Placement Document
Not for circulation and strictly confidential
Serial Number: _____

NATIONAL HIGHWAYS INFRA TRUST

(Registered in the Republic of India as an irrevocable trust set up under the Indian Trusts Act, 1882, on October 19, 2020, and registered as an infrastructure investment trust under the Securities and Exchange Board of India (Infrastructure Investment Trusts) Regulations, 2014, as amended, on October 28, 2020, having registration number IN/InvIT/20-21/0014. The Units of the Trust were listed on the Stock Exchanges on November 10, 2021.)

Principal Place of Business: G - 5 & 6, Sector 10, Dwarka, New Delhi – 110 075
Tel: +91 11 2507 6536 **Compliance Officer**: Smt. Gunjan Singh
E-mail: nhit@nhit.co.in; **Website**: www.nhaiinvit.in

SPONSOR	INVESTMENT MANAGER	TRUSTEE
NATIONAL HIGHWAYS AUTHORITY OF INDIA	NATIONAL HIGHWAYS INFRA INVESTMENT MANAGERS PRIVATE LIMITED	IDBI TRUSTEESHIP SERVICES LIMITED

ISSUE OF 497,926,000^ (THE "UNITS") BY WAY OF AN INSTITUTIONAL PLACEMENT TO ELIGIBLE INVESTORS, REPRESENTING AN UNDIVIDED BENEFICIAL INTEREST IN THE NATIONAL HIGHWAYS INFRA TRUST (THE "TRUST") AT A PRICE OF ₹ 124.14 PER UNIT ("ISSUE PRICE"), AGGREGATING TO APPROXIMATELY ₹61,812.53 MILLION BY THE TRUST (THE "ISSUE"). THE FLOOR PRICE IS ₹ 124 PER UNIT*. EACH BIDDER HAD TO MAKE A BID AT OR ABOVE THE FLOOR PRICE. BIDS BELOW THE SPECIFIED FLOOR PRICE, WERE LIABLE TO BE REJECTED.**

^ THE IM BOARD BY WAY OF ITS RESOLUTION DATED FEBRUARY 10, 2024 AND THE UNITHOLDERS OF THE TRUST BY WAY OF THEIR RESOLUTION DATED MARCH 4, 2024, HAVE APPROVED THE ISSUE OF UP TO 497,926,090 UNITS AT OR ABOVE THE BASE PRICE OF ₹ 122.86 PER UNIT.

****AS APPROVED BY THE IM BOARD BY WAY OF ITS RESOLUTION DATED FEBRUARY 10, 2024.***

***** AS APPROVED BY THE IM BOARD BY WAY OF ITS RESOLUTION DATED MARCH 13, 2024***

THE ISSUE, AND THE DISTRIBUTION OF THE PRELIMINARY PLACEMENT DOCUMENT AND THIS PLACEMENT DOCUMENT, HAS BEEN MADE ONLY TO ELIGIBLE INVESTORS IN RELIANCE UPON CHAPTER 7 ON '*GUIDELINES FOR PREFERENTIAL ISSUE AND INSTITUTIONAL PLACEMENT OF UNITS BY LISTED INVITS*' OF SEBI MASTER CIRCULAR NO. SEBI/HO/DDHS-PoD-2/P/CIR/2023/115 DATED JULY 6, 2023, AS AMENDED FROM TIME TO TIME ("SEBI INSTITUTIONAL PLACEMENT GUIDELINES"), THE SEBI CIRCULAR NO. SEBI/HO/DDHS/DDHS-PoD/P/CIR/2024/10 DATED FEBRUARY 8, 2024. AS AMENDED FROM TIME TO TIME AND THE SECURITIES AND EXCHANGE BOARD OF INDIA (INFRASTRUCTURE INVESTMENT TRUSTS) REGULATIONS, 2014, AS AMENDED ("INVIT REGULATIONS"). NO OFFER WAS MADE TO THE PUBLIC OR ANY OTHER CLASS OF INVESTORS.

The Units of the Trust are proposed to be listed on National Stock Exchange of India Limited ("**NSE**") and BSE Limited ("**BSE**" and together with NSE, the "**Stock Exchanges**"). The Trust has received in-principle approval from NSE and BSE each for listing of the Units pursuant to letters dated March 11, 2024 and March 11, 2024, respectively. Applications shall be made to the Stock Exchanges for obtaining the final listing and trading approvals for the Units to be Allotted pursuant to the Issue. The Stock Exchanges assume no responsibility for the correctness of any statements made, opinions expressed or reports contained herein. Admission of the Units to be Allotted pursuant to the Issue for trading on the Stock Exchanges should not be taken as an indication of the merits of the Trust or of the Units. A copy of the Preliminary Placement Document, and this Placement Document has been delivered to NSE and BSE.

The Issue Price, should not be taken to be indicative of the market price of the Units after the Units are listed. No assurance can be given regarding an active or sustained market for trading in the Units or regarding the price at which the Units will be traded after listing. This Placement Document has not been, and will not be, registered as a prospectus, will not be circulated or distributed to the public at large in India or any other jurisdiction, and will not constitute a public offer in India or any other jurisdiction.

The Units have not been and will not be registered under the United States Securities Act of 1933, as amended (the "**Securities Act**") and may not be offered or sold within the United States except pursuant to an exemption from, or in a transaction not subject to, the registration requirements of the Securities Act and applicable U.S. state securities laws. Accordingly, the Units are only being offered and sold outside the United States in "offshore transactions" as defined in, and in reliance on, Regulation S under the Securities Act ("**Regulation S**") and the applicable law of the jurisdictions where such offers and sales occur. The Units are transferable only in accordance with the restrictions described under the section entitled *"Selling and Transfer Restrictions"* on page 331 of this Placement Document.

THIS PLACEMENT DOCUMENT WILL BE PERSONAL TO EACH ELIGIBLE INVESTOR. THIS PLACEMENT DOCUMENT HAS BEEN PREPARED BY THE TRUST SOLELY FOR PROVIDING INFORMATION IN CONNECTION WITH THE ISSUE. YOU MAY NOT, AND ARE NOT AUTHORIZED TO, (1) DELIVER THIS PLACEMENT DOCUMENT TO ANY OTHER PERSON; OR (2) REPRODUCE THIS PLACEMENT DOCUMENT IN ANY MANNER WHATSOEVER. ANY DISTRIBUTION OR REPRODUCTION OF THIS PLACEMENT DOCUMENT, IN WHOLE OR IN PART, IS UNAUTHORIZED. FAILURE TO COMPLY WITH THIS INSTRUCTION MAY RESULT IN A VIOLATION OF THE SECURITIES AND EXCHANGE BOARD OF INDIA (INFRASTRUCTURE INVESTMENT TRUSTS) REGULATIONS, 2014, AS AMENDED OR OTHER APPLICABLE LAWS OF INDIA AND OF OTHER JURISDICTIONS.

INVESTMENTS IN UNITS INVOLVE RISKS AND INVESTORS SHOULD NOT INVEST ANY FUNDS IN THE ISSUE UNLESS THEY CAN AFFORD TO TAKE THE RISK OF LOSING THEIR ENTIRE INVESTMENT. IN MAKING AN INVESTMENT DECISION, INVESTORS MUST RELY ON THEIR OWN EXAMINATION OF THE TRUST, THE UNITS, THE ISSUE, AND THIS PLACEMENT DOCUMENT, INCLUDING THE RISKS INVOLVED. INVESTORS ARE ADVISED TO CAREFULLY READ THIS PLACEMENT DOCUMENT, INCLUDING THE SECTION ENTITLED "*RISK FACTORS*" ON PAGE 70 BEFORE MAKING AN INVESTMENT DECISION. EACH ELIGIBLE INVESTOR IS ADVISED TO CONSULT ITS OWN ADVISORS, ABOUT THE CONSEQUENCES OF AN INVESTMENT IN THE UNITS BEING ISSUED PURSUANT TO THIS PLACEMENT DOCUMENT.

Unless a serially numbered Preliminary Placement Document along with an Application Form was addressed to a particular Eligible Investor, no invitation to offer shall be deemed to have been made to such Eligible Investor to make an offer to subscribe to Units pursuant to the Issue. For further details, please see the section entitled "*Issue Procedure*" on page 340. The distribution of the Preliminary Placement Document and/or this Placement Document or the disclosure of its contents without the Trustee's or Investment Manager's prior consent, to any person, is unauthorized and prohibited.

Each addressee, by accepting delivery of the Preliminary Placement Document and this Placement Document, agrees to observe the foregoing restrictions and shall make no copies of this Placement Document or any documents referred to in this Placement Document.

LEAD MANAGERS			REGISTRAR AND UNIT TRANSFER AGENT
SBI CAPITAL MARKETS LIMITED 1501, 15th Floor, A & B Wing Parinee Crescenzo Building, G Block Bandra Kurla Complex, Bandra (East) Mumbai 400 051 **Tel:** +91 22 4196 8300 **E-mail:** nhaiinvit@sbicaps.com **Investor Grievance E-mail:** investor.relations@sbicaps.com **Contact Person:** Mandeep Singh **Website:** www.sbicaps.com **SEBI Registration Number:** INM000003531	**AXIS CAPITAL LIMITED** 1st Floor, Axis House Wadia International Centre Pandurang Budhkar Marg, Worli Mumbai 400 025 Maharashtra, India **Tel**: +91 22 4325 2183 **E-mail**: nhaiinvit@axiscap.in **Investor Grievance E-mail**: compliants@axiscap.com **Contact Person**: Harish Patel/Akash Aggarwal **Website**: www.axiscapital.co.in **SEBI Registration Number**: INM000012029	**ICICI SECURITIES LIMITED** ICICI Venture House, Appasaheb Marathe Marg, Prabhadevi, Mumbai 400 025, Maharashtra, India **Tel**: +91 22 6807 7100 **E-mail**: nhitinvit@icicisecurities.com **Investor Grievance E-mail**: customercare@icicisecurities.com **Contact Person**: Sumit Singh/ Rupesh Khant **Website**: www.icicisecurities.com **SEBI Registration Number**: INM000011179	**KFin Technologies Limited** Selenium, Tower B Plot No- 31 and 32, Financial District Nanakramguda, Serilingampally Hyderabad, Rangareddy 500 032 TG, India **Tel.**: +91 040 6716 2222/ 7961 1000 **E-mail**: srinivassudheer.venkatapuram@kfintech.com **Investor Grievance E-mail**: einward.ris@kfintech.com **Website**: www.kfintech.com **Contact Person**: Srinivas Sudheer Venkatapuram **SEBI Registration No.**: INR000000221

This Placement Document is dated March 15, 2024.

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NOTICE TO INVESTORS

The statements contained in this Placement Document relating to the Trust and the Units are, in all material respects, true and accurate and not misleading, and the opinions and intentions expressed in this Placement Document with regard to the Trust and the Units are honestly held, have been reached after considering all relevant circumstances and are based on reasonable assumptions and information presently available to the Investment Manager. There are no material facts in relation to the Trust and the Units, the omission of which would, in the context of the Issue, make any statement in this Placement Document misleading in any material respect. Further, the Investment Manager has made all reasonable enquiries to ascertain such facts and to verify the accuracy of all such information and statements.

The Lead Managers have not separately verified any information (financial, legal or otherwise) contained in this Placement Document. Accordingly, none of the Lead Managers or any of their respective shareholders, employees, counsel, officers, directors, representatives, agents, associates or affiliates make any express or implied representation, warranty or undertaking, and accept no responsibility or liability as to the accuracy or completeness of the information contained in this Placement Document or any other information supplied in connection with the Issue or the distribution of the Units, other than in relation to themselves.

Each Bidder acknowledges that such person has neither relied on the Lead Managers nor any of their respective shareholders, employees, counsel, officers, directors, representatives, agents, associates or affiliates in connection with such person's investigation of the accuracy of such information or such person's investment decision, and each such person must rely on his/her own examination of the Trust and the merits and risks involved in investing in the Units. Bidders should not construe the contents of this Placement Document as legal, business, tax, accounting or investment advice.

No person is authorized to give any information or to make any representation not contained in this Placement Document and any information or representation not so contained must not be relied upon as having been authorized by or on behalf of the Trust or by or on behalf of the Lead Managers. The delivery of this Placement Document, at any time, does not imply that the information contained in it is correct as of any time subsequent to its date.

Certain U.S. Matters

The Units to be issued pursuant to the Issue have not been approved, disapproved or recommended by any regulatory authority in any jurisdiction, including the United States Securities and Exchange Commission ("**SEC**"), any other federal or state authorities in the United States, the securities authorities of any non-United States jurisdiction or any other United States or non-United States regulatory authority. No authority has passed on or endorsed the merits of the Issue or the accuracy or adequacy of this Placement Document. Any representation to the contrary is a criminal offence in the United States and may be a criminal offence in other jurisdictions.

The Units have not been and will not be registered under the Securities Act and may not be offered or sold within the United States except pursuant to an exemption from, or in a transaction not subject to, the registration requirements of the Securities Act and applicable state securities laws. Accordingly, the Units are only being offered and sold outside the United States in "offshore transactions" as defined in, and in reliance on, Regulation S and the applicable laws of the jurisdictions where those offer and sales occur. The Units are transferable only in accordance with the restrictions described under the section "*Selling and Transfer Restrictions*" on page 331 of this Placement Document.

Each purchaser of the Units offered by this Placement Document will be deemed to have made the representations, agreements and acknowledgments as described in this section titled "*Notice to Investors – Representations by Eligible Investors*" on page 1 and in the section entitled "*Selling and Transfer Restrictions*" on page 331.

Notice to Investors in certain other jurisdictions

The distribution of this Placement Document and the issue of the Units in certain jurisdictions may be restricted by law. As such, this Placement Document does not constitute, and may not be used for, or in connection with, an offer or solicitation by anyone in any jurisdiction in which such offer or solicitation is not authorized or to any person to whom it is unlawful to make such offer or solicitation. In particular, no action has been taken by the Sponsor Group, Investment Manager or the Lead Managers which would permit an Issue of the Units or distribution of this Placement Document in any jurisdiction, other than India. Accordingly, the Units may not be offered or sold, directly or indirectly, and neither this Placement Document nor any Issue materials in connection with the Units be distributed or published in or from any country or jurisdiction that would require registration of the Units in such country or jurisdiction. For details, please see the section entitled "*Selling and Transfer Restrictions*" on page 331.

Representations by Eligible Investors

References herein to "you" or "your" is to each Eligible Investor in the Issue.

By purchasing, or subscribing to, Units pursuant to the Issue, you are deemed to have represented to the Trustee, the Investment Manager and the Lead Managers, and acknowledge and agree as follows:

(1) You are entitled to acquire the Units under the laws of all relevant jurisdictions and that you have all necessary capacity and have obtained all necessary consents, governmental or otherwise and authorisations to enable you to commit to this participation in the Issue and to perform your obligations in relation thereto (including, without limitation, in the case of any person on whose behalf you are acting, all necessary consents and authorisations to agree to the terms set out or referred to in this Placement Document) and will honour such obligations;

(2) You undertake to (i) hold, manage or dispose of any Units that are Allotted to you in accordance with the InvIT Regulations and all other applicable laws; and (ii) to comply with all requirements under applicable law in relation to reporting obligations, if any, in this relation;

(3) You will make all necessary filings, in relation to the Issue and your investment in Units, with appropriate governmental, statutory or regulatory authorities, including the RBI, as may be required, in accordance with applicable law, including in your respective jurisdiction;

(4) You agree to provide on request in a timely manner, and consent to the use and disclosure (including to any taxation or other regulatory authorities) of, any information or documentation in relation to yourself and, if and to the extent required, the direct or indirect beneficial ownership of your Units (if any), as may be necessary for the Trust (or the Trustee and its agents) and the Investment Manager to comply with any regulatory obligations and/or prevent the withholding of tax or other penalties under FATCA, the CRS or other similar exchange of tax information regimes. You acknowledge and agree that you shall have no claim against the Trust (or the Trustee and its agents) and the Investment Manager for any losses suffered by you (including in relation to the direct or indirect beneficial ownership of your Units (if any)) as a result of such use or disclosure of such information or documentation to, any relevant regulatory, governmental or statutory authority;

(5) You are aware that the Units have not been, and will not be, registered through a prospectus under the InvIT Regulations, or under any other law in force in India. This Placement Document has been submitted to the Stock Exchanges;

(6) You confirm that, either: (i) you have not participated in or attended any investor meetings or presentations by the Trust, or its agents ("**Presentations**") with regard to the Trust, the Units or the Issue; or (ii) if you have participated in or attended any Presentations, you understand and acknowledge that the Lead Managers or the Trustee may not have knowledge of the statements that the Trust, or its agents may have made at such Presentations and are therefore unable to determine whether the information provided to you at such Presentations may have included any material misstatements or omissions, and, accordingly you acknowledge that the Lead Managers, the Trustee (or its agents) or the Investment Manager have advised you not to rely in any way on any information that was provided to you at such Presentations;

(7) None of the Investment Manager, the Trustee or any of the Lead Managers or any of their respective shareholders, members, directors, officers, employees, counsel, representatives, agents or affiliates is making any recommendations to you or advising you regarding the suitability of any transactions it may enter into in connection with the Issue and that participation in the Issue is on the basis that you are not and will not, up to the Allotment, be a client of the Lead Managers. None of the Trustee, the Investment Manager, the Lead Managers or any of their respective shareholders, members, employees, counsel, officers, directors, representatives, agents or affiliates have any duties or responsibilities to you for providing the protection afforded to their clients, or for providing advice in relation to the Issue and are in no way acting in a fiduciary capacity towards you;

(8) All statements, other than statements of historical fact included in this Placement Document, including, without limitation, those regarding the Trust's financial position, business strategy, plans and objectives for future operations, the Investment Objectives, are forward-looking statements. Such forward-looking statements involve known and unknown risks, uncertainties and other important factors that could cause actual results to be materially different from future results, performance or achievements expressed or implied by such forward-looking statements. Such forward-looking statements are based on numerous assumptions regarding the Trust's present and future business strategies and the environment in which the Trust will operate in the future. You should not place undue reliance on forward-looking statements, which speak only as of the date of this Placement Document. The Trust, the Trustee, the Investment Manager and the Lead Managers or any of their respective shareholders, members, directors, officers, employees, counsel, representatives, agents, associates or affiliates assume no responsibility to update any of the forward-looking statements contained in this Placement Document;

(9) You have been provided a serially numbered copy of the Preliminary Placement Document and will be deemed to have read the Preliminary Placement Document in its entirety, including, in particular, the section entitled "*Risk Factors*" on page 70;

(10) You are aware and understand that the Units are being issued only to Eligible Investors and are not being offered to the general public and the Allotment shall be on a discretionary basis;

(11) You have made, or are deemed to have made, as applicable, the representations provided in the section entitled "*Selling and Transfer Restrictions*" on page 331;

(12) You (i) are not acquiring or subscribing for the Units as a result of any "directed selling efforts" (as defined in Regulation S) and (ii) are acquiring or subscribing for the Units in an "offshore transaction" as defined in, and in reliance on, Regulation S, and are not an affiliate of the Trust or the Lead Managers or a person acting on behalf of such an affiliate;

(13) You understand and agree that the Units are transferable only in accordance with the restrictions described in the section entitled "*Selling and Transfer Restrictions*" on page 331, and you warrant that you will comply with such restrictions;

(14) In making your investment decision, you have (i) relied on your own examination of the Trust, the Units and the terms of the Issue, including the merits and risks involved, (ii) made and will continue to make your own assessment of the Trust, the Units and the terms of the Issue based solely on the information contained in this Placement Document, (iii) consulted your own independent advisors or otherwise have satisfied yourself concerning, without limitation, the effects of local laws, (iv) relied solely on the information contained in this Placement Document and no other disclosure or representation by the Investment Manager or the Lead Managers or any other party; (v) received all information in this Placement Document that you believe is necessary or appropriate in order to make an investment decision in respect of the Trust and the Units, and (vi) relied upon your own investigation in deciding to invest in the Issue;

(15) You have such knowledge and experience in financial, business and investment matters as to be capable of evaluating the merits and risks of an investment in the Units. You and any accounts for which you are subscribing to the Units, (i) are each able to bear the economic risk of the investment in the Units; (ii) will not, subject to the terms of the Placement Document, look to any of the Investment Manager, the Trustee, or the Lead Managers or any of their respective shareholders, members, employees, counsel, officers, directors, representatives, agents or affiliates for all, or part, of any such loss or losses that may be suffered due to your investment in the Units; (iii) are able to sustain a complete loss on the investment in the Units; (iv) have no need for immediate liquidity with respect to the investment in the Units, and (v) have no reason to anticipate any change in your or their circumstances, financial or otherwise, which may cause or require any sale or distribution by you or them of all or any part of the Units. You acknowledge that an investment in the Units involves a high degree of risk and that the Units are, therefore, a speculative investment. You are seeking to subscribe to the Units in the Issue for your own investment and not with a view to resell or distribute in any manner that could characterise you as an underwriter or similar party in any jurisdiction;

(16) The Trustee, the Investment Manager, the Lead Managers or any of their respective shareholders, members, directors, officers, employees, counsel, representatives, agents or affiliates have not provided you with any legal, financial or tax advice or otherwise made any representations regarding the tax consequences of the Units (including but not limited to, the Issue and the use of the proceeds of the Issue). You will obtain your own independent legal, financial or tax advice and will not rely on the Investment Manager, the Trustee, the Lead Managers or any of their respective shareholders, members, employees, counsel, officers, directors, representatives, agents or affiliates or the Investment Manager when evaluating the tax consequences in relation to the Units (including but not limited to the Issue and the use of the proceeds of the Issue). You waive and agree not to assert any claim against the Lead Managers, the Trustee or the Investment Manager with respect to the tax aspects of the Units or the Issue or as a result of any tax audits by tax authorities, in relation to the Units and the Issue, wherever situated;

(17) You are not the Trustee, or the Valuer or an employee of the Valuer involved in the valuation of the Project SPVs;

(18) You are aware that (i) we have received the in-principle approval from NSE dated March 11, 2024, and the in-principle approval from BSE dated March 11, 2024, respectively, and (ii) the application for the final listing and trading approvals will be made only after Allotment. There can be no assurance that the final approvals for listing and trading of the Units will be obtained in a timely manner, or at all. The Trust, the Trustee and the Investment Manager shall not be responsible for any delay or non-receipt of such final approvals (except to the extent prescribed under the InvIT Regulations) or any loss arising from such delay or non-receipt;

(19) You shall not undertake any trade in the Units credited to your demat account until such time that the final listing and trading approvals for the Units have been issued by the Stock Exchanges, subject to compliance with applicable law;

(20) The only information you are entitled to rely on, and on which you have relied, in committing yourself to acquire the Units, shall be contained in this Placement Document, such information being all that you deem necessary to make an investment decision in respect of the Units and that you have neither received nor relied on any other information given or representations, warranties or statements made by the Trustee, the Lead Managers, the Investment Manager, and neither the Trustee, the Lead Managers nor the Investment Manager will be liable for your decision to accept an invitation to participate in the Issue based on any other information, representation, warranty or statement that you have obtained or received;

(21) You understand that the Units to be Allotted in this Issue will, when issued, be credited as fully paid and will rank *pari passu* in all respects with all other Units, including in respect of the right to receive all distributions declared, made or paid in respect of the Units after the Allotment. For details, please see the section entitled "*Distribution*" on page 302;

(22) You are eligible to Bid for, and hold, Units, so Allotted. Your unitholding after the Allotment of the Units shall not exceed the investment level permissible as per any applicable law and regulation;

(23) You agree to indemnify and hold the Trustee, Investment Manager, and the Lead Managers harmless from any and all costs, claims, liabilities and expenses (including legal fees and expenses) arising out of or in connection with any breach of the representations and warranties in this section;

(24) The Trustee, the Investment Manager, the Lead Managers, their respective shareholders, members, employees, counsel, offices, directors, representatives, agents or affiliates, will rely on the truth and accuracy of the foregoing representations, warranties, acknowledgements and undertakings which are given to the Lead Managers on their own behalf and on behalf of the Trust, the Investment Manager, the Trustee, and the same are irrevocable;

(25) You are eligible to invest in India and in the Units under applicable law, including the FEMA Rules, and have not been prohibited by SEBI or any other statutory, regulatory or judicial authority from buying, selling or dealing in securities;

(26) You understand that, subject to the terms of the Placement Document, neither the Lead Managers, the Investment Manager nor the Trustee has any obligation to purchase or subscribe to all, or any part, of the Units purchased by you in the Issue, or to support any losses directly or indirectly sustained or incurred by you for any reason whatsoever in connection with the Issue;

(27) Any dispute arising in connection with the Issue will be governed by, and construed in accordance with, the laws of the Republic of India and the courts at New Delhi shall have exclusive jurisdiction to settle any disputes which may arise out of or in connection with the Preliminary Placement Document or this Placement Document; and

(28) You have made, or are deemed to have made, as applicable, the representations provided in this section and each of the representations, warranties, acknowledgements and agreements set out above shall continue to be true and accurate at all times, up to, and including, the Allotment, listing and trading of the Units in the Issue.

Available Information

The Investment Manager agrees to comply with any undertakings given by it from time to time in connection with the Units to the Stock Exchanges and, without prejudice to the generality of foregoing, shall furnish to the Stock Exchanges all such information as the rules of the Stock Exchanges may require in connection with the listing of the Units on such Stock Exchanges.

IMPORTANT NOTICE

THE VALUE OF UNITS AND THE INCOME DERIVED FROM THEM MAY FALL AS WELL AS RISE. UNITS ARE NOT OBLIGATIONS OF, DEPOSITS IN, OR GUARANTEED BY, THE TRUST, THE TRUSTEE, THE INVESTMENT MANAGER, THE LEAD MANAGERS OR ANY OF THEIR RESPECTIVE SHAREHOLDERS, MEMBERS, EMPLOYEES, COUNSEL, OFFICERS, DIRECTORS, MEMBERS, REPRESENTATIVES, AGENTS, ASSOCIATES OR AFFILIATES. AN INVESTMENT IN UNITS IS SUBJECT TO INVESTMENT RISKS, INCLUDING THE POSSIBLE LOSS OF THE PRINCIPAL AMOUNT INVESTED. FURTHER, LISTING OF THE UNITS ON THE STOCK EXCHANGES DOES NOT GUARANTEE A LIQUID MARKET FOR THE UNITS. INVESTORS HAVE NO RIGHT TO REQUEST THE TRUST, THE TRUSTEE, THE SPONSOR OR THE INVESTMENT MANAGER OR ANY OF ITS SHAREHOLDERS, MEMBERS, EMPLOYEES, COUNSEL, OFFICERS, DIRECTORS, MEMBERS, REPRESENTATIVES, AGENTS, ASSOCIATES OR AFFILIATES TO REDEEM THEIR UNITS WHILE THE UNITS ARE LISTED, UNLESS OTHERWISE PERMITTED BY APPLICABLE LAW. THE PERFORMANCE OF ANY OF THE LISTED UNITS OF THE TRUST IS NOT NECESSARILY INDICATIVE OF THE FUTURE PERFORMANCE OF UNITS OF THE TRUST.

DEFINITIONS AND ABBREVIATIONS

This Placement Document uses the definitions and abbreviations set forth below which you should consider when reading the information contained herein.

References to any legislation, act, regulations, rules, guidelines, circulars, notifications, clarifications or policies shall be to such legislation, act, regulations, rules, guidelines, circulars, notifications, clarifications or policies as amended, supplemented, or re-enacted from time to time and any reference to a statutory provision shall include any subordinate legislation made under that provision.

The words and expressions used in this Placement Document, but not defined herein shall have the meaning ascribed to such terms under the InvIT Regulations, SEBI Institutional Placement Guidelines, the SEBI Act, the Depositories Act, and the rules and regulations made thereunder.

Notwithstanding the foregoing, the terms not defined but used in the Annexure A entitled "Audited Financial Information", and the section entitled "Taxation" and "Legal and other Information" on pages 349 and 318, respectively, shall have the meanings ascribed to such terms in those respective sections.

In this Placement Document, unless the context otherwise requires, a reference to "we", "us" and "our" refers to the Trust and the Project SPVs on a consolidated basis.

Trust Related Terms

Term	Description
A&F Policy	The Asset acquisition and unit funding policy adopted by the Investment Manager pursuant to the resolution of the IM Board dated September 30, 2021.
Abu Road - Swaroopganj Project	The Abu Road – Swaroopganj section of NH 27 with a total length of 31 kms, in the state of Rajasthan
Agra Bypass Project	Agra Bypass section with a total length of 32.80 kms, connecting NH19 (old NH2) to NH44 (old NH7) in Uttar Pradesh
Amended and Restated Project Implementation and Management Agreement	Amended and Restated Project Implementation and Management agreement dated March 7, 2024 entered into amongst the Trustee (on behalf of the Trust), the Project Manager, the Investment Manager and NHIPPL.
Appointed Date	In relation to (i) the R1 Toll Roads is the date on which all conditions precedent (as specified in the relevant concession agreement) have been satisfied, being, December 16, 2021; (ii) the R2 Toll Roads is the date on which all conditions precedent (as specified in the relevant concession agreement) have been satisfied, being, October 29, 2022; and (iii) the R3 Toll Roads shall be the date on which all conditions precedent (as specified in the relevant concession agreement) have been satisfied.
Asset Revenue Information	Revenue data of the InvIT Assets as has been historically collected through toll collection and maintenance contracts and based on actual toll collections, for the financial years ended March 31, 2023, March 31, 2022 and March 31, 2021 and for the period from April 1, 2023 to February 29, 2024.
Associate	Associate shall have the meaning set forth in Regulation 2(1)(b) of the InvIT Regulations. Since (i) the Sponsor is a body corporate whose capital is funded by the Central Government and members are appointed and executive decisions taken by the President of India (acting through the Department of Personnel and Training and MoRTH), and (ii) the President of India is the Promoter of the Investment Manager, persons or entities that may be classified as "associates" of the Sponsor and Investment Manager in terms of Regulation 2(1)(b)(ii) and Regulation 2(1)(b)(iii) of the InvIT Regulations, have not been identified as 'associates' of the Sponsor and the Investment Manager. Further, since the Project Manager is a wholly-owned subsidiary of the Sponsor, it has not been identified as 'associates' of the Sponsor and the Investment Manager.
Audited Financial Information	The audited standalone financial information of the Trust for the period from its date of settlement, i.e. October 19, 2020 up to March 31, 2021, and the audited consolidated financial information of the Trust as of and for the year ended March 31, 2022, March 31, 2023 and the nine months period ended December 31, 2023 and notes and other explanatory statements provided thereto, prepared in accordance with Ind AS.
Auditors	A.R. & Co., Chartered Accountants, present statutory auditors of the Trust
Audit Committee	The audit committee of the Investment Manager constituted in accordance with the InvIT Regulations
Borkhedi - Kelapur Project	Borkhedi-Kelapur-Maharashtra/Telangana border stretch of NH44 (old NH7) with a total length of 138.15 kms, in the state of Maharashtra
Borrowing Policy	The borrowing policy of the Trust adopted by the Investment Manager pursuant to a

Term	Description
	resolution of the IM Board dated February 3, 2021, as amended pursuant to the resolution of the IM Board dated September 27, 2021 and as amended from time to time.
Chichra – Kharagpur Project	Chichra – Kharagpur Road stretch on NH-49 with a total length of 56.12 kms, in the state of West Bengal.
Compliance Officer	The compliance officer of the Trust
Concessionaires	The Project SPVs
Concession Agreements	Collectively, the R1 Concession Agreements, R2 Concession Agreements and R3 Concession Agreements
Chittorgarh – Kota and Chittorgarh Bypass Project	Chittorgarh – Kota section of NH 27 with a total length of 160.50 kms, in the state of Rajasthan
Distribution Policy	The distribution policy adopted by the Investment Manager pursuant to a resolution of its board of directors dated March 4, 2024 as amended from time to time.
Existing Toll Roads	Collectively, the R1 Toll Roads and R2 Toll Roads
Chitradurga Bypass - Hubli Project/ Karnataka Project	Chitradurga Bypass - Chitradurga - Davanagere - Haveri – Hubli road stretch on NH- 48 with a total length of 214.47 kms, in the state of Karnataka
IM Board	The board of directors of the Investment Manager
Initial Concession Agreements	Collectively, the R1 Concession Agreements and R2 Concession Agreements
Investment Management Agreement	Investment management agreement dated October 21, 2020, entered into between the Trustee (on behalf of the Trust) and the Investment Manager, as amended on December 22, 2023 and February 2, 2024 and from time to time.
Investment Manager or NHIIMPL	National Highways Infra Investment Managers Private Limited
Investment Objectives	The investment objectives of the Trust, as provided under the section entitled "*Overview of the Trust*" on page 24
InvIT Assets	InvIT assets as defined in Regulation 2(1) (zb) of the InvIT Regulations, in this case being the concessions granted under the Concession Agreements, in respect of the R1 Toll Roads, R2 Toll Roads and the R3 Toll Roads
InvIT Documents	Collectively, (i) The Trust Deed; (ii) the Investment Management Agreement; (iii) the Project Implementation and Management Agreement; and (iv) such other policies, documents, agreements and letters executed in connection with the Trust, as originally executed and amended, modified, supplemented or restated from time to time, together with the respective annexures, schedules and exhibits, if any, as amended from time to time.
Kothakota Bypass – Kurnool Project	The Kothakota bypass – Kurnool section of NH 44 with a total length of 74.6 kms, connecting the states of Telangana to Andhra Pradesh.
Kachugaon - Kaljhar Project	Kachugaon - Rakhaldubi Bus Junction - Kaljhar section of NH 27 with a total length of 114.17 kms, in the state of Assam
Kaljhar - Patacharkuchi Project	Kaljhar - Patacharkuchi section of NH 27 with a total length of 27.30 kms, in the state of Assam
Lakhnadon – Mahagaon (Mohgaon) – Khawasa Project	Lakhnadon – Mahagaon (Mohgaon) – Khawasa section of NH 44 with a total length of 107.35 kms, in the state of Madhya Pradesh
Maharashtra/Karnataka Border (Kagal) – Belgaum Project	The Belgaum – Kagal section of NH 48 with a total length of 77.7 kms, connecting the states of Karnataka and Maharashtra
Orai – Barah Project	The Orai Barah Road stretch on NH- 27 with a total length of 62.90 kms in the state of Uttar Pradesh.
Palanpur/Khemana Abu Road Project	The Palanpur/Khemana – Abu Road section of NH 27 with a total length of 45 kms, connecting the states of Gujarat and Rajasthan
Parties to the Trust	The Sponsor, the Sponsor Group, the Trustee, the Investment Manager and the Project Manager
Project Manager or NHIPMPL	National Highways InvIT Project Managers Private Limited
Project SPV Facilities Agreements	Collectively, the NHIPPL Facility Agreement and the NEPPL Facility Agreement
NHIPPL	National Highways Infra Projects Private Limited
NHIPPL Facility Agreement	Each of the facility agreements dated September 30, 2021 and October 10, 2022, entered into between the Trust (acting through the Trustee), the Trustee, the Investment Manager and NHIPPL
NHIPPL Concession Agreements	Collectively, the R1 Concession Agreements and the R2 Concession Agreements
NEPPL	NHIT Eastern Projects Private Limited
NEPPL Facility Agreements	The facility agreements proposed to be entered into between the Trust (acting through the Trustee), the Trustee, the Investment Manager and NEPPL.
NEPPL Concession Agreements	The R3 Concession Agreements
Project SPVs	Collectively, NHIPPL and NEPPL
R1 Concession Agreements	Collectively, the concession agreements entered between NHAI and NHIPPL on March 30,

Term	Description
	2021, being, (i) Concession Agreement for the tolling, operation, maintenance transfer of Maharashtra/Karnataka border (Kagal) (from km 515+000 to km 592+705) of NH-48 in the State of Maharashtra/Karnataka; (ii) Concession Agreement for the tolling, operation, maintenance transfer of Chittorgarh Bypass to Kota Section (from km 891+929 to km 1052+429) of NH-27 in the State of Rajasthan; (iii) Concession Agreement for the tolling, operation, maintenance transfer of Kothakota Bypass – Kurnool Section (from km 135+469 to km 211+000) of NH-44 in the State of Telangana; (iv) Concession Agreement for the tolling, operation, maintenance transfer of Abu Road to Swaroopganj Section (from km 646+000 to km 677+000) of NH-27 in the State of Rajasthan; and (v) Concession Agreement for the tolling, operation, maintenance transfer of Palanpur/ Khemana to Abu-Road Section (from km 601+000 to km 646+000) of NH-27 in the State of Gujarat, Rajasthan.
R2 Concession Agreements	Collectively, (a) the concession agreements entered between NHAI and NHIPPL on September 26, 2022, being, (i) Concession Agreement for the tolling, operation, maintenance transfer of Agra bypass Section (from km 0.000 to km 32.800) of NH-19 in the state of Uttar Pradesh; (ii) Concession Agreement for the tolling, operation, maintenance transfer of Borkhedi-Wadner-Deodhari-Kelapur Section (from km 36.600 to km 175.000) of NH-44 in the state of Maharashtra; and (iii) Concession Agreement for the tolling, operation, maintenance transfer of Shivpuri – Jhansi Section (from km 1305.087 to km 1380.387) of NH-27 in the states of Madhya Pradesh and Uttar Pradesh; and (b) the supplementary agreements entered between NHAI and NHIPPL on November 2, 2022, being, (i) Supplementary Concession Agreement for the tolling, operation, maintenance transfer of Agra bypass Section (from km 0.000 to km 32.800) of NH-19 in the state of Uttar Pradesh; (ii) Supplementary Concession Agreement for the tolling, operation, maintenance transfer of Borkhedi-Wadner-Deodhari-Kelapur Section (from km 36.600 to km 175.000) of NH-44 in the state of Maharashtra; and (iii) Supplementary Concession Agreement for the tolling, operation, maintenance transfer of Shivpuri – Jhansi Section (from km 1305.087 to km 1380.387) of NH-27 in the states of Madhya Pradesh and Uttar Pradesh.
R2 Placement Document	The placement document dated October 11, 2022, issued in relation to the institutional placement of 111,602,600 units by in accordance with the InvIT Regulations and SEBI Institutional Placement Guidelines available at https://www.bseindia.com/downloads1/NHIT_PD.pdf
R3 Concession Agreements	Collectively, the concession agreements entered between NHAI and NEPPL on March 7, 2024 being, (i) Concession Agreement for the tolling, operation, maintenance transfer of Kaljhar to Patacharkuchi Section from Km 1013+000 to Km 1040+000 of NH 27 in the State of Assam; (ii) Concession Agreement for the tolling, operation, maintenance transfer of (a) Chitradurga Bypass from Km 0+000 to Km 20+700, (b) Chitradurga to Davanagere from Km 208+000 to Km 260+000 (c) Davanagere to Haveri from Km 260+000 to 338+923, and (d) Haveri to Hubli from Km 340+000 to Km 403+000 of NH 48 in the State of Karnataka; (iii) Concession Agreement for the tolling, operation, maintenance transfer of Lakhnadon – Mahagaon (Mohgaon) to Khawasa Section from Km 546+420 to Km 653+770 of NH 44 in the State of Madhya Pradesh; (iv) Concession Agreement for the tolling, operation, maintenance transfer of Four lane Chichra to Kharagpur (existing Km 185+150 (Design Km 16+130) to Km 129+000 (Design Km 72+250) of National Highway – 49 (Old NH -06) in the state of West Bengal; (v) Concession Agreement for the tolling, operation, maintenance transfer of Four Lane with paved shoulder of NH-27(old NH-31C) from Kachugaon to Rakhaldubi Bus junction (existing Km. 30+000 to Km 92+671) & NH-27(old NH-31) from Rakhaldubi Bus Junction to Kaljhar (Km 961+500 to Km 1013+000) in the State of Assam; (vi) Concession Agreement for the tolling, operation, maintenance transfer of Orai to Barah Section (From km 1515+713 To km 1578+872 on LHS & From km.1578+360 to km. 1515+713 on RHS) of NH25 (New NH – 27) in the State of Uttar Pradesh; and (vii) Concession Agreement for the tolling, operation, maintenance transfer of of Rewa-Katni-Jabalpur-Lakhnadon Section from Km 656+000 to Km 891+780 of NH 30 & Km 1358+000 to Km 1428+557 of NH-34 in the State of Madhya Pradesh (MP).
R1 Toll Roads	Collectively, (i) Abu Road - Swaroopganj Project; (ii) Chittorgarh – Kota and Chittorgarh Bypass Project; (iii) Kothakota Bypass – Kurnool Project; (iv) Maharashtra/Karnataka Border (Kagal) – Belgaum Project; and (v) Palanpur/Khemana Abu Road Project
R2 Toll Roads	Collectively, (i) Agra Bypass Project; (ii) Borkhedi - Kelapur Project; and (iii) Shivpuri Jhansi Project
R3 Toll Roads	Collectively, (i) Chichra – Kharagpur Project; (ii) Orai Barah Project; (iii) Rewa – Lakhnadon Project; (iv) Kachugaon - Kaljhar Project; (v) Kaljhar - Patacharkuchi Project; (vi) Lakhnadon – Mahagaon (Mohgaon) – Khawasa Project; and (vii) Chitradurga Bypass - Hubli Project/ Karnataka Project
Related Parties	Related parties, as defined under Regulation 2(1)(zv) of the InvIT Regulations
Relevant Stock Exchange	Relevant stock exchange, as defined under Clause 2.2 of the SEBI circular no.

Term	Description
	SEBI/HO/DDHS/DDHS/CIR/P/2019/143 dated November 27, 2019, as amended by SEBI Master Circular No. SEBI/HO/DDHS-PoD-2/P/CIR/2023/115 dated July 6, 2023
Rewa – Lakhnadon Project	Rewa – Katni – Jabalpur – Lakhnadon section of NH 30 and NH 34 with a total length of 306.34 kms, in the state of Madhya Pradesh
SEBI Exemption	Letter received from SEBI bearing reference no. SEBI/HO/DDHS-RAC-1/P/OW/2024/9557/1 dated March 6, 2024 in relation to the exemptions in relation to proposed institutional placement and preferential issue of units of the Trust. For further details, see "*Management's Discussion and Analysis Of Factors By The Directors Of The Investment Manager Affecting The Financial Condition, Results Of Operations And Cash Flows – SEBI Exemptions*" on page 292.
Shivpuri Jhansi Project	Jhansi-Shivpuri section of NH 27 with a total length of 75.30 kms, connecting the districts of Jhansi in the state of Uttar Pradesh and Shivpuri in the state of Madhya Pradesh
Sponsor	National Highways Authority of India
Sponsor Director	A director nominated on the IM Board by the Sponsor
Sponsor Group	NHAI Since the Sponsor is a body corporate whose capital is funded by the Central Government and whose members are appointed, and executive decisions taken by the President of India (acting through the Department of Personnel and Training and MoRTH), certain persons or entities that may be classified as "sponsor group" in terms of Regulation 2(1)(zxc) and Regulation 4(2)(d)(i) of the InvIT Regulations, have not been identified as the 'sponsor group'.
SPV(s)	Special purpose vehicles, as defined in Regulation 2(1)(zy) of the InvIT Regulations
Target Toll Roads	Collectively, (i) Chichra – Kharagpur Project; (ii) Orai Barah Project; (iii) Rewa – Lakhnadon Project; (iv) Kachugaon - Kaljhar Project; (v) Kaljhar - Patacharkuchi Project; (vi) Lakhnadon – Mahagaon (Mohgaon) – Khawasa Project; and (vii) Chitradurga Bypass - Hubli Project/ Karnataka Project
Technical Consultants	Samarth Infraengg Technocrats Pvt Ltd, Ramboll India Pvt Ltd and Egis India Consulting Engineers Pvt Ltd.
Technical Reports	The technical reports prepared by each of the Technical Consultants in respect of the R3 Toll Roads, which form part of this Placement Document, as set out in **Annexure D.**
Toll Roads	Collectively, the R1 Toll Roads, R2 Toll Roads and R3 Toll Roads
Traffic Consultant(s)	Steer Davies & Gleave India Private Limited, Ramboll India Pvt Ltd, and CRISIL Market Intelligence & Analytics
Traffic Reports	The traffic reports prepared by each of the Traffic Consultants in respect of the R3 Toll Roads, which forms part of this Placement Document, as set out in **Annexure C**.
Transitional Support Agreement	The transitional support agreement dated March 7, 2024 entered into amongst the Sponsor, Project Manager and NEPPL in relation to R3 Toll Roads. For further details, please see the section entitled "*Related Party Transactions – Transitional Support Agreement*" on page 307.
Trust	National Highways Infra Trust
Trust Deed	Trust deed dated October 19, 2020*, entered into between the Sponsor and the Trustee, and as amended from time to time. *An amendment to the Trust Deed has been executed on March 7, 2024 and will subsequently be registered under the Registration Act, 1908.*
Trustee	IDBI Trusteeship Services Limited
Unexpired Cash Flow	The amount calculated by multiplying the concession fee with the percentages provided in the relevant Concession Agreements
Unitholder(s)	Any Person who holds Units (as hereinafter defined) upon making a defined contribution as determined by the Trustee
Unit	An undivided beneficial interest in the Trust, and such Units together represent the entire beneficial interest in the Trust
UPSI Policy	The unpublished price sensitive information policy adopted by the Investment Manager pursuant to a resolution of its board of directors dated February 3, 2021, as amended pursuant to the resolution of the IM Board dated September 27, 2021, March 30, 2022 and January 4, 2023.
Valuation Reports	The valuation reports dated February 9, 2024 in relation to NHIPPL and NEPPL issued by the Valuer, which sets out their opinion as to the fair enterprise value of the Toll Roads as on December 31, 2023, which is set out in **Annexure B** to this Placement Document
Valuer	RBSA Valuation Advisor Ltd

Issue Related Terms

Term	Description
Allocated/ Allocation	The allocation of Units, to successful Bidders on the basis of the Application Form submitted by them, by the Investment Manager, in consultation with the Lead Managers
Allot/ Allotment/ Allotted	Unless the context otherwise requires, the issue and allotment of Units to successful Bidders, pursuant to the Issue
Allottees	Bidders to whom Units are issued and Allotted pursuant to the Issue
Application Form	The serially numbered form pursuant to which Eligible Investors had submitted a Bid for the Units in the Issue
Bid(s)	Indication of interest of an Eligible Investor, as provided in the Application Form, to subscribe for the Units at a price being at or above the floor price specified in the Preliminary Placement Document and the Application Form
Bid Amount	The Bid Price multiplied by the total number of Units Bid for by a Bidder as indicated in the Application Form
Bid/ Issue Closing Date	Wednesday, March 13, 2024
Bid/ Issue Opening Date	Tuesday, March 12, 2024
Bid/ Issue Period	Period between the Bid/ Issue Opening Date and the Bid/ Issue Closing Date, inclusive of both days, during which Eligible Investors submitted their Bids
Bid Lot/ Minimum Bid Size	A minimum of 2,119,000 Units and in multiples of 10 Units thereafter
Bid Price	An amount per Unit, at or above the Floor Price as indicated by a Bidder in the Application Form
Bidder	Any Eligible Investor, who made a Bid pursuant to the terms of the Preliminary Placement Document and the Application Form
Business Day	Any day from Monday to Friday, excluding any public holiday
Cash Escrow Account	'No-lien' and 'non-interest bearing' account opened with the Escrow Bank and in whose favour Bidders transferred money through direct credit/NEFT/NECS/RTGS in respect of the Bid Amount when submitting a Bid
Cash Escrow Agreement	The cash escrow agreement dated March 7, 2024, entered into amongst the Trust (acting through the Trustee), the Investment Manager, the Lead Managers, the Trustee and the Escrow Bank for, among others, collection of the Bid Amounts and for remitting refunds, if any, of the amounts collected, to the Bidders
Client ID	Client identification number maintained with one of the Depositories in relation to a demat account
Closing Date	The date on which Allotment of Units pursuant to the Issue shall be made, i.e. on or about Friday, March 15, 2024.
Demographic Details	Details of the Bidders, including the Bidder's address, name of the Bidder's father/husband, investor status, occupation and bank account details, PAN, DP ID and Client ID
Designated Date	The date of credit of Units to the Eligible Investors' demat accounts
Eligible Investors	Institutional Investors
Escrow Bank	Axis Bank Limited
Floor Price	The price of ₹ 124 per unit above which the Issue Price has been finalised and below which no Bids were accepted
Issue	Issue of 497,926,000 Units by way of a fresh issue, through an institutional placement to Eligible Investors aggregating up to approximately ₹ 61,812.53 million by the Trust
Institutional Investors	Institutional investors as defined in Regulation 2(1)(ya) of the InvIT Regulations
Listing Agreements	The listing agreements entered into with the Stock Exchanges by the Trust, in line with the format as specified under the Securities and Exchange Board of India circular number CIR/CFD/CMD/6/2015 dated October 13, 2015 on "Format of uniform Listing Agreement"
Listing Date	The date on which the Units offered pursuant to the Issue will be listed on the Stock Exchanges
Lead Managers	Collectively, the SBI Capital Markets Limited, Axis Capital Limited and ICICI Securities Limited
Mutual Funds	Mutual funds registered with SEBI under the Securities and Exchange Board of India (Mutual Funds) Regulations, 1996
Net Proceeds	Proceeds of the Issue that will be available to the Trust, i.e., Issue Proceeds, less Issue Expenses apportioned to the Trust
Issue Expenses	Expenses in relation to the Issue
Issue Price	₹ 124.14 per Unit
Issue Proceeds	The proceeds of the Issue that are available to the Trust. For further details about the use of the Issue Proceeds, please see the section entitled "*Use of Proceeds*" on page 273
Issue Size	The Issue of 497,926,000 Units aggregating to approximately ₹ 61,812.53 million
Placement Agreement	The placement agreement dated March 7, 2024 entered into among the Trust (acting through

	its Trustee), the Trustee, the Investment Manager, and the Lead Managers
Placement Document	This placement document dated March 15, 2024 issued in relation to this Issue in accordance with the SEBI Institutional Placement Guidelines, the InvIT Regulations and circulars issued therein
Preliminary Placement Document	The preliminary placement document dated March 11, 2024 issued in accordance with the SEBI Institutional Placement Guidelines, the InvIT Regulations and the circulars issued therein.
Registrar and Unit Transfer Agent or Registrar	KFin Technologies Limited
Working Day	Working Day, with reference to (a) Bid/ Issue Period, shall mean all days, excluding Saturdays, Sundays and public holidays, on which commercial banks in Mumbai are open for business; and (b) the time period between the Bid/ Issue Closing Date and the listing of the Units on the Stock Exchanges, shall mean all trading days of Stock Exchanges, excluding Sundays and bank holidays

Technical and Industry Related Terms

Term	Description
%	Percentage
2A	2 Axle truck
3A	3 Axle truck
AB	Agra Bypass Project
AADT	Annual Average Daily Traffic
ADT	Average Daily Traffic
AP	Palanpur/Khemana Abu Road Project
AR	Alternate Route
AS	Abu Road – Swaroopganj Project
BIA	Broad Influence Area
BOT	Build Operate Transfer
BRO	Border Roads Organisation
BWK	Borkhedi – Kelapur Project
CAGR	Compounded Annual Growth Rate
CDHH	Chitradurga - Davanagere - Haveri – Hubli
CJV	Cars / Jeeps / Vans
CK	Chittorgarh – Kota & Chittorgarh Bypass Project
CKP	Chichra Kharagpur Project
COD	Commercial Operations Date
CRISIL Report	Report entitled "*Roads and Highways"* by CRISIL Market Intelligence & Analytics in 2023
DBFOT	Design, Build, Finance, Operate and Transfer
DEA	Department of Economic Affairs
DME	Delhi Mumbai Expressway
DPR	Detailed Project Report
ETC	Electronic Toll Collection
FY	Financial Year
GDP	Gross Domestic Product
GSDP	Gross State Domestic Product
HAM	Hybrid Annuity Model
HCV	Heavy Commercial Vehicles
HME	Heavy Machinery and Equipment
IDC	Interest during construction
IHMCL	Indian Highways Management Company Limited
IIA	Immediate Influence Area
IRC	Indian Road Congress
InvIT	Infrastructure Investment Trust
Km	Kilometre
KK	Kachugaon - Kaljhar
KP	Kaljhar – Patacharkuchi
JEPL	Jadcherla Expressways Private Limited
KK	Kothakota Bypass – Kurnool Highway Project
LCV	Light Commercial Vehicle
LMMK	Lakhnadon – Mahagaon (Mohgaon) – Khawasa
M Bus	Minibus
MAV	Multi Axle Vehicle
MLCV	Mini LCV

Term	Description
NCT	National Capital Territory
NH	National Highway
NHAI	National Highways Authority of India
NHDP	National Highways Development Program
NHIIMPL or NHIMPL	National Highways Infra Investment Managers Private Limited
NHTIS	National Highway Toll Information System
NIP	National Infrastructure Pipeline
NPV	Net Present Value
NRRDA	National Rural Road Department Agency
NSDP	National State Domestic Production
OB	Orai Barah Project
O&M	Operation and Maintenance
OD	Origin Destination
ODS	Origin-Destination survey
OECD	Organisation for Economic Cooperation and Development
PCU	Passenger Car Unit
PIA	Project Influence Area
PR	Project Road
PWD	Public Works Departments
RL	Rewa - Lakhnadon Project
RNP	Registered Number Plate
RUCS	Road User Cost Study
SCF	Seasonality Correction Factors
SCOD	Scheduled commercial operations date
SEZ	Special Economic Zone
SH	State Highway
SJ	Shivpuri – Jhansi Project
SPV	Special Purpose Vehicle
T&R	Traffic and Revenue
TMS	Traffic Management System
TOT	Toll-Operate-Transfer
TP	Toll Plaza
TVC	Traffic Volume Count
VOC	Vehicle Operating Cost
VOT	Value of Time
WPI	Wholesale Price Index
YOY	Year on Year
YTD	Year to Date

Abbreviations

Term	Description
AIF	Alternative Investment Fund as defined in and registered with SEBI under the SEBI AIF Regulations
BSE	BSE Limited
CCEA	Cabinet Committee on Economic Affairs
CCI	Competition Commission of India
CDSL	Central Depository Services (India) Limited
CIN	Corporate Identity Number
Companies Act	Companies Act, 1956 and/or the Companies Act, 2013, as applicable
Companies Act, 1956	Erstwhile, Companies Act, 1956
Companies Act, 2013	Companies Act, 2013, read with the rules and regulations, thereunder
Competition Act	Competition Act, 2002
Depository	A depository registered with SEBI under the Securities and Exchange Board of India (Depositories and Participants) Regulations, 2018
Depositories Act	Depositories Act, 1996
DIN	Director Identification Number
FEMA	Foreign Exchange Management Act, 1999, read with rules and regulations thereunder
FEMA Rules	Foreign Exchange Management (Non-debt Instruments) Rules, 2019
Financial Year or Fiscal Year or Fiscal	Period of 12 months ended March 31 of that particular year, unless otherwise stated
FPI	Foreign portfolio investors
FVCI	Foreign venture capital investors, as defined under the SEBI FVCI Regulations

Term	Description
GAAR	General Anti-Avoidance Rules
GoI or Government	Government of India
GST	Goods and Services Tax
ICAI	Institute of Chartered Accountants of India
Income Tax Act or IT Act	The Income-tax Act, 1961
Ind AS	Companies (Indian Accounting Standards) Rules, 2015, notified on February 19, 2015 by the MCA, including any amendments or modifications thereto
Indian GAAP	Generally Accepted Accounting Principles in India
Indian GAAS	Generally Accepted Auditing Standards in India
InvIT	Infrastructure investment trust
InvIT Regulations	Securities and Exchange Board of India (Infrastructure Investment Trust) Regulations, 2014, including any circulars, modifications, guidelines, clarifications and amendments thereto
IRDAI	Insurance Regulatory and Development Authority of India
MCA	Ministry of Corporate Affairs, Government of India
MoEF	Ministry of Environment, Forest and Climate Change
MoRTH	Ministry of Road Transport and Highways
NACH	National Automated Clearing House
NEFT	National Electronic Funds Transfer
NHAI	National Highways Authority of India
NHAI Act	National Highways Authority of India Act, 1988, as amended
NSDL	National Securities Depository Limited
NSE	The National Stock Exchange of India Limited
PAN	Permanent account number
RBI	Reserve Bank of India
Regulation S	Regulation S under the Securities Act
RoC	Registrar of Companies, Delhi and Haryana at New Delhi
Rs./Rupees/INR/₹	Indian Rupees
RTGS	Real Time Gross Settlement
SCRA	Securities Contracts (Regulation) Act, 1956
SCRR	Securities Contracts (Regulation) Rules, 1957
SEBI	Securities and Exchange Board of India constituted under the SEBI Act
SEBI Act	The Securities and Exchange Board of India Act, 1992
SEBI AIF Regulations	Securities and Exchange Board of India (Alternative Investments Funds) Regulations, 2012
SEBI Circular on Financial Disclosures	SEBI Circular (CIR/IMD/DF/114/2016) dated October 20, 2016 on 'Disclosure of Financial Information in Offer Document/Placement Memorandum for InvITs'
SEBI Debenture Trustees Regulations	Securities and Exchange Board of India (Debenture Trustees) Regulations, 1993
SEBI FPI Regulations	Securities and Exchange Board of India (Foreign Portfolio Investors) Regulations, 2019
SEBI FVCI Regulations	Securities and Exchange Board of India (Foreign Venture Capital Investors) Regulations, 2000
SEBI Institutional Placement Guidelines	Chapter 7 read with Annexure 7 on '*Guidelines for preferential issue and institutional placement of units by listed InvITs*' of SEBI Master Circular No. SEBI/HO/DDHS-PoD-2/P/CIR/2023/115 dated July 6, 2023, as amended from time to time
Securities Act	U.S. Securities Act of 1933
Stock Exchanges	BSE Limited and the National Stock Exchange of India Limited
U.S./U.S.A./United States	United States of America
USD/US$	United States Dollars

PRESENTATION OF FINANCIAL DATA AND OTHER INFORMATION

Certain Conventions

All references in this Placement Document to "India" are to the Republic of India.

Unless stated otherwise, all references to page numbers in this Placement Document are to the page numbers of this Placement Document.

Financial Data

The Trust was settled on October 19, 2020, and has acquired ownership of NHIPPL on November 3, 2021. Further, NEPPL was incorporated on April 19, 2023, at New Delhi, under the Companies Act, 2013, having obtained a certificate of incorporation, from the Registrar of Companies, Delhi and Haryana on April 19, 2023. The Trust (jointly with its nominee) holds 100% of the issued, subscribed and paid-up share capital of the Project SPVs as on the date of this Placement Document. The audited standalone financial information of the Trust for the period from its date of settlement, i.e. October 19, 2020 up to March 31, 2021 and the audited consolidated financial information of the Trust as of and for the year ended March 31, 2022, March 31, 2023 and the nine months period ended December 31, 2023, prepared in accordance with Ind AS, is included in this Placement Document.

In relation to the Toll Roads, the asset revenue information that was provided by the Sponsor by way of its letters dated August 24, 2021, September 21, 2022 and March 7, 2024 has been disclosed in the section entitled "*Asset Revenue Information*" on page 364. Further, no separate financial information, including audited financial information for the previous three financial years is available for the Target Toll Roads, are currently available, which could be used to clearly ascertain financial information including revenue and expenses in respect of each of the Target Toll Roads. Accordingly, in lieu of the combined financial statements of the Trust along with the Project SPVs and in terms of the SEBI Exemption, the revenue data for the Target Toll Roads that NHAI has historically been collecting through toll collection and maintenance contracts, as communicated *vide* e-mails dated March 6, 2024 and March 5, 2024, has been included in the section entitled "*Asset Revenue Information*" on page 364. The said amounts being collected are at times intermittent on account of gaps in tolling contract periods and would not be a true reflection of the revenue that these Target Toll Roads are actually generating. Please refer to "*Risk Factors - We have no operating history or financial information for the R3 Toll Roads. Accordingly, the information disclosed in this Placement Document in relation to the R3 Toll Roads is limited*" on page 70 in this regard.

Further, this Placement Document includes summary audited financial information of the Sponsor, as of and for the financial years ended March 31, 2022, March 31, 2021 and March 31, 2020 and limited review financial information for the year ended March 31, 2023 and for the nine month period ended December 31, 2023. For further details, please see the sections entitled "*Summary Financial Information of the Sponsor*" on page 38.

The summary audited financial information of the Investment Manager for Fiscals 2021, 2022 and 2023 has been included in this Placement Document in the section entitled "*Summary Financial Information of the Investment Manager" on* page 51.

The degree to which the financial information included in this Placement Document will provide meaningful information is entirely dependent on the reader's level of familiarity with Indian accounting policies and practices, the Companies Act, Ind AS, Indian GAAP and the InvIT Regulations. Any reliance by persons not familiar with Indian accounting policies and practices on the financial disclosures presented in this Placement Document should accordingly be limited.

The financial year for the Trust and Parties to the Trust commences on April 1 and ends on March 31 of the next year; accordingly, all references to a particular financial year, unless stated otherwise, are to the 12 month period ended on March 31 of that year.

In this Placement Document, any discrepancies in any table between the total and the sums of the amounts listed are due to rounding off. All figures in decimals and all percentage figures have been rounded off to two decimal places.

Currency and Units of Presentation

All references to:

- "Rupees" or "₹" or "INR" or "Rs." are to Indian Rupee, the official currency of the Republic of India; and
- "USD" or "US$" are to United States Dollar, the official currency of the United States.

Except otherwise specified, certain numerical information in this Placement Document have been presented in "million" units. One million represents 1,000,000 and one billion represents 1,000,000,000. One lakh represents 1,00,000 and one crore represents 1,00,00,000.

Unless the context requires otherwise, any percentage amounts, as set forth in this Placement Document, have been calculated on the basis of the Audited Financial Information, and the summary financial statements of the Sponsor.

Exchange Rates

This Placement Document contains conversion of certain other currency amounts into Indian Rupees. These conversions should not be construed as a representation that these currency amounts could have been, or can be converted into Indian Rupees, at any particular rate.

The following table sets forth, for the dates indicated, information with respect to the exchange rate between the Rupee and the US$ (in Rupees per US$):

Currency	December 31, 2023	March 31, 2022	March 31, 2021	March 31, 2020
1 US$	83.12	75. 81	73.50	75.39

Source: www.rbi.org.in and www.fbil.org.in
In the event that any of the respective years/ period is a public holiday, the previous calendar day, not being a public holiday, has been considered.
The above exchange rates are for the purpose of information only and may not represent the rates used by the Trust for purpose of preparation or presentation of its financial statements. The rates presented are not a guarantee that any person could have on the relevant date converted any amounts at such rates or at all.

Industry and Market Data

Unless stated otherwise, industry and market data used in this Placement Document has been obtained or derived from publicly available information, as well as from the Report titled "*Roads and Highways*" dated 2023, prepared by CRISIL Market Intelligence & Analytics ("**CRISIL Report**"). The CRISIL Report is subject to the following disclaimer:

"*CRISIL MI & A, a division of CRISIL Limited (CRISIL) has taken due care and caution in preparing this report (Report) based on the Information obtained by CRISIL from sources which it considers reliable (Data). However, CRISIL does not guarantee the accuracy, adequacy or completeness of the Data / Report and is not responsible for any errors or omissions or for the results obtained from the use of Data / Report. This Report is not a recommendation to invest / disinvest in any entity covered in the Report and no part of this Report should be construed as an expert advice or investment advice or any form of investment banking within the meaning of any law or regulation. CRISIL especially states that it has no liability whatsoever to the subscribers / users / transmitters/ distributors of this Report. Without limiting the generality of the foregoing, nothing in the Report is to be construed as CRISIL providing or intending to provide any services in jurisdictions where CRISIL does not have the necessary permission and/or registration to carry out its business activities in this regard.* ***National Highways Infra Trust*** *will be responsible for ensuring compliances and consequences of non-compliances for use of the Report or part thereof outside India. CRISIL MI & A operates independently of, and does not have access to information obtained by CRISIL Ratings Limited, which may, in their regular operations, obtain information of a confidential nature. The views expressed in this Report are that of CRISIL MI & A and not of CRISIL Ratings Limited. No part of this Report may be published/reproduced in any form without CRISIL's prior written approval.*"

Although the Investment Manager believes that the industry and market data used in this Placement Document is reliable, it has not been independently verified by the Investment Manager, the Trustee or the Lead Managers, or any of their affiliates or advisors and their accuracy and completeness are not guaranteed and their reliability cannot be assured. The data used in these sources may have been re-classified by us for the purposes of presentation. Data from these sources may also not be comparable. Such data involves risks, uncertainties and numerous assumptions and is subject to change based on various factors, including those disclosed in the section entitled "*Risk Factors*" on page 70. Accordingly, no investment decisions should be based on such information.

The extent to which the market and industry data used in this Placement Document is meaningful depends on the reader's familiarity with and understanding of the methodologies used in compiling such data. There are no standard data gathering methodologies in the industry in which business of the Trust is conducted, and methodologies and assumptions may vary widely among different industry sources.

Traffic Consultants

The traffic reports in **Annexure C**, as well as the data used in this Placement Document from those reports, have been prepared by the Traffic Consultants.

Disclaimers from the Traffic Consultants

Disclaimer from Steer

"*This Preliminary Placement Document includes selected provisions of or a summary of the Steer_ Final Report_ Lakhnadon*

Khawasa (08022024) and Steer_ Final Report_ Kochugaon- Patacharkuchi (08022024) dated February 2024 (the "Report") prepared by Steer, Davies & Gleave India Private Limited, solely in its capacity as the Traffic Consultant (the "Traffic Consultant"), on behalf of NHIIMPL (the "Client") for the Offer and is not a full statement of the terms of the Report. Accordingly, such summary or excerpt is qualified in its entirety by reference to and is subject to the full text of the Report, which are attached Preliminary Placement Document/ Placement Document as Annexure C. Investors must view the summaries in the context of the full Report, which is subject to the limitations and disclaimers in such Report. Without limiting the generality of the foregoing, the Report is expressly subject to the qualifications, assumptions made, procedures followed, matters considered and any limitations on the scope of work contained therein.

Investors should note that these summaries, and the Report, are provided only as of the date set forth therein and do not contemplate any event, circumstances or changes with respect to Offer or otherwise after such date. The foregoing summaries of the Report may include projected information and data (financial and otherwise), and other forward-looking information, that may or may not occur or prove to be accurate. Such projected and forward-looking information is based on current expectations and projections about future events which are beyond the control of the Traffic Consultant, the Client or any other participant in the Offer, and such projections and information can be affected by inaccurate assumptions. While these projections and information were prepared in good faith, no assurance can be given as to the accuracy or adequacy of such projections and information, or the assumptions underlying such projections and information.

TO THE FULLEST EXTENT PERMITTED BY APPLICABLE LAW, THE LIABILITY OF THE TRAFFIC CONSULTANT FOR ANY LOSS, DAMAGE, COST OR EXPENSE SUFFERED OR INCURRED BY ALL PERSONS OR ENTITIES AND FOR ALL CLAIMS RESPECTING ITS WORK PERFORMED IN CONNECTION WITH THE PROJECT IS HEREBY LIMITED IN THE AGGREGATE TO THE AMOUNT OF FEES ACTUALLY PAID BY THE CLIENT TO THE TRAFFIC CONSULTANT IN CONNECTION WITH THE PROJECT."

Disclaimer from Ramboll

"*This Report is intended for the National Highways Infra Projects Private Limited's sole and exclusive use and is not for the benefit of any third party and may not be distributed to, disclosed in any form to, used by, or relied upon by, any third party, except as agreed between the Parties, without prior written consent of Ramboll, which consent may be withheld in its sole discretion.*

Use of this Report or any information contained herein, if by any party other than the Client, shall be at the sole risk of such party and shall constitute a release and agreement by such party to defend and indemnify Ramboll and its officers, employees from and against any liability for direct, indirect, incidental, consequential or special loss or damage or other liability of any nature arising from its use of the Report or reliance upon any of its content. To the maximum extent permitted by law, such release from and indemnification against liability shall apply in contract, tort (including negligence), strict liability, or any other theory of liability.

In preparing this report, Ramboll India Private Limited relied, in whole or in part, on data and information provided by National Highways Infra Projects Private Limited, which information has not been independently verified by Ramboll and which Ramboll has assumed to be accurate, complete, reliable, and current. Therefore, while Ramboll has utilized its best efforts in preparing this Report, Ramboll does not warrant or guarantee the conclusions set forth in this Report which are dependent or based upon data, information, or statements supplied by third parties or the client."

Disclaimer from CRISIL

"CRISIL Research, a division of CRISIL Limited (CRISIL) has taken due care and caution in preparing this report (Report) based on the Information obtained by CRISIL from sources which it considers reliable (Data). However, CRISIL does not guarantee the accuracy, adequacy or completeness of the Data / Report and is not responsible for any errors or omissions or for the results obtained from the use of Data /Report. This Report is not a recommendation to invest / disinvest in any entity covered in the Report and no part of this Report should be construed as an expert advice or investment advice or any form of investment banking within the meaning of any law or regulation. CRISIL especially states that it has no liability whatsoever to the subscribers / users / transmitters/ distributors of this Report. Without limiting the generality of the foregoing, nothing in the Report is to be construed as CRISIL providing or intending to provide any services in jurisdictions where CRISIL does not have the necessary permission and/or registration to carry out its business activities in this regard National Highways Infra Trust will be responsible for ensuring compliances and consequences of non-compliances for use of the Report or part thereof outside India. CRISIL MI&A operates independently of, and does not have access to information obtained by CRISIL Ratings Limited, which may, in their regular operations, obtain information of a confidential nature. The views expressed in this Report are that of CRISIL MI&A and not of CRISIL Ratings Limited. No part of this Report may be published/reproduced in any form without CRISIL's prior written approval."

MARKET PRICE INFORMATION

In this section, all market price information provided for Fiscal 2022 refers to such information for the period beginning November 10, 2021 (i.e. the date of listing of the Units on the BSE and NSE) until March 31, 2023. Further, market price information has been included for a period from April 1, 2023 to February 29, 2024.

As on the date of this Placement Document, 726,405,200 Units are issued, subscribed and are fully paid up. The units have been listed and are available for trading on BSE and NSE. The units have been listed and are available for trading on BSE and NSE.

(i) The following tables set forth the reported high, low, average market prices and the trading volumes of the Units on the Stock Exchanges on the dates on which such high and low prices were recorded and the total trading volumes for Fiscals 2023, and 2022:

BSE:

Fiscal Year	High (₹)	Date of high	Number of Units traded on date of high	Total turnover of Units traded on date of high (₹ million)	Low (₹)	Date of low	Number of Units traded on date of low	Total turnover of Units traded on date of low (₹ million)	Average price for the period (₹)	Units traded in the fiscal year	
										Volume	(in ₹ million)
2022*	116.10	March 7, 2022	200,000	23.22	101.99	November 18, 2021	400,000	40.80	107.02	1,800,000	187.62
2023	-	-	-	-	-	-	-	-	-	-	-
April 1, 2023 to March 13, 2024	118.75	June 7, 2023	3,000,000	356.25	116.45	August 8, 2023	2,200,000	256.19	118.08	9,000,000	1,062.92

** The market price data pertaining to the period from the date of listing of units i.e. with effect from November 10, 2021.*
(Source: www.bseindia.com)

Fiscal Year	High (₹)	Date of high	Number of Units traded on date of high	Total turnover of Units traded on date of high (₹ million)	Low (₹)	Date of low	Number of Units traded on date of low	Total turnover of Units traded on date of low (₹ million)	Average price for the period (₹)	Units traded in the fiscal year	
										Volume	(in ₹ million)
2022*	116.10	March 7, 2022	200,000	23.22	101.99	November 18, 2021	400,000	40.80	107.02	1,800,000	187.62
April 1, 2022 to October 13, 2022	-	-	-	-	-	-	-	-	-	-	-
October 14, 2022 to March 31, 2023	-	-	-	-	-	-	-	-	-	-	-
April 1, 2023 to March 13, 2024	118.75	June 7, 2023	3,000,000	356.25	116.45	August 8, 2023	2,200,000	256.19	118.08	9,000,000	1,062.92

** The market price data pertaining to the period from the date of listing of units i.e. with effect from November 10, 2021.*
(Source: www.bseindia.com)

NSE:

Fiscal Year	High (₹)	Date of high	Number of Units traded on date of high	Total turnover of Units traded on date of high (₹ million)	Low (₹)	Date of low	Number of Units traded on date of low	Total turnover of Units traded on date of low (₹ million)	Average price for the period (₹)	Units traded	
										Volume	(in ₹ million)
2022*	109.00	February 17, 2022	2,000,000	218.00	101.25	November 11, 2021	8,000,000	81.00	103.64	35,200,000	3,609.01
2023	120.00	May 10, 2022	200,000	24.00	109.70	October 14, 2022	5,400,000	592.53	113.49	620,000	684.07
April 1, 2023 to March 13, 2024	123.65	February 28, 2024	4,800,000	593.52	113.00	April 20, 2023	600,000	67.80	117.92	28,200,000	3,345.45

** The market price data pertaining to the period from the date of listing of units i.e. with effect from November 10, 2021.*
(Source: www.nseindia.com)

Fiscal Year	High (₹)	Date of high	Number of Units traded on date of high	Total turnover of Units traded on date of high (₹ million)	Low (₹)	Date of low	Number of Units traded on date of low	Total turnover of Units traded on date of low (₹ million)	Average price for the period (₹)	Units traded	
										Volume	(in ₹ million)
2022*	109.00	February 17, 2022	2,000,000	218.00	101.25	November 11, 2021	8,000,000	81.00	103.64	35,200,000	3,609.01
April 1, 2022 to October 13, 2022	120	May 10, 2022	2,00,000	24.00	114	April 20, 2022 & August 19, 2022*,	200,000, 200,000*	24.00, 22.80	116.00	600,000	69.60
October 14, 2022 to March 31, 2023	109.75	October 14, 2022	5,400,000	592.53	109.70	October 14, 2022	5,400,000	592.53	109.72	5,600,000	614.47
April 1, 2023 to March 13, 2024	123.65	February 28, 2024	4,800,000	593.52	113.00	April 20, 2023	600,000	67.80	117.92	24,600,000	2,900.81

* Since the Low price and also the volume of units was same on the two dates, hence information for both dates has been mentioned

Notes:

1. *High, low are based on the daily high and low prices respectively.*
2. *Average prices are based on the daily closing prices.*
3. *In case of two days with the same high or low prices, the date with the higher volume of units has been considered.*

(ii) The following tables set forth the reported high, low and average market prices and the trading volumes of the Units on the Stock Exchanges on the dates on which such high and low prices were recorded during each of the last six months:

BSE:

Month	High (₹)	Date of high	Number of Units traded on date of high	Total turnover of Units traded on date of high (in ₹ million)	Low (₹)	Date of low	Number of Units traded on date of low	Total turnover of Units traded on date of low (in ₹ million)	Average price for the month (₹)	Units traded in the month	
										Volume	(in ₹ million)
September 2023	-	-	-	-	-	-	-	-	-	-	-
October 2023	-	-	-	-	-	-	-	-	-	-	-
November 2023	-	-	-	-	-	-	-	-	-	-	-
December 2023	118.60	December 18, 2023	1,800,000	213.48	118.60	December 18, 2023	1,800,000	213.48	118.60	1,800,000	213.48
January 2024	118.50	January 9, 2024	2,000,000	237	118.50	January 9, 2024	2,000,000	237.00	118.50	2,000,000	237.00
February 2024	-	-	-	-	-	-	-	-	-	-	-

(Source: www.bseindia.com)

NSE:

Month	High (₹)	Date of high	Number of Units traded on date of high	Total turnover of Units traded on date of high (in ₹ million)	Low (₹)	Date of low	Number of Units traded on date of low	Total turnover of Units traded on date of low (in ₹ million)	Average price for the month (₹)	Units traded in the month	
										Volume	(in ₹ million)
September 2023	119.80	September 26, 2023	200,000	23.96	119.80	September 26, 2023	200,000	23.96	119.80	200,000	23.96
October 2023	-	-	-	-	-	-	-	-	-	-	-
November 2023	119.00	November 28, 2023	200,000	23.80	119.00	November 28, 2023	200,000	23.80	119.00	200,000	23.80
December 2023	118.50	December 20, 2023	2,000,000	237.00	118.50	December 20, 2023	2,000,000	237.00	118.50	2,000,000	237.00
January 2024	-	-	-	-	-	-	-	-	-	-	-
February 2024	123.65	February 28, 2024	4,800,000	593.52	123.65	February 28, 2024	4,800,000	593.52	123.65	4,800,000	593.52

(Source: www. nseindia.com)

Notes:

1. *High, low are based on the daily High and Low prices respectively.*
2. *Average prices are based on the daily closing prices.*
3. *In case of two days with the same high or low prices, the date with the higher volume of units has been considered*.
4. *Since the units of the Trust have not been traded, no such data is available for the specific months*.
5. *The data disclosed above has not resulted in any change in the capital structure of the Trust.*

The market price on the Stock Exchanges on February 11, 2024, the first working day following the approval of the Board of the Investment Manager for the Issue, is 118.50.

FORWARD-LOOKING STATEMENTS

Certain statements contained in this Placement Document that are not statements of historical fact constitute "forward-looking statements". Bidders can generally identify forward-looking statements by terminology such as "aim", "anticipate", "believe", "continue", "can", "could", "estimate", "expect", "intend", "may", "objective", "plan", "potential", "project", "pursue", "seek to", "shall", "should", "will", "would", or other words or phrases of similar import. Similarly, statements that describe the strategies, objectives, plans or goals of the Trust are also forward-looking statements. However, these are not the exclusive means of identifying forward-looking statements.

All statements regarding the Trust's expected financial conditions, results of operations and cash flows, business plans and prospects are forward-looking statements. These forward-looking statements include statements as to the Trust's business strategy, planned projects, revenue and profitability (including, without limitation, any financial or operating projections or forecasts), new business and other matters discussed in this Placement Document that are not historical facts.

The Valuation Reports included in this Placement Document, is based on certain projections and accordingly, should be read together with assumptions and notes thereto. For further details, please see the "*Valuation Reports*" attached as **Annexure B**. The Traffic Reports and Technical Reports include projections and estimates in relation to traffic growth and operation and maintenance expenses respectively, and accordingly, should be read in conjunction with the relevant notes and assumptions thereto.

Actual results may differ materially from those suggested by the forward-looking statements due to certain known or unknown risks or uncertainties associated with the Investment Manager's expectations with respect to, but not limited to, the actual growth in the infrastructure sector, the Investment Manager's ability to successfully implement the strategy, growth and expansion plans, cash flow projections, exposure to market risks, the outcome of any legal or regulatory proceedings, the future impact of new accounting standards, regulatory changes pertaining to the infrastructure sector in India and our ability to respond to them, general economic and political conditions in India which have an impact on our business activities or investments, changes in competition, and the Project Manager's ability to operate and maintain the Project SPVs and successfully implement any technological changes. By their nature, certain of the market risk disclosures are only estimates and could be materially different from what actually occurs in the future. As a result, actual future gains, losses or impact on net interest income and net income could materially differ from those that have been estimated.

Factors that could cause actual results, performance or achievements of the Trust to differ materially include, but are not limited to, those discussed in the sections entitled "*Risk Factors*", "*Industry Overview*", "*Our Business*" and "*Management's Discussion and Analysis of Factors by the Directors of the Investment Manager affecting the Financial Condition, Results of Operations and Cash Flows*", on pages 70, 145, 153 and 290, respectively. Some of the factors that could cause the Trust's actual results, performance or achievements to differ materially from those in the forward-looking statements and financial information include, but are not limited to, the following:

- The monies received from the Issue proceeds have been retained in the Cash Escrow Account until the completion of the allotment of units to the Sponsor pursuant to the preferential issue to Sponsor and will be refunded to the Bidders in case the proposed issue of Units on a preferential basis to the Sponsor is not completed prior to the Allotment of Units;

- We have no operating history or financial information for the R3 Toll Roads. Accordingly, the information disclosed in this Placement Document in relation to the R3 Toll Roads is limited;

- We must maintain certain investment ratios, which may present additional risks to us;

- NHIPPL may not be able to claim depreciation in relation to toll collection rights acquired from the Sponsor;

- We may not be able to make future distributions to Unitholders or the level of distributions may fall;

- Project SPVs may not be able to claim depreciation in relation to toll collection rights acquired from the Sponsor.

Forward-looking statements, Valuation Reports, Traffic Reports and Technical Reports reflect current views as of the date of the respective reports included in this Placement Document and are not a guarantee of future performance or returns to Bidders. These statements and projections are based on certain beliefs and assumptions, which in turn are based on currently available information. Although, the Investment Manager believes that the expectations and the assumptions upon which such forward-looking statements are based are reasonable at this time, the Investment Manager does not assure Bidders that such expectations will prove to be correct or accurate. Given these uncertainties, Bidders are cautioned not to place undue reliance on such forward-looking statements. In any event, these statements speak only as of the date of this Placement Document or the respective dates indicated in this Placement Document, and the Trust, the Investment Manager and the Lead Managers or any of their affiliates or advisors, undertake no obligation to update or revise any of the statements reflecting circumstances arising after the date hereof or to reflect the occurrence of underlying events, whether as a result of new information, future

events or otherwise after the date of this Placement Document. If any of these risks and uncertainties materialize, or if any of the Investment Manager's underlying assumptions prove to be incorrect, the actual results of operations or financial condition or cash flow of the Trust could differ materially from that described herein as anticipated, believed, estimated or expected. All subsequent forward-looking statements attributable to the Trust are expressly qualified in their entirety by reference to these cautionary statements.

THE ISSUE

The following is a general summary of the terms of this Issue. This summary should be read in conjunction with, and is qualified in its entirety by, the detailed information appearing elsewhere in this Placement Document:

Trust	National Highways Infra Trust is a contributory irrevocable trust set up under the Indian Trusts Act, 1882, and registered as an infrastructure investment trust under the InvIT Regulations on October 28, 2020, having registration number IN/InvIT/20-21/0014
Issue	Issue of 497,926,000 Units by way of an institutional placement to Eligible Investors, representing an undivided beneficial interest in the Trust through an institutional placement aggregating to approximately ₹ 61,812.53 million by the Trust
Floor Price	₹ 124 per Unit
Issue Price	₹ 124.14 per Unit
Bid Lot/ Minimum Bid Size	A minimum of 2,119,000 Units and in multiples of 10 Units thereafter
Bid/ Issue Opening Date	March 12, 2024
Bid/ Issue Closing Date	March 13, 2024
Sponsor	National Highways Authority of India
Trustee	IDBI Trusteeship Services Limited
Investment Manager	National Highways Infra Investment Managers Private Limited
Project Manager	National Highways InvIT Project Managers Private Limited
Eligible Investors	Institutional Investors subject to applicable law
Authority for this Issue	This Issue was authorised and approved by the IM Board on February 10, 2024 and by the Unitholders on March 4, 2024.
Tenure of the Trust	The Trust shall remain in force perpetually until it is dissolved or terminated in accordance with the Trust Deed. For details, please see the section entitled "*Parties to the Trust*" on page 101.
Units issued and outstanding immediately prior to this Issue	726,405,200 Units
Units issued and outstanding immediately after this Issue	131,22,00,600* Units[#]
Sponsor and Sponsor Group Units as on the date of this Placement Document	115,202,600 Units*. The Units held by the Sponsor will rank *pari passu* with, and have the same rights as the Units to be Allotted to other Bidders pursuant to the Issue.
Distribution	Please see the section entitled "*Distribution*" on page 302.
Indian Taxation	Please see the section entitled "*Taxation"* on page 349.
Use of Proceeds	Please see the section entitled *"Use of Proceeds*" on page 273.
Listing	The Units are proposed to be listed on NSE and BSE. The Trust has received the in-principle approvals from NSE and BSE pursuant to their letters dated March 11, 2024, for the listing of the Units. The Investment Manager shall apply to NSE and BSE for the final listing and trading approvals, after the Allotment and after the credit of the Units to the beneficiary accounts with the Depository Participants and the Units shall be listed within two working days from the date of Allotment. The Trust shall also file this Placement Document, along with the allotment report, containing the details of the allottees and allotment made, with SEBI within seven days of Allotment.
Closing Date	The date on which Allotment of the Units pursuant to this Issue shall be made, i.e. on or about Friday, March 15, 2024
Ranking	The Units being issued will rank *pari passu* in all respects, including rights in respect of distribution. The Unitholders will be entitled to participate in distribution, if any, declared by the Trust after the date of Allotment. Please see the section entitled "*Rights of Unitholders*" on page 335.
Lock-in and Rights of Unitholders	For details, please see the sections entitled "*Information concerning the Units*" and "*Rights of Unitholders*" on pages 270 and 335, respectively.
Risk Factors	Prior to making an investment decision, Bidders should consider carefully the matters discussed in the section entitled "*Risk Factors*" on page 70.

** The IM Board by way of its resolution dated February 10, 2024 and the Unitholders of the Trust by way of their resolution dated March 4, 2024, have approved the Issue of upto 497,926,090 Units at or above ₹ 122.86 per Unit ("**Base Price**"). The Trust proposes to undertake the issue of up to 117,159,080 Units to the Sponsor, on a preferential basis ("**Preferential Issue**"), in accordance with the SEBI Institutional Placement Guidelines and the InvIT Regulations. The Unitholders by way of a resolution dated March 4, 2024 have approved the Preferential Issue. The Sponsor, by way of its letter dated March 6, 2024, has confirmed its willingness to subscribe to atleast 87,869,310 Units, at a base offer price of ₹ 122.86 per Unit plus premium payable, if any. Further, the Sponsor, by way of its letter dated March 14, 2024 has agreed to subscribe to 87,869,400 Units at a price of ₹ 124.14 per Unit pursuant to the Preferential Issue.*

[#]Subject to completion of the allotment against subscription by the Sponsor pursuant to the Preferential Issue.

The Units, on Allotment, shall be traded only in the dematerialized segment of the Stock Exchanges.

In accordance with the InvIT Regulations, no Unitholder shall enjoy superior voting or any other rights over another Unitholder. Further, there shall not be multiple classes of Units.

None of the respective members of the Sponsor or promoters or partners or directors of the Investment Manager or Trustee is a fugitive economic offender declared under section 12 of the Fugitive Economic Offenders Act, 2018.

For further details in relation to this Issue, including the basis for the calculation of Issue Price and method of application, please see the section entitled "*Issue Procedure*" on page 340 and the Valuation Reports as set out in **Annexure B** to this Placement Document.

OVERVIEW OF THE TRUST

The following overview is qualified in its entirety by, and is subject to, the more detailed information contained in or referred to elsewhere in this Placement Document. Statements contained in this summary that are not historical facts may be forward-looking statements. Such statements are based on certain assumptions and are subject to certain risks, uncertainties and assumptions that could cause actual results of the Trust to differ materially from those forecasted or projected in this Placement Document. Under no circumstances should the inclusion of such information herein be regarded as a representation, warranty or prediction of the accuracy of the underlying assumptions by the Trust, the Parties to the Trust or the Lead Managers or any other person or that these results will be achieved or are likely to be achieved. Investment in Units involves risks. Bidders are advised not to rely solely on this overview, and, should read this Placement Document in its entirety and, in particular, the sections entitled "Risk Factors" and "Forward Looking Statements" on pages 70 and 20, respectively.

Structure and description of the Trust

The Sponsor settled the Trust on October 19, 2020, as a contributory irrevocable trust, pursuant to the Trust Deed, under the provisions of the Indian Trusts Act, 1882. The Trust was registered with SEBI on October 28, 2020, as an infrastructure investment trust under Regulation 3(1) of the InvIT Regulations having registration number IN/InvIT/20-21/0014. The Sponsor has settled the Trust for an initial sum of ₹ 10,000.

For details of the registered office and contact person of the Sponsor, please see the section entitled "*General Information*" on page 96. For the contact details of the Trust, please see the cover page.

Further, NHIIMPL is the investment manager, and NHIPMPL is the project manager to the Trust. For further details please see the section entitled "*Parties to the Trust*" on page 101.

Investment Objectives

The investment objectives of the Trust are to carry on the activity of and to make investments as an infrastructure investment trust as permissible in terms of the InvIT Regulations. The investment of the Trust shall only be in any manner permissible under, and in accordance with, the InvIT Regulations and applicable law, including in such holding companies and/or special purpose vehicles and/or infrastructure projects and/or securities in India as permitted under the InvIT Regulations. Whilst making such investments, the Trust shall adhere to the investment strategy as set out in the section entitled "*Our Business*" on page 153. The investment by the Trust shall be in compliance with the provisions of the InvIT Regulations.

As on the date of this Placement Document, the Trust is not permitted to carry out any other principal activity unless specifically provided under applicable law.

Fee and expenses

Annual Expenses

The expenses in relation to the Trust, other than such expenses incurred in relation to operations of Project SPVs, would broadly include fees and expenses payable to (i) Trustee; (ii) Investment Manager; (iii) Project Manager; (iv) Auditor; (v) Valuer; and (vi) other intermediaries and consultants.

The estimated recurring expenses on an annual basis are as follows:

(₹ in million)

Particulars	Estimated Expenses
Trustee fee	0.96
Investment Manager fee	180.00^
Project Manager fee	84.00
Fee payable to the credit rating agencies	0.64
Auditor fee, Valuer fee, other intermediaries and consultants and others	9.50**

^ *Effective from April 2023 with annual escalation as per the amended terms of the Investment Management Agreement.*
***Estimated fee for the financial year ended March 31, 2024.*

Issue Expenses

The total expenses of this Issue are estimated to be approximately ₹ 464.50 million which will be incurred by the Trust. For details in relation to the expenses for this Issue, please see the section entitled *"Use of Proceeds"* on page 273.

Details of credit ratings

The Trust has been given a rating by Care Ratings Limited of (a) 'Care AAA/Stable' for existing long-term facilities of Rs. 2,850 crore, bank facilities and issuer rating on February 14, 2024, the rationale for which is available at its website www.careratings.com/upload/CompanyFiles/PR/202402120226_National_Highways_Infra_Trust.pdf; (b) 'Care AAA/Stable' for the long-term facilities of Rs. 1,500 crore, non-convertible debentures on February 14, 2024, the rationale for which is

available at its website www.careratings.com/upload/CompanyFiles/PR/202402120226_National_Highways_Infra_Trust.pdf; and (c) 'Provisional Rating - Care AAA/Stable' for the proposed long-term facilities of Rs. 9,000 crore, bank facilities and issuer rating on February 14, 2024, the rationale for which is available at its website www.careratings.com/upload/CompanyFiles/PR/202402120226_National_Highways_Infra_Trust.pdf; and by India Ratings and Research Private Limited of (a) 'IND AAA/Stable' for public issue of non-convertible debentures aggregating up to ₹ 1,500 crore on March 4, 2024; the rationale for which is available at its website, https://www.indiaratings.co.in./pressrelease/68669 (b)'IND AAA/Stable' as long-term issue rating; (c) 'IND AAA/Stable' for rupee term loan of ₹ 2,850 crore on March 4, 2024; the rationale for which is available at its website, https://www.indiaratings.co.in./pressrelease/68669 and (d) 'Provisional Rating - IND AAA/Stable' for proposed rupee term loan of ₹ 4,500 crore on March 2, 2024; the rationale for which is available at its website https://www.indiaratings.co.in./pressrelease/68669

FORMATION TRANSACTIONS IN RELATION TO THE TRUST

Details of arrangement pertaining to the Trust

The Trust's portfolio comprises our Project SPVs namely National Highways Infra Project Limited and NHIT Eastern Projects Private Limited. The details of the Project SPVs are as provided below:

National Highways Infra Projects Private Limited ("NHIPPL")

NHIPPL is a private limited company incorporated on July 23, 2020, at New Delhi, under the Companies Act, 2013, having obtained a certificate of incorporation, from the Registrar of Companies, Delhi and Haryana on July 23, 2020. The CIN of NHIPPL is U45201DL2020GOI366737.

Capital structure of NHIPPL

Particulars	Number of equity shares of ₹ 10 each
Authorised capital	1,294,100,000
Issued, subscribed and paid-up capital	1,294,100,000

NHIT Eastern Projects Private Limited ("NEPPL")

NEPPL is a private limited company incorporated on April 19, 2023, at New Delhi, under the Companies Act, 2013, having obtained a certificate of incorporation, from the Registrar of Companies, Delhi and Haryana on April 19, 2023. The CIN of NEPPL is U42101DL2023PTC412707.

Capital structure of NEPPL

Particulars	Number of equity shares of ₹ 10 each
Authorised capital	1,000,000
Issued, subscribed and paid-up capital	1,00,000

The Trust (jointly with its nominee) holds 100% of the issued, subscribed and paid-up share capital of the Project SPVs as on the date of this Placement Document.

In light of the fact that the Project SPVs will constitute tolling rights and not underlying land, the requirement for conducting land diligence in respect of the Project SPVs does not arise.

The Investment Manager confirms that not less than 80% of the projects are 'eligible infrastructure projects' (as defined in the InvIT Regulations) in terms of Regulation 18(4) of the InvIT Regulations.

The Investment Manager confirms that not less than 80% of the value of the InvIT assets are invested in completed and revenue generating assets (as defined in the InvIT Regulations), in terms of the InvIT Regulations.

For further details in relation to the Project SPVs, please see the section entitled "*Our Business*" on page 153.

Borrowings of the Trust

The Trust has entered into a loan agreement dated September 29, 2021, with certain lenders for availing loans amounting to ₹ 20,000.00 million ("**Trust Loan 1**"). With respect to Trust Loan 1, as on December 31, 2023, the Trust has drawn down an amount equivalent to ₹ 14,800.00 million for payment of concession fee for R1 Toll roads and an amount equivalent to ₹ 462.60 million for capex and bank guarantees. Additionally, the Trust has entered into a facility agreement dated October 18, 2023, with certain lenders for availing loans amounting to ₹ 8,770.00 million ("**Trust Loan 2**"). With respect to the Trust Loan 2, as of December 31, 2023, the Trust has drawn down an amount equivalent to ₹ 390.00 million and non-fund-based facility equivalent to ₹ 49.25 million. For details of indebtedness in relation to the Trust Loans, please see the section entitled "*Financial Indebtedness and Deferred Payments*" on page 275.

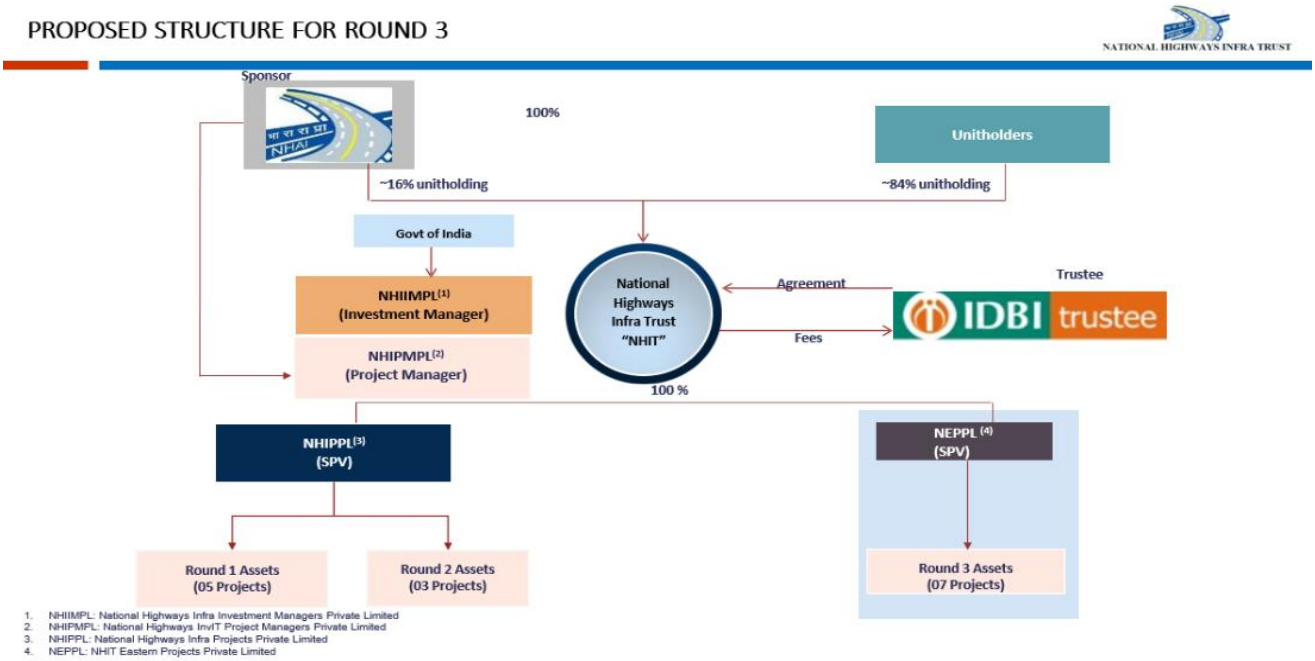
Utilisation of Net Proceeds

Further, upon the listing of the Units, the Trust shall utilize the Net Proceeds aggregating to an amount of ₹ 61,348.03 million for (a) infusion of debt and/or equity into NEPPL: The proceeds of the debt and/or equity infused into the NEPPL shall be utilized by NEPPL for: (a) part payment of (i) initial estimated concession value to the Sponsor; (ii) initial improvement cost; (iii) major maintenance cost; (iv) upfront fees to various agencies, as applicable; if any; and/or (b) creation and maintenance of major maintenance reserve, if any; (b) creation and maintenance of debt service reserve account at Trust level; (c) Additional concession fee; and (d) General corporate purposes.

Proposed post- Issue structure

For details of the pre- Issue and post- Issue unitholding structure of the Trust, please see the section entitled "*Information concerning the Units*" on page 270.

The following structure illustrates the proposed relationship between the Trust, the Trustee, the Sponsor, the Investment Manager, the Project Manager and the Unitholders post- Issue:



SUMMARY FINANCIAL INFORMATION OF THE TRUST

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Audited Consolidated Balance Sheet of National Highways Infra Trust			
Particulars	**As at December 31, 2023 (in Rs. lakhs)**	**As at March 31, 2023 (in Rs. lakhs)**	**As at March 31, 2022 (in Rs. lakhs)**
ASSETS			
1) Non - Current Assets			
(a) Property, Plant and Equipment	184.45	125.17	0.46
(b) Goodwill	10,144.46	10,144.46	10,144.46
(c) Intangible assets	1,095,766.28	1,001,400.09	733,984.39
(d) Financial Assets			
(i) Other Financial Assets	10,058.79	9,672.44	3,170.81
(e) Deferred Tax Assets (net)	9,305.55	4,685.32	262.53
(f) Other Non Current Assets	1,519.81	-	-
(g) Non -Current Tax Assets (Net)	16.81	12.06	-
Total non-current assets	**1,126,996.15**	**1,026,039.54**	**747,562.64**
2) Current Assets			
(a) Financial Assets			
(i) Trade receivables	660.05	350.87	600.47
(ii) Cash and Cash Equivalents	24,008.63	21,124.08	6,381.94
(iii) Bank Balances Other than Cash & Cash Equivalents	512.43	-	-
(iv) Other financial assets	4.74	6.65	5.38
(b) Other current assets	2,388.08	1,634.06	347.29
Total current assets	**27,573.93**	**23,115.66**	**7,335.07**
TOTAL ASSETS	**1,154,570.08**	**1,049,155.20**	**754,897.72**
EQUITY AND LIABILITIES			
EQUITY			
1) Unit Capital	741,593.47	741,604.32	599,442.82
2) Initial settlement amount	0.10	0.10	0.10
3) Other Equity	(17,205.93)	(2,469.86)	6,768.43
Total Equity	**724,387.64**	**739,134.56**	**606,211.35**
LIABILITIES			
1) Non-Current liabilities			
(a) Financial liabilities			

Audited Consolidated Balance Sheet of National Highways Infra Trust			
(i) Borrowings	295,648.02	292,158.33	145,556.94
(ii) Other Financial liabilities	28.98	-	-
(b) Provisions	43,474.19	6,318.81	403.37
Total non-current liabilities	**339,151.19**	**298,477.14**	**145,960.32**
2) Current liabilities			
(a) Financial liabilities			
(i) Borrowings	4,192.50	2,000.00	980.86
(ii) Trade Payables			
(a) Total Outstanding, dues of micro and small enterprises	660.96	137.23	-
(b) Total outstanding, dues of creditors other than micro and small enterprises	3,475.72	3,871.17	1,244.79
(iii) Other financial liabilities	2,737.40	5,284.95	97.85
(b) Other current liabilities	71.19	240.61	240.75
(c) Provisions	79,849.77	0.56	0.03
(d) Current Tax Liabilities (Net)	43.71	8.98	161.77
Total current liabilities	**91,031.25**	**11,543.50**	**2,726.06**
TOTAL EQUITY & LIABILITIES	**1,154,570.08**	**1,049,155.20**	**754,897.72**

Audited Consolidated Statement of Profit and Loss of National Highways Infra Trust			
Particulars	**For the Nine months ended December 31, 2023 (in Rs. lakhs)**	**For the year ended March 31,2023 (in Rs. lakhs)**	**For the year ended March 31, 2022 (in Rs. lakhs)**
INCOME			
Revenue from Operations	70,334.10	68,717.20	13,960.55
Interest Income	667.77	373.43	5.86
Profit on sale of investments	797.49	671.17	690.00
Other Income	26.35	326.11	318.67
TOTAL INCOME	**71,825.71**	**70,087.91**	**14,975.08**
EXPENSES			
Investment Manger Fee	1,356.16	1,263.70	1,931.71
Trusteeship Fee	8.73	9.60	3.73
Valuation expenses	5.40	4.00	-
Annual listing fees	40.53	20.00	-
Rating fees	6.35	0.20	0.57
Insurance expenses	573.32	628.74	166.04
Custodian Fees	2.38	0.84	-
Project Management Fees	743.40	991.20	290.43
Operating Expenses	10,770.38	9,025.05	849.77
Employee Benefits Expenses	843.96	296.22	2.12
Finance Cost	19,565.51	16,621.32	3,154.43
Depreciation & Amortization Expense	17,660.65	17,560.63	1,055.65
Other Expenses	1,602.61	1,917.06	504.87
Audit Fees			
- Statutory audit fees	13.44	7.73	4.86
- Other audit services (including certification)	1.04	0.93	0.52
TOTAL EXPENSES	**53,193.86**	**48,347.22**	**7,964.71**
Profit / (Loss) before Tax	**18,631.85**	**21,740.69**	**7,010.37**
Tax Expenses			
Current Tax	408.31	473.89	436.36

Audited Consolidated Statement of Profit and Loss of National Highways Infra Trust			
Current tax - earlier years	(2.52)	0.01	
Deferred Tax expense/(credit)	(4,620.23)	(4,422.79)	(262.32)
Total Tax	**(4,214.44)**	**(3,948.89)**	174.04
Profit/ (loss) for the period	**22,846.29**	**25,689.57**	**6,836.33**
Other Comprehensive Income			
Items that will not be reclassified to Profit and Loss	(2.24)	-	-
Income tax relating to items that will not be reclassified to profit or loss	0.45	-	-
	(1.79)	-	-
Total Comprehensive Income for the year/ period	**22,844.50**	**25,689.57**	**6,836.33**
Earnings per Unit			
Basic	3.14	3.91	1.15
Diluted	3.14	3.91	1.15

Audited Consolidated Cash Flow Statement of National Highways Infra Trust			
Particulars	**For the Nine months ended December 31, 2023 (in Rs. lakhs)**	**For the year ended March 31,2023 (in Rs. lakhs)**	**For the year ended March 31, 2022 (in Rs. lakhs)**
OPERATING ACTIVITIES (A)			
Net Profit/(Loss) Before Tax	18,631.85	21,740.68	7,010.37
Adjustments for :			
Depreciation and Amortization	17,660.65	17,560.63	1,055.65
Profit on redemption of mutual funds	(797.49)	(671.17)	(682.62)
Interest income from FDR	(667.77)	(373.43)	(5.86)
Finance Cost (net)	18,394.93	16,590.17	3,154.43
Provision for major maintenance expenses	6,666.36	5,879.20	403.29
Unwinding interest on major maintenance provision	1,042.86	24.95	-
Provision for Leave encashment and Gratuity	32.79	11.93	0.11
Provision for expected credit loss	-	59.60	-
Bad debts written off	-	9.90	-
Operating Profit/(Loss) before Working Capital Changes	**60,964.18**	**60,832.46**	**10,935.37**
Working Capital Adjustments:			
Decrease / (Increase) in Trade & Other Receivables	(309.18)	180.10	(600.47)
Decrease / (Increase) in Other Non Current Financial Assets	(0.68)	(208.85)	(0.00)
Decrease / (Increase) in Other Non Current/Current Assets	(670.49)	(834.96)	(347.29)
Decrease / (Increase) in Other Current Financial Assets	(4.74)	(293.53)	0.59
Increase / (Decrease) in Trade & Other Payables	128.32	3,267.01	651.07
Increase / (Decrease) in Other Financial Liabilities	(141.94)	57.50	(734,867.55)
Increase / (Decrease) in Provisions	(1.37)	(0.11)	0.00
Increase / (Decrease) in Other Current Liabilities	(163.37)	(0.14)	238.59
Increase/ (Decrease) in Current Tax Liabilities	-	-	(0.59)
	(1,163.45)	**2,167.02**	**(734,925.66)**

Audited Consolidated Cash Flow Statement of National Highways Infra Trust			
Income Tax paid	(375.82)	(626.67)	(274.00)
Net Cash Flows from/(used in) Operating Activities	**59,424.91**	**62,372.81**	**(724,264.28)**
INVESTING ACTIVITIES (B)			
Purchase of Property, Plant & Equipment, including CWIP, capital creditors and capital advances	(3,778.38)	(285,101.04)	(0.50)
Purchase of Non – Current Investments	-	-	(1.52)
Investment in FDR	(755.17)	(6,299.19)	(3,170.81)
Interest received on maturity of FDR	530.45	189.55	-
Profit on redemption of mutual funds	797.49	671.17	682.62
Net cash flows from (used in) Investing activities	**(3,205.61)**	**(290,539.51)**	**(2,490.21)**
FINANCING ACTIVITIES (C)			
Proceeds from Issue of Unit Capital	-	143,013.67	591,000.00
Expense incurred towards initial public debt offering	-	(1,689.00)	-
Expense incurred towards institutional unit allotment	(10.85)	(1,099.13)	(1,364.94)
Proceeds from issue of shares	-	-	-
Distribution to Unit Holders	(37,580.57)	(34,927.86)	-
Proceeds from Long Term Borrowings (net of processing fees)	7,900.00	150,000.00	147,646.00
Financing charges paid	-	(197.00)	-
Repayment of Long-Term Borrowings	(2,381.07)	(1,010.98)	(1,001.59)
Finance Costs Paid	(21,262.26)	(11,180.86)	(3,143.04)
Net cash flows from (used in) Financing activities	**(53,334.75)**	**242,908.84**	**733,136.43**
Net Increase/Decrease in Cash and Cash equivalents (A+B+C)	**2,884.55**	**14,742.14**	**6,381.94**
Cash and cash equivalents at the beginning of the year	21,124.08	6,381.94	-
Cash and cash equivalents at the end of the year/period	**24,008.63**	**21,124.08**	**6,381.94**

Audited Standalone Balance Sheet of National Highways Infra Trust	
Particulars	**As at March 31, 2021 *(in Rs.)***
ASSETS	
Current Assets	
- Financial Assets	
- Other financial assets	10,000.00
Total current assets	**10,000.00**
TOTAL ASSETS	**10,000.00**
EQUITY AND LIABILITIES	
EQUITY	
- Initial settlement amount	10,000.00
- Other Equity	(67,90,202.00)
Total Equity	**(67,80,202.00)**
LIABILITIES	
Current liabilities	
- Financial liabilities	
- Other financial liabilities	67,83,699.00
- Other current liabilities	6,503.00
Total current liabilities	**67,90,202.00**
TOTAL EQUITY & LIABILITIES	**10,000.00**

Audited Standalone Statement of Profit and Loss of National Highways Infra Trust	
Particulars	**For the period ended March 31, 2021 *(in Rs.)***
INCOME	
Revenue from Operations	-
TOTAL INCOME	-
EXPENSES	
Trusteeship Fee	4,21,260.00
Other Expenses	63,68,942.00
TOTAL EXPENSES	**67,90,202.00**
Profit / (Loss) before Tax	**(67,90,202.00)**
Tax Expenses	
Current Tax	-
Total Tax	-
Profit/ (loss) for the period	**(67,90,202.00)**
Other Comprehensive Income	
Items that will not be reclassified to Profit and Loss	-
Income tax relating to items that will not be reclassified to profit or loss	-
Total Comprehensive Income/(Loss) for the period	**(67,90,202.00)**

Audited Standalone Cash Flow Statement of National Highways Infra Trust	
Particulars	**For the period ended March 31, 2021 (in Rs.)**
OPERATING ACTIVITIES (A)	
Net Profit/(Loss) Before Tax	(67,90,202.00)
Operating Profit/(Loss) before Working Capital Changes	**(67,90,202.00)**
Working Capital Adjustments:	
Decrease / (Increase) in Loans, Advances and Other Current Financial Assets	(10,000.00)
Increase / (Decrease) in Trade & Other Payables	67,90,202.00
Cash Generated from Operations	**(10,000.00)**
Income Tax paid	-
Net Cash Flows from/(used in) Operating Activities	**(10,000.00)**
INVESTING ACTIVITIES (B)	
Net cash flows from (used in) Investing activities	**-**
FINANCING ACTIVITIES (C)	
Receipt from Initial Settlement Amount	10,000.00
Net cash flows from (used in) Financing activities	**10,000.00**
Net Increase/Decrease in Cash and Cash equivalents (A+B+C)	-
Cash and cash equivalents at the beginning of the year	-
Cash and cash equivalents at the end of the year/period	-

SUMMARY FINANCIAL INFORMATION OF THE SPONSOR

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NATIONAL HIGHWAYS AUTHORITY OF INDIA
G-5 & 6, Sector-10, Dwarka, New Delhi - 110075

STAEMENT OF ASSETS & LIABILITIES

(Rs. In lakhs)

Particulars	31/12/2023 Unaudited	31/12/2022 Unaudited	31/03/2023 Unaudited	31/03/2022 Audited
SOURCES OF FUNDS				
Shareholders' Fund				
a) Capital	66,598,065.06	46,020,969.61	49,532,132.03	33,659,587.67
b) Reserves & Surplus	-	-	-	-
Grants				
a) Capital	1,552,210.34	1,508,210.33	1,528,210.33	1,508,210.33
Borrowings				
a) Secured Loans	20,151,238.75	20,494,810.77	20,497,852.12	20,662,866.49
b) Unsecured Loans	13,736,327.10	13,870,714.29	13,813,571.43	14,227,857.14
TOTAL	102,037,841.25	81,894,705.00	85,371,765.91	70,058,521.64
APPLICATION OF FUNDS				
Fixed Assets				
a) Gross Block	43,801.18	41,946.17	42,409.43	40,983.90
b) Less: Assets created out of Grant	758.11	758.11	758.11	758.11
c) Assets out of Own Fund	43,043.07	41,188.06	41,651.32	40,225.79
d) Less: Depreciation	17,779.43	15,577.61	17,862.87	14,656.16
e) Net Block	25,263.64	25,610.45	23,788.45	25,569.62
Assets held on behalf of GoI				
a) Completed	38,638,893.52	30,436,789.61	38,341,889.16	30,051,557.50
b) Ongoing	55,938,987.75	48,396,228.04	46,372,427.16	39,477,213.91
Total (a+b)	94,577,881.27	78,833,017.65	84,714,316.32	69,528,771.42
Total	94,603,144.91	78,858,628.11	84,738,104.77	69,554,341.04
Investment	653,909.38	632,280.18	657,280.18	509,813.34
Current Assets, Loans and Advance				
a) Inventories				
b) Deposits, Loans & Advances	5,388,075.44	5,103,922.62	5,212,606.72	4,816,355.14
e) Cash & Bank Balance	5,576,880.74	1,316,009.74	375,705.86	397,127.04
sub total	10,964,956.18	6,419,932.35	5,588,312.58	5,213,482.19
Less: Current Liabilities and Provisions				
a) Liabilities	4,171,652.21	4,005,791.87	5,599,203.63	5,208,604.62
b) Reserves & Provisions	12,517.01	10,343.77	12,727.99	10,510.31
sub total	4,184,169.22	4,016,135.63	5,611,931.62	5,219,114.93
Net Current Assets	6,780,786.96	2,403,796.72	(23,619.04)	(5,632.75)
Misc. Expenditure	-	-	-	
(to the extent not written off)				
Profit & Loss Account	-	-	-	
(Debit balance if any)				
TOTAL	102,037,841.25	81,894,705.00	85,371,765.91	70,058,521.64

NATIONAL HIGHWAYS AUTHORITY OF INDIA
G-5 & 6, Sector-10, Dwarka, New Delhi - 110075
STATEMENT OF UNAUDITED FINANCIAL RESULTS FOR THE QUARTER AND NINE MONTHS ENDED 31ST DECEMBER 2023

Rs. in Lakhs

Particulars	Three Months Ended			Nine Months Ended		Year Ended
New Heading	31/12/2023	30/09/2023	31/12/2022	31/12/2023	31/12/2022	31/03/2023
		Unaudited		Unaudited	Unaudited	Unaudited
INCOME						
a) Value of Work done	0.00	0.00	0.00	0.00	0.00	0.00
b) Other income	291.07	472.03	473.40	1102.54	1380.11	3227.70
c) Interest (Gross)*	(13.44)	13.43	0.00	0.01	0.04	6.02
d) Net Increase/Decrease in Work-in-progress (+)/(-)	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL INCOME	**277.63**	**485.46**	**473.40**	**1102.55**	**1380.15**	**3233.72**
EXPENDITURE						
a) Construction Stores/Material consumed						
Other stores,spares & tools etc.consumed						
Work Expenses	0.00	0.00	0.00	0.00	0.00	0.00
Personnel & Administrative Expenses	21381.47	19634.45	18833.40	52886.14	45198.89	72362.04
Finance Charges	0.49	3.08	0.75	19.29	30.95	111.84
Depreciation	1.63	1.60	1.10	4.47	3.11	2327.39
Assets of Small Value Charged Off	5.15	6.47	4.18	16.22	17.53	27.19
Exceptional Items						
Loss: Transfer of shares of various SPVs	0.00	29300.07	0.00	29300.07	0.00	0.00
Loss:Conversion of recoverable accrued interest of various SPVs into shares	0.00	124068.89	0.00	124068.89	0.00	0.00
Net loss transferred to Capital (Sch-1)	0.00	(153368.96)	0.00	(153368.96)	0.00	0.00
TOTAL EXPENDITURE	**21388.74**	**19645.60**	**18839.43**	**52926.12**	**45250.49**	**74828.46**
Profit / (Loss) for the period	(21111.11)	(19160.14)	(18366.03)	(51823.57)	(43870.34)	(71594.74)
Add: Prior Period Items net Expenses / (Income)	2127.75	969.15	474.91	5118.09	4214.13	5367.97
Transfer of Net Establishment Expenses for the year to Sch-5	**23,238.86**	**20,129.29**	**18,840.94**	**56,941.66**	**48,084.47**	**76,962.71**

NATIONAL HIGHWAYS AUTHORITY OF INDIA
G-5 & 6, Sector-10, Dwarka, New Delhi - 110075

STATEMENT OF CASH FLOWS FOR NINE MONTHS ENDED 31ST DECEMBER, 2023

Rs. in Lakhs

Particulars	31/12/2023 Unaudited	31/12/2022 Unaudited	31/03/2023 Unaudited
Cash flow from operating activities:			
Net profit before tax	(51,823.57)	(43,870.34)	(71,594.74)
	-	-	
Adjustments for:	-	-	
Depreciation	4.47	3.11	2,327.39
Profit/Loss on sale of assets	(3.77)	(3.62)	(5.17)
Interest income	(0.01)	(0.04)	(6.02)
Operating profit before working capital changes	**(51,822.88)**	**(43,870.89)**	**(69,278.54)**
Adjustments for:			
(Increase)/Decrease in Deposits, Loans & Advances	(216,924.67)	(348,856.86)	(416,954.28)
Increase/(Decrease) in liabilities	(1,427,551.42)	(1,202,812.75)	390,599.01
Increase/(Decrease) in Provision for Gratuity and Leave Encashment	(210.98)	(186.55)	2,217.68
Cash flow before extraordinary item & prior period items	**(1,696,509.95)**	**(1,595,707.05)**	**(93,416.13)**
Loss due to conversion of receivable accrued interest into shares	(124,068.89)	-	-
Prior period items	(5,118.09)	(4,214.13)	(5,367.97)
Net cash generated from operating activities (A)	**(1,825,696.93)**	**(1,599,921.18)**	**(98,784.10)**
Cash flow from investing activities:			
Inter unit			
Purchase of fixed assets	(1,485.23)	(46.39)	(557.68)
Realisation from sale of assets	9.34	6.08	16.61
(Increase)/Decrease in Assets held on behalf of GoI	(8,160,850.75)	(7,493,866.65)	(12,940,488.59)
(Increase)/Decrease in investment	3,370.80	(122,466.83)	(147,466.83)
Interest Income	196,660.95	180,725.20	255,772.52
Capital Reserve (Receipts)	21,514.29	36,524.22	155,013.14
Net Loss from transfer of shares of various SPVs	(29,300.07)	-	-
Net cash used in investing activities (B)	**(7,970,080.67)**	**(7,399,124.38)**	**(12,677,710.83)**
Cash flow from financing activities:			
Cess funds received from Govt of India	12,700,000.00	9,669,100.00	11,067,392.10
Capital additional budgetary receipts	2,675,000.00	1,145,800.00	1,978,583.48
Proceeds from InvIT Projects	0.00	284,966.66	284,966.66
EAP Grant Received & utilised towards Revenue Expenditure	24,000.01	-	20,000.00
Adjusted Plough back of Toll Remittance,etc	1,844,301.99	1,261,515.29	2,541,602.13
Net decrease in loan from ADB due to Exchange Loss after Adjustment of Repayments	(6,587.87)	(10,313.62)	(7,272.28)
Proceeds from issue of 54EC Capital Gains Tax-Free Bonds	(294,825.50)	79,757.90	79,757.90
Proceeds / Repayment from issue of Taxable bonds	-	(237,500.00)	(237,500.00)
Proceeds / Repayment from NSSF Loan & SBI Term Loan	(77,244.33)	(57,142.86)	(114,285.71)
Redemption of Tax Free Secured Non-Convertible Bonds (10Yr) 11-12			-
Redemption of Masala Bonds	(45,200.00)	(1,918,255.10)	(300,000.00)
Interest and other expenditure on Bond	(1,822,491.80)	(300,000.00)	(2,558,170.52)
			-
Net cash generated from financing activities (C)	**14,996,952.50**	**9,917,928.26**	**12,755,073.75**
Net increase/(decrease) in cash and cash equivalents (A+B+C)	**5,201,174.88**	**918,882.70**	**(21,421.18)**
Opening cash and cash equivalents	375,705.86	397,127.04	397,127.04
Closing cash and cash equivalents	**5,576,880.74**	**1,316,009.74**	**375,705.86**
Cash and cash equivalents include:			
Cash and cheques in hand / in transit	6.40	9.15	2.65
Balance with banks-Current Account	4,288,795.16	1,272,356.36	273,479.41
Balance with banks-Savings Bank Account	1,192,189.52	12,330.26	69,508.61
Balance with banks-Fixed Deposit Account	95,889.66	31,313.97	32,715.19
Balance as per books of account	**5,576,880.74**	**1,316,009.74**	**375,705.86**

NATIONAL HIGHWAYS AUTHORITY OF INDIA
G-5 & 6, Sector-10, Dwarka, New Delhi - 110075

STAEMENT OF ASSETS & LIABILITIES

(Rs. In lakhs)

Particulars	31/12/2023 Unaudited	31/12/2022 Unaudited	31/03/2023 Unaudited	31/03/2022 Audited
SOURCES OF FUNDS				
Shareholders' Fund				
a) Capital	66,598,065.06	46,020,969.61	49,532,132.03	33,659,587.67
b) Reserves & Surplus	-	-	-	-
Grants				
a) Capital	1,552,210.34	1,508,210.33	1,528,210.33	1,508,210.33
Borrowings				
a) Secured Loans	20,151,238.75	20,494,810.77	20,497,852.12	20,662,866.49
b) Unsecured Loans	13,736,327.10	13,870,714.29	13,813,571.43	14,227,857.14
TOTAL	**102,037,841.25**	**81,894,705.00**	**85,371,765.91**	**70,058,521.64**
APPLICATION OF FUNDS				
Fixed Assets				
a) Gross Block	43,801.18	41,946.17	42,409.43	40,983.90
b) Less: Assets created out of Grant	758.11	758.11	758.11	758.11
c) Assets out of Own Fund	43,043.07	41,188.06	41,651.32	40,225.79
d) Less: Depreciation	17,779.43	15,577.61	17,862.87	14,656.16
e) Net Block	25,263.64	25,610.45	23,788.45	25,569.62
Assets held on behalf of GoI				
a) Completed	38,638,893.52	30,436,789.61	38,341,889.16	30,051,557.50
b) Ongoing	55,938,987.75	48,396,228.04	46,372,427.16	39,477,213.91
Total (a+b)	94,577,881.27	78,833,017.65	84,714,316.32	69,528,771.42
Total	**94,603,144.91**	**78,858,628.11**	**84,738,104.77**	**69,554,341.04**
Investment	**653,909.38**	**632,280.18**	**657,280.18**	**509,813.34**
Current Assets, Loans and Advance				
a) Inventories				
b) Deposits, Loans & Advances	5,388,075.44	5,103,922.62	5,212,606.72	4,816,355.14
e) Cash & Bank Balance	5,576,880.74	1,316,009.74	375,705.86	397,127.04
sub total	**10,964,956.18**	**6,419,932.35**	**5,588,312.58**	**5,213,482.19**
Less: Current Liabilities and Provisions				
a) Liabilities	4,171,652.21	4,005,791.87	5,599,203.63	5,208,604.62
b) Reserves & Provisions	12,517.01	10,343.77	12,727.99	10,510.31
sub total	**4,184,169.22**	**4,016,135.63**	**5,611,931.62**	**5,219,114.93**
Net Current Assets	**6,780,786.96**	**2,403,796.72**	**(23,619.04)**	**(5,632.75)**
Misc. Expenditure	-	-	-	
(to the extent not written off)				
Profit & Loss Account	-	-	-	
(Debit balance if any)				
TOTAL	**102,037,841.25**	**81,894,705.00**	**85,371,765.91**	**70,058,521.64**

NATIONAL HIGHWAYS AUTHORITY OF INDIA

G-5 & 6, Sector-10, Dwarka, New Delhi - 110075

STATEMENT OF UNAUDITED FINANCIAL RESULTS FOR THE THREE MONTHS ENDED 31st March 2023 & Year to Date

Particulars New Heading	Three Months Ended			Year to Date		Year Ended
	31/03/2023	31/12/2022	31/03/2022	31/03/2023	31/03/2022	31/03/2022
	Unaudited			Unaudited	Audited	Audited
INCOME						
a) Value of Work done	0.00	0.00	0.00	0.00	0.00	0.00
b) Other income	1375.27	473.40	1253.92	2755.38	3413.10	3413.10
c) Interest (Gross)*	5.98	0.00	0.15	6.02	0.15	0.15
d) Net Increase/Decrease in Work-in-progress (+)/(-)	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL INCOME	1381.25	473.40	1254.07	2761.40	3413.25	3413.25
EXPENDITURE						
a) Construction Stores/Material consumed						
Other stores,spares & tools etc.consumed						
Work Expenses	0.00	0.00	0.00	0.00	0.00	0.00
Personnel & Administrative Expenses	26319.90	18833.40	18992.26	71518.79	60102.96	60102.96
Finance Charges	79.43	0.75	11.60	110.38	44.25	44.25
Depreciation	2322.57	1.10	2020.07	2325.69	2026.19	2026.19
Assets of Small Value Charged Off	9.66	4.18	11.21	27.19	27.70	27.70
Exceptional Items						
Loss: On winding up of MTRCL	0.00	0.00	0.00	0.00	12709.59	12709.59
Less:Transferred to Capital (Sch-1)	0.00	0.00	0.00	0.00	(12709.59)	(12709.59)
Gain: On swaping of shares with units					(10142.00)	(10142.00)
Less: Transferred to Capital (Sch-1)					10142.00	10142.00
TOTAL EXPENDITURE	28731.56	18839.43	21035.13	73982.05	62201.10	62201.10
	0.00					
Profit / (Loss) for the period	(27350.31)	(18366.03)	(19781.06)	(71220.65)	(58787.86)	(58787.86)
	0.00					
Add: Prior Period Items net Expenses / (Income)	1165.16	474.91	766.87	5379.29	3777.50	3777.50
Transfer of Net Establishment Expenses for the year to Sch-5	28,515.47	18,840.94	20,547.93	76,599.94	62,565.36	62,565.36

swaping of shares with units , as per the significant accounting policy have been transferred to capital (Sch 1)

NATIONAL HIGHWAYS AUTHORITY OF INDIA
G-5 & 6, Sector-10, Dwarka, New Delhi - 110075

Statement of Cash Flows for the year ended March 31, 2023

Particulars	31/03/2023 Unaudited	31/03/2022 Audited
Cash flow from operating activities:		
Net profit before tax	(71,220.65)	(58,787.86)
	-	
Adjustments for:	-	
Depreciation	2,325.69	2,026.19
Terminated / Abondened Projectts Written off		
Profit/Loss on sale of assets	(5.19)	(4.34)
Interest income	(6.02)	(0.15)
Operating profit before working capital changes	**(68,906.18)**	**(56,766.15)**
Adjustments for:		
(Increase)/Decrease in Deposits, Loans & Advances	(346,662.26)	(94,564.33)
Increase/(Decrease) in liabilities	285,269.59	980,096.44
Increase/(Decrease) in Provision for Gratuity and Leave Encashment	(166.55)	1,797.05
Cash flow before extraordinary item & prior period items	**(130,465.39)**	**830,563.01**
Prior period items	(5,379.29)	(3,777.50)
Net cash generated from operating activities	**(135,844.67)**	**826,785.51**
Cash flow from investing activities:		
Inter unit		
Purchase of fixed assets	(557.77)	(16,423.12)
Realisation from sale of assets	16.63	7.40
(Increase)/Decrease in Assets held on behalf of GoI	(12,873,239.36)	(10,624,858.32)
(Increase)/Decrease in investment	(147,466.83)	(305,216.00)
Interest Income	236,664.70	152,003.34
Capital Reserve (Receipts)	154,714.51	420,191.37
Loss from investing activities		(2,567.59)
Net cash used in investing activities	**(12,629,868.12)**	**(10,376,862.92)**
Cash flow from financing activities:		
Capital Base received from Govt. of India	-	
Cess funds received from Govt of India	11,046,135.00	3,621,000.00
Capital additional budgetary receipts	1,978,596.00	1,614,218.00
Proceeds from InvIT Projects	284,966.68	735,040.00
EAP Grant Received & utilised towards Revenue Expenditure	20,000.00	100,000.00
Adjusted Plough back of Toll Remittance,etc	2,537,694.05	1,580,644.07
Net decrease in loan from ADB due to Exchange Loss after Adjustment of Repayments	(7,272.28)	(7,402.36)
Proceeds from issue of 54EC Capital Gains Tax-Free Bonds	79,757.90	502,845.80
Proceeds / Repayment from issue of Taxable bonds	(237,500.00)	807,570.00
Proceeds / Repayment from NSSF Loan & SBI Term Loan	(114,285.71)	3,542,857.14
Redemption of 54EC Capital Gains Tax- Free Bonds	-	-
Redemption of Tax Free Secured Non-Convertible Bonds (10Yr) 11-12	-	(671,408.12)
Redemption of Masala Bonds	(300,000.00)	-
Interest and other expenditure on Bond	(2,559,196.08)	(2,401,533.41)
		-
Net cash generated from financing activities	**12,728,895.54**	**9,423,731.12**
Net increase/(decrease) in cash and cash equivalents (A+B+C)	**(36,817.25)**	**(126,346.29)**
Opening cash and cash equivalents	397,127.04	523,473.33
Closing cash and cash equivalents	**360,309.79**	**397,127.04**
Cash and cash equivalents include:		
Cash and cheques in hand / in transit	2.65	2.32
Balance with banks-Current Account	287,008.52	246288.69
Balance with banks-Savings Bank Account	39,743.23	115740.43
Balance with banks-Fixed Deposit Account	33,555.39	35095.61
Balance as per books of account	**360,309.79**	**397,127.04**

NATIONAL HIGHWAYS AUTHORITY OF INDIA

G-5 & 6, Sector-10, Dwarka
NEW DELHI - 110 075

BALANCE SHEET AS AT 31st MARCH 2022

S. No.		PARTICULARS	SCHEDULE	CURRENT YEAR ₹ In Lakhs	PREVIOUS YEAR ₹ In Lakhs
		(1)	(2)	(3)	(4)
I.		**SOURCES OF FUNDS**			
	1	**Shareholders' Fund**			
		a) Capital	1	3,36,59,587.67	2,61,11,353.19
		b) Reserves & Surplus	2	-	-
	2	**Grants**			
		a) Capital	3	15,08,210.33	14,08,210.33
	3	**Borrowings**			
		a) Secured Loans	4	2,06,62,866.49	2,00,31,261.17
		b) Unsecured Loans		1,42,27,857.14	1,06,85,000.00
		TOTAL		**7,00,58,521.64**	**5,82,35,824.69**
II.		**APPLICATION OF FUNDS**			
	1	**Fixed Assets**	5		
		a) Gross Block		40,983.90	24,706.29
		b) Less: Assets created out of Grant		758.11	758.11
		c) Assets out of Own Fund		40,225.79	23,948.18
		d) Less: Depreciation		14,656.16	12,772.42
		Net Block		**25,569.62**	**11,175.76**
	2	**Assets held on behalf of GoI**			
		a) Completed		3,00,51,557.50	2,55,32,301.73
		b) Ongoing		3,94,77,213.91	3,15,38,628.77
		Total (a+b)		**6,95,28,771.42**	**5,70,70,930.50**
		Total		**6,95,54,341.04**	**5,70,82,106.26**
	3	**Investment**	6	**5,09,813.34**	**2,04,597.34**
	4	**Current Assets, Loans and Advance**	7		
		a) Inventories		-	-
		b) Deposits, Loans & Advances		47,48,549.17	46,53,984.84
		c) Interest accrued but not due on deposits		63,273.22	2,845.16
		d) Interest accrued and due on CALA deposits		4,532.75	6,039.20
		e) Cash & Bank Balance		3,97,127.04	5,23,473.33
		f) Inter Unit Account		-	-
		Sub total		**52,13,482.19**	**51,86,342.53**
		Less: Current Liabilities and Provisions			
		a) Liabilities	8	52,08,604.62	42,28,508.19
		b) Reserves & Provisions	9	10,510.31	8,713.26
		Sub total		**52,19,114.93**	**42,37,221.44**
		Net Current Assets		**(5,632.75)**	**9,49,121.09**
	5	**Misc. Expenditure**	10		
		(to the extent not written off)			
		Profit & Loss Account			
		(Debit balance if any)			
		TOTAL		**7,00,58,521.64**	**5,82,35,824.69**

NATIONAL HIGHWAYS AUTHORITY OF INDIA

G-5 & 6, Sector-10, Dwarka
NEW DELHI - 110 075

STATEMENT OF PROFIT AND LOSS ACCOUNT FOR THE YEAR ENDED 31st MARCH, 2022

S. No.		PARTICULARS	SCHEDULE	CURRENT YEAR ₹ In Lakhs	PREVIOUS YEAR ₹ In Lakhs
		(1)	(2)	(3)	(4)
I.		**INCOME**			
	a)	Value of Work done		-	-
	b)	Other income	11	3,413.10	2,781.30
	c)	Interest (Gross)	12	0.15	0.03
	d)	Net Increase/Decrease in Work-in-progress (+)/(-)	13	-	-
		TOTAL INCOME		**3,413.25**	**2,781.33**
		EXPENDITURE			
	a)	Construction Stores/Material consumed		-	-
		Other stores,spares & tools etc. consumed			
		Work Expenses	14	-	-
		Personnel & Administrative Expenses	15	60,102.96	48,022.67
		Finance Charges	16	44.25	5.10
		Depreciation		2,026.19	1,453.44
		Assets of Small Value Charged Off		27.70	26.44
		Exceptional Items			
		Loss: On winding up of MTRCL		12,709.59	-
		Less:Transferred to Capital (Sch-1)		(12,709.59)	-
		Gain: On swaping of shares with units		(10,142.00)	-
		Less: Transferred to Capital (Sch-1)		10,142.00	-
		TOTAL EXPENDITURE		**62,201.10**	**49,507.65**
		Profit / (Loss) for the period		**(58,787.86)**	**(46,726.31)**
		Add: Prior Period Items net(+/-) (details to be given)	17	3,777.50	3,063.89
		Net Estab. Expenses transferred to Sch-5		**62,565.36**	**49,790.21**
		Less/Add: Provision for Taxation			
		Net Profit			
		Less: Transfer to Capital Reserve			
		Less: Transfer to other specific Reserve/Fund			
		Less/Add: Transfer to/Transfer from General Reserve (+/-)			
		Less/Add: Surplus brought forward from previous year			
		Surplus carried to Balance Sheet			

Significant Accounting Policy (Schedule 18) and Notes on Accounts (Schedule 19) are integral part of this Financial Statements.

NATIONAL HIGHWAYS AUTHORITY OF INDIA

G-5 & 6, Sector-10, Dwarka
NEW DELHI - 110 075

CASH FLOW STATEMENT FOR THE YEAR ENDED 31st MARCH, 2022

S. No.	PARTICULARS	CURRENT YEAR ₹ In Lakhs	PREVIOUS YEAR ₹ In Lakhs
A.	**Cash flow from operating activities:**		
	Net profit before tax	(58,787.86)	(46,726.31)
	Adjustments for:		
	Depreciation	2,026.19	1,453.44
	Profit/Loss on sale of assets	(4.34)	(4.89)
	Interest income	(0.15)	(0.03)
	Operating profit before working capital changes	**(56,766.15)**	**(45,277.79)**
	Adjustments for:		
	(Increase)/Decrease in Deposits, Loans & Advances	(94,564.33)	(72,349.99)
	Increase/(Decrease) in liabilities	9,80,096.44	8,00,106.87
	(Increase)/Decrease in Provision for Gratuity and Leave Encashment	1,797.05	722.42
	Cash flow before extraordinary item & prior period items	**8,30,563.01**	**6,83,201.50**
	Prior period items	(3,777.50)	(3,063.89)
	Net cash generated from operating activities	**8,26,785.51**	**6,80,137.61**
B.	**Cash flow from investing activities:**		
	Purchase of fixed assets	(16,423.12)	(1,914.00)
	Realisation from sale of assets	7.40	8.88
	(Increase)/Decrease in Capital Work in progress	(1,06,24,858.32)	(90,84,224.57)
	(Increase)/Decrease in investment	(3,05,216.00)	(1,09,420.00)
	Interest Income	1,52,003.34	1,97,477.83
	Capital Reserve (Receipts)	4,20,191.37	1,57,630.52
	Loss from investing activities	(2,567.59)	0.00
	Net cash used in investing activities	**(1,03,76,862.92)**	**(88,40,441.34)**
C.	**Cash flow from financing activities:**		
	Capital Base	0.00	3,260.00
	Cess funds received from Govt of India	36,21,000.00	23,85,000.00
	Capital additional budgetary receipts	16,14,218.00	2,80,000.00
	Proceeds from InvIT Projects	7,35,040.00	-
	EAP Grant Received & utilised towards Revenue Expenditure	1,00,000.00	10,000.00
	Adjusted Plough back of Toll Remittance,etc	15,80,544.07	15,40,424.08
	Net decrease in loan from ADB due to Exchange Loss after Adjustment of Repayments	(7,402.36)	(9,154.20)
	Proceeds from issue of 54EC Capital Gains Tax-Free Bonds	5,02,845.80	3,42,730.60
	Proceeds from issue of Taxable bonds	8,07,570.00	45,80,260.00
	Proceeds from NSSF Loan & Term Loans	35,42,857.14	15,85,000.00
	Redemption of 54EC Capital Gains Tax- Free Bonds	0.00	(6,65,741.30)
	Redemption of Tax Free Secured Non-Convertible Bonds (10Yr) 11-12	(6,71,408.12)	-
	Interest and other expenditure on Bond	(24,01,533.41)	(20,02,529.70)
	Net cash generated from financing activities	**94,23,731.12**	**80,49,249.47**
	Net increase/(decrease) in cash and cash equivalents (A+B+C)	**(1,26,346.29)**	**(1,11,054.26)**
	Opening cash and cash equivalents	5,23,473.33	6,34,527.58
	Closing cash and cash equivalents	**3,97,127.04**	**5,23,473.32**
	Notes:		
	Cash and cash equivalents include:		
	Cash and cheques in hand / in transit	2.32	1.30
	Balance with banks-Current Account	2,46,288.69	1,41,972.38
	Balance with banks-Savings Bank Account	1,15,740.43	3,45,754.56
	Balance with banks-Fixed Deposit Account	35,095.61	35,745.09
	Balance as per books of account	**3,97,127.04**	**5,23,473.33**

NATIONAL HIGHWAYS AUTHORITY OF INDIA

G-5 & 6, Sector-10, Dwarka

NEW DELHI - 110 075

BALANCE SHEET AS AT 31st MARCH, 2021

S. No.		PARTICULARS	SCHEDULE	CURRENT YEAR Rs. In Lakhs	PREVIOUS YEAR Rs. In Lakhs
		(1)	(2)	(3)	(4)
I.		**SOURCES OF FUNDS**			
	1	**Shareholders' Fund**			
		a) Capital	1	26111353.19	2,19,02,669.11
		b) Reserves & Surplus	2	-	-
	2	**Grants**			
		a) Capital	3	14,08,210.33	13,98,210.33
	3	**Borrowings**	4	3,07,16,261.17	2,48,83,166.07
		TOTAL		**5,82,35,824.69**	**4,81,84,045.52**
II.		**APPLICATION OF FUNDS**			
	1	**Fixed Assets**	5		
		a) Gross Block		24,706.29	22,927.29
		b) Less: Assets created out of Grant		758.11	758.11
		c) Assets out of Own Fund		23,948.18	22,169.18
		d) Less: Depreciation		12,772.42	11,449.98
		e) Net Block		11,175.76	10,719.20
		Assets held on behalf of GoI			
		a) Completed		2,55,32,301.73	2,20,85,894.44
		b) Ongoing		3,15,38,628.77	2,42,03,759.62
		Total (a+b)		**5,70,70,930.50**	**4,62,89,654.06**
		Total		**5,70,82,106.26**	**4,63,00,373.26**
	2	**Investment**	**6**	**2,04,597.34**	**95,177.34**
	3	**Current Assets, Loans and Advance**	**7**		
		a) Inventories		-	-
		b) Deposits, Loans & Advances		46,53,984.84	45,81,634.85
		c) Interest accrued but not due on deposits		2,845.16	2,836.50
		d) Interest accrued and due on CALA deposits		6,039.20	5,888.13
		e) Cash & Bank Balance		5,23,473.33	6,34,527.58
		f) Inter Unit Account		(0.00)	-
		sub total		**51,86,342.53**	**52,24,887.07**
		Less: Current Liabilities and Provisions			
		a) Liabilities	8	42,28,508.19	34,28,401.31
		b) Reserves & Provisions	9	8,713.26	7,990.84
		sub total		**42,37,221.44**	**34,36,392.15**
		Net Current Assets		9,49,121.09	17,88,494.91
	4	**Misc. Expenditure**	10		
		(to the extent not written off)			
	5	**Profit & Loss Account**			
		(Debit balance if any)			
		TOTAL		**5,82,35,824.69**	**4,81,84,045.52**

Significant Accounting Policy (Schedule 18) and Notes on Accounts (Schedule 19) are integral part of this Financial Statements.

NATIONAL HIGHWAYS AUTHORITY OF INDIA

G-5 & 6, Sector-10, Dwarka

NEW DELHI - 110 075

PROFIT AND LOSS ACCOUNT FOR THE YEAR ENDED 31st MARCH, 2021

S. No.	PARTICULARS	SCHEDULE	CURRENT YEAR Rs. In Lakhs	PREVIOUS YEAR Rs. In Lakhs
	(1)	(2)	(3)	(4)
I.	**INCOME**			
	a) Value of Work done			
	b) Other income	11	2,781.30	1,261.30
	c) Interest (Gross)	12	0.03	0.15
	d) Net Increase/Decrease in Work-in-progress (+)/(-)	13		
	TOTAL INCOME		**2,781.33**	**1,261.45**
II.	**EXPENDITURE**			
	a) Construction Stores/Material consumed			
	Other stores,spares & tools etc.consumed			
	Work Expenses	14	-	-
	Personnel & Administrative Expenses	15	48,022.67	44,246.68
	Finance Charges	16	5.10	6.51
	Depreciation		1,453.44	1,286.21
	Assets of Small Value Charged Off		26.44	25.08
	Exceptional Item			
	Provision for diminution in the value of investment		-	-
	Less: Provision transferred to Capital (Sch-1)		-	-
	TOTAL EXPENDITURE		**49,507.65**	**45,564.48**
	Profit / (Loss) for the period		**(46,726.31)**	**(44,303.04)**
	Add: Prior Period Items net(+/-) (details to be given)	17	(3,063.89)	(4,582.72)
	Transfer of Net Establishment Expenses for the year to Sch-5		**49,790.21**	**48,885.76**
	Less/Add: Provision for Taxation		-	-
	Net Profit			
	Less: Transfer to Capital Reserve			
	Less: Transfer to other specific Reserve/Fund			
	Less/Add: Transfer to/Transfer from General Reserve (+/-)			
	Less/Add: Surplus brought forward from previous year			
	Surplus carried to Balance Sheet			

NATIONAL HIGHWAYS AUTHORITY OF INDIA

G-5 & 6, Sector-10, Dwarka

NEW DELHI - 110 075

CASH FLOW STATEMENT FOR THE YEAR ENDED 31st MARCH, 2021

S. No.	Particulars	CURRENT YEAR Rs. In Lakhs	PREVIOUS YEAR Rs. In Lakhs
A.	**Cash flow from operating activities:**		
	Net profit before tax	(46,726.31)	(44,303.04)
	Adjustments for:		
	Depreciation	1,453.44	1,286.21
	Profit/Loss on sale of assets	(4.89)	(5.39)
	Interest income	(0.03)	(0.15)
	Operating profit before working capital changes	**(45,277.79)**	**(43,022.36)**
	Adjustments for:		
	(Increase)/Decrease in Deposits, Loans & Advances	(72,349.99)	17,34,349.89
	Increase/(Decrease) in liabilities	8,00,106.87	(21,64,388.36)
	(Increase)/Decrease in Provision for Gratuity and Leave Encashment	722.42	889.45
	Cash flow before extraordinary item & prior period items	6,83,201.50	**(4,72,171.39)**
	Prior period items	(3,063.89)	(4,582.72)
	Net cash generated from operating activities	**6,80,137.61**	**(4,76,754.11)**
B.	**Cash flow from investing activities:**		
	Purchase of fixed assets	(1,914.00)	(5,177.24)
	Realisation from sale of assets	8.88	9.95
	(Increase)/Decrease in Capital Work in progress	(90,84,224.57)	(78,32,613.01)
	(Increase)/Decrease in investment	(1,09,420.00)	(1,560.00)
	Interest Income	1,97,477.83	2,27,263.74
	Capital Reserve (Receipts)	1,57,630.52	26,765.46
	Net cash used in investing activities	**(88,40,441.34)**	**(75,85,311.11)**
C.	**Cash flow from financing activities:**		
	Capital Base	3,260.00	-
	Cess funds received from Govt of India	23,85,000.00	11,09,100.00
	Capital additional budgetary receipts	2,80,000.00	1,00,000.00
	EAP Grant Received & utilised towards Revenue Expenditure	10,000.00	15,700.00
	Adjusted Plough back of Toll Remittance,etc	15,40,424.08	14,08,167.82
	Net decrease in loan from ADB due to Exchange Loss after Adjustment of Repayments	(9,154.20)	(2,027.66)
	Proceeds from issue of 54EC Capital Gains Tax-Free Bonds	3,42,730.60	4,45,081.30
	Proceeds from issue of Taxable bonds	45,80,260.00	49,53,600.00
	Proceeds from NSSF Loan & SBI Term Loan	15,85,000.00	21,00,000.00
	Redemption of 54EC Capital Gains Tax- Free Bonds	(6,65,741.30)	(5,57,274.20)
	Interest and other expenditure on Bond	(20,02,529.70)	(15,31,479.51)
	Net cash generated from financing activities	**80,49,249.47**	**80,40,867.75**
	Net increase/(decrease) in cash and cash equivalents (A+B+C)	**(1,11,054.26)**	**(21,197.47)**
	Opening cash and cash equivalents	6,34,527.58	6,55,725.06
	Closing cash and cash equivalents	**5,23,473.33**	**6,34,527.58**
Notes:			
	Cash and cash equivalents include:		
	Cash and cheques in hand / in transit	1.30	1.35
	Balance with banks-Current Account	1,41,972.38	78,188.52
	Balance with banks-Savings Bank Account	3,45,754.56	5,28,641.74
	Balance with banks-Fixed Deposit Account	35,745.09	27,695.98
	Balance as per books of account	**5,23,473.33**	**6,34,527.58**

SUMMARY FINANCIAL INFORMATION OF THE INVESTMENT MANAGER

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NATIONAL HIGHWAYS INFRA INVESTMENT MANAGERS PRIVATE LIMITED

CIN - U65929DL2020GOI366835

BALANCE SHEET AS AT MARCH 31, 2023

(All amounts in ₹ lakh, unless otherwise stated)

Particulars	Note No	As at March 31, 2023	As at March 31, 2022
ASSETS			
1) Non - Current Assets:			
(a) Property, Plant and Equipment	3	9.34	7.25
(b) Intangible assets	4	0.48	0.79
(c) Financial Assets			
i) Other financials asset	5	-	550.00
(d) Deferred tax assets (net)	6	14.40	5.67
(e) Other non-current tax assets (net)	7	99.19	66.56
Total Non-current assets		**123.43**	**630.26**
2) Current Assets:			
(a) Financial Assets			
(i) Cash and cash equivalents	8	577.88	72.03
(ii) Bank balances other than cash and cash equivalents	9	1,118.86	970.00
(iii) Other financial assets	10	46.16	59.52
(b) Other current assets	11	21.24	10.57
Total Current assets		**1,764.14**	**1,112.12**
Total Assets		**1,887.57**	**1,742.39**
EQUITY AND LIABILITIES			
EQUITY			
(a) Equity Share Capital	12	1,100.00	1,100.00
(b) Other Equity	13	536.05	481.15
Total Equity		**1,636.05**	**1,581.15**
LIABILITIES			
1) Non-Current liabilities:			
(a) Financial liabilities			
(i) Provisions	14	57.30	23.05
Total non-current liabilities		**57.30**	**23.05**
2) Current Liabilities			
(a) Financial liabilities			
(i) Trade Payables	15		
(a) Total Outstanding, dues of micro and small enterprises		5.24	0.23
(b) Total outstanding, dues of creditors other than micro and small enterprises		58.84	41.78
(ii) Other financial liabilities	16	11.46	63.77
(b) Other current liabilities	17	117.00	31.56
(c) Provisions	18	1.68	0.85
Total current liabilities		**194.22**	**138.19**
Total Equity and Liabilities		**1,887.57**	**1,742.39**

Significant Accounting Policies 2

The accompanying notes form an integral part of these financial statements. 3-44

This is the Balance Sheet referred to in our report of even date.

NATIONAL HIGHWAYS INFRA INVESTMENT MANAGERS PRIVATE LIMITED

CIN - U65929DL2020GOI366835

STATEMENT OF PROFIT AND LOSS FOR THE YEAR ENDED MARCH 31, 2023

(All amounts in ₹ lakh, unless otherwise stated)

Particulars	Note No	For the Year Ended March 31,2023	For the Year Ended March 31,2022
INCOME			
Revenue from Operations	19	1,263.70	1,637.04
Other Income	20	236.27	28.47
Total Income		**1,499.97**	**1,665.51**
EXPENSES			
Employee Benefits Expense	21	818.01	499.91
Depreciation & Amortization Expense	22	4.15	1.12
Other Expenses	23	529.31	295.93
Total Expenses		**1,351.46**	**796.96**
Profit before Tax		**148.51**	**868.55**
Tax Expenses			
Current Tax	24		
-Current year		43.47	169.97
-Earlier years		58.43	-
Deferred Tax credit		(8.73)	(5.67)
Total Tax		**93.17**	**164.30**
Profit for the year		**55.34**	**704.25**
Other Comprehensive Income			
A (i) Items that will not be reclassified to Profit and Loss			
'- Remeasurement of the defined benefit plans		(0.43)	-
'- Income tax relating to item that will not be reclassified to profit or loss		-	-
B (i) Items that will be reclassified to Profit and Loss		-	-
(ii) Income tax relating to items that will not be reclassified to profit or loss		-	-
Total Comprehensive Income for the year, Comprising Loss and Other comprehensive loss for the year		(0.43)	-
		54.90	**704.25**
Earnings per equity share (Face value of Rs.10/-each)			
Basic	25	0.50	6.40
Diluted	25	**0.50**	**6.40**
Significant Accounting Policies	2		
The accompanying notes form an integral part of these financial statements.	3-44		

This is the Statement Profit and Loss referred to in our report of even date.

NATIONAL HIGHWAYS INFRA INVESTMENT MANAGERS PRIVATE LIMITED

CIN - U65929DL2020GOI366835

CASH FLOW STATEMENT FOR THE YEAR ENDED MARCH 31, 2023

(All amounts in ₹ lakh, unless otherwise stated)

	Particulars	For the Year Ended March 31,2023	For the Year Ended March 31,2022
A.	**OPERATING ACTIVITIES**		
	Net Profit Before Tax	148.51	868.55
	Adjustments to reconcile profit before tax to net cash flows:		
	Depreciation and Amortization Expenses	4.15	1.12
	Interest earned on Investments	(76.88)	(28.47)
	Operating Profit before Working Capital Changes	**75.78**	**841.20**
	Working Capital Adjustments:		
	Decrease / (Increase) in Financial Assets	35.50	(37.86)
	Decrease / (Increase) in Non Current/ Current Assets	(10.67)	3.31
	Increase / (Decrease) in Trade & Other Payables	22.07	5.85
	Decrease / (Increase) in Other Financial Liabilities	(52.31)	50.79
	Increase / (Decrease) in Provisions	34.65	23.90
	Decrease / (Increase) in Other Current Liabilities	85.44	25.50
		190.45	**912.69**
	Income Tax paid	(134.54)	(236.54)
	Net Cash Flows from/(used in) Operating Activities	**55.92**	**676.15**
B.	**INVESTING ACTIVITIES**		
	Purchase of Property, Plant & Equipment	(5.94)	(9.16)
	Investment in FDRs	(618.86)	(1,520.00)
	Proceeds from FDR	1,020.00	-
	Interest Received	54.74	6.81
	Net cash flows from/ (used in) Investing activities	**449.94**	**(1,522.35)**
C.	**FINANCING ACTIVITIES**		
	Repayment of long term Borrowings	-	(500.00)
	Net cash flows (used in) Financing activities	-	**(500.00)**
	Net Increase/Decrease in Cash and Cash equivalents (A+B+C)	505.85	(1,346.20)
	Cash and cash equivalents at the beginning of the year	72.03	1,418.23
	Cash and cash equivalents at the end of the year (refer note 8)	**577.88**	**72.03**

The above statement of cash flows has been prepared under 'Indirect Method' as set out IND AS 7, 'Statement of Cash Flows'.
The accompanying notes form an integral part of these financial statements.

This is the Cash Flow Statement referred to in our report of even date.

NATIONAL HIGHWAYS INFRA INVESTMENT MANAGERS PRIVATE LIMITED

BALANCE SHEET AS AT 31ST MARCH, 2022

(All amounts in ₹ lakh)

PARTICULARS	NOTE NO.	AS AT 31st March, 2022	AS AT 31st March, 2021
ASSETS			
1) Non - Current Assets:			
(a) Property, Plant and Equipment	3	7.25	-
(b) Intangible assets	4	0.79	-
(c) Financial Assets			
i) Other Financials Asset	5	550.00	-
(d) Deferred tax assets	6	5.67	-
(e) Other Non Current Tax Assets (Net)	7	66.56	-
2) Current Assets:			
(a) Financial Assets			
(i) Cash and Cash Equivalents	8	72.03	1,418.23
(ii) Other than Bank Balances	9	970.00	-
(iii) Other financial assets	10	59.52	-
(b) Other current assets	11	10.57	13.88
Total Assets		**1,742.39**	**1,432.11**
EQUITY AND LIABILITIES			
EQUITY			
(a) Equity Share Capital	12	1,100.00	1,100.00
(b) Other Equity	13	481.15	276.90
LIABILITIES			
1) Non-Current liabilities:			
(a) Financial liabilities			
(i) Provision	14	23.05	-
2) Current Liabilities			
(a) Financial liabilities			
(i) Trade Payables	15		
(a) Total Outstanding, dues of micro and small enterprises		0.23	-
(b) Total outstanding, dues of creditors other than micro and small enterprises		41.78	36.17
(ii) Other financial liabilities	16	63.77	12.98
(b) Other current liabilities	17	31.56	6.06
(c) Provisions	18	0.85	-
Total Equity and Liabilities		**1,742.39**	**1,432.11**

Significant Accounting Policies 1-2
The accompanying notes form an integral part of these financial statements 3-43

This is the Balance Sheet referred to in our report of even date.

NATIONAL HIGHWAYS INFRA INVESTMENT MANAGERS PRIVATE LIMITED

STATEMENT OF PROFIT AND LOSS FOR THE YEAR ENDED 31ST MARCH, 2022

(All amounts in ₹ lakh)

PARTICULARS	NOTE NO.	YEAR ENDED 31-03-2022	YEAR ENDED 31-03-2021
INCOME			
Revenue from Operations	19	1,637.04	-
Other Income	20	28.47	-
Total Income		**1,665.51**	**-**
EXPENSES			
Employee Benefits Expense	21	499.91	49.55
Depreciation & Amortization Expense	22	1.12	-
Other Expenses	23	295.93	173.55
Total Expenses		**796.96**	**223.10**
Profit/(Loss) before Exceptional Items and Tax		**868.55**	**(223.10)**
Exceptional Items (net)		-	
Profit / (Loss) before Tax		**868.55**	**(223.10)**
Tax Expenses			
Current Tax	24	169.97	-
Deferred Tax expense/(credit)		(5.67)	
Total Tax		164.30	-
Profit/ (loss) for the period		704.25	(223.10)
Other Comprehensive Income			
Items that will not be reclassified to Profit and Loss		-	-
Items that will be reclassified to Profit and Loss		-	-
		-	-
Total Comprehensive Income for the period		704.25	(223.10)
Earnings per Equity Share (Par Value Rs.10/-each) -			
Basic	25	6.40	(2.03)
Diluted	25	**6.40**	**(2.03)**
Significant Accounting Policies	1-2		
The accompanying notes form an integral part of these financial statements.	3-43		

This is the Profit and Loss Account referred to in our report of even date.

NATIONAL HIGHWAYS INFRA INVESTMENT MANAGERS PRIVATE LIMITED
CASH FLOW STATEMENT FOR THE YEAR ENDED 31ST MARCH, 2022

(All amounts in ₹ lakh)

	PARTICULARS	YEAR ENDED 31-03-2022	YEAR ENDED 31-03-2021
A.	**OPERATING ACTIVITIES**		
	Net Profit/(Loss) Before Tax	868.55	(223.10)
	Adjustments to reconcile profit before tax to net cash flows:		
	Depreciation and Amortization	1.12	-
	Interest earned on Investments	(28.47)	-
	Operating Profit/(Loss) before Working Capital Changes	841.20	(223.10)
	Working Capital Adjustments:		
	Decrease / (Increase) in Trade and Other Receivables	-	-
	Decrease / (Increase) in Inventories	-	-
	Decrease / (Increase) in Financial Assets	(59.52)	-
	Decrease / (Increase) in Non Current/ Current Assets	3.31	(13.88)
	Increase / (Decrease) in Trade & Other Payables	5.85	55.21
	Decrease / (Increase) in Other Financial Liabilities	50.79	-
	Increase / (Decrease) in Provisions	23.90	-
	Decrease / (Increase) in Other Current Liabilities	25.50	-
		891.03	**(181.77)**
	Income Tax paid	(236.54)	-
	Net Cash Flows from/(used in) Operating Activities	**654.49**	**(181.77)**
B.	**INVESTING ACTIVITIES**		
	(Purchase)/ Sale of Property, Plant & Equipment	(9.16)	-
	Investment in FDRs	(1,498.34)	-
	Interest Received	6.81	-
	Net cash flows from/ (used in) Investing activities	**(1,500.69)**	-
C.	**FINANCING ACTIVITIES**		
	Proceeds from issue of shares (including Share Premium)*	-	1,100.00
	Proceeds from long term Borrowings	-	500.00
	Repayment of long term Borrowings	(500.00)	-
	Net cash flows from (used in) Financing activities	**(500.00)**	**1,600.00**
	Net Increase/Decrease in Cash and Cash equivalents (A+B+C)	(1,346.20)	1,418.23
	Cash and cash equivalents at the beginning of the year	1,418.23	-
	Cash and cash equivalents at the end of the year	**72.03**	**1,418.23**

The accompanying notes form an integral part of these financial statements.

This is the Cash Flow Statement referred to in our report of even date.

NATIONAL HIGHWAYS INFRA INVESTMENT MANAGERS PRIVATE LIMITED
Regd. Off.: - G-5 & 6, Sector -10, Dwarka, Delhi - 110075
CIN: U65929DL2020GOI366835
Standalone Balance Sheet as at March 31, 2021

Particulars	Note No.	As at March 31, 2021
ASSETS		
Non-current assets		
a) Property, Plant and Equipment		-
b) Capital work-in-progress		-
c) Intangible assets		-
d) Intangible assets under development		-
e) Financial Assets - Other financial assets		-
f) Deferred Tax Assets (Net)		-
g) Other non-current assets		-
	A	-
Current assets		
a) Financial Assets		
i) Investments		-
ii) Cash and cash equivalents	3	14,18,22,773.00
iii) Loans		-
iv) Other financial assets		-
b) Current tax assets (net)		-
c) Other current assets	4	13,87,878.00
	B	**14,32,10,651.00**
TOTAL ASSETS	**A+B**	**14,32,10,651.00**
EQUITY AND LIABILITIES		
EQUITY		
a) Equity Share capital	5	11,00,00,000.00
b) Other Equity	6	2,76,89,540.00
	C	**13,76,89,540.00**
LIABILITIES		
Non-current liabilities		
a) Financial liabilities		
i) Borrowings		-
ii) Other financial liabilities		-
b) Provisions		-
c) Other non-current liabilities		-
	D	-
Current liabilities		
a) Financial liabilities		
i) Borrowings		-
ii) Trade payables - MSME		-
iii) Trade payables - Others	7	33,078.00
iv) Other financial liabilities	8	48,81,823.00
b) Other current liabilities	9	6,06,210.00
c) Provisions		-
d) Current tax liabilities (net)		-
	E	**55,21,111.00**
TOTAL EQUITY AND LIABILITIES	**C+D+E**	**14,32,10,651.00**
Notes Forming Part of Financial Statements	1 to 12	

NATIONAL HIGHWAYS INFRA INVESTMENT MANAGERS PRIVATE LIMITED
Regd. Off.: - G-5 & 6, Sector -10, Dwarka, Delhi - 110075
CIN: U65929DL2020GOI366835
Standalone Statement of Profit and Loss for the Period Ended on March 31, 2021

Particulars	Note No.	For the Period Ended on March 31, 2021
INCOME		
Revenue from operations		-
Other income		-
TOTAL INCOME (I)		-
EXPENSES		
Operating Expenses		-
Employee benefit expenses	10	49,54,997.00
Finance costs	11	1,984.00
Depreciation and amortization expenses		-
Other expenses	12	1,73,53,479.00
TOTAL EXPENSES (II)		**2,23,10,460.00**
Profit/ (Loss) before tax (I - II)		**(2,23,10,460.00)**
Tax expense		
Current tax expense		-
Adjustment of tax relating to earlier periods		-
Deferred Tax Expense		-
		-
Profit/(Loss) after tax from continuing operations	**A**	**(2,23,10,460.00)**
Other Comprehensive Income		-
Items which will not be reclassified to profit & loss (net of tax)		-
Items which will be reclassified to profit & loss (net of tax)		-
-		
Total Comprehensive Income (loss) for the period	**B**	-
-		
Total	**(A+B)**	**(2,23,10,460.00)**

NATIONAL HIGHWAYS INFRA INVESTMENT MANAGERS PRIVATE LIMITED
Regd. Off.: - G-5 & 6, Sector -10, Dwarka, Delhi - 110075
CIN: U65929DL2020GOI366835
Standalone Cash flow statement for the period ended on March 31, 2021

Particulars	For the Period Ended on March 31, 2021
A. Cash flows from operating activities	
Net Profit/ (loss) before tax	(2,23,10,460.00)
Adjustments for:	
Depreciation expense	-
Interest expense	-
Interest income	-
Profit on sale of assets	-
Provision for Gratuity and Leave encashment	-
Capital work in progress written off	
Provision for doubtful debts and advances	-
Liability no longer required written back	-
Operating profit/(loss) before working capital changes	**(2,23,10,460.00)**
Movements in working capital:	
(Increase) / Decrease in inventories	-
(Increase) / Decrease in trade receivables	-
(Increase) /Decrease in loans and advances and other current assets	(13,87,878.00)
Receipts from/ (Repayments to) related party liabilities	-
Increase / (Decrease) in trade payables and liabilities	55,21,111.00
Cash generated from operations	**(1,81,77,227.00)**
Direct taxes paid (TDS receivable)	-
Net cash (used in)/generated from operating activities (A)	**(1,81,77,227.00)**
B. Cash flows from investing activities	
Sale /(Purchase) of tangible assets	-
Margin money (deposited) /matured	-
Interest received	-
Net cash (used in)/generated investing activities (B)	-
C. Cash flows from financing activities	
Receipts from Issue of Share Capital	11,00,00,000.00
Net Proceeds from /(repayment) of long/short term borrowings/other Equity	5,00,00,000.00
Interest paid	-
Net cash (used in)/generated from financing activities (C)	**16,00,00,000.00**
Net increase/(decrease) in cash and cash equivalents (A + B + C)	14,18,22,773.00
Cash and cash equivalents at the beginning of the period	-
Cash and cash equivalents at the end of the period	**14,18,22,773.00**

SUMMARY CASH FLOWS OF NHIPPL

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NATIONAL HIGHWAYS INFRA PROJECTS PRIVATE LIMITED

CIN: U45201DL2020GOI366737

Statement of Cash Flows for the year ended 31st March 2023

(All amounts in ₹ lakh unless otherwise stated)

	Particulars	For the year ended 31st March 2023	For the year ended 31st March 2022
A.	**OPERATING ACTIVITIES**		
	Loss before tax	(55,966.24)	(11,621.38)
	Adjustments for:		
	Depreciation and Amortization	17,360.63	1,035.63
	Provision for major maintenance expenses	5,879.20	403.29
	Unwinding interest on major maintenance provision	24.95	-
	Provision for gratuity and leave encashment	11.95	0.11
	Provision for expected credit loss	59.60	-
	Bad debts written off	9.90	-
	Profit on redemption of Mutual Funds	(248.97)	(20.79)
	Finance Cost (net)	94,698.30	22,843.13
	Interest Income on FDR	(21.15)	-
	Operating Profit/(Loss) before Working Capital Changes	**62,008.17**	**12,660.02**
	Working Capital Adjustments:		
	Decrease / (Increase) in Trade and Other Receivables	180.10	(935.29)
	Decrease / (Increase) in Financial Assets	(2.92)	-
	Decrease / (Increase) in Non Current/ Current Assets	(181.37)	-
	Increase / (Decrease) in Trade & Other Payables	2,873.90	787.94
	Increase / (Decrease) in Other Financial Liabilities	57.50	(7,34,943.27)
	Increase / (Decrease) in Provisions	(0.13)	0.00
	Increase / (Decrease) in Other Current Liabilities	57.16	140.93
		64,992.41	**(7,22,289.68)**
	Income Tax paid	(12.06)	0.00
	Net Cash Flows from/(used in) Operating Activities	**64,980.35**	**(7,22,289.68)**
B.	**INVESTING ACTIVITIES**		
	Purchase of Property, Plant & Equipment and Intangible Assets, including CWIP, Capital Creditors and Capital Advances	(2,85,101.03)	(0.50)
	Profit on redemption of Mutual Funds	248.97	20.79
	Interest Income on FDR	21.15	-
	Net cash flows from (used in) Investing activities	**(2,84,830.91)**	**20.29**
C.	**FINANCING ACTIVITIES**		
	Proceeds from issue of shares (including Share Premium)	-	1,29,400.00
	Proceeds from borrowings	2,84,966.66	6,05,640.00
	Finance Costs paid	(58,661.01)	(12,192.00)
	Net cash flows from (used in) Financing activities	**2,26,305.65**	**7,22,848.00**
	Net Increase/Decrease in Cash and Cash equivalents (A+B+C)	6,455.09	578.61
	Cash and cash equivalents at the beginning of the year	588.61	10.00
	Cash and cash equivalents at the end of the year (refer note 8)	**7,043.70**	**588.61**

Refer Note No. 13 for reconciliation of financing activities.

Note:

(i) The above Statement of Cash Flows has been prepared under the indirect method as set out in "Ind AS 7 Statement of Cash Flows".

(ii) Amounts in bracket represent outflows.

This is the Statement of Cash Flow referred to in our report of even date.

NATIONAL HIGHWAYS INFRA PROJECTS PRIVATE LIMITED

CASH FLOW STATEMENT FOR THE YEAR ENDED 31ST MARCH, 2022

(All amounts in ₹ lakh unless otherwise stated)

	PARTICULARS	YEAR ENDED 31-03-2022	YEAR ENDED 31-03-2021
A.	**OPERATING ACTIVITIES**		
	Net Profit/(Loss) Before Tax	(11,621.38)	(1.14)
	Adjustments to reconcile profit before tax to net cash flows:		-
	Depreciation and Amortization	1,055.65	-
	Loss/ (Gain) on sale of Investments (net)	(20.79)	-
	Finance Cost (net)	22,843.13	-
	Operating Profit/(Loss) before Working Capital Changes	12,256.61	(1.14)
	Working Capital Adjustments:		
	Decrease / (Increase) in Trade and Other Receivables	(935.29)	-
	Decrease / (Increase) in Financial Assets	-	-
	Decrease / (Increase) in Non Current/ Current Assets	-	-
	Increase / (Decrease) in Trade & Other Payables	787.94	-
	Decrease / (Increase) in Other Financial Liabilities	(7,34,943.27)	7,35,041.14
	Increase / (Decrease) in Provisions	403.40	-
	Decrease / (Increase) in Other Current Liabilities	140.93	-
		(7,22,289.68)	**7,35,040.00**
	Income Tax paid	**0.00**	-
	Net Cash Flows from/(used in) Operating Activities	**(7,22,289.68)**	**7,35,040.00**
B.	**INVESTING ACTIVITIES**		
	Purchase of Property, Plant & Equipment and Intangible Assets, including CWIP, Capital Creditors and Capital Advances	(0.50)	(7,35,040.00)
	(Purchase)/ Sale of non current Investments	(4,951.00)	-
	(Purchase)/ Sale of current Investments (net)	4,971.79	-
	Net cash flows from (used in) Investing activities	**20.29**	**(7,35,040.00)**
C.	**FINANCING ACTIVITIES**		
	Proceeds from issue of shares (including Share Premium)	1,29,400.00	10.00
	Working Capital Borrowings from Banks/other short term loans (net)	27,253.80	-
	Proceeds from long term borrowings	5,78,386.20	-
	Finance Costs paid	(12,192.00)	-
	Net cash flows from (used in) Financing activities	**7,22,848.00**	**10.00**
	Net Increase/Decrease in Cash and Cash equivalents (A+B+C)	578.61	10.00
	Cash and cash equivalents at the beginning of the year	10.00	-
	Cash and cash equivalents at the end of the year	**588.61**	**10.00**

This is the Cash Flow Statement referred to in our report of even date.

SUMMARY OF BUSINESS

Overview

We are a registered infrastructure investment trust under the InvIT Regulations. We currently have a right to toll, operate and maintain a portfolio of eight Existing Toll Roads (*defined below*) in the Indian states of Gujarat, Rajasthan, Telangana, Karnataka, Maharashtra, Uttar Pradesh and Madhya Pradesh and intend to toll, operate and maintain a portfolio of seven Target Toll Roads (*defined below*) in the Indian states of, Assam, Madhya Pradesh, Uttar Pradesh, West Bengal and Karnataka under the Toll Operate Transfer ("**TOT**") model conceived by NHAI. These Toll Roads (*defined below*) are operated and maintained pursuant to concessions granted by the NHAI. The Existing Toll Roads comprise eight stretches spanning a total length of approximately 635 kms and the Target Toll Roads comprise seven stretches spanning a total length of approximately 888 kms.

Our Sponsor is NHAI, an autonomous authority of the GoI under the MoRTH constituted on June 15, 1989 by an Act of the Indian Parliament titled – The National Highways Authority of India Act, 1988 (the "**NHAI Act**"). NHAI was operationalised in February 1995 with the appointment of a full-time Chairman and other members of the board. The functioning of NHAI is governed by the NHAI Act and the rules, and regulations framed thereunder.

The Project SPVs have entered into 15 independent Concession Agreements with the NHAI for concessions of each of the Toll Roads. We have satisfied all conditions precedent and commenced our Concessions on December 16, 2021 and October 29, 2022 in accordance with the terms of the Concession Agreements for the Existing Toll Roads and expect to satisfy all conditions precedent and commence our Concessions for the Target Toll Roads in accordance with the terms of the Concession Agreements for the Target Toll Roads. For further details, please see the section entitled "*Summary of the Concession Agreements*", "*Management's Discussion and Analysis of Financial Position and Results of Operations*" and "*Use of Proceeds*" on pages 232, 290 and 273, respectively.

The Concession Agreements provide the Project SPVs the right to collect tolls for a period of 20 years or 30 years (as applicable under the relevant Concession Agreement) from users of each Toll Road, with certain overlay activities and the construction of additional toll lanes in respect of certain of the Toll Roads (the "**Initial Improvement Works**") to be completed by the Project SPVs within 12 to 18 months from the Appointed Date (as defined in the section entitled "*Summary of the Concession Agreements*"). Responsibility for the supervision of the operations and maintenance of the Toll Roads also vests with us. In return, the Project SPVs is required to pay the concession fee to the NHAI prior to the commencement of the Concession, as set out in the respective Concession Agreements. For further information on the provisions of the Concession Agreements, see "*Summary of the Concession Agreements"* on page 232.

NHIPPL has a right to toll, operate and maintain the following toll road assets (the "**Existing Toll Roads**"):

- Palanpur/Khemana – Abu Road Project ("**Asset 1**"): Abu Road section of NH 27 with a total length of 45 kms, connecting the states of Gujarat and Rajasthan;
- Abu Road – Swaroopganj Project ("**Asset 2**"): Swaroopganj section of NH 27 with a total length of 31 kms, in the state of Rajasthan;
- Maharashtra/ Karnataka Border (Kagal) – Belgaum Project ("**Asset 3**"): Belgaum – Kagal section of NH 48 with a total length of 77.7 kms, connecting the states of Karnataka and Maharashtra;
- Chittorgarh – Kota & Chittorgarh Bypass Project ("**Asset 4**"): Chittorgarh – Kota section of NH 27 with a total length of 160.5 kms, in the state of Rajasthan;
- Kothakota Bypass – Kurnool Project ("**Asset 5**"): Kothakota bypass – Kurnool section of NH 44 with a total length of 74.6 kms, connecting the states of Telangana to Andhra Pradesh;
- Agra Bypass Project ("**Asset 6**"): Agra Bypass section with a total length of 32.80 kms, connecting NH19 (old NH2) to NH44 (old NH7) in Uttar Pradesh;
- Borkhedi – Kelapur Project ("**Asset 7**"): Borkhedi-Kelapur-Maharashtra/Telangana border section of NH44 (old NH7) with a total length of 138.15 kms, in the state of Maharashtra; and
- Shivpuri – Jhansi Project ("**Asset 8**"): Jhansi-Shivpuri section of NH 27 with a total length of 75.30 kms, connecting the districts of Jhansi in the state of Uttar Pradesh and Shivpuri in the state of Madhya Pradesh.

From the Appointed Date, NEPPL will have the right to toll, operate and maintain the following toll road assets (the "**Target Toll Roads**"):

- Chichra – Kharagpur Project ("**Asset 9**"): Chichra – Kharagpur section of NH 49 with a total length of 56.12 kms, in the state of West Bengal;
- Rewa –Lakhnadon Project ("**Asset 10**"): Rewa – Katni – Jabalpur – Lakhnadon section of NH 30 and NH 34 with a total length of 306.34 kms, in the state of Madhya Pradesh;
- Kachugaon – Kaljhar Project ("**Asset 11**"): Kachugaon – Rakhaldubi Bus Junction – Kaljhar section of NH 27 with a total length of 114.17 kms, in the state of Assam;
- Kaljhar – Patacharkuchi Project ("**Asset 12**"): Kaljhar – Patacharkuchi section of NH 27 with a total length of 27.30 kms, in the state of Assam;

- Lakhnadon – Mahagaon (Mohgaon) – Khawasa ("**Asset 13**"): Lakhnadon – Mahagaon (Mohgaon) – Khawasa section of NH 44 with a total length of 107.35 kms, in the state of Madhya Pradesh;
- Orai – Barah Project ("**Asset 14**"): Orai – Barah section of NH 27 with a total length of 62.90 kms, in the state of Uttar Pradesh; and
- Chitradurga Bypass – Hubli Project/ Karnataka Project ("**Asset 15**"): Chitradurga Bypass – Chitradurga – Davanagere – Haveri – Hubli section of NH 48 with a total length of 214.47 kms, in the state of Karnataka.

The following map depicts locations of the Toll Roads:

Note:

(1) *This map is for illustrative purposes only, is not to scale and is subject to change at any time.*

Strengths of the Trust

The strengths of the Trust are:

- Experienced Sponsor with consistent track record in operating and maintaining projects in the roads and highways sector in India;
- Sizeable portfolio of diversified long-term revenue generating Toll Road assets;

- Presence in strategic regions/ Strategic geographic location of portfolio assets;
- Experienced management team with industry experience;
- Growth opportunities and access to Sponsor's portfolio; and
- Favourable Concession Agreement terms with Low Counterparty Risk and Inflation Passthrough.

Strategies of Our Trust

The strategies of our Trust are:

- Organic growth through proactive management;
- Acquisition of toll road projects;
- Optimization of capital structure;
- Seamlessly transition all aspects of the Toll Roads upon acquisition; and
- Improve toll collection efficiencies across the Toll Roads.

SUMMARY OF INDUSTRY

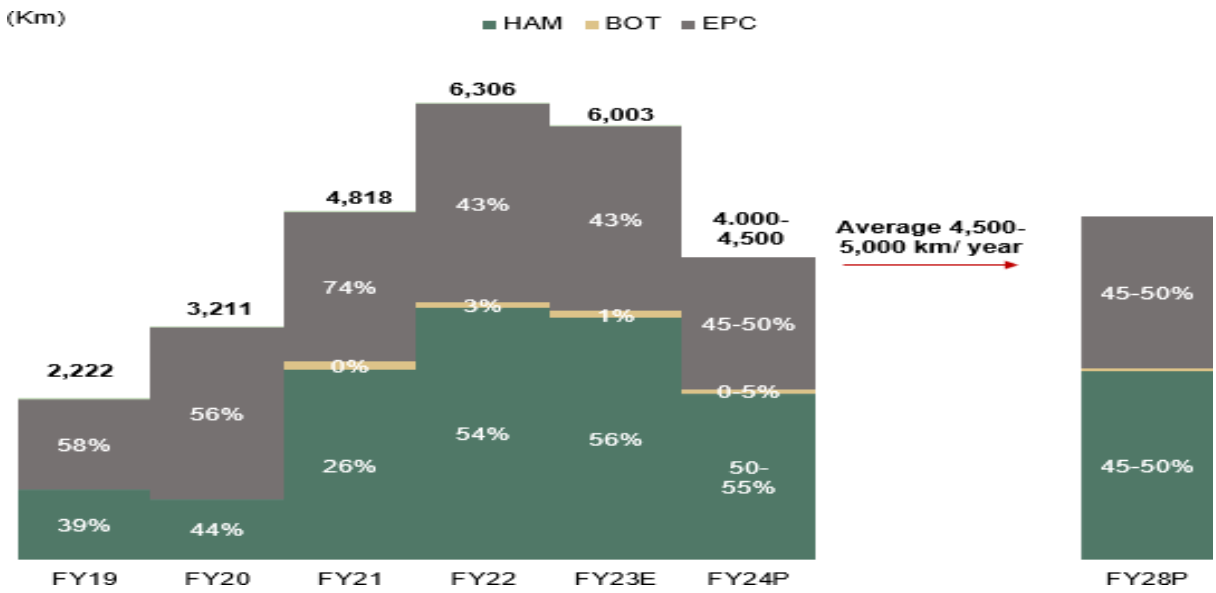
*The information contained in this section is derived from the report by CRISIL Market Intelligence & Analytics on Roads and Highways, dated 2023 ("**CRISIL Report**"). Neither we nor any other person connected with the Issue has independently verified this information. Industry sources and publications generally state that the information contained therein has been obtained from sources generally believed to be reliable, but that their accuracy, completeness and underlying assumptions are not guaranteed, and their reliability cannot be assured. Industry publications are also prepared based on information available as of specific dates and may no longer be current or reflect current trends. Accordingly, investment decisions should take these limitations into account. All references to years refer to calendar years except as otherwise stated. References to Indian financial years ("**FY**") are to the one-year period ending March 31 of the named year.*

Overview of the steady growth in fiscal 2024

Between fiscal years 2018 to2023 the road sector's capital expenditure grew steadily at a CAGR of 14%, this growth is driven by initiatives like Bharatmala and increased state investments despite challenges like the pandemic and prolonged monsoons. The outlook of the sector also remains positive due to previous fiscal's high awarding, Bharatmala, NIP pipeline of DPR ready projects and steady state capex. The National highways segment contribute 40-45% of total capex, with a 12-18% growth expected in fiscal 2024. State spending also grew by 21% in fiscal 2022 and 10-13% in fiscal 2023 and is expected to increase by 8-12% in fiscal 2024, maintaining historical averages.

Overview of the Investments on the National highways

In fiscal 2023, NHAI has awarded 6003 km of projects, with the hybrid annuity model ("**HAM**") share increasing from 54% in fiscal 2022 to 56% in fiscal 2023 while the engineering, procurement and construction ("**EPC")** remained unchanged at 43%. However, in fiscal 2024, awarding is expected to decrease to around 4000-4500 km due to challenged like cost overruns and the need for additional funds. Despite this, the shares of HAM, EPC and build-operate-transfer ("**BOT**") are predicted to remain stable. NHAI aims to maintain an average awarding of 15000 km per year from fiscal 2024 to 2026, with developers expected to deleverage through stake sales.

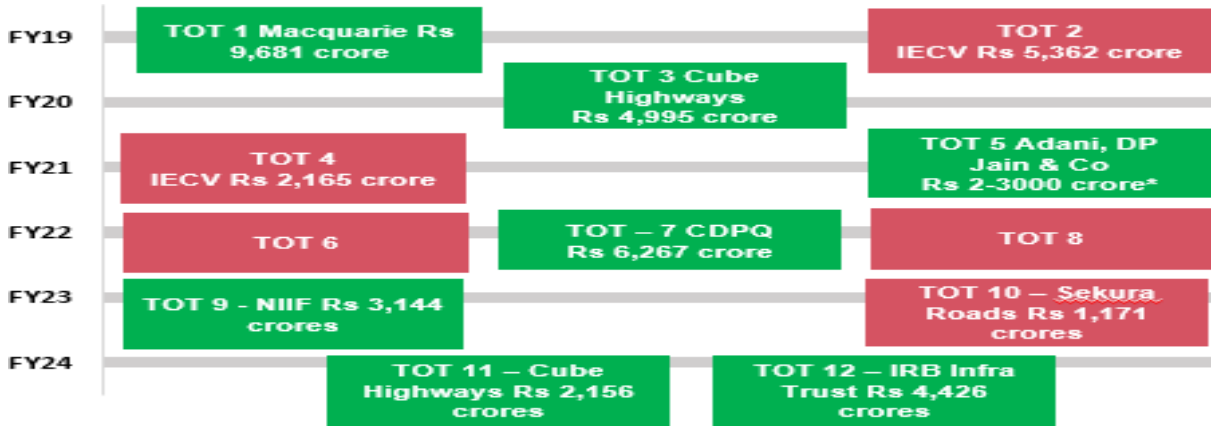


Source: NHAI, CRISIL MI&A Research

The high awarding volumes in earlier quarters have benefited large road developers, leading to an 11% year-on-year growth in their cumulative order books as of Quarter 4 fiscal 2023. This growth provides revenue visibility for developers amid intense competition and is a positive sign for the sector. Steady growth in order books is attributed to continuous high awarding activities.

NHAI's execution has been steadily increasing, raising from 4,175 km in fiscal 2021 to 4882 km in fiscal 2023. This growth is attributed to factors such as increased project awards, focus on resolving land acquisition issues, and initiatives to ease liquidity for EPC road players. Despite challenges like high commodity prices and elongated monsoons, NHAI's construction pace is expected to reach 5000-5500 km in fiscal 2024. Over the medium term, construction is forecasted to rise steadily, reaching around 16 km per day by fiscal 2028.

Overview of the financing on Public Funding



The Success of TOT is critical to meet ambitious Bharatmala targets. The authority has also tied up debt via SPV level funding for the Delhi-Mumbai expressway where it has already raised Rs 9,731 crores.

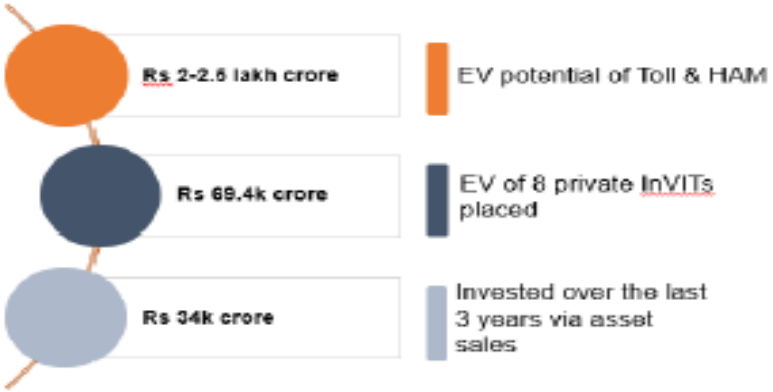
InVITs & SPV level financing

Source: NHAI, CRISIL Research

Overview of the financing on Private Funding

The private sector investments in national highways are expected to triple over the next 5 years, with private construction investments in national highways projected to increase 2x to Rs. 2.7 trillion between 2024 to 2028. This growth will primarily occur through the hybrid annuity model (HAM) mode due to a lack for interest in the BOT toll mode.

Policy changes such as modifications in Model Concession Agreements (MCA) and reduced bid eligibility criteria, are expected to encourage private participation. However, the share of HAM in total awarding is constrained by the cautious approach employed by banks in lending to HAM projects. Measures taken during the COVID-19 pandemic, such as releasing monthly payments and extending project timelines, have supported private participation but may fade from the next fiscal year onwards. Asset monetisation and equity infusion are crucial to sustaining private investment in the long run, with asset sales driven by the rationalisation of financial positions and participation on upcoming projects, while some are selling under-construction projects to financial investors to retain margins amidst competition. The potential Enterprise Value from BOT and HAM projects is estimated to be around Rs 2-2.5 lakh core, indicating significant potential for asset monetisation to improve developers balance sheets.



Overview of the Road Network in India

India possesses the world's second largest road network, totalling 6.2 million kilometres. Roads are the primary mode of transportation, handling 86% of passenger traffic and 67% of freight traffic. National highways through a small fraction of the network at 136,440 km and manages 40% of the total road traffic. State and major district roads constitute the majority of the network and carry the remaining 60% of traffic. Overall, roads transport 67% of total freight, surpassing railways.

Overview of the National Highways

The National Highways Development Project (NHDP) involves the construction, upgrade, and rehabilitation of national highways. It's executed by NHAI in collaboration with state public works departments and the Border Roads Organisation. NHDP is divided into seven phases and involves private players through contracts like EPC, BOT, and the HAM. Funding comes from various sources including budget allocations, toll revenue, and loans/grants from international organizations. NHDP projects, along with Bharatmala initiatives, are expected to dominate investments in the coming years, with NHAI's ability to raise funds for Bharatmala projects being crucial.

Bharatmala Pariyojana (BMP) is the new umbrella scheme, which supersedes the existing National Highways Development Programme (NHDP) aimed at constructing 65,000 km of highways, replacing NHDP. It includes various categories like National Corridors, Economic Corridors, Inter-corridor roads, and others. The Phase-I of BMP, approved in 2017, covers around 34,800 km with a focus on economic corridors, inter-corridor roads, and other types of connectivity. By October 2019, 255 road projects covering approximately 10,699 km were approved under BMP Phase-I, with an estimated cost of around Rs. 2.64 lakh crore.

Out of the 24,800 km approved under Bharatmala Pariyojana Phase-I, a total of 447 projects of length 14,519 km have been awarded by NHAI, post the approval of Bharatmala Pariyojana in the FY 21-22. Similarly, out of the 10,000 km approved under residual NHDP in Bharatmala Phase-I, a total of 127 projects of length 5,407 km have been awarded post the approval of Bharatmala Pariyojana in FY 21-22.

SR	Types of Corridor	No. of	Awarded
1	**Economic Corridors**	188	5,848
2	**Inter Corridor Routes**	51	**1.936**
3	**Feeder Routes**	19	669
4	**National Corridor**	59	1,
5	**National Corridor Efficiency**	25	705
6	**Expressway**	81	2,265
7	**Border Roads & International**	14	1,
8	**Coastal Roads**	2	**77**
9	**Port Connectivity**	8	1
	Bharatmala Total	**447**	**14,519**
10	NHDP	127	5,
	Grand Total	**574**	**19,926**

RISK FACTORS

An investment in the Units involves a high degree of risk. Before investing in the Units, prospective investors should pay particular attention to the fact that the Trust, the Parties to the Trust, the Project SPVs and each of their activities are governed by the legal, regulatory and business environment in India, which differs from that which prevails in other countries. Prospective investors should carefully consider the risks and uncertainties described below and the information contained elsewhere in this Placement Document before making an investment in the Units. In making an investment decision, each investor must rely on its own examination of us and the terms of the offering of the Units. The risks and uncertainties described in this section may not be the only risks and uncertainties the Trust currently faces. Additional risks and uncertainties not presently known to the Trustee or the Investment Manager, or that the Trustee or the Investment Manager currently deem immaterial, may arise or may adversely affect our business, financial condition, cash flows and results of operations. If any of the following risks, or other risks that are not currently known or are now deemed immaterial, actually occur, our business prospects, results of operations, cash flows and financial condition could suffer, the price of the Units could decline and prospective investors may lose all or part of their investments. Unless otherwise stated in the relevant risk factors set forth below, the Trustee and the Investment Manager are not in a position to specify or quantify the financial or other risks mentioned herein.

The financial and other related implications of the risk factors, wherever quantifiable, have been disclosed in the risk factors mentioned below. However, there are certain risk factors where the financial impact is not quantifiable and, therefore, cannot be disclosed in such risk factors. Unless specified or quantified in the relevant risk factors below, we are not in a position to quantify the financial or other implication of any of the risks described in this section.

Investors should be aware that the price of the Units, and the income from them, may be subject to volatility. If any of the risks described below occurs, our business and prospects could be materially and adversely affected, the trading price of the Units could decrease, and investors could lose all or part of their original investment.

This Placement Document also contains forward-looking statements that involve risks, assumptions, estimates and uncertainties. Our actual results could differ materially from those anticipated in such forward-looking statements as a result of certain factors including the considerations described below and elsewhere in this Placement Document.

In making an investment decision, prospective investors must rely upon your own examination and the terms of the Issue, including the merits and the risks involved. You should consult your tax, financial and legal advisors about the particular consequences of investing in the Issue.

In this section, unless specified otherwise, a reference to "we", "us" and "our" refers to the Trust and the Project SPVs on a consolidated basis.

Risks Related to the Structure of the Trust

1. ***The monies received from the Issue proceeds have been retained in the Cash Escrow Account until the completion of the allotment of units to the Sponsor pursuant to the Preferential Issue to Sponsor and will be refunded to the Bidders in case the Preferential Issue to the Sponsor is not completed prior to the Allotment of Units.***

   The IM Board by way of its resolution dated February 10, 2024 and the Unitholders of the Trust by way of their resolution dated March 4, 2024, have approved the Issue of upto 497,926,090 Units at or above ₹ 122.86 per Unit ("**Base Price**"). The Trust proposes to undertake the issue of up to 117,159,080 Units to the Sponsor, on a preferential basis ("**Preferential Issue**"), in accordance with the SEBI Institutional Placement Guidelines and the InvIT Regulations. The Unitholders by way of a resolution dated March 4, 2024 have approved the Preferential Issue.

   The Sponsor, by way of its letter dated March 6, 2024, had confirmed its willingness to subscribe to at least 87,869,310 Units, at a base offer price of ₹ 122.86 per Unit plus premium payable, if any. Further, the Sponsor, by way of its letter dated March 14, 2024 has agreed to subscribe to 87,869,400 Units at a price of ₹ 124.14 per Unit pursuant to the Preferential Issue.

   The Issue Closing Date for the Issue was Wednesday, March 13, 2024 and Allotment pursuant to the Issue may be delayed until the completion of the Preferential Issue. There can be no assurance that the Preferential Issue will be completed in a timely manner or at all. In the event the Preferential Issue is not completed for any reasons, the Allotment of Units pursuant to the Issue may be delayed and if completed, the Allotment may lead to the unitholding of certain Unitholders of the Trust exceeding the limits prescribed under the extant provisions of the InvIT Regulations. Accordingly, Bidders may not be allocated or Allotted Units, despite making valid Bids. Further, non-completion of the Preferential Issue would lead to the unitholding of the Sponsor getting diluted below 15%. Accordingly, the monies received from the Issue proceeds will be retained in the Cash Escrow Account till the completion of the Preferential Issue and will be refunded to the Bidders in case the Preferential Issue is not completed prior to the Allotment of Units.

2. ***We have no operating history or financial information for the R3 Toll Roads. Accordingly, the information disclosed in this Placement Document in relation to the R3 Toll Roads is limited.***

NEPPL was incorporated on April 19, 2023, to acquire tolling rights from the Sponsor for undertaking tolling, operation, and maintenance of certain national highways in India. Currently, we do not operate the R3 Toll Roads and accordingly NEPPL does not have any operating history. Furthermore, in accordance with Paragraph 11 of Annexure 6 of the Master Circular, the Investment Manager, by way of its letters dated February 27, 2024 and March 6, 2024, communicated to SEBI a request for relaxation of strict application of financial disclosure rules per the InvIT Regulations for the R3 Toll Roads ("SEBI Exemption Request").

SEBI has acceded to our request in relation to the financials disclosures of R3 Toll Roads and has accordingly mandated us to disclosure the Asset Revenue Information for R3 Toll Roads for the previous three financial years and for the period from April 1, 2023 till the completed month prior to the filing of this Placement Document. Accordingly, we have included the requisite revenue data for R3 Toll Roads basis the information provided by the Sponsor by way of its letter dated March 7, 2024. For further details, see "*Asset Revenue Information*" on page 364 of this Placement Document.

The absence of meaningful historical operating data in respect of R3 Toll Roads or financial statements may make it difficult for investors to evaluate our ability to operate, manage and maintain the R3 Toll Roads and assess our financial position or future prospects or results of operations. Our inability to successfully operate and manage the R3 Toll Roads or to operate and manage the R3 Toll Roads in an efficient and cost-effective manner could have an adverse effect on our results of operations and our ability to meet our payment obligations under the Units.

3. ***We must maintain certain investment ratios, which may present additional risks to us.***

Pursuant to the InvIT Regulations, we are required to invest not less than 80% of the value of our assets in eligible infrastructure projects as defined under the InvIT Regulations, such as the Project SPVs. In addition, we must not invest more than 20% of the value of our assets in certain financial instruments prescribed under the InvIT Regulations. If these conditions are breached on account of market movements of the price of the underlying assets or securities, the Investment Manager must inform the Trustee and ensure that these conditions are satisfied within six months of such breach (or within one year with Unitholders' approval). Failure to comply with these conditions may present additional risks to us, including divestment of certain assets, delisting and other penalties, which could have a material, adverse effect on our business, financial condition and results of operations.

4. ***We may not be able to make future distributions to Unitholders or the level of distributions may fall.***

The Trust's distributions are based on the cash flows generated from the operations undertaken by the underlying Project SPVs held by the Trust and not on whether the Trust makes an accounting profit or loss. The InvIT Regulations provide that not less than 90% of net distributable cash flows of the Project SPVs are required to be distributed to the Trust in proportion of its holding in the Project SPVs subject to applicable provisions of the Companies Act. Not less than 90% of distributable cash flows of the Trust shall be distributed to the Unitholders. Such distributions are required to be declared and made not less than once in every year and shall be made not later than fifteen days from the date of such declaration. The Trust has made distributions of ₹ 5.898 per unit for the for the period of April 1, 2023 to January 31, 2024. For more details, see the section entitled "*Distribution*" on page 302 of this Placement Document.

The Trust substantially relies on the receipt of interest, dividends, and principal repayments (net of applicable taxes and expenses) from the Project SPVs in order to make distributions to Unitholders. The distributions to Unitholders are in the form of dividends, interest and any other means permitted by law. There can be no assurance or guarantee that the Trust will have sufficient distributable or realised profits or surplus in any future period to make distributions every year in any amount or at all. The ability of the Project SPVs to pay dividends, make interest payments and repay shareholder loans may be affected by a number of factors including, among other things:

- business and financial position of the Project SPVs;
- insufficient cash flows received from the Project SPVs;
- applicable laws and regulations, which may restrict the payment of dividends by the Project SPVs;
- ability of the Project SPVs to borrow funds and access capital markets;
- operating losses incurred by the Project SPVs in any financial year;
- fluctuations in the working capital needs of the Project SPVs;
- changes in accounting standards, taxation laws and regulations, laws and regulations in respect of foreign exchange repatriation of funds, corporation laws and regulations relating thereto; and
- the terms of agreements, including the Concession Agreements or financing agreements, to which the Project SPVs are, or may become, a party.

Further, the method of calculation of the net distributable cash flows may change subsequently due to regulatory changes. Any change in applicable laws in India or elsewhere (including, for example, tax laws and foreign exchange controls) may limit our ability to pay or maintain distributions to our Unitholders. Furthermore, no assurance can be given that we will be able to pay or maintain the levels of distributions at all, or that the level of distributions will increase over time, or that future acquisitions will increase our distributable cash flow to our Unitholders. Any reduction in, or delay/default in payments of distributions could materially and adversely affect the market price of our Units.

In addition, the financing agreements entered into by Project SPVs with banks, financial institutions and/or other lenders contains certain restrictive covenants, including, but not limited to, requirements that they obtain consent from the lenders prior to making any dividend payments to the Trust. Any failure to obtain such consents in a timely manner or at all would impede our ability to make distributions to Unitholders on a regular basis or at all, which could materially and adversely affect the market price of the Units. Additionally, following a default under our financing agreements, lenders may take coercive actions as per the rights available to them under applicable law, which may restrict our ability to conduct business and operations.

5. **Project SPVs may not be able to claim depreciation in relation to toll collection rights acquired from the Sponsor.**

Few of the Toll Roads acquired by Project SPVs were based on BOT model and are eligible to claim expenditure incurred on development and construction of infrastructural facilities in terms of the CBDT circular no. 09/2014 dated April 23, 2014 ("Circular"). The Circular provides that cost of construction on development of infrastructure facility of roads/highways under BOT projects may be amortized evenly over the concession period (excluding time take for creation of such facility).

Considering the diverse judicial precedents and the multiple views as to whether the expenditure incurred on development and construction of infrastructural facilities like roads/ highways on BOT basis with right to collect toll is entitled for depreciation under section 32(1)(ii) of the Act or the same can be amortized by treating it as an allowable expenditure under the relevant provisions of the Act. The CBDT issued the Circular to clarify its position for tax treatment under BOT arrangements (where ownership is not vested with the taxpayer). The Circular clarifies that cost of construction on development of infrastructure facility of roads/highways under BOT projects may be amortized evenly over the concessionaire period (excluding time take for creation of such facility). Further, the Circular explicitly clarifies that the applicability is restricted to BOT arrangements where ownership is not vested with the taxpayer.

Under TOT projects, the concessionaire does not undertake major construction works, but primarily collects toll and operates and maintains the highway/ road. We believe that upfront concessional payment made by Project SPVs for acquisition of toll rights may be considered akin to acquisition of business or commercial rights and Project SPVs shall be eligible to claim depreciation under section 32 of the IT Act under the head of 'intangible assets'. Hence, based on the above interpretation, tax authorities may disallow the tax treatment adopted by Project SPVs of charging depreciation in relation to the project assets, which may adversely affect our business and profitability.

Risks Relating to Our Business and the Concession Agreements

6. ***Any payment by the Project SPVs, including in the event of the termination of the Concession Agreements, is subject to a mandatory escrow arrangement which restricts its flexibility to utilise the available funds.***

The escrow arrangement mandated under the Concession Agreements requires all monies that are received by the Project SPVs, including funds constituting the financial package, the fees and any other revenues collected from or in respect of the Project Highway (including the proceeds of any rentals, deposits, capital receipts or insurance claims) and all payments by the Sponsor (including, if any, in relation to the change of scope), to be deposited in an escrow account and utilised only in accordance with the order prescribed under the escrow agreement. The consent of NHAI, in its capacity as the concessioning authority (the "**Authority**"), and lenders, is required to amend the order of outflow of payments from such escrow account.

The escrow arrangements prioritise the payment of all taxes due, followed by payment of the concession fee to the Authority, expenses in connection with the construction of the project, operation and maintenance expenses, other costs and expenses incurred by the Sponsor, debt service payments, any payments and damages due and payable to the Sponsor, and balance, if any, in accordance with the instructions of the concessionaire. For details of the escrow arrangement, please see the section headed "*Summary of the Concession Agreements*" on page 232 of this Placement Document.

The debt financing provided by the Trust to the Project SPVs and any future debt financing proposed to be provided comprises of certain secured or unsecured interest-bearing loans (collectively, the "**Trust Financing**") which will be classified as senior debt under the Concession Agreements. In accordance with the escrow arrangement, the amounts payable to the Trust in respect of the Trust Financing, will be subordinated to the amounts payable in respect of taxes due, concession fees, construction expenses, operation, maintenance and other costs and expenses. Further, any reduction in the cash flows of the Project SPVs and/or an unanticipated increase in any of the abovementioned payments to be made by the Project SPVs from the escrow accounts may result in decreased and/or delayed payment to the Trust, materially and adversely impacting the ability of the Project SPVs to meet their payment obligations to the Trust. Any inability on the part of the Project SPVs to meet their payment obligations to the Trust may adversely impact the ability of the Trust to make distributions to the Unitholders in the manner described in this Placement Document or at all.

In case of withdrawals from the escrow account on termination, the escrow arrangement prioritises the payment of all taxes due and payable, followed by the payment due to senior lenders (which includes the Trust), any payments and damages due and payable to the Sponsor, retentions and payments arising out of liability for any defects and deficiencies, incurred or accrued operation and maintenance expenses and any other payments under the Concession Agreements, after which the

balance may be withdrawn by the Project SPVs for its own purposes. Therefore, in case of termination, the amounts payable to the Trust in respect of the Trust Financing may be recovered only after payment of all taxes.

7. ***The Sponsor, whose interests may be different from the other Unitholders, will be able to exercise significant influence over certain activities of the Trust, and under the InvIT Regulations, it has the ability to divest its holdings in the Units three years following the Issue.***

As of December 31, 2023, the Sponsor holds 15.86% of the Units. After the completion of the Issue, i.e. on a post- Issue basis, the Sponsor will own an aggregate of not less than 15% of the issued and outstanding Units and will be entitled to vote as a Unitholder on all matters other than matters where it is a related party and not permitted to vote under the InvIT Regulations. Thus, the Sponsor may be in a position to exercise significant influence in matters which require the approval of Unitholders by virtue of its ownership of Units in the Trust. The interests of the Sponsor may conflict with the interests of our other Unitholders and the Sponsor may, for business considerations or otherwise, seek to benefit itself instead of the Trust or the interests of the other Unitholders. The Sponsor will also exercise significant influence over the Project Manager, which is a wholly owned subsidiary of the Sponsor. Accordingly, the Project Manager may also be subject to conflicts of interest with respect to the Trust.

In addition, under the InvIT Regulations, the Sponsor and the Sponsor Group, collectively, is required to hold a minimum of 15% of our Units for a minimum period of three years from the date of listing pursuant to this Issue and the balance of its unitholding in the Trust is required to be locked in for a period of one year from the date of listing of the Units. Further, in accordance with the InvIT Regulations, the Sponsor and the Sponsor Group, collectively, are required to lock-in our Units as follows:

Period of unitholding	**Percentage (%)**
From the beginning of 4th year after the date of listing pursuant to the initial offer and till the end of 5th year from the date of listing pursuant to the initial offer	5% of total Units or ₹ 500 crores, whichever is lower
From the beginning of 6th year after the date of listing pursuant to the initial offer and till the end of 10th year from the date of listing pursuant to the initial offer	3% of total Units or ₹ 500 crores, whichever is lower
From the beginning of 11th year after the date of listing pursuant to the initial offer and till the end of 20th year from the date of listing pursuant to the initial offer	2% of total Units or ₹ 500 crores, whichever is lower
After completion of the 20th year from the date of listing pursuant to the initial offer	1% of total Units or ₹ 500 crores, whichever is lower

Given the influence that the Sponsor exerts on the Investment Manager and the Project Manager, and consequently the operations and credibility of the Trust, any material divestiture by the Sponsor in the Units, or any conflict of interest that it has compared to that of other Unitholders, could have a material adverse impact on our business, financial condition and results of operations.

8. ***The cost of implementing new technologies for collection of tolls and monitoring our projects could materially and adversely affect our business, financial condition and results of operations.***

Our future success will depend in part on our ability to respond to technological advances and emerging standards and practices on a cost-effective and timely basis. In addition, rapid and frequent technology and market-demand changes can often render existing technologies and equipment obsolete, requiring substantial new capital expenditures or write-downs of assets. Any failure by us to successfully adopt such technologies in a cost-effective and timely manner could increase our costs. Additionally, governmental authorities may require adherence with certain technologies in the execution of projects, tolling, operations and maintenance etc. and there can be no assurance that we would be able to implement the same in a timely manner, or at all. The FASTag is a device which is fitted on the front windscreen of vehicles to indicate online toll payment. The proper functioning of such technology infrastructure is essential to the conduct of our business. There can be no assurance that we would be able to replace or refurbish such equipment and further such replacement or refurbishment might not be undertaken in a cost-effective manner and any increased costs to us as a result of such replacement or refurbishment will adversely affect our profit margins and cash flows.

9. ***We may face limitations and risks associated with debt financing and refinancing.***

We are subject to regulatory restrictions in relation to our debt financing and refinancing. We may from time to time require debt financing and refinancing to carry out the Investment Manager's investment strategy and to cover maintenance costs. In the event that we undertake debt financing or refinancing, we may be limited by Indian law as to the form of financing or refinancing that we may undertake. As an InvIT, we may be unable to access certain debt capital available to companies.

In the event that we undertake debt financing or refinancing, we may also be subject to risks associated with debt financing and refinancing, including the risk that our cash flow may be insufficient to meet required payments of principal and interest under such financing and to make distributions to Unitholders. Our ability to generate sufficient cash to satisfy our debt obligations will depend on our future operating performance, which may be affected by prevailing economic conditions and financial, business and other factors beyond our control. There is no assurance that we will be able to generate sufficient cash

flow to meet all of our debt obligations. If we are unable to make payments due under our debt facilities, the lenders may be able to declare an event of default and initiate enforcement proceedings relating to any security provided in respect of the loan facilities, and/or call upon any guarantees, and this may materially and adversely affect our ability to make distributions to Unitholders. Such default may also result in the termination of the Concession Agreements by the Sponsor.

10. ***Certain actions of the Project SPVs require the prior approval of NHAI, and no assurance can be given that NHAI will approve such actions in a timely manner or at all.***

Certain terms and conditions in the Project SPV's Concession Agreements, financing agreements, and our other approvals require the Authority's prior written approval to be obtained for one or more of the following actions, among others, such as:

- assignment of the Concession Agreements to any persons, the creation of any encumbrance over, or transfer or disposal of rights and benefits of the Project SPVs under the Concession Agreements or any project agreements;
- the selection or replacement of any operation and maintenance contractor and execution of the operation and maintenance agreements;
- securing refinancing; and
- any change in ownership of the Project SPVs.

Furthermore, the Concession Agreements with NHAI typically require the submission to NHAI, for its review and comments, all project agreements to which the Project SPVs is a party prior to entry, amendment or replacement of such agreements. In terms of the R3 Concession Agreements, in the event NHAI does not provide any comments within 15 days of such submission, the project agreement may be executed and submitted to NHAI within 7 days of such execution.

The restrictions described above may impose constraints on our flexibility to conduct our business. Furthermore, if as a result of these restrictions, we are unable to pursue a favourable course of action or to respond to an unfavourable event, condition or circumstance, then our business, financial condition and results of operations may be materially and adversely affected. For further details on the terms of the Concession Agreements, section headed "*Summary of the Concession Agreements*" on page 232 of this Placement Document.

11. ***Any delay in determination of appointed date (as defined in the R3 Concession Agreements) by the Authority may adversely impact our cashflows and revenue.***

The rights, privileges, liberties and obligations of the Concessionaire, shall commence from the date on which all conditions precedents, as stipulated in the R3 Concession Agreements, would have been satisfied. The Concessionaire shall enter into commercial service on the Appointed Date whereupon the Concessionaire shall be entitled to demand and collect fee and perform its O&M obligations, subject to and in accordance with the provisions of the R3 Concession Agreements. The determination of the Appointed Date by the Authority shall be final, conclusive and binding on the Concessionaire. Any delay in such determination of the Appointed Date may adversely affect our revenue generation, toll collection and cash flows and would have a material impact on our business and operations.

12. ***The regulatory framework governing infrastructure investment trusts in India is evolving and the interpretation and enforcement thereof involve uncertainties, which may have a material, adverse effect on the ability of certain categories of investors to invest in the Units, our business, financial condition and results of operations and our ability to make distributions to Unitholders.***

The SEBI issued the InvIT Regulations with effect from September 26, 2014. The regulations have been amended and supplemented with additional guidelines and circulars.

As the regulatory framework governing infrastructure investment trusts in India comprises a separate set of regulations, interpretation and enforcement by regulators and courts involves uncertainties. Furthermore, regulations and processes with respect to certain aspects of infrastructure investment trusts, including, but not limited to, follow-on public offers and bonus issues, the liabilities of the Unitholders, and the procedure for dissolution and delisting of infrastructure investment trusts have not yet been issued. For example, infrastructure investment trusts are not "companies" or "bodies corporate" within the meaning of the Companies Act, 2013 and various SEBI regulations, including the Securities and Exchange Board of India (Buy-back of Securities) Regulations, 2018 and the Securities and Exchange Board of India (Substantial Acquisition of Shares and Takeovers) Regulations, 2011. Accordingly, letters to SEBI for grant of exemptions from the stringent application of certain regulations is made by the Investment Manager on behalf of the Trust from time to time. There is no assurance that such exemptions will be granted to the Trust. In the event that the Trust is unable to comply with stringent regulations or process, it may have a consequential impact on the business of the Trust and results of operations of the Trust.

In addition, new costs may arise from audit, certification and/or self-assessment standards required to maintain compliance with the InvIT Regulations. Such changes in regulation, interpretation and enforcement may have a material, adverse effect on our business, financial condition and results of operations.

As we will be operating in a new and relatively unclear regulatory environment, it is difficult to forecast how any new laws, regulations or standards or future amendments to the InvIT Regulations will affect infrastructure investment trusts and this could have any consequential impact on the infrastructure sector in India. For instance, pursuant to amendments to the InvIT

Regulations on February 14, 2023 the Investment Manager was required to include an independent woman director on the board of the Investment Manager under Regulation 26(H) of the InvIT Regulations. SEBI by way of exemption letter dated February 21, 2024 exempted the Investment Manager from the requirement till March 31, 2024. However there is no assurance that the exemption would be extended till an appropriate appointment has been made. Similarly, pursuant to Regulation 26G of the InvIT Regulations, the Investment Manager was required to re-constitute the Audit Committee in-line with the regulations by April 1, 2023. However, the re-constitution was undertaken on October 18, 2023 due to operational reasons. While a request for an exemption from strict compliance and condonation for the delay was requested, the same was no granted by SEBI. No assurance can be given that the regulatory system will not change in a way that will impair our ability to comply with the regulations, conduct our business, compete effectively or make distributions. For further information, please see section entitled *"Corporate Governance"* on page 125.

13. ***The Project SPV's toll-road concessions may be terminated prematurely under certain circumstances.***

The Toll Roads concessions of the Project SPVs are our principal assets. We will be unable to continue the operation of a particular road concession without a continuing concession right from the Sponsor, in its capacity as Authority. A concession may be terminated by the Authority for certain reasons set forth in the Concession Agreements, including, but not limited to, one or more of the following:

- any failure by the Project SPVs to comply with the change of ownership requirements;
- any failure by the Project SPVs to make any payments, including negative grants, to the Sponsor in a timely manner;
- any failure by the Project SPVs to comply with maintenance requirements;
- in the event the Project SPVs abandons or manifests intention to abandon the operation and maintenance of the Project Highway;
- any occurrence of an event of default under any financing document;
- any continuation of a force majeure event, such as an act of God, act of war, expropriation or compulsory acquisition of any project assets by the government, strikes, civil commotions, boycotts and political agitations, beyond a specified time; and
- any failure by the Project SPVs to comply with the Concession Agreements if such default causes a material adverse effect on the Sponsor.

If the Concession Agreements are terminated by the NHAI due to a default by the Project SPVs, or by the Project SPVs due to a default by the NHAI, the Project SPVs are entitled to termination payments or otherwise from the NHAI in accordance with the terms of the relevant Concession Agreements. If the Concession Agreements are terminated prematurely, our business, financial condition and results of operations may be materially and adversely affected. For further details on the termination of the relevant Concession Agreements, the termination payments, and the definition of "default" as contemplated under the Concession Agreements, see the section headed "*Summary of the Concession Agreements*" on page 232, of this Placement Document.

14. ***Toll collections and Toll Road traffic volumes may be affected by existing or new competing roads and bridges and other modes of transportation, and any improvements to, or construction of, such roads, bridges and other modes of transportation.***

Upon commencement of the concessions, our principal source of revenue will be the collection of toll fees from users of the Toll Roads. The level of toll collections may be affected by existing or new competing routes and alternative modes of transportation, such as adjacent free roads, new or existing toll roads including national highways or state toll roads, railways or air transport. Although the Concession Agreements contain certain restrictions on the ability of the Sponsor to construct or cause to be constructed any competing roads within 15 km of the Toll Roads, the Authority is not prohibited from constructing such competing free or toll roads if the average traffic on the Toll Road exceeds 90 per cent of its stipulated designed capacity for three consecutive years. Furthermore, the Sponsor is not restricted under the Concession Agreements from constructing alternative modes of travel which service the same areas as are serviced by the Toll Roads.

In particular, the Sponsor has entrusted the Project SPVs with the role of development, operation, maintenance and management of the Toll Roads mentioned hereinbelow.

S. No.	Toll Road	Length of Toll Road (in kms)	Connecting States/ in the State of
R1 Toll Roads			
1.	Abu road – Swaroopganj	31.00	Rajasthan to Gujarat
2.	Chittorgarh – Kota & Chittorgarh Bypass	160.50	Madhya Pradesh -Rajasthan
3.	Kothakota Bypass – Kurnool Highway	74.62	Telangana – Andhra Pradesh
4.	Palanpur/Khemana – Abu Road	45.00	Gujarat – Rajasthan
5.	Maharashtra Border – Belgaum	77.70	Maharashtra -Karnataka
R2 Toll Roads			
1.	Agra Bypass	32.80	Uttar Pradesh-Madhya Pradesh
2.	Borkhedi Kelapur Project Highway	138.15	Maharashtra – Telanagna
3.	Shivpuri Jhansi Project Highway	75.30	Madhya Pradesh – Uttar Pradesh

S. No.	Toll Road	Length of Toll Road (in kms)	Connecting States/ in the State of
R3 Toll Roads			
1.	Chichra – Kharagpur Project	56.12	–West Bengal
2.	Rewa– Lakhnadon Project	306.34	Madhya Pradesh
3.	Kachugaon – Kaljhar Project	114.17	Assam
4.	Kaljhar – Patacharkuchi Project	27.30	Assam
5.	Lakhnadon – Mahagaon (Mohgaon) – Khawasa Project	107.35	Madhya Pradesh
6.	Orai – Barah Project	62.90	Uttar Pradesh
7.	Chitradurga Bypass – Hubli Project/ Karnataka Project	214.47	Karnataka

Additionally, given the renewed focus of the GoI, at the national, state and local levels, on the development and strengthening of the highway network across India, subject to the aforementioned restriction, there can be no assurance that there will not be any construction, widening or improvement of any free or toll roads, or construction of other modes of transportation, in the proximity of the Toll Roads or which provide an alternative or more direct routing to locations served by the Toll Roads. Any such construction, widening or improvement may divert traffic away from the Toll Roads, which may adversely affect toll collections and, therefore, our ability to meet our payment obligations under the Units.

15. ***Our business will be subject to seasonal fluctuations that may affect our cash flows.***

Our cash flows will be affected by seasonal factors, which may materially and adversely affect traffic volumes. Traffic volumes tend to decrease during the monsoon season and conversely tend to increase during holiday seasons. The monsoon season may also restrict our ability to carry on activities related to our operation and maintenance of the Toll Roads. Further, extreme weather conditions, such as floods, incessant or torrential rain, acts of God, or any other force majeure event, could impair the safe operation of and traffic movement on the Toll Roads by causing events such as overtopping of structures on the carriageway, amongst others. This may also result in stoppage or diversion of traffic on Toll Roads or delays in periodic maintenance and may also reduce productivity, thereby materially and adversely affecting our business, financial condition and results of operations.

16. ***Toll rates and collections and Toll Road traffic volumes are dependent on factors beyond our control and are subject to significant fluctuations.***

Revenue from toll receipts is affected by traffic volume and toll rates, both of which are beyond our control. The toll rate structure is laid down under National Highways Fee (Determination of Rates and Collection) Rules, 2008, as amended from time to time (the "**Fee Rules**"). The Fee Rules specify that the applicable toll rates specified thereunder shall be increased by three per cent. Each year along with an adjustment based on an increase in the wholesale price index (the "**WPI**"). We are not provided with any flexibility to adjust the toll rates as the rates are explicitly changed by the GOI in accordance with the Fee Rules. See "*—Toll collections are affected by applicable toll rates and revisions to such rates and the number of road users subject to such rates.*"

Traffic volumes on the Toll Roads and toll collections are directly and indirectly affected by a number of other factors beyond our control, including but not limited to:

- the growth of the Indian economy and the economic development of the states in which the Toll Roads are located as well as neighbouring states (the "**Project Influence Area**");
- restrictions on mining, or a decline in manufacturing or exports of commodities plying on the Toll Roads due to regulatory clampdowns or other reasons;
- the number and type of motor vehicles in operation and the cost of purchasing and operating motor vehicles, including financing costs, environmental law compliance costs, exchange rate fluctuations and fuel prices, in the Project Influence Areas;
- weather conditions, such as floods or torrential rain, acts of God, strikes or any other force majeure event, including epidemics, such as COVID-19, that could impair the safe operation of, restrict traffic access to, or prevent use of the Toll Roads;
- traffic on the roads providing access to and from the Toll Roads, or the physical condition of such roads, which hampers the ability of road users to gain access to and from the Toll Roads;
- the capacity and physical condition of the Toll Roads, or any structure forming part of the Toll Roads, such as bridges, bypasses or tunnels, and the need for maintenance and repair of parts or all of the Toll Roads, or any structure forming part of the Toll Roads, which may result in restricted or no access to the Toll Roads for material periods of time;
- overall security of the Toll Roads as managed by the relevant security contractors, including the possible threat of terrorist attacks on the Toll Roads or any of their free-standing structures;
- a change in the applicable toll policies or other applicable laws which affects any category of vehicle or fuel;
- changes to axle load norms in order to further increase the permissible axle load limits in India, which may adversely impact traffic growth along Indian national and state highways and cause accelerated deterioration of the condition of the pavement of the Toll Roads;
- the reactions of the public or other national or state government institutions to toll rate increases; and
- seasonal holidays.

In the event there is a significant decrease in traffic volume or change in toll rates on the Toll Roads, there may be a corresponding decrease in toll collections which could have a material adverse effect on our ability to meet our payment obligations under the Units.

17. ***We are subject to environmental, social and safety risks associated with the operation of the Toll Roads which could adversely affect our business, cashflows and our results of operations.***

We are subject to laws and government regulations, including in relation to safety, health, and environmental protection along with other environmental and social risks in relation to our Toll Roads. Environmental laws and regulations in India are becoming more stringent, and their effect on our operations, cannot be predicted with any certainty. Any failure on our part to comply with any existing laws applicable to us may result in legal proceedings being commenced against us, third party claims, or the levy of regulatory fines. Further, the operation and maintenance of the Toll Roads may require certain permissions and regulatory approvals, for instance, approvals from the Ministry of Environment, Forest and Climate Change of India for conducting activities such as to cut down trees. There is no assurance that such permissions and regulatory approvals will be granted in every event, which may have an adverse impact on the ability of the concessionaire to operate and maintain the Toll Roads. Additionally, there may be safety and other operational and maintenance risks arising from environmental and social events as well. For instance, in relation to Lakhnadon-Khawasa project, around 21.63 km of the highways' stretch passes through a wildlife protection area which has 14 underpasses for wild-life and noise barriers installed at the margin of the carriageway on both sides. However, since forested areas dominate both sides of the stretch due to its proximity to the Pench Tiger Reserve, the presence and movement of large carnivores including several species of conservational significance including tigers, leopard, sloth bears, etc. have been reported from this corridor. Considering measures such as animal underpasses and noise barriers have been constructed for uninterrupted movement of wildlife to cross the Lakhnadon-Khawasa project, There is no assurance that there will be no accidents due to roadkill which may have an impact on the operations of the Lakhnadon-Khawasa project. Further, Lakhnadon-Khawasa project will require prior permission from the Forest Department for undertaking O&M obligations, the Concessionaire may experience restricted hours for undertaking routine maintenance and allied activities, which may have an adverse impact on the Concessionaire's ability to discharge of O&M obligations stipulated in the Concession Agreement and may lead to the imposition of damages and penalties on the Concessionaire.

18. ***Leakage of the tolls collected on the Toll Roads may adversely affect toll collections.***

Toll collections are primarily dependent on the integrity of our toll collection system. Upon commencement of the concessions, the Toll Roads will be operated on an "open" toll collection system with different toll rates applicable to certain classes of vehicles; each motorist using a particular class of vehicle is charged a flat rate at the point of entry to the toll road regardless of the actual distance travelled.

The level of toll collections may be reduced by leakage through toll evasion, fraudulent acts on the part of road users or our toll collection operators, theft, technical faults in our toll collection systems, or unlawful roadway entries or exits by road users to avoid paying the required toll. To the extent we become aware of any routes available to road users to bypass the toll plazas, we may face delays in obtaining approval from the Sponsor to implement additional toll plazas to prevent such unauthorized entry or exit to the Toll Roads, which may adversely affect our revenue and our ability to meet our payment obligations under the Units. If toll collection is not adequately monitored, leakage may reduce toll collections. Although we expect to put in place systems and software, as well as deploy a number of toll plaza supervisors and security manpower, to minimize leakage through fraud and theft, if there is any significant failure in the efficiency or effectiveness of our collection practices or of the installed system software or any significant failure by us or our contractors to control leakage in toll collection, there could be a material adverse effect on our toll collections.

Furthermore, there may be situations where toll collection is disrupted or stopped, for example, due to public disturbances, or strikes or work stoppages as a result of disputes with local labour unions. Any such disruption or other stoppage of toll collection may interfere with our collection practices, resulting in increased leakage and reduced toll collections by us, which may adversely affect our revenue and our ability to meet our payment obligations under the Units.

19. ***The termination payment due to us upon termination of the Concession Agreements may not adequately compensate us for the actual costs and investments associated with the Toll Roads in a timely manner or at all and thus may not provide us with sufficient funds to repay the Units.***

The Concession Agreements may be terminated by us or the NHAI prior to their expiration for a number of reasons. For details, see "*—The Project SPVs Toll-Road Concession may be terminated prematurely under certain circumstances.*" On page 75. In the event that the early termination of the Concession Agreements is due to a breach by us, we are entitled to receive a termination payment equal to 70 per cent of the Unexpired Cash Flow (*as defined in the Concession Agreements*) in addition to remaining liable for costs and liabilities in relation to the Toll Roads. In the event that the early termination of the Concession Agreements is due to a breach by the NHAI, we are entitled to receive a contractually agreed termination amount equal to 105% of the the Unexpired Cash Flow (*as defined in the Concession Agreements*). As the termination payment payable to us in the event of a breach by us would be lower than what we would have otherwise been entitled to receive in the event that the Concession Agreements had not been terminated, we may not be adequately compensated for the actual costs

and investments associated with the Toll Roads and, therefore, may not be able to meet our payment obligations in relation to the Units or proposed debt issuance.

There is no assurance that any termination payment due to us will be paid in a timely manner or at all. Further, there are no precedents of termination payments being triggered in respect any other TOT projects in India. In the event of a delay in the disbursement of a termination payment by the Sponsor, in particular, if any dispute arises in respect of such payment, or in the event the Sponsor fails to make the termination payment at all, there may be insufficient funds available for us to meet our payment obligations under the Units.

20. ***Toll collections are affected by applicable toll rates and revisions to such rates and the number of road users subject to such rates.***

Under the terms of the Concession Agreements, the toll rates applicable to the Toll Roads are determined in accordance with the Fee Rules. The applicable toll rates shall be increased by 3 per cent. Each year and are subject to an adjustment in accordance with the Fee Rules on April 1 of each year based on the difference in the WPI between the week ending on January 6, 2007 and the week ending on or immediately after January 1 of such year of adjustment (the "**WPI Adjustment**"). The WPI Adjustment shall be restricted to 40 per cent of the increase in the WPI. In recent years, there has been little correlation between changes in the consumer price index (the "**CPI**") and the WPI, or between increases in the minimum wage and the WPI. As such, in the event of high CPI inflation or increased minimum wages, we may experience significantly higher operating costs, but there may be little variation in the WPI resulting in a muted increase in the applicable toll rate. As the determination of the applicable toll rates does not take account of changes in our operating, financing or other costs, there can be no assurance that the toll rates will be sufficient to cover any increase in such costs or that we will be able to implement any changes in the toll rates at the time or in the manner which we believe is in our best interest. Furthermore, an increase in the applicable toll rates may result in a reduction in overall toll collections if the higher toll rates cause a reduction in the traffic flow on the Toll Roads.

Our toll collections may also be affected by the level of exemptions, i.e. the number of road users required to pay the applicable toll rates when using the Toll Roads. The Concession Agreements provide that certain users of the Toll Roads are exempt from paying User Fees for non-commercial use of the roads, while frequent users are entitled to discounted fees to use the Toll Roads.

Any inability to introduce or any delay in introducing adjusted toll rates to address, among other things, changes to the economic environment, higher operating and maintenance costs, decreased revenue due to a decrease in traffic volume, or changes in exchange rates or consumer preferences, any increase in the toll rates causing a reduction in traffic volume, or any increase in the number of road users who are exempt from payment of user fees or entitled to discounted fees in respect of the Toll Roads, would have a material adverse effect on our toll collections and, therefore, our ability to meet our payment obligations under the Units.

21. ***Our revenues under the Transitional Support Agreement are dependent on successful continuation of underlying tolling contracts.***

The Sponsor, Project Manager and the Project SPV 2 have entered into a transitional support agreement dated March 7, 2024 for the purpose of the Sponsor providing transitional support to (i) the Project SPV 2 in respect of its O&M obligations and tolling obligations in relation to the R3 Concession Agreements; and (ii) the Project Manager in respect of its obligations under the Project Implementation and Management Agreement. As a result, the Sponsor is obligated, during the term of the Transitional Support Agreement, to undertake the tolling obligations/ tolling related responsibilities under and in compliance with the R3 Concession Agreement(s) on behalf of the Concessionaire. In furtherance of this, the Sponsor has entered into tolling contracts with certain third-party contractors in respect of the project highways under which these contractors pay the Sponsor a fixed contracted fee on a regular basis irrespective of the actual quantum of fee collected in respect of the project highway.

The Sponsor shall continue to operate tolling contracts on "as is basis" during the transition period from appointed date. Further, the remittance (which would be due to the Sponsor) under such tolling contracts would be credited directly to the Project SPV 2 on consummation of the transaction. All these tolling contracts have a defined period and have set expiry dates. Furthermore, some of these tolling contracts may expire during the period of transition. Additionally, the tolling contracts have a clause related to pre-mature termination in case of default by the third-party contractors. In either of these scenarios, the Sponsor could be required to enter into new contracts or extend such contracts, and the remittance amount from those renewed tolling contracts might be lesser than the current contracted amount. This could have a material adverse effect on our business, financial condition and prospects.

22. ***The operation of the Toll Roads and the revenues generated from them may be impacted as a result of any capacity augmentation or other works required to be carried out in accordance with the terms of the Concession Agreements or any RFPs floated by the Sponsor.***

The Sponsor has the right under the terms of the Concession Agreements to undertake, through a contractor, at its own cost, capacity augmentation of the Toll Roads. In connection with any capacity augmentation work in respect of the Toll Roads, the

toll fees shall be reduced to 75% during the period of construction in terms of the applicable fee rules. While in the case of R2 Toll Roads and R3 Toll Roads, any financial loss incurred by the concessionaire, during the period of such capacity augmentation, will be compensated for by the Authority on a quarterly basis to place the concessionaire in the same financial position that it would have enjoyed had there been no reduction in toll rates due to capacity augmentation, the same compensation shall not be provided to R1 Toll Roads. Considering there can be no assurance that construction work in relation to such capacity augmentation work will be completed in the expected time frames, any delay in capacity augmentation works shall have an adverse impact on the R1 Toll Roads, in turn, adversely impacting the revenue of the Trust.

In exercise of its rights relating to capacity augmentation under the Concession Agreements, the Sponsor may from time to time release Request for Proposals ("RFPs") for construction activities on the Toll Roads. For example, in August 2021, the Sponsor had released RFPs inviting bids for construction works on certain sections of the Belgaum Kagal Project. The RFPs contained the timeframe within which the construction would be completed and details of works to be completed during augmentation including the proposed structures like flyovers and bridges. There can be no assurance that the capacity augmentation or construction under future RFPs would be completed within the expected time frames. Further, the length of these structures would determine the permitted increase in Toll Fees that the concerned Project SPV would be entitled to charge upon successful completion of the construction. The actual increase in length of the structures and in turn, permitted increase in Toll Fees is dependent on several factors beyond our control, such as, the final length of the structures constructed under the RFPs.

Moreover, there can be no assurance that the criteria for capacity augmentation of any stretch shall be strictly in accordance with the Concession Agreements. In addition to the criteria stipulated in the Concession Agreements, capacity augmentation may also be carried out by the government of India based on economic and strategic requirements. As such, the capacity augmentation may be commenced prior to the stipulated time period as per the Concession Agreements. For instance, the capacity augmentation for a stretch of road that forms part of Kotha Kurnool Project Highway is proposed prior to the stipulated time period as per the Kotha Kurnool Concession Agreement by the Government of India as part of its strategic initiative of Bharatmala Pariyojana and preparation of Detailed Project Report (as defined in the Kotha Kurnool Concession Agreement) for completion of the same has already been initiated. Accordingly, the Concessionaire will have to bear the additional cost of operation and maintenance of the widened road and the same may or may not be reimbursed by the Authority. Further, in terms of Kotha Kurnool Concession Agreement, the Concessionaire is required to complete certain initial improvement works within a timeframe of 24 months from the Appointed Date. However, since capacity augmentation is being carried out for the Kotha Kurnool Project by the Authority, the Authority has instructed the Concessionaire to hold off on initial improvement works as the same may lead to duplicity and wastage of resources. Accordingly, the Authority may issue the Concessionaire a negative change of scope and may seek compensation for the same which shall have an adverse implication on our business and financial condition.

Further, in terms of the R2 and R3 Concession Agreements, the detailed project report for capacity augmentation may be commenced immediately once the average daily traffic has met the target traffic. Additionally, any increase in revenue due to increase in Equivalent Tollable Length (*as defined in the R2 and R3 Concession Agreements*) of the project highways shall be paid to NHAI on a quarterly basis. For further details in relation to the differences in the terms of R1 Concession Agreements, R2 Concession Agreements and R3 Concession Agreements, see "*Summary of Concession Agreements – Differences amongst the R1 Concession Agreements, R2 Concessions Agreements and R3 Concession Agreements*" on page 269.

23. ***Changes in the policies adopted by governmental entities or in the relationships of any member of the Trust with the Government or State Governments could materially and adversely affect our business, financial performance and results of operations.***

The Project SPV would be deriving almost all of its revenue from the Concession Agreements with the NHAI and must maintain good relationships and strategic alliances with the Sponsor, the Government and State Governments. We expect that we will continue to depend on, and benefit from, policies relating to the terms of the concessions in respect of the Project SPV's existing projects and any future projects. In addition, we expect to benefit from, and depend on, the Sponsor and various Government and State Government entities in terms of policies, incentives, budgetary allocations and other resources provided by these entities for the road industry in general. Any adverse change in any existing governmental policies, incentives, allocations or resources, or any change in our relationships with governmental entities, could materially and adversely affect our business, financial condition and results of operations.

Additionally, the Toll Roads may be subject to delays, extensive internal processes, policy changes, changes due to local, national and internal political pressures and changes in governmental or external budgetary allocation and insufficiency of funds. Since governmental entities are responsible for awarding concessions and are a party to the development and operation of the awarded projects, our business will be directly and significantly dependent on their support. Any withdrawal of support or adverse changes in their policies, even if not quantifiable monetarily, may lead to the Project SPV's agreements being restructured or renegotiated or the concession period being decreased, which could materially and adversely affect the Project SPV's financing, capital expenditure, revenues, development or operations.

24. ***The Valuation Reports, and any underlying reports, are not opinions on the commercial merits of the Trust or the Project SPVs, nor are they opinions, expressed or implied, as to the future trading price of the Units or the financial condition of the Trust upon listing, and the valuation contained therein may not be indicative of the true value of the Project SPV's assets.***

RBSA Valuation Advisors LLP has been appointed as the independent valuers (the "**Valuers**") to undertake independent appraisals of the Toll Roads. The Valuers have issued the Valuation Report in relation to the NEPPL as at December 31, 2023, included in **Annexure B** to this Placement Document, which sets out their opinion as to the fair enterprise value of NEPPL as on December 31, 2023. In order to issue their Valuation Reports, the Valuers based their assumptions regarding the traffic volume, toll rates, operation and maintenance costs, amortization, debt repayments and non-cash net working capital projections amongst other things, on information provided by and discussions with or on behalf of the Investment Manager, and which reflects current expectations and views regarding future events and, therefore, necessarily involves known and unknown risks and uncertainties. Please see the Valuation Report included in Annexure B to this Placement Document for a more detailed description of all assumptions relied upon in the preparation thereof. The Valuation Report contains forecasts, projections and other "forward-looking" statements that relate to future events, which are, by their nature, subject to significant risks and uncertainties. The future events referred to in these forward-looking statements involve risks, uncertainties and other factors which may cause the actual results or performance to be materially different from any future results or performance expressed or implied by the forward-looking statements.

The Valuation Reports are not an opinion on the commercial merits and structure of the Trust or the Project SPVs, nor is it an opinion, expressed or implied, as to the future trading price of the Units in or the financial condition of the Trust upon listing. The Valuation Reports does not purport to contain all the information that may be necessary or desirable to fully evaluate the Trust or the Project SPVs or an investment in the Trust or the Units. The Valuation Reports is not based on a comprehensive review of the business, operational or financial condition of the Project SPVs and, accordingly, makes no representation or warranty, expressed or implied, in this regard. The Valuation Reports does not confer rights or remedies upon investors or any other person, and does not constitute and should not be construed as any form of assurance as to the financial condition or future performance of the Trust or as to any other forward-looking statements included therein, including those relating to certain macro-economic factors, by or on behalf of the Investment Manager, the Project Manager, the Trust, or the Lead Managers. Further, we cannot assure you that the valuation prepared by the Valuers reflects the true value of the net future revenues of the Project SPVs or that other valuers would arrive at the same valuation. Accordingly, the valuation contained therein may not be indicative of the true value of the Project SPV's assets. The Valuation Reports have been issued as at February 9, 2024, but does not take into account any subsequent developments and should not be considered as a recommendation by the Investment Manager, the Project Manager, the Trust or the Lead Manager or any other party that any person should take any action based on the Valuation Reports. Accordingly, investors should not completely place on reliance on the Valuation Reports in making an investment decision to purchase Units in the Trust.

25. ***We have referred to the data derived from (i) Technical Consultant Report commissioned from the Technical Consultants, and (ii) Traffic Reports commissioned from the Traffic Consultants which are based on certain bases, estimates and assumptions that are subjective in nature and may not be accurate.***

We have appointed Samarth Infraengg Technocrats Pvt Ltd, Ramboll India Pvt Ltd and Egis India Consulting Engineers Pvt Ltd, independent third-party research agencies for undertaking technical due diligence of the R3 Toll Roads, as our technical consultants (the "**Technical Consultants**"). The Technical Consultants have prepared technical reports on the R3 Toll Roads, which are set out in **Annexure D** to this Placement Document (the "**Technical Report**").

We have appointed Steer Davies & Gleave India Private Limited, Ramboll India Pvt Ltd, and CRISIL Market Intelligence & Analytics as our traffic consultants ("**Traffic Consultants**") to prepare the detailed Traffic Consultant Reports and provide their analysis and forecast of traffic volumes for the R3 Toll Roads. The traffic reports are set out in **Annexure C** to this Placement Document (the "**Traffic Reports**").

Furthermore, we have also commissioned valuation reports dated February 9, 2024 in relation to NHIPPL and NEPPL issued by the Valuer, which sets out their opinion as to the fair enterprise value of the Toll Roads as on December 31, 2023. All of the Technical Reports, the Traffic Reports and the Valuation Reports (together referred to as "**Industry Expert Reports**") are subject to various limitations and are based upon certain bases, estimates and assumptions that are subjective in nature and that are based, in part, on information provided by and discussions with or on behalf of the Investment Manager. In particular, certain of the information we have provided the Traffic Consultants for the purposes of the Traffic Reports has been aggregated from data collected by third-party service providers. Although we believe such data to be accurate, we have not verified the information and cannot assure you that it is free from error. The Industry Expert Reports reflect current expectations and views regarding future events, and therefore, necessarily involve known and unknown risks and uncertainties. The Industry Expert Reports contain forecasts, projections and other "forward-looking" statements that relate to future events, which are, by their nature, subject to significant risks and uncertainties, including population growth, gross domestic product growth, vehicle ownership rates, per capita income, agricultural output and fuel consumption. The future events referred to in the Industry Expert Reports involve risks, uncertainties and other factors which may cause the actual traffic volumes to be materially different from any future traffic volumes expressed or implied by the Industry Expert Reports. There can be no assurance that the bases, estimates and assumptions adopted by the Technical Consultants, Valuer or the Traffic Consultants for the purposes of preparing their respective reports will prove to be accurate. If any of these traffic

assumptions are incorrect, future traffic volumes for the R3 Toll Roads could be materially different from those that are set forth in these reports and this Placement Document.

26. ***Certain provisions of the standard form of Concession Agreements may be untested, and the Concession Agreements may contain certain restrictive terms and conditions which may be subject to varying interpretations.***

The Concession Agreements that we have entered into is substantially based on a model concession agreement prescribed by the Sponsor. For example, the toll fees under the Concession Agreements is fixed, subject to annual adjustments to account for inflation as specified in the Concession Agreements. In addition, the operation and maintenance standards and specifications require the Project SPVs to incur operation and maintenance costs on a regular and periodic basis. The Concession Agreements also provide for a fixed term concession and, although our Concession Agreements provide for an extension or reduction of the concession period based on certain factors, including actual average toll collection on specified target dates, the Concession Agreements do not provide for renewal of the Concession Agreements after the expiry of the term.

The form of the Concession Agreements has evolved within the last decade and there is limited guidance available on the interpretation of a number of terms and conditions of the Concession Agreements. In addition, certain terms of the Concession Agreements, such as those related to an augmentation in the capacity of the toll roads, substitution of the Sponsor in any or all of the project agreements, termination payments by the Sponsor, construction of additional competing roads by the Sponsor, the Government or State Governments and payment of compensation by the Sponsor for changes in law are untested. Accordingly, the interpretation of certain terms and conditions in the Concession Agreements of the Project SPVs by the Sponsor, the courts or regulators may be different from our interpretation of such terms and conditions.

The terms and conditions of the Concession Agreements contain restrictive terms and conditions. For example, the Concession Agreements contain provisions that mandate substitution clauses in the project agreements. Such substitution clauses allow the Sponsor to step into project agreements in place of the Project SPVs in the event of suspension of the Project SPVs or termination of the Concession Agreements due to a breach or default by the Project SPVs. The Concession Agreements also provides that the lenders to a Project SPV may substitute the Project SPV with new entities approved by the Sponsor in the event of a default by the Project SPV under the relevant Concession Agreements or financing agreements. The terms of the Project SPV's Concession Agreements requires the Project SPV to indemnify the Sponsor for losses arising out of breach of the obligations of the Project SPV under the Concession Agreements.

In the event the Sponsor or a lender invokes any restrictive term or condition in the Concession Agreements, or the Sponsor, a court, or regulator interprets any term or condition in an adverse manner, such invocation or interpretation may materially and adversely affect our business, financial condition and results of operations.

27. ***We may be subject to increases in costs, including operation and maintenance costs, which we cannot recover by increasing toll fees under the Concession Agreements.***

The terms and conditions of the Concession Agreements are fixed and are not negotiable during the concession period. The costs of operating and maintaining the InvIT Assets may increase due to factors beyond the Project SPV's control, including, among other things:

- increase in the cost of labour, materials and insurance;
- the Project SPV being required to install intelligent toll-collection systems at their own costs;
- the Project SPV being required to restore their project roads in the event of any landslides, floods, road subsidence, other natural disasters, accidents or other events causing structural damage or compromising safety;
- increase in electricity tariff rates or other fuel costs resulting in an increase in the cost of energy;
- adverse weather conditions;
- unforeseen legal, tax and accounting liabilities relating to acquired assets; and
- other unforeseen operational and maintenance costs.

In the event that our costs increase, we may be unable to offset such increases with higher revenues by increasing toll fees due to the restrictions of the Concession Agreements.

Any significant increase in operation and maintenance costs beyond the amounts budgeted for by us, or any failure to meet quality standards, may reduce our profits, could expose us to penalties imposed by the concessioning authorities and could have a material, adverse effect on our business, financial condition and results of operations. Such events may also impact the ability of the Project SPVs to service the debt obtained from the Trust and our ability to make distributions to Unitholders. As such, the inability to change the terms and conditions, including the toll fees of the concession during the concession period, may materially and adversely affect our operational and financial flexibility.

28. ***We will depend on certain directors, executive officers and key employees of the Investment Manager, the Project Manager and the Project SPVs, and such entities may be unable to appoint, retain such personnel or to replace them with similarly qualified personnel, which could have a material, adverse effect on the business, financial condition, results of operations and prospects of the Trust.***

Our performance will depend, in part, upon the continued service and performance of certain directors, executive officers and key personnel of the Investment Manager, the Project Manager and the Project SPVs. The continued operations and growth of our business will be dependent upon the Investment Manager, the Project Manager and the Project SPVs being able to attract and retain personnel who have the necessary and required experience and expertise. There is a probability that the target talent pool may misrepresent about their experience and expertise. We cannot assure you that the parties to the Trust shall be able to identify such misrepresentation, if it occurs in future, in a timely manner.

Further, competition for qualified personnel with relevant industry expertise in India is intense due to the scarcity of qualified individuals in the toll-road business, and the aforesaid entities may not be able to retain their executive officers and key employees or attract and retain fresh talent in the future. Any inability by the Investment Manager, the Project Manager and the Project SPVs to retain their directors, executive officers and key employees, or the inability to replace such individuals with similarly qualified personnel, could have a material, adverse effect on the business, financial condition, results of operations and prospects of the Trust.

29. ***There can be no assurance that we will be able to successfully undertake future acquisitions of road assets or efficiently manage the infrastructure road assets we have acquired or may acquire in the future.***

Our growth strategy in the future may involve strategic acquisitions of toll roads and other road assets. We may not be able to identify or conclude appropriate or viable acquisitions in a timely manner. The success of our past acquisitions and any future acquisitions will depend upon several factors, including:

- our ability to identify, finance and acquire operational toll roads and other road assets on a cost-effective basis;
- our ability to integrate acquired personnel, operations, products and technologies into our organisation effectively;
- unanticipated problems or legal liabilities of the acquired businesses; and
- tax or accounting issues relating to the acquired businesses.

There can be no assurance that we will be able to achieve the strategic purpose of such acquisitions or operational integration or an acceptable return on such investments, which may materially and adversely affect our profits, financial condition and distributions.

Furthermore, Concession Agreements for future toll-road projects may also contain terms and conditions that are more restrictive than those under the current Project SPV's Concession Agreements for the Toll Roads. These restrictions may restrict our flexibility in managing our business or projects and could in turn materially and adversely affect our business prospects, financial condition and results of operations.

30. ***The Project SPVs may not be able to comply with their maintenance obligations under the Concession Agreements, which may result in the termination of the Concession Agreements, the suspension of the Project SPV's rights to collect tolls or the requirement that the Project SPV pay compensation or damages to the Sponsor.***

The Project SPVs are required to undertake operation and maintenance of the Toll Roads within periods and in the manner as specified in the Concession Agreements. There can be no assurance that the Project SPVs will not breach the maintenance obligations under the Concession Agreements on account of the Project Manager's failure to undertake the stipulated maintenance work in a timely manner, or at all.

If any Project SPV is in breach or default of its obligations, then the NHAI has the right to (a) suspend the right of the Project SPV, including the right to collect tolls and other fees, (b) claim compensation for all direct, additional costs suffered or incurred by the Sponsor arising out of such default, or (c) terminate the Concession Agreements. Further, the Rewa – Lakhnadon, Chichra-Kharagpur, Orai – Barah , Chitradurga Bypass – Hubli Project/ Karnataka, and Lakhnadon – Mahagaon (Mohgaon) – Khawasa projects are currently being operated and maintained by various concessionaires/EPC contractors under their respective contractual agreements. These projects shall be handed over to the Trust as per the O&M handover schedule stipulated under the respective concession agreements. While the subsisting agencies EPC contractors are required to ensure compliance of the performance obligations relating to each of the projects mentioned above, above and the Seller is obligated to handover the asset as per the stipulated specifications, at the time of O&M Handover, however there is no assurance that the subsisting agencies and EPC contractors will not default in discharging their obligations. In such an event, the Trust could incur additional costs to remedy such defects and deficiencies to meet its performance obligations under the respective concession agreement(s). Accordingly, there may be a potential claims against the non-fulfilment of divesture or defect liability period obligations by the existing engineering, procurement and construction contractors which may have an impact on the results of operations and business of the Trust.

If the Concession Agreements are terminated, the right to collect tolls is suspended or the Project SPV is required to pay compensation or damages, our business, financial condition and results of operations may be materially and adversely affected. For further details of the maintenance obligations, suspension and termination events under the Concession Agreements, see the section headed "*Summary of the Concession Agreements*" on page 232 of this Placement Document.

31. ***The insurance policies for the R3 Toll Roads are not currently in place for any protection against various risks associated with our Operations in relation to R3 Toll Roads and any future insurance coverage obtained may be inadequate.***

The Investment Manager, on behalf of the Trust, has obtained insurance policies for the R1 Toll Roads and the R2 Toll Roads in relation to risks related to fire, act of burglary or theft, earthquake, an act of theft or terrorism or interruption of business due to petrochemical or non-petrochemical risks. However, we cannot assure that the policies that have been obtained shall adequately cover the loss. We also cannot assure that we will be able to renew the policies from time to time.

In relation to the R3 Toll Roads, the insurance policies are currently not in place. Under the terms of the R3 Concession Agreements entered into for the tolling rights for the R3 Toll Roads, such tolling rights would be granted as on and with effect from the appointed date which shall occur upon the conditions specified in the R3 Concession Agreements which would be subsequent to the allotment of the Units pursuant to the Issue. As such, obtaining adequate insurance would only be undertaken on or after the appointed date under the R3 Concession Agreements and we have currently not obtained insurance for the R3 Toll Roads.

There can be no assurance that all risks in relation to R3 Toll Roads shall be adequately insured against or that we will be able to procure adequate insurance coverage at commercially reasonable rates in the future.

Further the Toll Roads/InvIT Assets are subject to various risks that we may not be insured against, adequately or at all, including:

- changes in governmental and regulatory policies;
- shortages of, or adverse price movement for, construction materials;
- design and engineering defects;
- breakdown, failure or substandard performance of the road assets and other equipment;
- improper installation or operation of the road assets and other equipment;
- labour disturbances;
- terrorism and acts of war;
- inclement weather and natural disasters;
- environmental hazards, including earthquakes, flooding, tsunamis and landslides; and
- adverse developments in the overall economic environment in India.

Further, we are subject to various risks in the operation of the Toll Roads, including on account of accidents on the Toll Roads. Any insurance obtained for R3 Toll Roads may not provide adequate coverage in certain circumstances and is subject to certain deductibles, exclusions and limits on coverage. To the extent we suffer damage or loss which is not covered by insurance, or exceed our insurance coverage, such damage or loss would have to be borne by us. We can make no assurance that material losses in excess of insurance proceeds (if any at all) will not occur in the future, which could materially and adversely affect our financial condition, business and results of operations.

32. ***The Sponsor and the Trustee are involved in certain legal and other proceedings, which may not be decided in their favour.***

The Sponsor, certain of its Associates and the Trustee are involved in legal proceedings or claims which are pending at different levels of adjudication before various courts, tribunals and regulatory authorities. For details of certain material outstanding legal proceedings, see the section headed "*Legal and Other Information"* on page 318 of this Placement Document. There is no assurance that these legal proceedings and regulatory matters will be decided in favour of the respective entities. Decisions in any of the aforesaid proceedings adverse to our interests may have a material adverse effect on our or their business, future financial performance and results of operations. If the courts or tribunals rule against the Sponsor or its Associates or the Trustee, we or the Sponsor may face monetary and/or reputational losses and may have to make provisions in our financial statements, which could increase expenses and liabilities.

33. ***We do not own the "NHAI" trademark and logo. Our license to use the "NHAI" trademark and logo may be terminated under certain circumstances and our ability to use the trademark and logo may be impaired.***

We do not own the "NHAI" trademark and "NHAI" logo, which is a trademark currently applied for by the Sponsor and which has been accepted and advertised by the Trademark Registry, Government of India. However, pursuant to a separate trademark license agreement dated September 26, 2022, the Sponsor has granted to the Trust, the non-transferable and non-assignable right to use the name of NHAI as part of the trade name of the Trust, as well as the Sponsor's trademarks ("**Trademarks**") in connection with the business of the Trust, on a non-exclusive basis, for the use in the Republic of India and globally. On the expiry of the license on September 26, 2023, the Trust has entered into a Trademark License Agreement dated March 5, 2024. The license granted to the Trust in terms of the Trademark License Agreement shall be for a term of 1 (one) year from March 5, 2024. The Trust's right to use the Trademarks shall stand terminated with immediate effect if any of the terms of the license are breached. The Trust is using the Sponsor's logo pursuant to the terms of the aforesaid trademark license agreement, and does not separately hold any trademarks in its name. The termination or failure to register its logo as a

trademark in a timely manner may have a material, adverse effect on the operations of the Trust and require management's time and attention.

34. ***We will depend on NHAI and various third parties to undertake certain activities in relation to the operation and maintenance of the InvIT Assets. Any delay, default or unsatisfactory performance by these third parties could materially and adversely affect our ability to effectively operate or maintain the InvIT Assets.***

We will depend on the availability and skills of NHAI and third-party employees and contractors pertaining to the operation and maintenance of the InvIT Assets. Under the Transitional Support Agreement, NHAI will provide support pertaining to the operation and maintenance of the R3 Toll Roads. When the Transitional Support Agreement expires, i.e. after a period of six months commencing from the appointed date as per the respective Concession Agreements, we will need to appoint third-party entities to undertake operations and maintenance and tolling, and the terms of these future contracts may not be favourable to us. We can also make no assurance that the services of such third parties will continue to be available at reasonable rates in the areas in which we conduct our operations. We may also be exposed to risks relating to the ability of such third parties to obtain requisite approvals for the operation and maintenance activities, as well as the quality of their services, equipment and supplies. In particular, failure to ensure the reliability and sustainability of toll collectors who are required to man the toll booths continuously may materially and adversely affect our overall level of net revenue. We may also be exposed to civil and criminal liability in relation to the actions of other third parties, including our employees and contractors.

Further, if we undertake limited development, while we may sub-contract our construction work, we may still be liable for accidents on our projects due to defects in design and quality of construction of our projects during their construction and operation. In addition, we can make no assurance that such contractors or their sub- contractors will continue to hold or renew valid registrations under the relevant labour laws in India or be able to obtain the requisite approvals for undertaking such construction and operation. Any delay, default or unsatisfactory performance by these third parties could materially and adversely affect our ability to manage the operation and maintenance of the InvIT Assets under the Concession Agreements in a timely manner or at all. Any of the foregoing factors could have a material, adverse effect on our business, financial condition, reputation and results of operations.

35. ***The completion certificate and provisional completion certificate in respect of one of the R1 Toll Roads are not traceable and accordingly, alternate documents have been relied upon in relation to certain disclosures made in this Placement Document.***

The Authority is unable to trace the completion certificate and provisional completion certificate in respect of one of the R1 Toll Roads. Under these circumstances, we have relied on alternative documents such as the defects liability certificate dated May 17, 2010, issued by M/s Stanley Consultants Inc. in joint venture with M/s RITES Limited, certifying completion of all works on April 27, 2010, and the Technical Reports in respect of Chittorgarh to Kota section in Rajasthan for upgrading of NH-76 of east west corridors undertaken by NHAI ("**Chittorgarh – Kota Project Highway**"). We cannot assure you that the information relating to completion of the works in connection with the Chittorgarh – Kota Project Highway included in "*Regulatory Approvals*", as disclosed on page 262 of the Final Placement Memorandum available at https://www.sebi.gov.in/filings/invit-private-issues/nov-2021/national-highways-infra-trust_53956.html are true and accurate.

36. ***The Trust and the Project SPVs are subject to government regulation and if there is a failure to obtain, maintain or renew statutory and regulatory licenses, permits, and approvals required to operate the business, results of operations and cash flows may be adversely affected.***

The Trust and the Project SPVs may be required to obtain and maintain a number of statutory and regulatory licenses, permits and approvals for carrying out the business and acquiring new projects, including consents to establish and operate under environmental laws, which are granted for a limited duration and require renewal. We cannot assure you that such approvals will be issued or granted to us in a timely manner, or will be granted at all. The R3 Toll Roads to be acquired by the Trust are completed and revenue generating assets. The Sponsor, by way of its letter dated March 6, 2024 in relation to the R3 Toll Roads has confirmed that it had obtained all the necessary approvals and clearances required during the construction stage of the R3 Toll Roads.

Further, we shall obtain all other material permits, registrations, licenses, approvals, consents and other authorizations as may be required upon acquisition of the R3 Toll Roads. For details, see "*Regulatory Approvals*" on page 317. If we do not receive such approvals or are not able to renew the approvals in a timely manner, our business and operations may be materially adversely affected.

37. ***Significant differences exist between Indian GAAS used to prepare the Sponsor's Audited Financial Information and other accounting principles, such as Ind-As and IFRS, with which investors may be more familiar.***

The Sponsor has prepared its Audited Financial Information in accordance with Indian GAAS in accordance with the NHAI Act and the rules thereunder. The Sponsor has not attempted to quantify the impact of Ind-As or International Financial Reporting Standards ("**IFRS**") on the Audited Financial Information, nor will the Sponsor provide a reconciliation of our financial statements to those of IFRS or Ind-As. If we were to prepare our Audited Financial Information in accordance with such other accounting principles, our results of operations, financial condition and cash flows may be substantially different.

Accordingly, the degree to which the Sponsor's Audited Financial Information will provide meaningful information is entirely dependent on your level of familiarity with Indian accounting practices under Indian GAAS. Any reliance by persons not familiar with such accounting practice on our financial disclosures presented in this Placement Document should accordingly be limited. Persons not familiar with Indian accounting practices should, accordingly, consult their own professional advisors before relying on the financial disclosures presented in this Placement Document.

Risks Related to the Trust's Relationships with the Sponsor and the Investment Manager

38. ***The Investment Manager may not be able to implement its investment or corporate strategies and the fees payable to the Project Manager are dependent on various factors.***

The Investment Manager's strategies focus on three main areas:

- managing the underlying assets of the Trust;
- managing the Trust's acquisitions and disposals; and
- managing the Trust's capital structure to maximize distributions.

There is no assurance that the Investment Manager will be able to implement these strategies successfully or that it will be able to expand our portfolio at any specified rate or to any specified size or to maintain distributions at projected levels. The Investment Manager may not be able to make acquisitions or investments on favourable terms or within a desired time frame, and it may not be able to manage the operations of its underlying assets in a profitable manner. Factors that may affect this risk may include, but are not limited to, changes in the regulatory framework in India, competition for assets, partial award of concessions or licenses favouring local or other competitors of the Trust, changes in the Indian regulatory or legal environment or macro-economic conditions. If the Investment Manager is unable to implement these strategies successfully or expand our portfolio, we will nonetheless be required to pay the Investment Manager an annual management fee, exclusive of taxes, in accordance with the terms of appointment of the Investment Manager.

Even if the Investment Manager is able to successfully grow the operating business of the underlying assets and to acquire toll roads and other eligible infrastructure projects in India as desired, there can be no assurance that the Investment Manager will achieve its intended return on such acquisitions or capital investments. Furthermore, the Investment Manager's investment mandate involves a higher level of risk as compared to a portfolio which has a more diverse range of investments. The Investment Manager may only be removed by a resolution of Unitholders (excluding the Sponsor) such that the votes cast in favour of the resolution are not less than one-and-a-half times the votes cast against the resolution.

Further, the fees payable to the Project Manager may vary each year based upon the operating and maintenance work that is actually required to be undertaken by the Project Manager with respect to the Project SPV, and accordingly, cannot be a flat rate or decided upfront for all periods and hence may lead to potential disagreements between Trust and Project Manager. Additionally, any such payment of fees will be in the nature of a related party transaction and the approval of Unitholders will be required prior to making such a payment to the Project Manager. For further information, please see "*Overview of the Trust*" on page 24 of this Placement Document.

39. ***While the Sponsor had communicated its intention of transferring around 1500 km of roads, the Trust may be unable to bid effectively for them.***

In accordance with the approval granted by the Chairman of NHAI, by way of communication dated March 29, 2021, the Sponsor will offer around 1,500 km of roads in three years to the Trust. The Sponsor has transferred 247 km of roads by way of R2 Concession Agreements dated September 26, 2022. The Sponsor has further transferred 888.65 km of roads by way of R3 Concession Agreements.

There can be no assurance that the Trust will be able to accurately or effectively assess the Future Assets on the basis of the information to it or in the time available, and its bids may provide to be uncompetitive. Furthermore, the Sponsor may accept or reject any binding offer made by the Trust, based on various factors regarding which the Trust may have no influence.

Access to future toll road assets sourced by the Sponsor or its existing or future subsidiaries will be an important source of growth in the future for the Trust, and any inability to bid competitively for Future Assets or the inability to win contracts from the Sponsor for their operation for any reason could have a material adverse effect on the Trust's operations, financial condition or prospects.

40. ***Parties to the Trust are required to maintain the eligibility conditions specified under Regulation 4 of the InvIT Regulations on an ongoing basis. The Trust may not be able to ensure such ongoing compliance by the Sponsor, the Sponsor Group, the Investment Manager, the Project Manager and the Trustee, which could result in the cancellation of the registration of the Trust.***

Each of the parties to the Trust are required to maintain the eligibility conditions specified under Regulation 4 of the InvIT Regulations on an ongoing basis. These eligibility conditions include, among other things, that (a) the Sponsor, Investment Manager and Trustee are separate entities, (b) the Sponsor has a net worth of not less than ₹ 1,000 million and has a sound

track record in the development of infrastructure or fund management in the infrastructure sector, (c) the Investment Manager has a net worth of not less than Rs. 100 million and has not less than five years' experience in fund management or advisory services or development in the infrastructure sector or the combined experience of the directors, partners and employees of the investment manager in fund management or advisory services or development in the infrastructure sector is not less than 30 years, (d) the Trustee is registered with the SEBI under Securities and Exchange Board of India (Debenture Trustees) Regulations, 1993 and is not an associate of the Sponsor or Investment Manager and I each of the Sponsor, Sponsor Group, Investment Manager, Project Manager and Trustee are "fit and proper persons" as defined under Schedule II of the Intermediaries Regulations on an ongoing basis. The Trust may not be able to ensure such ongoing compliance by the Sponsor, the Investment Manager, the Project Manager and the Trustee, which could result in the cancellation of the registration of the Trust.

Further, in terms of Regulation 4(2)(e)(v) of the InvIT Regulations, the Investment Manager should, inter-alia, have not less than half of its directors as independent directors. As on the date of this Placement Document, the IM Board consists of eight directors out which four are independent directors. For details, please see "*Parties to the Trust – The IM Board*" on page 110.

41. ***The Investment Manager is required to comply with certain ongoing reporting and management obligations in relation to the Trust. There can be no assurance that the Investment Manager will be able to comply with such requirements.***

The Investment Manager is required to comply with certain ongoing reporting and management obligations in relation to the Trust in accordance with the InvIT Regulations. These requirements include, among other things, (a) making investment decisions with respect to the underlying assets or projects of the Trust, (b) overseeing the activities of the Project Manager, (c) investing and declaring distributions in accordance with the InvIT Regulations, (d) submitting reports to the Trustee, (e) ensuring the audit of the Trust's accounts. There can be no assurance that the Investment Manager will be able to comply with such requirements in a timely manner or at all, which could subject the Investment Manager, the other parties to the Trust, the Trust or any person involved in the activity of the Trust to applicable penalties under the InvIT Regulations, the Intermediaries Regulations and/or the SEBI Act. Any such failure to comply or the imposition of any penalty could have a material adverse effect on our business, financial condition and results of operations. Under the InvIT Regulations, the SEBI also has the right to inspect documents, accounts and records relating to the activity of the Trust, Project SPVs or parties to the InvIT and may issue directions in the nature of, *inter alia*, (i) requiring the Trust to delist its Units and surrender its certificate of registration; (ii) requiring the Trust to wind-up; (iii) requiring the Trust to sell its assets; (iv) requiring the Trust or parties to the Trust to take such action as may be in the interest of investors; or (v) prohibiting the Trust or parties to the Trust from operating in the capital market or from accessing the capital market for a specified period.

42. ***Our Investment Manager is wholly-owned and controlled by the GoI, which makes us susceptible to changes to its policies.***

The Investment Manager is currently wholly-owned and controlled by the President of India acting through the Ministry of Road Transport and Highways ("**MORTH**"). Accordingly, the GoI will be able to exercise significant influence over the Investment Manager, its policies and affairs. Although, by way of its letter dated July 12, 2022, MORTH has communicated that the Investment Manager can manage its affairs as per its corporate governance framework and may recruit, compensate and remove the human resources as per the policies approved by the Nomination and Remuneration Committee of the IM Board, we cannot assure that the GoI will not change its policies in the times to come. Further, the GoI may require the Investment Manager to take actions aimed at serving the public interest, which may not be aligned with the commercial objectives of the unitholders.

Risks related to India

43. ***Changing laws, rules and regulations and legal uncertainties may materially and adversely affect our business, financial condition and results of operations.***

Our business, financial condition and results of operations could be materially and adversely affected by any change in laws or interpretations of existing, or the promulgation of new, laws, rules and regulations applicable to us and our business. There can be no assurance that the Government or State Governments will not implement new regulations and policies which will require the Trust Group to obtain additional approvals and licenses from governmental and other regulatory bodies or impose onerous requirements and conditions on our operations. The Investment Manager cannot predict the terms of any new policy, and there can be no assurance that such policy will not be onerous.

44. ***Significant increases in the price or shortages in the supply of crude oil and products derived therefrom, including petrol and diesel fuel, could materially and adversely affect the volume of traffic at the projects operated by the Project SPVs and the Indian economy in general, including the infrastructure sector.***

India imports a significant majority of its requirements of crude oil. Crude oil prices are volatile and are subject to a number of factors, including the level of global production and political factors, such as war and other conflicts, particularly in the Middle East, where a substantial proportion of the world's oil reserves are located. Any significant increase in the bitumen price or shortages in the supply of crude oil could materially and adversely affect the volume of traffic at the projects operated

by the Project SPVs and materially and adversely affect the Indian economy in general, including the infrastructure sector, which could have a material, adverse effect on our business, financial condition and results of operations. Further, any increase in the prices of bitumen may lead to a potential increase in the cost of repairs, maintenance and major maintenance works carried out by the Project SPVs and adversely affect the financial conditions and results of operations of the Trust.

45. ***We may be affected by competition law in India and any adverse application or interpretation of the Competition Act could materially and adversely affect our business.***

The Competition Act, 2002, as amended (the "**Competition Act**"), regulates practices having an appreciable adverse effect on competition in the relevant market in India. Under the Competition Act, any formal or informal arrangement, understanding or action in concert, which causes or is likely to cause an appreciable adverse effect on competition is considered void and results in the imposition of substantial monetary penalties. Further, any agreement among competitors which directly or indirectly involves the determination of purchase or sale prices, limits or controls production, supply, markets, technical development, investment or provision of services, shares the market or source of production or provision of services by way of allocation of geographical area, type of goods or services or number of customers in the relevant market or directly or indirectly results in bid-rigging or collusive bidding is presumed to have an appreciable adverse effect on competition. The Competition Act also prohibits abuse of a dominant position by any enterprise.

On March 4, 2011, the Government issued and brought into force the combination regulation (merger control) provisions under the Competition Act with effect from June 1, 2011. These provisions require acquisitions of shares, voting rights, assets or control or mergers or amalgamations that cross the prescribed asset-and turnover-based thresholds to be mandatorily notified to and pre-approved by the Competition Commission of India (the "**CCI**"). Additionally, on May 11, 2011, the CCI issued the Competition Commission of India (Procedure in regard to the transaction of business relating to combinations) Regulations, 2011, as amended, which set out the mechanism for implementation of the merger control regime in India. The Competition Act aims to, among other things, prohibit all agreements and transactions which may have an appreciable adverse effect on competition in India. Further, the CCI has extra-territorial powers and can investigate any agreements, abusive conduct or combination occurring outside India if such agreement, conduct or combination has an appreciable adverse effect on competition in India.

The Government of India has also introduced the Competition (Amendment) Bill, 2022 in the Lok Sabha in August 2022, which has proposed several amendments to the Competition Act, such as introduction of deal value thresholds for assessing whether a merger or acquisition qualifies as a "combination", expedited merger review timelines, codification of the lowest standard of "control" and enhanced penalties for providing false information or a failure to provide material information. As these are draft amendments, we cannot ascertain at this stage as to whether the proposed amendments will come into force in the form suggested or at all, their applicability in respect of our operations, partially or at all once they come into force, or the extent to which the amendments, if and when they come into force, will result in additional costs for compliance, which in turn may adversely affect our business.

In the event, the Project SPVs or the Trust enters into any agreements or transactions that have an appreciable adverse effect on competition in the relevant market in India, the provisions of the Competition Act will be applicable. Further, while, pursuant to our analysis, we may determine that no applications to the CCI for relevant approvals in relation to such transactions are required to be made, we cannot assure you that the CCI will not take a different view. In the event such applications are not made, or such approvals are not granted, in a timely manner or at all, it may result in, amongst other things, penalties being imposed against the Trust. Any penalties levied under the Competition Act or adverse orders issued could materially and adversely affect our financial condition and results of operations. Any adverse impact on our financial condition or operations due to the Competition Act may have a material adverse impact on our business, financial condition, results of operations and prospects and our ability to make distributions to the Unitholders.

46. ***Any downgrading of India's debt rating by rating agencies could have a negative impact on our business.***

India's sovereign rating has been affirmed to Baa3 with a "stable" outlook by Moody's and BBB- with a "stable" outlook (Fitch); and BBB (low) "stable" by Dominion Bond Rating Service ("**DBRS**"). India's sovereign ratings from S&P is BBB- with a "stable" outlook. India's sovereign rating could be downgraded due to various factors, including changes in tax or fiscal policy or a decline in India's foreign exchange reserves, which are outside our control. Any adverse revisions to India's credit ratings by rating agencies may adversely affect our ability to raise additional financing, and the interest rates and other terms at which such additional financing is available. This could materially and adversely affect our ability to obtain financing for capital expenditure, which could in turn materially and adversely affect our business, prospects, financial condition, results of operations and cash flows. India's sovereign debt rating could be downgraded due to various factors, including changes in tax or fiscal policy or a decline in India's foreign exchange resources, which are outside our control.

47. ***We are subject to risks associated with outbreaks of diseases or similar pandemics or public health threats, such as the novel coronavirus ("COVID-19"), which could have a material adverse impact on our business and our results of operations and financial condition.***

In the past, various contagious diseases have spread throughout the world, including India where the entire operations of Sponsor or the Toll Roads are located. In the recent past, beginning in late 2019 and continuing in 2020, 2021 and 2022, the global spread of COVID-19 has created significant economic and political volatility and uncertainty and business disruption.

The spread of COVID-19 has led to governments around the world to take various measures such as the implementation of incoming and outgoing travel restrictions, voluntary and mandatory cessations of business operations, mandatory quarantines and work-from-home and other alternative working arrangements, curfews, limitations on social and public gatherings and partial lockdowns of cities or regions in order to limit the virus' spread. The spread of COVID-19 and governmental responses have resulted in worker absences, reduced business productivity, other business disruptions, reduced demand and stagnated economic activity in India and around the world. The ultimate extent of COVID-19 on our business, financial condition and results of operations will depend on future developments, which are highly uncertain and cannot be predicted. More generally, any epidemic, pandemic or other health crisis, whether similar to COVID-19, SARS, H1N1, MERS or other past global diseases, could materially and adversely affect our business, financial condition and results of our operations.

Risks Related to Ownership of the Units

48. ***The Trust may be dissolved, and the proceeds from the dissolution thereof may be less than the amount invested by the Unitholders.***

The Trust is an irrevocable trust registered under the Registration Act and it may only be extinguished (i) if it is impossible to continue with the Trust or if the Trustee, on the advice of the Investment Manager, deems it impracticable to continue with the Trust; (ii) on the written recommendation of the Investment Manager and upon obtaining the prior written consent of such number of the Unitholders as is required under the InvIT Regulations; (iii) if the Units of the Trust are delisted from the Stock Exchanges; (iv) if the SEBI passes a direction for the winding up of the Trust or the delisting of the Units; or (v) in the event the Trust becomes illegal. Under the Trust Deed, in the event of dissolution, the net assets of the Trust, remaining after settlement of all liabilities, and the retention of any reserves which the Trustee deems to be necessary to discharge contingent or unforeseen liabilities, shall be paid to the Unitholders. Should the Trust be dissolved, depending on the circumstances and the terms upon which assets of the Trust are disposed of, there is no assurance that a Unitholder will recover all or any part of his investment.

49. ***The reporting requirements and other obligations of infrastructure investment trusts post-listing are still evolving. Accordingly, the level of ongoing disclosures made to and the protection granted to Unitholders may be more limited than those made to or available to the shareholders of a company that has listed its equity shares upon a recognized stock exchange in India.***

The InvIT Regulations, along with the guidelines and circulars issued by the SEBI from time to time, govern the affairs of infrastructure investment trusts in India. However, as compared to the statutory and regulatory framework governing companies that have listed their equity shares upon a recognized stock exchanges in India, the regulatory framework applicable to infrastructure investment trusts is relatively nascent and thus, still evolving. Pursuant to a circular dated November 29, 2016, the SEBI has prescribed certain continuous disclosure requirements that will be applicable to an InvIT after listing of its units.

Accordingly, the ongoing disclosures made to Unitholders under the InvIT Regulations may differ from those made to the shareholders of a company that has listed its equity shares upon a recognized stock exchange in India in accordance with the Securities and Exchange Board of India (Listing Obligations and Disclosure Requirements) Regulations, 2015. Further, the rights of the Unitholders may not be as extensive as the rights of the shareholders of a company that has listed its equity shares upon a recognized stock exchange in India, and accordingly, the protection available to the Unitholders may be more limited than those available to such shareholders.

50. ***Any additional debt financing or issuance of additional Units may have a material, adverse effect on the Trust's distributions, and your ability to participate in future rights offerings may be limited.***

The Investment Manager may require additional debt financing or the issuance of additional Units in order to support the operating business or to make acquisitions and investments. If obtained, any such additional debt financing may decrease distributable income, and any issuance of additional Units may dilute existing Unitholders' entitlement to distributions.

We are not required to offer pre-emptive rights to existing Unitholders when issuing new Units. Compliance with securities laws or other regulatory provisions in some jurisdictions may prevent certain investors from participating in any future rights issuances and thereby result in dilution of their existing holdings in Units.

51. ***The Trust may be unable to dispose of its non-performing assets in a timely manner.***

Due to the nature of its structure, the Trust may be unable to dispose of its non-performing assets in a timely manner, or at all. As a result, no assurance can be given that the Trust may be able to adapt to market developments, changes in asset quality, or adverse macroeconomic factors in a way comparable to, or competitive with, its competitors or more traditional corporate entities in general. Any ability to dispose of non-performing assets may in turn adversely affect the financial condition, business and prospects of the Trust, as well as distributions that the holders of the Units may receive from the Trust.

52. ***Fluctuations in the exchange rate of the Indian Rupee with respect to the U.S. Dollar or other currencies will affect the foreign currency equivalent of the value of the Units and any distributions.***

Fluctuations in the exchange rates between the Indian Rupee and other currencies will affect the foreign currency equivalent of the Indian Rupee price of the Units. Such fluctuations will also affect the amount that holders of the Units will receive in foreign currency upon conversion of any cash distributions or other distributions paid in Indian Rupees by us on the Units, and any proceeds paid in Indian Rupees from any sale of the Units in the secondary trading market.

53. ***Unitholders are unable to require the redemption of their Units.***

Unitholders will not have the right to redeem Units or request or require the redemption of Units by the Investment Manager while the Units are listed on the Stock Exchanges, although the Trust Deed provides that the Investment Manager may repurchase Units at its sole discretion if it has obtained the prior approval of Unitholders in a general meeting by passing an ordinary resolution in accordance with the Trust Deed but subject to other requirements of the relevant laws, regulations and guidelines imposed by authorities in India.

54. ***The units of the Trust have a limited history of being publicly traded and the listing of the Units, pursuant to this Issue, on the Stock Exchanges may not result in an active or liquid market for the Units.***

The Units of the Trust are currently not frequently traded. There is a limited public market for the Units prior to the Issue and an active public market for the Units may not develop or be sustained after the Listing Date. Listing and quotation does not guarantee that a trading market for the Units will develop or, if a market does develop, that there will be liquidity of that market for the Units. Accordingly, prospective Unitholders should view the Units as illiquid and must be prepared to hold their Units for an indefinite length of time.

55. ***Any future issuance of Units by us or sales of Units by the Sponsor or any of other significant Unitholders may materially and adversely affect the trading price of the Units.***

The Trust proposes to undertake the issue of Units to the Sponsor, on a preferential basis ("**Preferential Issue**"), in accordance with the SEBI Institutional Placement Guidelines and the InvIT Regulations. The IM Board by way of its resolution dated February 10, 2024 and the Unitholders of the Trust by way of their resolution dated March 4, 2024, have approved the Issue of upto 497,926,090 Units at or above ₹ 122.86 per Unit ("**Base Price**"). The Trust proposes to undertake the issue of up to 117,159,080 Units to the Sponsor, on a preferential basis ("**Preferential Issue**"), in accordance with the SEBI Institutional Placement Guidelines and the InvIT Regulations. The Unitholders by way of a resolution dated March 4, 2024 have approved the Preferential Issue. The Sponsor, by way of its letter dated March 6, 2024, had confirmed its willingness to subscribe to atleast 87,869,310 Units, at a base offer price of ₹ 122.86 per Unit plus premium payable, if any. Further, the Sponsor, by way of its letter dated March 14, 2024 has agreed to subscribe to 87,869,400 Units at a price of ₹ 124.14 per Unit pursuant to the Preferential Issue.

The Preferential Issue by us could dilute investors' holdings of Units. Any such future issuance of Units may also materially and adversely affect the trading price of the Units, and could impact our ability to raise capital through an offering of our securities. There can be no assurance that we will not issue further Units. In addition, any perception by investors that such issuances might occur could also affect the trading price of the Units.

Further, the Units are tradable on the Stock Exchanges. If the Sponsor (following the lapse of its lock-up arrangements or pursuant to any applicable waivers), directly or indirectly, sells or is perceived as intending to sell a substantial number of its Units, or if a secondary offering of the Units is undertaken, the market price for the Units could be materially and adversely affected. These sales may also make it more difficult for us to raise capital through the issue of new units at a time and at a price we deem appropriate.

56. ***Our rights and the rights of the Unitholders to recover claims against the Investment Manager or the Trustee are limited.***

Under the Investment Management Agreement, the Investment Manager is not liable for, among other things, any action or omission, if it has carried out its duties and exercised its powers with reasonable skill and care expected of an investment manager (except in the case of fraud, negligence or wilful misconduct). Pursuant to the Trust Deed, the Trustee is not liable for anything done or omitted to be done or suffered by the Trustee in good faith. Further, the Trustee is not liable for any action or omission that results in any depletion in the value of the trust fund and consequent losses of the Unitholder, except in situations where such depletion is a result of the gross negligence or wilful default on the part of the Trustee. The Investment Management Agreement provides that the Investment Manager is entitled to be indemnified out of the Trust Fund against all taxes and other liabilities, claims, costs, losses, damages and expenses (including reasonable attorney's fees and costs) ("**Losses**") incurred in connection with the Trust, unless arising out of gross negligence, dishonest acts or commissions or omissions, wilful misfeasance, reckless disregard of duty or breach of duties under the Investment Management Agreement. As a result, the Trust's rights and the rights of the Unitholders to recover claims against the Investment Manager are limited. Furthermore, recourse to the Trustee may be limited under the Trust Deed. The Trust Deed provides for the indemnification of the Trustee and the Investment Manager for all Losses, except Losses incurred due to any gross negligence, default, breach of duty or trust, or a failure to show a requisite degree of diligence and care. Accordingly, the liability of the Investment Manager and the Trustee are limited under the terms of these agreements and the Unitholders may

not be able to recover claims against the Trustee or the Investment Manager, including claims with respect to any offer documents relating to the Issue.

Further, pursuant to the Trust Deed, the Trustee is not under any obligation to institute, acknowledge the service of, appear in, prosecute or defend any action, suit, proceeding or claim, which in its opinion might involve it in expense or liability that exceeds the value of the fund. The Trust (acting through the Trustee) and the Investment Manager intend to apply the proceeds of the Issue towards the objects set out in this Placement Document. Accordingly, the Net Proceeds may not be sufficient to recover claims, including claims with respect to any offer documents in relation to the Issue.

57. ***Information and the other rights of Unitholders under Indian law may differ from such rights available to equity shareholders of an Indian company or under the laws of other jurisdictions.***

The Trust Deed and various provisions of Indian law govern our corporate affairs. Legal principles relating to these matters and the validity of corporate procedures, fiduciary duties and liabilities, and Unitholders' rights may differ from those that would apply to a company in India or a trust in another jurisdiction. Unitholders' rights and disclosure standards under Indian law may also differ from the laws of other countries or jurisdictions. See the section headed "*Rights of Unitholders*" on page 335 of this Placement Document.

58. ***Under Indian law, foreign investors are subject to restrictions that limit their ability to transfer or redeem Units, which may adversely impact the trading price of the Units.***

Under foreign exchange regulations currently in force in India, transfers of Units between non-residents and residents are permitted, subject to certain limited exceptions, if they comply with the pricing and reporting requirements specified by RBI. If a transfer of Units is not compliant with such pricing or reporting requirements and does not fall under any of the exceptions specified by RBI, then RBI's prior approval is required.

Additionally, Unitholders who seek to convert Indian rupee proceeds from a sale of Units in India into foreign currency and repatriate that foreign currency from India require a no-objection or a tax clearance certificate from the Indian income tax authorities.

We cannot assure you that any required approval from RBI or any other Governmental agency can be obtained on any particular terms or in a timely manner, or at all.

Our Unitholders will not have the right to redeem or request the redemption of our Units while our Units are listed on the Stock Exchanges. In terms of the InvIT Regulations, an infrastructure investment trust may redeem Units only by way of a buyback or at the time of delisting of Units and may be subject to additional conditions and restrictions under Indian regulations.

59. ***There is no assurance that our Units will remain listed on the Stock Exchanges. There is a risk pertaining to low or no trading of Units on stock exchanges which directly affects any investor's ability to either sell their units entirely, or sell/exit in a timely manner.***

Although it is currently intended that the Units will remain listed on the NSE and the BSE, there is no guarantee of the units of the Trust not being compulsorily delisted due to among other factors, us not continuing to satisfy the listing requirements of the Stock Exchanges. Accordingly, Unitholders will not be able to sell their Units through trading on the Stock Exchanges if the Units are no longer listed on the Stock Exchanges. In accordance with the InvIT Regulations and Chapter 11 of the Master Circular for Infrastructure Investment Trusts dated July 6, 2023 issued by the SEBI in relation to the manner and mechanism of providing exit option to dissenting Unitholders pursuant to Regulation 22(5C) and Regulation 22(7) of the InvIT Regulations, we are required to provide investors with an exit prior to delisting. Further, under the InvIT Regulations, we are required to maintain a minimum of 20 Unitholders at all times after the listing of the Units and certain minimum public holding. Failure to maintain such minimum number of Unitholders or public holding may result in action being taken against us by SEBI and the Stock Exchanges, including the compulsory delisting of our Units. Further, Investors in this Issue are not permitted to sell the Units Allotted to them for a period of one year from the date of Allotment, except on a recognized stock exchange. An active trading market for the Units may not sustain and there may be low or no active market for our Units on the Stock Exchanges, including due to factors beyond our control. In such an event, an investor may not be able to sell their Units, acquired through this Issue or otherwise, in a timely manner or at all.

60. ***The price of the Units may decline after the Listing Date.***

The Issue Price has been determined by the Investment Manager in consultation with the Lead Managers. The Issue Price may not be indicative of the market price of the Units upon completion of the Listing. The market price of the Units may also be highly volatile and could be subject to wide fluctuations. If the market price of the Units declines significantly, investors may be unable to resell their Units at or above their purchase price, if at all. There can be no assurance that the market price of the Units will not fluctuate or decline significantly in the future. The market price of the Units will depend on many factors, including, among others:

- the perceived prospects of our business and investments and the market for toll roads and other infrastructure projects;
- differences between our actual financial and operating results and those expected by investors and analysts;

- the perceived prospects of future toll roads and other infrastructure projects that may be added to our portfolio in accordance with our investment mandate;
- changes in research analysts' recommendations or projections;
- changes in general economic or market conditions;
- the market value of our assets;
- the perceived attractiveness of the Units against those of other business trusts, equity or debt securities;
- the balance of buyers and sellers of the Units;
- the size and liquidity of the Indian business trusts market;
- any changes to the regulatory system, including the tax system, both generally and specifically in relation to India business trusts;
- the ability of the Investment Manager to implement successfully its investment and growth strategies;
- foreign exchange rates;
- broad market fluctuations, including increases in interest rates and weakness of the equity and debt markets;
- variations in our quarterly operating results;
- difficulty in assessing our performance against either domestic or international benchmarks, as there are few listed comparables;
- publication of research reports about us, other road businesses, the road industry in general or other relevant sectors, or the failure of securities analysts to cover the Units after the Total Issue;
- additions or departures of key management personnel of the Trust and/or the Trust Group;
- changes in the amounts of our distributions, if any, and changes in the distribution payment policy or failure to execute the existing distribution policy;
- actions by Unitholders;
- changes in market valuations of similar business entities or companies;
- announcements by us or our competitors of significant contracts, acquisitions, disposals, strategic partnerships, joint ventures or capital commitments;
- speculation in the press or investment community; and
- changes or proposed changes in laws or regulations affecting the road industry and infrastructure development in India or enforcement of these laws and regulations, or announcements relating to these matters.

To the extent that we retain operating cash flow for investment purposes, working capital reserves or other purposes, these retained funds, while increasing the value of our underlying assets, may not correspondingly increase the market price of the Units. Our failure to meet market expectations with regard to future earnings and cash distributions may materially and adversely affect the market price of the Units.

Where new Units are issued at less than the market price of the Units, the value of an investment in the Units may be affected. In addition, Unitholders who do not, or are not able to, participate in the new issuance of Units may experience a dilution of their interest in the Trust. In addition, the Units are not capital-safe products and there is no guarantee that Unitholders can regain the amount invested, in full or in part. If the Trust is extinguished, it is possible that investors may lose a part or all of their investment in the Units.

Risks Related to Tax

61. ***Unitholders should consider the impact of U.S. Foreign Account Tax Compliance Act withholding.***

Pursuant to certain provisions of the U.S. Internal Revenue Code of 1986, commonly known as FATCA, a "foreign financial institution" may be required to withhold on certain payments it makes ("foreign passthru payments") to persons that fail to meet certain certification, reporting, or related requirements. A number of jurisdictions, including India, have entered into, or have agreed in substance to, intergovernmental agreements with the United States to implement FATCA ("**IGAs**"), which modify the way in which FATCA applies in their jurisdictions. Certain aspects of the application of the FATCA provisions and IGAs to instruments such as the Units, including whether withholding would ever be required pursuant to FATCA or an IGA with respect to payments on instruments such as the Units, are uncertain and may be subject to change. Even if withholding would be required pursuant to FATCA or an IGA with respect to payments on instruments such as the Units, proposed regulations have been issued that provide that such withholding would not apply prior to the date that is two years after the date on which final regulations defining "foreign passthru payments" are published in the U.S. Federal Register. In the preamble to the proposed regulations, the U.S. Treasury Department indicated that taxpayers may rely on these proposed regulations until the issuance of final regulations. Holders should consult their own tax advisors regarding how these rules may apply to their investment in the Units.

62. ***The Trust may be classified as a passive foreign investment company for U.S. federal income tax purposes, which could subject U.S. holders of Units to significant adverse tax consequences.***

The Trust may be classified as a passive foreign investment company ("**PFIC**") for a particular taxable year if, after the application of certain "look-through" rules, either (i) 75% or more of its gross income is "passive income" as that term is defined in the relevant Code provisions or (ii) 50% or more of the value (determined on the basis of a quarterly average) of its

assets are considered "passive assets" (generally, assets that generate “passive income” or are held for the production of “passive income”). The determination of PFIC status is an annual determination, cannot be made until the close of a taxable year, involves extensive factual investigation, including ascertaining the fair market value of all assets on a quarterly basis and the character of each item of income earned, and is subject to uncertainty in several respects. The Trust has not made, and does not expect to make, any determination as to its potential classification as a PFIC during any taxable year. If the Trust were to be treated as a PFIC, material adverse tax consequences could result for U.S. Holders (as defined below under “Tax Considerations—United States”), including with respect to any gain realized on the sale, exchange or disposition of the Units and on the receipt of certain “excess distributions” received with respect to the Units, and certain additional reporting requirements may apply. U.S. Holders should consult their own tax advisers regarding the potential application of the PFIC rules.

63. ***Tax laws are subject to changes and differing interpretations, which may materially and adversely affect our operations.***

The current tax laws and regulations in India provide certain exemptions to interest income earned by business trusts from a special purpose vehicle as a result of which the InvIT and subsequently the Unitholders would be subject to relatively lower tax liabilities. These exemptions could be modified or removed at any time or clarified in a manner adverse to Unitholders, which could adversely affect our profitability and the amount available for distribution to Unitholders.

Tax laws and regulations are subject to differing interpretations by tax authorities. Differing interpretations of tax and other fiscal laws and regulations may exist within governmental ministries, including tax administrations and appellate authorities, thus creating uncertainty and potential unexpected results. The degree of uncertainty in tax laws and regulations, combined with significant penalties for default and a risk of aggressive action by the governmental or tax authorities, may result in tax risks in the jurisdictions in which we operate being significantly higher than expected. For instance, while the Investment Manager intends to take measures to ensure that it is in compliance with all relevant tax laws, there is no assurance that the tax authorities will not take a position that differs from the position taken by us with regard to our tax treatment of various items. Any of the above events may result in a material, adverse effect on our business, financial condition, results of operations and/or prospects and our ability to make distributions to the Unitholders. Tax authorities in India may also introduce additional or new regulations applicable to our business which could adversely affect our business and profitability.

Further, the tax authorities in India may not agree with the positions adopted by the Project SPVs or by the Trust, and may take a divergent view with respect to allowability of any expense (including interest payment) or in relation to taxability of any income during the assessment proceedings, if any. This may adversely affect the profitability of Project SPVs and Trust, and may affect the ability to make distributions to the Unitholders.

64. ***Changes in legislation or the rules relating to such tax regimes and surcharges could materially and adversely affect our business, prospects and results of operations.***

The GoI announced the union budget for the Fiscal Year 2024 and the Finance Act, 2023 (“Finance Act 2023”) was notified with effect from April 1, 2023.

The Finance Act 2023, provides for tax on the unitholders for such portion of distribution received by them that is not covered under section 10(23FC) or 10(23FCA) of the IT Act and that which is not chargeable to tax under section 115UA(2) of the IT Act. Any distribution not covered under the aforementioned clauses will be taxed in the hands of the unitholders as ‘income’ under section 56(2)(xii) of the IT Act, provided the amount received (including similar distributions in earlier years to the same unitholder or any other unitholder) is in excess of the amount at which units were issued by the InvIT, as reduced by the amount which would have been charged to tax earlier under this provision. The aforementioned amounts received by a unitholder being a specified person covered under section 10(23FE) of the IT Act shall not be subject to taxes upon the fulfilment of certain conditions set out in the IT Act. Further, any such distribution received by a unitholder to the extent not chargeable to tax under section 56(2)(xii) and not covered under sections 10(23FC), 10(23FCA) or 115UA(2) shall be reduced from the cost of units. We cannot assure you that there will be no adverse impact on the tax incidence to the unitholders pursuant to the Finance Act 2023. For details, please see section entitled *“Taxation”* on page 349.

Further, by way of the Finance Act, 2021 the GoI, amongst others, amended the Securities Contracts (Regulation) Act, 1956 (“SCRA”) to recognise pooled investment vehicles and recognise the units, debentures, other marketable securities and other instruments issued by InvITs as “securities”. The Finance Act, 2021 exempted the payment of tax deducted at source on dividends paid to InvITs.

The Finance Act, 2020 amended the definition of ‘business trusts’, and also abolished the dividend distribution tax regime as applicable to companies and shifted the incidence of taxation of dividend on the shareholder or unitholders.

There had been two key reforms in Indian tax laws, namely the introduction of the Goods and Services Tax (“**GST**”) and provisions relating to general anti-avoidance rules (“**GAAR**”). The GST regime came into effect on July 1, 2017, combining taxes and levies by the Government and State Governments into a unified rate structure.

Additionally, there is limited clarity on the availability of input tax credit, and any unfavourable orders in this regard may have a material adverse impact on our financial position and cash flows. Further, any application of existing law or future amendments may affect our overall tax efficiency, and may result in significant additional taxes becoming payable.

Tax laws and regulations are subject to differing interpretations by tax authorities. Differing interpretations of tax and other fiscal laws and regulations may exist within governmental ministries, including tax administrations and appellate authorities, thus creating uncertainty and potential unexpected results. The degree of uncertainty in tax laws and regulations, combined with significant penalties for default and a risk of aggressive action by the governmental or tax authorities, may result in tax risks being significantly higher than expected.

The GAAR regime came into effect on April 1, 2017. The GAAR regime is a broad set of provisions which grant powers to India tax authorities to invalidate any arrangement for tax purposes in the event, the main purpose of entering into the transaction by the taxpayer is to obtain a tax benefit. Besides the "tax benefit", the transaction should meet any one of the following specified additional tests: (i) creates rights, or obligations, which are not ordinarily created between persons dealing at arm's length; (ii) results, directly or indirectly, in the misuse, or abuse, of the provisions of the IT Act; (iii) lacks commercial substance or is deemed to lack commercial substance as prescribed under the IT Act in whole or in part; and (iv) is entered into, or carried out, by means which are, or in a manner which is, not ordinarily employed for bona fide purposes.

Such transactions are declared as impermissible avoidance arrangements and the consequence in relation to tax arising from such arrangements, including denial of a tax benefit or a benefit under a tax treaty, shall be determined according to the circumstances of the case. The rules notified with respect to GAAR prescribe that these shall not be applicable to FIIs in accordance with the SEBI (Foreign Institutional Investors) Regulations, 1995 subject to the fulfilment of certain conditions. In the absence of any precedents on the subject, the application of these provisions is uncertain. GAAR may have a material adverse tax impact on the Trust, the Sponsor and the Unitholders.

In respect of non-residents, the tax rates and the consequent taxation mentioned under Statement of Tax Benefits shall be further subject to any benefits available under the applicable DTAA, if any, between India and the country in which the non-resident has fiscal domicile. Further, it is pertinent to meet the terms and condition viz. Principal purpose test, beneficial ownership test etc. as enacted in DTAAs entered into by India with various countries based on Multilateral Convention to implement tax treaty related measures to prevent Base Erosion and Profit Shifting ('MLI').

Further, pursuant to amendments introduced by Finance Act, 2022, the applicability of section 94(7) of the IT Act has been extended to the units of business trust (with effect from Financial Year 2022-23), which provides in certain situation, loss, if any, arising from the sale and purchase of securities and units, to the extent of dividend or income received or receivable on such securities or unit, shall be ignored for computing income chargeable to tax. The Finance Act, 2022 has also extended the applicability of section 94(8) of the IT Act (commonly known as bonus stripping) to the units of business trusts (with effect from Financial Year 2022-23), which provides certain other situations where loss, if any, arising from the sale and purchase of all or any of the units shall be ignored for computing income chargeable to tax and notwithstanding anything contained in any other provision of the IT Act, the amount of loss so ignored shall be deemed to be the cost of purchase or acquisition of such additional units referred to in clause (ii) above as are held on the date of such sale or transfer.

The Investment Manager has not determined the impact of such existing or proposed legislations on our business. We may incur increased costs relating to compliance with any new requirements, which may also require management time and other resources, and any failure to comply may adversely affect our business, results of operations and prospects. Uncertainty in the applicability, interpretation or implementation of any amendment to, or change in, governing law, regulation or policy, including by reason of an absence, or a limited body, of administrative or judicial precedent may be time consuming as well as costly for us to resolve, and may impact the viability of our current business or restrict our ability to grow our business in the future.

65. ***The Ministry of Finance, GoI, has constituted a task force to draft new direct tax legislation, the provisions of which may have an unfavourable implication for us.***

The Ministry of Finance, GoI, has set up a panel to review the Income Tax Act and to draft a new direct tax legislation ("**Panel**"). The Panel has been tasked with drafting appropriate direct tax legislation aimed at (i) aligning India's domestic direct tax regime in line with international best practices; and (ii) ensuring and encouraging compliance. The impact of the report by the Panel, including findings and recommendations in their report and the provisions of the proposed direct tax legislation could have an unfavourable implication on us. Since the Panel and its report, including their recommendations and the draft of the new direct tax legislation has not been released yet, the possible impact on us is cannot be determined at this point in time.

66. ***Investors may be subject to Indian taxes arising out of capital gains on the sale of Units and on any dividend or interest component of any returns from the Units.***

Under current Indian tax laws, units of a business trust held for more than 36 months are considered as long term capital assets. In case of sale of such units through a recognised stock exchange in India and payment of securities transaction tax ("**STT**"), any gain arising in excess of ₹ 0.10 million is subject to long term capital gains tax at a concessional rate of 10%

(plus applicable surcharge and cess). However, if the said units are sold in any other manner, the entire gain shall be subject to long term capital gains tax at the rate of 20% with indexation benefit (plus applicable surcharge and cess).

In case the units are held for less than or up to 36 months, the same shall be regarded as short term capital asset. Any gain arising in case of sale of such units through a recognised stock exchange in India and subject to payment of STT, is subject to short term capital gains tax at concessional rate of 15% (plus applicable surcharge and cess). However, if the said units are sold in any other manner, the same shall be subject to short term capital gains tax at applicable tax rates of the holder (plus applicable surcharge and cess).

The aforesaid taxability in India is subject to tax treaty benefits in the case of a non-resident holder. Further, the applicable taxes on the sale of ordinary units, if any, and on any dividend or interest component of any returns from the unit will also be subject to the category of investor holding or selling the Ordinary Units.

The Finance Act, 2020 amended the Income Tax Act to abolish the dividend distribution tax regime and shift the incidence of taxation of dividend (declared or distributed on or after April 1, 2020) to shareholder. Under the Finance Act, 2020, a distribution made by a business trust, being in nature dividend income received from a special purpose vehicle, will not be subject to tax in the hands of a unitholder, so long as the special purpose vehicle has not opted to pay corporate tax under the beneficial regime introduced under Section 115BAA of the Income Tax Act. Similarly, a business trust (which includes an infrastructure investment trust) will not be required to withhold tax on any distributions which are in the nature of dividend income received from a special purpose vehicle, so long as such special purpose vehicle has not opted to pay corporate tax under the beneficial regime introduced under Section 115BAA of the Income Tax Act. However, where the special purpose vehicle opts to pay tax under Section 115BAA of the Income Tax Act, dividend income distributed by the business trust would be taxed in the hands of a non-resident unitholder at 20% (plus applicable surcharge and cess) or the applicable treaty rate and at the ordinary rate for a resident unitholder. Further, the business trust would be required to withhold tax on such distributions made from dividend received from the special purpose vehicle. Thus, the taxability of dividends distributed by the Trust will depend on the taxation regime opted by the Project SPVs.

It may also be noted that in terms of Section 194LBA (1) of the IT Act, any distributable income in the nature of interest income and dividend income (where the Project SPV has opted to pay corporate tax under the beneficial regime introduced under Section 115BAA of the IT Act) in the hands of a resident investor is subject to deduction of tax at the rate of 10%. Similarly, in terms of Section 194LBA (2) of the IT Act, any distributable income in the nature of interest income and dividend income (where the SPV has opted to pay corporate tax under the beneficial regime introduced under Section 115BAA of the IT Act) in the hands of a non-resident is subject to deduction of tax at the rate of 5% (plus applicable surcharge and cess) and 10% (plus applicable surcharge and cess) respectively. The ultimate tax liability in the hands of the Unitholder may depend on various factors/ considerations.

The Finance Act 2023, as amended, proposes to tax the unitholders for such portion of distribution received by them that is not covered under section 10(23FC) or 10(23FCA) of the IT Act and that which is not chargeable to tax under section 115UA(2) of the IT Act. Any distribution not covered under the aforementioned clauses is proposed to be taxed in the hands of the unitholders as 'income' under section 56(2)(xii) of the IT Act, provided the amount received (including similar distributions in earlier years to the same unitholder or any other unitholder) is in excess of the amount at which units were issued by the InvIT, as reduced by the amount which would have been charged to tax earlier under this provision. The aforementioned amounts received by a unitholder being a specified person covered under section 10(23FE) of the IT Act shall not be subject to taxes upon the fulfilment of certain conditions set out in the IT Act. Further, any such distribution received by a unitholder to the extent not chargeable to tax under section 56(2)(xii) and not covered under sections 10(23FC), 10(23FCA) or 115UA(2) is proposed to be reduced from the cost of units.

Furthermore, the Trust might not be able to pay or maintain the levels of distributions or ensure that the level of distributions will increase over time, or that future acquisitions will increase the Trust's distributable free cash flow to the Unitholders. Any reduction in, or elimination or taxation of, payments of distributions could materially and adversely affect the market price of the Units.

67. ***The income of the Trust in relation to which pass through status is not granted under the IT Act may be chargeable to Indian taxes.***

Under the provisions of the IT Act, the total income of the Trust other than capital gains, interest and dividend income from the Project SPVs would be taxable at the maximum marginal rate ("**MMR**"). MMR is defined under the provisions of the IT Act to mean the rate of income-tax (including surcharge on income-tax, if any) applicable in relation to the highest slab of income.

In accordance with Section 115UA of the IT Act, the MMR applicable to the Trust, a separately assessable resident entity, is 30.0% (plus applicable surcharge and cess). However, the tax authorities may view the Trust as a "pass through" entity and the applicable tax rate will be the MMR applicable to its beneficiaries. If any beneficiary is chargeable to MMR at a rate higher than the rate applicable to other beneficiaries, the income of the Trust attributable to the share of such beneficiary will be taxed at a higher applicable rate. For example, if any Unitholder is a non-resident, the MMR of 40.0% (plus applicable surcharge and cess) would apply. As there are divergent views, there is a possibility that the matter may be litigated if the tax authorities subscribe to the latter view.

GENERAL INFORMATION

National Highways Infra Trust

National Highways Infra Trust ("**Trust**") was settled on October 19, 2020, in New Delhi pursuant to the Trust Deed as a contributory irrevocable trust in accordance with the Indian Trusts Act, 1882. The Trust was registered with SEBI on October 28, 2020, under Regulation 3(1) of the InvIT Regulations and has obtained a certificate of registration from SEBI bearing number IN/InvIT/20-21/0014. The principal place of business of the Trust is situated at G - 5 & 6, Sector 10, Dwarka, New Delhi – 110 075.

The Trust is an infrastructure investment trust established for making investments in special purpose vehicles as defined under Regulation 2(1)(zy) of the InvIT Regulations, or infrastructure projects or securities of Indian companies engaged in the infrastructure sector, as may be permitted in terms of Regulation 18(5) of the InvIT Regulations. For information on the background of the Trust and the description of the InvIT Assets, please see the sections entitled "*Overview of the Trust*" and "*Our Business*" on pages 24 and 153, respectively.

Compliance Officer of the Trust

The Compliance Officer is Gunjan Singh. Her contact details are as follows:

Gunjan Singh
Address: G-5 & 6
Sector – 10, Dwarka
New Delhi 110 075
Tel: +91 11 2507 4100 Extn: 1671
E-mail: cs.nhim@nhit.co.in

Bidders can contact the Compliance Officer or the Registrar to the Issue in case of any pre- Issue or post- Issue related problems such as non-receipt of Allotment Advice/letter of Allotment, non-credit of Allotted Units in the respective beneficiary account, non-receipt of refund orders and non-receipt of funds by electronic mode.

The Sponsor – National Highways Authority of India

Head office and address for correspondence*:*

G-5 & 6
Sector – 10, Dwarka
New Delhi 110 075

Contact Person of the Sponsor

NRVVMK Rajendra Kumar is the contact person of the Sponsor. His contact details are as follows:

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The Investment Manager - National Highways Infra Investment Managers Private Limited

Registered office and address for correspondence*:*

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Contact Person: Suresh Goyal

The Project Manager – National Highways InvIT Project Managers Private Limited

Registered office and address for correspondence

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Tel: +91 11 2507 4100/1318
Contact Person: Shri Akhil Khare

The Trustee – IDBI Trusteeship Services Limited

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Con tact Person: Deepak Kumar / Mahendra Singh Chouhan
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Other Parties involved in the Trust

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E-mail: nhitinvit@icicisecurities.com
Investor Grievance E-mail: customercare@icicisecurities.com
Contact Person: Sumit Singh/ Rupesh Khant
Website: www.icicisecurities.com
SEBI Registration Number: INM000011179

Escrow Bank

Axis Bank Limited
Axis House, 6th Floor,
C-2, Wadia International Centre,
Pandurang Budhkar Marg,

Worli, Mumbai 400 025,
Maharashtra, India
Tel.: 022 24253672
Email: vishal.lade@axisbank.com
Website: www.axisbank.com
Contact Person: Vishal M. Lade
SEBI Registration No.: INBI00000017

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5th Floor, Peninsula Chambers
Peninsula Corporate Park
Ganpatrao Kadam Marg
Lower Parel
Mumbai 400 013
Tel: +91 22 2496 4455

Indian legal counsel to the Lead Managers

J. Sagar Associates
One Lodha Place, 27th Floor,
Senapati Bapat Marg, Lower Parel, Mumbai 400 001
Tel: +91 22 4341 8600

International Legal counsel to the Trust and the Sponsor as to United States Federal Securities law

Linklaters Singapore Pte. Ltd.
One George Street #17-01,
Singapore 049145
Tel: +65 6692 5700

Registrar and Transfer Agent

KFin Technologies Limited
Selenium, Tower B
Plot No. 31 & 32, Financial District
Nanakramguda, Serilingampally
Hyderabad, Rangareddi 500 032
TG, India
Tel: 040 6716 2222/ 7961 1000
E-mail: srinivassudheer.venkatapuram@kfintech.com
Investor Grievance E-mail: einward.ris@kfintech.com
Website: www.kfintech.com
Contact Person: Srinivas Sudheer Venkatapuram
SEBI Registration No.: INR000000221

Credit Rating Agencies

CARE Ratings Limited
32, Titanium, Prahaladanagar Corporate Road,
Satellite, Ahmedabad- 380015
Tel.: 079-40265656, 91-85111 90079
Fax: 079-40265657
Email: Maulesh.desai@careedge.in
Website: www.careratings.com
Contact Person: Mr. Maulesh Desai
SEBI Registration No.: IN/CRA/004/1999

India Ratings and Research Private Limited
Wockhardt Towers, 4th Floor, West Wing,
Bandra Kurla Complex, Bandra (E)
Mumbai-400 051
Tel.: 022-40001700
Fax: 022-40001701
Email: infogrp@indiaratings.co.in
Website: www.indiaratings.co.in

Contact Person: Rishabh Jain
SEBI Registration No.: IN/CRA/002/1999

Details of credit ratings

The Trust has been given a rating by Care Ratings Limited of (a) 'Care AAA/Stable' for existing long-term facilities of Rs. 2,850 crore, bank facilities and issuer rating on February 14, 2024, the rationale for which is available at its website www.careratings.com/upload/CompanyFiles/PR/202402120226_National_Highways_Infra_Trust.pdf; (b) 'Care AAA/Stable' for the long-term facilities of Rs. 1,500 crore, non-convertible debentures on February 14, 2024, the rationale for which is available at its website www.careratings.com/upload/CompanyFiles/PR/202402120226_National_Highways_Infra_Trust.pdf; and (c) 'Provisional Rating - Care AAA/Stable' for the proposed long-term facilities of Rs. 9,000 crore, bank facilities and issuer rating on February 14, 2024, the rationale for which is available at its website www.careratings.com/upload/CompanyFiles/PR/202402120226_National_Highways_Infra_Trust.pdf; and by India Ratings and Research Private Limited of (a) 'IND AAA/Stable' for public issue of non-convertible debentures aggregating up to ₹ 1,500 crore on March 4, 2024; the rationale for which is available at its website, https://www.indiaratings.co.in./pressrelease/68669 (b)'IND AAA/Stable' as long-term issue rating; (c) 'IND AAA/Stable' for rupee term loan of ₹ 2,850 crore on March 4, 2024; the rationale for which is available at its website, https://www.indiaratings.co.in./pressrelease/68669 and (d) 'Provisional Rating - IND AAA/Stable' for proposed rupee term loan of ₹ 4,500 crore on March 2, 2024; the rationale for which is available at its website https://www.indiaratings.co.in./pressrelease/68669

It is clarified that the details available on these websites do not form a part of this Placement Document.

PARTIES TO THE TRUST

A. The Sponsor and Sponsor Group – National Highways Authority of India

History and Certain Corporate Matters

NHAI is an autonomous body under MoRTH, and was established on June 15, 1989, by the NHAI Act, as a body corporate, having a perpetual succession and common seal. It was made operational in February, 1995, with the appointment of the Chairman and other Members. NHAI is responsible for the development, maintenance and management of the national highways in India entrusted to it by the Central Government.

NHAI has an all India presence through its different offices (regional offices/project implementation units/corridor management units) in different cities. The functioning of NHAI is governed by NHAI Act, and the rules and regulations framed thereunder.

Background of the Sponsor

NHAI is an autonomous body under Ministry of Road, Transport and Highways. It is established and governed by the NHAI Act. NHAI is not a company in terms of the Companies Act, 2013 (or in terms of the Companies Act, 1956), and accordingly, does not have a share capital.

Pursuant to Section 17 of the NHAI Act, NHAI may receive additional capital and grants from the Central Government to discharge its functions. Additionally, NHAI has not issued any shares against such capital or grants invested by the Central Government.

As per Section 3(3) of the NHAI Act, NHAI shall consist of: (i) a chairman; (ii) not more than six full-time members; and (iii) not more than six part-time members, and each of the above shall be appointed by the Central Government by notification in the official gazette.

In accordance with the eligibility criteria specified under the InvIT Regulations, NHAI had a shareholders' fund of not less than ₹ 1,000 million as on March 31, 2023.

Further, none of the members of the Sponsor are fugitive economic offenders as declared under section 12 of the Fugitive Economic Offenders Act, 2018.

B. The Trustee – IDBI Trusteeship Services Limited

History and Certain Corporate Matters

IDBI Trusteeship Services Limited is the Trustee of the Trust. The Trustee is a registered intermediary with SEBI under the Securities and Exchange Board of India (Debenture Trustees) Regulations, 1993, as a debenture trustee. The Trustee has obtained a certificate of registration dated February 14, 2017 (having registration code IND000000460), which is valid until suspended or cancelled by SEBI. The Trustee was incorporated in India under the Companies Act, 1956 with corporate identity number U65991MH2001GOI131154. The Trustee was originally incorporated on March 8, 2001 at Mumbai, Maharashtra. The Trustee's registered office and principal place of business is situated at Asian Building, Ground Floor, 17, R. Kamani Marg, Ballard Estate, Mumbai 400 001, Maharashtra. The Trustee is jointly promoted by IDBI Bank Limited, Life Insurance Corporation and General Insurance Corporation for providing corporate and other trusteeship services.

Background of the Trustee

The Trustee is permitted to engage in the following activities: (a) to act as (i) a debenture or bond trustee; (ii) a security trustee or facility agent; (iii) a securitization trustee; (iv) a share pledge trustee or share monitoring agent; (v) an escrow agent; (vi) a venture capital fund trustees, trustee of an infrastructure investment trust or a trustee to an AIF; and (b) providing services including (i) safe keeping or locker services; (ii) management of private trusts or execution of wills; and (iii) special corporate services.

The Trustee confirms that it has maintained, and undertakes to ensure that it will at all times maintain, adequate infrastructure personnel and resources to perform its functions, duties and responsibilities with respect to the Trust, in accordance with the Trust Deed, the InvIT Regulations and other applicable law.

The Trustee is not an Associate of the Sponsor or the Investment Manager. Further, neither the Trustee nor any of the promoters or directors of the Trustee (i) are debarred from accessing the securities market by SEBI; (ii) are promoters, directors or persons in control of any other company or a sponsor, investment manager or trustee of any other infrastructure investment trust or an infrastructure investment trust which is debarred from accessing the capital market under any order or direction made by SEBI; or (iii) are in the list of wilful defaulters published by the RBI.

Board of Directors of the Trustee

The board of directors of the Trustee is entrusted with the responsibility for the overall management of the Trustee. Please see below the details in relation of the board of directors of the Trustee:

Sr. No.	*Name*	*DIN*
1.	*Pradeep Kumar Malhotra*	*09817764*
2.	*Pradeep Kumar Jain*	*07829987*
3.	*Jayashree Vijay Ranade*	*09320683*
4.	*Baljinder Kaur Mandal*	*06652016*
5.	*Jayakumar S. Pillai*	*10041362*

Key Terms of the Trust Deed

The Trustee has entered into the Trust Deed, in terms of the InvIT Regulations, the key terms of which, are provided below:

1. *Powers of the Trustee*

The Trustee has been provided with various powers under the Trust Deed in accordance with the Indian Trusts Act, 1882 and the InvIT Regulations, including but not limited to:

(i) The Trustee shall, in relation to the Trust, have every and all powers that a person competent to contract and acting as a legal and beneficial owner of such property has.

(ii) The Trustee shall have the power to determine, in accordance with the Investment Management Agreement and the investment objectives of the Trust, distributions to Unitholders and other rights attached to the Units in compliance with the InvIT Regulations and applicable law.

(iii) The Trustee shall oversee voting of the Unitholders in accordance with the InvIT Regulations.

(iv) The Trustee shall have the power to do the following, which may be delegated to the Investment Manager:

(a) cause offering of the Units through any placement documents;

(b) cause any placement documents to be provided to the Bidders;

(c) issue and allot Units;

(d) summon and conduct meetings of the Unitholders; and

(e) approve transfer of the Units.

(v) The Trustee shall be empowered to make investment decisions with respect to the underlying assets or projects of the Trust including any further investments or divestment, subject to InvIT Regulations. Further, the Trustee is also empowered to:

(a) acquire, hold, manage, trade and dispose of shares, stocks, convertibles, debentures, bonds and other equity or equity-related securities and other debt or mezzanine securities of all kinds issued by any SPVs, infrastructure projects in India, falling within the investment objectives, whether in physical or dematerialised form, including power to hypothecate, pledge or create encumbrances of any kind to be used as collateral security for any borrowings by the Trust;

(b) avail commercial loans, including the power to hypothecate, pledge or create encumbrances of any kind on the InvIT Assets as collateral security for any such loans availed by the InvIT;

(c) keep the capital and monies of the Trust on deposit with banks or other institutions whatsoever;

(d) accept contributions;

(e) collect and receive the profit, interest, repayment of principal of debt or debt like or equity or equity like, mezzanine securities, dividend, return of capital as and when the same may become due and receivable;

(f) invest in securities or in units of mutual funds in accordance with the InvIT Regulations and applicable law;

(g) invest in money market instruments including government securities, treasury bills, certificates of deposit and commercial paper in accordance with applicable law;

(h) to give, provide and agree to provide to any SPV financial assistance in the form of investment in the Trust's debt securities or share capital of any class including ordinary, preference, participating, non-participating, voting, non-voting or other class, and in the form of investment in securities convertible into share capital; and

(i) to invest, acquire, purchase, hold, divest, sale, hypothecate, pledge or otherwise transfer land and building and immovable property of any kind including any rights and interest therein.

(vi) The Trustee shall have the power to make such reserves out of the income or capital as the Trustee may deem proper and any decisions of the Trustee whether made in writing or implied from its acts, so far as the applicable law may permit, shall be conclusive and binding on the Unitholders. Any distribution made by the Trust from such reserves shall be in terms of the Trust Deed;

(vii) The Trustee shall have the power to employ and pay at the expense of the Trust, any agent in any jurisdiction whether attorneys, solicitors, brokers, banks, trust companies or other agents whether associated or connected in any way with the Trustee or not, without being responsible for the default of any agent if employed in good faith to transact any business, including without limitation, the power to appoint agents to raise funds, or do any act required to be transacted or done in the execution of the trusts hereof including the receipt and payment of moneys and the execution of documents.

(viii) The Trustee shall, on behalf of the Trust, appoint an Investment Manager to manage the Trust.

(ix) The Trustee shall oversee the activities of the Investment Manager in the interest of the Unitholders, ensure that the Investment Manager complies with the InvIT Regulations and applicable laws including in relation to the appointment of Unitholder Nominee Directors by Eligible Unitholders as per SEBI InvIT Amendment 2023 read with Nomination Circular, and shall obtain a Compliance Certificate or such other reports and information as may be prescribed under the InvIT Regulations from time to time from the Investment Manager on a quarterly basis or such other time period as prescribed by Applicable law, in the form prescribed by SEBI, if any.

(x) The Trustee shall, on behalf of the Trust, appoint a Project Manager for the operation and management of the InvIT Assets.

(xi) The Trustee shall oversee the activities of the Project Manager and shall obtain a compliance certificate from the project manager on a quarterly basis or such other time period as prescribed by applicable law.

(xii) The Trustee may appoint any custodian in order to provide custodian services.

(xiii) The Trustee shall have the power and duty to pay all such duties, fees or taxes (and any interest or penalty chargeable thereon) as well as to create any reserves for future potential tax liability out of the Trust or the income thereof, as may be permitted under applicable law.

(xiv) The Trustee shall, subject to the advice of the Investment Manager, have the power to pay Trust expenses out of the funds held by the Trust in accordance with the Trust documents.

(xv) The Trustee shall have the power to take the opinion of legal or tax counsel in any jurisdiction concerning any disputes or differences arising under the Trust Deed or any matter relating to the Trust and the fees of such counsel shall be paid out of the funds held in the Trust.

(xvi) The Trustee may sell, rent or buy any property, or borrow property from or carry out any other transaction with the trustees of any other trust or the executors or administrators of any estate provided that such power is delegated to, and exclusively exercised by the Investment Manager pursuant to the Investment Management Agreement.

(xvii) The Trustee, in consultation with the Investment Manager, shall have the power to accept any property before the time at which it is transferable or payable, pay or allow any claim on any evidence, accept any security payable or immovable in lieu of any amounts payable to it, alter the dates for payment of any amounts payable to it and compromise, compound, abandon or otherwise settle any claim or thing whatsoever relating to the Trust of the Trust Deed.

(xviii) The Trustee shall, subject to the advice of the Investment Manager, have the power to cause the Trust to borrow funds, including any subordinated equity, bonds or other fund from any person or authority on such terms and

conditions and for such periods and for the purpose of the Trust and the InvIT Assets, subject to any approval of the Unitholders, and the power to provide such security for funds borrowed including by way of hypothecation, pledge or creation of encumbrances of any kind on the InvIT Assets as collateral security for any such borrowings.

(xix) The Trustee may, subject to any advice of the Investment Manager, retain the proceeds received by the Trust from any InvIT Assets.

(xx) The Trustee, in consultation with the Investment Manager, may make rules to give effect to and carry out the investment objectives. The Trustee may provide, not inconsistent with the provisions of the Trust Deed and the InvIT Regulations, for all or any of the following matters:

(a) manner of maintaining of the records and particulars of the Unitholders;

(b) norms of investment by the Trust in accordance with the investment objectives of the Trust and in accordance with the powers and authorities of the Trustee;

(c) matters relating to entrustment / deposit or handing over of any securities or SPVs of the Trust to any one or more custodians and the procedure relating to the holding thereof by the custodian;

(d) such other administrative, procedural or other matters relating to the administration or management of the affairs of the Trust and which matters are not by the very nature required to be included or provided for in the Trust Deed or by the management thereof;

(e) procedure for seeking the vote of the Unitholders either by calling a meeting or through postal ballot or otherwise; and

(f) procedure for summoning and conducting meetings of Unitholders.

(xxi) The Trustee, whether by itself or through the Investment Manager, shall cause the depository to maintain the depository register in accordance with applicable law.

(xxii) The Trustee shall advise the Investment Manager in relation to the appointment of valuer, auditors, registrar and transfer agent, merchant bankers, custodian, credit rating agency and any other intermediary or service provider or agent with respect to the activities pertaining to the Trust.

(xxiii) The Trustee shall review the reports required in terms of InvIT Regulations and applicable law, as submitted by the Investment Manager including, without limitation, in relation to Eligible Unitholder(s), as prescribed from time to time, in the event such reports are not submitted in timely manner, the trustee, after due follow up, shall intimate the same to SEBI as required in terms of the InvIT Regulations, any circular thereunder and Applicable Law.

(xxiv) The Trustee shall have the power to open one or more bank accounts for the purposes of the Trust, to deposit and withdraw money and fully operate the same.

(xxv) The Trustee shall have the power to take up with SEBI or with the stock exchange(s) as applicable, any matter which has been approved in any meeting of Unitholders, if the matter requires such action, including any reorganisation or restructuring or rearrangement of the assets of the InvIT.

(xxvi) The Trustee shall also have the following powers and authorities:

(a) to institute, conduct, compromise, compound, or abandon any legal proceedings for or on behalf of or in the name of the Trust or the Trustee, and to defend, compound or otherwise deal with any such proceedings against the Trustee or Trustee or its officers or concerning the affairs of the Trust, and also to compound and allow time for payment or satisfaction of any equity due and of any claims or demands by or against the Trust and observe and perform in relation to any decisions thereof;

(b) to make and give receipts, releases and other discharges for moneys payable to the Trust and for the claims and demands of the Trust;

(c) to enter into all such negotiations and contracts, and, execute and do all such acts, deeds and things for or on behalf of or in the name of the Trust as the Trustee may consider expedient;

(d) to sign, seal, execute, deliver and register according to law all deeds, documents, agreements, and assurances;

(e) to negotiate, sign, seal, execute and deliver the Trust documents, including but not limited to, any issue agreement, share purchase agreement, services agreement, deed of right of first offer, debenture subscription agreement, escrow agreement, underwriting agreement, loan documentation, placement documents or any other deed, agreement or document;

(f) take into their custody and/or control all the capital, assets, property of the Trust and hold the same in trust for the Unitholders in accordance with this Deed, the InvIT Regulations and applicable law; and

(g) generally to exercise all such powers as it may be required to exercise under the InvIT Regulations and applicable law for the time being in force and do all such matters and things as may promote the Trust or as may be incidental to or consequential upon the discharge of its functions and the exercise and enforcement of all or any of the powers and rights under the Trust Deed.

(xxvii) The Trustee may at any time, buy-back the Units from the Unitholders, subject to applicable law.

(xxviii) The Trustee may, delegate to any committee or any other person, any powers set out above and the duties set out below, provided, however, that the Trustee shall remain responsible and liable for any such persons' acts of commission or omission as determined by a court of competent jurisdiction whose decision is final, binding and non-appealable, except the roles and responsibilities delegated by the Trustee to Investment Manager, Project Manager or any third party expert, or any sub-delegation by the Investment Manager or the Project Manager.

2. *Duties of the Trustee*

The Trustee shall perform its duties as required under the Trust Deed in accordance with the Indian Trusts Act, 1882 and the InvIT Regulations, including but not limited to:

(i) The Trustee shall carry on and conduct its business in a proper and efficient manner in the best interest of the Unitholders.

(ii) The Trustee shall appoint an investment manager and project manager in accordance with the InvIT Regulations and applicable law.

(iii) The Trustee shall, on behalf of the Trust, enter into the Investment Management Agreement with the Investment Manager.

(iv) The Trustee shall ensure that the Investment Manager performs its obligations as specified below:

(a) The Trustee shall ensure that the Investment Manager complies with reporting and disclosure requirements in accordance with InvIT Regulations and in case of any delay or discrepancy, require the Investment Manager to rectify such delay or discrepancy on an urgent basis;

(b) The Trustee shall review the transactions carried out between the Investment Manager and its associates and where the Investment Manager has advised that there may be a conflict of interest, it shall obtain a certificate from a practising chartered accountant or valuer, as applicable, that such transaction is on arm's length basis;

(c) The Trustee shall review the valuation report submitted by the Investment Manager;

(d) The Trustee shall require the Investment Manager to set up such systems and procedures and submit such reports to the Trustee, as may be necessary for effective monitoring of the functioning of the Trust; and

(e) The Trustee shall ensure that the Investment Manager convenes meetings of the Unitholders in accordance with the InvIT Regulations and oversee the voting by Unitholders. The Trustee shall ensure that the Investment Manager convenes meetings of Unitholders not less than one every year and the period between such meetings shall not exceed 15 months.

(v) The Trustee shall provide SEBI and the stock exchange(s), where applicable, such information as may be sought by SEBI or by the stock exchange(s) pertaining to the activity of the Trust. The Trustee shall comply with intimation requirements under the InvIT Regulations and applicable law, including in relation to intimating SEBI in case of any discrepancy in the operation of the InvIT with the InvIT Regulations and any placement documents. The Trustee shall also immediately inform SEBI in case any act which is detrimental to the interest of the Unitholders is noted.

(vi) The Trustee shall at all times exercise due diligence in carrying out its duties and protecting the interests of the Unitholders.

(vii) The Trustee shall delegate all such powers to the Investment Manager and the Project Manager as may be required to carry out obligations under the Investment Management Agreement, Project Implementation and Management Agreement and applicable law.

(viii) The Trustee shall delegate all such powers to the Project Manager as may be required by the Project Manager to carry out its obligations under the Project Implementation and Management Agreement and under Applicable Law.

(ix) The Trustee shall appoint a new investment manager in accordance with the InvIT Regulations and Applicable Law, in case of change in Investment Manager due to removal or otherwise, within the time period prescribed under the InvIT Regulations. The Trustee shall ensure that the new investment manager shall stand substituted as a party in all the documents to which the earlier investment manager was a party. The Trustee shall also ensure that the earlier investment manager continues to be liable for all its acts of omissions and commissions for the period during which it served as investment manager, notwithstanding its termination.

(x) The Trustee shall appoint a new project manager in accordance with the InvIT Regulations and applicable law in case of change in Project Manager due to removal or otherwise. The Trustee shall appoint a new project manager within the time period prescribed under the InvIT Regulations. The Trustee may, either *suo moto* or based on the advice of the concessioning authority(ies) appoint an administrator in connection with an infrastructure project for such terms and on such conditions as it deems fit. The Trustee shall ensure that the new project manager shall stand substituted as a party in all the documents to which the earlier project manager was a party. The Trustee shall also ensure that the earlier project manager continues to be liable for all its acts of omissions and commissions for the period during which it served as project manager, notwithstanding its termination.

(xi) The Trustee shall obtain the prior approval from the Unitholders in accordance with the InvIT Regulations and from SEBI in case of change in control of the Investment Manager.

(xii) The Trustee shall ensure that in case of change in control of the Project Manager, written consent is obtained from the concessioning authority(ies) in terms of the concession agreement(s), prior to such change, if applicable.

(xiii) The Trustee shall ensure that subscription amount is kept in a separate bank account in name of the Trust and is only utilised for adjustment against allotment of Units or refund of money to the applicant till the time such Units are listed and the same will be utilised for objectives of the offering as will be mentioned in the relevant placement documents.

(xiv) The Trustee shall cause the books of accounts of the InvIT to be in accordance with the Trust Deed.

(xv) The Trustee shall ensure that all acts, deeds and things are done for the attainment of the investment objective of the Trust and in compliance with the InvIT Regulations and applicable law and to secure the best interests of the Unitholders.

(xvi) The Trustee shall file such reports as may be required by SEBI or any other regulatory authority or as required under the InvIT Regulations and applicable law with regard to the activities carried on by the Trust.

(xvii) The Trustee shall periodically review the status of the Unitholders' complaints and their redressal undertaken by the Investment Manager, in accordance with the InvIT Regulations.

(xviii) The Trustee and its directors, officers, employees and agents shall at all times maintain the greatest amount of confidentiality as regards the activities and assets of the Trust and such other matters connected with them and the Trust generally and shall not disclose any confidential information to any other person, other than the Investment Manager, or the Project Manager, unless such information is required to be disclosed to some regulatory authority, court or any other person under any order of court or any law in force in India.

(xix) The assets and liabilities of the Trust shall at all times be segregated from the assets and liabilities of the Trustee and the assets and liabilities of other trusts managed by the Trustee.

(xx) The Trustee shall ensure that the Investment Manager shall ensure that a detailed valuation is undertaken of the InvIT assets by a valuer at such intervals and in the manner as may be prescribed under the InvIT Regulations and applicable law. The Trustee shall ensure that the remuneration of the valuer is not linked to or based on the value of the asset being valued.

(xxi) The Trustee of the InvIT shall not invest in Units of the Trust.

(xxii) The Trustee shall fulfil its obligations in terms of the InvIT Regulations.

(xxiii) The Trustee shall ensure that the activity of the Trust is being operated in accordance with the provisions of the Trust Deed, the InvIT Regulations, applicable law and the Trust documents and in case of any discrepancy, it shall inform SEBI immediately in writing.

(xxiv) The Trustee shall immediately inform SEBI in case any act which is detrimental to the interest of the Unitholders is noted.

(xxv) The Trustee shall maintain records in accordance with the InvIT Regulations and applicable law.

(xxvi) The Trustee shall wind up the Trust in accordance with the InvIT Regulations and applicable law. Upon winding up of the Trust, the Trustee shall surrender the certificate of registration to SEBI.

3. *Rights of the Trustee*

The Trustee shall have the following rights:

(i). The Trustee may, in the discharge of its duties, act upon any advice obtained in writing from any bankers, accountants, brokers, lawyers, professionals, consultants, or other experts acting as advisers to the Trustee.

(ii). Subject to applicable law, no Unitholder shall be entitled to inspect or examine the Trust's premises or properties (including any holding company and SPVs) without the permission of the Trustee, who shall give such permission, if necessary, in consultation with the Investment Manager. Further, no Unitholder shall be entitled to require discovery of any information respecting any detail of the Trust's activities or any matter which may relate to the conduct of the business of the Trust and which information may, in the opinion of the Trustee and the Investment Manager adversely affect the interest of the Unitholder.

(iii). The Trustee shall be entitled to reimburse itself and shall be entitled to charge the Trust, and shall be entitled to be indemnified and be kept indemnified from the Trust and from any distributions made by the Trust to the Unitholders, with the expenses, outgoings, taxes, levies, and liabilities (including indemnity obligations of the Trust, if any).

(iv). The Trustee may accept as sufficient evidence for the value of any investment or for the cost price or sale price thereof or for any other fact within its competence, a certificate by a valuer or any other professional person appointed by the Investment Manager for the purpose.

4. *Liabilities of the Trustee*

The liabilities of the Trustee in terms of the Trust Deed are as follows:

(i). The Trustee shall only be chargeable for such monies, stocks, funds and securities as the Trustee shall have actually received and shall not be liable or responsible for any banker, broker, custodian or other person in whose hands the same may be deposited or placed, nor for the deficiency or insufficiency in the value of any investments of the Trust nor otherwise for any involuntary loss. Any receipt signed by the Trustee for any monies, stocks, funds, shares, securities, investment or property, paid, delivered or transferred to the Trustee under or by virtue of the Trust Deed or in exercise of the duties, functions and powers of the Trustee shall effectively discharge the Trustee or the person or persons paying, delivering or transferring the same therefrom or from being bound to see to the application thereof, or being answerable for the loss or misapplication thereof provided that the Trustee and such persons shall have acted in good faith, without negligence and shall have used their best efforts in connection with such dealings and matters.

(ii). The Trustee shall not be under any liability on account of anything done or omitted to be done or suffered by the Trustee in good faith if the Trustee is able to establish that it performed its rights and duties and exercised its powers, as a reasonable person in such a position would have, in compliance with the provisions of the Trust Deed and applicable law.

(iii). The Trustee shall not be under any obligation to institute, acknowledge the service of, appear in, prosecute or defend any action, suit, proceedings or claim in respect of the provisions hereof or in respect of the InvIT assets or any part thereof or any corporate action which in its opinion would or might involve it in expense or liability unless the Investment Manager shall so request in writing and the Trustee is satisfied that the value of the investment is sufficient to provide adequate indemnity against costs, claims, damages, expenses or demands to which it may be put as Trustee as a result thereof. The costs in relation to such action, suit, proceedings or claims (whether undertaken upon request of Investment Manager or otherwise) incurred by the Trustee in connection with or arising out of the Trust, shall be borne by the Trust.

(iv). The Trustee shall not be liable in respect of any action taken or damage suffered by it on reliance upon any

notice, resolution, direction, consent, certificate, affidavit, statement, certificate of stock, plan of reorganization or (without being limited in any way by the foregoing) other paper or document believed to be genuine and to have been passed, sealed or signed by appropriate authorities or entities.

(v). The Trustee shall not be liable to the Unitholders for doing or failing to do any act or thing which by reason of any provision of any present or future law or regulation made pursuant thereto, or of any decree, order or judgment of any court, or by reason of any request announcement or similar action (whether of binding legal effect or not) which may be taken or made by any person or body acting with or purporting to exercise the authority of any government (which legally or otherwise) it shall be directed or requested to do or perform or to forbear from doing or performing. If for any reason it becomes impossible or impracticable to carry out any of the provisions of these presents the Trustee shall not be under any liability therefore or thereby.

(vi). The Trustee shall not be responsible to any Unitholder for the authenticity of any signature affixed to any document or be, in any way, liable for any forged or unauthorized signature on or for acting upon or giving effect to any such forged or unauthorized signature. The Trustee shall be entitled but not bound to require that the signature of any Unitholder to any document required to be signed by him under or in connection with these presents shall be verified to the Trustee's reasonable satisfaction.

(vii). If the Trustee is required by the InvIT Regulations or any applicable law to provide information regarding the Trust or the Sponsor or the Unitholders, the investments made by the Trust and income therefrom and provisions of these presents and complies with such request in good faith, whether or not it was in fact enforceable, the Trustee shall not be liable to the Unitholders or to any other party as a result of such compliance or in connection with such compliance.

(viii). The Trustee shall not incur any liability for any act or omission or (as the case may be) failing to do any act or thing which may result in a loss to a Unitholder (by reason of any depletion in the value of the InvIT assets or otherwise), except in the event that such loss is a direct result of fraud, gross negligence or wilful default on the part of the Trustee or results from a breach by the Trustee of this Deed, as determined by a court of competent jurisdiction.

(ix). If the Trustee engages any external advisors or experts to discharge its obligations or undertakes any work (in consultation with the Investment Manager, in the interest of the Unitholders) which is not covered within the scope of work of the Trustee and such additional work is beyond the obligations of the Trustee under applicable law, the Trustee shall be entitled to recover such costs, charges and expenses which the Trustee may incur in this regard, from the funds of the Trust.

(x). The liability of the Trustee shall be limited to the extent of the fees received by it, in all circumstances whatsoever except (a) in case of any negligence or misconduct or fraud on the part of the Trustee as may be determined by a court of competent jurisdiction, or (b) any failure on the part of the Trustee to protect the interests of the Unitholders.

(xi). The exercise of all power and discretion by the Trustee shall be valid only if the same are carried out upon the approval of a majority of the directors on the board of the Trustee to any officer of the Trustee, if the exercise of such powers is within the parameters of such delegated authority.

5. *Provisions relating to Unitholders*

(i). The aggregate liability of each Unitholder shall be limited to making the capital contribution payable by it in respect of the Units subscribed by it.

(ii). Each Unit allotted to the Unitholders shall have one vote for any decisions requiring a vote of Unitholders and shall carry such rights as provided in the InvIT Regulations.

(iii). No Unitholder shall enjoy preferential voting or any other rights over another Unitholder except as permitted under applicable law.

(iv). In no event shall the Trustee or the Investment Manager be bound to make payment to any Unitholder, except out of the funds held by it for that purpose under the provisions of the Trust Deed.

(v). A Unitholder whose name and account details are entered in the depository register shall be the only person entitled to be recognised by the Trustee as having a right, title, interest in or to the Units registered in his name and the Trustee shall recognise such holder as an absolute owner and shall not be bound by any notice to the contrary and shall also not be bound to take notice of or to see to the execution of any trust, express or implied, save as expressly provided or as required by any court of competent jurisdiction to recognise any trust or equity or interest affecting the title of the Units.

(vi). The Unitholders shall not give any directions to the Trustee or the Investment Manager (whether in a meeting of

Unitholders or otherwise) if it would require the Trustee or the Investment Manager to do or omit doing anything which may result in:

(a) the Trust or the Trustee, in its capacity as the trustee of the Trust or the Investment Manager, in its capacity as the investment manager of the Trust ceasing to comply with applicable law;

(b) interference with the exercise of any discretion expressly conferred on the Trustee by the Trust Deed or the Investment Manager by the Investment Management Agreement, or the determination of any matter which requires the agreement of the Trustee or the Investment Manager, provided that nothing shall limit the right of the Unitholder to require the due administration of the Trust in accordance with the Trust Deed.

(vii). The depository register shall (save in case of manifest error) be conclusive evidence of the number of Units held by each depositor and in the event of any discrepancy between the entries of the depository register and any statement issued by the depository, the entries in the depository register shall prevail unless the depositor proves to the satisfaction of the Trustee and the depository that the depository register is incorrect.

(viii). The Unitholders shall have the right to call for certain matters to be subject to their consent, in accordance with the InvIT Regulations and applicable law.

(ix). The Unitholders may, in accordance with the provisions of the Trust documents and applicable law, transfer any of the Units to an investor where such investor accepts all the rights and obligations of the transferor and the Trustee or the Investment Manager shall give effect to such transfer in accordance with applicable law.

(x). The Trustee shall and shall ensure that the Investment Manager obtains the consent of the Unitholders for the matters prescribed under the InvIT Regulations in accordance with the provisions of the InvIT Regulations, including Regulation 22 of the InvIT Regulations.

(xi). The Unitholders shall have the right to receive income or distributions in respect of the Units, as provided in the placement documents.

(xii). The Eligible Unitholders shall have the right to appoint Unitholder Nominee Directors on the board of directors of the Investment Manager from time to time, in the manner prescribed under the InvIT Regulations. The Trustee shall supervise and ensure that the Investment Manager takes all such actions and compliances, as may be prescribed under the InvIT Regulations from time to time, in relation to the right of Eligible Unitholders to appoint Unitholder Nominee Directors on the board of directors of the Investment Manager.

6. *Indemnity*

In addition to the fees, distributions and expense reimbursements herein described, the InvIT Assets shall be utilized to indemnify and hold harmless the Trustee, the Sponsor and any of their respective officers, directors, shareholders, sponsors, partners, members, employees, advisors and agents ("**Indemnified Parties**") from and against any claims, losses, costs, damages, liabilities and expenses, including legal fees ("**Losses**") suffered or incurred by them by reason of their activities on behalf of the Trust, unless such Losses resulted from fraud, gross negligence, wilful default or wilful misconduct or breach of any obligations or duties under applicable law by the relevant Indemnified Party, as determined by a court of competent jurisdiction.

7. *Termination*

The InvIT is subject to dissolution and termination in accordance with and subject to the InvIT Regulations and applicable law:

(i). if the Trust fails to make any offer of Units by way of private placement, within the time period stipulated in the InvIT Regulations or any other time period as specified by SEBI, the Trust shall surrender its certificate to SEBI and cease to operate as an investment infrastructure trust, unless the period is extended by SEBI;

(ii). upon the liquidation of InvIT Assets;

(iii). if there are no projects remaining under the Trust and the Trust does not invest in any project for six months thereafter;

(iv). delisting of the Units in accordance with the InvIT Regulations; or

(v). illegality of the InvIT under applicable law.

C. The Investment Manager – National Highways Infra Investment Managers Private Limited

History and Certain Corporate Matters

National Highways Infra Investment Managers Private Limited was incorporated as a private limited company on July 25, 2020, under the Companies Act, 2013. The Investment Manager was initially incorporated as a wholly owned subsidiary of NHAI. Subsequently, NHAI transferred its entire shareholding in the Investment Manager to the President of India, acting through the Ministry of Road Transport and Highways, Government of India. Accordingly, at present, the Investment Manager is a government company as defined under the Companies Act, 2013, as amended. The CIN of the Investment Manager is U65929DL2020GOI366835.

The principal business of the Investment Manager in terms of its memorandum of association is, *inter alia*:

(a) to carry on the business of acting as investment manager investment adviser, trustee, settler, sponsor, promoter, portfolio manager, manager, administrator, attorney, agent, consultant, representative or nominee of or for any collective investment schemes, trusts, special purpose vehicles, infrastructure investment trusts, real estate investment trusts, properties and/or assets of any kind, including any fund set up, formed or established in India or in any other country by the Company or by any other person including bodies corporate, limited liability partnerships, partnerships, trusts, societies, associations of persons or by government, state or local authority (whether incorporated or not) of any other agency or organisation with respect to any class of assets, and to thereby settle, administer, manage, deploy funds, acquire, take up, manage, invest, hold, sell, deal or dispose of all or any property, investments, securities or other assets of any kind whatsoever, acting in such capacity;

(b) to negotiate and obtain concessions from the appropriate Government/ s for the rights to build, operate and own or transfer highways, interchangers, viaducts and bridges and any other structures, buildings and services that are ancillary thereto in India and upon such terms for such benefits as may be set forth in the concessions or negotiated from time to time and generally to carry on the business of owners, operators or toll collectors or concessionaires of highways, bridges, tunnels, railways, ports, airports, public utilities, telecommunication facilities and any other rights, properties, utilities and services wherever situated; and

(c) to carry on the business of builders and contractors for the construction, upgradation, maintenance and repairs of roads, highways, bridges, viaducts, buildings, interchangers, tunnels, railways, ports, airports, public utilities, telecommunication and other related works and generally to carry on the business of engineers, contractors, consultants, advisors, managers and administrators in all its branches, mechanical, electrical and telecommunication, engineering and incidental thereto, to provide financing or act as guarantors for project financing to owner where to required.

Background of the Investment Manager

The Trustee, *vide* their letter dated July 31, 2020, appointed NHIIMPL as the investment manager of the proposed Trust, based on the recommendation of the Sponsor.

The Investment Manager confirms that it has, and undertakes to ensure that it will at all times maintain, adequate infrastructure, personnel and resources to perform its functions, duties and responsibilities with respect to the management of the Trust, in accordance with the InvIT Regulations, the Investment Management Agreement and applicable law.

In accordance with the eligibility criteria specified under the InvIT Regulations, the Investment Manager had a consolidated net worth of not less than ₹ 100 million as on the date of this Placement Document.

Neither the Investment Manager nor the promoter or directors of the Investment Manager (i) are debarred from accessing the securities market by SEBI; (ii) are promoters, directors or persons in control of any other company or a sponsor, investment manager or trustee of any other infrastructure investment trust or an infrastructure investment trust which is debarred from accessing the capital market under any order or direction made by SEBI; or (iii) are in the list of wilful defaulters published by the RBI.

The IM Board

The IM Board is entrusted with the responsibility for the overall management of the Investment Manager. The Sponsor, acting together with MoRTH, have the right to nominate up to two directors on the Board of the IM. Please see below the details in relation of the IM Board:

Sr.No.	Name	DIN
1.	Sumit Bose	03340616
2.	Suresh Goyal	02721580
3.	N.R.V.V.M.K. Rajendra Kumar	09494456
4.	Mahavir Parsad Sharma	03158413

Sr.No.	Name	DIN
5.	Shailendra Narain Roy	02144836
6.	Pushkar Kulkarni	00090996
7.	Debapratim Hajara	09804007
8.	Pradeep Singh Kharola	05347746

Brief Biography of the Directors of the Investment Manager

Please see below a brief biography of the directors of the Investment Manager:

Suresh Goyal is managing director and chief executive officer of the Investment Manager. He has a bachelor's degree in electrical engineering from Shri Govindram Seksaria Institute of Technology and Science, Indore, and a post-graduate diploma in management from the Indian Institute of Management, Lucknow. He has over several years of experience in the corporate and asset management sector. He was employed with the Macquarie group for over ten years wherein he was involved in various infrastructure investment management projects. At Macquarie, he spent over five years in managing investments in the toll road sector. He was previously associated with Macquarie Infrastructure & Real Assets, Singapore, and has served as Executive Director within Macquarie Asset Management.

N.R.V.V.M.K. Rajendra Kumar is a nominee director of the Investment Manager. He holds a doctorate degree in Economics from Hyderabad Central University. He also has a master's in public management from Harvard Kennedy School and Lee Kuan Yew School of Public Policy. He has been the Chief General Manager of the Internal Debt Management Department, Mumbai at the Reserve Bank of India since 2021. He is also the member (finance) of NHAI since 2022.

Mahavir Parsad Sharma is an independent director of the Investment Manager. He has a bachelor's degree in law from the University of Delhi, and has passed the institution examinations of the Institution of Engineers, India. He also worked as Chief Engineer and Additional Director General in the Ministry of Road transport and Highways. He has previously served as a technical advisor in the Ministry of Road Transport and Highways, Government of India.

Shailendra Narain Roy is an independent director of the Investment Manager. He has a bachelor's degree in engineering from the Indian Institute of Technology (BHU), and is a graduate of the Wharton Advanced Management Program. He has previously served as a whole-time director of Larsen & Toubro Limited for over eight years, and was on the board of several and associate companies of the L&T Group. He was also a former chief executive officer and managing director of L&T Power Limited. He was associated with the setting up India's first ultra-supercritical thermal power plant at Khargone for NTPC, the first supercritical power plant, Nabha Power Ltd. and five supercritical power plants across the country.

Pushkar Kulkarni is a unitholder nominee director of the Investment Manager. He holds a bachelor's degree in electronics engineering from V.J. Technical Institute, Mumbai University and a master's degree in management studies from Jamnalal Bajaj Institute of Management Studies, Mumbai University. He has been associated with Canada Pension Plan Investment Board ("CPPIB") since 2016. He has over 11 years of experience in the infrastructure investment sector. He was previously associated with Serco India Private Limited as a director.

Debapratim Hajara is a Unitholder Nominee Director of the Investment Manager. He holds a postgraduate diploma in management from Xavier Institute of Management, Bhubaneswar and a master's degree in physics from Indian Institute of Technology, Kanpur. He is currently the managing director, Infrastructure & Natural Resources at Ontario Teachers' Pension Plan ("Ontario Teachers'"). He has over 11 years of experience in infrastructure investment and was previously associated with SBI Capital Markets Limited, IDFC Alternatives Limited and Macquarie Infrastructure and Real Assets (India) Private Limited. He is currently also a director on the board of directors of National Investment and Infrastructure Fund Limited, Mahindra Susten Private Limited, Sustainable Energy Infra Investment Managers Private Limited and Green Energy Infra Project Managers Private Limited.

Pradeep Singh Kharola is an independent director of the Investment Manager. He has a bachelor's degree in mechanical engineering from Shri Govindram Seksaria Institute of Technology and Science, Indore and holds a master's degree in technology (industrial engineering) from Indian Institute of Technology, Delhi. He also holds a doctorate basis his thesis titled "Systems approach to estimate the optimal modal mix of passenger transport" from Indian Institute of Technology, Delhi. He is an Indian Administrative Officer of the Karnataka cadre. He has previously served as the Principal Secretary to the Chief Minister of Karnataka, and Commissioner of Commercial Taxes, Karnataka. He has also served as Secretary, Civil Aviation, government of India and as the managing director of Air India. He has won the Prime Minister's Award for Excellence in Public Administration for transforming the tax regime in Karnataka.

Sumit Bose is an independent director of the Investment Manager. He was an IAS officer of the Madhya Pradesh cadre. He retired as the Union Finance Secretary in 2014. He holds a master's degree in social policy and planning from the London School of Economics and a master's degree in history from St. Stephen's College, University of Delhi. He has 38 years of experience in administration, fiscal management, and corporate sector. He has served as an independent director at Coromandal International Limited, Tata AIG General Insurance Company, HDFC Life Insurance Company Limited, HDFC Pensions, JB Chemicals & Pharmaceuticals and J.M Financial Services Limited. He has also previously served as the public interest director at BSE Limited.

Key Terms of the Investment Management Agreement

The Investment Manager has entered into the Investment Management Agreement, in terms of the InvIT Regulations, the key terms of which, are provided below.

1. *Powers of the Investment Manager*

The Investment Manager has been provided with various powers under the Investment Management Agreement in accordance with the InvIT Regulations, including but not limited to:

(i). The Investment Manager shall take all decisions in relation to the day-to-day management and administration of InvIT Assets and the investments of the Trust as may be incidental or necessary for the advancement or fulfilment of the investment objectives of the Trust in accordance with the InvIT Regulations and other applicable law. The Investment Manager shall ensure that all investments shall be registered in the name of the Trustee (acting on behalf of the InvIT) or the Trust.

(ii). The Investment Manager shall, subject to such approval as may be required from the Unitholders, make the investment decisions with respect to the underlying assets or projects of the Trust, including any further investments or divestments, subject to InvIT Regulations and in accordance with the Placement Document, and in this regard is also empowered to do the following acts including:

(a) acquire, hold, manage, trade and dispose of shares, stocks, convertibles, debentures, bonds and other equity or equity-related securities and other debt or mezzanine securities of all kinds issued by any SPVs, infrastructure projects in India, whether in physical or dematerialised form, including power to hypothecate, pledge or create encumbrances of any kind on such securities held by the Trust in such holding companies, and/or SPVs, or infrastructure projects to be used as collateral security for any borrowings by the Trust;

(b) keep the capital and monies of the Trust in deposit with banks or other institutions, whatsoever;

(c) accept contributions;

(d) collect and receive the profit, interest, repayment of principal of debt or debt like, or equity or equity like, mezzanine securities, dividend, return of capital of any type by the holding companies, or SPVs, or infrastructure projects and income of the Trust as and when the same may become due and receivable;

(e) invest in securities or in units of mutual funds in accordance with the InvIT Regulations and other applicable law;

(f) invest in money market instruments including government securities, treasury bills, certificates of deposit and commercial paper in accordance with applicable law;

(g) to give, provide and agree to provide to any holding companies, or SPVs financial assistance in the form of investment in the Trust's debt securities or share capital of any class including ordinary, preference, participating, non-participating, voting, non-voting or other class, and in the form of investment in securities convertible into share capital; and

(h) to invest, acquire, purchase, hold, divest, sale, hypothecate, pledge or otherwise transfer land and building and immovable property of any kind including any rights and interest therein.

(iii). The Investment Manager along with the Trustee shall, within a reasonable time from the date of execution of the Investment Management Agreement, appoint a Project Manager for the Trust, by execution of the Project Implementation and Management Agreement.

(iv). The Investment Manager shall oversee activities of the Project Manager with respect to compliance with the InvIT Regulations and the Project Implementation and Management Agreement and in terms of the InvIT Regulations and applicable law. The Investment Manager shall obtain a compliance certificate from the Project Manager in the form as may be specified by SEBI, on a quarterly basis or such other intervals as may be prescribed, under applicable law.

(v). The Trustee authorizes the Investment Manager to do all such other acts, deeds and things as may be incidental or necessary for the advancement or fulfilment of the investment objectives of the Trust, as set out in the Placement Document, in accordance with the InvIT Regulations and applicable law.

(vi). The Investment Manager shall have the power to issue and allot Units in accordance with the InvIT Regulations. The Investment Manager shall have the power to accept subscriptions to Units of the InvIT and issue and allot Units to Unitholders or such other persons and undertake all related activities under applicable law. Further, if the Investment Manager fails to allot or list the Units or refund subscription money within the time specified in the InvIT Regulations, it shall pay necessary interest to the Unitholders thereon, in accordance with applicable law. Further, the Investment Manager shall, subject to and only in accordance with the terms of the Trust documents and applicable law, have the power to transfer the Units.

(vii). The Investment Manager, acting on behalf of the Trustee, shall cause the depository to maintain a depository register.

(viii). The Investment Manager shall make such reserves out of the income or capital as it may deem proper, and any directions of the Trustee in this behalf whether made in writing or implied from their acts shall, so far as the applicable law may permit, be conclusive and binding.

(ix). The Investment Manager shall have the power to cause the Trust to borrow funds, including any subordinated equity, bonds or other fund from any person or authority (whether Government or otherwise, whether Indian or overseas) on such terms and conditions and for such periods and for the purpose of the Trust and the InvIT Assets, and shall have the power to hypothecate, pledge or create encumbrances, including any assignment of rights, of any kind on such securities held by the InvIT in such Holding Companies, and/or SPVs, or road infrastructure projects to be used as collateral security for any borrowings by the InvIT, subject to any approval of the Unitholders.

(x). The Investment Manager shall have the power to exercise all rights of the Trust in the InvIT Assets, including voting rights, rights to appoint directors, whether pursuant to securities held by it, or otherwise, in such manner as it deems to be in the best interest of the InvIT, and in accordance with the InvIT Regulations and applicable law. Additionally, if the InvIT has invested in infrastructure projects through the holding company or SPVs, then the Investment Manager, in consultation with the Trustee, shall appoint the majority of the directors of the Holding Company(ies) and/or the SPV(s), in accordance with the applicable law, as well as ensure that in every general meeting including the annual general meeting of any SPV or holding company, the voting of the InvIT is exercised, in accordance with the InvIT Regulations and applicable law.

(xi). The Investment Manager may use the services of external advisors and rely on the information provided in the due diligence process of assessing investment proposals as it deems necessary in its sole discretion.

(xii). The Investment Manager shall have the power to employ and pay at the expense of the Trust, any agent in any jurisdiction whether attorneys, solicitors, brokers, banks, trust, companies or other agents, without being responsible for the default of any agent if employed in good faith to transact any business.

(xiii). The Investment Manager may appoint any custodian in order to provide custodian services, and may permit any property comprised in the Trust to be and remain deposited with a custodian or with any person or persons in India or in any other jurisdiction subject to such deposit as authorised by the Trustee and permissible under the applicable law.

(xiv). The Investment Manager, in consultation with the Trustee, shall appoint and have the power to appoint, determine the remuneration and enter into, execute, deliver and terminate all documents and agreements, any contracts, agreements, including share purchase agreement, deed of right of first offer and refusal, escrow agreements, debt documentation, underwriting agreements and other Trust documents, any investment pooling agreement, agreement relating to strategic investments, co-investment agreements and other any and all documents and instruments containing customary terms including any amendments or supplements thereto as may be applicable with respect to the activities pertaining to the Trust in a timely manner and as per the provisions of the InvIT Regulations and applicable law.

(xv). The Investment Manager shall have the power and duty to pay all such duties, fees or taxes (and any interest or penalty chargeable thereon) as well as to create any reserves for future potential tax liability (and any such interest or penalty) out of the Trust's income, in accordance with Applicable Law. The Investment Manager shall exercise due care and prudence in payment of duties and taxes of the Trust and shall endeavour to ensure that there are no material outstanding dues in that behalf, except for any claim or demand made by any tax department or authority subsequently, or any amounts disputed in good faith.

(xvi). The Investment Manager shall have the power to pay Trust expenses out of the funds of the Trust, or all or any of the InvIT Assets, in such proportion as may be determined from time to time, and the Investment Manager shall be entitled to reimbursement of any such expenditure duly incurred.

(xvii). The Investment Manager shall have the power to take the opinion of legal / tax counsel in any jurisdiction

concerning any difference arising under the Investment Management Agreement or any matter in any way relating to the Investment Management Agreement or to its duties in connection with the Investment Management Agreement.

(xviii). Subject to applicable law, the Investment Manager shall have the power to:

(a) accept any property before the time at which it is transferable or payable;

(b) pay or allow any equity or claim on any evidence that it thinks sufficient;

(c) accept any composition or any security, movable or immovable, for any equity or other property;

(d) allow any time for payment of any equity; and

(e) subject to such approval as may be required from the Unitholders, compromise, compound, abandon, submit to arbitration or otherwise settle any equity account, claim or thing whatsoever relating to the Trust or the Investment Management Agreement.

(xix). Subject to the conditions laid down in any placement document and applicable law, the Investment Manager may retain or reinvest the invested capital portion of any proceeds received by the Trust from any holding company or SPV.

(xx). The Investment Manager may make rules to give effect to, and carry out the investment objectives, subject to applicable law. In particular, and without prejudice to the generality of such power, the Investment Manager may provide for all or any of the following matters, namely:

(a) manner of maintaining of the records and particulars of Unitholders;

(b) norms of investment by the Trust in accordance with the investment objectives of the Trust and in accordance with the powers and authorities of the Trustee as set out in the Trust Deed;

(c) matters relating to entrustment, deposit or handing over of any securities or SPVs of the Trust to any one or more custodians and the procedure relating to the holding thereof by the custodian;

(d) such other administrative, procedural or other matters relating to the administration or management of the affairs of the Trust and which matters are not, by their very nature, required to be included or provided for in the Trust Deed or by the management thereof and which matters are not inconsistent with the investment objectives;

(e) procedure for seeking the vote of the Unitholders either by calling a meeting or through postal ballot or otherwise; and

(f) procedure for summoning and conducting of meetings of Unitholders.

(xxi). Subject to applicable law, no Unitholder shall be entitled to inspect or examine the Trust's premises or properties without the prior permission of the Investment Manager. Further, no Unitholder shall be entitled to require discovery of any information with respect to any detail of the Trust's activities or any matter which may be related to the conduct of the business of the Trust and which information may, in the opinion of the Investment Manager, adversely affect the interest of other Unitholders.

(xxii). Investment Manager, on behalf of the InvIT, may buyback the Units from the Unitholders at the end of the term of the Trust or any other time or in any other manner in accordance with applicable law.

(xxiii). The Investment Manager shall provide the Trustee with advice and recommendations regarding the extension of loans from the Trust to the holding company and SPV and also subscription to debt securities or quasi-debt securities or any similar kind of securities issued by the holding company and SPV from the Trust or extension of loans from the Trust in compliance with applicable law.

(xxiv). The Investment Manager shall at all times comply with the SEBI circular dated September 11, 2023 in letter and spirit, as amended from time to time.

(xxv). The Investment Manager shall facilitate the appointment of Unitholder Nominee Directors by Eligible Unitholders in the manner prescribed under the InvIT regulations from time to time.

(xxvi). The Investment Manager shall also have the following powers and authorities:

(a) to institute, conduct, compromise, compound, or abandon any legal proceedings for or on behalf of or in the name of the Trust, and to defend, compound or otherwise deal with any such proceedings against the Trust or the Investment Manager or their officers or concerning the affairs of the Trust, and also to compound and allow time for payment or satisfaction of any equity due and of any claims or demands by or against the Trust and to refer any differences to arbitration and observe and perform any awards thereof;

(b) to make and give receipts, releases and other discharges for moneys payable to the Trust and for the claims and demands of the Trust;

(c) to enter into all such negotiations and contracts, and, execute or terminate and do all such acts, deeds and things for or on behalf of or in the name of the Trust as it may consider expedient for or in relation to any of the matters or otherwise for the purposes of the Trust;

(d) to ascertain, appropriate, declare and distribute or reinvest the surplus generally or under the Trust, to determine and allocate income, profits and gains in respect of the Trust to and amongst the Unitholders, to carry forward, reinvest or otherwise deal with any surplus and to transfer such sums, as it may deem fit, to one or more reserve funds which may be established by it;

(e) to open one or more bank accounts and demat accounts for the purposes of the Trust, to deposit and withdraw money, and fully operate and manage any such account fully;

(f) to sign, seal, execute, deliver and register according to applicable law all deeds, documents, and assurances in respect of the Trust;

(g) pay out of the income of the Trust, after deducting all expenses, the income and other distributions in accordance with the InvIT Regulations and applicable law;

(h) take into their custody or control all the capital, assets, property of the Trust and hold the same in trust for the Unitholders in accordance with the Trust Deed, applicable law and the InvIT Regulations;

(i) generally to exercise all such powers as it may be required to exercise under the InvIT Regulations and applicable law for the time being in force and do all such matters and things as may promote the investment objectives of the Trust or as may be incidental to or consequential upon the discharge of its functions and the exercise and enforcement of all or any of the powers and rights under the Investment Management Agreement, Applicable Law and the InvIT Regulations;

(j) in accordance with applicable law, individually or collectively, with the Trustee, initiate, prosecute or defend any action or other proceedings in any court of law or through arbitration or in any other manner for recovery of debts or sums of money, right, title or interest, property, claim, matter or thing whatsoever now or hereafter to become due or payable or in any way and belonging to the Trust by any means or on any account whatsoever in respect of and pertaining to the investments made by it and the same actions or proceedings or suits to discontinue or settle, as it shall in its best judgment or discretion deem fit;

(k) to issue statement of accounts or Unit certificates (if requested) to the Unitholders on behalf of the Trustee in accordance with Applicable Law, to submit Units for dematerialisation and to make all applications and execute all documents with the depositories and depository participants as may be necessary in this regard;

(l) to set up such systems and procedures, and submit such reports, as may be required by the Trustee as necessary for effective monitoring of the functioning of the Trust.

2. *Duties of the Investment Manager*

The Investment Manager shall perform its duties as required under the Investment Management Agreement in accordance with the InvIT Regulations, including but not limited to:

(i). The Investment Manager shall use best endeavours to carry on and conduct its business in a proper and efficient manner in the best interest of the Unitholders. Further, it shall at all times exercise due diligence in carrying out its duties and protecting the interest of the Unitholders.

(ii). The Investment Manager shall coordinate with the Trustee, as may be necessary, with respect to the operations of the InvIT.

(iii). The Investment Manager shall ensure that the valuation of the InvIT Assets is done by the valuer(s) and the valuer(s) acts in accordance with the InvIT Regulations. The Investment Manager shall further ensure that the valuer is not an associate of the Investment Manager and shall be eligible to act as a valuer in accordance with the InvIT Regulations or any clarifications, guidelines, notifications or exemptions issued by SEBI. The Investment Manager shall submit to the stock exchanges valuation reports as required under the InvIT Regulations within fifteen days of the receipt of the valuation report from the valuer. Further, in case of any material development that may have an impact on the valuation of the assets of the InvIT, the Investment Manager shall require the valuer to undertake full valuation of the infrastructure project under consideration within not more than two months from the date of such event and disclose the same to the Trustee and the designated stock exchanges within fifteen days of such valuation.

(iv). The Investment Manager shall arrange for adequate insurance coverage for the InvIT Assets in accordance with the InvIT Regulations. The Investment Manager shall ensure that the InvIT Assets held by the holding companies or the SPVs are adequately insured.

(v). The Investment Manager shall maintain proper books of accounts, documents and records with respect to the Trust, to give a true, fair and accurate account of the investments, expenses, earnings, profits etc. of the Trust. The Investment Manager shall ensure that audit of the accounts of the Trust by the auditors is undertaken in accordance with the InvIT Regulations and such report is submitted to the stock exchange(s) within the time stipulated by the stock exchange(s), if any, and in accordance with the InvIT Regulations.

(vi). The Investment Manager shall declare distributions to Unitholders in accordance with the InvIT Regulations. Subject to applicable law, such percentage of the net distributable cash flows of the SPVs shall be distributed to the Trust in terms of the InvIT Regulations. Such declared distributions shall be made within the time period prescribed by the InvIT Regulations.

(vii). The Investment Manager shall convene meetings of the Unitholders and maintain records pertaining to the meetings in accordance with the InvIT Regulations and other applicable law.

(viii). The Investment Manager shall intimate the Trustee prior to any change in control of the Investment Manager to enable the Trustee to seek prior approval from the Unitholders and SEBI, if required under applicable law in this regard, and shall ensure that no such change is given effect to until the approval of the Unitholders and SEBI has been obtained, or the Investment Management Agreement is terminated and a new investment manager has been appointed.

(ix). The Investment Manager will monitor the Trust, including monitoring current and projected financial position of the Trust and the InvIT Assets, including the SPVs. The Investment Manager shall place before its board of directors, a report on the activity and performance of the Trust, in accordance with the InvIT Regulations. The Investment Manager shall designate an employee or a director as the compliance officer for monitoring of compliance with the InvIT Regulations and any circulars or guidelines issued thereunder and intimating SEBI in case of non-compliance.

(x). The Investment Manager shall maintain records pertaining to the activity of the Trust in terms of the InvIT Regulations.

(xi). The Investment Manager shall manage the Trust in accordance with the InvIT Regulations and the investment objectives of the Trust, and shall ensure that the investments made by the Trust are in accordance with the investment conditions enumerated in the InvIT Regulations, applicable Law and in accordance with the investment objectives and the investment strategy set out in the placement documents. The Investment Manager may review, revise, amend, vary or alter the investment objectives or the investment strategy set out in the placement documents.

(xii). The Investment Manager shall review the transactions carried out between the Project Manager and its associates and where the Project Manager has advised that there may be a conflict of interest, shall obtain confirmation from a practising chartered accountant or a valuer, as applicable, that such transaction is on an arm's length basis.

(xiii). The Investment Manager shall ensure adequate and timely redressal of all Unitholders' grievances pertaining to the activities of the InvIT in accordance with the InvIT Regulations.

(xiv). The Investment Manager shall submit to the Trustee:

(a) quarterly reports on the activities of the Trust including receipts for all funds received by it and for all payments made, status of compliance with the InvIT Regulations, performance report, status of development of under-construction projects, within the time period specified under the InvIT Regulations;

(b) valuation reports as required under the InvIT Regulations within the time period specified under the InvIT Regulations;

(c) proposal/decision to acquire, sell or develop, or bid for any asset or project or expand existing completed assets or projects along with rationale for the same;

(d) details of any action which requires approval from the Unitholders as may be stipulated under the InvIT Regulations;

(e) details of transactions it enters into with its associates;

(f) details of any other material fact including change in its directors, change in its shareholding, any legal proceedings that may have a significant bearing on the activity of the Trust, within such period as stipulated under applicable law;

(g) such information, document and records as pertaining to the activities of the Trust as may be reasonably necessary for, and sought by, the Trustee with respect to its responsibilities under the Trust Deed, the InvIT Regulations and Applicable Law; and

(h) such other information, document and records as pertaining to its activities, obligations, duties and responsibilities under the Investment Management Agreement, the InvIT Regulations and applicable law, as may be reasonably necessary for, and sought by, the Trustee.

(xv). The Investment Manager shall be responsible for all activities pertaining to any issue and listing of the Units of the InvIT in accordance with applicable law, including:

(a) filing the placement document with SEBI and/or the stock exchange(s) within the prescribed time period;

(b) dealing with all matters up to the allotment of Units to the Unitholders;

(c) obtaining in-principle approval and final listing and trading approvals from the designated stock exchange; and

(d) dealing with all matters relating to the issue and listing of the Units.

(xvi). The Investment Manager shall also ensure that all relevant provisions of the InvIT Regulations and applicable law have been complied with and all statements and disclosures made in any placement document are material, true, correct, not misleading and are adequate disclosures in order to enable the investors to make an informed decision and are in accordance with the InvIT Regulations and applicable law, and such placement document should not contain any untrue statement of a material fact or omit to state a material fact necessary in order to make the statements therein, in the light of the circumstances under which they were made, not misleading.

(xvii). In terms of the InvIT Regulations, the Investment Manager shall apply for delisting of units of the Trust to SEBI and the designated stock exchange in accordance with the InvIT Regulations and applicable law.

(xviii). The Investment Manager shall within the time period prescribed under the InvIT Regulations, submit an annual report to all the Unitholders electronically or provide physical copies and to the designated stock exchange.

(xix). The Investment Manager shall submit half-yearly reports within the time period prescribed under the InvIT Regulations to the stock exchange(s) and provide any information having bearing on the operation or performance of the Trust, as well as price sensitive information and other information that is required in terms of the InvIT Regulations and applicable law.

(xx). Subject to applicable law, the Investment Manager shall ensure that it shall discharge its obligations under the agreement and the InvIT Regulations in accordance with the corporate governance policies adopted by the Investment Manager in relation to the InvIT.

(xxi). The Investment Manager shall ensure that prior written consent of the trust lenders is obtained in accordance with the provisions of the trust financing documents.

(xxii). The Investment Manager will also have the following duties and obligations:

(a) ensure that computation and declaration of Net Asset Value of the Trust is based on the valuation done by the valuer in accordance with the InvIT Regulations and applicable law;

(b) maintain regular interaction with the Trustee regarding performance of the Trust and providing the Trustee with any information in relation to the operations of the Trust as maybe required under applicable law;

(c) conducting its affairs and the affairs of the Trust in such a manner that no Unitholder will have any personal liability (except to the extent of their Unitholding, where such Unit is partly paid) with respect to any liability or obligation of the Trust;

(d) keeping the Unitholders of the Trust informed and updated on investment activities of the Trust in accordance with the terms of the InvIT Documents;

(e) collecting all dividends, fees, property and other payments due and receivable by the Trust declaring distribution to the Unitholders in the manner set out in the Deed and in terms of the InvIT Regulations and applicable law;

(f) to ensure that no commission or rebate or any other remuneration, by whatever name called, arising out of transactions pertaining to the Trust is collected by it or its associates for the purpose of the issue of the Units;

(g) to ensure that the InvIT Assets including the holding companies and the SPVs, have proper legal titles, to the extent applicable, and that all the material contracts entered into on behalf of the Trust or the InvIT Assets are legal, valid, binding and enforceable by and on behalf of the Trust or the InvIT assets, as applicable;

(h) to ensure that all the activities of the intermediaries or agents or service providers appointed by it are in accordance with the InvIT Regulations or any guidelines or circulars issued thereunder;

(i) to ensure that any possible conflict of interest involving its role as Investment Manager is reported to the Trustee;

(j) to ensure that disclosures or reporting to Unitholders, SEBI, the Trustee and the designated stock exchange(s) are in accordance with the InvIT Regulations and applicable law;

(k) provide SEBI, the designated stock exchange(s) and Trustee, where applicable, such information as may be sought by SEBI or by the designated stock exchange(s) or Trustee pertaining to the activity of the Trust;

(l) submit a compliance certificate to the Trustee, in the form and at such intervals as may be specified under the InvIT Regulations and applicable law;

(m) to inform the Trustee in writing about any change in the representations and warranties provided under the Investment Management Agreement; and

(n) take any other actions reasonably incidental to any of the foregoing, or necessary or convenient in order to fully effect or evidence any action or transaction contemplated under the Investment Management Agreement.

(xxiii). Related Party Transactions: The Investment Manager shall provide such assistance to ensure that all related party transactions shall be on an arms-length basis in accordance with relevant accounting standards, in the best interest of the Unitholders, consistent with the strategy and investment objectives of the InvIT and in accordance with the InvIT Regulations.

(xxiv). The Investment Manager shall provide to the Trustee such assistance as may be required by the Trustee in fulfilling its obligation towards the Trust under applicable law or as may be required by any regulatory authority with respect to the Trust.

(xxv). The Investment Manager shall rectify any delay or discrepancy or non-compliance of reporting or disclosures requirements under the InvIT Regulations and applicable law on an urgent basis.

(xxvi). Disclose to the Trustee any pending business transactions, contracts under negotiation and other arrangements with the valuer and any other factors that may interfere with the valuer's ability to give an independent and professional valuation of the assets.

3. *Liabilities of the Investment Manager*

The liabilities of the Investment Manager in terms of the Investment Management Agreement are as follows:

(i). The Investment Manager shall not be liable in respect of any action taken or damage suffered by it on reliance upon any notice, resolution, direction, consent, certificate, affidavit, statement, certificate of stock, plan of reorganization or, without being limited in any way by the foregoing, other paper or document believed to be genuine and to have been passed, sealed or signed by appropriate authorities or entities.

(ii). The Investment Manager shall not be liable to the Unitholders for doing or failing to do any act or thing which by reason of any provision of any present or future law or regulation made pursuant thereto, or of any decree, order or judgment of any court, or by reason of any request, announcement or similar action, whether of binding legal effect or not, which may be taken or made by any person or body acting with or purporting to exercise the authority of any government (legally or otherwise) it shall be directed or requested to do or perform or to forbear from doing or performing. If for any reason it becomes impossible or impracticable to carry out any of the provisions of the Investment Management Agreement, the Investment Manager shall not be under any liability.

(iii). The Investment Manager shall not be liable to the Unitholder or any of them or to any other party as a result of such compliance or in connection with such compliance if the Investment Manager is required by the InvIT Regulations or applicable law to provide information regarding the Trust or the Unitholders, the Trust investments and income therefrom and provisions of these presents and complies with such request in good faith, whether or not it was in fact enforceable. If permitted under Applicable Law and if reasonably practicable, the Investment Manager shall provide prior written notice to the Trustee and the relevant Unitholders of such disclosure requirement.

(iv). The Investment Manager shall not incur any liability for any act or omission which may result in a loss to a Unitholder by reason of any depletion in the value of the InvIT Assets or otherwise, except in the event that such loss is a result of fraud or gross negligence or wilful default on the part of the Investment Manager.

(v). The Investment Manager shall be liable to pay interest to the Unitholders at the rate as may be prescribed in the InvIT Regulations until the distribution is made, and such interest shall not be recovered in the form of fees or any other form payable to the Investment Manager by the Trust.

(vi). The Investment Manager shall continue to be liable for all of its acts of omission and commission with respect to the activities of the InvIT, notwithstanding surrender of registration of the InvIT to SEBI.

(vii). The Investment Manager shall be liable to any Unitholder for the authenticity of any signature or of any seal affixed to any endorsement or other document affecting the title to or the transmission of Units or interests in the Trust or of any investments of the Trusts or be in any way liable for any forged or unauthorized signature or seal affixed to such endorsement, transfer or other document, or for acting upon or giving effect to any such forged or unauthorized signature or seal. The Investment Manager shall be bound to require that the signature of any Unitholder to any document required to be signed by such Unitholder, under or in connection with these presents shall be verified to its reasonable satisfaction.

4. *Indemnity*

In addition to the fees, distributions and expense reimbursements herein described, the Trustee shall, from the Trust assets, indemnify and hold harmless the Investment Manager and its respective officers, directors, shareholders, partners, members, employees, advisors and agents ("**Indemnified Parties**") from and against any claims, losses, costs, damages, liabilities, suits, proceedings and expenses, including legal fees ("**Losses**") suffered or incurred by them by reason of their activities on behalf of the Trust, unless such Losses resulted from fraud, gross negligence, wilful default or wilful misconduct or breach of any obligations or duties under applicable law by the relevant Indemnified Party, as determined by a court of competent jurisdiction.

The Trustee, its directors, employees and officers ("**Trustee Party**") shall be indemnified by the Investment Manager against any and all direct and actual losses, actions, claims, suits, proceedings, damages, liabilities, costs and expenses including legal fees, incurred or suffered by the Trustee Party in connection with the breach of any of the terms of the Investment Management Agreement by the Investment Manager, or failure in furnishing information required by SEBI or any regulatory authority with respect to the Trust, or furnishing incorrect information by the Investment Manager under the InvIT Regulations or related to Trust including in any placement document, or arising out of gross negligence, wilful default or misconduct or fraud on part of the Investment Manager, in carrying out its obligations under the Investment Management Agreement, Trust Deed, the other Trust documents, any information memorandum, placement document and applicable law. The Trustee acknowledges and agrees that the aggregate maximum liability of the Investment Manager in each financial year, shall be limited to the aggregate fees paid to the Investment Manager for the immediately preceding one financial year, in accordance with the terms of the

Investment Management Agreement, provided that such aggregate maximum liability shall not be applicable in the event such liability of the Investment Manager to indemnify the Trustee Party for losses or damages suffered arises out of any gross negligence, wilful default or misconduct or fraud of the Investment Manager, as determined by a court of competent jurisdiction.

5. *Termination*

The Investment Management Agreement shall be effective from the date of execution of the Investment Management Agreement and shall terminate in accordance with the terms of the Investment Management Agreement. The appointment of the Investment Manager may be terminated by the Trustee or the Unitholders in accordance with the procedure specified under the InvIT Regulations.

(i). The Unitholders, other than any party related to the transactions and its associates holding not less than such percentage by value as specified under the InvIT Regulations, may apply in writing to the Trustee for removal of the Investment Manager.

(ii). Subject to the approval of Unitholders (if required) and compliance with other requirements under Applicable Law, the Investment Management Agreement may be terminated:

(a) by the Investment Manager by delivery of a prior written notice of 30 (thirty) business days to the Trustee, subject to appointment of new Investment Manager in accordance with the Investment Management Agreement and the InvIT Regulations;

(b) by the Trustee by delivery of a written notice to the Investment Manager at any time, upon breach of any of the terms, covenants, conditions or provisions of the Investment Management Agreement by the Investment Manager and a failure of the Investment Manager to cure the said breach within a period that is earlier of: (a) the period stipulated under applicable law, or (b) 90 business days; or such other period as may be mutually agreed to cure such breach;

(c) by the InvIT (acting through the Trustee) pursuant to a resolution of Unitholders; or

(d) by any Party by delivery of a written notice to the other Party upon the bankruptcy of such other Party, or if winding up or liquidation proceedings are commenced against such other Party, and such proceedings persist for a period of more than three months.

(iii). After approval from the Unitholders in accordance with the InvIT Regulations, the Trustee shall appoint a new investment manager and execute a new investment management agreement within three months from the termination of the previous investment management agreement in accordance with applicable law. The Trustee shall also ensure that the new investment manager stands substituted as a party in all documents to which the Investment Manager was a party, in relation to the Trust in its capacity as the Investment Manager. The Investment Manager shall remain in office until the appointment of a new investment manager. The Investment Manager shall continue to be liable for all of its acts, omissions and commissions during its tenure as Investment Manager, notwithstanding the termination of the Investment Management Agreement.

(iv). Upon removal or replacement of the Investment Manager, the Investment Manager shall, within a period of 90 (ninety) business days, transfer custody of the Trust to the Trustee and give the Trustee all books of accounts, correspondence, documents and records relating to the InvIT which the Investment Manager has in its possession. In the event of removal or resignation of the Investment Manager, the Investment Manager shall be entitled to receive Management Fees only up to the date of such removal or resignation.

(v). Notwithstanding anything contained hereinabove, (i) in the event that the offer of Units does not occur within the time period stipulated in the InvIT Regulations or such other date as may be mutually agreed to between the Investment Manager and the Trustee, or (ii) in the event of cancellation of registration of the Trust by SEBI, or (iii) winding up of the Trust, then the Investment Management Agreement shall automatically terminate without any liability on any party.

D. The Project Manager – National Highways InvIT Project Managers Private Limited

History and Certain Corporate Matters

National Highways InvIT Project Managers Private Limited was incorporated as a private limited company on March 9, 2021, under the Companies Act, 2013. The CIN of the Project Manager is U45201DL2021GOI378178.

Background of the Project Manager

The Project Manager is a wholly-owned subsidiary of NHAI.

The Project Manager shall (directly through the appointment of appropriate agents) undertake operations and management of the Trust, including making arrangements for the maintenance of assets held under the Trust. The Project Manager has been appointed as per the terms of the Project Implementation and Management Agreement.

Neither the Project Manager nor any of the promoters or directors of the Project Manager (i) is debarred from accessing the securities market by SEBI; (ii) is a promoter, director or person in control of any other company or a sponsor, investment manager or trustee of any other infrastructure investment trust or an infrastructure investment trust which is debarred from accessing the capital market under any order or direction made by SEBI; or (iii) is in the list of wilful defaulters published by the RBI.

Key terms of the Amended and Restated Project Implementation and Management Agreement

The Project Manager has entered into the Amended and Restated Project Implementation and Management Agreement, in terms of the InvIT Regulations, the key terms of which, are provided below.

1. *Scope of Services*

The scope of services of the Project Manager are as follows:

i. Whilst the primary obligation under the Concession Agreements remains with the SPV in the manner contemplated therein, the Project Manager shall ensure that the InvIT Assets are operated, maintained and managed as per the terms and conditions of the Concession Agreements, respective O&M Agreements and the InvIT Regulations, either directly or through the appointment and supervision of appropriate agents or contractors or consultants by the SPV or by the Project Manager, and perform obligations as stipulated therein. The Project Manager shall provide and/cause to procure and ensure procurement of all such services as are required to enable the SPV to perform its operation and maintenance related obligations under and in compliance with the Concession Agreements. The responsibilities and the scope of services of the Project Manager include, but not limited to, those specifically provided which may be modified from time to time.

ii. Costs and expenses to be paid to any third party (engaged by the SPV or Project Manager, on behalf of the Project SPV, with the consent of the Investment Manager) shall be borne by the SPV in accordance with the terms and conditions of the contract entered into between the SPV and such third party.

2. *Duties of the Project Manager*

The duties of the Project Manager in terms of the Project Implementation and Management Agreement and the InvIT Regulations are as follows:

i. The Project Manager shall undertake implementation, development, maintenance, operation and management of the InvIT Assets including making arrangements for the appropriate maintenance, either directly or through the appointment and supervision of agents or consultants, if any, as may be necessary for discharge of its duties under the terms of the Project Implementation and Management Agreement, the O&M Agreements and under the InvIT Regulations.

ii. The Project Manager shall facilitate and ensure, either directly or through appropriate agents or consultants engaged either by them or through the SPV, the progress of development, approval status and other aspects of the InvIT Assets that may be under development or, of any new projects, until its completion in accordance with any agreement that may be entered into in this regard, including the supervision of agents or consultants appointed for such purpose.

iii. The Project Manager shall discharge all obligations in respect of achieving timely completion of the infrastructure projects, wherever applicable, implementation, development, operation, maintenance and management of the infrastructure projects in terms of the O&M Agreements, the Project Implementation and Management Agreement and the InvIT Regulations.

iv. The Project Manager acknowledges that the Trustee and the Investment Manager will be overseeing the activities of the Project Manager in accordance with the InvIT Regulations and accordingly, the Project Manager shall extend complete coordination to enable the Trustee and the Investment Manager to perform such obligations in accordance with the InvIT Regulations. Further, the Project Manager shall provide relevant documents in connection with the Projects, including reports and compliance certificate(s), as may be specified, to the Investment Manager and the Trustee in accordance with the InvIT Regulations, in the form prescribed by SEBI or the Investment Manager, if any.

v. The Project Manager shall provide the Investment Manager with details of transactions carried out between itself and

its associates in relation to the Trust, and disclose any conflict of interest in such cases to the Investment Manager, in accordance with the InvIT Regulations.

vi. The Project Manager shall intimate the Trustee prior to any Change in Control of the Project Manager to enable the Trustee to seek approval from the relevant authority in accordance with the Concession Agreements or other project documents pertaining to the InvIT Assets, if applicable.

vii. The Project Manager shall provide to the Trustee and Investment Manager, or to such other person as the Trustee and/or the Investment Manager may authorise and direct, all information that may be necessary for each of them to maintain the records of the InvIT and as may be required for making submissions to SEBI or any other Governmental Authority, including with respect to relevant approvals, consents and other documents required in relation to the Projects and the reporting requirements under the InvIT Regulations, in a proper and timely manner, and in the format prescribed (if any), as required by the Trustee and /or Investment Manager.

viii. The Project Manager shall appoint one of its qualified employees acceptable to the Investment Manager and the SPV with adequate and appropriate experience as a principal contact for the board of directors of the SPV, the Trustee and the Investment Manager in relation to the Projects and the Services. The Project Manager shall receive directions and instructions from the Investment Manager, which directions or instructions shall have been issued by the Investment Manager on its own or on behalf of the Project SPV, and to take actions in relation to and ensure compliance with such directions and instructions and report back to the Trustee and the Investment Manager.

ix. The Project Manager shall at all times ensure that the transactions or arrangements entered into by the Project Manager with a related party are on an arm's length basis.

x. The Project Manager shall promptly inform the Parties in writing of any act, occurrence or event, which the Project Manager believes is reasonably likely to increase the cost of or the time for implementation taken in relation to any InvIT Asset, or materially to change the financial viability, quality or function of any InvIT Asset.

xi. If any defects are found in the maintenance, materials and workmanship of the Services provided under the Project Implementation and Management Agreement by the Project Manager and/or by the PM Agents, the Project Manager shall promptly, in consultation and agreement with the other Parties, regarding appropriate remedying of the defects, and at its own cost, repair, replace or otherwise make good (as any SPV shall, at its discretion, determine) such defects as well as any damage caused by such defect.

xii. The Project Manager shall be liable to the other Parties for any direct loss or damage attributable to the non-performance or breach of the obligations of the Project Manager including those of the PM Agents, under the Project Implementation and Management Agreement The Trustee and the Investment Manager acknowledge and agree that the aggregate maximum liability of the Project Manager shall be limited to the fees payable to the Project Manager in accordance with the terms of the Project Implementation and Management Agreement.

xiii. The duties of Project Manager shall also include the following:

a. providing the necessary certification as may be required under applicable laws and the InvIT Regulations;

b. facilitate and ensure execution and completion of activities in relation to any InvIT Assets under development in accordance with and in the manner contemplated in any agreement entered into by any or all the InvIT Assets;

c. exercising diligence and vigilance in carrying out its duties directly or through its agents/ contractors of the SPV and protecting the InvIT Assets;

d. keeping the Investment Manager informed on all matters which have a material bearing on the operations of the InvIT Assets, and attending meetings with the Investment Manager and/or the SPV, as may be required;

e. liaising with Governmental Authorities in respect of its obligations under the Project Implementation and Management Agreement and the O&M Agreements;

f. taking appropriate measures to mitigate the risks which may be encountered by the InvIT in respect of the InvIT Assets, including creation of risk registers and periodic risk auditors either directly or through its agents;

g. keeping proper records for actions taken in respect of the InvIT Assets; and

h. complying with the instructions of the Investment Manager and the Trustee and the provisions of the InvIT Regulations.

xiv. The Parties may, from time to time, agree to the provision of certain additional services to be rendered by the Project Manager. If, in the assessment of the Project Manager, such additional services are required for the purposes of carrying out its duties and obligations under the Project Implementation and Management Agreement, the O&M Agreements, and Applicable Law, the Project Manager shall notify the Parties in writing of such requirement, including the fee payable and the terms and conditions for such additional services, and obtain prior written approval of the Parties in this regard.

xv. In case of any inconsistency or discrepancy between the Project Implementation and Management Agreement and the O&M Agreements, the Project Manager shall bring the same into the notice of the Investment Manager. The Investment Manager shall issue instructions (in writing) for resolving the inconsistency, to the Project Manager. The Project Manager shall be bound to comply with the instructions of the Investment Manager.

xvi. Notwithstanding anything to the contrary contained in the Project Implementation and Management Agreement, nothing contained in the Project Implementation and Management Agreement shall be construed to limit or restrict the performance of any duties or obligations of the Project Manager, Investment Manager or the Trustee contained in the InvIT Regulations and other Applicable Law.

xvii. During the term of the Project Implementation and Management Agreement, in the event the representations provided by the Project Manager under the Project Implementation and Management Agreement, become untrue or incorrect or incomplete in any respect, the Project Manager shall, within a reasonable time, inform the Trustee and Investment Manager of such event.

xviii. The Project Manager shall promptly and periodically notify the Investment Manager regarding any deficiency in the services of the SPV Team or any third party contractor or service provider engaged either directly by the Project Manager or through the SPV, along with an assessment report covering, amongst others, the details of deficiency in service, remedial measures and financial impact on the Project SPV. Any such deficiency shall be remedied in the manner provided in the Project Implementation and Management Agreement.

xix. Other than on account of any non-compliance or deficiency, the Project Manager shall promptly notify the Investment Manager regarding any proposed change in the SPV Team along with an assessment report covering, amongst other things, rationale for the change and its assessment of the same and professional competence of the persons proposed to be appointed to the SPV Team. The Project Manager shall not grant consent for any change in the SPV Team without prior consultation with, and approval of, the Investment Manager, in accordance with the Project Implementation and Management Agreement.

3. *Indemnity*

The Trustee, the Investment Manager, the Project SPV and their respective directors, employees, officers and the InvIT ("**Indemnified Parties**") shall be indemnified by the Project Manager against any claims, suits, proceedings, losses, costs, damages, liabilities and expenses, including legal fee from and incurred or suffered by the Indemnified Parties in connection with the breach of any of the terms of the Project Implementation and Management Agreement by the Project Manager, or failure in furnishing information required by SEBI or any regulatory authority with respect to the InvIT, or furnishing wrong information by the Project Manager under the InvIT Regulations or related to InvIT including in any offer documents, or arising out of gross negligence, wilful default, wilful misconduct or fraud on part of the Project Manager, in carrying out its obligations under the Project Implementation and Management Agreement, the other InvIT Documents and Applicable Law. The Trustee and the Investment Manager acknowledge and agree that the aggregate maximum liability of the Project Manager in each financial year shall be limited to the fees payable to the Project Manager in such financial year in accordance with the terms of the Project Implementation and Management Agreement, provided that such maximum aggregate liability shall not be applicable in the event such liability of the Project Manager arises out of any gross negligence, wilful default, wilful misconduct or fraud on the part of the Project Manager, as determined by a court of competent jurisdiction.

4. *Termination*

(i). The Project Implementation and Management Agreement shall remain effective, unless terminated by the parties in accordance with the provisions hereto or extended by mutual consent expressed in writing by the parties, for the period that the concession agreement is in force or such other period as may be mutually agreed between the Parties ("**Validity Period**").

(ii). Prior to the expiry of its Validity Period, the Project Implementation and Management Agreement, may be terminated:

(a) by the Investment Manager after consultation with the Trustee by delivery of a written notice of 30 (thirty) business days, specifying the reasons for such termination, to the Project Manager at any time, subject to appointment of new project manager in accordance with the Project Implementation and Management Agreement and the InvIT Regulations; or

(b) by the Investment Manager after consultation with the Trustee by delivery of a written notice to the Project Manager at any time, upon breach of any of the terms, covenants, conditions or provisions of the Project Implementation and Management Agreement by the Project Manager and a failure of the Project Manager to remedy the said breach within a period of 60 Business Days or such other period as may be mutually agreed by the parties; or

(c) by any party by delivery of a written notice to the other party upon the bankruptcy of such other party or if insolvency resolution process, winding up or liquidation proceedings, whether voluntary or involuntary, are commenced against such other party (and such proceedings persist for a period of more than three months).

(iii). Notwithstanding anything contained hereinabove, the Trustee in consultation with the Investment Manager shall appoint a new project manager having satisfactory credentials and execute a new project implementation and management agreement within three months from the termination of the earlier project implementation and management agreement in accordance with applicable law. The Trustee and Investment Manager shall also ensure that the new project manager stands substituted as a party in all documents (including the O&M Agreements) to which the Project Manager was a party. The Project Manager shall remain in office until the appointment of a new project manager. The Project Manager shall continue to be liable for all its acts and omissions and commissions notwithstanding its termination until the appointment of a new project manager.

(iv). The termination of the Project Implementation and Management Agreement shall not affect the rights and obligations of the parties accrued prior to such termination.

(v). In case of early termination prior to the expiry of the Validity Period, the Project Manager shall be entitled to and the Trust shall be liable to pay (from the funds of the InvIT or the SPV) to the Project Manager the reimbursement of all out of pocket expenses incurred by the Project Manager while performing services in terms of the Project Implementation and Management Agreement up to that date. The fees shall be paid to the Project Manager within a period of 60 business days from the date of receipt of demand in this regard from the Project Manager failing which the fees, or any part thereof, which remains outstanding shall attract interest at the rate of 10% per annum on the outstanding amount.

(vi). Notwithstanding anything contained hereinabove, the termination of any of the O&M Agreements, as the case may be, will not result in the termination of Project Implementation and Management Agreement, and the Project Implementation and Management Agreement shall continue to be in force in respect of the other O&M Agreements that are not terminated and the InvIT Assets.

(vii). Notwithstanding anything herein contained, in the event of:

(a) any amendment or supplement or restatement of any of the O&M agreements or execution of a new O&M agreement;

the same shall be deemed to have been incorporated in the Project Implementation and Management Agreement and the Agreement shall stand modified to such extent.

(viii). Notwithstanding anything contained hereinabove, the Project Implementation and Management Agreement shall automatically terminate: (i) in the event the offer of the Units does not occur within the time period stipulated in the InvIT Regulations, or such other date as may be mutually agreed to between the parties; (ii) in the event of cancellation of the registration of the Trust by SEBI; or (iii) upon winding up of the Trust, in accordance with the InvIT Regulations.

In case of any inconsistency between the Project Implementation and Management Agreement or any InvIT Documents, and the InvIT Regulations or any applicable law, the InvIT Regulations or applicable law shall prevail.

CORPORATE GOVERNANCE

The section below is a summary of the corporate governance framework in relation to the Trust, adopted by the Investment Manager.

1. Investment Manager

1.1. Board of Directors

Composition of the Board of Directors of the Investment Manager

In addition to applicable provisions of the Companies Act, 2013, the board of directors should adhere to the following:

(a) The Board of Directors shall comprise of not less than six directors and have not less than one woman independent director*;
(b) Not less than 50% of the board of directors shall comprise of independent directors and not directors or members of the governing board of the Investment Manager of another infrastructure investment trust registered under the Securities and Exchange Board of India (Infrastructure Investment Trust) Regulations, 2014, as amended;
(c) the chairman of the board of directors should be a non-executive independent director; and
(d) collective experience of directors should cover a broad range of commercial experience, particularly experience in infrastructure sector (including the applicable sub-sector), investment management or advisory and financial matters.

** In terms of SEBI exemption letter dated February 21, 2024 the Investment Manager has been granted an exemption from appointing a woman independent director on the board of the Investment Manager in terms of Regulation 26(H) of the SEBI InvIT Regulations till March 31, 2024. For further information in relation to the risks associated with the regulatory framework governing infrastructure investment trusts, please see section entitled "Risk Factors" on page 70.*

Quorum

The quorum shall be 1/3rd of total strength or three directors whichever is higher including atleast 1(one) independent director.

Frequency of meetings

The board of directors should meet at least four times every year, with a maximum gap of 120 days between any two successive meetings. Additionally, the board of directors should meet prior to any meeting of the unitholders and approve the agenda for unitholders' meetings.

1.2. Remuneration of directors

Remuneration including sitting fees of the directors will be decided by the board of directors, from time to time.

1.3. Independent Directors

Independent Directors shall mean the independent directors who complies with requirements of SEBI InvIT Regulations, as amended from time to time.

1.4. Committees of the board of directors

(a). Audit Committee

Composition of the Audit Committee

The audit committee should comprise at least 2/3rd of independent directors and will comprise of at least three members. The chairperson of the audit committee should be an independent director. All members of the audit committee should be financially literate and at least one member should have accounting or related financial management expertise. The company secretary shall act as the secretary to the audit committee.*

**Pursuant to Regulation 26G of the InvIT Regulations introduced through amendment to the InvIT Regulations dated February 14, 2023, our audit committee was required to be re-constituted by April 1, 2023. However, we were able to undertake the re-constitution on October 18, 2023, due to operational issues. Accordingly, by way of e-mail dated December 13, 2023, the Investment Manager sought condonation*

for delay of reconstitution of the audit committee during the period from April 1, 2023 to October 17, 2023 and for relaxation from strict compliance with the requirement under Regulation 26G. However, SEBI by way of letter dated January 23, 2024 did not accede to the request for condonation of delay. For further information in relation to the risks associated with the regulatory framework governing infrastructure investment trusts, please see section entitled "Risk Factors" on page 70.

Quorum

The quorum shall either be 2 (two) members or 1/3rd of the members of the audit committee, whichever is greater, with at least two independent directors.

Frequency of meetings

The audit committee should meet at least four times every year, with a maximum gap of 120 days between any two successive meetings. Additionally, the audit committee should meet prior to any declaration of distributions and provide recommendations to the board of directors regarding any proposed distributions.

Scope of the Audit Committee

The terms of reference of the audit committee should include the following:

(i). recommending to the board of directors the appointment, re-appointment and replacement, remuneration and terms of appointment of the statutory auditor of the Trust and the audit fee, subject to the approval of the unitholders;

(ii). Approving the payment to statutory auditors for any other services rendered by the statutory auditors;

(iii). Discussion with statutory auditors before the audit commences, about the nature and scope of audit as well as post-audit discussion to ascertain any area of concern;

(iv). Evaluation of internal financial controls and risk management systems;

(v). reviewing and monitoring with the management, the independence and performance of statutory and internal auditors of the Trust, and adequacy and effectiveness of the audit process and internal control systems, as necessary;

(vi). Reviewing the adequacy of internal audit function, if any, including the structure of the internal audit department, staffing and seniority of the official heading the department, reporting structure coverage and frequency of internal audit;

(vii). Reviewing management letters/letters of internal control weaknesses issued by the statutory auditors and the findings of any internal investigations in relation to the Trust, into matters where there is suspected fraud or irregularity or a failure of internal control systems of a material nature, discussing such findings with internal and statutory auditors and follow ups thereon and reporting the matter to the board of directors;

(viii). Oversight of the Trust's financial reporting process and the disclosure of its financial information to ensure that the financial statement is correct, sufficient and credible;

(ix). Reviewing the annual financial statements and auditor's report thereon of the Trust and the Investment Manager, before submission to the board of directors for approval, with particular reference to:

- matters required to be included in the director's responsibility statement to be included in the board's report of the Investment Manager in terms of clause (c_) of sub-section (3) of Section 134 of the Companies Act, 2013;
- changes, if any, in accounting policies and practices and reasons for such change;
- major accounting entries involving estimates based on the exercise of judgment by management;
- significant adjustments made in the financial statements arising out of audit findings;
- compliance with listing and other legal requirements relating to financial statements;
- disclosure of any related party transactions; and
- modified opinions or qualifications in the draft audit report;

(x). reviewing, with the management, the Trust's financial disclosure and reporting process and all periodic financial statements, including but not limited to quarterly, half-yearly and annual financial statements of the Trust, whether standalone or consolidated or in any other form as may be required under applicable law, before submission to the board of directors for approval;

(xi). Reviewing the management's discussion and analysis of financial condition and results of operations;

(xii). Reviewing and evaluating the adequacy of financial controls, risk management systems and internal audit function if any of the Trust, including the structure of the internal audit department, staffing and seniority of the official heading the department, reporting structure coverage and frequency of internal audit;

(xiii). Reviewing, with the management, the statement of uses/application of funds raised through an issue of units by the Trust (including but not limited to public issue, rights issue, preferential issue, private placements, etc.) and any issue of debt securities, and the statement of funds utilised for purposes other than those stated in the offer documents/ notice, and making appropriate recommendations to the board of directors for follow-up action;

(xiv). (a) reviewing the procedures put in place by the Investment Manager for reviewing related party transactions, the indemnification of expenses or liabilities incurred by the Investment Manager, and the setting of fees or charges payable out of the Trust's assets, (b) reviewing the statement of significant related party transactions, submitted by the management; and (c) approving or any subsequently modifying transactions of the Trust with related parties, and recommending such transactions to the board of directors or the unitholders, as may be required, in terms of the InvIT Regulations;

(xv). Scrutiny of inter-corporate loans and investments of the Trust, including (a) reviewing the investment decisions with respect to the underlying assets or projects of the Trust from the Sponsor including any further investments or divestments and (b) approving any proposal in relation to acquisition of assets, further issue of units including in relation to acquisition or assets; and undertaking other functions to ensure protection of the interest of unitholders;

(xvi). Reviewing the utilization of loans and/ or advances from/investment by the Trust in the SPVs exceeding rupees 100 crore or 10% of the asset size of the SPVs, whichever is lower including existing loans / advances / investments;

(xvii). Valuation of undertakings or assets of the Trust, wherever it is necessary

(xviii). Giving recommendations to the board of directors regarding appointment, re-appointment and replacement, remuneration and terms of appointment of the valuer of the Trust; as well as reviewing and monitoring the independence and performance of the valuer of the Trust;

(xix). Providing recommendations to the board of directors regarding any proposed distributions, and evaluating any defaults or delay in payment of distributions to the unitholders or dividends by the Project SPV to the Trust and payments to any creditors or debenture holders of the Trust or the Project SPV, and recommending remedial measures; and

(xx). To review the functioning of the whistle blower mechanism;

(xxi). Approval of appointment of chief financial officer after assessing the qualifications, experience and background, etc. of the candidate;

(xxii). Consider and comment on rationale, cost-benefits and impact of schemes involving merger, demerger, amalgamation etc., on the Trust and its unitholders or Investment Manager and its shareholders.

(xxiii). Formulating any policy for the Investment Manager as necessary, in relation to its functions, as specified above.

(b). <u>Stakeholders' Relationship Committee</u>

Composition of the Stakeholders' Relationship Committee

The stakeholders' relationship committee should comprise at least three members. At least one member of the committee shall be an independent director. The chairperson of this committee shall be a non-executive director.

Quorum

The quorum shall be at least 50% of the members of the committee.

Frequency of meetings

The stakeholders' relationship committee should meet at least four times every year, or as frequently as determined by the board of directors or as directed by the trustee of the Trust, with a maximum gap of 120 days between any two successive meetings.

Scope of the Stakeholders' Relationship Committee

The terms of reference of the stakeholders' relationship committee should include the following:

(i) Consider and resolve grievances of the unitholders or debenture holders, including complaints related to the transfer/transmission of units, non-receipt of annual report, non-receipt of declared distributions and non-receipt of interest or principal repayment on debentures, general meetings;

(ii) Review of measures taken for effective exercise of voting rights by shareholders;

(iii) Review of any litigation related to unitholders' grievances;

(iv) Review of adherence to the service standards adopted by the listed entity in respect of various services being rendered by the Registrar & Share Transfer Agent;

(v) Review of the various measures and initiatives taken by the Trust or Investment Manager for reducing the quantum of unclaimed distributions and ensuring timely receipt of distribution warrants/annual reports/statutory notices by the unitholders of the Trust;

(vi) update unitholders on acquisition / sale of assets by the Trust and any change in the capital structure of the Project SPV;

(vii) Reporting specific material litigation related to unitholders' grievances to the board of directors;

(viii) Approve report on investor grievances to be submitted to the Trustee;

(ix) Undertaking all functions in relation to resolution of any conflicts of interest;

(x) Coordination with the unitholders on matters in connection with voting (including in respect of actions which require approval of the unitholders in accordance with applicable law); and

(xi) provide the unitholders with regular updates and information on the operation or performance of the Trust.

(c). *Nomination and Remuneration Committee*

Composition of the Nomination and Remuneration Committee[5]

The nomination and remuneration committee should comprise at least three members. All the members of the Committee shall be Independent directors. The chairperson of this committee shall be an independent director. Provided that the chairperson of the Board, may be appointed as a member of the Nomination and Remuneration Committee and shall not chair such Committee.

Quorum

The quorum shall be either 2(two) members or 1/3rd of the members of the Nomination and Remuneration Committee whichever is greater.

Frequency of meetings

The nomination and remuneration committee should meet atleast once or at a frequency as determined by the board of directors or as directed by the trustee of the Trust, with a maximum gap of 120 days between any two successive meetings.

Scope of the Nomination and Remuneration Committee

The terms of reference of the nomination and remuneration committee should include the following:

(i) ensuring compliance with the requirements of the Companies Act, 2013, Invit Regulations;

(ii) formulation of the criteria for determining qualifications, positive attributes and independence of a director, key managerial persons and other employees;

(iii) formulation of criteria for evaluation of performance of independent directors and the board of directors;

(iv) recommending to the board, all remuneration, in whatever form, payable to senior management;

(v) identifying persons who are qualified to become directors and who may be appointed in senior management in accordance with the criteria laid down, and recommend to the board of directors their appointment and removal;

(vi) making all recommendation in relation to appointment or re-appointment or replacement or removal of (a) independent directors; (b) any key managerial personnel; and (c) directors on the board of directors of the Project SPV;

(vii) formulating the following policies:

(a) the policy for appointment of independent directors (including the skills, knowledge, qualification and experience requirements, compensation model, performance parameters, process for appointment, evaluation and removal);

(b) the policy for nomination of directors on the board of directors of the Project SPV (including qualification and experience requirements, compensation model, performance parameters, process for appointment and removal);

(c) the human resources policy (in relation to employment terms including remuneration) for the key managerial personnel; and

(d) devising a policy on diversity of board of directors.

(viii) whether to extend or continue the term of appointment of the independent director, on the basis of the report of performance evaluation of independent directors.

(d). Risk Management Committee

The board of directors shall define the role and responsibility of the Risk Management Committee and may delegate monitoring and reviewing of the risk management plan to the committee and such other functions as it may deem fit such function shall specifically cover cyber security.
The Risk Management Committee shall have powers to seek information from any employee, obtain outside legal or other professional advice and secure attendance of outsiders with relevant expertise, if it considers necessary.

Composition of the Risk Management Committee

The Risk Management committee should comprise at least three members with majority of them being members of the board of directors, including at least one independent director. The chairperson of this committee shall be a member of the Board of Directors and senior executives may be member of committee

Quorum

The quorum shall be either 2 members or 1/3rd of the members of the committee, whichever is higher, including at least one member of the board of directors in attendance.

Frequency of meetings

The Risk Management committee should meet at least twice in a year or as frequently as determined by the board of directors or as directed by the trustee of the Trust, with a maximum gap of 180 days between any two successive meetings.

Scope of the Risk Management Committee

The terms of reference of the Risk Management committee should include the following:

(i) To formulate a detailed risk management policy which shall include:
(a) A framework for identification of internal and external risks specifically faced by the listed entity, in particular including financial, operational, sectoral, sustainability (particularly, ESG related risks), information, cyber security risks or any other risk as may be determined by the Committee.
(b) Measures for risk mitigation including systems and processes for internal control of identified risks.
(c) Business continuity plan.

(ii) To ensure that appropriate methodology, processes and systems are in place to monitor and evaluate risks associated with the business;

(iii) To monitor and oversee implementation of the risk management policy, including evaluating the adequacy of risk management systems;

(iv) To periodically review the risk management policy, at least once in two years, including by considering the changing industry dynamics and evolving complexity;

(v) to keep the board of directors informed about the nature and content of its discussions, recommendations and actions to be taken;

(vi) The appointment, removal and terms of remuneration of the Chief Risk Officer (if any) will be done as per the extant HR Policies of the Company by MD &CEO in consultation with the Risk Management Committee.

1.5. Operating Committee(s) of the Investment Manager

(a) Investment and Finance Committee

Composition of the Investment and Finance Committee

The investment committee will comprise at least three members, out of which one member shall be the chief executive officer of the Investment Manager, and at least one member shall be an independent director.

Quorum

The quorum shall be at least 50% of the members of the Investment and Finance Committee.

Frequency of meetings

The Investment and Finance Committee shall meet as and when expedient.

Scope of the Investment and Finance Committee

The terms of reference of the Investment and Finance Committee should include the following:

(i). Completing all legal, statutory and procedural formalities, including opening bank accounts, escrow accounts, approving and filing, where applicable, draft offer documents, offer documents and final offer documents with SEBI, the stock exchanges and such other authorities, as may be applicable, and making necessary amendments or alterations, therein in relation to a proposed issue of securities or units by the Company or the Trust, or any other forms or applications required to be filed with any other statutory agencies or relevant authorities in accordance with applicable law and do all acts in relation thereto;

(ii). to negotiate, finalise and settle and to execute where applicable and deliver or arrange the delivery of the draft placement memorandum, placement memorandum, final placement memorandum, the preliminary and final international wraps, the agreements and all other documents, deeds, agreements and instruments and any notices, supplements and corrigenda thereto, as may be required or desirable in relation to an issue of securities or units by the Company or the Trust;

(iii). to appoint and enter into arrangements with the trustee, sponsors, lead managers and any other agencies or persons or intermediaries in relation to a proposed issue of securities or units by the Company or the Trust and to negotiate and finalise the terms of their appointment;

(iv). to appoint the registrar and other intermediaries in relation to a proposed issue of securities or units by the Company or the Trust, in accordance with the InvIT Regulations and other statutory and/or regulatory requirements;

(v). to submit undertakings/certificates, make applications, seek or provide clarifications, obtain approvals and seek exemption, where necessary, to or from the Securities and Exchange Board of India, stock exchanges, Registrar of Companies and such other statutory and governmental authorities in connection with a proposed issue of securities or units by the Company or the Trust, where necessary and accept on behalf of the Board such conditions and modifications as may be prescribed or imposed by any of them while granting such approvals, consents, permissions and sanctions as may be required in relation to a proposed issue of securities or units by the Company or the Trust;

(vi). to give or authorise the giving by concerned persons of such declarations, affidavits, certificates, consents and authorities as may be required from time to times;

(vii). to seek, if required, the consent of the lenders, parties with whom the Project SPV has entered into various commercial and other agreements, all concerned government and regulatory authorities in India or outside India, and any other consents that may be required in connection with a proposed issue of securities or units by the Company or the Trust;

(viii). to issue all documents and authorise one or more officers of the Company to sign all or any of the aforestated documents;

(ix). to seek the listing of the units or other securities on any Indian stock exchange, submitting the listing application to such stock exchanges and taking all actions as may be necessary in connection with obtaining such listing and trading approval;

(x). to authorise the maintenance of a register of unitholders/shareholders;

(xi). authorizing and empowering authorized officers, for and on behalf of the Investment Manager, to execute and deliver, on a several basis, any agreements and arrangements as well as amendments or supplements thereto that the Authorized Officer considers necessary, desirable or advisable, in connection with a proposed issue of securities or units by the Company or the Trust, including, without limitation, engagement letter(s), memoranda of understanding, the listing agreements, the registrar's agreement, the depositories agreements, the placement agreement with the lead managers (and other entities as appropriate), the escrow agreement, confirmation of allocation notes and any agreement or document in connection thereto, and to make payments to or remunerate by way of fees, commission, brokerage or the like, the lead managers, registrar, escrow agents, accountants, auditors, legal counsel, depositories, trustees, custodians, credit rating agencies and all such persons or agencies as may be involved in or concerned with a proposed issue of securities or units by the Company or the Trust, if any; and any such agreements or documents so executed and delivered and acts and things done by any such Authorized Officer shall be conclusive evidence of the authority of the Authorized Officer and the Company in so doing; and

(xii). to do all such acts and deeds as may be required to issue units of the Trust in dematerialised form and to sign agreements and/or such other documents as may be required with the National Securities Depository Limited the Central Depository Services (India) Limited and such other agencies, as may be required in this connection.

1.6. Articles of Association of the Investment Manager

The articles of association should not include any affirmative rights for the Sponsor.

1.7. Policies to be adopted by the Board of Directors of the Investment Manager

The Investment Manager, through its Board or Committees, should adopt, among others, the following policies in relation to management of the Trust:

(i). Code of Conduct
(ii). Borrowing Policy
(iii). Policy in relation to related party transactions and conflict of interests - In relation to periodic reporting of associates of (i) Trustee and (ii) Sponsor, to Investment Manager, (i) the investment management agreement will include an obligation on the Trustee to report its list of associates to the Investment Manager; and (ii) the agreement in relation to transfer for assets to the Trust will include an obligation on the Sponsor to report its list of associates to the Investment Manager, respectively.
(iv). Distribution Policy

(v). Policy on appointment and removal of other Intermediaries
(vi). Policy on appointment of Auditor and Valuer of the Trust
(vii). Policy on Unpublished Price-Sensitive Information and Dealing in Units by the Parties to the Trust and Insider Trading
(viii). Policy on Materiality for periodic disclosures to the Stock Exchanges
(ix). Anti-bribery and Anti-corruption Policy
(x). Anti-money laundering policy
(xi). Environment, Health and Safety Policy
(xii). Hedging Policy
(xiii). Policy for Preservation of Documents
(xiv). Vigil Mechanism Policy including Whistle Blower policy
(xv). Familiarisation Programme for Independent Directors

2. Project SPV

2.1. Board of Directors of Project SPV

The Investment Manager, in consultation with the Trustee, shall appoint majority of the board of directors of the Project SPV.

Summary of certain policies, amongst others, as adopted by the board in relation to the management of the Trust:

(i). Code of conduct

The Trust and the Investment Manager ("**IM**") shall comply with the Code at all time, in accordance with the InvIT Regulations, for all matters for which they are dealing / acting on behalf of the Trust, including that:

1. the Directors and Senior Management Personnel of the IM are expected to comply with the code in letter and spirit.
2. the Directors and Senior Management Personnel of the IM shall comply with all applicable laws, regulations, confidentiality obligations and other corporate policies
3. the Directors and Senior Management Personnel of the IM shall not enter into any transaction or engage in any practice, directly or indirectly, that would tend to influence him/her to act in any manner other than in the best interests of the Trust or IM.
4. the Directors and Senior Management Personnel of the IM should make a full disclosure to the IM Board of any transaction that they reasonably expect, could give rise to actual conflict of interest with the Trust or the IM and seek authorization to pursue such transaction
5. the Directors and Senior Management Personnel of the IM should endeavor to ensure that they use the assets, proprietary information and resources of the Trust or IM only for legitimate business purpose and not for personal gains
6. any information concerning the IM's /Trust's business, performance, its customers, suppliers, etc., which is not in the public domain and to which the Directors/Senior Management personnel have access or possesses such information must be considered confidential and held in confidence, unless authorized to do so and when disclosure is required under any law.
7. the Directors and Senior Management Personnel shall neither receive nor offer or make, directly or indirectly, any illegal payments, remuneration, gifts, donations or comparable benefits which are intended to or perceived to obtain business or uncompetitive favours for the conduct of its business.
8. the Directors and Senior Management Personnel should endeavor to deal fairly and not seek to take unfair advantage through manipulation, concealment, abuse of privileged information, misrepresentation of material facts or other unfair dealing.
9. The Directors and Senior Management Personnel shall respect safety and health of all employees and provide working conditions, which are safe and healthy. They shall strive for maintaining a safe workplace by following safety and health rules and practices
10. The Directors and Senior Management Personnel shall endeavor to provide equal opportunities to all employees and aspirants for employment in the IM or Trust irrespective of gender, caste, religion, race or colour, merit being the sole differentiating factor.
11. The Directors and Senior Management Personnel shall endeavor to make all efforts to establish cordial relationships with all stakeholders of the Company with whom they interface while carrying out their duties for the Company and would try to make positive contributions to the communities in which they perform such duties.
12. None of the Directors or the Senior Management Personnel shall derive any benefit nor assist to derive any benefit by giving investment advice from access to and possession of information about the IM or Trust, which is not in public domain or constitutes insider information.
13. Every Director of the IM shall endeavor to comply with the provisions of Section 166 of the Companies Act, relating to the duties of directors.

(ii). Anti-Bribery And Corruption Policy

a. The Trust maintains and promotes the highest ethical and legal standards in its business, especially in relation to bribery and corruption, and expect employees of the Trust and those with whom the Trust does business to do the same.
b. The policy on bribery and corruption applies to the Trust's dealings in both the public and the private sectors, and any violation of this policy is a matter of serious concern.

Management oversight and leadership:

a. The Trust's audit committee, together with its chief executive officer, chief financial officer and Compliance Officer, are responsible for providing leadership, resources and active support for the implementation of the policy.
b. The compliance officer appointed to ensure compliance of the policy ("**Compliance Officer**"), who may be a person other than the compliance officer of the Trust appointed as per the requirements of Companies Act, 2013, as amended, will communicate the policy to all levels of the Trust, project SPVs of the Trust ("**Project SPV**") and relevant external parties at least annually, and at such other times as he considers appropriate, such as when the policy is amended or updated.

Definitions of bribery and corruption:

a. "ABC" means anti-bribery and corruption.
b. "Anti-Bribery Laws" means the ABC laws and regulations , which shall include, the Prevention of Corruption Act, 1988, relevant portions of the Indian Penal Code, 1860, the Central Vigilance Commission Act, 2003, applicable to, the Trust and its employees.
c. "Bribe / Bribery" means the giving, acceptance, solicitation or facilitation of a financial advantage to or by any person which (i) does or might induce, influence or reward the improper performance or non performance of any activity or function in either the public or private sector, (ii) which in itself constitutes the improper performance of a relevant function or activity, or (iii) is intended to obtain or retain business or a business advantage.
d. A promise or offer to give, accept, solicit or facilitate a financial advantage will also constitute Bribery. Equally, a violation may occur if you do anything which is prohibited through another person, as much as if you did it yourself.
e. A financial advantage may be anything of value. It can be a payment, payoff, influence payment or a 'kickback'. Equally, it may also take the form of a gift, hospitality or entertainment, or be something intangible, like an offer of employment.
f. "Corruption" means dishonest or fraudulent conduct by those in power, typically involving Bribery.
g. The term "Official" includes any person who holds a legislative, judicial or administrative position of any kind; any official, employee or representative of, or any other person acting in an official capacity or performing a public function on behalf of: a government (including any entity it owns or controls) or any government authority or agency; the legislature; the judiciary; a political party or political candidate; or a public international organization.

Prohibition on bribery:

a. The Trust prohibits:

   (i) Giving Bribes including:
   - Bribing someone to get a contract or other business advantage such as a license, consent or permit (including from that person or by using that person's influence);
   - Bribing any Official in order to influence any official decision, or to induce them to use their influence to affect any act or decision of a governmental authority; or
   - Bribing any officer, employee or agent of a company or body corporate with which the Trust interacts in the conduct of Trust's activities and operations for the purpose of influencing any act or decision of that company or body corporate.

   (ii) Receiving Bribes including:

   - Asking, agreeing to or receiving a Bribe from anyone in exchange for giving or continuing to give a person any business, or any business advantage, or for otherwise improperly performing any activity or function.

b. Circumstances which may suggest an increased risk of Bribery or Corruption and which should therefore be discussed with the Compliance Officer include:

   (i) Intermediaries (as defined below) engaged by the Trust which is accused of improper practices;
   (ii) A party with whom the Trust does business requests payment in cash or to offshore accounts;

(iii) Requests for payment, entertainment or hospitality at a time when the recipient is making an important decision that affects or could be perceived to affect the operations of the Trust;
(iv) Refusal by any Intermediary to use written agreements;
(v) Requests or directions to record (or issue receipts) for payments or fees in a manner which does not reflect their true nature;
(vi) Previous relationships between Trust's employees or Intermediaries and a government office or Official;
(vii) Requests for special payments, such as a 'special acceleration fee' or any other payment to reduce delay or remove the need to comply with applicable procedures.

c. The above examples are not exhaustive and any matters which give you cause for concern should be promptly raised with the Compliance Officer.

d. Practices that may appear typical or customary may still be unlawful and in breach of the policy.

e. The Trust should always consider whether any conduct may give an appearance that it creates an obligation on, or may influence, the recipient (or a third party) to act in a way that may be improper, or which may be perceived as being capable of influencing an Official exercise of discretionary authority, even where this is not the intention. Such conduct should be discussed with the Compliance Officer.

Dealing with intermediaries:

a. The term intermediaries ("**Intermediaries**") refers to an associate's representatives, vendors, contractors, sub-contractors, consultants and any other persons engaged by an associate, or who are engaged to act for the associate in its business dealings with any government or official, or in obtaining governmental approvals.
b. The Trust engages Intermediaries only for ordinary and legitimate business purposes and only on arms-length, commercially reasonable terms.
c. Any contracts between associates and Intermediaries must be in writing and must be signed by the parties.
d. Different types of Intermediaries are subject to different ABC risk assessment and risk mitigation measures. It is clarified that such provisions and procedures would be prepared by the Trust in consultation with the Compliance Officer which are to be followed when engaging an Intermediary and for the Trust's standard anti-bribery related contractual provisions which are to be included in the Trust's contracts with Intermediaries.

In general:

a. The Trust expects that Intermediaries and vendors with which it does business to either formally acknowledge and abide by relevant aspects of the policy by way of an undertaking, or to have adequate anti-bribery and corruption policies and procedures of its own in place.

b. When engaging an Intermediary, an associate should:

(i) perform proportionate and risk-based due diligence checks on the Intermediary based on an understanding of the potential relationship (e.g. the sector in which the Intermediary operates, the type of services it will be providing and the level of interaction it will have with Officials or private sector parties); and
(ii) consider and respond appropriately to the findings of that due diligence, particularly where areas of high concern are identified.

Charitable donations:

a. The Trust supports the work of registered and reputable charities.

b. However, unless appropriate procedures are adopted, there is a risk that charitable donations given by the Trust or its employees may be perceived as seeking to improperly influence decisions which affect the Trust, or to induce those who have authority to make such decisions to give an improper business advantage to the Trust.

c. The key principles regarding donations are as follows:

(i) donations must not be made using Trust's funds, under the Trust's name, or in connection with the Trust, without first obtaining specific approval from the Compliance Officer;
(ii) where making a donation as a private citizen, Trust's employee should ensure it is made clear to the recipient and in any publicly available material that the donation is not being made for or on behalf of the Trust, or in connection with the activities of the Trust; and
(iii) A donation should not be made either privately or by the Trust if the intent or possible effect of the donation is or may be to influence the decisions of any Official or other person on matters affecting the Trust.

d. All donations must be properly recorded and accounted for in the central register of political and charitable donations maintained by the Compliance Officer.

Gifts, Hospitality and Entertainment ("GH&E"):

a. The Trust recognizes that constructive business relationships may include occasional, incidental provision of gifts, hospitality and entertainment.

b. However, gifts, hospitality and entertainment which are or may be seen as exceptional, lavish or disproportionate, or given to certain individuals who have the ability to make decisions affecting the Trust, may be regarded as improper or unlawful.

c. As a general rule, gifts, hospitality and entertainment must:

(i) be reasonable and proportionate in terms of frequency, value and the status/seniority of the recipient;
(ii) be provided in an open and transparent manner; and
(iii) always be provided for legitimate business purposes and in kind only.

d. The Trust and its employees must not:

(i) offer gifts, hospitality and entertainment, or anything else of value, which might influence the decisions of counterparties or Officials in connection with the business of the Trust; or
(ii) accept any gifts, hospitality and entertainment, or anything else of value, which might influence their own decisions.

e. The Trust shall comply with GH&E at all time, in accordance with the InvIT Regulations, including that:

- GH&E which is or may be regarded as, exceptional, lavish or disproportionate and/or intended to induce or reward improper conduct is prohibited.
- Trust and its employees must not offer, provide, accept or solicit gifts in the form of cash, cash equivalents, commissions, loans, securities or goods/services at below-market value.
- The Trust must pay all costs associated with GH&E (e.g. transport, accommodation and meals) directly to suppliers and not to the recipients of the GH&E.
- GH&E must not be offered or provided to family members or friends of the recipient.
- Approval of GH&E, including GH&E relating to Officials, is required in accordance with the policy and must be obtained in advance of any offer or acceptance of GH&E. If circumstances clearly prevent obtaining advance approval, the GH&E must be reported to the Compliance Officer at the earliest available opportunity.
- Failure to comply with the policy may result in disciplinary action, including possible termination of employment.
- All GH&E must be properly recorded and accounted for in the books and records and must be supported by original receipts.
- All GH&E approval forms (whether approved or declined) must be held on file by the Compliance Officer for a period of five years.
- GH&E with a value in excess of Rs. 5,000 must be approved by the Compliance Officer and in excess of Rs. 10,000 must be approved by the managing director of the Trust, and all such GH&E shall be recorded by the Compliance in the annual GH&E central register.
- The annual GH&E central register must be submitted to, and reviewed annually by, the Audit Committee.

f. Trust's employees should consider the above guidelines in respect of all gifts, hospitality and entertainment which they propose to offer or accept.

Facilitation Payments:

a. The Trust is committed to complying with the laws applicable to its business. The trust acknowledges that facilitation payments, which usually are small payments made to obtain or expedite routine actions for specific performance, are not permitted under the laws of many jurisdictions and that authorities in many parts of the world are seeking to eliminate such practices.
b. If an employee of the Trust becomes aware that a facilitation payment may be made, this must be referred to the Compliance Officer, who will consider, consult as necessary and recommend action.
c. The Compliance Officer will report to the Audit Committee on any matters relating to facilitation payments.

Conflict of Interest:

a. Employees of the Trust must seek to avoid any real or perceived conflict between their private interests and the performance of their duties to the Trust.
b. A conflict of interest arises when an individual's private interests influence, or may appear to influence, the objective exercise of his or her duties to the Trust. Conflicts of interest can arise where, for example, an employee and/or the Trust is considering business arrangements involving the Trust which may provide the employee with a

private benefit, or where an employee position within the Trust gives them an opportunity to provide special advantages or benefits to a partner, child or friend.

c. If a situation arises which may give rise to a conflict of interest involving an employee, another employee or an external party in connection with matters affecting the Trust, the employee must promptly raise this with the Compliance Officer.

Books and Records:

a. The books and records of the Trust must reflect, accurately and fairly, the transactions of the Trust and dispositions of its assets, including ensuring that a transaction is accurately described in its books and records and the amount of each transaction is accurately recorded.
b. No payment on behalf of the Trust is to be approved or made with the express or implied agreement or the intention that any part of it is to be used for a purpose other than that described by the documents supporting the payment.
c. Employees should never agree to requests for false invoices or for payments of expenses that are unusual, excessive, inadequately or improperly described, or otherwise raise questions under the policy.
d. No undisclosed or unrecorded funds or assets are to be established or used for any purpose.

Training:

a. Employees of the Trust will receive regular (at least annual) training relevant to their role to ensure that they:

    (i) understand the Anti-Bribery Laws applicable to them;
    (ii) are aware of and understand the policy;
    (iii) are equipped to respond to the specific risks which relate to their particular role; and
    (iv) know what the Trust expects of them.

b. Where appropriate Intermediaries will also receive training appropriate to their role. The nature of such training and those Intermediaries who are to be subject to it will be determined by the Compliance Officer.
c. Employees of the Trust should check with the Compliance Officer in connection with engaging Intermediaries and any training obligations which apply.

Whistle-blowing, investigations and non-retaliation:

a. Employees and Intermediaries (anonymously or by name) who are aware of possible or suspected corrupt acts by colleagues, demands for Bribes or other violations of Anti-Bribery Laws or the policy must report these to the Compliance Officer or head of department. Any such reports will be promptly investigated by the Trust.
b. An employee of the Trust or Intermediary will not suffer demotion or any other adverse consequences for refusing to pay Bribes or for reporting in good faith possible corrupt acts by colleagues, demands for Bribes or other suspected violations of Anti-Bribery Laws applicable where the Trust operates or the policy, even if it may result in the Trust losing business.
c. Any Trust employee who retaliates, or attempts to retaliate, against a person who has made a report relating to a violation of Anti-Bribery Laws or the policy will be subject to disciplinary action, which may include termination of their employment with the Trust.

Compliance:

a. Any employee of the Trust who violates any Anti-Bribery Law or any aspect of the policy will be subject to disciplinary action, which may include termination of their employment with the Trust.
b. Employees of the Trust should understand that additionally, they could be subject to civil and criminal liability for violations of applicable law.
c. Violations of any Anti-Bribery Laws or the policy should be reported.

Continuous monitoring and improvement:

a. The Audit Committee and Compliance Officer are responsible for monitoring the implementation of, compliance with and periodic review and updating of the policy, including to comply with changes in Anti-Bribery Laws.

b. In line with this, the Compliance Officer will report:

- on a regular basis, on general compliance by the Trust with the policy and its effectiveness; and
- to the Audit Committee annually on the above matters in connection with the annual ABC risk assessment and audit.
- The Compliance Officer will also notify the Audit Committee should he/she become aware of any particular instance of non-compliance (or suspicion of non-compliance) with Anti-Bribery Laws or the policy.

- The Trust carries out an annual ABC risk assessment and audit to assess the effectiveness of the policy. The terms of reference of such audits are set annually by the Audit Committee, which will also oversee the annual audit. Where issues are identified, the Audit Committee will prescribe appropriate remedial measures to be implemented by the Trust in order to address these.
- Any material deficiencies in the policy which are identified by employees of the Trust during the year should be reported to the Compliance Officer for an appropriate action to be taken.

The Compliance Officer:

The Trust employs a Compliance Officer who is responsible for day to day implementation and oversight of the policy. Their responsibilities also include:

a. receiving and investigating reports of ABC-related incidents;
b. escalating known ABC issues to the Audit Committee, as appropriate;
c. reporting to the Audit Committee as set out above;
d. ensuring employees of the Trust complete ABC questionnaires and certifications (as relevant) in a timely manner;
e. maintenance of the central donations register and annual gifts, hospitality and entertainment register; conducting regular spot checks of compliance with the policy and the Trust's books and records;
f. providing guidance to Trust's employees on the policy; and
g. Record keeping in connection with the policy and associated training.

Advice and Assistance:

Employees should contact the Compliance Officer for advice and assistance on any matters relating to the policy.

Minimum Due Diligence Requirements:

In the event that the InvIT considers any new investment opportunity, independent and reputable consultants shall be engaged to conduct the respective due diligence for all key workstreams. The key workstreams include: (i) traffic, (ii) technical, (iii) financial and tax, (iv) legal and (v) anti-corruption and anti-bribery aspects, environmental health safety aspects and compliance as well as (vi) reputational risk assessment of a remaining existing minority unitholder in an asset, if any.

KYC Compliances:

Any person who is a unitholder in the Trust or any Project SPV holding the Trust assets would be required to comply with the stringent KYC norms that is in line with international market standards and customary policies of global financial institutions of repute, including sanctions enacted by OFAC or the European Union or other similar bodies. Any person who does not meet these requirements is not eligible to become a unitholder/shareholder of these entities or be appointed as Investment Manager or Project Manager.

Reporting of Litigation:

Relevant information (e.g. parties, forum, nature of dispute/claim, monetary amount involved and status) pertaining to all litigations/disputes (matters above a monetary threshold of ₹ 80 million) of all Project SPVs shall be prepared on a quarterly basis, and be made available to all the unitholders, if requested for by any unitholder.

Compliance with InvIT Documents and InvIT Regulations:

All current and future Project SPVs shall amend their respective Articles of Association to include a requirement that the Project SPVs shall, at all times, conduct their affairs in compliance with the provisions of the Trust documents and the Securities and Exchange Board of India (Infrastructure Investment Trusts) Regulations, 2014, as amended.

(iii). Borrowing Policy

The Investment Manager is required to ensure that all funds borrowed in relation to the Trust are in compliance with the InvIT Regulations. Accordingly, the Investment Manager, has adopted the Borrowing Policy pursuant to the resolution of the IM Board dated February 3, 2021. The Borrowing Policy was subsequently amended pursuant to resolution of the IM Board dated September 27, 2021.

(iv). Distribution policy

The Investment Manager has adopted the Distribution Policy pursuant to a resolution of its board of directors dated February 3, 2021, in relation to Trust. The Distribution Policy was subsequently amended pursuant to the resolution of the IM Board dated September 27, 2021 and thereafter on March 4, 2024. For details of the Distribution Policy, please see the section entitled "*Distribution*" on page 302.

(v). Policy on appointment of auditor and valuer of the Trust

For details on the Policy on appointment of the auditor and the valuer of the Trust, adopted by the IM Board pursuant to its resolution dated February 3, 2021, see "*Other Parties Involved in the Trust – Policy on Appointment of Auditor and Valuer*" on page 142.

(vi). Policy on unpublished price-sensitive information and dealing in units by the parties to the Trust

The Investment Manager has adopted the UPSI Policy pursuant to a resolution of the IM Board on February 3, 2021. The UPSI Policy was subsequently amended pursuant to resolutions of the IM Board dated September 27, 2021, March 30, 2022 and January 4, 2023. The purpose of the policy is, inter alia, to ensure that the Trust complies with applicable law, including the InvIT Regulations or such other Indian laws, regulations, rules or guidelines prohibiting insider trading and governing disclosure of material, unpublished price sensitive information ("**UPSI**").

The key principles of the UPSI Policy are set out below:

a) The Investment Manager shall promptly disclose to the relevant stock exchanges all UPSI that would impact price discovery no sooner than credible and concrete information comes into being in order to make such information generally available;

b) The Investment Manager shall follow uniform and universal dissemination of UPSI to avoid selective disclosure;

c) The Company Secretary and Compliance officer shall be designated as a Chief Investor Relations Officer who shall be responsible for dissemination of information and disclosure of UPSI. The Chief Investor Relations Officer shall oversee and co-ordinate disclosure and dissemination of UPSI in a timely, adequate, uniform and universal manner to avoid selective disclosure, and shall educate employees on disclosure policies and procedures.

d) The Investment Manager shall promptly disseminate UPSI that gets disclosed out of accidental omission, selectively, inadvertently or otherwise to make such information generally available.

e) The Compliance Officer shall be responsible for deciding whether a public announcement is necessary for verifying or denying rumours and then making the disclosure, in accordance with the procedure specified in the Policy for Determining Materiality of Information for Periodic Disclosures and applicable law;

f) The Compliance Officer shall also make an appropriate and fair response to the queries, rumours or requests by the regulatory authorities, in accordance with the procedure specified in the Policy for Determining Materiality of Information for Periodic Disclosures. The Chief Investor Relations Officer should not comment on market rumours except when requested by regulatory authorities to verify such rumours;

g) The Compliance Officer shall make transcripts or records of proceedings of meetings with analysts and other investor relations conferences on the official website to ensure official confirmation and documentation of disclosures made; and

h) The Investment Manager shall handle all UPSI on a "need to know basis", provided that UPSI may be disclosed to persons who need such information for furtherance of legitimate purposes, performance of duties or discharge of legal obligations in relation to the Trust.

Further, the UPSI Policy also provides the process and procedures for closure of the trading window for dealing in Securities, pre-clearance of dealing in securities and approval requirements, disclosure by insiders, inquiry into leak of any UPSI and handling and investigation into complaints by whistleblowers.

(vii). ***Employment, Safety, Environment and Governance ("ESG") Policy***

The key principles of the ESG Policy are set out below:

Employment, Health and Safety ("EHS"):

In connection with EHS, the Investment Manager shall:

- Promote a positive EHS culture.
- Comply with all statutory and other applicable legal and regulatory requirements with respect to EHS and seeks to ensure its Intermediaries do the same.
- Incorporate EHS considerations in business processes, including by ensuring appropriate health and safety measures are adopted, ensuring employees are provided with, and use, protective equipment when dealing with potential hazards, and by the provision of regular occupational health and safety training for employees.

- Identify, monitor and control EHS risks which arise in connection with its projects and operations, including in subcontracted works.
- Record and review all accidents, occupational health and safety related incidents and lost time days and investigate all serious occupational health and safety incidents, including in subcontracted works.
- Ensure that all of its workplaces which are exposed to high-risk hazards have appropriate emergency plans in place.
- Screen, evaluate and engage Intermediaries based on its EHS management systems and practice.
- Encourage communication, consultation and collaboration with all employees and stakeholders.

Workers' Rights:

To achieve the Trust's objective in connection with workers' rights, the Investment Manager shall:

- Respect the rights of its employees, including by providing fair and timely wages, supporting their work-life balance, providing safe working conditions, fostering worker engagement, including by the provision to employees of information on workers' rights and of mechanisms to raise employment related grievances, and permitting freedom of association.
- Prohibit the use of any child or young workers and the use of any form of forced or compulsory labour in connection with its business.
- Prohibit all forms of discrimination and abuse in its work place.
- Complies with all statutory and other applicable legal and regulatory requirements with respect to workers' rights.
- Have in place policies governing the provision to its employees of overtime, vacation and public holidays and maternity, sickness and disability benefits.
- Protect the rights of migrant workers in accordance with applicable statutory and other legal requirements.
- Screen, evaluate and engage Intermediaries based on their respect for workers' rights.
- Monitor compliance with and risks to workers' rights in connection with Projects, including in subcontracted works.
- Encourage communication, consultation and collaboration with all employees and stakeholders.

The Environment:

To achieve the Trust's objective in connection with the environment, the Investment Manager shall:

- Seek to adopt sustainable and resource-efficient processes and to conserve natural resources, reduce adverse environmental impacts (such as waste and environmental emissions) and enhance energy efficiency.
- Comply with all statutory and other applicable legal and regulatory requirements with respect to the environment (including by seeking all required environmental clearances, permits, and licenses, and maintaining a register of these) and seek to ensure Intermediaries do the same.
- Seek to identify, monitor and control environmental risks which arise in connection with its projects and operations, including in subcontracted works.

Dealing with Intermediaries:

The term intermediaries ("**Intermediaries**") refers to an associate's representatives, vendors, contractors, sub-contractors, consultants and any other persons engaged by an associate, or who are engaged to act for the associate in its business dealings with any government or official, or in obtaining governmental approvals.

In general:

- The Trust expects that Intermediaries and vendors with which it does business either formally acknowledge and abide by relevant aspects of this policy by way of an undertaking, as suitably incorporated in their appointment terms, or to have adequate ESG policies and procedures of their own in place.
- When engaging an Intermediary, the associate should:
  - perform proportionate and risk-based due diligence checks on the Intermediary; and
  - consider and respond appropriately to the findings of that due diligence, particularly where areas of high concern are identified.

Training:

The Trust's employees will receive training to ensure they understand applicable ESG law, are aware of and understand this policy, are equipped to respond to specific risks which relate to their particular role and know what the Trust expects of them. Where appropriate, Intermediaries will also receive training appropriate to their role.

Process for reporting possible violations of applicable law or this policy:

The Trust will promptly investigate reports of possible or suspected violations of applicable ESG law or this policy in accordance with this policy. Employees or Intermediaries will not be demoted or suffer any other unfavourable treatment as a result of making a good faith report of a possible violation of applicable law or this policy, even if it may result in the Trust losing business. If any employee of the Trust violates this policy or retaliates against another employee who has reported a possible violation of applicable law or this policy then they will be subject to disciplinary action, which may include termination of employment.

Management leadership, oversight, implementation and review:

The Audit Committee, together with its chief executive officer, chief financial officer and compliance officer are responsible for providing leadership, resources and active support for the implementation of this policy. The compliance officer appointed to ensure compliance of the ESG Policy ("**Compliance Officer**"), who may be a person other than the compliance officer of the Trust appointed as per the requirements of Companies Act, 2013, as amended, will communicate this policy to the Trust and relevant external parties at least annually, and at other appropriate times, such as when this policy is amended or updated. The Audit Committee will oversee compliance with this policy. The Compliance Officer is responsible for its day to day implementation. The Trust shall have an annual ESG risk assessment and audit to assess the effectiveness of this policy. The terms of reference of such audits are set annually by the Audit Committee, which will also oversee the annual audit. Where issues are identified, the Audit Committee will prescribe solutions to be implemented by the Trust. The Compliance Officer will report on general compliance with this policy and its effectiveness on a regular basis to the Audit Committee annually in connection with the annual ESG risk assessment and audit. The Compliance Officer will also notify the Audit Committee should they become aware of any non-compliance (or potential non-compliance) with applicable law or this policy. If an employee identifies a deficiency in this policy they should report it to the Compliance Officer who will initiate appropriate action.

Advice and assistance:

Employees should contact the Compliance Officer for advice and assistance on any matters relating to this policy.

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OTHER PARTIES INVOLVED IN THE TRUST

The Auditor

Background and terms of appointment

The Investment Manager, in consultation with the Trustee, has appointed A.R. & Co., Chartered Accountants (Firm Registration No. 002744C), as the statutory auditors of the Trust for a period of three years commencing from Fiscal financial year 2022-23 till financial year 2024-25. The Auditors have audited the Audited Financial Information, and their reports in relation to such Audited Financial Information dated August 18, 2021, May 23, 2022, May 22, 2023 and March 4, 2024 have been included in this Placement Document.

Functions, Duties and Responsibilities of the Auditor

The functions, duties and responsibilities of the Auditor will be in accordance with the InvIT Regulations. Presently, in terms of the InvIT Regulations, the Auditor is required to comply with the following conditions at all times:

1. the Auditor shall conduct audit of the accounts of the Trust and draft the audit report based on the accounts examined and after taking into account the relevant accounting and auditing standards, as may be specified by SEBI;

2. the Auditor shall, to the best of his information and knowledge, ensure that the accounts and financial statements give a true and fair view of the state of the affairs of the Trust, including profit or loss and cash flow for the period and such other matters as may be specified;

3. the Auditor shall have a right of access at all times to the books of accounts and vouchers pertaining to activities of the Trust; and

4. the Auditor shall have a right to require such information and explanation pertaining to activities of the Trust as he may consider necessary for the performance of his duties as auditor from the employees of the Trust or holding company or Parties to the Trust or holding company or the special purpose vehicles or any other person in possession of such information.

The Valuer

Background and terms of appointment

The Investment Manager, in consultation with the Trustee, has appointed RBSA Valuation Advisors LLP with effect from May 17, 2023, as the valuers of the Trust for a period of three years. In accordance with the InvIT Regulations, the Valuers have undertaken a full valuation of the Target Toll Roads as at December 31, 2023 which is proposed to be acquired by the Trust, and their report in relation to such valuation dated February 9, 2024, has been included in this Placement Document."

Functions of the Valuer

The functions, duties and responsibilities of the Valuer will be in accordance with the InvIT Regulations. Presently, in terms of the InvIT Regulations, the Valuer is required to comply with the following conditions at all times:

1. the Valuer shall ensure that the valuation of the Trust assets is impartial, true and fair and is in accordance with Regulation 21 of the InvIT Regulations;

2. the Valuer shall ensure that adequate and robust internal controls to ensure the integrity of its valuation reports;

3. the Valuer shall ensure that it has sufficient key personnel with adequate experience and qualification to perform valuations;
4. the Valuer shall ensure that it has sufficient financial resources to enable it to conduct its business effectively and meet its liabilities;

5. the Valuer and any of its employees involved in valuing of the assets of the Trust, shall not, (i) invest in units of the Trust or in the assets being valued; and (ii) sell the assets or units of the Trust held prior to being appointed as the Valuer, until the time such person is designated as valuer of the Trust and not less than six months after ceasing to be valuer of the Trust;

6. the valuer shall conduct valuation of the Trust's assets with transparency and fairness and shall render, at all times, high standards of service, exercise due diligence, ensure proper care and exercise independent professional judgment;

7. the valuer shall act with independence, objectivity and impartiality in performing the valuation;

8. the valuer shall discharge its duties towards the Trust in an efficient and competent manner, utilizing its knowledge, skills and experience in best possible way to complete given assignment;

9. the valuer shall not accept remuneration, in any form, for performing a valuation of the Trust's assets from any person other than the Trust or its authorized representative;

10. the valuer shall before accepting any assignment, from any related party of the InvIT, disclose to the Trust any direct or indirect consideration which the valuer may have in respect of such assignment;

11. the valuer shall disclose to the Trust any pending business transactions, contracts under negotiation and other arrangements with the investment manager or any other party whom the Trust is contracting with and any other factors that may interfere with the valuer's ability to give an independent and professional valuation of the assets;

12. the valuer shall not make false, misleading or exaggerated claims in order to secure assignments;

13. the valuer shall not provide misleading valuation, either by providing incorrect information or by withholding relevant information;

14. the valuer shall not accept an assignment which interferes with its ability to do fair valuation; and

15. the valuer shall, prior to performing a valuation, acquaint itself with all laws or regulations relevant to such valuation.

Further, in accordance with the InvIT Regulations, a full valuation shall be conducted by the valuer not less than once every financial year. However, the Investment Manager shall conduct a valuation through a SEBI registered valuer for any quarter, based on the specific request of any unitholder.

Policy on Appointment of Auditor and Valuer

The Investment Manager has adopted a policy on the appointment of auditor and valuer of the Trust, which will stand amended, to the extent of any amendment to the InvIT Regulations or applicable law, details of which are provided below:

Appointment and Role of Auditor of the Trust

(i). The Investment Manager, in consultation with the trustee to the Trust (the "**Trustee**"), shall appoint the auditor of the Trust (the "**Auditor**"), in a timely manner and in accordance with the Securities and Exchange Board of India (Infrastructure Investment Trusts) Regulations, 2014, as amended or supplemented, including any guidelines, circulars, notifications and clarifications framed or issued thereunder (the "**InvIT Regulations**").

(ii). The Investment Manager shall ensure that the appointment of the Auditor and the fees payable to the Auditor is approved by the unitholders of the Trust ("**Unitholders**") in accordance with the InvIT Regulations.

(iii). The Investment Manager shall appoint an Auditor for a period of not more than five consecutive years; provided that the Auditor, not being an individual, may be reappointed for a period of another five consecutive years, subject to approval of Unitholders in the annual meeting in accordance with the InvIT Regulations.

(iv). The Auditor shall conduct the audit of the accounts of the Trust and draft the audit report based on the accounts examined by it after taking into account the relevant accounting and auditing standards under applicable law, including the InvIT Regulations and any guidelines, circulars, notifications and clarifications framed or issued by the Securities and Exchange Board of India ("**SEBI**"), as may be specified from time to time.

The Auditor shall comply with the conditions prescribed under the InvIT Regulations at all times, including the following:

(a). The accounts of the Trust shall be subjected to audit by the Auditors and shall be accompanied by a report of the Auditors in such manner and at such intervals as may be prescribed under applicable law, including InvIT Regulations;
(b). the Auditor shall, to the best of his information and knowledge, ensure that the accounts and financial statements give a true and fair view of the state of the affairs of the Trust, including profit or loss and cash flow for the period and such other matters as may be specified by SEBI;
(c). the Auditor shall have a right of access at all times to the books of accounts and vouchers pertaining to activities of the Trust; and
(d). the Auditor shall have a right to obtain such information and explanation pertaining to activities of the Trust as he may consider necessary for the performance of his duties as auditor from the employees of Trust or any holding company or parties to the Trust or any holding company or the special purpose vehicle(s) or any other person in possession of such information.
(e). The auditor should have subjected itself to the Peer review process of ICAI and holds such a valid certificate.

(v). The Investment Manager, in consultation with the Trustee, shall have the right to take all necessary steps to remove the Auditor who ceases to comply with the eligibility criteria required under the InvIT Regulations and applicable law. In case of removal of the auditor and appointment of another auditor to the Trust, approval from the Unitholders shall be required in accordance with Regulation 22(5)(f) of the InvIT Regulations. Additionally, any change in the auditor of the Project SPVs shall be made in accordance with the Companies Act, 2013, as amended.

Appointment and Role of Valuer of the Trust

(i). The Investment Manager, in consultation with Trustee, shall appoint the valuer of the Trust ("**Valuer**"), in a timely manner and shall determine the remuneration of such Valuer, in accordance with the InvIT Regulations. A 'Valuer' shall have the meaning provided under the InvIT Regulations.

(ii). The remuneration of the Valuer shall not be linked to or based on the value of the assets being valued.

(iii). The Valuer shall not be an associate of any of the Sponsor or the Investment Manager or Trustee.

(iv). The Valuer shall be eligible to act as a valuer in accordance with the InvIT Regulations or any clarifications, guidelines, notifications or exemptions issued by SEBI.

(v). A Valuer shall not undertake valuation of the same project for more than four years consecutively, provided that the Valuer may be reappointed after a period of not less than two years from the date it ceases to be the Valuer of the Trust.

(vi). The Valuer shall not undertake valuation of any assets in which it has either been involved with the acquisition or disposal within the last twelve months other than such cases where the Valuer was engaged by the Trust for such acquisition or disposal.

(vii). The Valuer shall comply with the following conditions at all times:

(a) the Valuer shall ensure that the valuation of the Trust assets is impartial, true and fair and is in accordance with the InvIT Regulations;
(b) the Valuer shall ensure adequate and robust internal controls to ensure the integrity of its valuation reports;
(c) the Valuer shall ensure that it has sufficient key personnel with adequate experience and qualification to perform valuations;
(d) the Valuer shall ensure that it has sufficient financial resources to enable it to conduct its business effectively and meet its liabilities;
(e) the Valuer and any of its employees involved in valuing of the assets of the Trust, shall not:
- invest in units of the Trust or in the assets being valued; and
- sell the assets or units of the Trust held prior to being appointed as the Valuer,

until the time such person is designated as Valuer of the Trust and not less than six months after ceasing to be Valuer of the Trust;
(f) the Valuer shall conduct valuation of the Trust assets with transparency and fairness and shall render, at all times, high standards of service, exercise due diligence, ensure proper care and exercise independent professional judgment;
(g) the Valuer shall act with independence, objectivity and impartiality in performing the valuation;
(h) the Valuer shall discharge its duties towards the Trust in an efficient and competent manner, utilizing its knowledge, skills and experience in best possible way to complete given assignment;
(i) the Valuer shall not accept remuneration, in any form, for performing a valuation of the Trust assets from any person other than the Trust or its authorized representative;
(j) the Valuer shall before accepting any assignment, from any related party of the Trust, disclose to the Trust, by disclosing to the Investment Manager or the Trustee, any direct or indirect consideration which the Valuer may have in respect of such assignment;
(k) the Valuer shall disclose to the Trust, through the Investment Manager, any pending business transactions, contracts under negotiation and other arrangements with the Investment Manager or any other party whom the Trust is contracting with and any other factors that may interfere with the Valuer's ability to give an independent and professional valuation of the assets, and other necessary disclosures required under the InvIT Regulations;
(l) the Valuer shall not make false, misleading or exaggerated claims in order to secure assignments;
(m) the Valuer shall not provide misleading valuation, either by providing incorrect information or by withholding relevant information;
(n) the Valuer shall not accept an assignment which interferes with its ability to do fair valuation; and
(o) the Valuer shall, prior to performing a valuation, acquaint itself with all laws or regulations relevant to such valuation.

(viii). The Investment Manager in consultation with the Trustee shall have the right to take all necessary steps to remove the Valuer who ceases to comply with the eligibility criteria required under the InvIT Regulations and applicable law. If

the removal of the Valuer and appointment of another valuer to the Trust is taken up at a meeting of the Unitholders at the request of the Unitholders, such removal of the Valuer shall be approved by the Unitholders in accordance with the InvIT Regulations.

*The information contained in this section is derived from the report by CRISIL MI & A on Roads and Highways, dated 2023 ("**CRISIL Report**"). Neither we nor any other person connected with the Issue has independently verified this information. Industry sources and publications generally state that the information contained therein has been obtained from sources generally believed to be reliable, but that their accuracy, completeness and underlying assumptions are not guaranteed, and their reliability cannot be assured. Industry publications are also prepared based on information available as of specific dates and may no longer be current or reflect current trends. Accordingly, investment decisions should take these limitations into account. All references to years refer to calendar years except as otherwise stated. References to Indian financial years ("**FY**") are to the one-year period ending March 31 of the named year.*

Strong government thrust likely to deliver steady growth in fiscal 2024

Overall road sector capex, comprising of National Highways, State Highways & rural roads is estimated to have grown at a CAGR of 14% between fiscals 2018 & 2023. This growth, driven by Bharatmala and increased state spends on roads has been achieved despite brief hiccups such as the pandemic and hampered construction due to elongated monsoons. The outlook of the sector also remains firm supported by higher awarding of previous fiscals, Bharatmala, NIP pipeline of DPR ready projects and steady state capex.

The NH segment contributes around 40-45% of the overall capex. While the execution remained flattish in fiscal 2023 vis—vis fiscal 2022, capex grew by 12-18% due to a rise in construction of high value projects and high commodity prices. In fiscal 2024, we expect the national highway capex to grow by 15-20% driven primarily by increased execution.

On the low base of fiscal 2021, the state spends grew by 21% in fiscal 2022 and are estimated to have grown further by 10-13% in fiscal 2023 largely in line with the growth in budgetary outlay. In fiscal 2024, state spends are expected to go up further by 8-12% as their percentage achievement of budgetary allocations are expected to be largely in line with historical average.

Momentum to continue, supported by Bharatmala and NIP pipeline

(Rs lakh crore)

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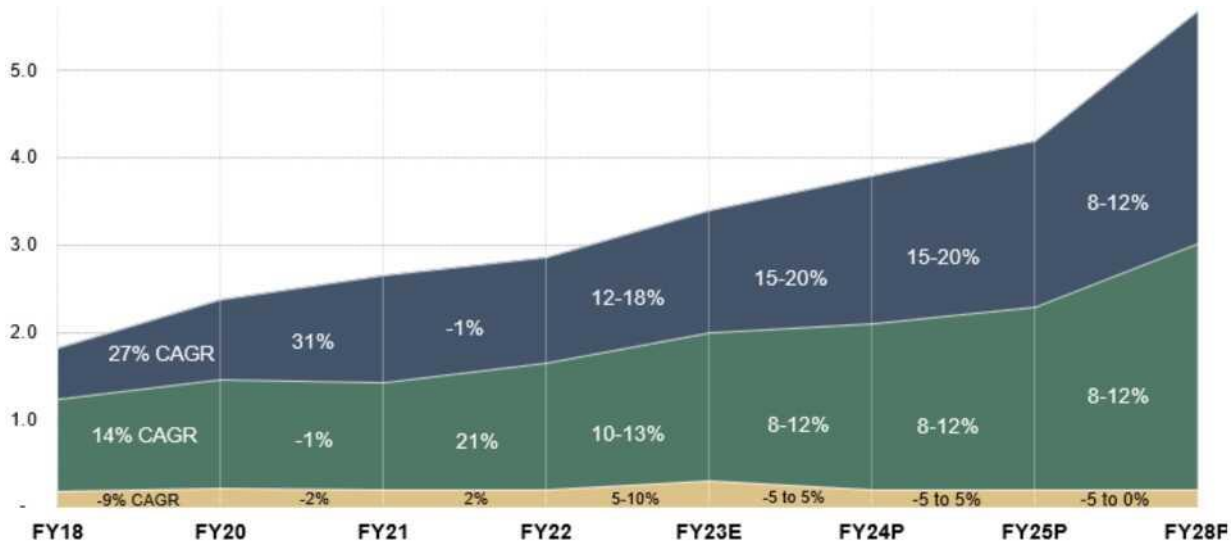


Note: Capex excludes the land-acquisition costs

Source: NHAI, MoRTH, State budget documents, PMGSY, CRISIL MI&A Research

Investments: National highways

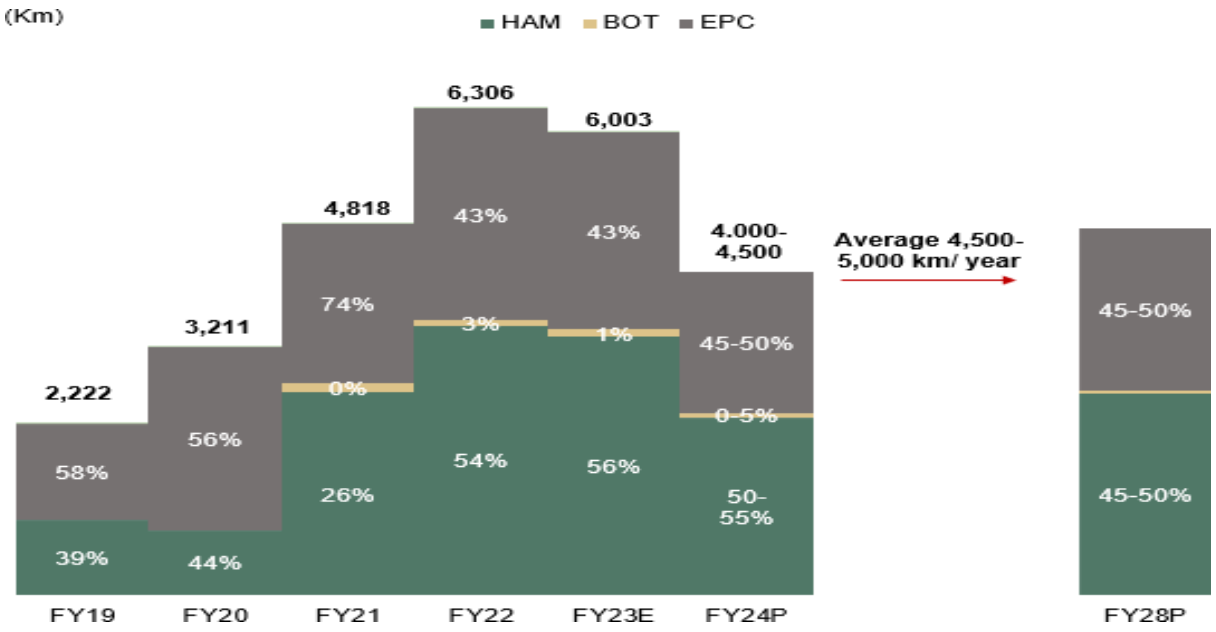
NHAI awarding to moderate in fiscal 2024, share of HAM likely to remain stable

National Highways Authority of India (NHAI) awarding has witnessed a rise from merely 2,222 km in fiscal 2019 to 6,003 km in fiscal 2023. Favorable changes in the BOT and HAM agreements, and relaxation of bidder eligibility criteria not only indicated a clear policy shift to improve private-sector participation but also aided the spurt in the HAM awards. In fiscal

2023, NHAI's awarding volume remained above the 6,000 km mark for the second consecutive year as 6,003 km was awarded during the fiscal year. The share of HAM in awarding increased slightly from 54% in fiscal 2022 to 56% in fiscal 2023. On the other hand, the share of EPC remained unchanged at 43%.

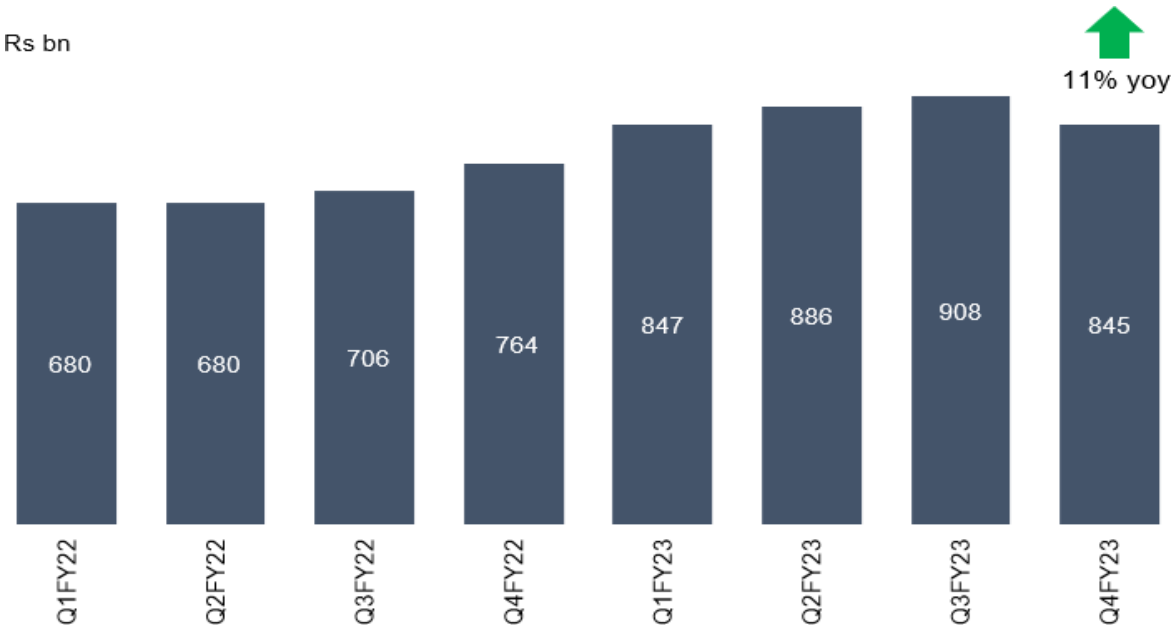
In fiscal 2024, awarding momentum has been marred by various roadblocks. NHAI's flagship Bharatmala Pariyojana Programme (BMP) Phase-1 has witnessed significant cost overrun on account of costlier land acquisition and high inflation. Notably, as per CAG audit report, while only 75% of the estimated project length has been awarded, 158% of the original estimated financial cost has already been expended. Currently, the estimated cost of the BMP phase-1 is almost twice and the initial estimate and the ministry is awaiting cabinet approval for a revamped programme and additional funds in order to undertake rapid awarding of projects in the pipeline. As a result, as per CRISIL MI&A estimates, NHAI awarding is expected to moderate to ~4,000-4,500 kms this fiscal. However, the respective shares of HAM, EPC and BOT in the total awarding are expected to remain at similar levels vis--vis fiscal 2023. Over the medium term, it is expected that the NHAI would continue to award ~5,000 kms per year on an average between fiscals 2024 and 2026. Furthermore, the shares of HAM, EPC and BOT in the awarding are expected to remain largely stable without any significant deviations. Additionally, going forward, developers are also likely to free up capital and deleverage their balance sheets through stake sales supported by the strong pipeline of projects under Bharatmala and the NIP.

Share of HAM in NHAI awarding to remain similar despite moderation in awarding momentum



Source: NHAI, CRISIL MI&A Research

The high awarding volumes in the earlier quarters have augured well for the order book of large-sized road developers despite intense competition. The cumulative orderbook of these key players has grown by 11% on-year as of Q4 of fiscal 2023. This is a key positive for the sector as it provides good revenue visibility for the incumbent developers. Orderbooks have also seen a steady growth due to high awarding.



Note: Data on order book is based on 5 key road players Ashoka Buildcon, Dilip buildcon, KNR construction, IRB infra, PNC Infratech.

Source: Company filings, CRISIL MI&A Research

NHAI execution is also rising steadily with focus on swifter execution

Even though overall national highways construction at the MoRTH level remained flattish in fiscals 2022 and 2023, NHAI execution witnessed strong momentum. NHAI execution sequentially rose from 4,175 km in fiscal 2021 to 4,882 km in fiscal 2023. Acceleration in project awards, sharper focus on resolving land acquisition issues, and the Atmanirbhar Bharat initiatives to ease liquidity (monthly milestone payments, release of rentention money, reduction in performance secuirty & extension of 3-6 months in milestones & SCODs) for EPC road players augured well for the pace of construction during this period even though issues such as exorbitant commodity prices and elongated monsoons acted as headwinds.

CRISIL MI&A expects fiscal 2024 NHAI construction to be in the range of 5,000-5,500 kms on the back of higher awarding witnessed in the previous fiscals and many of those projects receiving appointed dates only towards the fag end of fiscal 2023. Over the medium term, the pace of construction is expected to rise steadily to reach ~16 km per day by fiscal 2028.

NHAIs pace of construction rising steadily with continued focus on swifter execution

Source: NHAI, CRISIL MI&A Research

Policy push for HAM enabled higher share in awarding

NHAI awards roads & highway projects under:

- EPC
- BOT

- HAM

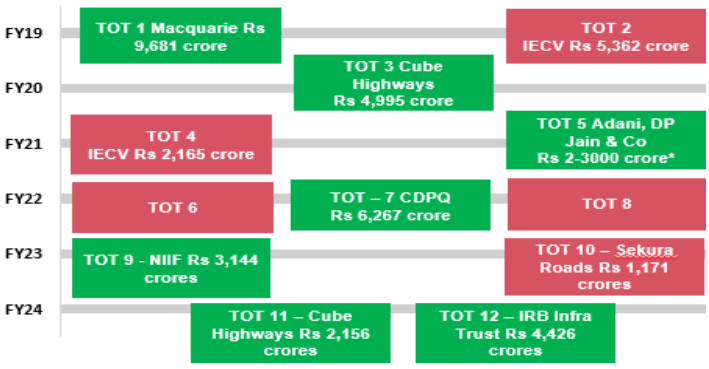
The Ministry and NHAI, post multiple suggestions from various stakeholders have amended the HAM Model Concession Agreement across the below mentioned paramters in Oct 2020. These are largely aimed to protect developers' returns and ease their liquidity.

Recent changes in HAM MCA incorporate developers' concerns

	Old Clause	Revised Clause	Impact
Annuity Payments	Interest on annuity payment linked to RBI determined Bank Rate + 3%	Interest on annuity payment linked to average of one year MCLR of top 5 Scheduled Commercial Banks + 1.25%	Differential between cost of borrowing and interest on annuity reduced thus preventing erosion of developers' returns due to RBI repo rate changes
Milestone Payments	5 instalments, each equal to 8% of the Bid Project Cost	10 instalments, each equal to 4% of the Bid Project Cost	Quicker payments helping developers' liquidity
Change in ownership	Original sponsor/ concessionaire shall hold at least 26% of equity during construction period and 2 years thereafter	Original sponsor/ concessionaire shall hold at least 26% of equity during construction period and 6 months thereafter	Quicker stake sell-off would ease up developers' balance sheets to bid for new projects
Financial Closure	No clarity on amount on FC	FC to be undertaken for an amount no lower than either: 1. Total Project Cost (60% of BPC); or 2. 10% less than (Estimated Project Cost minus 40% of Bid Project Cost)	Would likely prevent termination of projects due to inadequate financing
Dispute resolution board	In case of a dispute, either party may call upon the Independent Engineer to mediate.	Failing mediation by the IE, either party may require such dispute to be referred to the Dispute Resolution Board (DRB).	Quicker dispute resolution mechanism to prevent stuck projects.
Others	Interest mobilization advance linked to bank rate. Termination payments based on previous milestone payments.	Interest on mobilization advance linked to MCLR. Termination payments based on new milestone payments.	NA

Financing: Public Funding

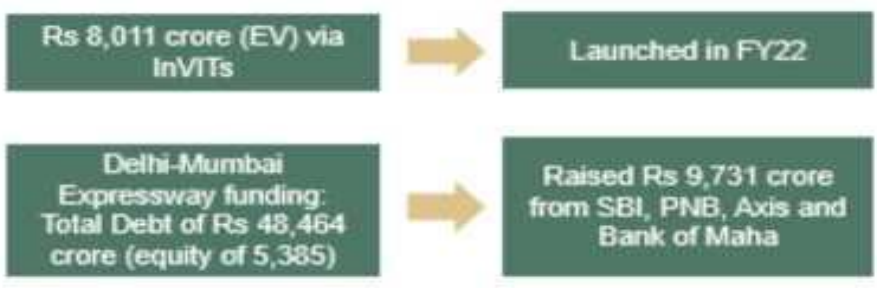
Success of TOT critical to meet ambitious Bharatmala targets



Source: NHAI, CRISIL Research

The authority has also tied up debt via SPV level funding for the Delhi-Mumbai expressway where it has already raised Rs 9,731 crores.

InVITs & SPV level financing



Source: NHAI, CRISIL Research

Financing: Private Funding

Investments by private sector to grow 3x times over the next 5 years

CRISIL MI&A expects private construction investments in national highways to increase 2x to Rs 2.7 trillion over fiscals 2024 to 2028 compared with the previous five years. This is expected to be mainly through the hybrid annuity model (HAM) mode, as the build-operate-transfer (BOT) toll mode may have only a few takers.

A policy push in the form of changes in Model Concession Agreements (MCA) for HAM and BOT projects and reduction in bid eligibility criteria across all national highway projects would bode well for private participation. However, the share of HAM in total awarding is constrained by the cautious approach employed by banks in lending to HAM projects.

Amidst the COVID-19 pandemic, NHAI and the ministry have taken various steps under the Atmanirbhar package to ease issues faced by developers. Releasing monthly payments, instead of milestone based payments; extension of timelines for completion of projects, etc have sustained private participation in the sector. While these have been extended till Oct 2020, they are likely to fade from next fiscal onwards.

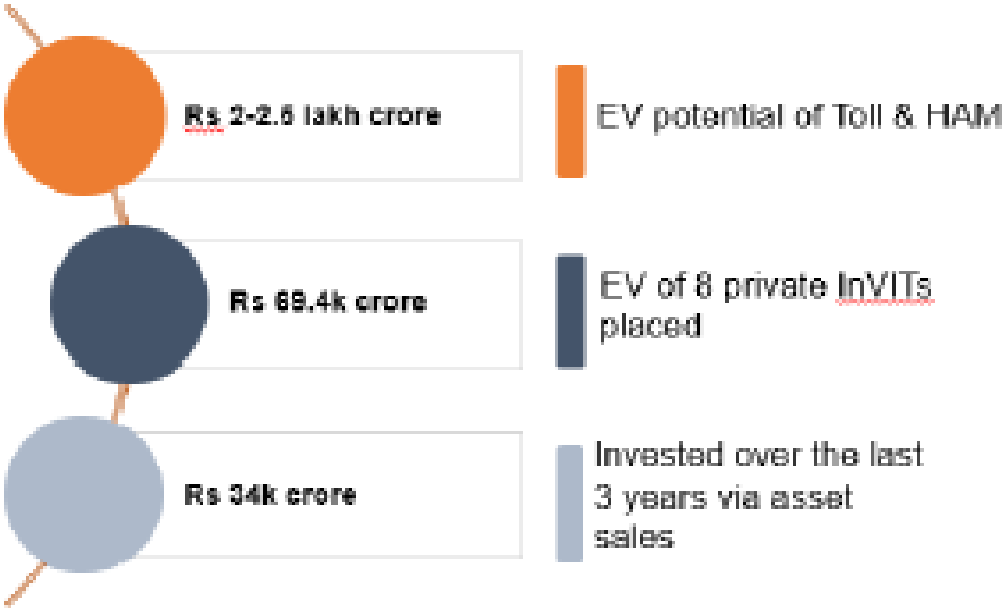
Asset monetisation, equity infusion key to support private investment in the long run

Currently, there are two broad drivers of asset sales in the roads sector - rationalisation of financial position to improve balance sheet strength and asset churning to be able to participate in the upcoming projects. The erstwhile major BOT players are selling off assets to reduce their debt burden and free up equity, which can be infused in under-execution projects.

The players present in HAM are currently selling off HAM assets to participate further in upcoming HAM projects. Some players intend to sell off under-construction projects to financial investors with projects being executed by the same player. Thus, they are able to convert HAM projects to EPC without facing the cut-throat competition they deal with currently in the EPC mode. This will help them retain margins.

About Rs 70,000 - 80,000 crore has already been invested through these modes. CRISIL's analysis of BOT and HAM projects indicates a potential of ~Rs 2-2.5 lakh crore in terms of Enterprise Value.

Asset monetisation has a lot of potential to free up developers' balance sheets



Source: Industry, CRISIL MI&A Research

Overview: Road Network in India

Extensive Road Network

India has the second largest road network in the world, aggregating 6.2 million km. Roads are the most common mode of transportation and account for about 86% of passenger traffic and close to 67% of freight traffic.

In India, national highways, with a length of close to 136,440 km, constitute a negligible percentage of the road network but carry about 40% of the total road traffic. On the other hand, state roads and major district roads are the secondary system of roads; they carry another 60% of traffic and account for nearly the entire road length.

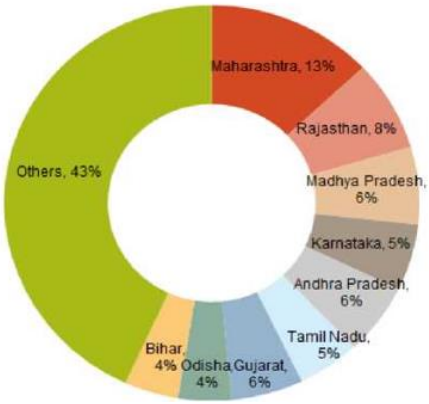
The road network in India can be divided into the following categories:

Road network in India as in fiscal 2022

Road network	Length (km)	Percentage of total		Connectivity to
		Length	Traffic	
National highway	140,995	2	40	Union capital, state capitals, major ports, foreign highways
State highway	171,039	3	60	Major centres within the states, national highways
Other roads	6,059,813	95		Main roads, rural roads, production centres, markets
Total	6,371,847	100.0	100.0	

Source: MoRTH Annual report 2020-2021, CRISIL Research

State-wise length of National Highways in India as in fiscal 2022



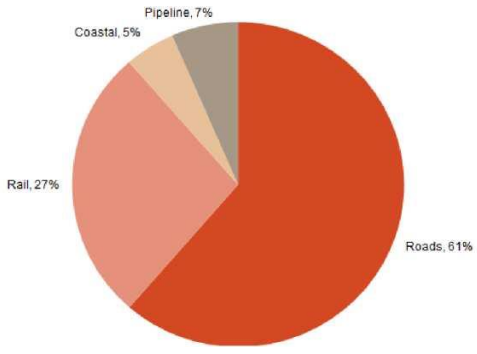
Source: MoRTH Annual report 2020-2021, CRISIL Research

Source: MoRTH, CRISIL Research

Roads account for 67% of total freight traffic

Road transport is the most frequently used mode of transport for both freight and passengers. For fiscal 2021, it is estimated that ~67% of total freight (in terms of BTKM) will be carried by roads when compared with railways. In 2009-10, roads accounted for approximately 58% of the total freight traffic.

Proportion of freight traffic across modes of transport - Fiscal 2022

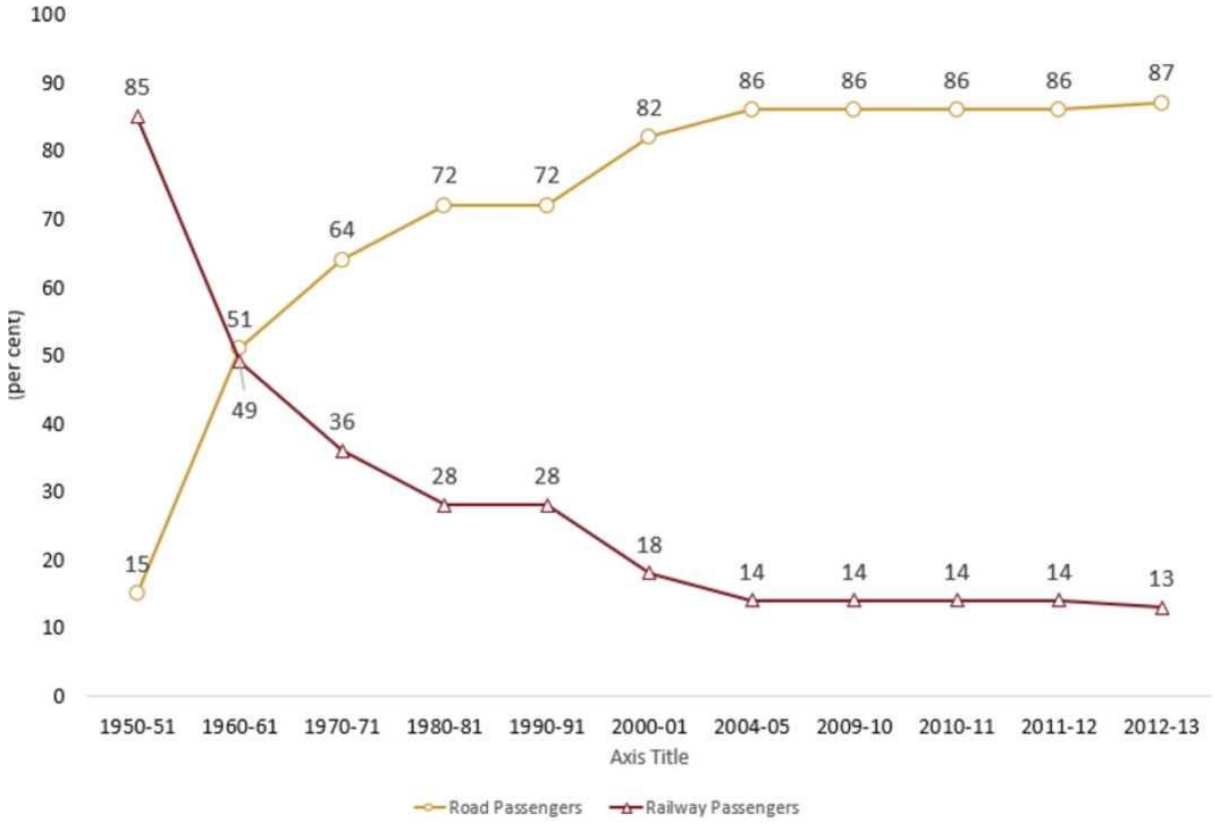


Source: CRISIL Research

Note: For details, kindly refer to CRISIL Research's coverage on Domestic Freight Transportation Services industry

Higher passenger traffic on roads than railways

Passenger traffic - Roads v/s railways



Note: FY13 is the latest available data

Source: Working Group Report on Road Transport for Eleventh Five-Year Plan, Industry

Overview: National Highways

National Highways Development Project

The NHDP encompasses building, upgradation, rehabilitation and broadening of existing NHs. The project is executed by the NHAI, in coordination with the public works departments of various states. The NHAI also collaborates with the Border Roads Organisation for the development of certain stretches. The NHDP is being implemented in seven phases.

NHDP projects are awarded to private players either on EPC (cash) or build-operate-transfer (BOT) basis, and now on the newly introduced hybrid annuity model (HAM). NHDP cash contracts are mainly financed through budgetary allocations from the Central Road Fund, negative grants/premium received, and toll revenue. Loans and grants are also received from the World Bank and the Asian Development Bank.

Projects under existing the NHDP phases of 5,000-5,500 km to be awarded completely by fiscal 2021. These residual projects would dominate 50% of investments over the next five years. According to CRISIL estimates, Bharatmala awarding was ~5,500-6,000 km over fiscals 2018 and 2019. Investments under Bharatmala would be slow to pick up and contribute ~30% of total investments. As projects awarded under Bharatmala are 60% EPC and 40% HAM, NHAIs ability to raise funds to execute these projects would be a key monitorable.

Bharatmala Pariyojana

Bharatmala Pariyojana (BMP) is the new umbrella scheme, which supersedes the existing National Highways Development Programme (NHDP). The programme envisages to construct about 65,000 km of highways, under the following categories: National Corridor (North-South, East-West and Golden Quadrilateral), Economic Corridors, Inter corridor roads, Feeder roads, International connectivity, Border roads, Coastal roads, Port connectivity roads and Expressways. This will include existing NHDP programme as well. Some projects awarded in FY18 and YTD FY19 under Bharatmala are actually part of NHDP.

The Government of India had approved Bharatmala Pariyojana Phase-I in October, 2017 with an aggregate length of about 34,800 km (including 10,000 km residual NHDP stretches) at an estimated outlay of Rs. 5,35,000 crore for development of about 9,000 km length of Economic corridors, about 6,000 km length of Inter-corridor and feeder roads, about 5,000 km

length of National Corridors Efficiency improvements, about 2,000 km length of Border and International connectivity roads, about 2,000 km length of Coastal and port connectivity roads, and about 800 km length of Expressways. Total of 255 road projects with an aggregate length of about 10,699 km have been approved till October, 2019 under Bharatmala Pariyojana with total Cost of Rs. 2,64,916 crore approximately. Bharatmala Pariyojana Phase-I is targeted for completion by 2021-22.

Components of Bharatmala Pariyojana (Phase -I)

Category	Description	Total Length (Km)	Length Completed (km)
Economic Corridors	Connecting of economically important production & Consumption centres	9,000	1,567
Inter Corridors & Feeder Roads	Inter- Connection between economic corridors, first mile & last mine connectivity	6.000	562
National Corridor Efficiency Improvement	Lane expansion,De-congestion of existing National corridor	5,000	1,012
Border & International Road Connectivity	Connectivity to border areas and boosting trades with neighbouring countries	2 i. Ji.	1.120
Coastal & Port Connectivity Roads	Connectivity to coastal areas to enable port-led economic development	2.000	52
Expressways	Greenfield expressway	800	449
Subtotal		24,800	4,752

Source: NHAI, CRISIL Research

Award of Projects under Bharatmala Pariyojana

Out of the 24,800 km approved under Bharatmala Pariyojana Phase-I, a total of 447 projects of length 14,519 km have been awarded by NHAI, post the approval of Bharatmala Pariyojana in the FY 21-22. Similarly, out of the 10,000 km approved under residual NHDP in Bharatmala Phase-I, a total of 127 projects of length 5,407 km have been awarded post the approval of Bharatmala Pariyojana in FY 21-22.

SR No.	Types of Corridor	No. of Projects	Awarded Length (Km)
1	Economic Corridors	188	5,848
2	Inter Corridor Routes	51	1.936
3	Feeder Routes	19	669
4	National Corridor	59	1,552
5	National Corridor Efficiency Improvement	25	705
6	Expressway	81	2,265
7	Border Roads & International Connectivity	14	1,282
8	Coastal Roads	2	77
9	Port Connectivity	8	187
	Bharatmala Total	447	14,519
10	NHDP	127	5,407
	Grand Total	574	19,926

Source: NHAI, CRISIL Research

OUR BUSINESS

Overview

We are a registered infrastructure investment trust under the InvIT Regulations. We currently have a right to toll, operate and maintain a portfolio of eight Existing Toll Roads (*defined below*) in the Indian states of Gujarat, Rajasthan, Telangana, Karnataka, Maharashtra, Uttar Pradesh and Madhya Pradesh and intend to toll, operate and maintain a portfolio of seven Target Toll Roads (*defined below*) in the Indian states of, Assam, Madhya Pradesh, Uttar Pradesh, West Bengal and Karnataka under the Toll Operate Transfer ("**TOT**") model conceived by NHAI. These Toll Roads (*defined below*) are operated and maintained pursuant to concessions granted by the NHAI. The Existing Toll Roads comprise eight stretches spanning a total length of approximately 635 kms and the Target Toll Roads comprise seven stretches spanning a total length of approximately 888 kms.

Our Sponsor is NHAI, an autonomous authority of the GoI under the MoRTH constituted on June 15, 1989 by an Act of the Indian Parliament titled - The National Highways Authority of India Act, 1988 (the "**NHAI Act**"). NHAI was operationalised in February 1995 with the appointment of a full-time Chairman and other members of the board. The functioning of NHAI is governed by the NHAI Act and the rules, and regulations framed thereunder.

The Project SPVs have entered into 15 independent Concession Agreements with the NHAI for concessions of each of the Toll Roads. We have satisfied all conditions precedent and commenced our Concessions on December 16, 2021 and October 29, 2022 in accordance with the terms of the Concession Agreements for the Existing Toll Roads and expect to satisfy all conditions precedent and commence our Concessions for the Target Toll Roads in accordance with the terms of the Concession Agreements for the Target Toll Roads. For further details, please see the section entitled "*Summary of the Concession Agreements*", "*Management's Discussion and Analysis of Financial Position and Results of Operations*" and "*Use of Proceeds*" on pages 232, 290 and 273, respectively.

The Concession Agreements provide the Project SPVs the right to collect tolls for a period of 20 years or 30 years (as applicable under the relevant Concession Agreement) from users of each Toll Road, with certain overlay activities and the construction of additional toll lanes in respect of certain of the Toll Roads (the "**Initial Improvement Works**") to be completed by the Project SPVs within 12 to 18 months from the Appointed Date (as defined in the section entitled "*Summary of the Concession Agreements*"). Responsibility for the supervision of the operations and maintenance of the Toll Roads also vests with us. In return, the Project SPVs is required to pay the concession fee to the NHAI prior to the commencement of the Concession, as set out in the respective Concession Agreements. For further information on the provisions of the Concession Agreements, see "*Summary of the Concession Agreements".*

NHIPPL has a right to toll, operate and maintain the following toll road assets (the "**Existing Toll Roads**"):

- Palanpur/Khemana – Abu Road Project ("**Asset 1**"): Abu Road section of NH 27 with a total length of 45 kms, connecting the states of Gujarat and Rajasthan;
- Abu Road – Swaroopganj Project ("**Asset 2**"): Swaroopganj section of NH 27 with a total length of 31 kms, in the state of Rajasthan;
- Maharashtra/ Karnataka Border (Kagal) – Belgaum Project ("**Asset 3**"): Belgaum – Kagal section of NH 48 with a total length of 77.7 kms, connecting the states of Karnataka and Maharashtra;
- Chittorgarh – Kota & Chittorgarh Bypass Project ("**Asset 4**"): Chittorgarh – Kota section of NH 27 with a total length of 160.5 kms, in the state of Rajasthan;
- Kothakota Bypass – Kurnool Project ("**Asset 5**"): Kothakota bypass – Kurnool section of NH 44 with a total length of 74.6 kms, connecting the states of Telangana to Andhra Pradesh;
- Agra Bypass Project ("**Asset 6**"): Agra Bypass section with a total length of 32.80 kms, connecting NH19 (old NH2) to NH44 (old NH7) in Uttar Pradesh;
- Borkhedi - Kelapur Project ("**Asset 7**"): Borkhedi-Kelapur-Maharashtra/Telangana border section of NH44 (old NH7) with a total length of 138.15 kms, in the state of Maharashtra; and
- Shivpuri – Jhansi Project ("**Asset 8**"): Jhansi-Shivpuri section of NH 27 with a total length of 75.30 kms, connecting the districts of Jhansi in the state of Uttar Pradesh and Shivpuri in the state of Madhya Pradesh.

From the Appointed Date, NEPPL will have the right to toll, operate and maintain the following toll road assets (the "**Target Toll Roads**"):

- Chichra - Kharagpur Project ("**Asset 9**"): Chichra - Kharagpur section of NH 49 with a total length of 56.12 kms, in the state of West Bengal;
- Rewa –Lakhnadon Project ("**Asset 10**"): Rewa – Katni – Jabalpur – Lakhnadon section of NH 30 and NH 34 with a total length of 306.34 kms, in the state of Madhya Pradesh;
- Kachugaon - Kaljhar Project ("**Asset 11**"): Kachugaon - Rakhaldubi Bus Junction – Kaljhar section of NH 27 with a total length of 114.17 kms, in the state of Assam;
- Kaljhar – Patacharkuchi Project ("**Asset 12**"): Kaljhar – Patacharkuchi section of NH 27 with a total length of 27.30 kms, in the state of Assam;

- Lakhnadon – Mahagaon (Mohgaon) – Khawasa ("**Asset 13**"): Lakhnadon – Mahagaon (Mohgaon) – Khawasa section of NH 44 with a total length of 107.35 kms, in the state of Madhya Pradesh;
- Orai – Barah Project ("**Asset 14**"): Orai – Barah section of NH 27 with a total length of 62.90 kms, in the state of Uttar Pradesh; and
- Chitradurga Bypass – Hubli Project/ Karnataka Project ("**Asset 15**"): Chitradurga Bypass - Chitradurga - Davanagere - Haveri – Hubli section of NH 48 with a total length of 214.47 kms, in the state of Karnataka.

The following map depicts locations of the Toll Roads:

Note:
(1) This map is for illustrative purposes only, is not to scale and is subject to change at any time.

Strengths of the Trust

Experienced Sponsor with consistent track record in operating and maintaining projects in the roads and highways sector in India

Our Sponsor, NHAI is India's national agency responsible for the development, maintenance and management of India's national highways network. Our Sponsor has a consistent track record of growth and operational performance. Our Sponsor has been entrusted with National Highways Development Project ("**NHDP**"), which along with other minor projects, has vested in it 50,329 kms of national highways for development, maintenance and management. As part of the NHDP, our Sponsor infuses funds into immediate areas of development and enables private sector participation bringing about a healthy participatory economy.

Our Sponsor is also involved in the *Bharatmala Pariyojana* project *(more information available in the Industry Overview section)* and envisages development of 50 economic corridors, that would provide connectivity to 550 districts through national highway linkages and improve average road travel speed. Out of the total 34,800 kms of approval granted by the Cabinet Committee on Economic Affairs ("**CCEA**") to our Sponsor for Phase-1 of *Bharatmala Pariyojana*, our Sponsor has already completed construction of 27,500 kms of national highways as part of the *Bharatmala Pariyojana*, Phase-1. A further 12,413 kilometers have been awarded and 2,921 kilometers have been constructed as of August 2020. *(Source: NHAI Annual Report 2018-2019)*

Our Sponsor's awarding of new projects has witnessed a sequential rise from merely 2,222 km in FY 19 to 6,306 km in FY 22. FY 21 was a pivotal year since despite the COVID-induced disruptions, there was a healthy growth in awarding of new projects with the award of 4,818 kms. Of these, 54% were awarded under the Hybrid Annuity Model (HAM), 3% under the Build-Operate-Toll (BOT) mode and rest under the Engineering, Procurement and Construction (EPC) mode. In FY 22, the awarding momentum continued unabated as our Sponsor awarded 6,306 kms. Despite the lockdowns and labour-related issues, developers made up for the lost time and construction as NHAI projects rose 5% year-on-year to 4,175 kms in FY 21. In FY 22, our Sponsor's focus on swifter execution of projects paid dividends as 4,673 kms were constructed which translated into a 12% growth as compared to the last fiscal. (*Source: CRISIL Research*)

Having NHAI as our Sponsor, we believe we are well positioned to drive new initiatives in the road sector in India. For more details about our Sponsor and the projects, please see *"Industry Overview"* on page 145 of this Placement Document.

Sizeable portfolio of diversified long-term revenue generating Toll Road assets

We own 100% of the Project SPVs. The Project SPVs toll, operates and maintains the Existing Toll Roads and will toll, operate and maintain the Target Toll Roads. The Concession Agreements provide the Project SPVs the right to collect toll for the respective concession periods. The R1 Toll Roads have concession periods of 30 years and the R2 Toll Roads and the Target Toll Roads have concession periods of 20 years. We believe the Toll Roads currently have a healthy mix of passenger and commercial traffic. For details of the project traffic for each of the Toll Roads, please see Annexure C. We also believe that the Toll Roads possess a good mix of captive short distance traffic and long-distance traffic. In addition, the range of commodities transported by commercial traffic across the Toll Roads varies from agricultural products and other perishable goods to steel, cement and multiple industrial products, representing a broad cross-section of the Indian economy. Each Toll Road has a distinct set of users based on its local economy, which results in significant independence of traffic across the Toll Roads. As a result, we expect the geographical diversification of the Toll Roads to reduce our reliance on the local economy of any single state or district. The diversified composition of traffic along the Toll Roads is expected to provide us with stable cash flows.

We believe that the Toll Roads have revenue growth potential due to expected growth in traffic volumes as a result of regional and national growth and expected increases in toll fees as a result of inflation adjustments.

Presence in strategic regions/ Strategic geographic location of portfolio assets

The Toll Roads comprise 15 stretches of toll roads located in the Indian states of Gujarat, Rajasthan, Telangana, Karnataka, Uttar Pradesh, Maharashtra and Madhya Pradesh. Three (3) Toll Roads are located in southern India, four (4) are located in central – western India, one (1) in western India, two (2) in central India, three (3) in eastern India and two (2) in northern India. According to the Traffic Consultants, these corridors are among the primary corridors for long distance commercial traffic movement and have witnessed high traffic growth rates in the past few years.

- ***Asset 1 – Palanpur/Khemana – Abu Road Project***: This project stretch starts at Palanpur in the State of Gujarat and ends at Abu Road in the state of Rajasthan.

- ***Asset 2 – Abu Road – Swaroopganj Project***: This project stretch starts at the end of Asset 1 and mainly falls in the state of Rajasthan, India. As per the Traffic Consultant, this project is one of the main highway corridors connecting

Gujarat with an important tourist destination of Mount Abu. Palanpur, Ahmedabad, Mount Abu and Udaipur are some of the important cities in the vicinity of this stretch.

- ***Asset 3 – Maharashtra/ Karnataka Border (Kagal) – Belgaum Project***: This project stretch starts at Belgaum in the State of Karnataka and ends at the Maharashtra/ Karnataka Border and is a part of the corridor between Mumbai-Pune and Bengaluru.

- ***Asset 4 – Chittorgarh – Kota & Chittorgarh Bypass Project***: This project stretch starts from Chittorgarh and ends at Kota Bypass about 10 km short of Chambal River Hanging Bridge. This project is divided into three sections based on toll plaza junctions. The project road is short in length and reduces travel time between Kota and Chittorgarh, providing congestion free services.

- ***Asset 5 – Kothakota Bypass – Kurnool Highway Project***: This project stretch connects the state of Telangana with Andhra Pradesh. The project road offers the shortest itinerary, in length and travel time between Kothakota and Kurnool, and is a part of the corridor between Hyderabad and Bengaluru.

- ***Asset 6 – Agra Bypass*:** This project stretch is a 32.80 km four-lane road, forming part of the section connecting NH19 (old NH2) to NH44 (old NH7) in Uttar Pradesh, branches out to NH52 (old NH3) and NH44 (old NH7) at Gwalior.

- ***Asset 7 - Borkhedi – Kelapur Stretch*:** This project is located on NH44 and is about 138.15 kms long section between Borkhedi and Maharashtra/ Telangana Border (at Penganga River bridge) traversing through the districts of Nagpur, Wardha and Yavatmal in the state of Maharashtra. This stretch is a part of the corridor between Nagpur and Hyderabad.

- ***Asset 8 - Jhansi – Shivpuri Project***: This project is a 4-lane, 75.3 kms long stretch, on national highways (NH) 27 which connects the districts of Jhansi and Shivpuri in the state of Uttar Pradesh and Madhya Pradesh, respectively.

- ***Asset 9 – Chichra – Kharagpur Project***: This project is a 4-lane, 56.12 kms long stretch, on NH 49 which connects Chichra and Kharagpur in West Bengal.

- ***Asset 10 - Rewa –Lakhnadon Project***: This project is a 4-lane, 306.34 km long stretch, on NH 30 and NH 34 which connects Rewa, Katni, Jabalpur and Lakhnadon districts of Madhya Pradesh.

- ***Asset 11 – Kachugaon - Kaljhar Project***: This project is a 4-lane, 114.17 kms long stretch on NH 27, in the state of Assam.

- ***Asset 12 - Kaljhar – Patacharkuchi Project***: This project is a 4-lane, 27.30 kms long stretch on NH 27, in the state of Assam.

- ***Asset 13 - Lakhnadon – Mahagaon (Mohgaon) – Khawasa Project***: This project is a 4-laned, 107.35 kms divided section between Lakhnadon and Khawasa traversing through the districts of Mandai, Chhapara and Seoni in the state of Madhya Pradesh.

- ***Asset 14 - Orai – Barah Project***: The project road section Orai-Barah, with approximate length of 62.90 km, starts near Orai in Jalaun district and ends near Barah in Kanpur Dehat district.

- ***Asset 15 - Chitradurga Bypass – Hubli Project/ Karnataka Project*** : This project is a 214.47 kms long stretch on NH 48 in the state of Karnataka.

We believe that future development of highways along the Toll Roads as highlighted by the Traffic Consultant in their Traffic Reports and the increased government initiatives such as *Bharatmala Pariyojana* to improve efficiency across roads in India, will provide an impetus to the growth in traffic on the Toll Roads. Furthermore, each of the Toll Roads lie upon significant inter-city connection routes within the populous states of Maharashtra, Madhya Pradesh, Uttar Pradesh, Karnataka, Rajasthan, Telangana and Andhra Pradesh, with captive passenger and commercial traffic.

Experienced management team with industry experience

We are managed by qualified personnel of the Investment Manager who have management and operational experience in the roads and highways sector. In addition, qualified personnel of the Project Manager manage our projects. For further details, see the section entitled "*Parties to the Trust*" on page 101 of this Placement Document. We believe that the experience and leadership of these teams will contribute to our growth and success and will position the Toll Road assets to be operated and managed in an efficient manner.

Growth opportunities and access to Sponsor's portfolio

Through our relationship with the Sponsor, and in accordance with the approval granted by the Chairman of NHAI, by way of communication dated March 29, 2021, our Sponsor will offer to us around 1,500 km of roads in three (3) years ("**Future Assets**") of which the Target Toll Roads have been offered for acquisition by the Sponsor. The process of identification of Future Assets, offer of Future Assets to Trust and completion of transfer of Future Assets to the Trust including valuation mechanism may be refined and/or modified in line with the internal policies of NHAI.

We believe that this access to future toll road assets of the Sponsor or its existing or future subsidiaries will be an important source of growth in the future.

Favourable Concession Agreements terms with Low Counterparty Risk and Inflation Passthrough

We believe that we have balanced Concession Agreements terms with low counterparty risk due to the creditworthiness of our Sponsor. We believe this, along with the following factors, provide for promising prospects for our business:

- *Long Concession Life with the possibility for an extension.* Our Concession Agreements are for a period of 20 years and/or 30 years (as applicable) from the relevant Appointed Date. We believe this is a sufficiently long period that provides us with ample opportunity to refinance the assets on a fully amortized basis. For details, see "*Summary of the Concession Agreements*".

- *Termination Payments.* Furthermore, our Concession Agreements provide for termination payments under various default scenarios such as NHAI events of default or *force majeure* events. Under the Concession Agreements, NHAI is obligated to make termination payments in the case of a concessionaire event of default. NHAI's strong track record of meeting its obligations when they become due gives us confidence that any termination payments will be made in a timely manner. Such termination payments may be used to compensate our creditors. For details, see "*Summary of the Concession Agreements*".

- *Minimal Price Risk.* The toll rates for all Toll Roads are determined with reference to published base toll rates and are adjusted annually at the beginning of each fiscal year equal to 40% of the movement in the wholesale price index measured in December of the preceding year plus a fixed 3% as per NHAI Fee Rules. Given India's long track record of relatively higher inflation rates as well as the 3% fixed portion of the increase, we anticipate a continuing increase in toll rates over the life of the concession. We expect that this formula will minimize any risk of increasing operating costs over time.

- *Prohibition Against Additional Tollways.* Subject to certain exemptions, NHAI is prohibited from constructing, or permitting the construction of, any competing expressway or other toll road ("**Additional Tollway**") between specified stretches of each Toll Road at any time during the relevant Concession Period. We will be compensated in line with the terms of the Concession Agreement if our toll collection activities are impacted by the Additional Tollway. NHAI is also obligated to use its best efforts to ensure that the tolls to be levied on vehicles using the Additional Tollway are at least 25% higher than the toll rates of the impacted Toll Road.

- *Prohibition Against Competing Roads.* Subject to certain exemptions, NHAI is prohibited from constructing a Competing Road (as such term is defined in the Concession Agreements) of each of the Toll Roads during the respective Concession Periods.

- *Compensation for reduced toll rates.* In terms of the Concession Agreements for the Target Toll Roads, if the Project SPVs suffer a loss in revenue owing to reduction in the Equitable Tollable Length (*as defined in the relevant Concession Agreement*) pursuant to Capacity Augmentation (*as defined in the relevant Concession Agreement*), NHAI shall compensate the Project SPVs for such loss incurred by the Project SPVs, on a quarterly basis.

- *Installation of Additional Check Plazas.* Under the Concession Agreements, subject to certain restrictions we are permitted to install temporary or permanent fee collection booths to prevent fee evasion by users of the Toll Roads. We believe the installation of these check plazas will significantly decrease leakage in the Toll Roads, increasing cash collections and performance.

Strategies of Our Trust

Organic growth through proactive management

Our principal investment strategy is to proactively manage the Toll Road assets to support growth. In particular, the Investment Manager will seek to maintain or improve the Project SPVs' net incomes by, among other initiatives, curbing leakages, conducting proper due diligence, formulating and adopting policies and procedures and structuring investments to address tax or regulatory considerations. The Project Manager will assist the Investment Manager by carrying out the

operations, management and maintenance of the project in accordance with the Concession Agreement and the Project Implementation Agreement and by procuring, operating and maintaining the project's toll management systems, including but not limited to, employing staff for toll collection, monitoring toll collection and providing security arrangements at toll plazas.

The Investment Manager will also focus on minimizing project operating expenses. The roads and highways sector are a highly competitive sector that is capital intensive and requires significant expenditure. Our ability to efficiently manage the costs associated with the Toll Road assets is critical to maintaining the Project SPVs' profit margins. The Investment Manager also intends to focus on increasing the margins of the Project SPVs by strengthening internal processes and systems so as to improve utilization of resources and reduce costs. As part of our operations and maintenance systems and processes, the Investment Manager intends to work closely with the Project Manager to promote best practices, to minimize downtime or defects with respect to the Toll Road assets and to monitor performance of toll booth operators and maintenance contractors. The Investment Manager also intends to work with the Project Manager and the Project SPVs to upgrade technology as needed, to manage any leakages in toll collections and to streamline collection, route and maintenance operations. With this focus on proactive asset management and operating expense minimization, the Investment Manager hopes to increase our profit margins and achieve long-term growth.

Acquisition of toll road projects

The Investment Manager intends to expand our initial portfolio by identifying and selectively acquiring additional toll road projects that meet our investment criteria described below. The Investment Manager intends to capitalize on opportunities to acquire road projects that provide attractive cash flows and yields. While evaluating acquisition opportunities, the Investment Manager intends to focus on, among other things, the following investment criteria in order to make asset selections:

- *Yield thresholds.* The Investment Manager will seek to acquire assets with returns that are estimated to be above our cost of capital so as to maintain or enhance returns to the Unitholders;
- *Traffic characteristics*. The Investment Manager will seek to acquire assets with potential for traffic growth;
- *Residual concession period*. The Investment Manager will actively seek projects with residual concession periods of sufficient duration to meet the investment objectives of the Trust to generate stable returns and ensure long-term growth;
- *Geographic diversity*. The Investment Manager will seek projects in a variety of geographical locations in India to mitigate concentration risk and to take advantage of regional growth; and
- *Other*. In addition, the Investment Manager will also take into account factors such as estimated *maintenance* costs based on technical assessments of projects under evaluation, the impact of acquisitions on our expected distributions, and the requirements under the InvIT Regulations to propel our portfolio of completed and revenue generating projects and under-construction projects.

Optimization of capital structure

The Investment Manager will seek to employ appropriate financing policies and diversify its sources of financing with the objective of minimizing our overall cost of capital. The Investment Manager shall ensure that the Trust operates within the InvIT Regulations for borrowing, whereby the maximum level of external debt in the Trust Group will not exceed 70% (or such other percentage as may, from time to time, be prescribed in the InvIT Regulations) of the value of the assets of the Trust. If it is in the interests of the Unitholders, the Investment Manager may also consider pursuing growth opportunities that require raising additional capital through the issuance of new Units, in accordance with the process laid down by SEBI.

Seamlessly transition all aspects of the Toll Roads upon acquisition

Each of the Toll Roads are publicly funded toll roads which have been operated, pursuant to an annual toll contract, by sub-contractors of NHAI. Upon acquisition of the Toll Roads pursuant to our Concession Agreements, we expect to seamlessly transition the O&M of each of the Toll Roads in a timely and efficient manner to ensure a smooth transition of operation of the Toll Roads and in order to minimize disruption to toll collection or road usage.

The O&M of the Agra Bypass Project, Chittorgarh - Kota & Chittorgarh Bypass Project, Borkhedi – Kelapur Project and Shivpuri-Jhansi Project, is being handled by us. However, with respect to certain Toll Roads, the (i) Abu Road – Swaroopganj Project (ii) Palanpur/Khemana – Abu Road Project, (iii) Kothakota Bypass – Kurnool Highway Project, (iv) Orai – Barah Project, (v) Chitradurga Bypass – Hubli Project/ Karnataka Project, (vi) Maharashtra/Karnataka Border (Kagal) – Belgaum Project we will take over the operations and maintenance of these Toll Roads upon expiration of their existing concessions on the dates provided in the table below, and the Appointed Date(s) respectively:

Project	**O&M handover date**
Abu Road – Swaroopganj Project	March 25, 2024
Palanpur/Khemana – Abu Road Project	March 25, 2024
Kothakota Bypass – Kurnool Highway Project	September 16, 2026

Maharashtra/Karnataka Border (Kagal) – Belgaum Project	December 16, 2021
Orai - Barah Project	December 13, 2024
Chitradurga Bypass – Hubli Project/ Karnataka Project	September 23, 2035 (km 340+000 to km 403+000) May 28, 2036 (km 260+000 to km 338+923) June 24, 2036 (km 208+000 to km 260+000 and km 0+000 to km 20+700)
Lakhnadon – Mahagaon (Mohgaon) – Khawasa	March 28, 2027 (km 546+420 to km 596+750) November 29, 2027 (km 596+750 to km 624+480) February 7, 2025 (km 624+480 to km 653+770) Appointed Date for km 551+600 to km 567+550
Chichra – Kharagpur Project	Appointed Date
Rewa –Lakhnadon Project	Appointed Date or date of completion of repairs, whichever is later for (Km 656+000 to Km 774+068 & for Km 793+065 to 1428+557 of NH 30) July 01, 2029 (for Km 774+068 to Km 793+065 of NH30

The operations of Target Toll Roads shall be taken over from the Appointed Date, in accordance with the Additional Concession Agreements.

Furthermore, the Sponsor, Project Manager and the Project SPVs had entered into a transitional support agreement in relation to the Existing Toll Roads for the purpose of the Sponsor providing the transitional support to (i) the Project Manager in respect of its obligations under the Project Implementation and Management Agreement, and (ii) the Project SPVs in respect of its O&M obligations and tolling obligations (*as provided under the Concession Agreements*). The terms and conditions of the transitional support agreement were, in respect of each Concession Agreement and the Project Implementation and Management Agreement, effective and binding on the Parties for a period of 6 (six) months commencing from the appointed date of the respective Concession Agreements, and has expired as of the date of this Placement Document. Additionally, the Sponsor, Project Manager and the Project SPVs have entered into a transitional support agreement in relation to the Target Toll Roads for the purpose of the Sponsor providing the transitional support to (i) the Project Manager in respect of its obligations under the Project Implementation and Management Agreement, and (ii) the Project SPVs in respect of its O&M obligations and tolling obligations (*as provided under the Additional Concession Agreements*). The terms and conditions of the transitional support agreement shall, in respect of each Concession Agreement and the Project Implementation and Management Agreement, be effective and binding on the Parties (i) for a period of 3 (three) months for the Existing Toll Roads, and (ii) for a period of 6 (six) months for the R3 Toll Roads, commencing from the appointed date of the respective Concession Agreements, unless terminated earlier by mutual consent.

Improve toll collection efficiencies across the Toll Roads

We intend to transition from the existing semi-automatic and hybrid ETC toll collection methods currently employed at the Toll Roads to automated toll collection system which we expect will improve efficiency, reduce leakage and decongest toll plazas. The adoption of automated toll collection system involves, among other things, the upgradation of toll management software to record vehicles crossing toll plazas, the usage of robust two-fold toll monitoring (including an automated traffic counter and vehicle classifiers to be installed at each toll lane and a remote video monitoring center to be established at our head office) and strict implementation of ETC at the toll lanes. This strategy is in line with the GoI's recent initiatives to increase digitization, including the adoption of FASTags for all toll collections across India. Hitherto, the Toll Roads have seen an increasing share of ETC/FASTag-based toll collection, and according to the Traffic Consultants, this share is expected to grow further. For more details, please see the **Annexure C** of this Placement Document.

Further, we intend the Project SPVs to engage with local communities around the Toll Roads to improve our relationship with users. We intend to adopt practices such as, conducting community consultation, supporting road safety, installing rainwater harvesting systems and planting trees. We believe these practices will improve our reputation with our key stakeholders including communities and road users.

Summary of our Toll Roads

	AP	AS	KK	MH-B	CK	BWK	AB	SJ	CHK	OB	RL	KK	KP	LMMK	CDHH
Highway	NH27	NH27	NH44	NH48	NH27	NH 44	Connecting NH 19 and NH44	NH 27	NH 49	NH 27	NH 30 & NH 34	NH 27	NH 27	NH 44	NH 48
State	Gujarat /Rajasthan	Rajasthan	Telangana	Karnataka	Rajasthan	Maharashtra/ Telangana	Uttar Pradesh	Uttar Pradesh – Madhya Pradesh	West Bengal	Uttar Pradesh	Madhya Pradesh	Assam	Assam	Madhya Pradesh	Karnataka
Original COD	Mar-09	Mar-09	Dec-09	Jul-04	Mar-09	Apr-11	Mar-17	Jul-09	13-Feb-20	13-Aug-21	**	Patgaon: February 2020 Dahalapara: January 2020	November 2021	P1: Khawasa: Sept 2010 TP2: Allonia: June 2010 TP2: Madai: 2021	14.02.2023 (COD) 24.06.2021 (PCOD) 28.05.2021 (PCOD) 27.04.2022 (COD) 23.09.2020 (PCOD)
Length (km)	45.0	31.0	74.6	77.7	160.5	138.4	32.8	75.3	56.12	62.9	306.34	114.17	27.3	107.35	214.47
No. of Lanes	4	4	4	^^4	4	4	4	4	4	4	4	4	4	4	6
Km Chainage (km)	601-646	646 – 677	135.5 - 211	515 – 592.240	891.9 – 1052.4	36.6-175	0 – 32.8	1305.08 – 1380.38	185+150 to 129+000	KM 1515.713 TO km 1578.872 (LHS) & km 1578.360 (RHS)	Km 656+000 to Km 725+185 of NH-30, Km 725+185 to km. 813+257, 4 Km 813+257 to Km 880+600 of NH-30, Km 880+600 of NH-30 (old NH-7) to Km 1428+557 of NH-34	Patgaon: KM 30+000 – KM 92+671 Dahalapara: KM 961+500 – KM 1013+000	KM 1013+000m – KM 1040+300	KM 546+420 to Km 653+770	0+000 to 20+700 208+000 to260+000 260+000 to338+923 340+000 to 403+000
Toll Plaza (Kilometric point location)	Khemana (602.75)	Undvaria (670.75)	Pullur (200.95)	Hattargi (537.77), Kognoli (591.24)	Bassi (929.63), Aroli (986.63), Dhaneshwar	Darodha (92.50) Kelapur (150.45)	Raibha (10.80)	Raksha (1374.65)	Balibhasa 157+915	Usaka TP km 1519.880	km 840.567 (Mohtara Toll plaza), km 1362+780	Patgaon: KM 49+600, Dahalapara: KM	Galia: KM 1017+350	Khawasa (km 651+718) Madai (km 549+200)	(Hebbalu at Existing Ch. 237+650 (Design

	AP	AS	KK	MH-B	CK	BWK	AB	SJ	CHK	OB	RL	KK	KP	LMMK	CDHH
					(1032.63)						(Boharipar Toll plaza), r km 739+000 (Kherwasani Toll plaza), km 675.700 (Odhaki Toll Plaza)	971+200			Ch. 239+330), Chalageri at Ch. 286+110 (Design Ch. 287+845), Bankapur at Existing Ch.352+550 (Design Ch. 353+090) for the Project length of 214.470 Km.
Pavement Type	Flexible	Flexible	Flexible	Rigid/ Flexible	Rigid/ Flexible	Flexible	Flexible	Flexible	Rigid/ Flexible	Rigid/ Flexible	Rigid/ Flexible	Flexible	Flexible	Rigid/ Flexible	Rigid/ Flexible
Initial Development Model	Annuity	Annuity	Annuity	Annuity	EPC	EPC	EPC	EPC	EPC	Annuity	EPC	EPC	EPC	BOT	HAM
						-	-	-							September 23, 2035
Annuity Concession End	Mar-24	Mar-24	Sep-26	Dec-19	-				-	Apr-26	-	-	-	-	May 28, 2036 June 24, 2036
						-	-	-							PNC Chitradurga highways, IRCON Davangere Haveri Highways Ltd, Monte Carlo Hubli Haveri Highways Pvt Ltd, URS Scott Wilson, L.N. Malviya Infra Projects Pvt. Ltd.
Current Concessionaire[1]	L&T IDPL*	L&T IDPL*	APEL^	-	-				-	O B Infrastructure Ltd	-	-	-	Malaxmi Highway Pvt. Ltd, Indinfravit, Dilip Buildcon	

	AP	AS	KK	MH-B	CK	BWK	AB	SJ	CHK	OB	RL	KK	KP	LMMK	CDHH
Tolling Handover date[(2)]	16-Dec-21	16-Dec-21	16-Dec-21	16-Dec-21	16-Dec-21	29-Oct-22	29-Oct-22	29-Oct-22	Appointed Date	Appointed Date	Appointed Date	Appointed Date	Appointed Date	Appointed Date	Appointed Date
O&M Handover date	Mar-24	Mar-24	Sep-26	16-Dec-21	16-Dec-21	29-Oct-22	29-Oct-22	29-Oct-22	13th Feb, 2024 and Appointed date	13-Dec-24	13th Feb, 2024 and Appointed date	-	-	28th March, 2027, Appointed date, 29th November, 2027, 7th February, 2025	September 23, 2035 May 28, 2036 June 24, 2036
InvIT - Concession period	30 Years	30 Years	30 Years	30 Years	30 Years	20 Years	20 Years	20 Years	20 Years	20 Years	20 Years	20 Years	20 Years	20 Years	20 Years
FasTag enablement date.....	16-Feb-21	16-Feb-21	16-Feb-21	16-Feb-21	16-Feb-21	16-Feb-21	16-Feb-21	16-Feb-21	16-Feb-21	16-Feb-21	16-Feb-21	16-Feb-21	16-Feb-21	16-Feb-21	16-Feb-21

Source: Traffic reports, National Highways Infra Trust
^^6 laning of the highway is underway
**L&T Interstate Road Corridor Limited*
^Andhra Pradesh Expressway Limited
**

RKJL		PCOD/COD
Odhaki		30-Oct-19
Kherwasani	1 Pkg - 2A 725+185 774+068	18-Aug-19
	2 Katni Bypass 774+068 793+065	Scheduled to be completed in June 2024
	3 Pkg - 2B 793+065 813+257	18-Aug-19
Mohtara		04-Sep-19
Bohoripar		14-Aug-20

Notes:

(1) Maintenance for project stretches to continue under scope of existing concessionaire until end of current concession.

(2) Appointed date as per the relevant Concession Agreements. Transitional support agreement has been entered into between NHAI and the Trust to manage tolling and O&M for the first 6 months for the Existing Toll Roads and for the first 3 months for the Target Toll Roads.

Description of Our Toll Roads

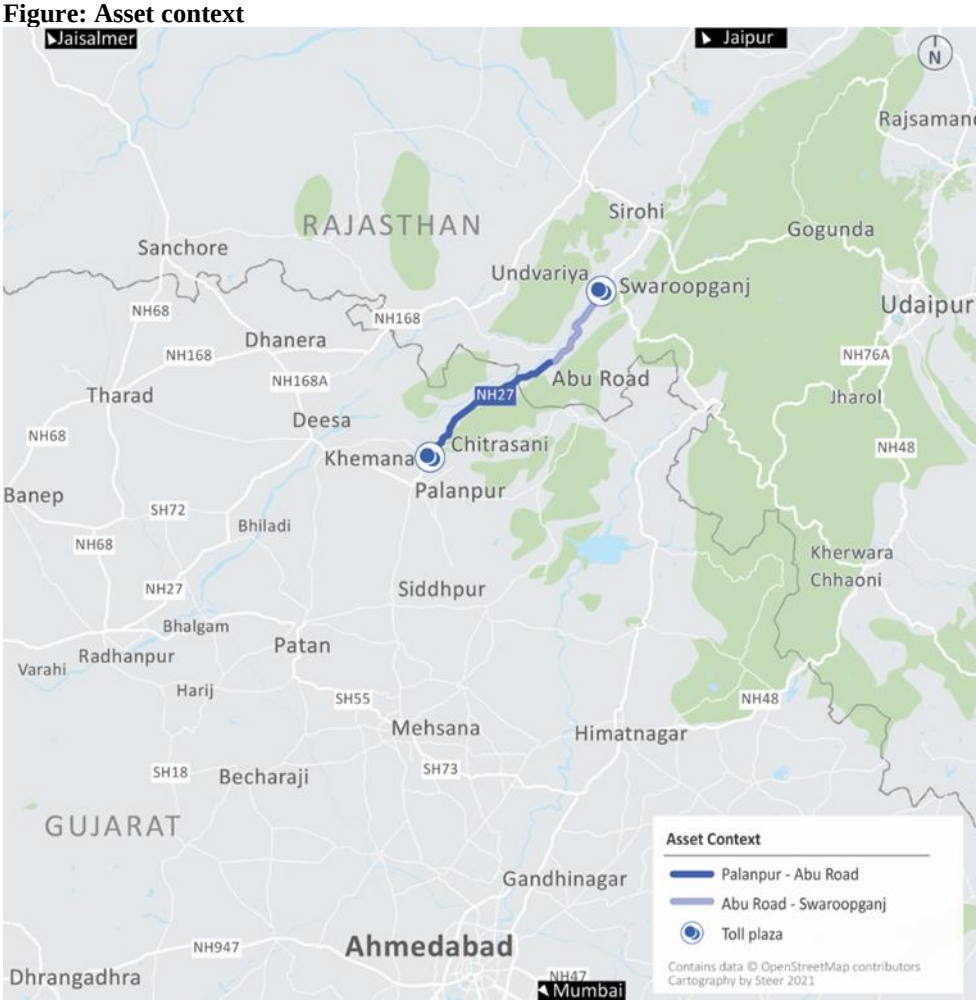
1. *Palanpur/Khemana – Abu Road Project (“Asset 1”) and Abu Road –Swaroopganj Project (“Asset 2”)*

Project overview

The Assets are located on NH 27 in the states of Rajasthan and Gujarat and has one toll plaza each in the respective states namely Undavariya and Khemana. Both the toll plazas lie on the continuous section of NH 27 as shown in the map below and are located at:

- Undavariya (KM 670.750): Four-laned Asset starts near Swaroopganj on the NH 27 and ends near Abu Road.
- Khemana (KM 602.750): Four-laned Asset starts south of Abu Road and ends just south of Chitrasani village.

Figure: Asset context



Source: Steer cartography using OpenStreetMap data

Salient growth features and traffic generators

Undavariya (Rajasthan), Khemana (Gujarat) Toll Plazas lie on NH 27 which is the second longest highway in India. This section is one of the key connectors between Gujarat, Rajasthan and Eastern India and catering to East-West movement.

The Assets cater to the demands generated by the states connected through the National Highway. NH 27 runs over 3,507 kms completing the East-West movement and connects some of the major states and industrial centres of Western states of Gujarat, Rajasthan with Eastern states of West Bengal, Assam, UP etc. The traffic profile is largely goods vehicles undertaking long distance movements and CJV traffic between Rajasthan & Gujarat.

The key industries in this region include dairy, textile, diamond polishing, and marble processing. Palanpur is a major hub for dairy production, having one of the largest dairies in the State – Banas Dairy. Mehsana is a town located south of Palanpur and is also known for its dairy production and related processing services.

Udaipur in the east and Jodhpur in the north of the asset, are popular tourist destinations in the state of Rajasthan. Tourism constitutes most of the state’s tertiary sector and Rajasthan is one of the key tourist destinations in India which has attracted more than 50 million domestic tourists in 2019.

CJV movements on these Assets are predominantly local and of a short distance between Palanpur, Swaroopganj, Deesa and other small towns. MAV traffic on the other hand is long-distance in nature, connecting Rajasthan, Punjab, Delhi, and

Haryana in the north to industrial cities in Gujarat. The toll plazas also cater port-bound traffic including Gandhidham industrial cluster while connecting the regional centres, i.e., Bhilwara, Jodhpur, etc., with the port towns Kandla and Mudra in the Kutch region. There is also an amount of traffic carrying powder and other inputs to ceramic-based industry located in the Morbi area in Gujarat.

(a) **Traffic volume and composite of vehicles**

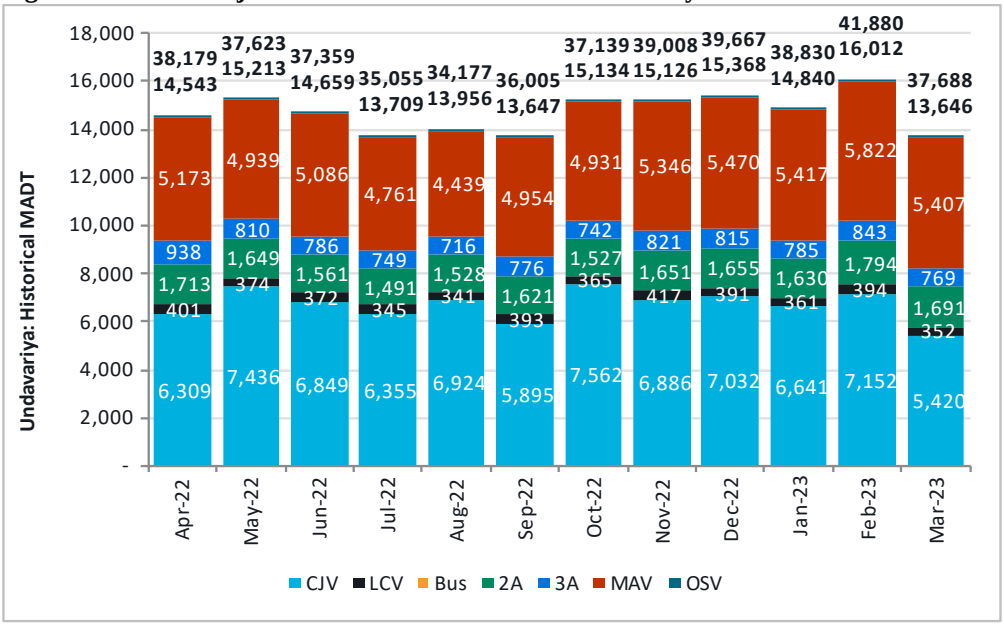
Historical traffic data

As discussed already, the toll plaza data is available from 1st Apr 2021 till 27th Mar 2023 for Undavariya TP and from 1st Apr 2021 till 31st Mar 2023 for Khemana TP.

It was found that for Undavariya, the violations abruptly got zero from an average of 1800 and exemptions reduced to half to about 850 from Aug-22 onwards. Whereas, for Khemana, we didn't observe such drastic change in violations/ exemptions data. It is understood from the client and toll plaza management that this was a result of improved reporting from Aug 2022, after the toll plazas were taken over by NHIPPL and the run-through traffic which was incorrectly recorded was removed from the traffic data reporting. Based on discussions with the client in order to make the old traffic data (i.e., before Aug-22) consistent with the data reported from Aug-22 onwards, the adjustment in the exemptions/ violations and passes traffic from Apr-22 to Jul-22 based on the exemptions/ violations and passes traffic observed from Aug-2022 onwards for CJV and LCV categories were made. For the remaining categories, we have relied on toll plaza data for all ticket type traffic.

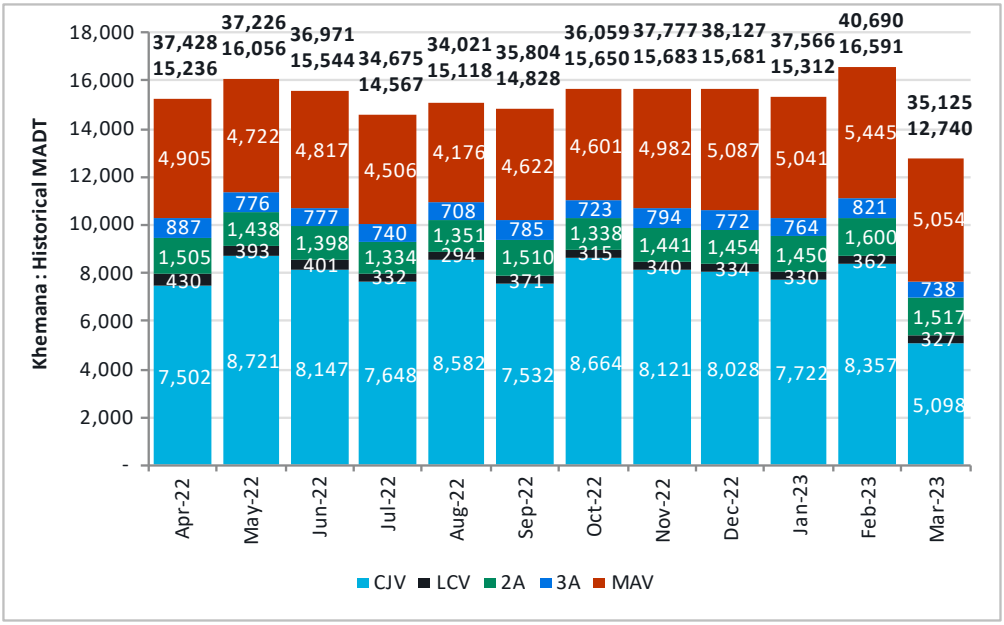
The Assets trend at 35,000 PCU levels in FY23 with robust CJV and MAV performance. Undavariya toll plaza observed an average of ~14.700 AADT and Khemana ~15,300 AADT in FY23. The Asset has shown a flattish growth, recording a PCU growth (excluding CJV and LCV) of ~2.5% and ~1.1% at Undavariya and Khemana respectively in FY23 with respect to FY22N. On an average, the daily revenue collection at Undavariya and Khemana are ~INR 18 lakhs and ~INR 26 lakhs respectively.

Figure: PCU and Adjusted MADT for FY23 - AS: Undavariya



Source: Steer analysis of client toll plaza data

Figure: PCU and Adjusted MADT for FY23 – PA: Khemana



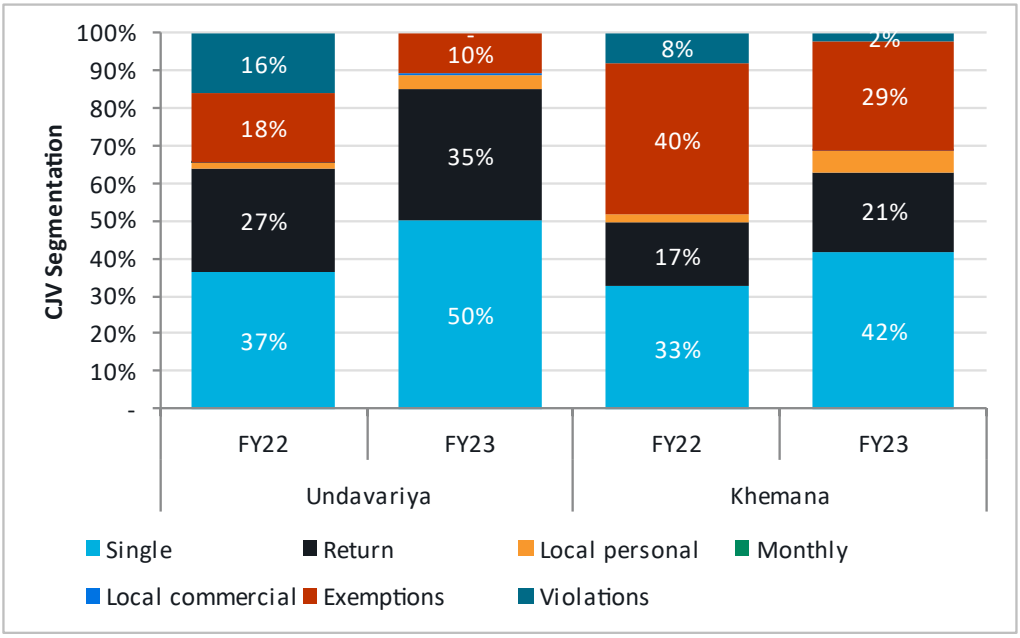
Source: Steer Analysis of client toll plaza data

Toll segmentation

On the Assets, CJVs are observed to have ~40-45% exemptions/violations in FY22-23 YTD. There has been a significant improvement in exemptions/violation from FY22 to FY23 which is due to plazas taken over by NHIPPL in Aug 2022.

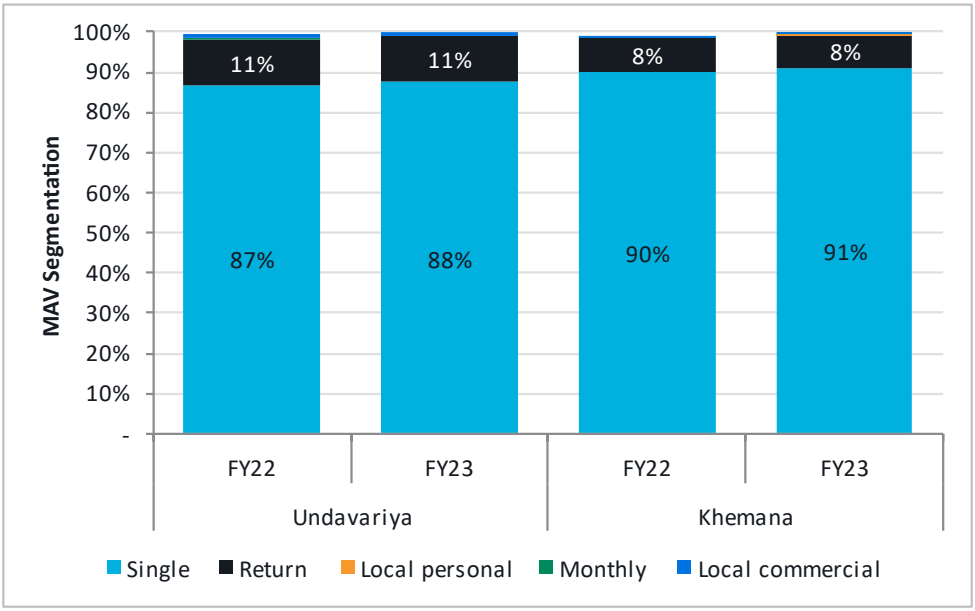
85%-90% of the commercial vehicles (3A/ MAV) plying on the Asset are observed to buy single tickets as the Asset caters to long-distance movements. Return trips are primarily attributed to the short distance trips in the vicinity of the Asset.

Figure: Segmentation CJV



Source: Steer Analysis

Figure: Segmentation MAV

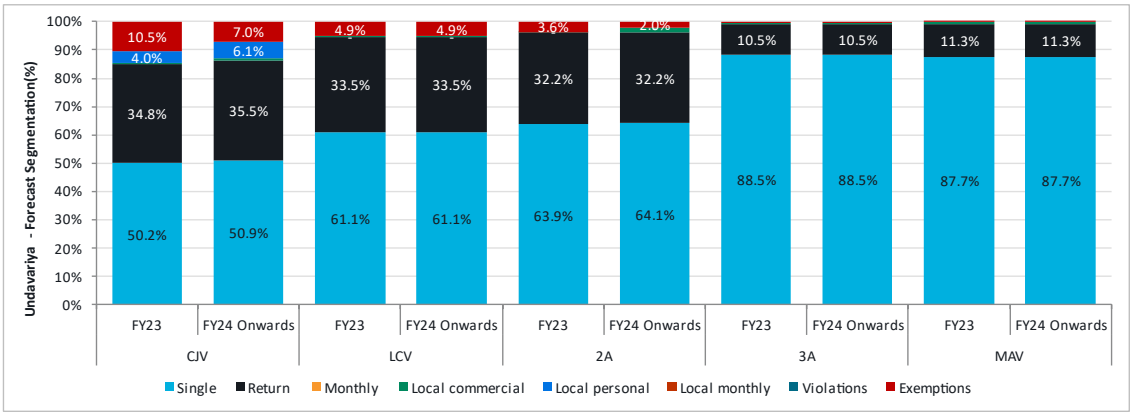


Source: Steer Analysis

However, as the above-mentioned segmentation doesn't correctly reflect the share of non-toll paying traffic, i.e., violations and exemptions. The same has been assessed based on the difference between TMS and TVC dataset in the final adopted segmentation.

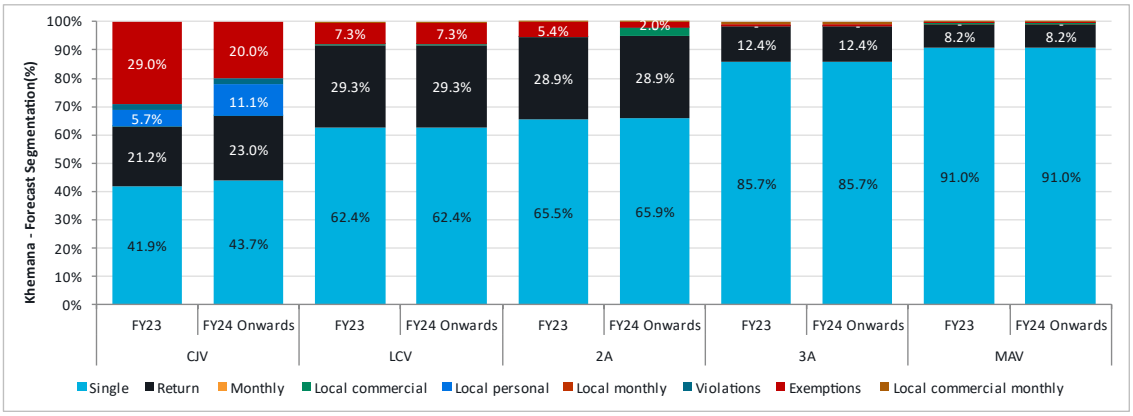
The final forecast segmentation is shown in the charts below. The changes in forecast toll segmentation observed on toll plaza is due to our understanding that once the Assets are taken over by the Client, the overall reporting practises will improve as the toll plaza will be operated by a reputed toll operator and may result in a decrease in total exemptions. Increasing compliance due to better operational efficiency in the next year will see the number of exemptions decrease further, with a subsequent increase in the Local passes, as well as the Single and Return ticket categories.

Figure: Toll segmentation (%) at AS: Undavariya



Source: Steer Analysis

Figure: Toll segmentation (%) at PA: Khemana



Source: Steer Analysis

(b) **Traffic forecast**

The increase of traffic on any existing road alignment depends on how fast the background travel demand (background growth) will grow; and on how successfully the project road is in attracting that traffic (traffic capture). Background travel demand is driven by the prevalent socio-economic conditions in the region, which include:

- Changes in factors such as population, employment, and income distribution
- Economic growth (GSDP, and GDP).
- Growth of local industries near the Asset.

The model uses India GDP and GSDP of Rajasthan & Gujarat as the two macro-economic inputs which operate as growth drivers on our base year forecasts.

The network developments near the Assets' alignment which Steer believes would affect traffic on the Asset during the concession period are Amritsar Jamnagar Expressway, completion of Wester Dedicated Freight Corridor (WDFC), Two laning of Udaipur-Sirohi-Tharad road sections; Six Laning & LoS Improvement and 3A/MAV recovery (at Khemana TP).

Steer has developed traffic and revenue forecasts for the Assets by taking into consideration all inputs discussed above – base year estimates, macro-economic assumptions, growth drivers, elasticities, and forecast ticket segmentation. The table below provides the final (background plus impacts) traffic growth on the Assets.

Table: Final (background plus impacts) AADT forecast – AS: Undavariya

Vehicle Type	FY24	FY25	FY30	FY35	FY40	FY43
PCUs	**38,746**	**39,769**	**49,928**	**64,248**	**80,337**	**91,054**

Source: Steer Analysis

Table: Final (background plus impacts) AADT forecast – PA: Khemana

Vehicle Type	FY24	FY25	FY30	FY35	FY40	FY43
PCUs	**37,927**	**39,273**	**49,492**	**63,648**	**79,844**	**90,642**

Source: Steer Analysis

Tollable Length and Toll Rates

In terms of tollable length, Undavariya currently (FY24) comprises 32.59 km whereas at Khemana the tolling length is 50.92 km. In India, toll rates are as per notification by the Ministry of Road Transport and Highways in the National Gazette. The present toll rates are determined with reference to the published base toll rates and are adjusted annually at the beginning of each fiscal year equal to 40% of the movement in the wholesale price index in December of the preceding year plus a fixed 3%.

In line with the NHAI's toll notification for FY24, i.e., April 1, 2023, onwards, the toll rates at the Undavariya and Khemana toll plazas for Assets are as follows:

Table: FY24 toll rates – AS: Undavariya

Vehicle Type	Single	Return	Monthly

CJV	45	70	1555
LCV	75	115	2510
Bus/Truck	160	235	5260
3A	170	260	5735
MAV/ HCM/EME	245	370	8245
OSV	300	450	10040

Source: Steer Analysis

Table: FY24 toll rates – PA: Khemana

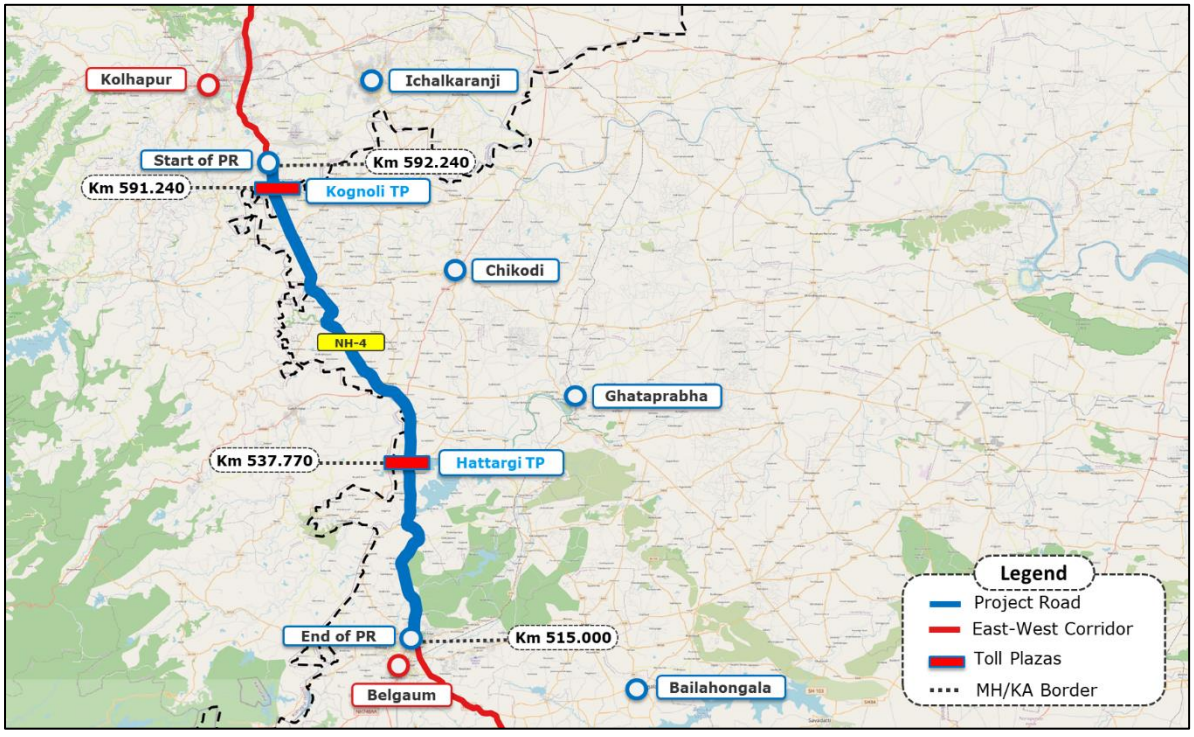
Vehicle Type	Single	Return	Monthly
CJV	75	110	2425
LCV	120	175	3920
Bus/Truck	245	370	8215
3A	270	405	8960
MAV/ HCM/EME	385	580	12885
OSV	470	705	15685

Source: Steer Analysis

2. *Maharashtra Border – Belgaum Project ("Asset 3")*

Project overview

According to the Traffic Consultant, the four-lane Asset 3 is part of the NH-4 in the state of Maharashtra/Karnataka, starts at KM 592.705 of NH-4 near Kagal and ends at KM 515.000 of NH-4 near Belgaum with a length of about 77.24 km. The project road falls under the jurisdiction of Kolhapur district of Maharashtra and Belgaum district of Karnataka passing through settlements of Kagal, Kognoli, Nippani, Sankeshwar, Hattargi and Belgaum. There are two operational toll plazas on the project road, one near Kognoli (KM 591.240) and other near Hattargi (KM 537.770).



Source: Traffic Report

Salient growth features and traffic generators

According to the Traffic Consultant, Asset 3 serves the long-distance traffic for freight vehicles, which are majorly plying between Mumbai/Pune/Delhi and Goa/Bangalore/Chennai/Vellore. Apart from long distance traffic, it also serves the short distance traffic for both passenger and freight which is mainly generated between Kolhapur/Sangli/Goa/Belgaum/Khanapur/Hubli/Dharwad and nearby places.

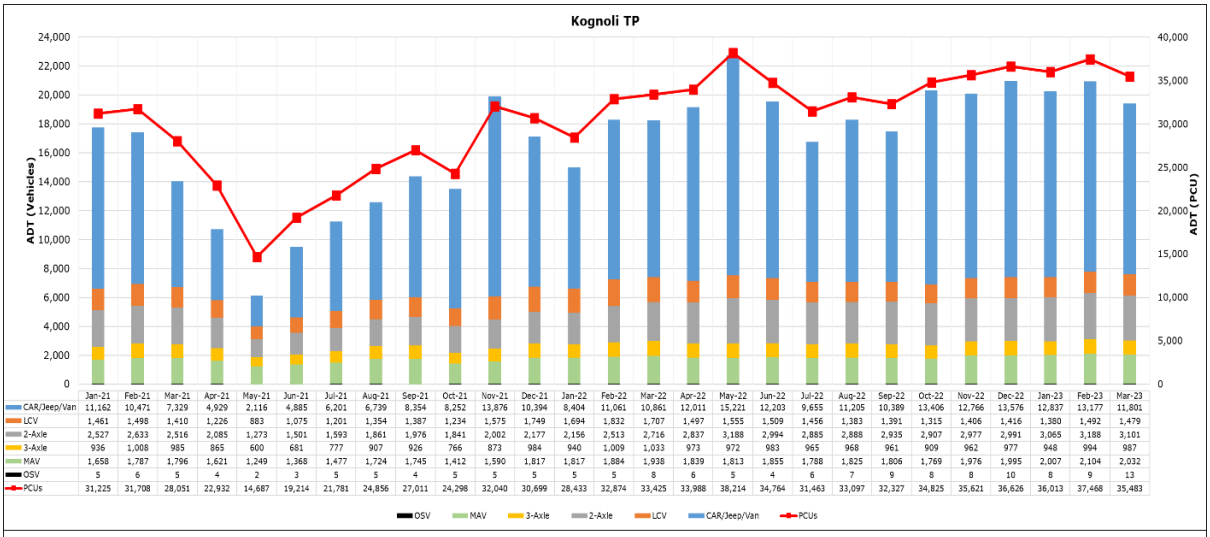
Kolhapur district is situated in the southern side of the state of Maharashtra, bounded by Sindhudurg district in the west, Sangli district in the north, Bijapur district of Karnataka in the east and Belgaum district of Karnataka in the south. It is one of the industrialised districts in Maharashtra. Due to the presence of abundant water and fertile soil, the district is prominent in cultivation of sugarcane, paddy, banana, soyabean and several vegetables. It is the major producer of jaggery and sugar. The district also houses many dairy and poultry farms. It is one of the prime centres of the textile industry, cotton mills and arts and handicrafts industry. The district also has the highest number of sugar refineries in the country and is also known as the sugar bowl of India.

Belgaum district is situated in northwest of the state of Karnataka, sharing borders with Goa and Maharashtra. Belgaum district is surrounded by Dharwad and Uttara Kannada districts on the south, Bagalkot and Bijapur districts in the east, and Kolhapur district of Maharashtra in the north. The district with different agro climatic conditions and soil types has vast agricultural potential. Major crops grown in the district are paddy, maize, jowar, oil seeds, cotton, onion, tomato and sugarcane. Belgaum has 16 industrial estates, six industrial areas and one SEZ. Belgaum district is important centre for manufacturing of valves, pumps, and its accessories, heavy machine tools and high-pressure oil hydraulics. It has 58 export-oriented units and 22 sugar industries in different parts of district. Rich deposits of natural resources like bauxite, uranium, silica sand, aluminium, laterite, limestone, dolomite, quartzite and china clay are also found in the district.

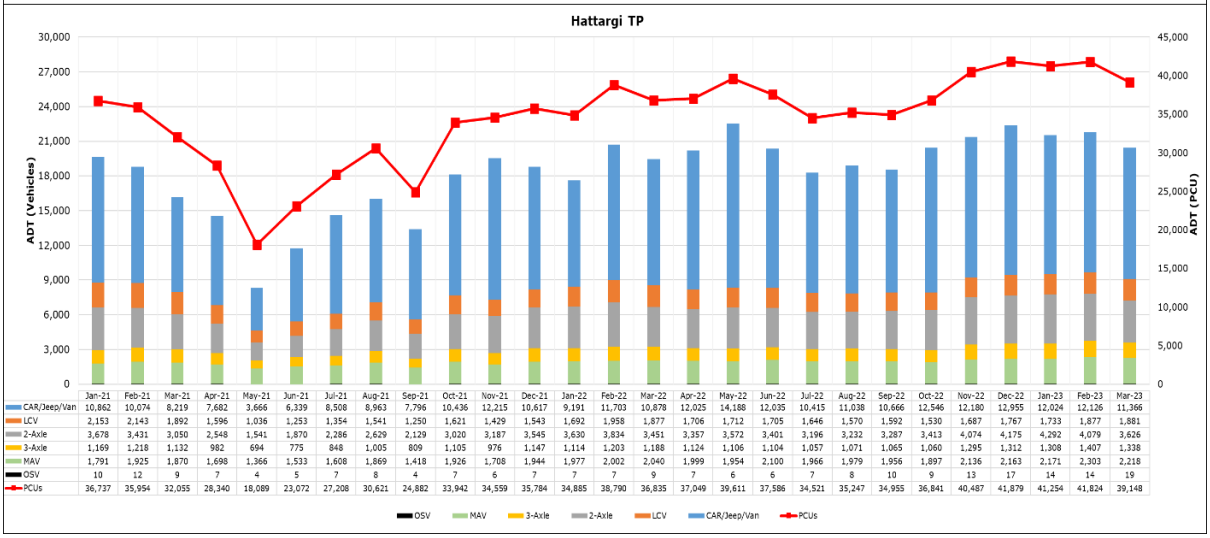
Traffic volume and composite of vehicles

<u>Historical traffic data</u>

The following table shows the historical traffic data of Asset 3, according to the Traffic Report annexed as Annexure C:



	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23
CAR/Jeep/Van	11,162	10,471	7,329	4,929	2,116	4,885	6,201	6,739	8,354	8,252	13,876	10,394	8,404	11,061	10,861	12,011	15,221	12,203	9,655	11,205	10,389	13,406	12,766	13,576	12,837	13,177	11,801
LCV	1,461	1,498	1,410	1,226	883	1,075	1,201	1,354	1,387	1,234	1,575	1,749	1,694	1,832	1,707	1,497	1,555	1,509	1,456	1,383	1,391	1,315	1,406	1,416	1,380	1,492	1,479
2-Axle	2,527	2,633	2,516	2,085	1,273	1,501	1,593	1,861	1,976	1,841	2,002	2,177	2,156	2,513	2,716	2,837	3,188	2,994	2,885	2,888	2,935	2,907	2,977	2,991	3,065	3,188	3,101
3-Axle	936	1,008	985	865	600	681	777	907	926	766	873	984	940	1,009	1,033	973	972	983	965	968	961	909	962	977	948	994	987
MAV	1,658	1,787	1,796	1,621	1,249	1,368	1,477	1,724	1,745	1,412	1,590	1,817	1,817	1,884	1,938	1,839	1,813	1,855	1,788	1,825	1,806	1,769	1,976	1,995	2,007	2,104	2,032
OSV	5	6	5	4	2	3	5	5	4	5	5	5	5	5	8	6	5	4	6	7	9	8	8	10	8	9	13
PCUs	31,225	31,708	28,051	22,932	14,687	19,214	21,781	24,856	27,011	24,298	32,040	30,699	28,433	32,874	33,425	33,988	38,214	34,764	31,463	33,097	32,327	34,825	35,621	36,626	36,013	37,468	35,483



	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23
CAR/Jeep/Van	10,862	10,074	8,219	7,682	3,666	6,339	8,508	8,963	7,796	10,436	12,215	10,617	9,191	11,703	10,878	12,025	14,188	12,035	10,415	11,038	10,666	12,546	12,180	12,955	12,024	12,126	11,366
LCV	2,153	2,143	1,892	1,596	1,036	1,253	1,354	1,541	1,250	1,621	1,429	1,543	1,692	1,958	1,877	1,706	1,712	1,705	1,646	1,570	1,592	1,530	1,687	1,767	1,733	1,877	1,881
2-Axle	3,678	3,431	3,050	2,548	1,541	1,870	2,286	2,629	2,129	3,020	3,187	3,545	3,630	3,834	3,451	3,357	3,572	3,401	3,196	3,232	3,287	3,413	4,074	4,175	4,292	4,079	3,626
3-Axle	1,169	1,218	1,132	982	694	775	848	1,005	809	1,105	976	1,147	1,114	1,203	1,188	1,124	1,106	1,104	1,057	1,071	1,065	1,060	1,295	1,312	1,308	1,407	1,338
MAV	1,791	1,925	1,870	1,698	1,366	1,533	1,608	1,869	1,418	1,926	1,708	1,944	1,977	2,002	2,040	1,999	1,954	2,100	1,966	1,979	1,956	1,897	2,136	2,163	2,171	2,303	2,218
OSV	10	12	9	7	4	5	7	8	4	7	6	7	7	7	9	7	6	6	7	8	10	9	13	17	14	14	19
PCUs	36,737	35,954	32,055	28,340	18,089	23,072	27,208	30,621	24,882	33,942	34,559	35,784	34,885	38,790	36,835	37,049	39,611	37,586	34,521	35,247	34,955	36,841	40,487	41,879	41,254	41,824	39,148

Source: Traffic Report

The 12-month average traffic from April 2022 to March 2023 has been taken as the AADT for FY23 by the Traffic Consultant, as provided below:

Location/ Mode	Car/Jeep/ Van/Taxi	LCV	2A	3A	MAV	OSV
TP01	12,354	1,440	2,996	966	1,901	8
TP02	11,964	1,675	3,635	1,136	2,068	11

Source: Traffic Report

Toll Segmentation

The tolling stream distribution under the present study has been derived from the toll data taking an average of FY23 and The table below presents the proposed segmentation for Toll Plaza Kognoli and Toll Plaza Hattargi.

Ticket Type/ Modes	Car	LCV	Bus/ 2A Truck	3 A Truck	4-6 A Truck	OSV
TP01 - Kognoli						
Single	47.6	74.1	63.4	87.1	90.9	96.8
Return	42.4	21.6	32.6	12.3	8.7	2.6
Monthly	0.0	0.0	0.0	0.0	0.0	0.0
Local personal	5.5	0.0	0.0	0.0	0.0	0.0
Local commercial	0.0	0.0	3.3	0.0	0.0	0.1
Exempt	4.4	4.3	0.7	0.6	0.3	0.5
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
TP01 – Hattargi						
Single	40.6	71.6	56.2	81.0	87.8	79.6
Return	53.1	24.0	34.6	18.4	11.9	2.7
Monthly	0.0	0.0	0.2	0.0	0.0	0.0
Local personal	1.5	0.0	0.0	0.0	0.0	0.0
Local commercial	0.2	0.8	8.6	0.2	0.1	0.0
Exempt	4.7	3.6	0.4	0.4	0.3	17.7
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Traffic Report

Projected Traffic Data: Growth Passenger Car Unit (PCU)

The Traffic Consultant projects that there will be continued sustained growth in PCU of Asset 3 across all vehicle types until FY2052. The below table shows the expected PCU by financial year for the Toll Plaza of Kognoli and Hattargi:

Kognoli	**FY24**	**FY27**	**FY32**	**FY37**	**FY42**	**FY47**	**FY52**
PCU	35,796	40,245	41,109	50,552	60,893	72,474	84,727

Hattargi	**FY24**	**FY27**	**FY32**	**FY37**	**FY42**	**FY47**	**FY52**
PCU	39,054	43,802	45,130	55,050	65,889	77,976	90,715

Source: Traffic Report

Operations and maintenance

The Maharashtra/Karnataka Border (Kagal) - Belgaum Toll Road was under the operations and maintenance contract of the Authority until the appointed date in the relevant Concession Agreement, being, December 16, 2021.

Pursuant to the completion of Transitional Support Agreement, NHIPPL has taken over the toll operations with effect from June 21, 2022 and have engaged a third party for undertaking user fee collection services for the same for a period of one year.

In relation to the routine maintenance and incident management activities of Asset 3, the same being undertaken by an agency appointed by NHAI and which shall continue to do so until the appointed date of the relevant EPC contract. The EPC contractor shall be responsible for the scope till the completion of the defects liability period of the relevant EPC agreement.

The Authority has appointed two EPC Contractors for undertaking the 4-6 laning works of this section. The Appointed date of the EPC Contractor is likely to declared on or before October 2022. The time for completion of the six laning works is 2.5 years from the Appointed Date.

Tollable Length and Toll Rates

In terms of tollable length, the Maharashtra/Karnataka Border (Kagal) - Belgaum Toll Road comprises 60.73 kms for Kognoli Toll Plaza and 23.74 kms for Hattargi Toll Plaza. In India, toll rates are as per notification by the Ministry of Road Transport and Highways in the National Gazette. The present toll rates are determined with reference to the published base toll rates and are adjusted annually at the beginning of each fiscal year equal to 40% of the movement in the wholesale price index in December of the preceding year plus a fixed 3%.

In line with the NHAI's toll notification dated March 24, 2022, the toll rates at the Kognoli toll plaza of the Maharashtra Border - Belgaum Project for FY2024 are as follow:

Vehicle Type	**Single Journey**	**Multiple Journey**	**Monthly Pass**	**Fee for Commercial Vehicle Registered within the district of the Kognoli Toll Plaza**
		(Rs.)		
Car/Jeep/Van	85	125	2755	40
LCV	135	200	4450	65
Bus/Truck	280	420	9325	140
Vehicles with up to 3 axles	305	460	10175	155
HCM/EME (3 to 6 axles).....	440	660	14625	220
Oversized vehicles (Vehicles with 7 or more axles)	535	800	17805	265

Source: NHAI

In line with the NHAI's toll notification dated March 24, 2022, the toll rates at the Hattargi toll plaza of the Maharashtra Border - Belgaum Project for FY2024 are as follows:
Source: NHAI

Vehicle Type	**Single Journey**	**Multiple Journey**	**Monthly Pass**	**Fee for Commercial Vehicle Registered within the district of the Hattargi Toll Plaza**
		(Rs.)		
Car/Jeep/Van	30	50	1075	15
LCV	50	80	1740	25
Bus/Truck	110	165	3645	55
Vehicles with up to 3 axles	120	180	3975	60
HCM/EME (3 to 6 axles).....	170	255	5715	85
Oversized vehicles (Vehicles with 7 or more axles)	210	315	6960	105

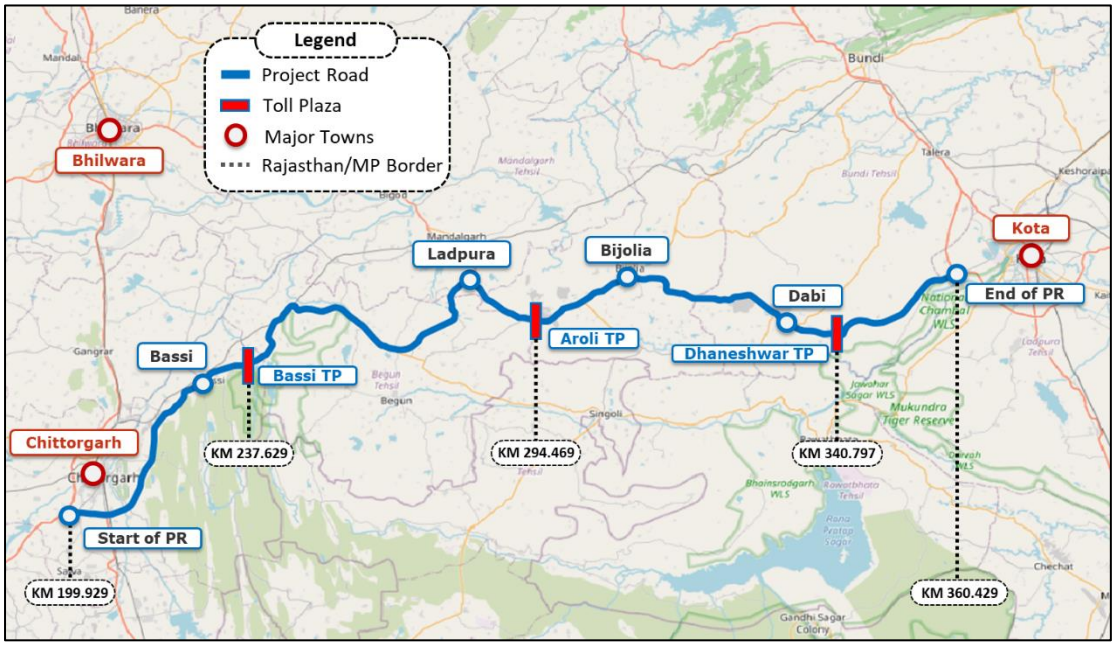
Source: NHAI

3. *Chittorgarh – Kota & Chittorgarh Bypass Project ("Asset 4")*

Project overview

According to the Traffic Consultant, Asset 4 is a 4-lane, 160.5 km long stretch, on national highway (NH) 27, with three (3)

toll plazas at Airoli, Bassi and Dhaneshwar. The project highway, NH-27, is part of the East – West corridor envisaged under National Highway Development Program (Phase – II). The total length of NH-27 is roughly 3,530 km starting from Porbandar in the state of Gujarat and ending at Silchar in the state of Assam while passing through the states of Rajasthan, Madhya Pradesh, Uttar Pradesh, Bihar and West Bengal. NH–27 connects important tourist and industrial cities and towns like Porbandar (port city), Rajkot, Palanpur, Udaipur, Chittorgarh, Jhansi, Kanpur, Lucknow, Muzaffarpur, Purnea, Siliguri, Jalpaiguri. The project road section, Chittorgarh-Kota, part of the NH-27 in the state of Rajasthan, starts at KM 891.929 of NH-27 near Chittorgarh and ends at KM 1,052.429 of NH-27 at Kota with a length of about 160.5 km. The project road falls under the jurisdiction of Chittorgarh, Bhilwara, Bundi and Kota districts passing through settlements of Chittorgarh, Bassi, Aroli, Ladpura, Bijolia, Dhaneshwar, Dabi and Kota. There are three operational toll plazas on the project road, near Bassi (KM 929.629), near Aroli (KM 986.629), and near Dhaneshwar (KM 1,032.629).



Source: Traffic Report

Salient growth features and traffic generators

According to the Traffic Consultant, the project stretch mostly falls in four districts, namely Chittorgarh, Bhilwara, Bundi and Kota.

The Chittorgarh district is situated in south-east part of Rajasthan. The economy of the district is predominated by agriculture with about 72% of the workers being involved in agriculture or as agricultural labourers. The major crops grown in the district are maize, soybean, groundnut, sorghum, cotton and black gram in kharif season and wheat, mustard, gram, barley and opium in rabi season. Also, cultivation of fruits and vegetables is done in limited portions of land. The district is rich in mineral resources like barytes, china clay, limestone, sandstone and ochre. Several industries like cement, fabric processing units, chemical and fertilizer manufacturing units, polypropylene, HDPE woven sacks and fabric manufacturing units are present in the district. The cement plants include Birla Corporation Limited, Wonder Cement Limited, Aditya Cement Limited, Lafarge India Private Ltd. and J K Cement Works. Hindustan Zinc Limited has various plants spread across the district which produce sulphuric acid, refined zinc, refined lead. There is an atomic power plant and a heavy water plant located at Rawatbhata beside Rana Pratap Sagar dam. In addition to this, the presence of Chittorgarh fort and palaces makes it a famous tourist destination.

The Bhilwara district is located in the south-eastern part of Rajasthan and its economy driven by agriculture with 62.6% of the total workers involved in the primary sector. The major crops grown in the district include maize, oil seeds, wheat, pulses, jowar, barley and fibres with small quantities of different spices, bajra and some fruits and vegetables. The major agro-based industries here are oil mills, flour mills, ice candy manufacturing units, dal mills and units producing biscuits, confectionary items, khandsari, masala and cattle feed. The district is also well established in textile industry and known as Vastra Nagari and Manchester of Rajasthan. It is famous for manufacturing of synthetics and cotton mix fabric and synthetic yarn. The mineral resources available in the district include lead, zinc, soap stone, china clay, feldspar, quartz, mica, marble, granite, asbestos and garnet. It is one of the largest producers of raw material required for ceramic industry –quartz feldspar, china clay.

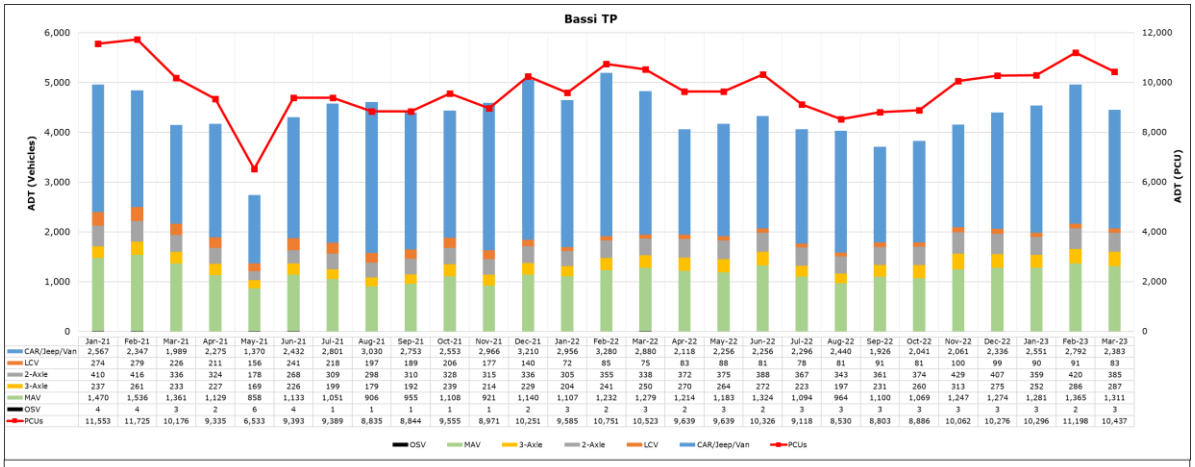
The Bundi district is famous for its contribution to agriculture. Major agricultural crops include pulses, wheat, gram, barley, cotton, tobacco and oil seeds. Among oil seeds, mustard and rapeseed are the mostly produced. Important fruit trees in Bundi include orange, pomegranate, lemon, guava and mango. Textile, tourism, handicrafts and small-scale industries play a pivotal role in the economic prosperity of Bundi in Rajasthan. Polyster fiber is the major produce as a part of textiles. The district is famous for its beautiful forts and palaces which have been converted into heritage hotels and step-well reservoirs to attract more tourists.

The Kota district is the trade centre for cotton, millet, wheat, coriander and oilseeds. Major cultivated crops include soybean, paddy and maize in kharif season while rapeseed & mustard, wheat, coriander and gram in rabi season. Ramganj mandi in Kota is famous for the stone and coriander market. It is the largest market for coriander in India. The industries prevalent in the district include cotton and oilseed milling, textile weaving, distilling, dairying, and the manufacture of metal handcrafts. Kota city is also known as the "Education hub of India" with the presence of a number of coaching institutes for engineering and medical entrance exams.

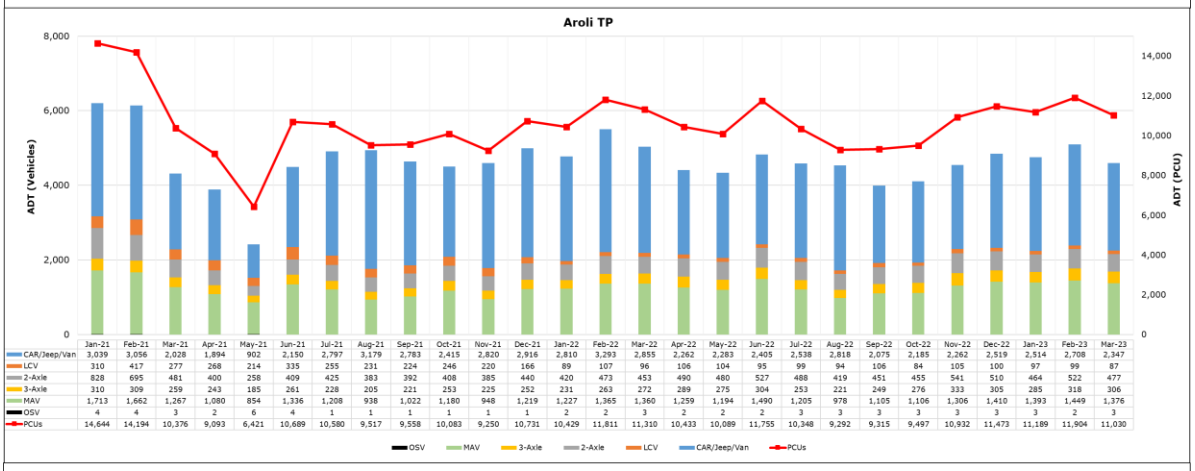
Traffic volume and composite of vehicles

Historical traffic data

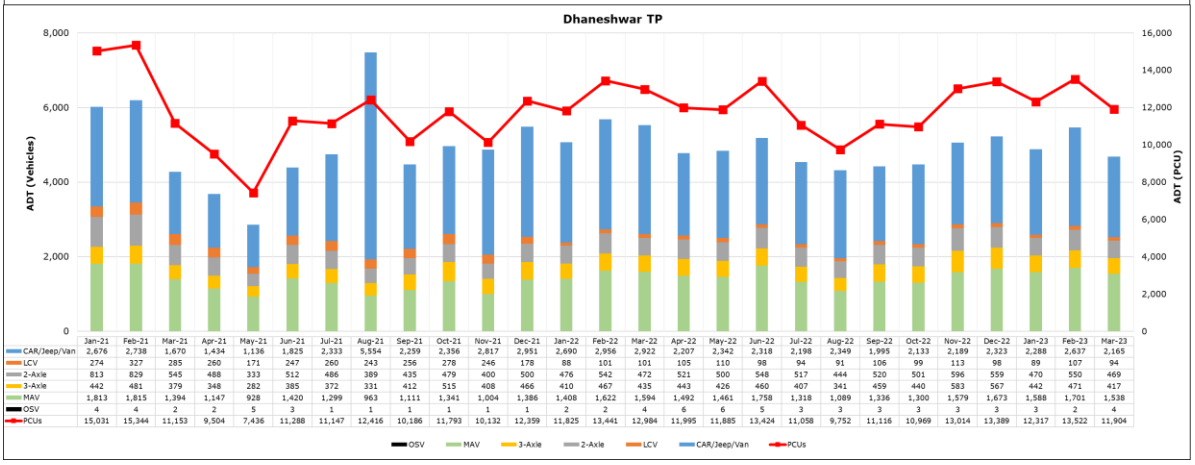
The following table shows the historical traffic data of Asset 4 according to the Traffic Report annexed as Annexure C:



	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23
CAR/Jeep/Van	2,567	2,347	1,989	2,275	1,370	2,432	2,801	3,030	2,753	2,553	2,966	3,210	2,956	3,280	2,880	2,118	2,256	2,256	2,296	2,440	1,926	2,041	2,061	2,336	2,551	2,792	2,383
LCV	274	279	226	211	156	241	218	197	189	206	177	140	72	85	75	83	88	81	78	81	91	81	100	99	90	91	83
2-Axle	410	416	336	324	178	268	309	298	310	328	315	336	305	355	338	372	375	388	367	343	361	374	429	407	359	420	385
3-Axle	237	261	233	227	169	226	199	179	192	239	214	229	204	241	250	270	264	272	223	197	231	260	313	275	252	286	287
MAV	1,470	1,536	1,361	1,129	858	1,133	1,051	906	955	1,108	921	1,140	1,107	1,232	1,279	1,214	1,183	1,324	1,094	964	1,100	1,069	1,247	1,274	1,281	1,365	1,311
OSV	4	4	3	2	6	4	1	1	1	1	1	2	3	2	3	2	3	2	3	3	3	3	3	3	3	2	3
PCUs	11,553	11,725	10,176	9,335	6,533	9,393	9,389	8,835	8,844	9,555	8,971	10,251	9,585	10,751	10,523	9,639	9,639	10,326	9,118	8,530	8,803	8,886	10,062	10,276	10,296	11,198	10,437



	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23
CAR/Jeep/Van	3,039	3,056	2,028	1,894	902	2,150	2,797	3,179	2,783	2,415	2,820	2,916	2,810	3,293	2,855	2,262	2,283	2,405	2,538	2,818	2,075	2,185	2,262	2,519	2,514	2,708	2,347
LCV	310	417	277	268	214	335	255	231	224	246	220	166	89	107	96	106	104	95	99	94	106	84	105	100	97	99	87
2-Axle	828	695	481	400	258	409	425	383	392	408	385	440	420	473	453	490	480	527	488	419	451	455	541	510	464	522	477
3-Axle	310	309	259	243	185	261	228	205	221	253	225	252	231	263	272	289	275	304	253	221	249	276	333	305	285	318	306
MAV	1,713	1,662	1,267	1,080	854	1,336	1,208	938	1,022	1,180	948	1,219	1,227	1,365	1,360	1,259	1,194	1,490	1,205	978	1,105	1,106	1,306	1,410	1,393	1,449	1,376
OSV	4	4	3	2	6	4	1	1	1	1	1	1	2	2	3	2	2	2	3	3	3	3	3	3	3	2	3
PCUs	14,644	14,194	10,376	9,093	6,421	10,689	10,580	9,517	9,558	10,083	9,250	10,731	10,429	11,811	11,310	10,433	10,089	11,755	10,348	9,292	9,315	9,497	10,932	11,473	11,189	11,904	11,030



	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23
CAR/Jeep/Van	2,676	2,738	1,670	1,434	1,136	1,825	2,333	5,554	2,259	2,356	2,817	2,951	2,690	2,956	2,922	2,207	2,342	2,318	2,198	2,349	1,995	2,133	2,189	2,323	2,288	2,637	2,165
LCV	274	327	285	260	171	247	260	243	256	278	246	178	88	101	101	105	110	98	94	91	106	99	113	98	89	107	94
2-Axle	813	829	545	488	333	512	486	389	435	479	400	500	476	542	472	521	500	548	517	444	520	501	596	559	470	550	469
3-Axle	442	481	379	348	282	385	372	331	412	515	408	466	410	467	435	443	426	460	407	341	459	440	583	567	442	471	417
MAV	1,813	1,815	1,394	1,147	928	1,420	1,299	963	1,111	1,341	1,004	1,386	1,408	1,622	1,594	1,492	1,461	1,758	1,318	1,089	1,336	1,300	1,579	1,673	1,588	1,701	1,538
OSV	4	4	2	2	5	3	1	1	1	1	1	1	2	2	4	6	6	5	3	3	3	3	3	3	3	2	4
PCUs	15,031	15,344	11,153	9,504	7,436	11,288	11,147	12,416	10,186	11,793	10,132	12,359	11,825	13,441	12,984	11,995	11,885	13,424	11,058	9,752	11,116	10,969	13,014	13,389	12,317	13,522	11,904

Source: Traffic Report

The 12-month average traffic from April 2022 to March 2023 has been taken as the AADT for FY23 at all the three toll plaza by the Traffic Consultant, as provided below:

Location/Mode	Car/Jeep/ Van/Taxi	LCV	2A	3A	MAV	OSV
TP01	2,288	87	382	261	1,202	2
TP02	2,410	98	485	284	1,273	1
TP03	2,262	100	516	455	1,486	2

Source: Traffic Report

Toll Segmentation

Tolling distribution considered for respective toll plaza location across the project road is based on the average ticket distribution of FY23 toll data by the Traffic Consultant. The table below presents proposed segmentation for the three (3) toll plazas of Asset 4:

Ticket Type/Modes	Car			LCV	Bus/ 2A Truck	3A Truck	MAV	OSV
	FY22	FY23	FY24 onwards					
TP01-Bassi								
Single	40.9	57.9	47.4	47.4	59.7	72.2	87.7	40.9
Return	44.8	39.1	43.2	43.2	39.9	18.0	11.2	44.8
Monthly	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
Local personal	1.3	0.0	0.0	0.0	0.0	0.0	0.0	1.3
Local commercial	0.1	0.9	9.1	9.1	0.2	9.6	0.0	0.1
Exempt	13.0	1.6	0.3	0.3	0.2	0.2	1.1	13.0
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
TP02-Aroli								
Single	43.9	54.3	43.3	43.3	57.7	68.5	85.4	43.9
Return	51.8	44.2	56.6	56.6	42.2	31.5	14.4	51.8
Monthly	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Local personal	3.3	0.0	0.0	0.0	0.0	0.0	0.0	3.3
Local commercial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exempt	1.0	1.5	0.0	0.0	0.0	0.0	0.2	1.0
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
TP03-Dhaneshwar								
Single	40.3	51.4	43.0	43.0	40.7	52.7	58.9	40.3
Return	46.7	46.5	54.4	54.4	53.6	44.5	40.9	46.7
Monthly	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0
Local personal	10.9	0.0	0.0	0.0	0.0	0.0	0.0	10.9
Local commercial	0.0	0.0	2.4	2.4	5.6	2.8	0.0	0.0
Exempt	2.1	0.7	0.2	0.2	0.1	0.0	0.2	2.1
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Traffic Report

Projected Traffic Data: Growth Passenger Car Unit (PCU)

The Traffic Consultant project that there will be continued sustained growth in PCU of Asset 4 across all vehicle types until FY2052. The below table shows the expected PCU by financial year:

Bassi	**FY24**	**FY27**	**FY32**	**FY37**	**FY42**	**FY47**	**FY52**
PCU	10,284	12,491	16,186	20,486	25,451	31,102	37,162

Aroli	**FY24**	**FY27**	**FY32**	**FY37**	**FY42**	**FY47**	**FY52**
PCU	11,164	13,508	17,460	22,05 7	27,359	33,387	39,847

Dhaneshwar	**FY24**	**FY27**	**FY32**	**FY37**	**FY42**	**FY47**	**FY52**
PCU	12,654	15,251	19,677	24,821	30,746	37,474	44,676

Source: Traffic Report

Operations and maintenance

Upon completion of the Transitional Support Agreement, the NHIPPL has taken over the toll operations with effect from June 21, 2022, and have appointed a third party for undertaking user fee collection services for the same, for a period of one year.

Tollable Length and Toll Rates

In terms of tollable length, the Chittorgarh – Kota & Chittorgarh Bypass Project comprises 64.18 kms for Bassi Toll Plaza, 54.82 kms for Aroli Toll Plaza and 53.50 kms for Dhaneshwar Toll Plaza. In India, toll rates are as per notification by the Ministry of Road Transport and Highways in the National Gazette. The present toll rates are determined with reference to the published base toll rates and are adjusted annually at the beginning of each fiscal year equal to 40% of the movement in the wholesale price index in December of the preceding year plus a fixed 3%.

In line with the NHAI's toll notification dated March 23, 2022, the toll rates at the Aroli toll plaza for the Chittorgarh – Kota & Chittorgarh Bypass Toll Road for FY2024 are as follows:

Vehicle Type	**Single Journey**	**Multiple Journey**	**Monthly Pass**	**Fee for Commercial Vehicle Registered within the district of the Aroli Toll Plaza**
		(Rs.)		
Car/Jeep/Van	80	120	2615	40
LCV	125	190	4220	65
Bus/Truck	265	400	8845	135
Vehicles with up to 3 axles	290	435	9650	145
HCM/EME	415	625	13870	210
Vehicles with 7 or more axles	505	760	16885	255

Source: NHAI

According to the NHAI's toll notification dated March 23, 2022, the toll rates at the Bassi toll plaza for the Chittorgarh – Kota & Chittorgarh Bypass Toll Road for FY2023 are as follows:

Vehicle Type	**Single Journey**	**Multiple Journey**	**Monthly Pass**	**Fee for Commercial Vehicle Registered within the district of the Bassi Toll Plaza**
		(Rs.)		
Car/Jeep/Van	90	140	3060	45
LCV	150	220	4940	75
Bus/Truck	310	465	10350	155
Vehicles with up to 3 axles	340	510	11295	170
HCM/EME	485	730	16235	245
Vehicles with 7 or more axles	595	890	19765	295

Source: NHAI

According to the NHAI's toll notification dated March 23, 2022, the toll rates at the Dhaneshwar toll plaza for the Chittorgarh – Kota & Chittorgarh Bypass Toll Road for FY2023 are as follows:

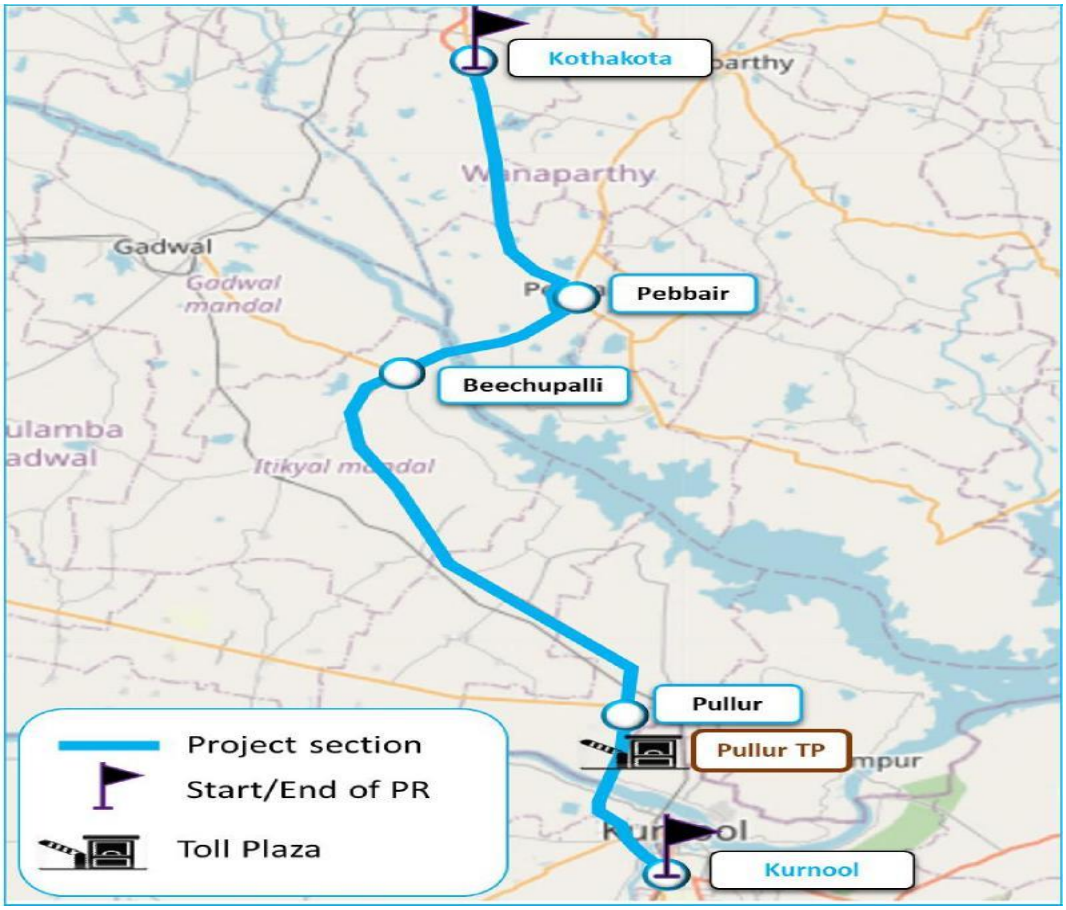
Source: NHAI

4. *Kothakota Bypass – Kurnool Highway Project ("Asset 5")*

Vehicle Type	Single Journey	Multiple Journey	Monthly Pass	Fee for Commercial Vehicle Registered within the district of the Dhaneshwar Toll Plaza
		(Rs.)		
Car/Jeep/Van	75	115	2550	40
LCV	125	185	4120	60
Bus/Truck	260	390	8630	130
Vehicles with up to 3 axles	280	425	9415	140
HCM/EME.....	405	610	13535	205
Vehicles with 7 or more axles.....	495	740	16480	245

Project overview

According to the Traffic Consultant, Asset 5 is a 4-lane, 74.6 kms long stretch, on national highways (NH) 44 which starts in Telangana State and ends at Kurnool in the state of Andhra Pradesh, with one toll plaza at Pullur. The project road serves for long distance traffic which is majorly plying between Hyderabad/Nagpur/northern region and Bengaluru/Mysuru/southern region. Apart from long distance traffic, it also serves the short distance traffic which is mainly generated between Mahbubnagar/ Kothakota/ Wannaparthy/ Pebbair and Kurnool/Ananthpur areas. NH-44, which is the project highway for Asset 5 is the longest highway in India connecting Srinagar with Kanyakumari and is part of North-South corridor envisaged under National Highway Development Program (Phase – II). NH-44 passes through the cities of Jammu, Jalandhar, Delhi, Faridabad, Agra, Gwalior, Jhansi, Sagar, Nagpur, Hyderabad, Bengaluru and Salem.



Source: Traffic Report

Salient growth features and traffic generators

According to the Traffic Consultant, the project stretch mostly passes through the districts of Wanaparthy and Jogulamba Gadwal in the state of Telangana and Kurnool in the state of Andhra Pradesh.

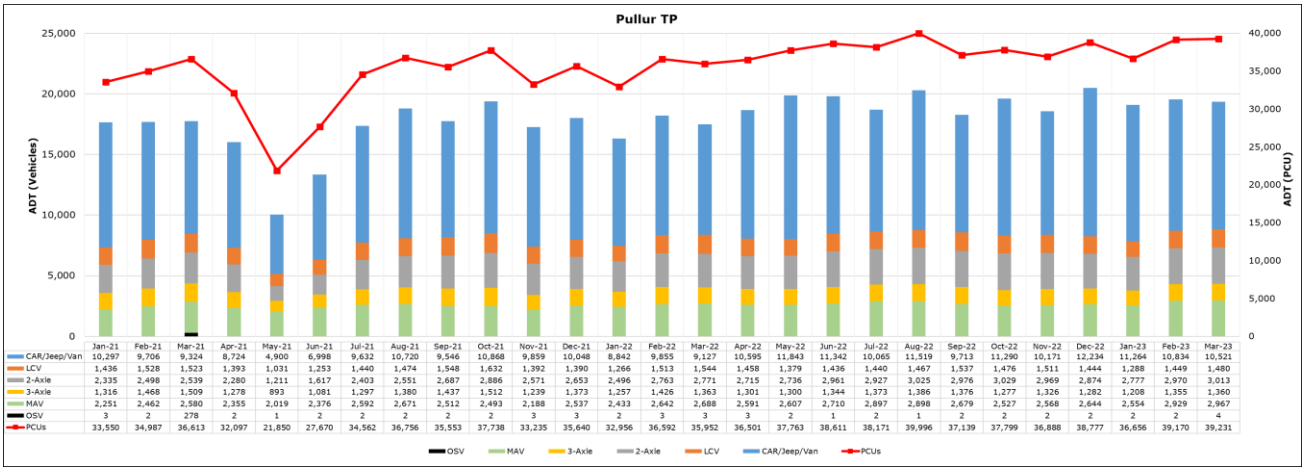
The Wanaparthy district is situated in south-east part of Telangana State, sharing border with the state of Andhra Pradesh. Wanaparthy district is surrounded by Mahabubnagar district in north, Nagarkurnol district in east, the state of Andhra Pradesh in south and Jogulamba Gadwal district in west. Agriculture is the main livelihood of the people in Wanaparthy district with 75% total workers engaged in agro-based labour. Red sandy soil and sandy loam soil covers 89% of the area. Paddy, groundnut, jowar, maize, red gram, castor, cotton and chili are the major crops cultivated within the district. Wanaparthy district, being one of the newly formed districts finds its place in backward districts of the state. Sri Ranganayaka Temple, Ghanpur Fort, Pangal Fort, Wanaparthy Palace, Saralasagar Project are few tourist attractions present in the district.

The Kurnool District is situated in Western part of Andhra Pradesh. It is surrounded by Nagarkurnool, Wanaparthy districts of Telangana state in north, Kadapa and Anantapur Districts in south, the Bellary district of Karnataka state in west and Prakasam District in east. Almost half of the geographical area is under agriculture use. Paddy, cotton, tomato and onion are the major crops grown in the district. Mining/quarrying is the prevailing industry in the district. District has deposits of limestone, iron ore, barites and shale within its geographical area. Belum Caves, Mahanandi, Manthralayam, Srisailam and Rollapadu sanctuary are the main tourist attractions in the district.

Traffic volume and composite of vehicles

Historical traffic data

The following table shows the historical traffic data of Asset 5 according to the Traffic Report annexed as Annexure C:



	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23
CAR/Jeep/Van	10,297	9,706	9,324	8,724	4,900	6,998	9,632	10,720	9,546	10,868	9,859	10,048	8,842	9,855	9,127	10,595	11,843	11,342	10,065	11,519	9,713	11,290	10,171	12,234	11,264	10,834	10,521
LCV	1,436	1,528	1,523	1,393	1,031	1,253	1,440	1,474	1,548	1,632	1,392	1,390	1,266	1,513	1,544	1,458	1,379	1,436	1,440	1,467	1,537	1,476	1,511	1,444	1,288	1,449	1,480
2-Axle	2,335	2,498	2,539	2,280	1,211	1,617	2,403	2,551	2,687	2,886	2,571	2,653	2,496	2,763	2,771	2,715	2,736	2,961	2,927	3,025	2,976	3,029	2,969	2,874	2,777	2,970	3,013
3-Axle	1,316	1,468	1,509	1,278	893	1,081	1,297	1,380	1,437	1,512	1,239	1,373	1,257	1,426	1,363	1,301	1,300	1,344	1,373	1,386	1,376	1,277	1,326	1,282	1,208	1,355	1,360
MAV	2,251	2,462	2,580	2,355	2,019	2,376	2,592	2,671	2,512	2,493	2,188	2,537	2,433	2,642	2,688	2,591	2,607	2,710	2,897	2,898	2,679	2,527	2,568	2,644	2,554	2,929	2,967
OSV	3	2	278	2	1	2	2	2	2	2	3	3	2	3	3	3	2	1	2	1	2	2	2	2	2	2	4
PCUs	33,550	34,987	36,613	32,097	21,850	27,670	34,562	36,756	35,553	37,738	33,235	35,640	32,956	36,592	35,952	36,501	37,763	38,611	38,171	39,996	37,139	37,799	36,888	38,777	36,656	39,170	39,231

Source: Traffic Report

12-month average traffic of April 2022 to March 2023 for the estimation of AADT for FY23 by Traffic Consultant, as provided below:

Location/Mode	Car/Jeep/ Van/Taxi	LCV	2A	3A	MAV	OSV
TP01	10,636	1,410	2,849	1,296	2,651	2

Source: Traffic Report

Toll Segmentation

The tolling stream distribution under the present study has been derived from the toll data taking an average of ticket wise traffic of FY23. The table below presents proposed segmentation of total traffic assessed from the toll data for the toll plaza of Asset 5:

Ticket Type/Modes	Car	LCV	Bus/ 2A Truck	3A Truck	MAV	OSV
Single	50.5	68.3	54.8	81.9	91.4	90.6
Return	39.5	31.5	43.9	18.0	8.5	9.4
Monthly Pass	0.0	0.0	1.2	0.0	0.0	0.0
Local personal	8.7	0.0	0.0	0.0	0.0	0.0
Local commercial	0.0	0.0	0.0	0.0	0.0	0.0
Exempt	1.2	0.2	0.1	0.1	0.1	0.0
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Traffic Report

Projected Traffic Data: Growth Passenger Car Unit (PCU)

The Traffic Consultant projects that there will be continued sustained growth in PCU of Asset 5 across all vehicle types until FY2052. The below table shows the expected PCU by financial year:

Pullur	**FY24**	**FY27**	**FY32**	**FY37**	**FY42**	**FY47**	**FY52**
PCU	38,889	42,589	50,674	63,468	78,471	95,839	114,787

Source: Traffic Report

Operations and maintenance

The Kothakota Bypass – Kurnool Highway Toll Road is currently operated under the BOT (Annuity) model, whereby the concessionaire is responsible for construction, operations and maintenance of the toll road while the relevant authority collects tolls and makes annuity payments to the Concessionaire. The current concessionaire is Andhra Pradesh Expressway Limited. We expect the current concessionaire to undertake routine and major maintenance works, as per the requirement of its current concession obligations, up to the termination of its concession period and our O&M Handover Date for the Kothakota Bypass – Kurnool Highway Toll Road on September 16, 2026. Following our takeover of O&M on September 16, 2026, we plan to perform ongoing major maintenance works on a regular basis to maintain in good condition the Kothakota Bypass – Kurnool Highway Toll Road.

Upon completion of the Transitional Support Agreement, NHIPPL has taken over the toll operations with effect from June 21, 2022 and have appointed a third party for undertaking user fee collection services for the same, for a period of one year.

NHAI by way of its letter bearing reference NHAI/PIU-HYD/NH-44/AP- 5/InvIT/2022/939 dated June 10, 2022, has informed that it proposes to undertake six-laning of NH-44 from KM 22.300 to KM 210.369 which includes the stretch of Asset 5 from KM 135.469 to KM 211.00. Accordingly, NHAI has advised NHIPPL (being the Concessionaire) to keep the proposed initial improvement works on Asset 5 on hold until the completion of the proposed six-laning of of NH-44 from KM 22.300 to KM 210.369 is completed.

Tollable Length and Toll Rates

In terms of tollable length, the Kothakota Bypass – Kurnool Highway Toll Road comprises 92.43 kms of roads. In India, toll rates are as per notification by the Ministry of Road Transport and Highways in the National Gazette. The present toll rates are determined with reference to the published base toll rates and are adjusted annually at the beginning of each fiscal year equal to 40% of the movement in the wholesale price index in December of the preceding year plus a fixed 3%.

In line with the NHAI's toll notification dated March 17, 2022, and Subsequent toll fee revision, the toll rates at the Pullur toll plaza for the Kothakota Bypass – Kurnool Highway Toll Road for FY2024 are as follows:

Vehicle Type	**Single Journey**	**Multiple Journey**	**Monthly Pass**	**Fee for Commercial Vehicle Registered within the district of the Pullur Toll Plaza**
		(Rs.)		
Car/Jeep/Van	130	200	4405	65
LCV	215	320	7120	105
Bus/Truck	445	670	14195	225
Vehicles with up to 3 axles	490	730	16270	245
HCM/EME (Vehicles with 4 to 6 axles)	700	1,050	23385	350
Vehicles with 7 or more axles	855	1,280	28470	425

Source: NHAI

5. *Agra Bypass ("Asset 6")*

Project overview

According to the Traffic Consultant, Asset 6 is a 32.80 km four-lane road, forming part of the section connecting NH19 (old NH2) to NH44 (old NH7) in Uttar Pradesh, branches out to NH52 (old NH3) and NH44 (old NH7) at Gwalior. Asset 6 is in operations since March 2017. Asset 6 acts as a bypass to the city of Agra, a majority of approach roads and structures on the Asset 6 are already six lanes as this was required as per the construction requirements when Asset 6's construction was completed by the NHAI's contractors. Asset 6 lies on the outskirts of Agra, bypassing the city and acting as a key connection between Delhi to the regions of Gwalior and south. It further connects the traffic originating from west from areas such as Gujarat and Jaipur to the cities in the East (Kanpur, Lucknow and beyond), thereby supporting the east-west movement. A small section of Agra Bypass is currently incomplete due to land acquisition issues and financing hurdles. However, according to the Traffic Consultant, this link will get completed in the due course of time, as pressure on local government and NHAI increases, due to growing urban settlements within Agra.

Source: Steer cartography using OpenStreetMap data

Salient growth features and traffic generators

According to the Traffic Consultant, Asset 6 serves:

- NH19/NH2 – North to Central/Eastern movements originating from Delhi and northern parts of the country (Punjab, Haryana, Himachal Pradesh, Jammu and Kashmir) to the central (UP, Bihar) and eastern (West Bengal, Jharkhand, Chhattisgarh, North-Eastern region) of the country.
- NH2/19 – NH52 and NH44 connection. This is the traditional north south movement between Delhi (and northern states) to destination such as Indore (Madhya Pradesh), Maharashtra, and all southern states. The traffic having origin destinations to south of Asset 6 split at Gwalior to use NH52 and NH44 depending on the destination.
    - NH52 (old NH3): predominantly serves the Indore, Nashik, Mumbai movement in addition to movements between Delhi-Bangalore, Goa, and other destinations;
    - NH44 (old NH7): serves the Karnataka, Telangana, Andhra Pradesh, Tamil Nadu and Kerala movements.
- East-West movements NH21 traffic between Gujarat, Rajasthan, and Kanpur/Lucknow in addition to the Gujarat – Delhi (and north) movements.

The traffic profile is predominantly goods vehicles undertaking long distance movements between the locations discussed above. The commodity mix carried by the vehicles observed at the toll plaza during site visit was mix of manufacturing, courier/parcel, automobile, and agriculture confirming the long-distance nature of the traffic.

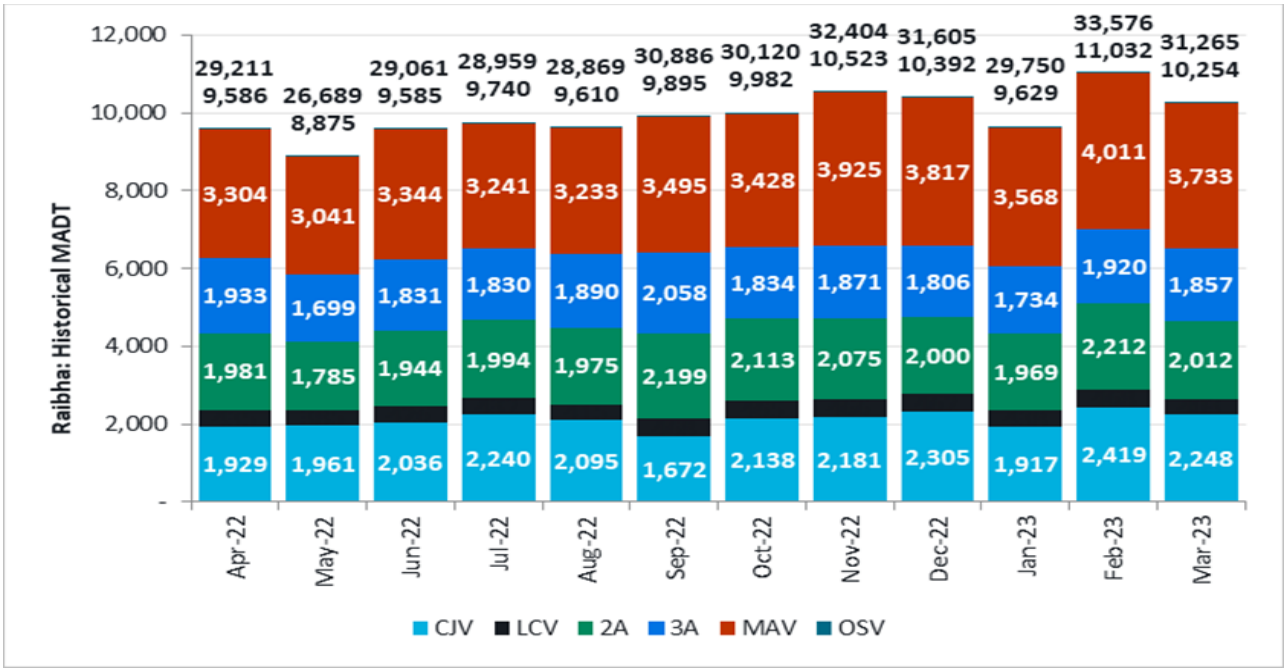
Asset 6 forms part of the section connecting NH2 to NH44, later branching out to NH52 and NH44 at Gwalior. The Asset caters to the demands generated by the states connected through the above-mentioned highways. NH2 runs over 1,465 kms completing the east – west movement and connects some of the major states and industrial centres of Delhi, Haryana, Uttar Pradesh with the eastern states of Bihar, Jharkhand, and West Bengal. On the contrary, NH44 completes the north-south movement of the country as it connects the northern states/UTs of Jammu and Kashmir, Punjab, Haryana, Delhi, Uttar Pradesh, Rajasthan, Madhya Pradesh, Maharashtra with the southern states of Telangana, Andhra Pradesh, Karnataka, and Tamil Nadu. Following a parallel route with NH44, NH52 starts in Punjab and ends in Karnataka. The Asset acts as a key connection between Delhi NCR and cities in Madhya Pradesh such as Gwalior and Indore, a city in south of the Asset in the state of Madhya Pradesh. Gwalior has an existing industrial area where the economy is driven by textile mills, artificial silk manufacturing plants, handicraft, and hand loom industries, tanning industries, and chemical industries. The city is also home to Gwalior Chemical Industries Limited. The group is primarily into the business of manufacturing and marketing of specialty chemicals, catering to both the domestic and exports customers in the agrochemical, paints and coatings, dyes, and flavour & fragrance industries. Indore has large industrial cluster for automobile and other ancillary industries. Pithampur industrial area is one of the biggest industrial clusters in the country and support large industrial activity.

The Asset lies on the outskirts of Agra which has several medium and small-scale industries and is one of the prime centres of the handloom, plastic pallets, and automotive spares, in addition to being a key tourist destination because of the Taj Mahal. Numerous major tourist attractions also exist in the vicinity of the Asset. Agra, Mathura, Fatehpur Sikri and other towns in the region are home to several historical monuments, places of worship and heritage sites.

Traffic volume and composite of vehicles

Monthly Average Daily Traffic

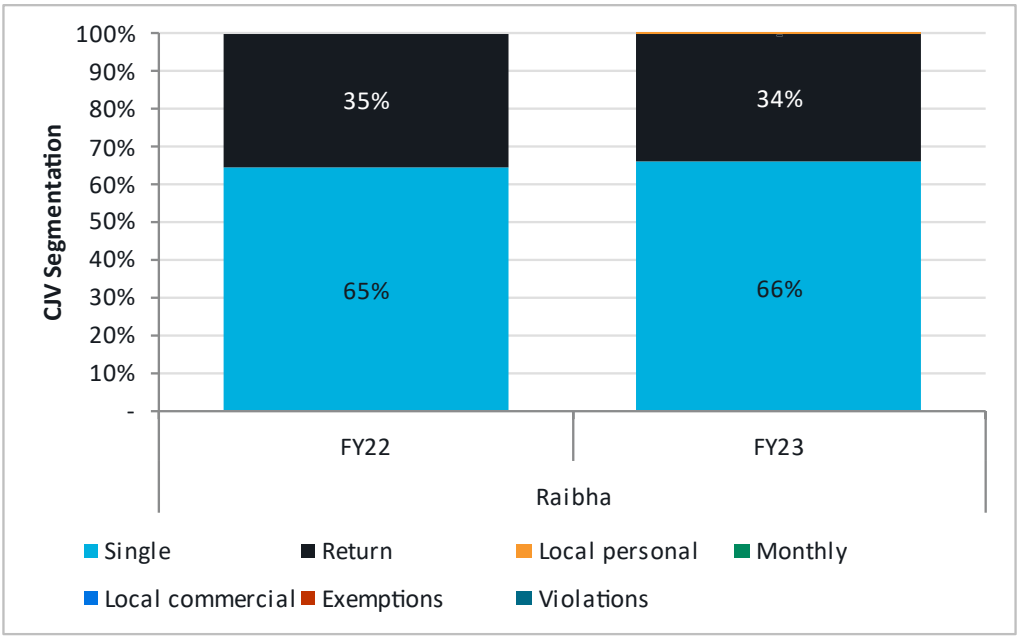
The chart below presents the reported traffic volume for toll plaza Raibha on Asset 6, in terms of monthly average daily traffic (MADT) from April 2022 to March 31, 2023.



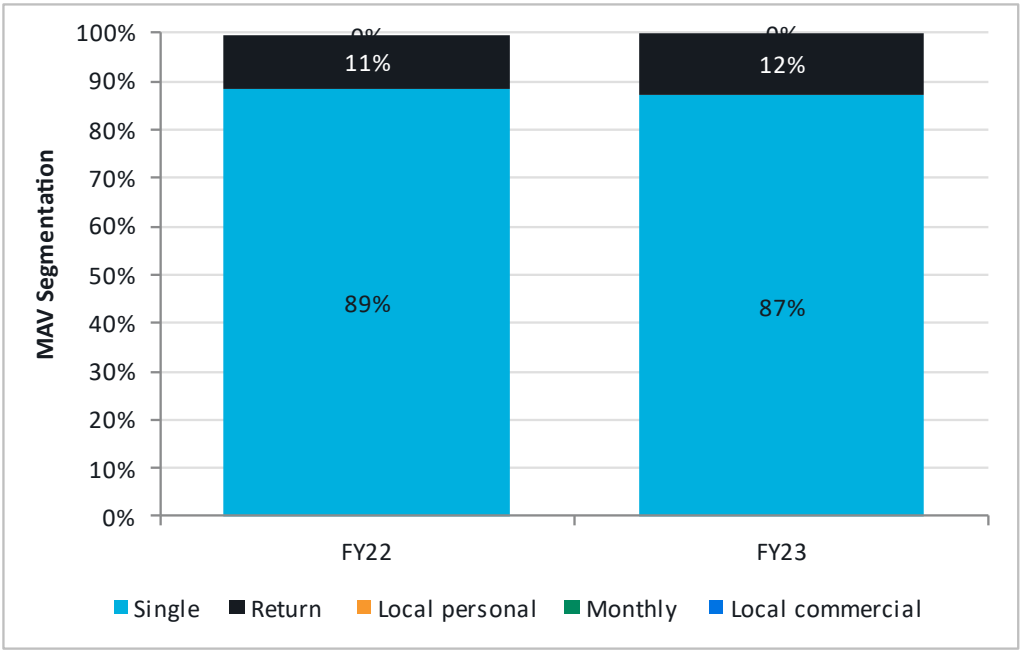
Source: Steer analysis of client toll plaza data

Toll Segmentation

The chart below presents the estimated segmentation based on traffic data from FY23 for Toll Plaza Raibha.

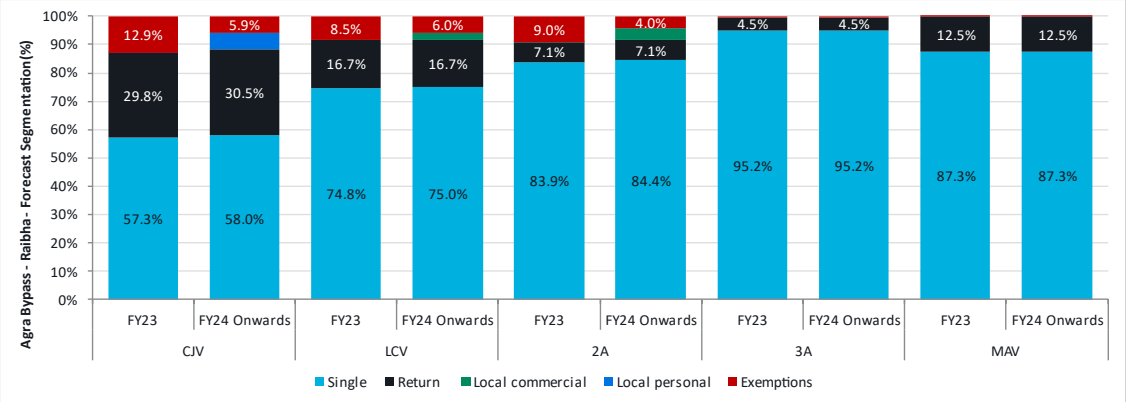


Source: Traffic Report, Steer analysis of traffic data.



Source: Traffic Report, Steer analysis of traffic data.

In addition, the Traffic Consultant has also forecasted toll segmentation for FY24.



Source: Steer analysis

Projected Traffic Data: Growth in Passenger Car Unit (PCU)

The table below provides the final (background plus impacts) AADT CAGR % for the toll plaza at Raibha, as provided by the Traffic Consultant:

Vehicle Type	FY24	FY25	FY30	FY35	FY40	FY43
PCU's	**32,338**	**31,400**	**41,354**	**53,015**	**66,956**	**76,364**

Source: Steer analysis

Tollable Length and Toll Rates

In terms of tollable length, the Agra Bypass Toll Road currently comprises 56.04 kms of roads. In India, toll rates are as per notification by the Ministry of Road Transport and Highways in the National Gazette. The present toll rates are determined with reference to the published base toll rates and are adjusted annually at the beginning of each fiscal year equal to 40% of the movement in the wholesale price index in December of the preceding year plus a fixed 3%.

In line with the NHAI's toll notification dated March 24, 2022, the toll rates at the Raibha toll plaza for Asset 6 for FY2024 are as follows:

Vehicle Type	Single Journey	Multiple Journey	Monthly Pass	Fee for Commercial Vehicle Registered within the district of the Raibha Toll Plaza
		(Rs.)		
Car/Jeep/Van	80	120	2630	40
LCV	130	190	4250	65
Bus/Truck	265	400	8905	130
Vehicles with up to 3 axles	290	435	9715	145
HCM/EME (Vehicles with 4 to 6 axles)	420	630	13965	210
Vehicles with 7 or more axles	510	765	17000	255

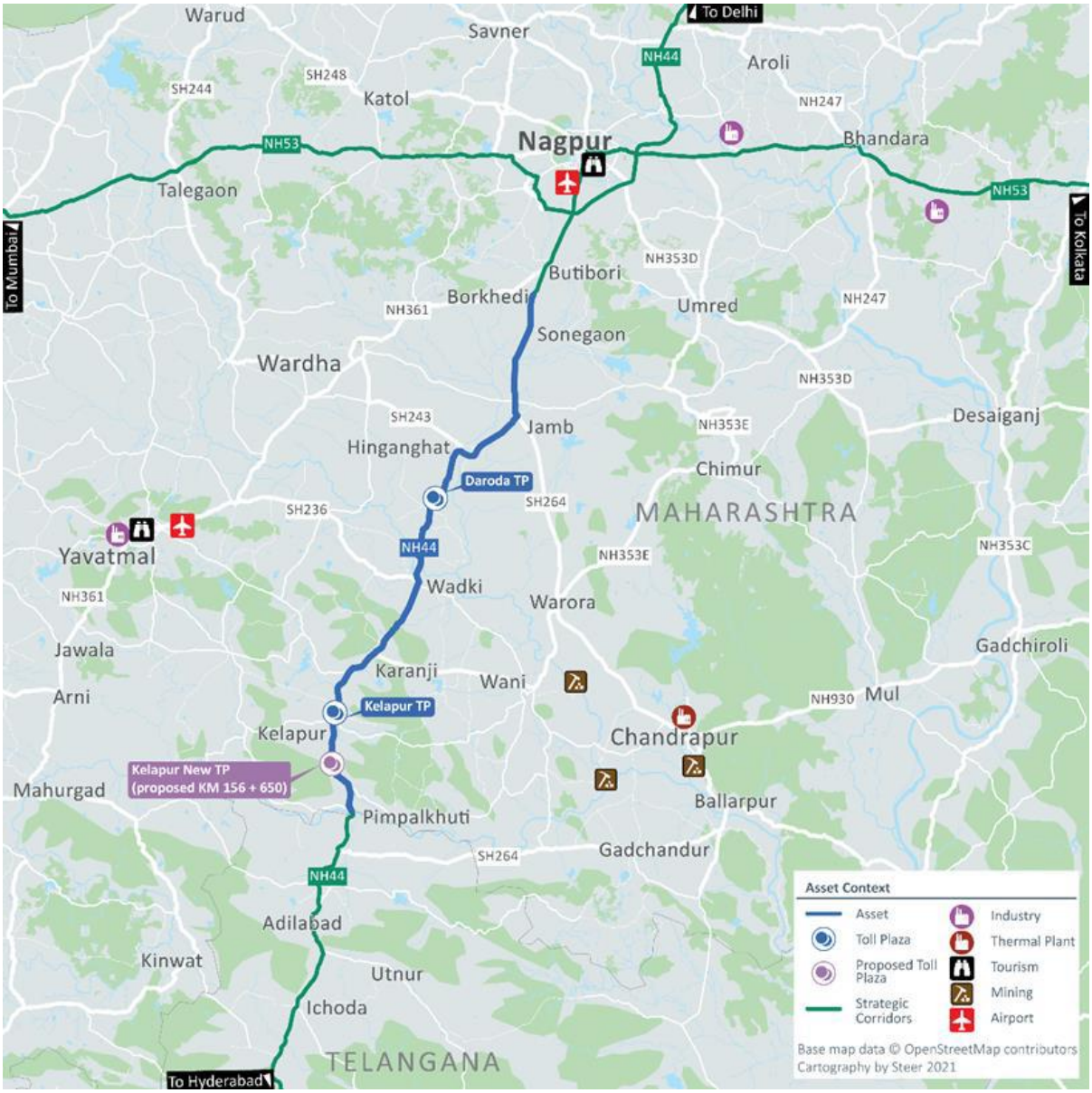
Source: NHAI

For further details in relation to Asset 6, please refer to **Annexure C** of this Placement Document.

6. ***Borkhedi – Kelapur Project ("Asset 7")***

Project overview

According to the Traffic Consultant, Asset 7 is located on NH44 and is about 138.15 kms long section between Borkhedi and Maharashtra/ Telangana Border (at Penganga River bridge) traversing through the districts of Nagpur, Wardha and Yavatmal in the state of Maharashtra. The two toll plazas on Asset 7 are located at Darodha (KM 92.500) and Kelapur (KM 150.450, to be shifted to KM 156.650). Kelapur toll plaza is proposed to be relocated to a new location, approximately 6 km south of the existing location in absence of adequate land to construct proper toll plaza at the present location. This is named as Kelapur New TP (KM 156 +250) in the map below.



Source: Traffic Report

Salient growth features and traffic generators

According to the Traffic Consultant, Asset 7 is in vicinity of Nagpur, which is home to several manufacturing hubs, food processing units, and CONCOR's multi modal logistics logistic hub. Yavatmal (textile/cotton), Butibori (MIDC), and Chandrapur (coal) are some of key traffic generators for the Asset. Asset 7 forms part of NH19/NH7 (new NH44) north-south long-distance strategic corridor connecting Srinagar in Kashmir (northernmost state) to Kanyakumari in Tamil Nadu (southernmost state). It directly connects national capital Delhi and northern states with state capitals of Hyderabad (Telangana), Bengaluru (Karnataka) including other major cities/industrial nodes/ junctions along the way like Agra (Uttar Pradesh), Gwalior and Jhansi (Madhya Pradesh), Nagpur (Maharashtra), Selam, Madurai, Tirunelveli (Tamil Nadu). The Asset also provides strategic linkage between Delhi and Chennai via Hyderabad- Kadapa and Hyderabad-Ongole routes. In addition to its role as national connector, the Asset provides important regional connectivity between neighbouring states i.e., Maharashtra and Telangana. Nagpur, being centrally located in the country, acts as a strategic junction within immediate influence area in Maharashtra. The Asset provides fair condition round the year connectivity to various urban/ semi-urban centres of eastern Maharashtra i.e., Chandrapur, Wadner, Padharkawada, Yavatmal among each other and with regional commercial centre of Nagpur. The major commodities observed during surveys are manufacturing, courier/parcel, agricultural products, and groceries. The traffic profile is predominantly goods vehicles undertaking long distance movements between the locations discussed above. The commodity mix carried by the vehicles observed at the toll plaza during site visit was mix of manufacturing, courier/parcel, automobile, and agriculture confirming the long-distance nature of the traffic. The Asset has seen an increase in proportion of the long-distance goods traffic in recent years as compared to past performance which may be attributed to shift of long-distance traffic from other corridors to NH44 (old NH7) corridor as NH44 observed continuous Level of Service (LoS) upgrades. Being the shortest route between Delhi and Hyderabad/Bengaluru, the increased LoS on the corridor attracted traffic on NH44 post improvement.

The Asset lies on the outskirts of Nagpur which is the third largest city in Maharashtra. It is known for medium to large scale industries alongside agriculture, being, manufacturing and food processing. Manufacturing segment includes products ranging

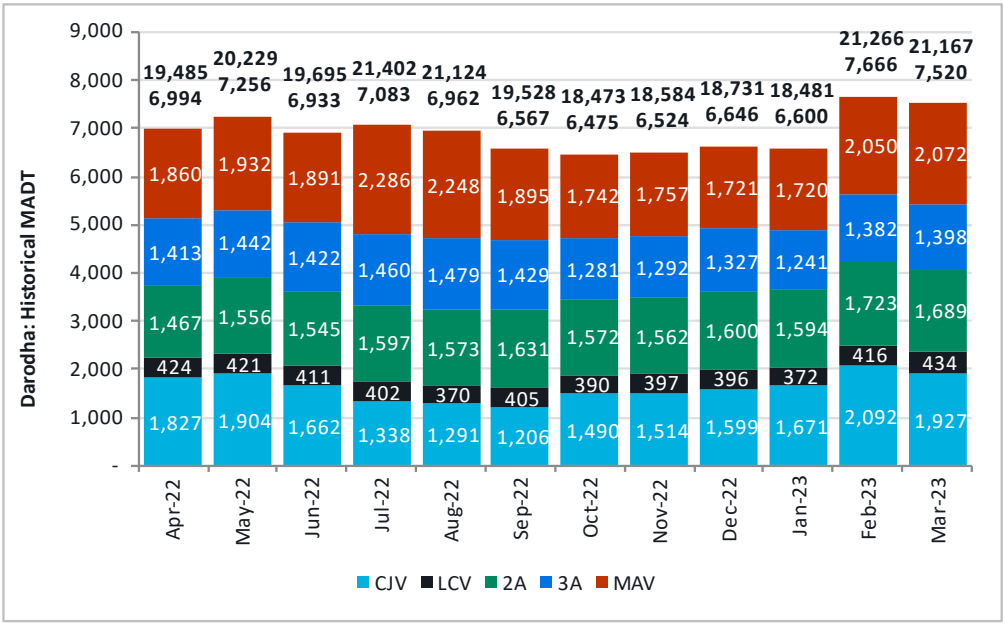
from agriculture equipment, aluminum products, castings, cement, chemicals, paper and packaging, electrical equipment and fittings, textile engineering goods, tools manufacturing, fabrication and machining, ferro alloys, paints, furniture, plastic and moulding products, etc. Food processing giants having presence at Nagpur includes Haldiram, Dinshaw, Patanjali and other medium scales orange and spices processing units, etc. Government of Maharashtra has set-up Multi-Modal International Passenger and Cargo Hub Airport at Nagpur (MIHAN). That will upgrade existing domestic airport along with a Special Economic Zone which is abutting to the boundary of the airport. MIHAN houses plant of Tata Aeronautics which manufactures parts for Boeing and Air India and Dassault's assembly plants. Container Corporations of India Limited (CONCOR) constructed Multi Modal Logistic Park along with a rail terminal connecting MIHAN with different ports in country. Butibori industrial area established by Maharashtra Industrial Development Corporation (MIDC), north of the Asset, is one of the country's largest industrial hubs. It houses textile, machine and metal fabrication and manufacturing units and is home to industrial giants like KEC, Hyundai, and Unitech. Koradi Thermal Power Station and Khaparkheda Thermal Power Station are the two major thermal power stations located in vicinity of the hub. Yavatmal industrial area, in west of the Asset, has textile and cotton processing industries including Raymond India's garment plant. The industrial hub is also home to export units of machineries, cement, medicines, limestones, and clothes. Chandrapur is key coal mining centre in close vicinity of the Asset and has thermal plant, cement, paper and ferro alloy manufacturing industries.

The agricultural stretches present along the Asset as well as in Nagpur generate a considerable share of traffic on the Asset. Nagpur, also known as Orange City, is famous for the production of oranges in addition to being home to large number of Paddy, Jowar, Cotton, Tur and Soyabean fields. The same is observed in our 'commodity analysis', a part of survey results, as well as ~13% of the MAVs were found to carry agricultural products.

Traffic volume and composite of vehicles

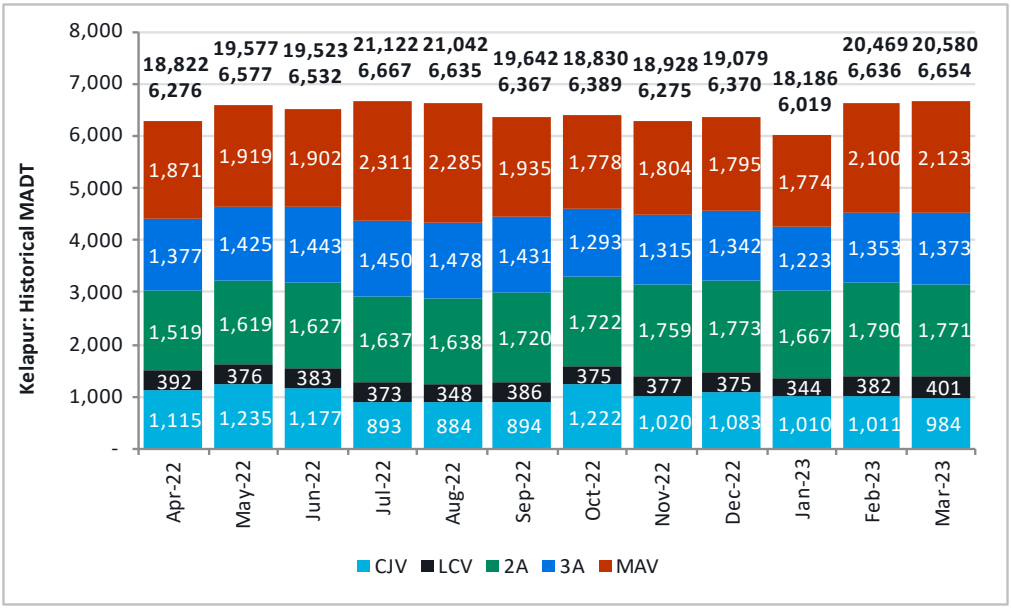
Monthly Average Daily Traffic

The chart below presents the reported traffic volume for toll plaza Darodha on Asset 7, in terms of monthly average daily traffic (MADT) from April 2022 to March 31, 2023.



Source: Steer analysis

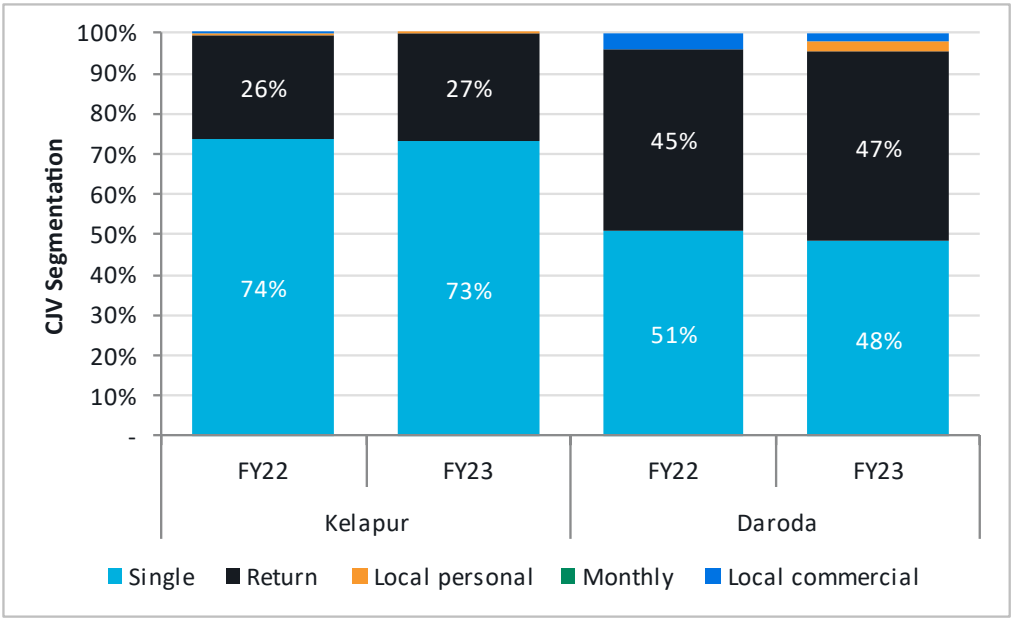
The chart below presents the reported traffic volume for toll plaza Kelapur on Asset 7, in terms of monthly average daily traffic (MADT) from April 2022 to March 31, 2023.



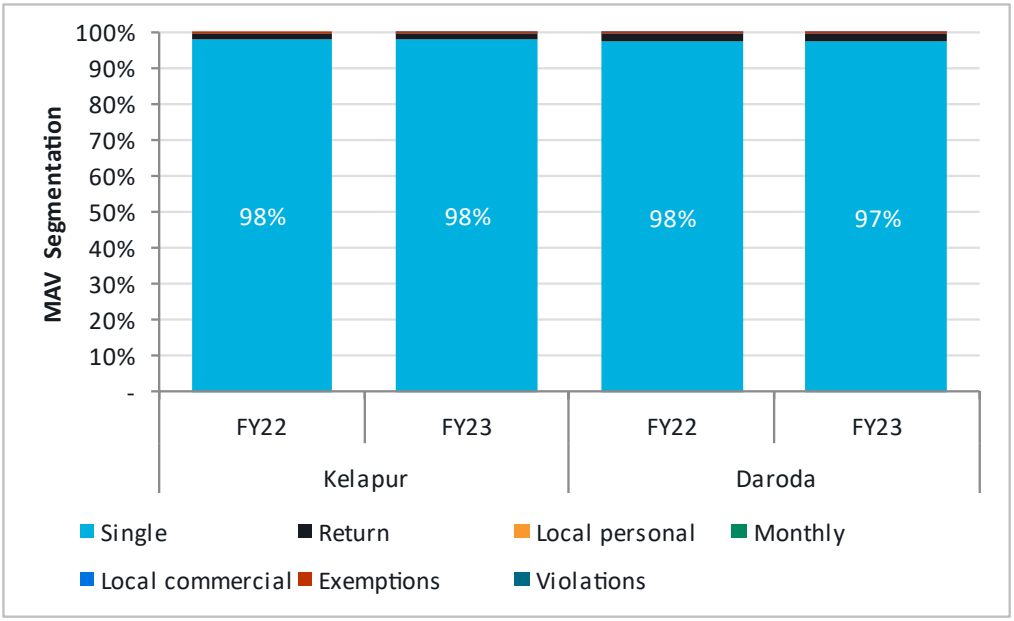
Source: Steer analysis

Toll Segmentation

The charts below present the estimated segmentation based on traffic data from FY22 and FY23 (until July 31, 2022) for Toll Plaza Darodha and Kelapur.

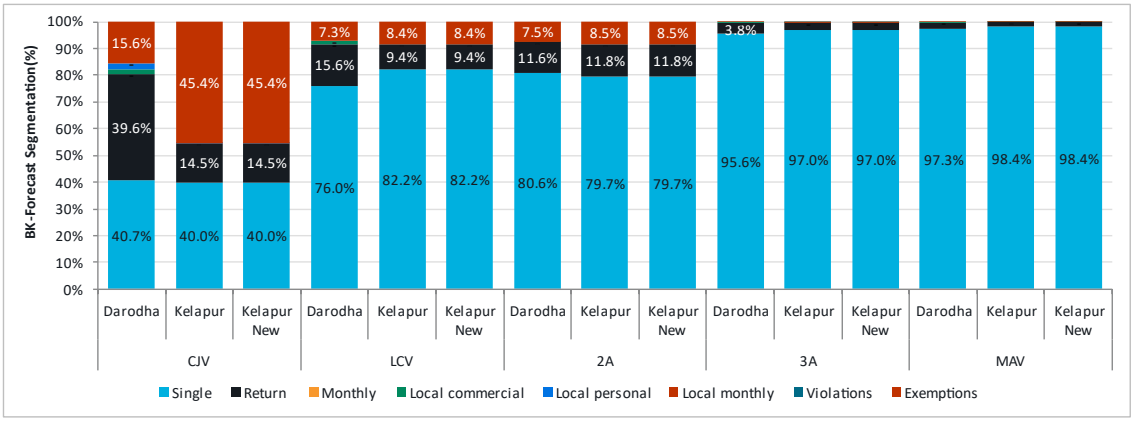


Source: Steer analysis



Source: Steer analysis

In addition, the Traffic Consultant has also forecasted toll segmentation for FY23.



Source: Steer analysis

Projected Traffic Data: Growth in Passenger Car Unit (PCU)

The table below provides the final (background plus impacts) AADT forecast at the Darodha toll plaza, as provided by the Traffic Consultant:

Vehicle Type	FY24	FY25	FY30	FY35	FY40	FY43
PCU	21,507	22,582	26,401	33,369	41,606	47,123

Source: Traffic Report

The table below provides the final (background plus impacts) AADT forecast at the Kelapur toll plaza, as provided by the Traffic Consultant:

Vehicle Type	FY24	FY25	FY30	FY35	FY40	FY43
PCU	21999	23095	27042	34154	42558	48187

Source: Traffic Report

Tollable Length and Toll Rates

In terms of tollable length, the Borkhedi – Kelapur Project currently comprises 80.08 kms of roads at the Darodha toll plaza and 75.16 kms of roads at the Kelapur toll plaza. In India, toll rates are as per notification by the Ministry of Road Transport and Highways in the National Gazette. The present toll rates are determined with reference to the published base toll rates and

are adjusted annually at the beginning of each fiscal year equal to 40% of the movement in the wholesale price index in December of the preceding year plus a fixed 3%.

In line with the NHAI's toll notification dated March 25, 2022, the toll rates at the Darodha toll plaza for Asset 7 for FY2024 are as follows:

Vehicle Type	Single Journey	Multiple Journey	Monthly Pass	Fee for Commercial Vehicle Registered within the district of the Darodha Toll Plaza
		(Rs.)		
Car/Jeep/Van	115	170	3835	60
LCV	185	275	6165	95
Bus/Truck	390	580	13000	195
Vehicles with up to 3 axles	425	635	14165	215
HCM/EME (Vehicles with 4 to 6 axles)	610	910	20335	305
Vehicles with 7 or more axles	740	1110	24665	370

Source: NHAI

In line with the NHAI's toll notification dated March 25, 2022, the toll rates at the Kelapur toll plaza for Asset 7 for FY2024 are as follows:

Vehicle Type	Single Journey	Multiple Journey	Monthly Pass	Fee for Commercial Vehicle Registered within the district of the Kelapur Toll Plaza
		(Rs.)		
Car/Jeep/Van	105	160	3500	55
LCV	175	260	5835	90
Bus/Truck	365	545	12165	185
Vehicles with up to 3 axles	395	595	13165	200
HCM/EME (Vehicles with 4 to 6 axles)	570	855	19000	285
Vehicles with 7 or more axles	695	1040	23165	350

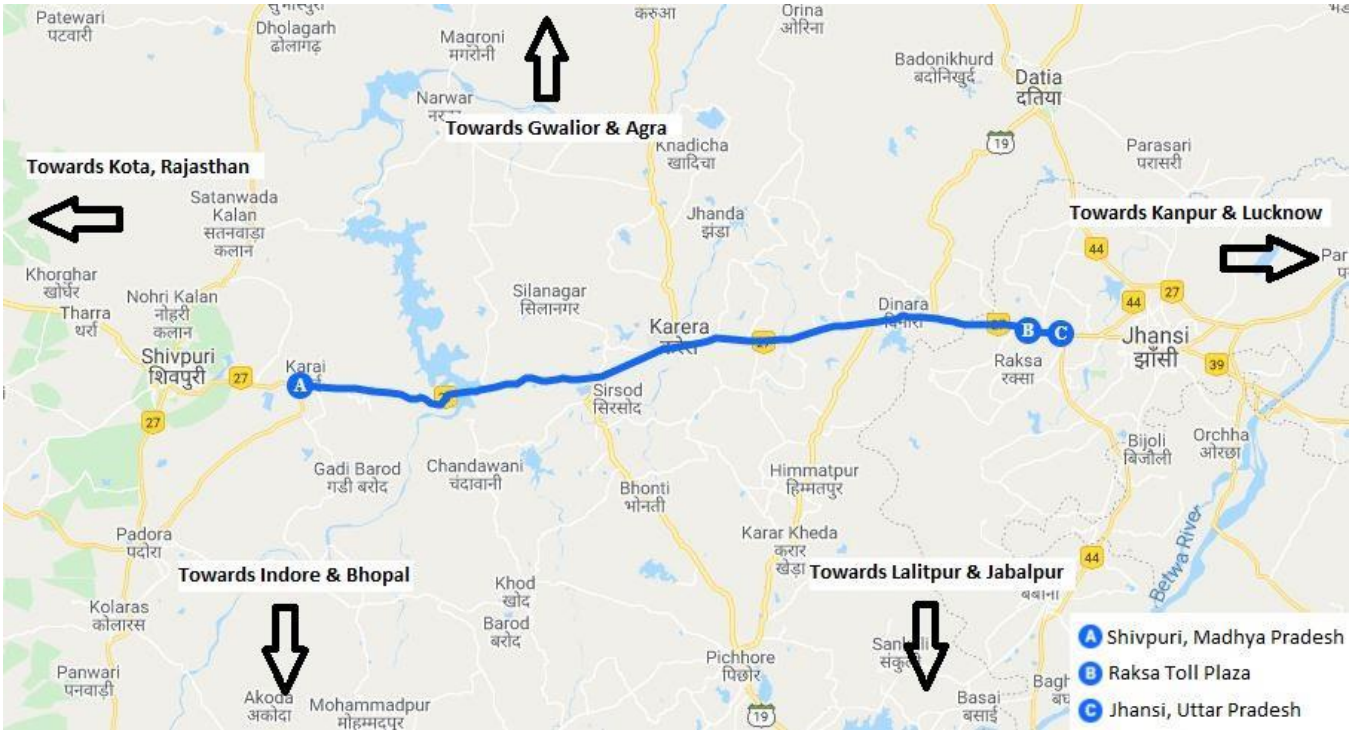
Source: NHAI

For further details in relation to Asset 7, please refer to **Annexure C** of this Placement Document.

7. *Jhansi – Shivpuri Project ("Asset 8")*

Project overview

According to the Traffic Consultant, Asset 8 is a 4-lane, 75.3 kms long stretch, on national highways (NH) 27 which connects the districts of Jhansi and Shivpuri in the state of Uttar Pradesh and Madhya Pradesh, respectively. The two states Uttar Pradesh and Madhya Pradesh form the two key project stretch influence states. The project stretch has one toll plaza by the name of Raksha toll plaza which lies at the chainage of km 1374+650 near Jhansi. In the larger road network, the project stretch is a part of East-West corridor (NH-27) which connects Porbandar in Gujarat to Silchar in Assam. Hence, the project stretch witnesses higher proportion of long route traffic between the eastern and western regions.



Source: CRISIL Research

Salient growth features and traffic generators

According to the Traffic Consultant, the project stretch is used by the traffic originating and destined in regions such as Kanpur-Lucknow cluster, Indore cluster, Maharashtra and Gujarat. Lucknow and Indore are the key regions where the east-west traffic converges. Currently, the traffic between Indore-Lucknow uses the project stretch which takes them 13-14 hours and travels ~793 km. There exists an alternate route between Lucknow and Indore which passes through Chhatarpur and Sagar. This route takes 16-17 hours and the distance is 801 km. The key reason for this longer travel time is that the alternate route is a mix of 2 lane and 4 lanes. Kanpur to Bhopal section of the alternate route which is nearly 527 km is 2 lanes. Under the Bharatmala program, the section from Lucknow to Sagar and Sagar to Kandla are proposed for augmentation. Hence, the Traffic Consultant has assumed FY33 to be start year for the alternate road stretch.

Further, there is a greenfield expressway coming up in the region. The 4-lane access controlled Atal progress-way (Chambal expressway) will connect Etawah (UP) to Kota (Rajasthan). The connection point is likely to be the Agra-Lucknow expressway on one end and the Delhi-Mumbai expressway on the Kota side. Thus, the traffic from eastern region converging at Lucknow will have an alternative to the project stretch. The traffic can travel on the Agra-Lucknow expressway and Atal progress-way to reach Rajasthan. They also have Delhi-Mumbai expressway connectivity to Gujarat and Maharashtra. The Delhi-Mumbai expressway is expected to begin operations in mid-2024 and for the Atal progress-way, the Traffic Consultant has assumed FY29 to be start year for the road stretch.

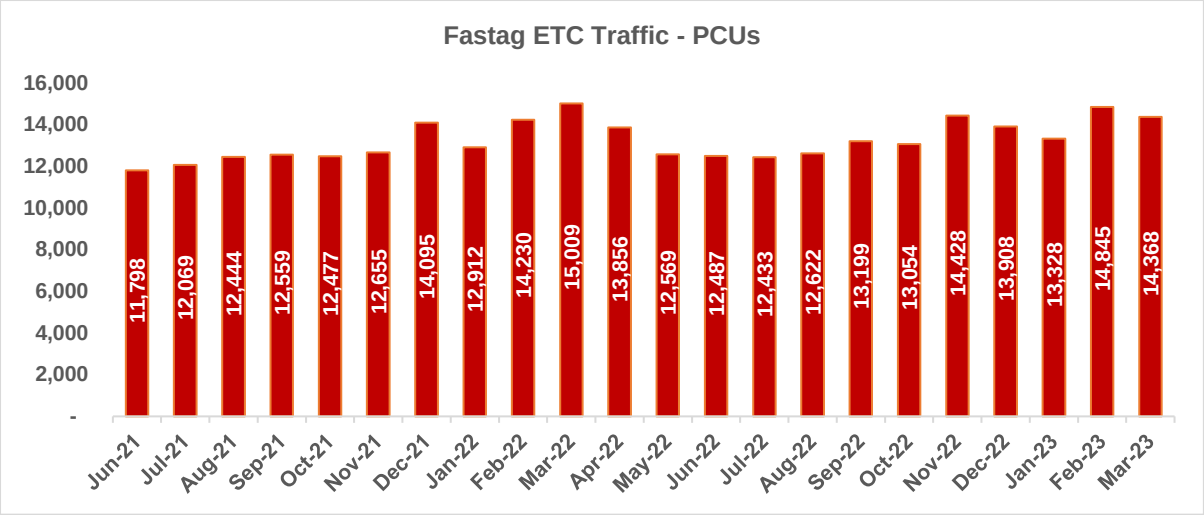
Agri produce forms the key commodity travelling on the project stretch, followed by courier & parcels, construction material, consumer items, and iron and steel. Kanpur, Lucknow, Jhansi, Indore, Mumbai and Rajkot are the major contributors to the goods traffic on the project stretch. Project stretch and its vicinity regions such as Kanpur, Lucknow, Indore etc. are the key origin-destination for the passenger traffic.

The Shivpuri-Jhansi Project is a part of the East-West Corridor, which includes industrialised districts such as Kanpur and Lucknow. These districts form the origination and destination points of the traffic. Other key consumption/industrial centres include Indore, Jhansi, Ahmedabad, Mumbai, and Pune. These are also catered by the stretch. Shivpuri and Jhansi districts, immediately adjacent to the stretch, have witnessed an economic growth greater than the national average (8.4% vs 7.1%).

Traffic volume and composite of vehicles

Historical traffic data

The chart below shows the average daily traffic on Asset 8 over June 2021 to March 2023:



Source: CRISIL Research

Toll Segmentation

The table below presents a segmentation of total traffic assessed from the toll data June 2021 to May 2022 for the toll plaza of Asset 8. The trip segmentation has been assumed to remain constant throughout the projection period i.e., over fiscals 2023 to 2043 as follows:

Vehicle	Single	Return	Monthly Pass	Local Non-commercial	Local commercial	Exemption	Total
Car, Jeep, Van or Light Motor Vehicle	47.1%	40.3%	0.0%	9.5%	0.0%	3.1%	100.0 %
Light Commercial Vehicle, Light Goods Vehicle or Mini Bus	86.3%	11.1%	0.7%	0.0%	0.5%	1.4%	100.0 %
Bus or Truck (Two Axles)	83.5%	15.2%	0.0%	0.0%	0.0%	1.2%	100.0 %
Three- axle commercial vehicles	91.4%	7.6%	0.0%	0.0%	0.0%	1.0%	100.0 %
Heavy Construction Machinery (HCM) or Earth Moving Equipment (EME) or Multi Axle Vehicle (MAV) (four to six axles)	95.0%	4.5%	0.0%	0.0%	0.0%	0.5%	100.0 %
Over Sized Vehicles	92.1%	7.9%	0.0%	0.0%	0.0%	0.0%	100.0 %

Source: CRISIL Research

Projected Traffic Data: Growth in Passenger Car Unit (PCU)

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
Total PCU	**15,130**	**15,995**	**18,026**	**23,138**	**29,225**	**33,427**

Source: CRISIL Research

Tollable Length and Toll Rates

In terms of tollable length, the Jhansi – Shivpuri Project comprises 89.66 kms of roads. In India, toll rates are as per notification by the Ministry of Road Transport and Highways in the National Gazette. The present toll rates are determined with reference to the published base toll rates and are adjusted annually at the beginning of each fiscal year equal to 40% of

the movement in the wholesale price index in December of the preceding year plus a fixed 3%.

Single toll rates in INR at the Raksha toll plaza, applicable from April 2023 until March 2024 are as provided below:

Type of Vehicle	SJ: Raksha
CJV	130
LCV	205
Bus/Truck	435
3A	475
MAV/ HCM/EME	680
OSV	830

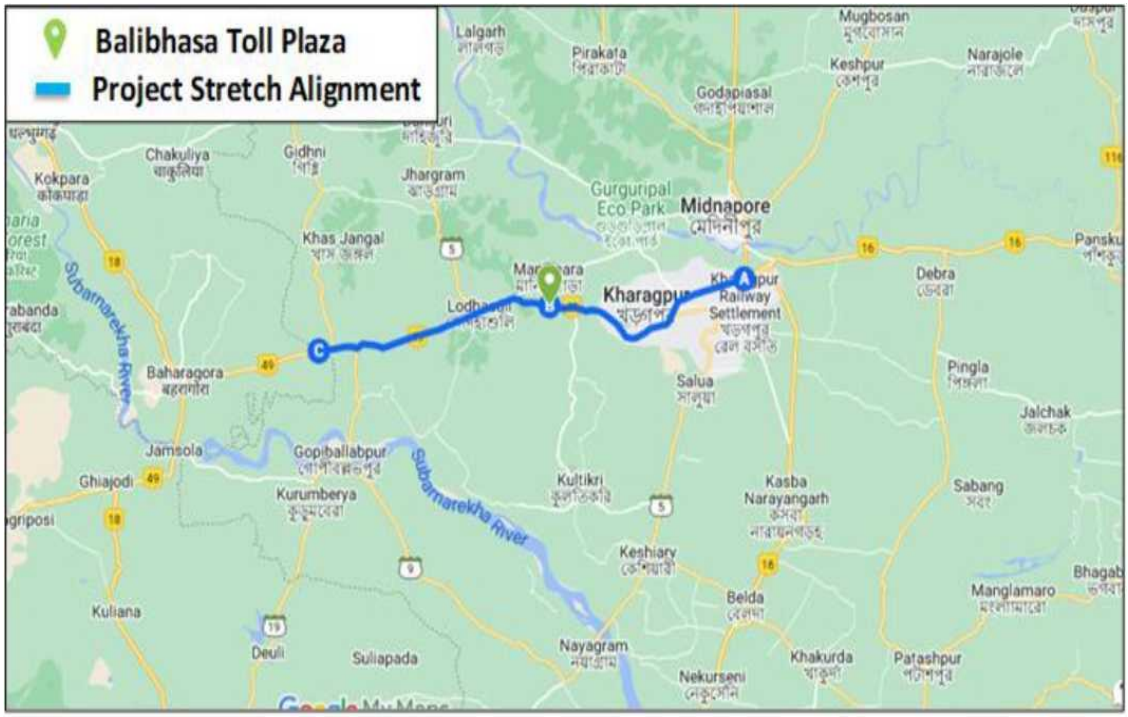
Source: CRISIL Research

For further details in relation to Asset 8, please refer to **Annexure C** of this Placement Document.

8. *Chichra – Kharagpur Project ("Asset 9")*

Project overview

According to the Traffic Consultant, Chichra-Kharagpur is a 4-lane, 56.120 kms long stretch, on national highways (NH) 49 which connects Chichra and Kharagpur to Jharkhand and Odisha states in the vicinity. The two states Jharkhand and Odisha form the two key project stretch influence states. The project stretch has one toll plaza by the name of Balibhasa Toll Plaza which lies at the chainage of km 157+915 near Guptamoni. In the larger road network, the project stretch is a part of East-West connectivity which connects Mumbai and Kolkata. Due to presence of sand mining blocks near Gopiballapur, which is in the vicinity of project stretch, the traffic is mostly West Bengal state bound, with construction materials like sand being the top commodity plying on the project stretch.



Source: CRISIL MI&A

Salient growth features and traffic generators

According to the Traffic Consultant, the project stretch is used by the traffic originating and destined in regions such as Gopiballapur (sand mining), Kolkata, Jhargram in West Bengal. For the traffic travelling in Chichra to Kharagpur direction, though West Bengal dominates as the origin state (~59% share), Jharkhand and Odisha are amongst the other states responsible for the originating traffic with almost combined share of ~29%. Sand mining is prevalent in the vicinity of stretch,

due to which, sand is the topmost commodity plying on the project stretch which originates majorly from Gopiballapur belt and destined at Kolkata and nearby areas.

There exists an alternate route between Lodhasuli and Kharagpur which could have been a potential route to bypass the Toll Plaza, however the route is majorly under construction in patches, also it passes through multiple small villages, and moreover it is a 2L road which increases the travel time by almost 2x, in comparison to the equivalent road stretch that passes through the Project Stretch. Thus, for commercial vehicles, this route is unfavourable over the project stretch route, which shall continue to be the preferred route owing to better condition of roads, which will result in saving time too.

Further, there is a greenfield expressway coming up in vicinity of project stretch. Varanasi-Kolkata Expressway connects West Bengal and Uttar Pradesh states which is anticipated to improve the connectivity between these two states. The expressway passes through Jharkhand, which is one of the neighbouring states of West Bengal. Tatanagar, Chaibasa, Ranchi are amongst the originating points for the traffic on the project stretch. Commodities like Iron and Steel products is plying on the vehicles originating from these cities and destinated at West Bengal. However, the overall impact shall be marginal as the Traffic plying on the project stretch is mostly West Bengal bound. The impact of Varanasi-Kolkata Expressway is assumed partially from FY27 and fully from FY28 onwards.

Construction Materials forms the key commodity travelling on the project stretch, followed by Agri Produce, Iron and Steel, and courier and parcel. Gopiballapur, Mahapal, Jhargram are the major contributors to the goods traffic on the project stretch. Project stretch and its vicinity regions such as Jhargram, Midnapore, Kolkata etc. are the key origin-destination places for the passenger traffic. Sand is the topmost commodity plying on the project stretch. There are sand blocks located near Subarnarekha River, which is in the vicinity of Chichra-Kharagpur stretch. Gopiballapur, Sankrail and Mahapal are amongst the key areas where sand mining blocks are located. However, Gopiballapur belt dominates amongst the three regions with more than ~70% mining leases in the region. West Bengal government have been taking vital decisions to regulate the sand mining processes and put a cap on illegal sand mining, the impact of which could be seen in the years to come.

Rashmi Metallics plant is situated near Kharagpur district, which is one of the important industries on the project stretch responsible for the traffic movement on the project stretch. Odisha and Kolkata are amongst the key OD pairs for the traffic due to Rashmi Metallics plant.

Traffic volume and composite of vehicles

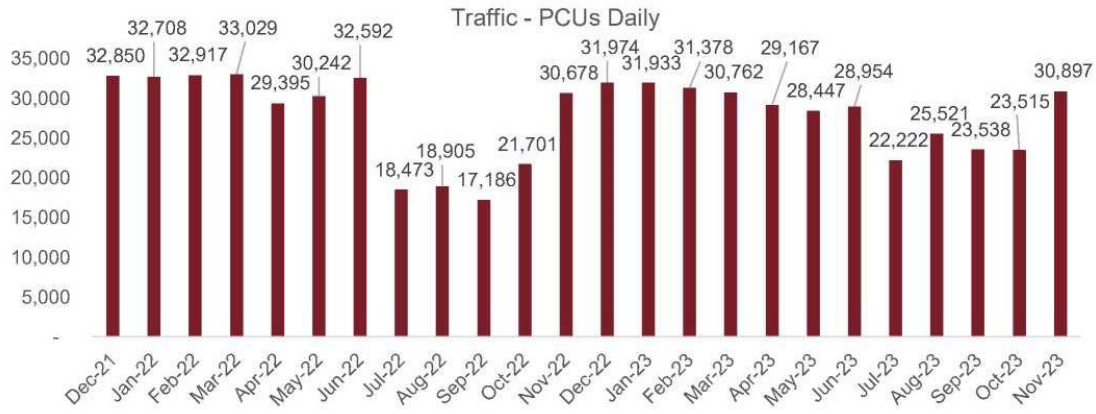
Historical traffic data

The following table shows the TVC seven-day traffic count of Chichra-Kharagpur stretch according to the Traffic Consultant:

Date	Days	Car	LCV + 2 Axle	3- axle	MAV	Total	Total (PCUs)
11/23/2022	Wednesday	2,381	3,298	1,094	3529	10,302	30,268
11/24/2022	Thursday	2,367	3,000	1,161	3865	10,393	31,197
11/25/2022	Friday	2,783	2,938	1,208	3725	10,654	30,937
11/26/2022	Saturday	2,828	2,810	1,181	3961	10,780	31,607
11/27/2022	Sunday	2,887	2,921	1,206	3767	10,781	31,237
11/28/2022	Monday	2,675	2,810	949	2968	9,402	26,453
11/29/2022	Tuesday	2,651	3,077	1,059	3607	10,394	30,164
ADT		**2,653**	**2,979**	**1,123**	**3,632**	**10,387**	**30,266**

Source: CRISIL MI&A

The chart below shows the average daily traffic on Chichra-Kharagpur stretch over December 2021 to November 2023.



Source: CRISIL MI&A

Overloading scenario on the project stretch

To ascertain the quantum of overloading, a seven day axle load survey was done by the technical consultants of the client. The results of axle load survey provided by the client, reveal that overloaded vehicles form a sizeable share of vehicles across categories. As per the survey, 49% of the MAVs, 33% of 3 axle and 11% of the 2 Axle vehicles are overloaded (considering more than 5% overload than permissible limits).

Sand, iron, steel, and coal are key commodities which are overloaded. Overloading is also prevalent in Chichra to Kharagpur direction primarily.

As per discussions with the client, it is proposed that overloading will be levied on 25% of MAV and 3 Axle vehicles which are overloaded for more than 20% of the threshold. The quantum of vehicles for charging overloading penalty is decided after considering the practical numbers which can be charged per lane per hour. The revenue potential is arrived at, by considering an overloading levy equivalent to 1x of single journey toll rates.

Following table shows the overloading scenario for commercial vehicles on the stretch.

Direction	Vehicle Category	Sample	>5% overload	>20% overload	>5% overload	>20% overload
Overall	MAV	571	281	171	49%	30%
Overall	2A	403	46	5	11%	1%
Overall	3A	286	95	44	33%	15%
Chichra- Kharagpur	MAV	286	216	147	76%	52%
Chichra- Kharagpur	2A	212	42	4	20%	2%
Chichra- Kharagpur	3A	136	79	42	58%	31%
Kharagpur- Chichra	MAV	285	65	24	23%	8%
Kharagpur- Chichra	2A	191	4	0	2%	0%
Kharagpur- Chichra	3A	150	16	3	10%	2%

Source: CRISIL MI&A

Toll Segmentation

The table below presents a segmentation of total traffic assessed from the toll data from January 2023 to November 2023 (based on available data) for the Balibhasa toll plaza of Chichra-Kharagpur stretch. The trip segmentation has been assumed to remain constant throughout the projection period i.e., over fiscals 2024 to 2044 as follows:

Vehicle category	Single journey	Return Journey	Local monthly pass	Local commercial vehicles	Exemption

Vehicle category	Single journey	Return Journey	Local monthly pass	Local commercial vehicles	Exemption
Car, jeep, van or LMV	34.59%	62.72%	1.63% (local noncommercial)	-	1.07%
LCV, light goods vehicle, or minibus	37.05%	61.55%	-	-	1.40%
Bus or truck (2-axle)	34.34%	65.14%	-	0.15%	0.37%
3-axle CV	64.99	34.85	-	-	0.16%
HCM, EME or MAV (4-6 axle)	53.60%	46.18%	-	-	0.22%

Source: CRISIL MI&A

The table below provides the traffic growth rates considering diversions to expressway and other alternative routes and other impact factors, as provided by the Traffic Consultant:

CAGR	FY24-25	FY25-30	FY30-40	FY24-44
Car	4.9%	4.1%	4.0%	3.9%
Bus	2.5%	2.4%	2.0%	2.1%
Minibus	2.0%	1.8%	1.6%	1.6%
LCV	4.2%	3.2%	3.0%	3.1%
2-axle	6.8%	5.0%	3.9%	4.2%
3-axle	6.5%	4.8%	4.0%	4.2%
MAV	6.0%	4.6%	3.9%	4.1%
Total PCU	**6.0%**	**4.6%**	**3.9%**	**4.1%**
Revenue growth	**8.1%**	**9.3%**	**8.1%**	**8.3%**

Note: Revenue growth includes overloading levies

Source: CRISIL MI&A

Vehicle Type	FY24	FY25	FY30	FY40	FY43
Car	2,949	3,094	3,782	5,583	6,185
Bus	120	123	138	168	177
Minibus	106	109	119	139	145
LCV	233	242	284	382	415
2-axle	1,679	1,793	2,287	3,360	3,730
3-axle	1,050	1,118	1,416	2,088	2,322
MAV	3,777	4,005	5,007	7,312	8,111
Total	9,915	10,484	13,033	19,031	21,086
Total PCU	29,003	30,744	38,440	56,115	62,214

Tollable Length and Toll Rates

In terms of tollable length, the Chichra - Kharagpur Project comprises 56.667 kms of 4-Lane equivalent length and 6.094 kms of 2-Lane equivalent length, which sums up to 62.761 kms of total tollable length. In India, toll rates are as per notification by the Ministry of Road Transport and Highways in the National Gazette. The present toll rates are determined with reference to the published base toll rates and are adjusted annually at the beginning of each fiscal year equal to 40% of the movement in the wholesale price index in December of the preceding year plus a fixed 3%.

Single toll rates in INR at the Balibhasa toll plaza, calculated as per schedule-M data, applicable until March 2024 are as provided below:

Type of Vehicle	SJ: Balibhasa
CJV	90
LCV	145
Bus/Truck	305
3A	330
MAV/ HCM/EME	475
OSV	580

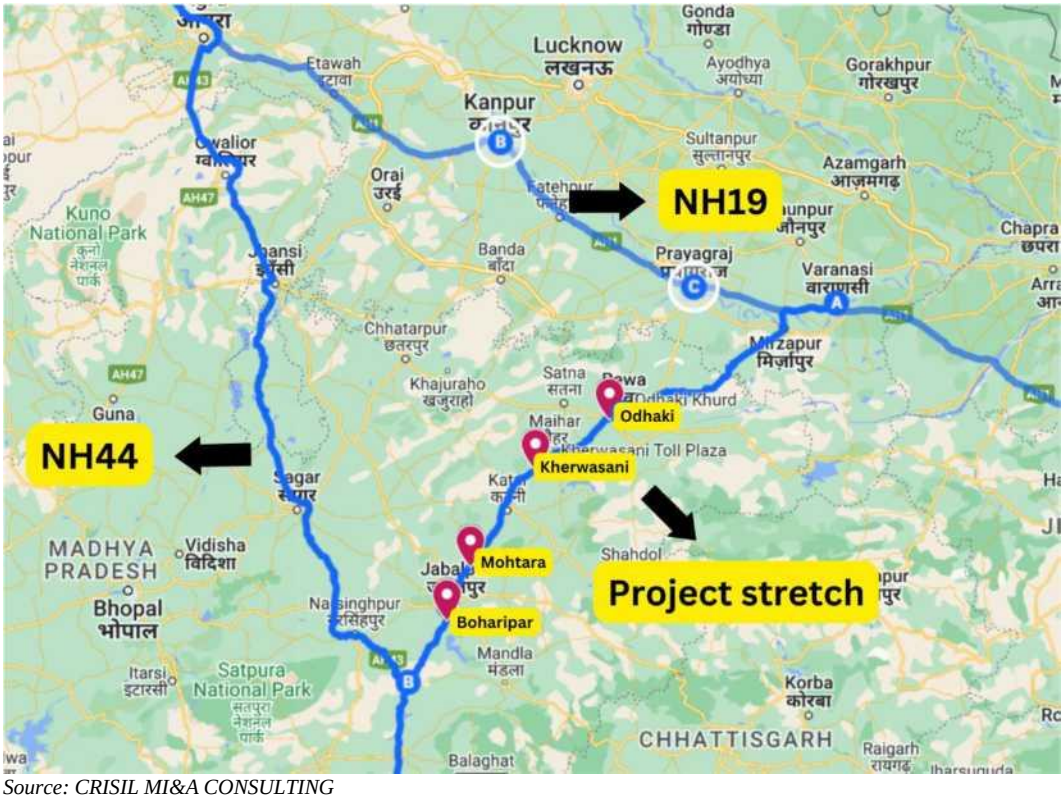
Source: CRISIL MI&A

9. *Rewa -Lakhnadon Project ("Asset 10")*

Project overview

According to the Traffic Consultant, Rewa- Lakhnadon project is a 4-lane, 265 km long stretch, on national highways (NH) 30 & (NH) 34 which connects Rewa, Katni, Jabalpur and Lakhnadon districts of Madhya Pradesh. The project stretch has four toll plazas - Odhaki Paipkhar, Kherwasani, Mohtara, and Boharipar. In the larger road network, the project stretch connects East-West Corridor (NH-19), which connects Kolkata in West Bengal to Delhi and North-South corridor (NH44) towards south. The project stretch largely caters to the vehicle traffic within state only. Other prominent states with residual traffic are Uttar Pradesh, Gujarat, and Maharashtra.

Figure 1: Project and adjoining NH network map



Source: CRISIL MI&A CONSULTING

Salient growth features and traffic generators

According to the Traffic Consultant, the project stretch is used by the traffic originating and destined in regions such as the Prayagraj-Varanasi cluster, & Pune-Nashik cluster. Prayagraj-Varanasi & Pune-Nashik are the key regions where the north-south traffic converges. The traffic travelling between these two clusters uses the project stretch which takes them 23-24 hours and travels ~1321 km. There exists an alternative route between Pune and Varanasi that passes through Indore and uses Jhansi Shivpuri stretch and Bundelkhand expressway. This route takes 28 hours, and the distance is ~1506 km. However, due to both longer distance and time, the route is not a threat to a long haul through traffic.

There exists an alternative route between Lucknow and Indore which passes through Chhatarpur and Sagar. This route takes 16-17 hours, and the distance is 955 km. The key reason for this higher time is that the alternative route is a mix of two and four lanes. Banda to Bhopal section of the alternative route, of nearly 430 km, is 2-lane. The Maharashtra and Gujarat traffic can also use this road, as they converge at Indore, where they will have the option to go towards the project stretch or towards

Sagar and use the alternative road. Under the Bharatmala programme, the sections from Kandla to Sagar and Sagar to Lucknow are proposed for augmentation. Hence, in the future, when the augmentation gets completed, the alternative route will be a feasible route in competition to the project stretch. We have assumed the impact of this augmented road to begin in fiscal 2028. To assess the at-risk traffic for Kandla-Sagar corridor and Sagar-Lucknow corridor, traffic between Indore (Traffic originating from Gujarat and Northern Maharashtra could choose to come via Indore) and Eastern UP have been considered.

Agri produce is the largest category on the stretch, comprising mostly wheat, rice and vegetables (including onions) from MP and UP. MP state's Rabi crop production is growing at 4%+ over the last decade, while Kharif has grown at sub 1%, and horticulture has grown at 8.2% (Food grains & Horticulture have 50-50% share in total Agri production). Hence overall agriculture growth is expected to be in the range of ~3.0%. For Mohtara, the growth rate is 5% in the short term and 2.0-3.0% in the long term on account of higher horticulture share in the OD mix.

Cement (~40%) & Stone/limestones (~35-40%) form majority of construction materials, largely originated from MP with clusters of cement manufacturing in Maihar (Satna) aka Cement capital of India, Katni, Jabalpur, and Rewa districts and the availability of limestones in the districts across the stretch. MP cement growth to be higher than national average owing to election next year and large-scale irrigation projects underway. Cement to grow at 5-6% (Central region), historical limestones production is at 3-4%

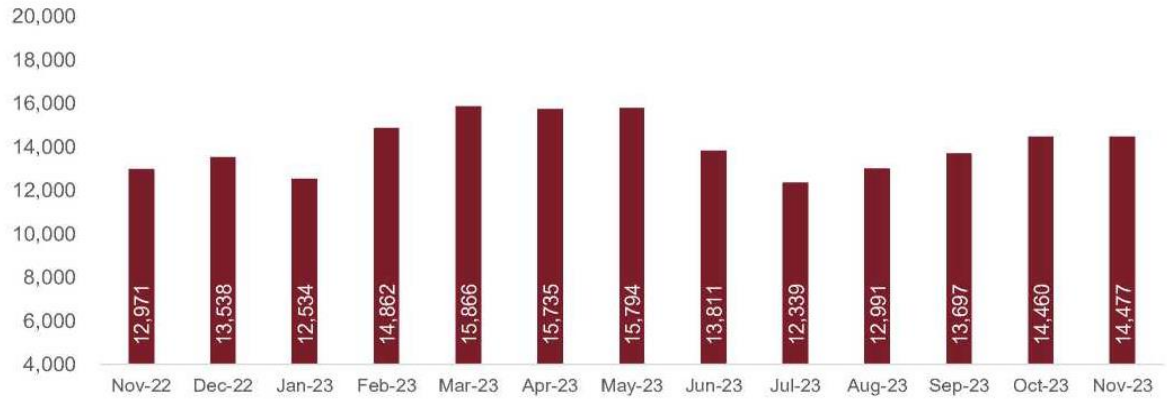
The key destination states are MP & UP owing to strong growth in housing development across schemes such as PMAY Urban and Rural. In the last five years, the central (MP and UP) and eastern (Odisha, Bihar, and West Bengal) regions exhibited strong demand led by a surge in infrastructure. construction and rural housing.

MP and UP are the key origination and destination states for the courier and parcel traffic of the project stretch. The stretch connects warehouse centres like Nagpur, Jabalpur at one end and Prayagraj & Patna at the other end. Proximity of these clusters and connectivity of consumption centres such as Jabalpur, Rewa, Satna, Prayagraj, and Varanasi is expected to lead strong growth for this category. The origination regions are key warehousing clusters such as Jabalpur, Indore, and Prayagraj. Smaller warehousing regions which have fair amount of origination on the stretch include Rewa, Katni and Varanasi.

The chart below shows the average daily traffic over Nov 2022 to Nov 2023:

Odhaki Toll Plaza

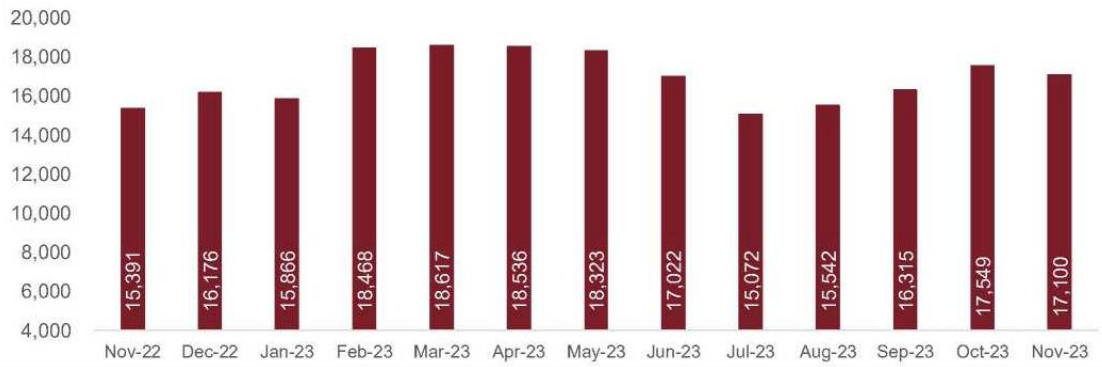
ETC Traffic - PCUs (Daily)



Source: CRISIL MI&A CONSULTING

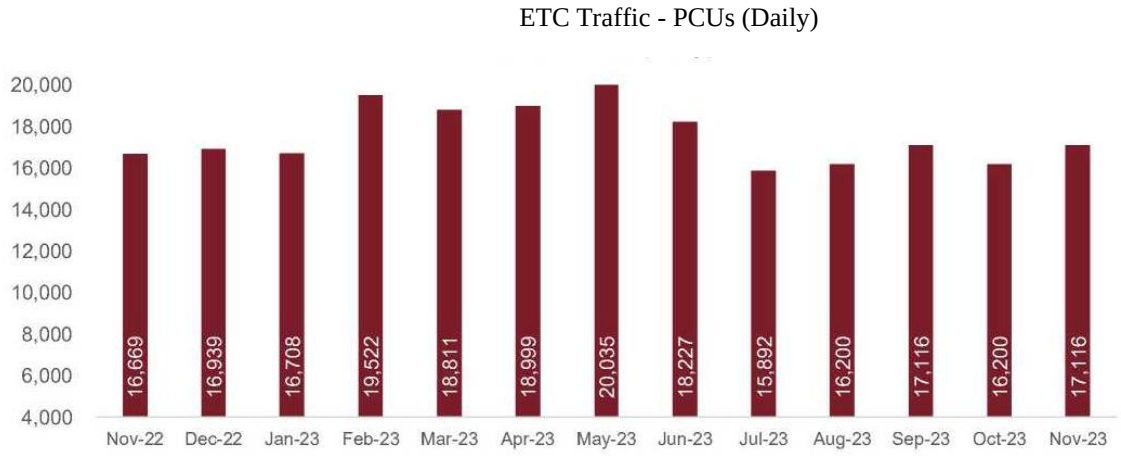
Kherwasani Toll Plaza

ETC Traffic - PCUs (Daily)



Source: CRISIL MI&A CONSULTING

Boharipar Toll Plaza



Source: CRISIL MI&A CONSULTING

Toll Segmentation

Trip segmentation has been derived from the average share of a single journey, return journey and other categories, based on ETC, cash and exemption data. April 2023 - Nov 2023 period is considered for trip segmentation.

For revenue calculation, the trip factor used for a return journey is two, and for a monthly pass it is 45. Exemptions have been estimated based on the TMS dataset of the toll plazas data from Apr-22 to July-23. The trip segmentation has been assumed to remain constant throughout the projection period i.e., over fiscals 2024 to 2053.

Odhaki - Details of trip segmentation across vehicle categories

Vehicle Category	Single Journey	Return Journey	Local Monthly Pass	Local Commercial Vehicles	Exemption
Car, jeep, van or LMV	43.76%	45.60%	2.21%	0.00%	8.43%
LCV, light goods vehicle, or minibus	40.86%	44.69%	0.00%	3.80%	10.65%
Bus or truck (2-axle)	73.61%	24.95%	0.00%	0.00%	1.44%
3-axle CV	80.61%	18.24%	0.00%	0.00%	1.15%
HCM, EME or MAV (4-6 axle)	76.42%	23.40%	0.00%	0.00%	0.18%

Source: Toll Plaza data, CRISIL MI&A CONSULTING

Kherwasani - Details of trip segmentation across vehicle categories

Vehicle Category	Single Journey	Return Journey	Local Monthly Pass	Local Commercial Vehicles	Exemption
Car, jeep, van or LMV	46.25%	42.75%	0.33%	0.01%	10.66%
LCV, light goods vehicle, or minibus	46.23%	41.56%	0.00%	2.75%	9.46%
Bus or truck (2-axle)	72.20%	26.84%	0.00%	0.09%	0.87%
3-axle CV	78.27%	20.17%	0.00%	0.00%	1.56%
HCM, EME or MAV (4-6 axle)	78.62%	21.00%	0.00%	0.06%	0.33%

Source: Toll Plaza data, CRISIL MI&A CONSULTING

Mohtara - Details of trip segmentation across vehicle categories

Vehicle Category	Single Journey	Return Journey	Local Monthly Pass	Local Commercial Vehicles	Exemption
Car, jeep, van or LMV	33.44%	47.07%	8.46%	1.93%	9.10%
LCV, light goods vehicle, or minibus	36.94%	31.93%	0.00%	17.32%	13.82%
Bus or truck (2-axle)	63.44%	28.97%	0.00%	6.14%	1.45%
3-axle CV	51.95%	26.33%	0.00%	21.51%	0.21%
HCM, EME or MAV (4-6 axle)	87.13%	11.62%	0.00%	1.08%	0.17%

Source: Toll Plaza data, CRISIL MI&A CONSULTING

Boharipar - Details of trip segmentation across vehicle categories

Vehicle Category	Single Journey	Return Journey	Local Monthly Pass	Local Commercial Vehicles	Exemption
Car, jeep, van or LMV	37.74%	40.70%	7.70%	0.05%	13.80%
LCV, light goods vehicle, or minibus	44.59%	38.94%	1.84%	0.91%	15.57%
Bus or truck (2-axle)	59.15%	37.23%	0.59%	0.73%	2.89%
3-axle CV	72.22%	20.97%	0.43%	4.25%	2.56%
HCM, EME or MAV (4-6 axle)	92.76%	6.71%	0.00%	0.07%	0.47%

Source: Toll Plaza data, CRISIL MI&A CONSULTING

The table below provides the traffic growth rates considering diversions to expressway and other alternative routes, as provided by the Traffic Consultant:

Odhaki Toll Plaza

CAGR	FY24-26	FY26-31	FY31-41	FY24-44
Car	7.4%	5.9%	4.3%	4.8%
Bus	3.7%	3.1%	2.1%	2.4%
Minibus	3.7%	3.1%	2.1%	2.4%
LCV	3.7%	2.8%	3.0%	3.0%
2 axles	4.0%	2.9%	3.4%	3.3%
3 axles	4.0%	1.9%	3.2%	2.9%
MAV	4.5%	3.2%	3.7%	3.6%
Total PCU	5.0%	3.7%	3.7%	3.8%
Revenue growth	9.1%	7.9%	7.9%	8.0%

Source: CRISIL MI&A CONSULTING

Kherwasani Toll Plaza

Note: FY24-26 revenue CAGR includes the increased toll collection due to addition of Katni bypass in the tollable length. The commencement of Katni Bypass is considered from 1st Jan 2025.

CAGR	FY24-26	FY26-31	FY31-41	FY24-44
Car	7.4%	5.9%	4.3%	4.8%
Bus	3.7%	3.1%	2.1%	2.4%

CAGR	FY24-26	FY26-31	FY31-41	FY24-44
Minibus	3.7%	3.1%	2.1%	2.4%
LCV	3.5%	2.9%	2.9%	2.9%
2 axles	4.2%	3.3%	3.5%	3.4%
3 axles	3.7%	2.3%	2.9%	2.8%
MAV	4.4%	3.2%	3.6%	3.6%
Total PCU	4.9%	3.7%	3.7%	3.7%
Revenue growth	27.2%	8.0%	7.9%	9.6%

Source: CRISIL MI&A CONSULTING

Mohtara Toll Plaza

CAGR	FY24-26	FY26-31	FY31-41	FY24-44
Car	7.4%	5.7%	4.3%	4.7%
Bus	3.7%	3.1%	2.1%	2.4%
Minibus	3.7%	3.1%	2.1%	2.4%
LCV	3.5%	3.0%	3.0%	3.0%
2 axles	3.8%	2.9%	3.1%	3.1%
3 axles	3.4%	2.2%	2.7%	2.6%
MAV	4.4%	3.1%	3.7%	3.6%
Total PCU	5.1%	3.9%	3.7%	3.8%
Revenue growth	8.7%	8.1%	7.9%	7.9%

Source: CRISIL MI&A CONSULTING

Boharipar Toll Plaza

CAGR	FY24-26	FY26-31	FY31-41	FY24-44
Car	7.4%	6.2%	4.3%	4.9%
Bus	3.7%	3.1%	2.1%	2.4%
Minibus	3.7%	3.1%	2.1%	2.4%
LCV	3.5%	3.2%	2.9%	3.0%
2 axles	3.9%	3.5%	3.3%	3.4%
3 axles	3.7%	3.3%	3.0%	3.1%
MAV	4.7%	4.3%	4.0%	4.1%
Total PCU	5.2%	4.6%	3.8%	4.1%
Revenue growth	8.8%	8.9%	8.1%	8.2%

Source: CRISIL MI&A CONSULTING

Projected Traffic Data: Growth in Passenger Car Unit (PCU)

Odhaki Toll Plaza

Vehicle Type	FY24	FY26	FY31	FY36	FY41	FY44
Car	3,324	3,835	5,107	6,457	7,749	8,473
Bus	130	140	163	184	201	211
Minibus	121	130	151	170	186	195
LCV	199	214	245	286	330	357
2-axle	557	603	694	823	967	1,058
3-axle	272	294	323	379	440	478
MAV	1,948	2,128	2,491	3,004	3,586	3,962
Total	**6,550**	**7,343**	**9,175**	**11,303**	**13,460**	**14,734**
Total PCU	**15,447**	**17,038**	**20,451**	**24,817**	**29,486**	**32,370**

Source: CRISIL MI&A CONSULTING

Kherwasani Toll Plaza

Vehicle Type	FY24	FY26	FY31	FY36	FY41	FY44
Car	3,693	4,261	5,674	7,174	8,610	9,414
Bus	180	194	226	254	278	291
Minibus	60	65	75	85	93	97
LCV	317	339	392	455	523	565
2-axle	771	837	985	1,173	1,383	1,516
3-axle	363	390	438	509	584	631
MAV	2,284	2,489	2,910	3,496	4,159	4,587
Total	**7,669**	**8,575**	**10,699**	**13,146**	**15,631**	**17,102**
Total PCU	**18,482**	**20,330**	**24,412**	**29,523**	**34,989**	**38,364**

Source: CRISIL MI&A CONSULTING

Mohtara Toll Plaza

Vehicle Type	FY24	FY26	FY31	FY36	FY41	FY44
Car	6,193	7,145	9,421	11,910	14,294	15,629
Bus	186	200	234	263	288	302
Minibus	96	103	120	135	148	155
LCV	391	419	486	565	650	703
2-axle	930	1,001	1,157	1,357	1,576	1,713
3-axle	587	627	701	805	916	983
MAV	1,664	1,812	2,114	2,545	3,033	3,349
Total	**10,047**	**11,308**	**14,233**	**17,580**	**20,906**	**22,834**
Total PCU	**19,520**	**21,570**	**26,119**	**31,686**	**37,480**	**40,982**

Source: CRISIL MI&A CONSULTING

Boharipar Toll Plaza

Vehicle Type	FY24	FY26	FY31	FY36	FY41	FY44
Car	3,626	4,184	5,653	7,147	8,578	9,379
Bus	173	186	216	243	267	279
Minibus	34	36	42	48	52	55
LCV	247	265	309	359	413	445
2-axle	739	798	949	1,120	1,310	1,429
3-axle	256	275	323	377	435	471
MAV	1,191	1,305	1,608	1,966	2,380	2,651
Total	**6,265**	**7,048**	**9,100**	**11,261**	**13,434**	**14,710**
Total PCU	**12,908**	**14,283**	**17,878**	**21,826**	**26,020**	**28,598**

Source: CRISIL MI&A CONSULTING

Tollable Length and Toll Rates

As per NHTIS, the Rewa-Lakhnadon project comprises 315.368 kms of tollable length. In India, toll rates are as per notification by the Ministry of Road Transport and Highways in the National Gazette. The present toll rates are determined with reference to the published base toll rates and are adjusted annually at the beginning of each fiscal year equal to 40% of the movement in the wholesale price index in December of the preceding year plus a fixed 3%.

Single toll rates in INR at four toll plazas, applicable from April 2023 until March 2024 are as provided below:

Single toll rates across toll plazas

Type of Vehicle	Odhaki	Kherwasani	Mohtara	Boharipar
CJV	110	115	120	150
LCV	180	185	195	245
Bus/Truck	375	390	415	515
3A	410	430	450	560
MAV/ HCM/EME	590	615	650	805
OSV	720	750	790	980

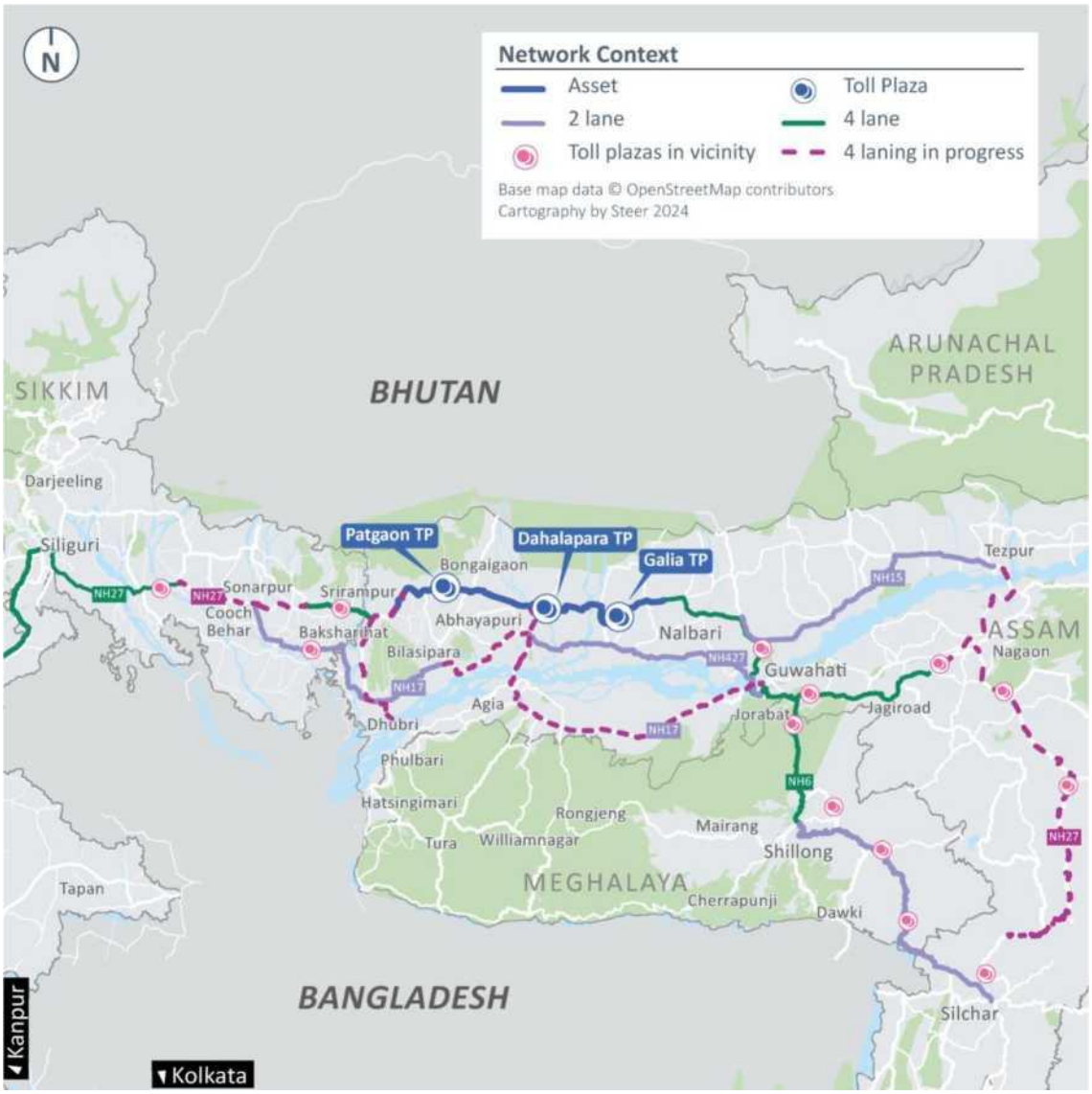
Source: NHTIS, CRISIL MI&A CONSULTING

10. ***Kachugaon - Kaljhar Project ("Asset 11") and Kaljhar – Patacharkuchi Project ("Asset 12") (for the purposes of the summary provided below, collectively referred to as "Asset")***

Project overview

The Asset is located on the National Highway (NH) 27, the east-west corridor of India. The highway starts in Porbandar in Gujarat and ends in Silchar in Assam and passes though the states of Gujarat, Rajasthan, Madhya Pradesh, Uttar Pradesh, Bihar, West Bengal, and Assam.

The Asset consists of three toll plazas namely Patgaon (at KM 49+600, located 215km west of Guwahati), Dahalapara (at KM 971+200, located 160km west of Guwahati) and Galia (at KM 1017+350, located 120km west of Guwahati), as shown in the map below.



Source: Steer cartography using OpenStreetMap data

Salient growth features and traffic generators

The Asset is located in the state of Assam, which is the most industrialized state within northeast (NE) India. The growth observed in NE region is largely driven by the state of Assam which contributes ~ 65% to the region's economy. Some of the key industries in Assam include oil and gas, limestone and cement, and coal.

The Asset located on NH27, the east-west corridor of India, is connected via the Siliguri corridor, also called the Chicken Neck. The Siliguri Corridor and the Asset connects the seven states of northeast India to the rest of India. The Asset acts as a feeder for the NE India and caters to the long-distance traffic entering the region via Assam.

No major urban settlements are present near the Asset. Guwahati, one of the largest settlements in the northeast region, is located ~185 km from the Asset. It is a key manufacturing and industrial centre of the region and is home to numerous warehouse and storage depots. The traffic from rest of the country uses the Asset to reach Guwahati from where it is distributed to rest of northeast India, with Guwahati acting as a sink and as a source.

The north-eastern states of India, being consumption based in nature, depend heavily on the rest of India for their consumption needs. The commodities from West Bengal, central India, and north India are transported to the warehouses of Guwahati via the Asset, from where these goods are redistributed to the rest of northeast region. Key commodities observed are groceries, manufactured goods, industrial equipment, parcels and couriers, petroleum products etc. From Guwahati and rest of northeast region, trucks carry cement (from Jagiroad, Morigaon), petroleum products (from refineries in Bongaigaon, Guwahati), bamboo, tea, rubber, and groceries to the rest of country.

The state is famous for its tea cultivation and accounts for approximately half of India's tea production. Apart from tea cultivation, the state is also a major producer of rice, horticulture crops (mango, banana), spices (cardamom, ginger, and turmeric).

Assam is a major producer of crude oil and natural gas in India. Most of the oilfields in state are located in the upper Assan region with the refineries being located in Guwahati, Digboi, Numaligarh and Bongaigaon. Indian Oil Corporation Limited

(IOCL) refinery at Bongaigaon is located on the Asset between Patgaon and Dahalapara plazas.

High-grade fossil limestone (Sylhet limestone) is found in Garo and Khasi hills of Assam and is majorly used for production of cement. The availability of raw material has facilitated the setting up of large cement industries in Assam. Guwahati/Kamrup district is home to the largescale industries of Purbanchal Cement, Topcem Cement, Star Cement, Dalmia Cement etc.

Traffic volume and composite of vehicles

Historical traffic data

ETC daily-level data, segmented with ticket categories, was available from December 2021 - November 2023 for Patgaon, from November 2021 - November 2023 for Dahalapara and from November 2021 - November 2023 for Galia. For Patgaon and Dahalapara, FY23 PCU is trending at 15,361 and 18,884 which grows to 15,932 and 18,937 in 8 months of FY24YTD. FY23 PCU at Galia is 19, 617 while 8 months FY24YTD is 19,102.

The revenue collection for FY23 is INR 61 Cr and INR 63 Cr for Patgaon and Dahalapara respectively. For FY24 YTD (Apr-Nov'23) it is INR 44 Cr and INR 43.5 Cr for Patgaon and Dahalapara respectively. For FY23, ETC collection including cash collection reported by Schedule V is INR 35Cr which for first 8 months of FY24 (Apr-Nov'23) is INR 23.7Cr at Galia.

Figure: MADT, PCU Patgaon

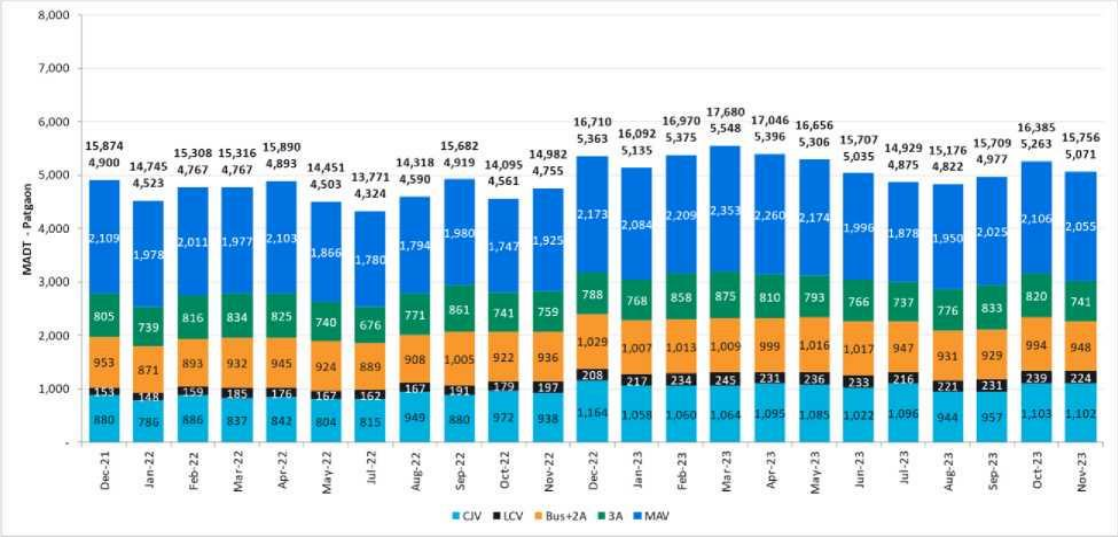


Figure: MADT, PCU Dahalapara

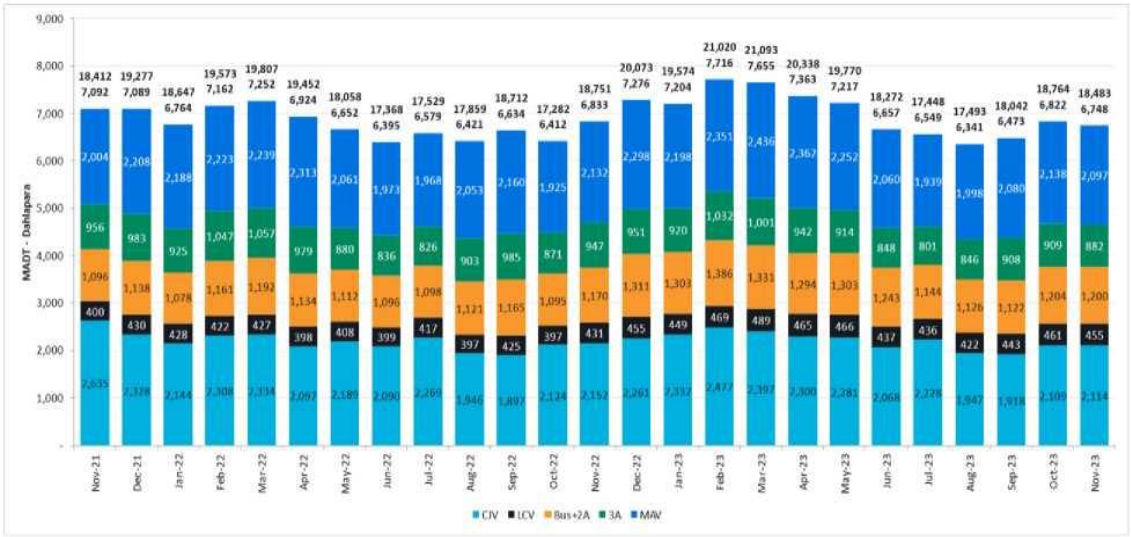
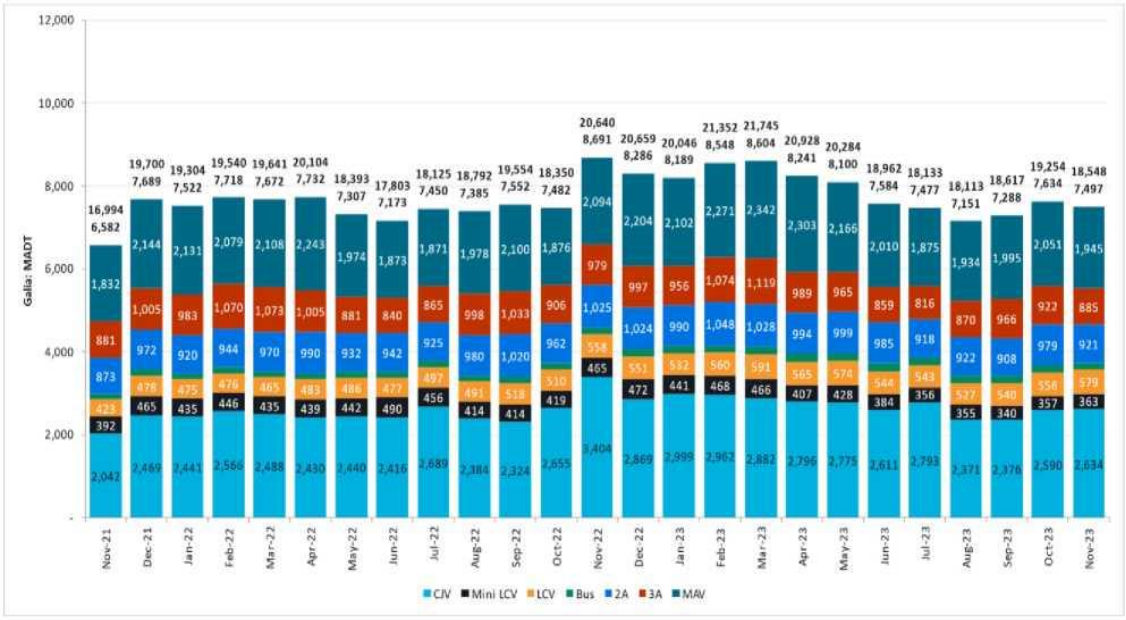


Figure: MADT, PCU Galia



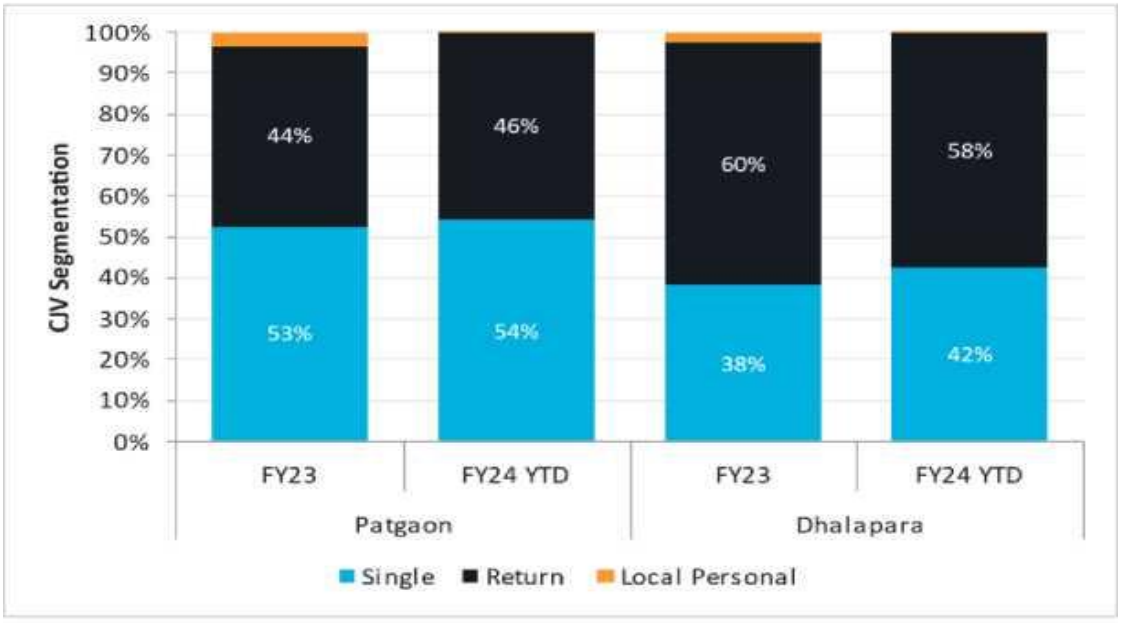
Source: Steer analysis

Toll segmentation

On the Asset, CJV ticket segmentation observes a healthy share of 'return' trips due to the local nature of movement. This is observed across all three toll plazas on the Asset.

The majority of MAV traffic at Patgaon, Dahalapara and Galia is long-distance traffic which has one end in Guwahati/northeast and the other in the rest of the country (west of Patgaon). Patgaon has higher influence of long-distance traffic originating from West Bengal/Bihar and North India. Whereas moving east towards the Asset the influence of local traffic from Bongaigaon, Barpeta, Pathshala, Howly increases which is visible on Dahalapara and Galia. Overall, the travel patterns remain similar on all these plazas.

Figure: Segmentation CJV- Patgaon, Dahalapara



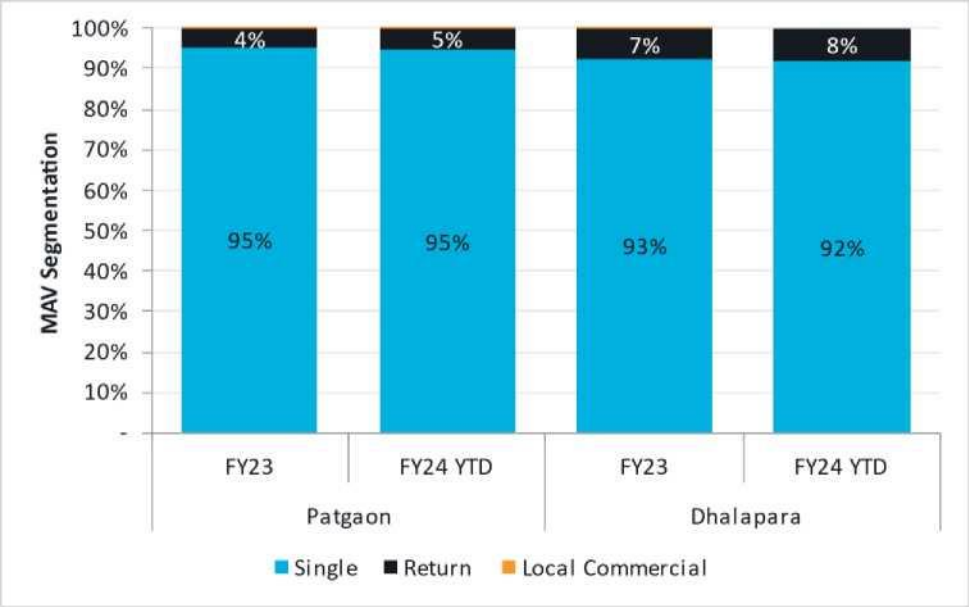
Source: Steer analysis

Source: Steer analysis

Figure: Segmentation CJV- Galia

Source: Steer analysis

Figure: Segmentation MAV- Patgaon, Dahalapara



Source: Steer analysis

Figure: Segmentation MAV- Galia

Source: Steer analysis

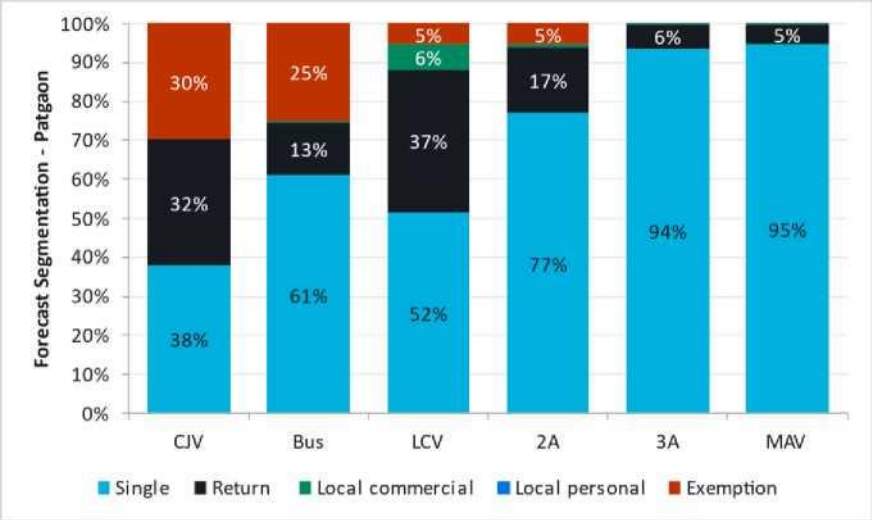
However, as the above-mentioned segmentation is sourced from the ETC (segmented) dataset Patgaon and Dahalapara the segmentation doesn't include information regarding cash/monthly pass-based trips and exemptions. Therefore, the difference between ETC (segmented) and TMS dataset is added (as a % of ETC traffic) as cash (single) and monthly pass-based trips. It

should be noted that the TMS data had information regarding the number cash-based and the number of monthly passes sold per day.

While for Galia cash transactions at monthly were already provided. Additionally, for exemptions the difference between TVC and ETC dataset is added (as a % of ETC traffic) in the final adopted segmentation as non-paying traffic.

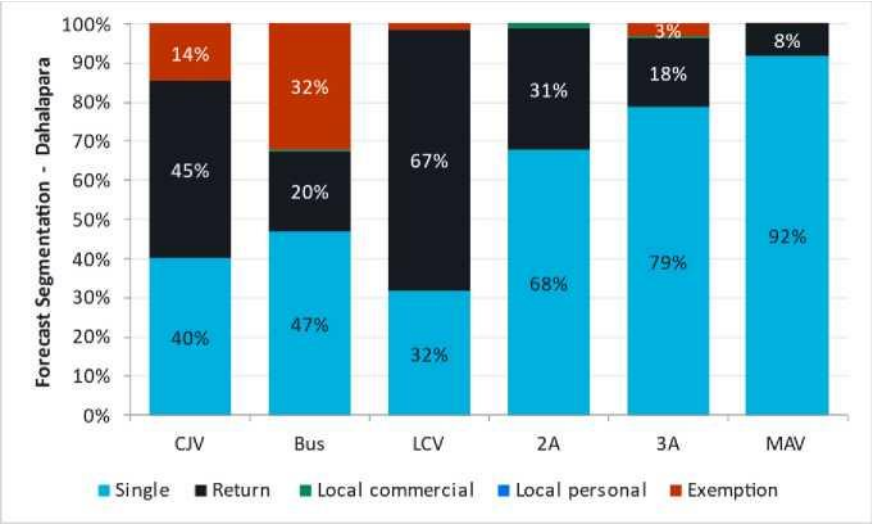
The adopted segmentation of FY24YTD is shown in the charts below. We have assumed the forecast segmentation to remain same across the concession life.

Figure: Toll segmentation (%) FY24 onwards- Patgaon



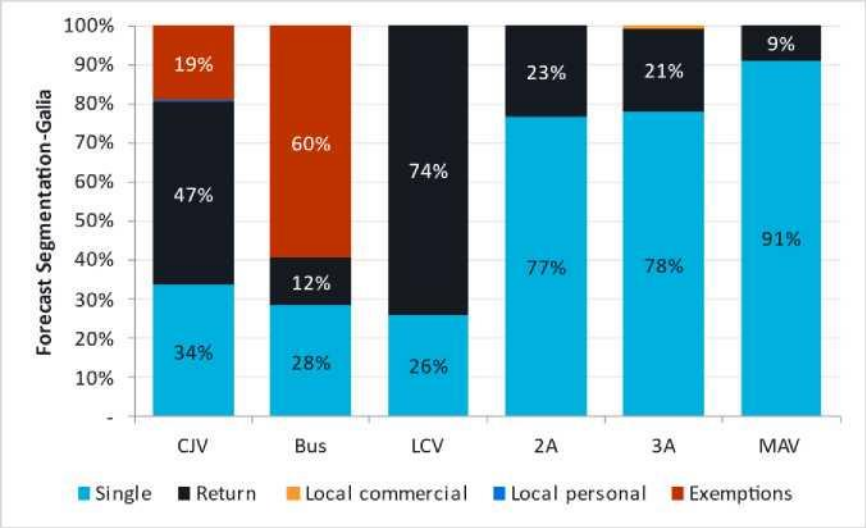
Source: Steer analysis

Figure: Toll segmentation (%) FY24 onwards- Dahalapara



Source: Steer analysis

Figure: Toll segmentation (%) FY24 onwards- Galia



Source: Steer analysis

Traffic forecast

The increase of traffic on any existing road alignment depends on how fast the background travel demand (background growth) will grow; and on how successfully the project road is in attracting that traffic (traffic capture). Background travel demand is driven by the prevalent socio-economic conditions in the region, which include:

- Changes in factors such as population, employment, and income distribution
- Economic growth (GSDP, and GDP).
- Growth of local industries near the Asset.

The model uses India GDP and Assam GSDP as the two macro-economic inputs which operate as growth drivers on our base year forecasts.

The network developments near the Asset's alignment which Steer believes would affect traffic on the Asset during the concession period are 4 Laning of NH17 (Hapachara to VIP Chowk) +New Goalpara bridge, Guwahati Ring Road, Flyover construction (Passenger), 4 laning of NH127B + Phulbari bridge and 4-laning of West Bengal Section (Cooch Bihar to Bilasparia to Guwahati).

Steer has developed traffic and revenue forecasts for the Asset by taking into consideration all inputs discussed above - base year estimates, macro-economic assumptions, growth drivers, elasticities, and forecast ticket segmentation. The table below provides the final (background plus impacts) traffic growth on the Asset.

Final (background plus impacts) AADT forecast - Patgaon

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
CJV	1,331	1,417	1,515	1,937	2,581	3,384	4,341
Mini LCV	314	320	327	352	384	418	451
Bus	133	135	138	147	158	169	180
LCV	265	270	276	297	324	351	379
2A	954	991	1,031	1,113	1,322	1,554	1,803
3A	807	827	850	893	1,002	1,117	1,234
MAV	2,178	2,297	2,429	2,768	3,529	4,437	5,477
OSV	2	2	2	2	3	3	4
AADT	**5,985**	**6,259**	**6,566**	**7,510**	**9,303**	**11,433**	**13,868**
PCU's	**17,536**	**18,345**	**19,249**	**21,661**	**26,789**	**32,828**	**39,675**

Final (background plus impacts) AADT CAGR (%) - Patgaon

Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FY30-FY35	FY25-FY26	FY26-FY30	FY30-FY35
CJV	6.4%	6.9%	6.3%	5.9%	5.6%	5.1%	5.8%
Mini LCV	1.9%	2.1%	1.9%	1.8%	1.7%	1.5%	1.7%
Bus	1.6%	1.7%	1.6%	1.5%	1.4%	1.3%	1.4%
LCV	1.9%	2.0%	1.9%	1.7%	1.6%	1.5%	1.7%
2A	3.8%	4.1%	1.9%	3.5%	3.3%	3.0%	3.1%
3A	2.5%	2.7%	1.3%	2.3%	2.2%	2.0%	2.0%
MAV	5.4%	5.8%	3.3%	5.0%	4.7%	4.3%	4.5%
OSV	5.5%	5.8%	5.4%	5.0%	4.7%	4.3%	4.9%
AADT	**4.6%**	**4.9%**	**3.4%**	**4.4%**	**4.2%**	**3.9%**	**4.1%**
PCU's	**4.6%**	**4.9%**	**3.0%**	**4.3%**	**4.1%**	**3.9%**	**4.0%**

Source: Steer analysis

Final (background plus impacts) AADT forecast - Dahalapara

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
CJV	2,382	2,454	2,710	3,466	4,619	6,055	7,768
Mini LCV	460	464	479	517	564	613	661
Bus	231	235	239	254	274	293	313
LCV	495	504	515	549	599	649	700
2A	1,129	1,172	1,219	1,250	1,483	1,744	2,024
3A	938	962	988	934	1,048	1,168	1,291
MAV	2,200	2,320	2,454	2,602	3,317	4,170	5,147
OSV	1	1	1	2	2	3	3
AADT	**7,837**	**8,112**	**8,605**	**9,573**	**11,905**	**14,695**	**17,906**
PCU's	**20,386**	**21,225**	**22,348**	**23,836**	**29,431**	**36,034**	**43,536**

Source: Steer analysis

Final (background plus impacts) AADT CAGR (%) - Dahalapara

Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FT30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
CJV	3.0%	10.4%	6.3%	5.9%	5.6%	5.1%	5.8%
Mini LCV	0.8%	3.2%	1.9%	1.8%	1.7%	1.5%	1.7%
Bus	1.6%	1.7%	1.6%	1.5%	1.4%	1.3%	1.4%
LCV	1.9%	2.0%	1.6%	1.7%	1.6%	1.5%	1.7%
2A	3.8%	4.1%	0.6%	3.5%	3.3%	3.0%	2.8%
3A	2.5%	2.7%	(1.4%)	2.3%	2.2%	2.0%	1.5%
MAV	5.4%	5.8%	1.5%	5.0%	4.7%	4.3%	4.1%
OSV	5.5%	5.8%	5.4%	5.0%	4.7%	4.3%	4.9%

Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FT30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
AADT	**3.5%**	**6.1%**	**2.7%**	**4.5%**	**4.3%**	**4.0%**	**4.0%**
PCU's	**4.1%**	**5.3%**	**1.6%**	**4.3%**	**4.1%**	**3.9%**	**3.7%**

Source: Steer analysis

Final (background plus impacts) AADT forecast - Galia

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
CJV	3,385	3,489	3,851	4,925	6,563	8,604	11,038
Mini LCV	392	394	405	431	464	497	530
LCV	574	585	597	644	703	764	824
Bus	465	474	483	521	569	618	667
2A	970	1,007	1,048	1,066	1,266	1,489	1,729
3A	941	965	991	956	1,072	1,195	1,320
MAV	2,113	2,227	2,354	2,436	3,099	3,890	4,794
OSV	2	2	2	2	3	3	4
AADT	**8,842**	**9,143**	**9,733**	**10,981**	**13,740**	**17,060**	**20,906**
PCU's	**21,283**	**22,128**	**23,324**	**24,922**	**30,764**	**37,673**	**45,542**

Source: Steer analysis

Final (background plus impacts) AADT CAGR (%) – Galia

Vehicle Type	FY24-25	FY25-FY26	FY26-FY30	FY30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
CJV	3.1%	10.4%	6.3%	5.9%	5.6%	5.1%	5.8%
Mini LCV	0.6%	2.7%	1.6%	1.5%	1.4%	1.3%	1.4%
LCV	1.9%	2.1%	1.9%	1.8%	1.7%	1.5%	1.7%
Bus	1.9%	2.1%	1.9%	1.8%	1.7%	1.5%	1.7%
2A	3.8%	4.1%	0.4%	3.5%	3.3%	3.0%	2.8%
3A	2.5%	2.7%	(0.9%)	2.3%	2.2%	2.0%	1.6%
MAV	5.4%	5.7%	0.9%	4.9%	4.6%	4.3%	4.0%
OSV	5.4%	5.7%	5.3%	4.9%	4.6%	4.3%	4.8%
AADT	**3.4%**	**6.4%**	**3.1%**	**4.6%**	**4.4%**	**4.1%**	**4.2%**
PCU's	**4.0%**	**5.4%**	**1.7%**	**4.3%**	**4.1%**	**3.9%**	**3.7%**

Source: Steer analysis

Toll Rates

In India, toll rates are as per notification by the Ministry of Road Transport and Highways in the National Gazette. The present toll rates are determined with reference to the published base toll rates and are adjusted annually at the beginning of each fiscal year equal to 40% of the movement in the wholesale price index in December of the preceding year plus a fixed 3%.

According to the NHAI's toll notification for FY24, i.e., April 1, 2023, onwards, the toll rates at the toll plazas for Asset are as follows:

FY24 single toll rates Patgaon, Dahalapara and Galia

Type of Vehicle	Patgaon	Dahalapara	Galia
CJV	100	90	45
LCV	165	145	75
Bus/Truck	340	300	155
3A	370	325	170
MAV/ HCM/EME	535	470	245

Source: NHAI Revision of User fee Rate w.e.f 01.04.2023

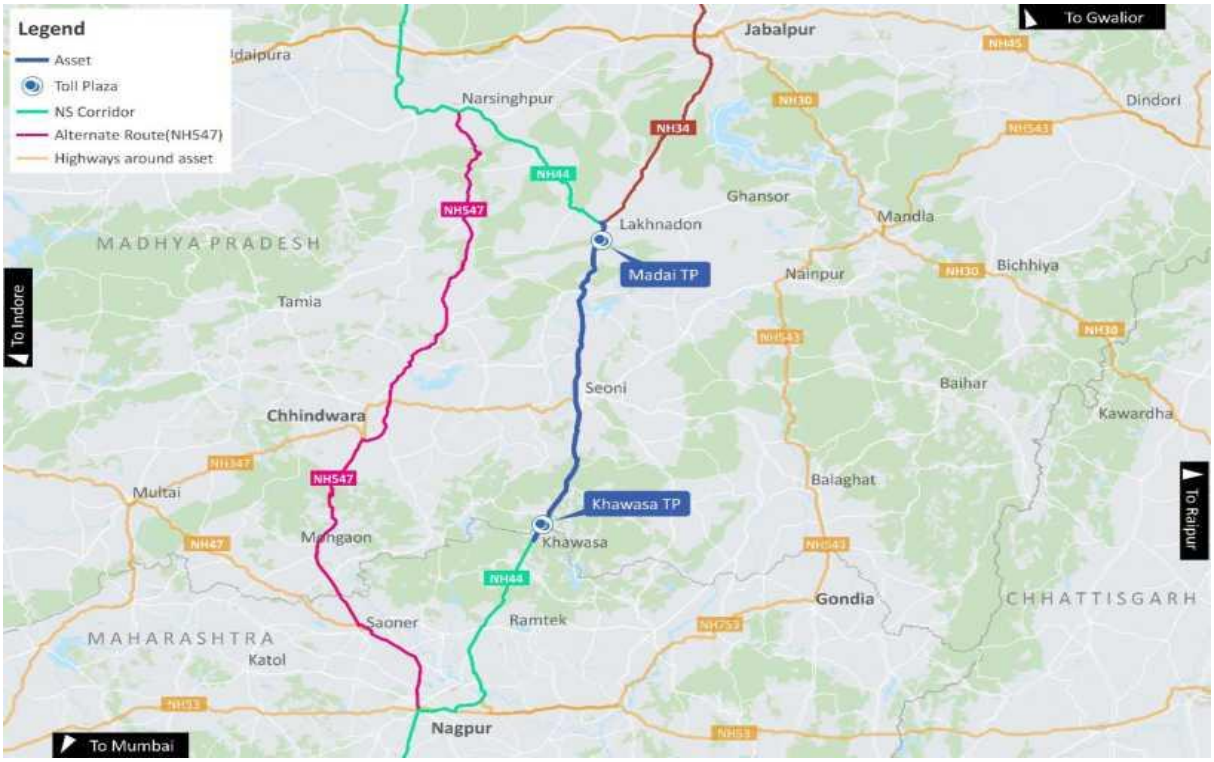
11. Lakhnadon – Mahagaon (Mohgaon) – Khawasa ("Asset 13")

Project overview

The Asset forms part of NH44 north-south long-distance strategic corridor. The Asset is a 4- laned divided section between Lakhnadon and Khawasa traversing through the districts of Mandai, Chhapara and Seoni in the state of Madhya Pradesh. There are two toll plazas on the asset and are located at and is shown in the map below:

- Khawasa (KM 651+718)
- Madai (KM 549+200)

Asset context – LK



Source: Steer cartography using OpenStreetMap data

Salient growth features and traffic generators

The Asset is present in the state of Madhya Pradesh close to Madhya Pradesh and Maharashtra border. The Asset forms part of the strategic NH44 corridor catering to the north-south movement.

The Asset caters to the demand generated by the states connected through the abovementioned highway. NH44 runs over 4,112 kms completing the north-south movement and connects some of the major states and industrial centres of northern states/UTs of Jammu and Kashmir, Punjab, Haryana, Delhi, Uttar Pradesh, Rajasthan, Madhya Pradesh, Maharashtra with the southern states of Telangana, Andhra Pradesh, Karnataka, and Tamil Nadu. The traffic profile is predominantly goods vehicles undertaking both medium and long-distance movements between Nagpur, Jabalpur, Chhindwara, Delhi, Bangalore, Hyderabad and more.

The Asset lies between the urban centres of Jabalpur and Nagpur. Jabalpur has medium to large scale industries alongside agriculture-based economy. Whereas Nagpur being the manufacturing and food processing hub has industries like Butibori, Umred generating goods demand. The key economic activities are detailed below:

- **Manufacturing** segment includes products ranging from agriculture equipment, aluminium products, castings, cement, chemicals, paper and packaging, electrical equipment and fittings, textile engineering goods, tools manufacturing, fabrication and machining, ferro alloys, paints, furniture, plastic and moulding products, etc.

- **Food processing** giants having presence at Nagpur includes Haldiram, Dinshaw, Patanjali and other medium scales orange and spices processing units, etc.

- **Agriculture production** In Jabalpur, some of the important commercial crops cultivated are cotton, pulses, sugarcane, oilseeds and medicinal crops. The fertile alluvial soil of Narmada basin also provides other crops like wheat, sorghum, millet and rice. Jabalpur is the largest producer of soyabeans in Madhya Pradesh.

Apart from the above-mentioned industrial segments present in Nagpur, the following are some additional developments announced by the government for the region:

- Government of Maharashtra has set-up Multi-Modal International Passenger and Cargo Hub Airport at Nagpur (MIHAN). That will upgrade existing domestic airport along with a Special Economic Zone which is abutting to the boundary of the airport. MIHAN houses plant of Tata Aeronautics which manufactures parts for Boeing and Air India and Dassault's assembly plants.

- Container Corporations of India Limited (CONCOR) constructed Multi Modal Logistic Park along with a rail terminal connecting MIHAN with different ports in country.

Butibori industrial area established by Maharashtra Industrial Development Corporation (MIDC), north of the Asset, is one of the country's largest industrial hubs. It houses textile, machine and metal fabrication and manufacturing units and is home to industrial giants like KEC, Hyundai, and Unitech. Koradi Thermal Power Station and Khaparkheda Thermal Power Station are the two major thermal power stations located in vicinity of the hub.

Yavatmal industrial area, in west of the Asset, has textile and cotton processing industries including Raymond India's garment plant. The industrial hub is also home to export units of machineries, cement, medicines, limestones, and clothes.

Chandrapur is key coal mining centre in close vicinity of the Asset and has thermal plant, cement, paper and ferro alloy manufacturing industries.

Chhindwara is home to brands like Raymond's & Hindustan Unilever. The city has rich market areas such as Mansarover Complex, Fawwara Chowk, Nagpur Road, Gole Gunj & Gandhi Gunj. The city is home to old industries of pottery, leather moots and ornaments of zinc, brass and bell metal. On the outskirts, vegetables, especially potatoes, are raised in large quantities for export to nearby districts. Western Coalfields Limited is the major company of Chhindwara approximate ten thousand people work together here.

Seoni railway station and its goods yard work as an important agricultural export hub. It is one of the 24 districts in Madhya Pradesh currently receiving funds from the Backward Regions Grant Fund Programme (BRGF). Railway connectivity to Seoni has increased the agricultural import export business from Seoni.

The agricultural stretches present along the Asset as well as in Nagpur generate a considerable share of traffic on the Asset. Nagpur, also known as Orange City, is famous for the production of oranges in addition to being home to large number of paddy, jowar, cotton, tur and soyabean fields. Also, Jabalpur is the largest producer of soyabeans in Madhya Pradesh. The city serves as a major wholesale market for food grains and other commodities. It is also a market center for its agricultural production of wheat, rice, green peas, maize, oil seeds and pulses.

Long-distance goods traffic has seen an increase in proportion in recent years due to the shift of traffic from other corridors to NH44 as this is the shortest route between Hyderabad/Bengaluru and Delhi.

Traffic volume and composite of vehicles

Historical traffic data

Toll plaza data from Oct-21 to Nov-23 and Dec'21 to Nov'23 for Khawasa and Madai, respectively, was shared by the Client. Therefore, to build the base estimate for FY24, we have considered:

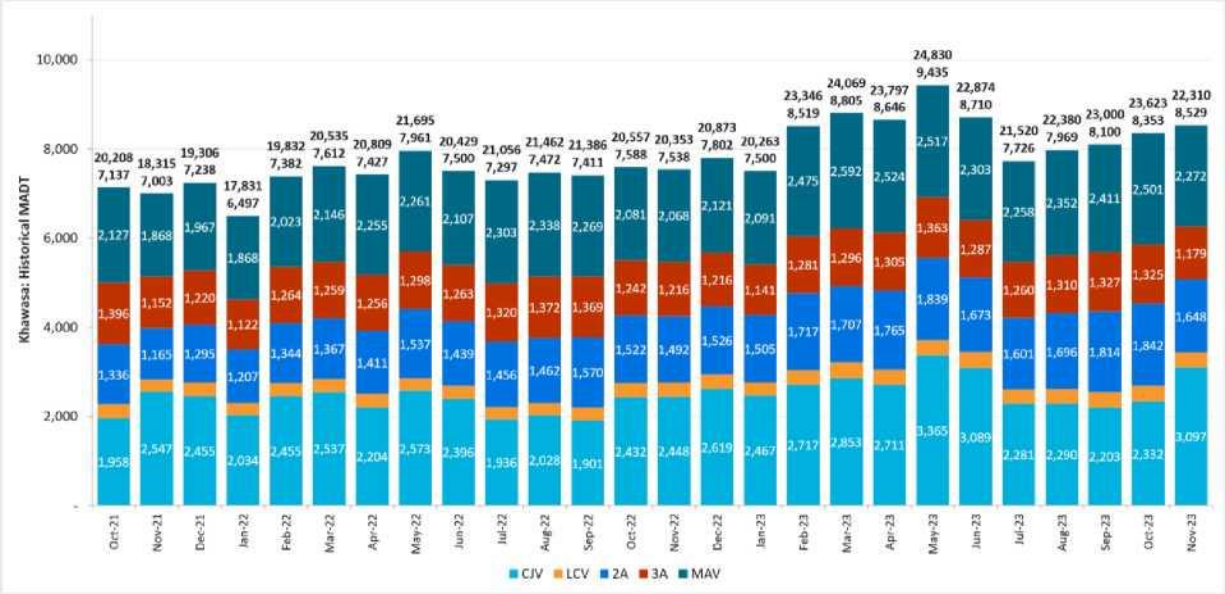
There are three data sources as mentioned in the table above, the Electronic Toll Collection (ETC) data provided by NHAI, IHMCL data and Schedule V data. For the purpose of base estimation and analysis of traffic trends ETC and cash data has been used. For the purpose for cash transactions Schedule V has been relied upon.

All these data sets together have been considered for historical analysis and revenue reconciliation.

The Asset is trending at ~23,000 PCU for 8 months of FY24. On both the plazas, traffic composition is majorly dominated by trucks (2A/3A/MAV) with over 2/3rd of total traffic on Khawasa and Madai each, as they primarily serve long-distance north-south traffic movement. Khawasa toll plaza observed an average of ~8,433 AADT and Madai ~9,303 AADT in FY24YTD.

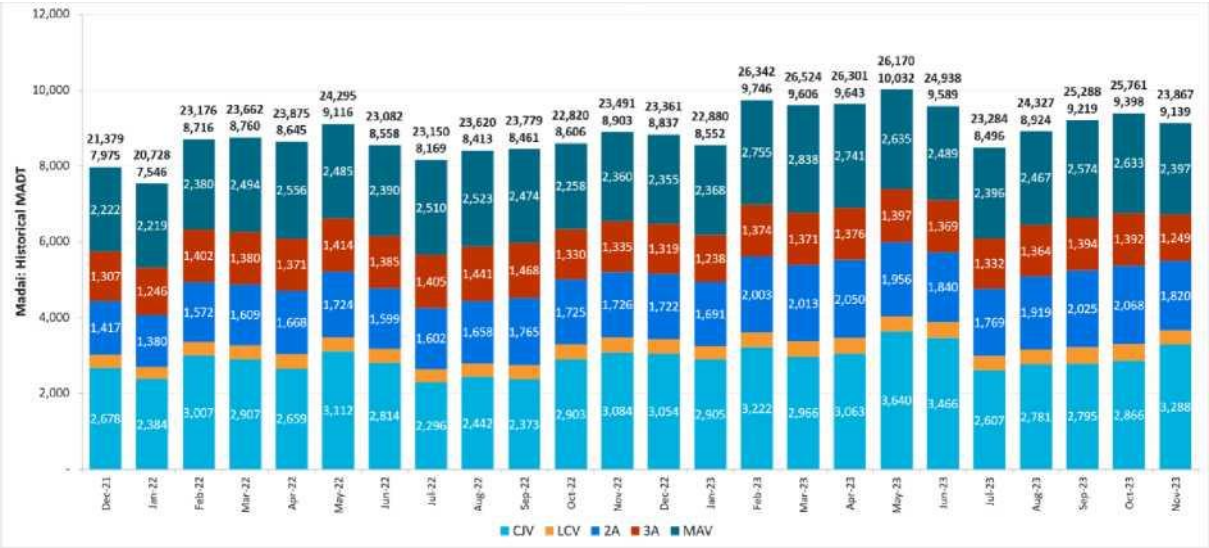
Per day Collection increased ~11% in FY24 compared to FY23 on the Asset. Total annual collection of 186 Cr in FY23 is increasing to 138 Cr in 8months for FY24YTD. On an average, the daily revenue collection on the Asset is ~INR 57 lakhs.

Khawasa Historical Traffic (ETC + Cash MADT, PCU)



Source: Steer analysis of client toll plaza data

Madai Historical Traffic (ETC + Cash MADT, PCU)

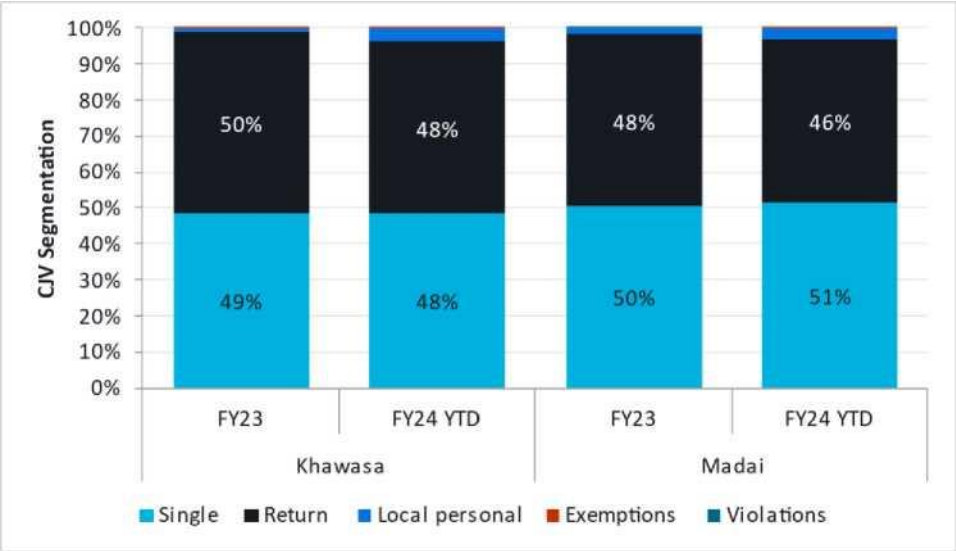


Source: Steer analysis of client toll plaza data

Toll segmentation

On the Asset, CJVs observe approximately equal split between single and return tickets on both Khawasa and Madai as the plazas cater to inter-urban movement influenced by the presence of major consumption centres, Nagpur and Jabalpur on either ends of the asset.

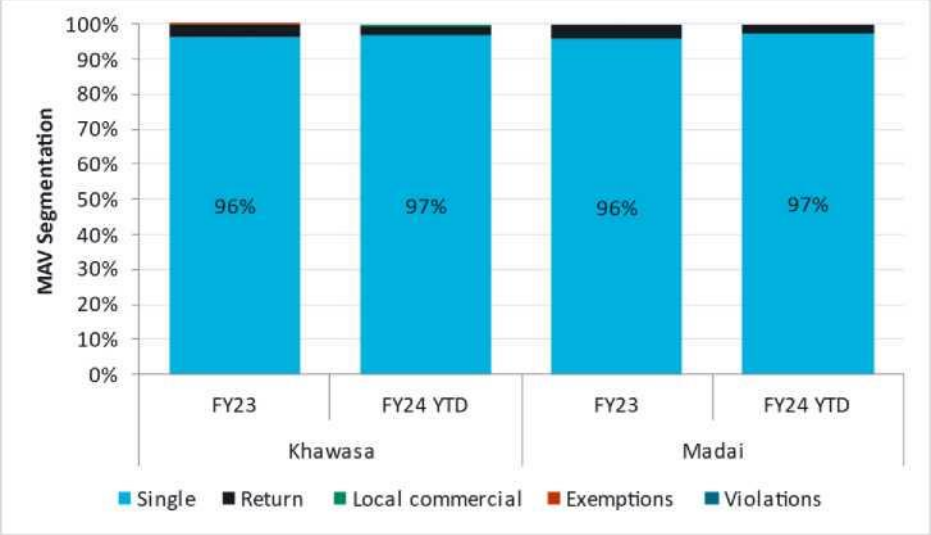
Segmentation CJV



Source: Steer analysis

Over ~95% of the commercial vehicles (2A/3A/MAVs) plying on the Asset are observed to buy single tickets suggesting through-movement on the Asset. The observation is in line with the fact that the Asset is key connector for Delhi/NCR and Maharashtra/neighbouring zones and hence caters to long-distance traffic. The Asset observed negligible level of exemptions and violations for trucks.

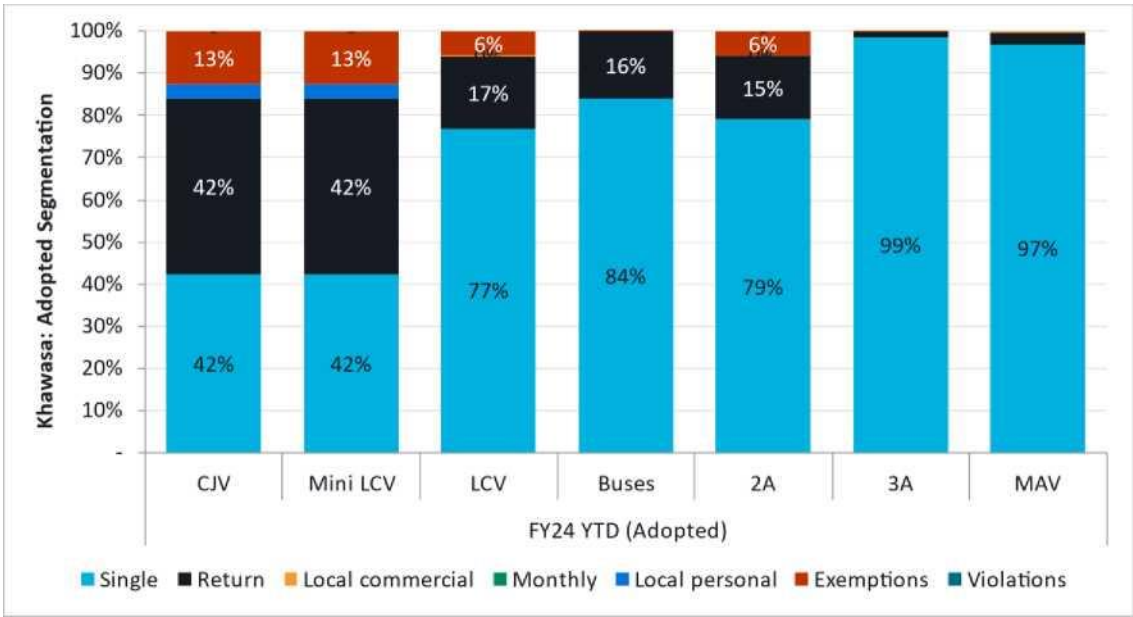
Segmentation MAV



Source: Steer analysis

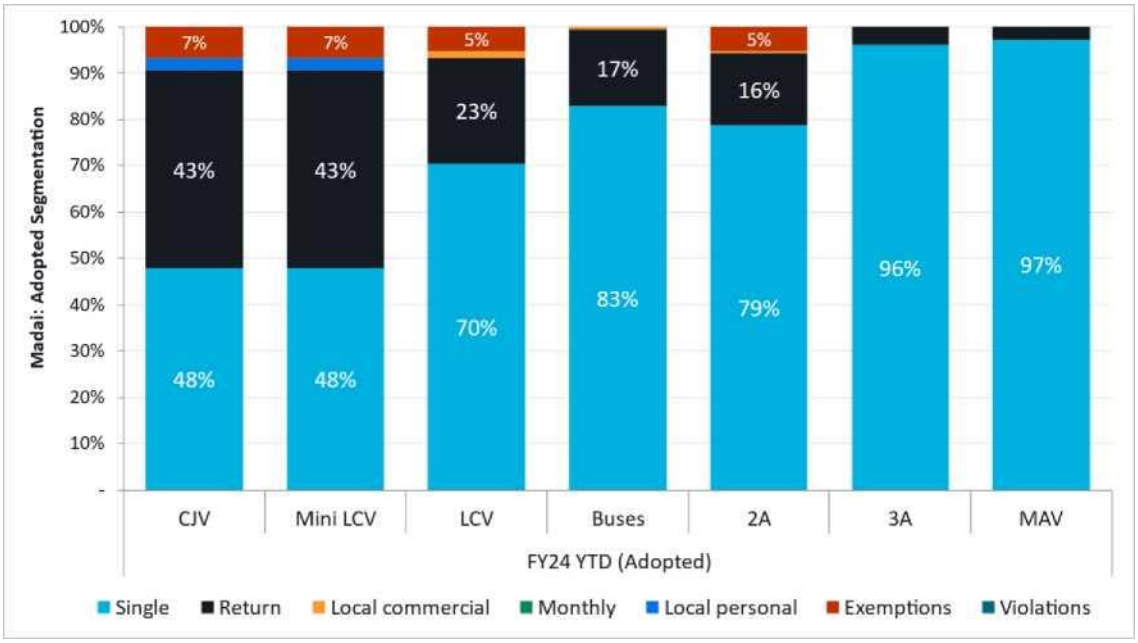
However, as the above-mentioned segmentation doesn't correctly reflect the share of non-toll paying traffic, i.e., violations and exemptions. The same has been assessed based on the difference between TMS and TVC dataset in the final adopted segmentation.

Adopted Toll segmentation (%) for Khawasa - FY24YTD



Source: Steer analysis

Adopted Toll segmentation (%) for Madai- FY24YTD



Source: Steer analysis

For Madai, Schedule V reported cash transactions at monthly were already provided for overlapping period from Nov'21 onwards. Additionally, for exemptions the difference between TVC and ETC+ Cash dataset is added (as a % of ETC traffic) in the final adopted segmentation as non-paying traffic. In data availability, same proportion of cash traffic is assumed on Khawasa as well considering their similar profile and travel pattern.

Traffic forecast

The increase of traffic on any existing road alignment depends on how fast the background travel demand (background growth) will grow; and on how successfully the project road is in attracting that traffic (traffic capture). Background travel demand is driven by the prevalent socio-economic conditions in the region, which include:

- Changes in factors such as population, employment, and income distribution
- Economic growth (GSDP, and GDP).
- Growth of local industries near the Asset.

The model uses India GDP and GSDP of Madhya Pradesh & Maharashtra as the two macroeconomic inputs which operate as growth drivers on our base year forecasts.

The network developments near the Asset's alignment which Steer believes would affect traffic on the Asset during the concession period are DME & SCE put together and 2 lane improvement of NH547+ Nagpur Ring Road.

Steer has developed traffic and revenue forecasts for the Asset by taking into consideration all inputs discussed above - base year estimates, macro-economic assumptions, growth drivers, elasticities, and forecast ticket segmentation. The table below provides the final (background plus impacts) traffic growth on the Asset.

Final (background plus impacts) AADT forecast - LK - Khawasa

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
CJV	2,962	3,172	3,407	4,394	5,859	7,632	9,712
Mini LCV	285	292	301	333	374	417	459
LCV	372	382	386	404	454	506	558
Bus	251	256	262	282	308	334	360
2A	1,633	1,714	1,781	1,965	2,454	3,026	3,670
3A	1,275	1,315	1,340	1,361	1,566	1,787	2,017
MAV	2,433	2,584	2,724	3,225	4,252	5,518	7,013
OSV	2	2	2	3	4	5	7
AADT	**9,213**	**9,718**	**10,203**	**11,968**	**15,272**	**19,225**	**23,796**
PCU	**24,241**	**25,530**	**26,705**	**30,687**	**39,053**	**49,105**	**60,738**

Final (background plus impacts) AADT CAGR (%) - LK - Khawasa

Vehicle Type	FY: FY: 24-25	FY25-FY26	FY26-FY30	FY30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
CJV	7.1%	7.4%	6.6%	5.9%	5.4%	4.9%	5.8%
Mini LCV	2.6%	2.8%	2.6%	2.4%	2.2%	2.0%	2.3%
LCV	2.6%	1.0%	1.2%	2.4%	2.2%	2.0%	1.9%
Bus	2.0%	2.1%	1.9%	1.8%	1.6%	1.5%	1.7%
2A	5.0%	3.9%	2.5%	4.5%	4.3%	3.9%	3.9%
3A	3.1%	1.9%	0.4%	2.8%	2.7%	2.5%	2.2%
MAV	6.2%	5.4%	4.3%	5.7%	5.3%	4.9%	5.2%
OSV	6.2%	6.6%	6.1%	5.7%	5.3%	4.9%	5.6%
AADT	**5.5%**	**5.0%**	**4.1%**	**5.0%**	**4.7%**	**4.4%**	**4.6%**
PCU's	**5.3%**	**4.6%**	**3.5%**	**4.9%**	**4.7%**	**4.3%**	**4.5%**

Source: Steer analysis

Final (background plus impacts) AADT forecast - LK - Madai

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
CJV	2,672	2,862	3,074	3,965	5,287	6,886	8,763
Mini LCV	741	760	782	866	973	1,084	1,195
LCV	434	445	446	457	514	572	631
Bus	264	269	274	296	324	351	378
2A	1,820	1,910	1,962	2,094	2,616	3,225	3,911
3A	1,337	1,379	1,398	1,399	1,610	1,837	2,074
MAV	2,588	2,749	2,890	3,396	4,477	5,810	7,385
OSV	3	3	3	4	5	6	8
AADT	**9,858**	**10,377**	**10,830**	**12,477**	**15,805**	**19,772**	**24,344**
PCU	**25,984**	**27,344**	**28,449**	**32,186**	**40,848**	**51,242**	**63,259**

Final (background plus impacts) AADT CAGR (%) - LK – Madai

Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FY30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
CJV	7.1%	7.4%	6.6%	5.9%	5.4%	4.9%	5.8%
Mini LCV	2.6%	2.8%	2.6%	2.4%	2.2%	2.0%	2.3%
LCV	2.6%	0.3%	0.6%	2.4%	2.2%	2.0%	1.8%
Bus	2.0%	2.1%	1.9%	1.8%	1.6%	1.5%	1.7%
2A	5.0%	2.7%	1.6%	4.5%	4.3%	3.9%	3.7%
3A	3.1%	1.4%	0.0%	2.8%	2.7%	2.5%	2.1%
MAV	6.2%	5.1%	4.1%	5.7%	5.3%	4.9%	5.1%
OSV	6.2%	6.6%	6.1%	5.7%	5.3%	4.9%	5.6%
AADT	**5.3%**	**4.4%**	**3.6%**	**4.8%**	**4.6%**	**4.2%**	**4.4%**
PCU's	**5.2%**	**4.0%**	**3.1%**	**4.9%**	**4.6%**	**4.3%**	**4.3%**

Source: Steer analysis

Tollable Length and Toll Rates

In terms of tollable length, Khawasa currently (FY24) comprises 72.305 km whereas at Madai the tolling length is 74.086 km. In India, toll rates are as per notification by the Ministry of Road Transport and Highways in the National Gazette. The present toll rates are determined with reference to the published base toll rates and are adjusted annually at the beginning of each fiscal year equal to 40% of the movement in the wholesale price index in December of the preceding year plus a fixed 3%.

According to the NHAI's toll notification for FY24, i.e., April 1, 2023, onwards, the toll rates at the toll plazas for Asset are as follows:

Single toll rates on the Asset (INR), applicable for FY24

Type of Vehicle	Khawasa	Madai
CJV	105	105
LCV	165	170
Bus/Truck	350	360
3A	380	390
MAV/ HCM/EME	550	560
OSV	670	685

Source: NHAI Revision of User fee Rate w.e.f 01.04.2023

12. Orai – Barah Project ("Asset 14")

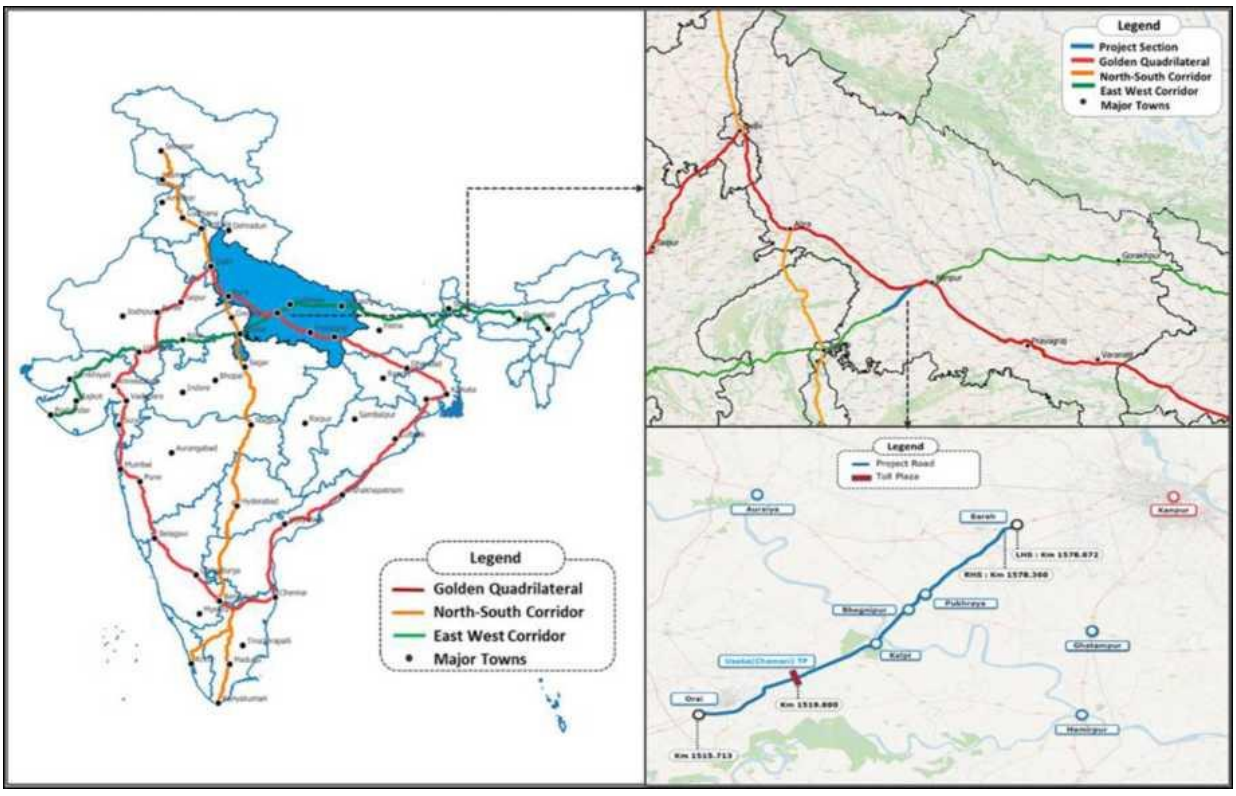
Project Overview

The project highway, NH-27, is a crucial part of the East-West corridor, as envisioned in the National Highway Development Program (Phase-II). This project spans approximately 3,530 km, starting from Porbandar in Gujarat and ending in Silchar, Assam, passing through Rajasthan, Madhya Pradesh, Uttar Pradesh, Bihar, and West Bengal. The highway connects several prominent tourist and industrial cities, such as Porbandar (a port city), Rajkot, Palanpur, Udaipur, Chittorgarh, Jhansi, Kanpur, Lucknow, Muzaffarpur, Purnea, Siliguri, and Jalpaiguri etc.

The project road section Orai-Barah, with approximate length of 62.8 km, starts near Orai in Jalaun district and ends near Barah in Kanpur Dehat district. The project road has one operational toll plaza (Usaka TP) near Chamari.

Figure below shows the context and alignment of project road with major places along the highway.

Orai-Barah Section and Location of Toll Plaza



Project Road Characteristics and Profile of Influencing Districts

The project road serves as a major route for east-west long-distance traffic between the Lucknow/Gorakhpur/eastern region and Palanpur/Rajkot/western region, while also catering to short-distance traffic between Orai/Jhansi and Kanpur/Lucknow/Unnao areas. The project road section is located in the districts of Jalaun and Kanpur Dehat.

The economy of Jalaun district broadly relies on agriculture with wheat, pea, lentil, gram, different types of pulses, mango, mushrooms and other crops being major agricultural products. Despite being moderately industrialized, the district has a few industries of handloom, dairy, and agro food processing. Pea has been listed under the ODOP Programme by MOFPI, while handmade paper art has been listed by GoUP under its ODOP Programme.

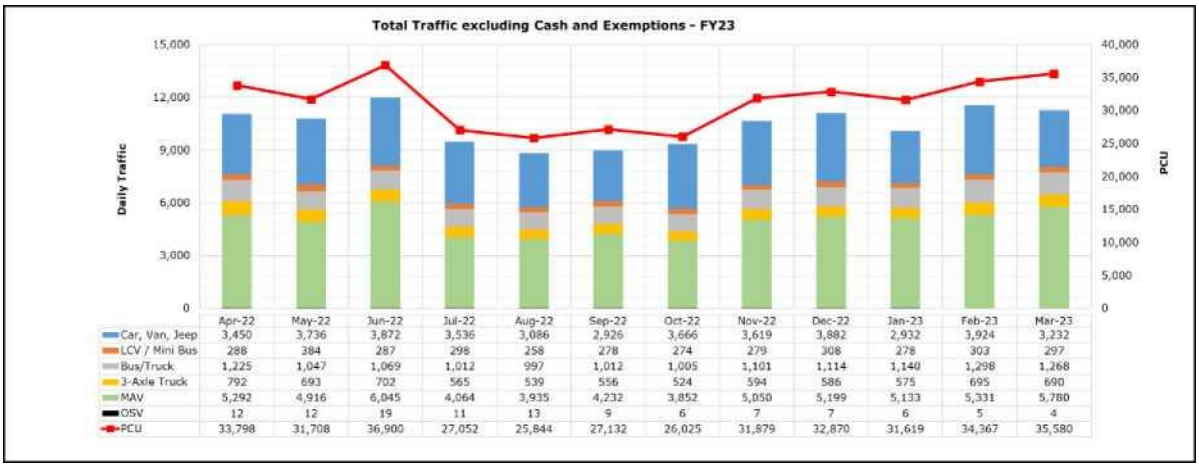
Kanpur Dehat district is located in the central plain zone, with fertile agricultural hinterland being its advantage. The staple agricultural produce includes wheat, paddy, rice, pulses, sugarcane, oil seeds, maize, and potato. Fisheries and animal husbandry also contribute to its economy. The district is moderately industrialized, with leather, iron, food grains, yarn, wood, cloth, and fertilizer being some of the important commodities exported. Milk products have been listed under the ODOP Programme by MOFPI, while aluminium utensils have been listed by GoUP under its ODOP Programme.

Annual Average Daily Traffic (AADT)

Estimation of FY23 AADT

The month-on-month mode wise ETC data (excluding cash and exemptions) for the period April 2022 to March 2023 for the toll plaza is presented below.

Month on Month Traffic Data for Usaka TP - FY23



	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23
Car, Van, Jeep	3,450	3,736	3,872	3,536	3,086	2,926	3,666	3,619	3,882	2,932	3,924	3,232
LCV / Mini Bus	288	384	287	298	258	278	274	279	308	278	303	297
Bus/Truck	1,225	1,047	1,069	1,012	997	1,012	1,005	1,101	1,114	1,140	1,298	1,268
3-Axle Truck	792	693	702	565	539	556	524	594	586	575	695	690
MAV	5,292	4,916	6,045	4,064	3,935	4,232	3,852	5,050	5,199	5,133	5,331	5,780
OSV	12	12	19	11	13	9	6	7	7	6	5	4
PCU	33,798	31,708	36,900	27,052	25,844	27,132	26,025	31,879	32,870	31,619	34,367	35,580

The AADT for FY23 has been derived using ETC data for the period of 12 months from the complete financial year data series of FY23 viz., April 2022 to March 2023. The daily cash and exemption data was available from the traffic count summary report of M/s PATH Ltd for the period of April 2022-December 2022. The FY23 AADT has been derived by adding these exemption and cash traffic to the estimated FY23 ETC AADT. The steps of derivation of FY23 AADT are presented below:

Estimation of FY23 AADT

Sr. No.	Particulars	Car/Jeep/Van	LCV	2 Axle	3 Axle	MAV	OSV	PCU
Daily Total Traffic without Cash and Exemptions								
A = April 2022-March 2023 Monthly Traffic/365	Total Traffic without Cash and exemption	3,485	294	1,106	625	4,896	9	31,192
Daily Cash and Exemptions from the Traffic Count Summary Report of PATH								
B	Daily Cash (Apr-Dec 2022 Avg)	72	4	2	1	1	0	-
C	Daily Exemptions (Apr-Dec 2022 Avg)	430	7	5	2	4	0	-
D = A+B+C	**Total Traffic with Cash and Exemption - AADT FY23**	3,987	304	1,112	628	4,901	9	31,760

Estimation of FY24 AADT

The month-on-month mode wise ETC data (excluding cash and exemptions) for the period April 2023 to November 2023 for the toll plaza is presented below:

Month on Month Traffic Data for Usaka TP - FY24

	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23
Car, Van, Jeep	3,111	3,843	3,663	2,983	2,944	2,926	3,189	3,908
LCV / Mini Bus	293	312	317	290	278	286	314	301
Bus/Truck	1,201	1,171	1,154	1,066	1,114	1,104	1,150	1,186
3-Axle Truck	686	640	611	565	567	582	596	543
MAV	5,762	5,408	5,355	4,274	3,954	4,578	4,640	3,915
OSV	5	5	5	4	4	3	4	5
PCU	35,162	34,102	33,553	27,559	26,211	29,027	29,795	27,185

The ETC data has been made available for the period of 9 months from April 2023 to November 2023. Based on the analysis of the traffic, FY24 AADT for cars and LCVs have been estimated by applying 8-12 months factor on April-November 2023 average ETC traffic. For other modes of 2A/3A and MAV, it is found appropriate that the base traffic from Aug to November is utilised for estimating the AADT for FY24 as these months present the actual trend of traffic after opening of Bundelkhand Eway. In view of this, 412 months factor has been applied on August-November 2023 average traffic of these modes. The correction factors were derived from average ETC traffic for FY23 of the adjacent toll plazas of Ait, Semri and project road TP of Usaka.

The steps of derivation of FY24 AADT are presented below:

Estimation of FY24 AADT

Sr. No.	Particulars	Car/Jeep/Van	LCV	2 Axle	3 Axle	MAV	OSV	PCU
Daily Total Traffic without Cash and Exemptions								
A. April-Nov 2023 Average	Total Traffic without Cash and exemption	3,823	309					
B. Aug-Nov 2023 Average				1,145	575	4,276	4	
C. 8-12 months (April-Nov)	SCF	1.02	1.01					
D. 4-12 months (Aug-Nov)				1.05	1.09	1.10	1.09	
E. ETC AADT		3,888	312	1,205	625	4,702	4	31,021
Daily Cash and Exemptions from the Traffic Count Summary Report of PATH								
F	Daily Cash (Apr-Dec 2022 Avg)	72	4	2	1	1	0	
G	Daily Exemptions (Apr-Dec 2022 Avg)	430	7	5	2	4	0	
AADT FY24 Including cash and Exemptions								
I = E+F+G	**AADT**	4,389	322	1,211	628	4,706	4	31,589

Travel Pattern as per November 2022 OD Survey

- Provides direct connectivity to Kanpur/Lucknow & beyond in the east and Jhansi/Gwalior/Indore & beyond in the west.
- Project road is majorly influenced by the stone mining units located near Jhansi. About 50 percent of freight and around 90 percent of passenger traffic on the project road has interactions between Jhansi/Orai and Kanpur/Lucknow. About 15 percent of freight traffic is to/from Indore/Bhopal from/to Kanpur/Lucknow.

- The majority of car traffic (around 37.9 percent) has trip lead between 100 to 200 km at toll plaza location. These trips are observed mainly from/to Orai/Jhansi to/from Kanpur/Unnao/Lucknow/Kalpi/Daulatpur. In addition, short distance trips (>25 & < = 50 km) of about 15.8 percent are found to be between Orai to Kalpi/ Daulatpur/Bhognipur/Pukhrayan.

Network Impacts

In context of the project road, two road network developments which may impact the traffic on the project road are:

- Improvement of Sagar-Kanpur-Lucknow corridor under Bharatmala Pariyojana - applicable traffic stream is from/to Indore/Bhopal & surroundings to/from Kanpur & beyond.
- Completion of Chambal Expressway (CE) and Delhi-Mumbai Expressway (DME) - Analysis done for two traffic streams:
- Ahmedabad & surroundings - Kanpur & beyond
- Mumbai & surroundings - Kanpur & beyond

The potential traffic and diverted traffic related to these two developments are presented below:

Diversion Analysis for Indore-Kanpur via Sagar Route

Modes	2A	3A	MAV
Potential Traffic as % of AADT			
Indore-Kanpur via Sagar Route			
Indore-Kanpur via Sagar traffic as % of AADT	4.6	5.8	8.1
Ahmedabad/Mumbai via DME & CE Route			
Ahmedabad-Kanpur Traffic via DME & CE	6.7	7.7	7.5
Mumbai-Kanpur Traffic via DME & CE	5.7	8.1	9.9
Loss as % of AADT			
Indore-Kanpur via Sagar Route	-0.9	-1.1	-1.7
Ahmedabad/Mumbai via DME & CE Route (A)	-8.7	-11.5	-11.6
Adopted Loss as % of AADT			
Indore-Kanpur via Sagar Route	-0.9	-1.1	-1.7
Ahmedabad/Mumbai via DME & CE Route			
B. Captive Traffic for PR (%)	33.3	33.3	33.3
C. Diverted to Expressway (%) = A*(1-B)	-5.8	-7.7	-7.7

The Kandla - Lucknow economic corridor is expected to be completed in FY28. Therefore, the impact of Indore - Kanpur via Sagar diversion has been considered under the base case from FY28 onwards and phased over three years with 50% diversion in FY28, 75 percent in FY29 and 100% in FY30 onwards.

Similarly, the impact of Ahmedabad/ Mumbai via DME & CE route has been considered under the base case from FY29 onwards and phased over three years with 50 percent diversion in FY29, 75 percent in FY30 and 100 percent in FY31 onwards.

Traffic Growth rates

The estimated traffic growth rates for the project road based on the elasticity approach along with the implied growth rates after considering the impact of diversions have been presented below:

Projected Traffic Growth Rates for Project Road (%)

Cars FY/Modes	LCV	Bus/ 2A Truck	3A	MAV	Cars	LCV	Bus/ 2A Truck	3A	MAV
	Normal Growth Rates				**Implied Growth Rates**				
2025	8.1	3.1	3.1	3.8	6.2	8.1	3.1	3.1	3.8	6.2
2026	8.6	3.3	3.3	4.0	6.7	8.6	3.3	3.3	4.0	6.7
2027	8.3	3.2	3.2	3.9	6.4	8.3	3.2	3.2	3.9	6.4
2028	8.2	3.2	3.2	3.8	6.3	8.2	3.2	2.9	3.2	5.4
2029	7.8	3.0	3.0	3.6	6.0	7.8	3.0	1.2	-0.7	1.5
2030	7.4	2.9	2.9	3.5	5.7	7.4	2.9	1.9	1.1	3.1
2031	6.8	2.9	2.9	3.5	5.2	6.8	2.9	2.0	1.3	3.0

Cars FY/Modes		LCV	Bus/ 2A Truck	3A	MAV	Cars	LCV	Bus/ 2A Truck	3A	MAV
2032	6.8	2.9	2.9	3.5	5.2	6.8	2.9	2.9	3.5	5.2
2033	6.8	2.9	2.9	3.5	5.2	6.8	2.9	2.9	3.5	5.2
2034	6.7	2.8	2.8	3.4	5.1	6.7	2.8	2.8	3.4	5.1
2035	6.6	2.8	2.8	3.3	5.0	6.6	2.8	2.8	3.3	5.0
2036	6.5	2.7	2.7	3.3	4.9	6.5	2.7	2.7	3.3	4.9
2037	6.4	2.7	2.7	3.2	4.9	6.4	2.7	2.7	3.2	4.9
2038	6.3	2.7	2.7	3.2	4.8	6.3	2.7	2.7	3.2	4.8
2039	6.2	2.6	2.6	3.1	4.7	6.2	2.6	2.6	3.1	4.7
2040	6.1	2.6	2.6	3.1	4.6	6.1	2.6	2.6	3.1	4.6
2041	5.5	2.0	2.0	2.5	4.1	5.5	2.0	2.0	2.5	4.1
2042	5.4	2.0	2.0	2.5	4.0	5.4	2.0	2.0	2.5	4.0
2043	5.4	2.0	2.0	2.5	3.9	5.4	2.0	2.0	2.5	3.9
2044	5.3	1.9	1.9	2.4	3.9	5.3	1.9	1.9	2.4	3.9

Mode-wise Traffic Projections

Mode-wise traffic at the project road under the base case scenario after considering diversion impacts is presented below:

Projected Traffic Mode-Wise for Project Road (After Diversion)

FY End	CJV	LCV	Bus/2A	3A	MAV	OSV	Total PCU
2024	4,389	322	1,211	628	4,706	4	31,584
2025	4,743	332	1,249	652	5,000	4	33,461
2026	5,150	343	1,290	678	5,332	5	35,585
2027	5,578	354	1,332	704	5,676	5	37,782
2028	6,035	366	1,370	727	5,985	5	39,832
2029	6,506	377	1,387	722	6,074	5	40,752
2030	6,988	387	1,412	730	6,263	6	42,206
2031	7,466	399	1,441	739	6,450	6	43,656
2032	7,976	410	1,482	765	6,783	6	45,886
2033	8,522	422	1,524	791	7,134	7	48,235
2034	9,095	434	1,567	818	7,496	7	50,667
2035	9,697	446	1,611	846	7,872	7	53,190
2036	10,330	458	1,655	873	8,260	8	55,806
2037	10,995	471	1,699	902	8,661	8	58,517
2038	11,691	483	1,744	931	9,076	9	61,322
2039	12,419	496	1,790	960	9,503	9	64,217
2040	13,181	509	1,836	990	9,944	9	67,209
2041	13,910	519	1,873	1,015	10,347	10	69,956
2042	14,668	529	1,910	1,040	10,760	10	72,777
2043	15,453	540	1,948	1,066	11,182	10	75,670
2044	16,268	550	1,985	1,092	11,614	11	78,634
CAGR (%) (FY24 to FY44)	6.8	2.7	2.5	2.8	4.6	5.1	4.7

Tolling Segmentation

The tolling stream distribution has been estimated from the ETC data of FY24 (August 2023 to November 2023) to which annualised Cash & Exemptions data available from April 2022 to December 2022 has been added. The resultant ticket distribution is presented below:

Tolling Distribution

Type	Car	LCV	Bus/ 2A Trucks	3A Trucks	MAV	OSV
Single	36.4	72.9	62.3	83.7	47.0	100.0
Return	44.5	24.9	36.5	15.0	51.9	
Monthly						
Local personal	2.7					
Local commercial	0.4	0.0	0.7	0.9	1.0	
Exemptions and Violations	16.0	2.3	0.4	0.4	0.1	

Type	Car	LCV	Bus/ 2A Trucks	3A Trucks	MAV	OSV
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Objective and Scope of Services

The scope of the study includes the following:

- Undertake Traffic Survey on the highway section as per the following:
    a. Seven days 24 hours Videography Traffic Counts at the existing toll plaza location on the project road to derive the Average Daily Traffic (ADT)
    b. One day Origin-Destination survey at the existing toll plaza location to assess the existing travel pattern of vehicles plying on the project road - origin and destination
- Establish seasonality factors using available past traffic data and/or from using fuel sales data or any relevant data
- Estimation of the base year AADT using seasonality factors for conversion of ADT to AADT
- Analysis of OD data to cover:
    a. Regional distribution of traffic and influence factors for different zones contributing traffic on the corridor
    b. Identification of Project Influence Area from analysis of travel pattern - regional distribution of traffic,
    c. Main traffic generators (industrial areas, towns, ports etc.)
    d. Commodity composition- Goods type distribution
    e. Top OD pairs by vehicle types
- Review of past traffic studies, traffic/toll data and other relevant reports as may be available to determine category wise volume of traffic for past years as well as for current year
- To identify competing route and analyse the network conditions, traffic characteristics & level of toll charged and the advantage/ disadvantage of the competing road and their impact on the project traffic
- Carry out a study of past economic performance of influence area
- Diversion analysis, wherever needed - cost ratio-based diversion analysis using spreadsheets to be carried out for respective potential OD pairs.
- Preparation of traffic projections till year FY53 (maximum extendable concession period) in three scenarios - low, most likely and high
- Capacity analysis of the road or any other requirements for potential capacity augmentation
- Estimation of tollable traffic streams by toll category and estimation of toll revenue as per categories of traffic streams stipulated in the tolling schedule for the study period
- Review future road and transportation network developments in the area of influence of the project and identify those schemes that may impact positively or negatively traffic on the toll road
- Identify factors which may have a positive and / or negative impact on the traffic - all major developments like DFC, industrial corridors, economic corridors, ports, Bharatmala, Sagarmala
- Scenario Analysis of toll revenue - Critical parameters of diversion (if applicable) and three scenarios of traffic growth (most likely, low and high).

Tollable Length and Toll Rates

The details of normal tolling lengths, bypass length (at 1.5 times) and equivalent structure lengths being charged at toll plaza as per the information in Schedule M for the project road are presented below:

Tolling Length (in km) for the Project Road

Usaka (TP01) at km 1519.880	FY24 onwards
A. Normal	61.729
B. Bypass	0.000
C. Eq. structure	11.74
Total Road Length	62.903
Tolling Length = A+(B*1.5) + (C*10)	73.469

The stream of toll rates to be charged at the toll plaza of the project road in cardinal years till FY44 is presented below:

Table 8: Toll Rates at Toll Plaza (in Rs)

FY	Car	LCV	Bus/ 2- axle Truck	3-axle Truck	MAV	O/size/ HME	Car Local
2024	105	170	355	390	560	680	330
2025	110	175	365	400	570	695	340
2030	135	215	455	495	710	865	420
2035	165	265	555	605	870	1,060	515
2040	200	325	675	740	1,060	1,290	630
2044	235	380	795	865	1,245	1,515	735

Note: The toll fee has been rounded to nearest 5 Rupees as per toll fee rules.

Project Road Revenue

The travel pattern and commodity distribution with prominence of building materials (Muram and Gitti) at Usaka toll plaza is similar to that of Ait and Semri toll plazas.

As observed from the seven-day axle load analysis, around 35 percent of the MAVs and 2 percent of 3A trucks are above 20 percent overloading limit at Usaka TP whereas 3 percent of 3A trucks and 8 percent of MAVs are in the 10 percent to 20 percent overloaded category.

Continuing with the practice of two times toll, since MAVs are heavily overloaded, with WIM in place at Usaka, the practice of charging them for one-time extra payment can be put in place.

13. Chitradurga Bypass – Hubli Project/ Karnataka Project ("Asset 15")

Project Overview

The project highway, NH-48 (Old NH-4), is part of the Golden Quadrilateral connecting many of the major industrial, agricultural and cultural centres of India. The total length of NH-48 (Old NH-4) is roughly 1,235 km starting from Chennai in the state of Tamil Nadu and ending at Mumbai in the state of Maharashtra. The highway acts as a primary conduit for transportation of freight as well as passenger traffic in these states as well as various other important states in India. NH-48 (Old NH-4) connects important cities and towns like Pune, Satara, Karad, Sangli, Kolhapur, Belgaum, Dharwad, Hubli, Bangalore etc.

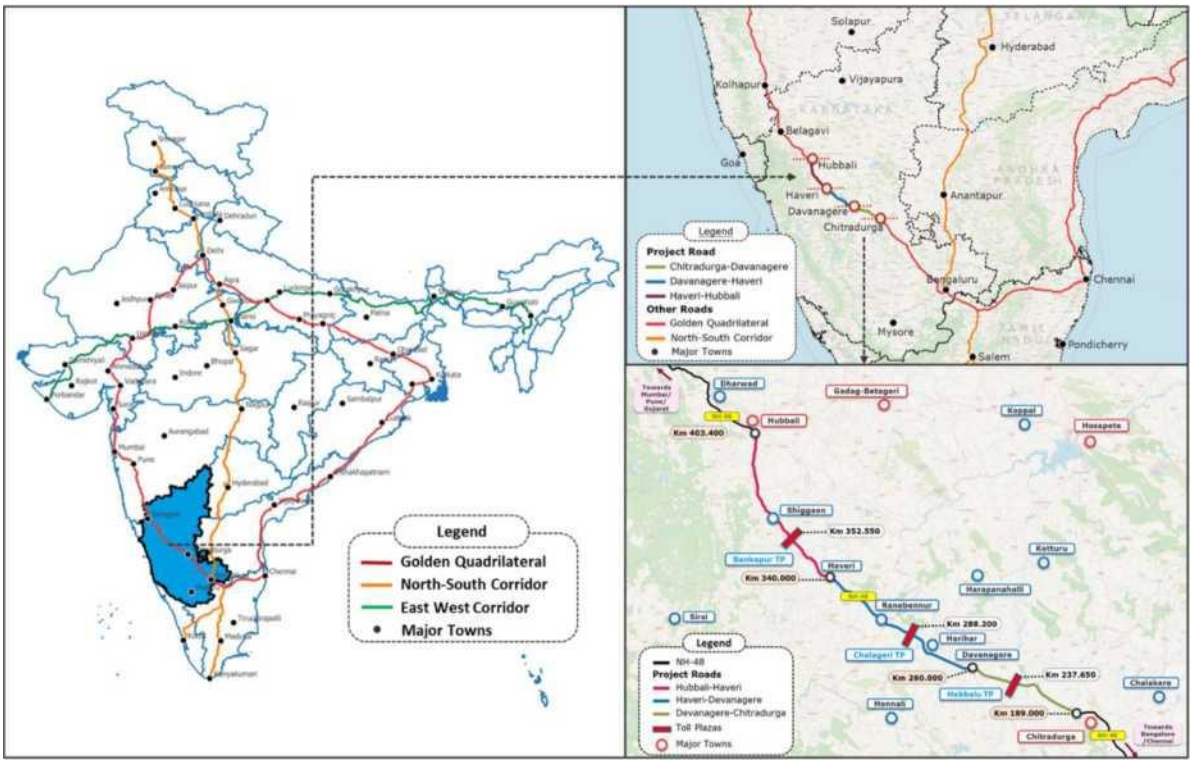
The project road section consists of three continuous toll roads and the details of the three project road sections, lengths, chainage, toll plazas and tolling lanes at the toll plaza locations are presented in the table below:

Details of Project Section

S No.	Project Section	Length (km)	Start km	End km	Toll Plaza	Tolling Lanes
1	Hubli-Haveri	71.0	Km 340.00	Km 403.40	Bankapur (km 352.550)	7+7
2	Haveri-Davangere	72.0	Km 260.00	Km 340.00	Chalageri (km 288.200)	7+7
3	Davanagere-Chitradurga	62.0	Km 189.00	Km 260.00	Hebbalu (km 237.650)	7+7

Figure 1 shows the context and alignment of project road with major places along the highway.

Figure 1: Alignment of Project Road and Location of Toll Plazas



Project Road Characteristics and Profile of Influencing Districts

The project road, in wider context, serves the long-distance traffic for the freight vehicles, which is majorly plying between Mumbai/ Pune/ Delhi Chitradurga/Bangalore/ Chennai/ Vellore. Apart from long distance traffic, it also serves the short distance traffic for both passenger and freight which is mainly generated between Hubli/Dharwad/Haveri/Davanagere/Ranebennur/Chitradurga and nearby places.

The project road falls under the jurisdiction of four districts in the state of Karnataka.

Dharwad is one of the emerging districts in North Karnataka region and its economy relies broadly on agriculture with jowar, wheat, Bengal gram, tur dal, ground nut, onion, maize, sunflower and cotton as the major produce. Dharwad district is fast developing as the commercial and industrial hub in the state. These industrial areas have several small, medium and scale industries present some of which include agro equipment and agro food processing industries, polymers, engineering works, steel and wire works, engineering and automobiles manufacturing, chemical and fertilizers industries, textiles, paper products, printing, and other consumer products-based industries.

Haveri district is majorly dependent on agriculture for its economy with major produce being maize, paddy, jowar, hybrid cotton, groundnut, chilly, pulses etc. It is rich in spice cultivation and the major spice industry in the district has chilly powder mills and processing facilities. The district also has an industrial base having several large and medium industries having Agriculture and allied industries, sericulture, animal husbandry, textile and handloom industries as potential industrial sectors in the district.

Davanagere district economically is dependent on agriculture primarily with major agricultural crops including paddy, maize, red gram, green gram, black gram, groundnut, sunflower, sugarcane, cotton etc. Davanagere is known as the Manchester of Karnataka and has a dominant textile sector that is set to grow along with the food processing sector which provides the highest employment in the district. The district has large industrial units, small and medium scale industries. Other notable sectors include agro and allied activities, wood and wood-based furniture manufacturing industries, horticulture units of marigold dye processing and arecanut processing.

Chitradurga district has agriculture as the backbone of the district economy having major agricultural produce of paddy, ragi, jowar, maize, red gram, horse gram, green gram, black gram, bengal gram, tur, groundnut, sunflower, cotton, tobacco and betul nut. The district also has several small-scale industrial units in the district are engaged in agro and food processing activities and textile constitutes second highest number of large & medium scale industries in the district. The district is rich in mineral reserves of iron ore, manganese, limestone, dolomite, gray granite and building stone. Chitradurga is the 4th largest producer of wind energy in the country.

Annual Average Daily Traffic (AADT)

The AADT for FY24 has been derived from the average of ETC toll data of FY24 from April 2023 to November 2023. The cash (April - November 2023) and exemption traffic (average of October and November 2023) has been added to the ETC traffic. This 8month traffic has been annualised by applying an 8-12 month factor from IHMCL for cars and for rest of the

modes, factor has been adopted from the adjacent section of Belgaum Dharwad. The AADT for FY24 derived for all three toll plazas with 8 months to yearly factors is presented in the table below:

AADT for FY24

Mode	Car	LCV	Bus/Truck	3A	MAV	OSV	PCUs
Bankapur(TP01)							
A. Apr 23 - Nov 23 (ETC Traffic +Cash)	6,472	1,430	2,710	940	1,619	6	26,879
B. Oct 23 - Nov 23 Average Exempt	639	11	8	1	0	0	
C. ADT (A+B)	7,111	1,441	2,718	940	1,620	6	27,563
D. SCF (8-12-month factor)	1.03	1.05	1.06	1.03	1.03	1.03	
E. AADT FY24 (C*D)	**7,304**	**1,509**	**2,873**	**966**	**1,663**	**6**	**28,596**
Chalageri (TP02)							
A. Apr 23 - Nov 23 (ETC Traffic +Cash)	6,387	1,379	2,586	910	1,605	5	26,188
B. Oct 23 - Nov 23 Average Exempt	357	3	2	1	1	0	
C. ADT (A+B)	6,744	1,382	2,587	911	1,605	5	26,559
D. SCF (8-12-month factor)	1.02	1.05	1.06	1.03	1.03	1.03	
E. AADT FY24 (C*D)	**6,898**	**1,447**	**27,35**	**935**	**1,649**	**5**	**27,522**
Hebbalu (TP03)							
A. Apr 23 - Nov 23 (ETC Traffic +Cash)	7,432	1,435	2,491	922	1,594	6	27,025
B. Oct 23 - Nov 23 Average Exempt	360	8	1	1	1	0	
C. ADT (A+B)	7,792	1,444	2,492	924	1,595	6	27,406
D. SCF (8-12-month factor)	1.01	1.05	1.06	1.03	1.03	1.03	
E. AADT FY24 (C*D)	**7,900**	**1,512**	**2,634**	**948**	**1,638**	**6**	**28,311**

Travel Pattern

- Serves the long-distance traffic majorly plying between Mumbai/ Pune/ Delhi Chitradurga/Bangalore/ Chennai/ Vellore.
- The project road also serves the short distance traffic for both passenger and freight which is mainly generated between Hubli/Dharwad/Haveri/Davanagere/Ranebennur/Chitradurga and nearby places.
- The passenger traffic on the road were found to be for the purpose of work and business at the toll plaza locations.
- The MAV traffic is observed to be having Bangalore-Mumbai as top OD pair at all three toll plazas.

Network Impacts

In context of the project road, two road network developments which may impact the traffic on the project road are:

Impact of Pune - Bangalore Expressway

The assessment for the route between Pune and Bangalore/Chennai has been done for the four traffic streams:

- Traffic plying between Mumbai/Pune/Nashik & surroundings and Bangalore & beyond
- Traffic from/to Mumbai/Pune/Nashik & surroundings to/from Chennai & beyond
- Traffic plying between Hubli and surroundings and Bangalore & beyond
- Traffic from/to Hubli and surroundings to/from Chennai & beyond

The total diverted traffic after the operation of Pune Bangalore Expressway at the three toll plazas is presented in the table below

Total Impact Due to Pune-Bangalore Expressway

Modes	Car	2A	3A	MAV
Bankapur(TP01)	5.4%	15.0%	34.2%	33.1%
Chalageri (TP02)	5.7%	15.7%	35.3%	33.4%
Hebbalu (TP03)	5.0%	16.3%	34.8%	33.6%

The proposed expressway will be a greenfield alignment and considering the usual timelines for a long greenfield expressway project, the diversion impact is considered from FY31 onwards under Base Case. Owing to the gradual shift of traffic away from the project road, the traffic impacts have been assumed to take place in phases with about 50 percent in FY31, 75 percent in FY32 and 100 percent from FY33 onwards.

Impact of completion of 6 laning construction activities on National Highway 48 (Old NH-4- Route via PR)

The potential and divertible traffic (gain) due to completion of 6 laning construction activities on National Highway 48 (Old NH-4) is presented in the table below:

Potential and Divertible Traffic Due To Completion Of 6 Laning Construction Activities On NH-48 (Route via PR)

Potential Traffic (Nagarhalla TP)	2A	3A	MAV	2A/3A/MAV	PCU
A. Earlier study of Solapur-Bijapur (July-22) - FY23	156	80	197	434	1,598
B. Traffic on Solapur-Bijapur -FY24 (5% growth on earlier study) - A*(1+5%)	164	84	207	456	1,678
C. AR potential at Nagarhalla TP (FY24)	284	124	539	947	3,650
D. SCF Jan	0.90	0.99	0.93	-	-
E. AADT (C*D)	257	123	504	883	3,406
F. Absolute Increase (E-B)	93	39	297	428	1,728
G. % Shift to PR	61.4%	61.9%	66.2%	-	-
H. Traffic Shift to PR (F*G)	57	24	196	277	1,126

NH-48 may have a gain of about 57 2A trucks, 24 3A trucks and 196 MAV trucks resulting in a total PCU gain of 1,126. As the 6 laning is expected to be completed in FY25, the impact has been considered in phases with 50 percent in FY26 and 100 percent in FY27.

Traffic Growth rates

The estimated traffic growth rates for the project road based on the elasticity approach applicable across all the three toll plazas have been presented in the table below:

Projected Traffic Growth Rates for Project Road (%)

FY/Modes	Car	LCV	Bus/2A	3A	MAV/OSV
Normal Growth Rates					
2025	7.3	2.7	3.5	2.0	6.6
2026	7.8	2.9	3.7	2.1	7.0
2027	7.5	2.8	3.6	2.0	6.8
2028	7.4	2.8	3.5	2.0	6.7
2029	7.1	2.6	3.4	1.9	6.4
2030	6.7	2.5	3.2	1.8	6.0
2031	6.7	2.5	3.2	1.8	5.4
2032	6.7	2.5	3.2	1.8	5.4
2033	6.7	2.5	3.2	1.8	5.4
2034	6.6	2.5	3.1	1.8	5.3
2035	6.5	2.4	3.1	1.8	5.3
2036	5.8	2.4	3.0	1.7	4.6
2037	5.7	2.4	3.0	1.7	4.5
2038	5.6	2.3	3.0	1.7	4.5
2039	5.5	2.3	2.9	1.7	4.4
2040	5.4	2.2	2.9	1.6	4.3
2041	5.3	2.2	2.8	1.6	4.3
2042	5.2	2.2	2.8	1.6	4.2
2043	5.2	2.1	2.7	1.6	4.1
2044	5.1	2.1	2.7	1.5	4.1

Implied Traffic Growth rates

The implied traffic growth rates for the project road after considering the impact of diversions at all the three toll plazas have been presented in the table below:

Implied Traffic Growth Rates for Project Road After Diversion (%)

FY/ Mode	TP01-Bankapur					TP02-Chalageri					TP03-Hebbalu				
	Car	LCV	Bus/ 2A	3A	MAV /OSV	Car	LCV	Bus/ 2A	3A	MAV/ OSV	Car	LCV	Bus/ 2A	3A	MAV/ OSV
2025	7.3	2.7	3.5	2.0	6.6	7.3	2.7	3.5	2.0	6.6	7.3	2.7	3.5	2.0	6.6
2026	7.8	2.9	4.7	3.4	13.3	7.8	2.9	4.8	3.4	13.4	7.8	2.9	4.8	3.4	13.4
2027	7.5	2.8	4.6	3.3	12.7	7.5	2.8	4.7	3.3	12.8	7.5	2.8	4.7	3.3	12.8
2028	7.4	2.8	3.5	2.0	6.7	7.4	2.8	3.5	2.0	6.7	7.4	2.8	3.5	2.0	6.7
2029	7.1	2.6	3.4	1.9	6.4	7.1	2.6	3.4	1.9	6.4	7.1	2.6	3.4	1.9	6.4
2030	6.7	2.5	3.2	1.8	6.0	6.7	2.5	3.2	1.8	6.0	6.7	2.5	3.2	1.8	6.0
2031	3.8	2.5	-4.5	-15.6	-12.0	3.7	2.5	-4.9	-16.1	-12.2	4.0	2.5	-5.2	-15.9	-12.3
2032	5.2	2.5	-1.0	-8.7	-5.0	5.1	2.5	-1.2	-9.1	-5.1	5.3	2.5	-1.4	-8.9	-5.2
2033	5.2	2.5	-1.2	-9.9	-6.2	5.1	2.5	-1.4	-10.4	-6.3	5.3	2.5	-1.6	-10.2	-6.4
2034	6.6	2.5	3.1	1.8	5.3	6.6	2.5	3.1	1.8	5.3	6.6	2.5	3.1	1.8	5.3
2035	6.5	2.4	3.1	1.8	5.3	6.5	2.4	3.1	1.8	5.3	6.5	2.4	3.1	1.8	5.3
2036	5.8	2.4	3.0	1.7	4.6	5.8	2.4	3.0	1.7	4.6	5.8	2.4	3.0	1.7	4.6
2037	5.7	2.4	3.0	1.7	4.5	5.7	2.4	3.0	1.7	4.5	5.7	2.4	3.0	1.7	4.5
2038	5.6	2.3	3.0	1.7	4.5	5.6	2.3	3.0	1.7	4.5	5.6	2.3	3.0	1.7	4.5
2039	5.5	2.3	2.9	1.7	4.4	5.5	2.3	2.9	1.7	4.4	5.5	2.3	2.9	1.7	4.4
2040	5.4	2.2	2.9	1.6	4.3	5.4	2.2	2.9	1.6	4.3	5.4	2.2	2.9	1.6	4.3
2041	5.3	2.2	2.8	1.6	4.3	5.3	2.2	2.8	1.6	4.3	5.3	2.2	2.8	1.6	4.3
2042	5.2	2.2	2.8	1.6	4.2	5.2	2.2	2.8	1.6	4.2	5.2	2.2	2.8	1.6	4.2
2043	5.2	2.1	2.7	1.6	4.1	5.2	2.1	2.7	1.6	4.1	5.2	2.1	2.7	1.6	4.1
2044	5.1	2.1	2.7	1.5	4.1	5.1	2.1	2.7	1.5	4.1	5.1	2.1	2.7	1.5	4.1

Traffic Projections

Mode-wise projected traffic for the three toll plazas of the project road under the base case after considering diversion impacts till FY44 is presented in the tables below:

Projected Mode-wise Traffic at TP01

FY/Modes	Car	LCV	Bus/2A	3A	MAV	OSV	PCU
2024	7,304	1,509	2,873	966	1,663	6	28,595
2025	7,837	1,550	2,973	985	1,772	6	30,040
2026	8,445	1,595	3,113	1,018	2,008	7	32,300
2027	9,081	1,640	3,257	1,052	2,264	7	34,686
2028	9,754	1,685	3,372	1,073	2,415	8	36,517
2029	10,442	1,730	3,485	1,094	2,568	8	38,368
2030	11,143	1,773	3,597	1,113	2,723	9	40,227
2031	11,569	1,817	3,434	940	2,396	9	38,239
2032	12,174	1,863	3,400	858	2,275	10	38,027
2033	12,808	1,909	3,361	774	2,135	10	37,728
2034	13,652	1,956	3,466	787	2,249	11	39,515
2035	14,539	2,004	3,573	801	2,367	11	41,372
2036	15,376	2,052	3,682	815	2,476	12	43,143

FY/Modes	Car	LCV	Bus/2A	3A	MAV	OSV	PCU
2037	16,248	2,100	3,793	829	2,589	12	44,971
2038	17,157	2,149	3,905	843	2,705	13	46,855
2039	18,100	2,198	4,019	857	2,824	14	48,792
2040	19,079	2,247	4,134	871	2,946	14	50,786
2041	20,095	2,297	4,250	885	3,072	15	52,836
2042	21,148	2,347	4,368	899	3,201	15	54,943
2043	22,238	2,397	4,488	913	3,333	16	57,106
2044	23,366	2,447	4,608	927	3,468	17	59,324

Projected Mode-wise Traffic at TP02

FY/Modes	Car	LCV	Bus/2A	3A	MAV	OSV	PCU
2024	6,898	1,447	2,735	935	1,649	5	27,522
2025	7,401	1,486	2,830	953	1,757	5	28,913
2026	7,976	1,529	2,965	986	1,992	6	31,114
2027	8,576	1,572	3,103	1,019	2,246	6	33,439
2028	9,212	1,616	3,213	1,039	2,396	6	35,206
2029	9,862	1,659	3,321	1,059	2,549	7	36,992
2030	10,523	1,700	3,427	1,079	2,703	7	38,787
2031	10,909	1,743	3,258	904	2,374	8	36,727
2032	11,469	1,786	3,219	822	2,252	8	36,442
2033	12,056	1,831	3,174	737	2,109	9	36,065
2034	12,850	1,876	3,273	750	2,222	9	37,774
2035	13,684	1,922	3,375	763	2,339	10	39,549
2036	14,472	1,967	3,478	777	2,447	10	41,242
2037	15,294	2,014	3,582	790	2,558	10	42,988
2038	16,149	2,060	3,688	803	2,673	11	44,789
2039	17,036	2,107	3,795	816	2,790	11	46,640
2040	17,958	2,155	3,904	830	2,911	12	48,545
2041	18,914	2,202	4,014	843	3,035	12	50,503
2042	19,905	2,250	4,126	856	3,163	13	52,516
2043	20,932	2,298	4,238	870	3,293	13	54,583
2044	21,993	2,347	4,352	883	3,427	14	56,702

Projected Mode-wise Traffic at TP03

FY/Modes	Car	LCV	Bus/2A	3A	MAV	OSV	PCU
2024	7,900	1,512	2,634	948	1,638	6	28,312
2025	8,476	1,553	2,726	967	1,746	6	29,767
2026	9,134	1,598	2,857	1,000	1,979	7	32,040
2027	9,822	1,643	2,991	1,033	2,233	7	34,440
2028	10,550	1,689	3,097	1,054	2,382	8	36,289
2029	11,295	1,733	3,201	1,074	2,534	8	38,157
2030	12,052	1,776	3,303	1,093	2,687	9	40,036
2031	12,540	1,821	3,130	919	2,356	9	38,065
2032	13,210	1,867	3,087	838	2,233	10	37,876
2033	13,913	1,913	3,037	753	2,090	10	37,602
2034	14,830	1,960	3,132	766	2,201	11	39,420
2035	15,792	2,008	3,229	779	2,317	11	41,310
2036	16,702	2,056	3,328	793	2,424	12	43,110
2037	17,650	2,104	3,428	807	2,534	12	44,970
2038	18,637	2,153	3,529	820	2,648	13	46,888
2039	19,661	2,202	3,632	834	2,764	14	48,861
2040	20,724	2,251	3,736	847	2,884	14	50,893
2041	21,828	2,301	3,841	861	3,007	15	52,985
2042	22,972	2,351	3,948	874	3,133	15	55,135
2043	24,156	2,402	4,056	888	3,263	16	57,344
2044	25,381	2,452	4,165	902	3,395	17	59,611

Projections of the total vehicles based on the most likely growth rates before and after considering diversion impacts is presented in the table below:

Projected Traffic (in PCUs)

FY	Total Traffic After Diversion			Total Traffic Before Diversion		
	TP01	TP02	TP03	TP01	TP02	TP03
2024	28,595	27,522	28,312	28,595	27,522	28,312

FY	Total Traffic After Diversion			Total Traffic Before Diversion		
	TP01	TP02	TP03	TP01	TP02	TP03
2025	30,040	28,913	29,767	30,040	28,913	29,767
2026	32,300	31,114	32,040	32,300	31,114	32,040
2027	34,686	33,439	34,440	34,686	33,439	34,440
2028	36,517	35,206	36,289	36,517	35,206	36,289
2029	38,368	36,992	38,157	38,368	36,992	38,157
2030	40,227	38,787	40,036	40,227	38,787	40,036
2031	38,239	36,727	38,065	42,115	40,606	41,946
2032	38,027	36,442	37,876	44,102	42,523	43,960
2033	37,728	36,065	37,602	46,196	44,541	46,082
2034	39,515	37,774	39,420	48,364	46,630	48,281
2035	41,372	39,549	41,310	50,613	48,798	50,564
2036	43,143	41,242	43,110	52,755	50,862	52,735
2037	44,971	42,988	44,970	54,963	52,990	54,976
2038	46,855	44,789	46,888	57,238	55,182	57,286
2039	48,792	46,640	48,861	59,576	57,434	59,660
2040	50,786	48,545	50,893	61,981	59,750	62,104
2041	52,836	50,503	52,985	64,452	62,131	64,618
2042	54,943	52,516	55,135	66,991	64,575	67,200
2043	57,106	54,583	57,344	69,595	67,084	69,851
2044	59,324	56,702	59,611	72,265	69,655	72,571
CAGR (FY24 to FY44)	3.7%	3.7%	3.8%	4.7%	4.8%	4.8%

Tolling Segmentation

The tolling stream distribution for the project road has been derived from the average of ETC toll data of FY24 from April 2023 to November 2023. The cash (April - November 2023) and exemption traffic (average of October and November 2023) has been added to the ETC traffic distribution and the resultant tolling segmentation is presented in the table below:

Tolling Distribution

Ticket Type/Modes	Car	LCV	Bus/ 2A Truck	3A Truck	MAV	OSV
TP01-Bankapur						
Single	51.9	80.7	58.9	85.8	93.5	100.0
Return	35.4	16.6	31.0	12.6	6.2	
Local personal	0.9					
Local commercial	2.7	2.0	9.8	1.6	0.3	
Exempt	9.0	0.8	0.3	0.1	0.0	
Total	100.0	100.0	100.0	100.0	100.0	100.0
TP02-Chalageri						
Single	58.4	81.8	60.6	87.4	93.2	100.0
Return	32.0	16.0	33.5	11.6	6.3	
Local personal	3.1					
Local commercial	1.2	2.0	5.9	0.9	0.4	
Exempt	5.3	0.2	0.1	0.1	0.0	
Total	100.0	100.0	100.0	100.0	100.0	100.0
TP03-Hebbalu						
Single	57.6	78.4	56.9	80.5	92.8	100.0
Return	34.9	17.5	34.9	10.3	6.6	
Local personal	2.3					
Local commercial	0.6	3.6	8.2	9.1	0.6	
Exempt	4.7	0.6	0.0	0.1	0.0	
Total	100.0	100.0	100.0	100.0	100.0	100.0

Tollable Length and Toll Rates

The details of normal tolling lengths, bypass length (at 1.5 times) and equivalent structure lengths being charged at Bankapur, Chalageri and Hebbalu are presented in the table below:

Existing Tolling Lengths at PR

	TP01 - Bankapur		TP02 - Chalageri		
Toll Plazas	**TP1 at 75%**	**TP1 at 100%**	**TP2 at Chalageri- 6 Lane**	**TP2 at Chalageri- 4 Lane**	**TP03- Hebbalu**
A. Normal length	62.339	62.339	42.799	4.943	44.714
B. Bypass length			28.227	2.242	27.698
C. Equivalent Structure length	5.380	5.38	7.120		2.680
D. Total tolling length=(A+1.5*B+C)	67.719	67.719	92.260	8.306	88.941

The Schedule M lengths have been considered from FY24 onwards for TP01 and TP03. However, for TP02, Schedule M lengths have been considered from January 2025 onwards. The details of tolling length as per Schedule M are presented in the table below:

Tolling Distribution from Toll Data for present study (in %)

Toll Plazas	**Schedule M**		
	TP01-Bankapur	**TP02-Chalageri**	**TP03-Hebbalu**
A. Normal length	62.339	47.732	44.714
B. Bypass length		30.469	27.698
C. Equivalent Structure length	5.38	7.12	2.68
D. Total tolling length=(A+1.5*B+C)	67.719	100.556	88.941

The stream of toll rates to be charged at the toll plaza of the project road in cardinal years till FY44 is presented in the table below:

Toll Rates at Toll Plaza (in Rs)

FY End	Car	LCV/ M Bus	Bus/2A Truck	3A	MAV	OSV	Car Local
TP01-Bankapur							
2024	95	155	330	360	515	625	330
2025	100	160	335	365	525	640	340
2030	125	200	420	455	655	795	420
2035	150	245	510	555	800	975	515
2040	185	300	625	680	980	1,190	630
2044	215	350	730	800	1,150	1,400	735
TP02-Chalageri							
2024	140	225	470	510	735	895	330
2025 Existing Length	140	230	480	525	755	915	340
2025 Schedule M Length	145	240	500	545	780	950	340
2030	185	295	620	675	975	1,185	420
2035	225	360	760	825	1,190	1,445	515
2040	275	440	925	1,010	1,455	1,770	630
2044	320	520	1,085	1,185	1,705	2,075	735
TP03-Hebbalu							
2024	125	205	430	470	675	820	330
2025	130	210	440	480	690	840	340
2030	160	260	550	600	860	1,045	420
2035	200	320	670	730	1,050	1,280	515
2040	240	390	820	895	1,285	1,565	630
2044	285	460	960	1,050	1,510	1,835	735

Note: The toll fee has been rounded to nearest 5 Rupees as per toll fee rules.

Project Road Revenue

The travel pattern and commodity distribution reveal the presence of building materials, iron and steel products and miscellaneous items in which there could be an ongoing practice of overloading on PR and is not being currently charged.

As observed from the seven-day axle load analysis, around 20 percent of the MAVs and 5.0 percent of 3A trucks are above 20 percent overloading limit at Bankapur TP whereas around 3 percent of 3A trucks and 10 percent of MAVs are in the above 20 percent overloading limit at both Chalageri and Hebbalu Toll Plazas.

Continuing with the practice of two times toll, since 3A and MAVs are heavily overloaded, with WIM installed at all the toll plazas, the practice of charging them for one-time extra payment can be put in place.

14. ***Revalidation of Traffic and Revenue Estimates Based on Recent Data***

Steer Davies & Gleave India Private Limited, Ramboll India Private Ltd, and CRISIL Market Intelligence & Analytics were engaged to carry out a review of the earlier traffic and revenue forecasts pertaining to the Traffic Report submitted by the Traffic Consultants in relation to the Existing Toll Roads upto the month of September 2023, based on the actual traffic/ revenue data up to September 2023("**Revalidation Note**"). In the Revalidation Note, Steer Davies & Gleave India Private Limited, Ramboll India Private Ltd, and CRISIL Market Intelligence & Analytics has confirmed that the previous estimates of traffic and revenue for the Existing Toll Roads provided in the Traffic Reports for Fiscal Year 2024 and beyond can still be considered as valid. The detailed revalidation note is annexed as **Annexure C**.

Operations

Toll collection system

Toll is collected for each journey through each of the toll plazas. Signs setting out the toll rates for the Toll Road assets are displayed at the toll booths and tolls can be paid or tendered by the driver of any vehicle in the following manners:

Cash

Tolls paid by means of cash are collected by toll collectors at the manual toll booths.

Electronic toll collection

To ensure seamless traffic movement through toll plazas and increase transparency in collection of user fees using FASTag, the National Electronic Toll Collection (NETC) programme has been implemented on a pan-India basis. FASTags are simple to use reloadable tags to enable automatic deduction of toll charges from a pre-paid account without having to stop at toll plazas for cash transactions.

FASTag was started as a pilot project in 2014 on the stretch of Golden Quadrilateral between Mumbai and Ahmedabad. It was later extended to other toll plazas, with the FASTag use made mandatory across the country in February 2021. To ease the process of getting a FASTag for citizens, the Ministry also mandated that all vehicles manufactured after December 2017 should be pre-fitted with a FASTag. This reform has been immensely beneficial for citizens and toll plaza operators.

Transition to 100% FASTag was implemented w.e.f 15th February, 2021 and thereafter, significant increase in toll collection through FASTag has been observed**.** (*Source: CRISIL Report*)

Monitoring

Toll collection

Payments at the toll plazas, both electronic as well as cash payments, are processed through a semi-automated or a fully automated toll collection system, depending on complexity of the project. Both these systems collect and store traffic and payment data, thereby reducing the need for manual operation. A semi-automated system consists of a revenue collection software desktop, a barrier gate, smart cards and monitoring cameras and a fully automated system includes equipment such as vehicle counting classifier, vehicle audit system, communication channels and traffic control equipment in addition to all the components of a semi-automated system.

For the purpose of identifying categories of vehicles and to charge an appropriate toll rate, the automatic vehicle identification based in-road/infrared sensors are also used. The Project SPVs would use weigh-in-motion technology for projects where weight-based toll collection is mandated. The weight based tolling systems are integrated with the fully automatic toll collection system for enhanced revenue controls.

There are cameras installed particularly for capturing and recording any toll evasion incidents by vehicles. There is also a back-up power supply system to ensure that there is no interruption to power supply at the toll plazas in order to maintain a stable power supply for the sub-systems and equipment. Servers used in the toll collection systems at the toll plazas are capable of real time uploading of transaction data from toll lane equipment and performing an automatic daily backup to prevent any toll data loss and to enable quick system recovery, which would allow the Project SPVs to collect variable amounts of tolls depending on the class of motor vehicles and serves as a traffic information system.

Only certain authorised persons have access to the toll collection systems and the activities are recorded for security purposes. The Project SPVs are responsible for operating the toll collection system at its toll plaza and taking regular preventive and corrective measures to maintain such systems at the highest levels of security and reliability.

Traffic control

There are helpline numbers displayed along the national highways for communication between the road users and the control room in case of any emergency. This provides a reliable communication channel for the road users in cases of an exigency where they need to communicate with staff at the Control Room. The Project SPVs would take regular preventive and corrective measures to maintain the emergency telephone system at the highest levels of reliability and safety. The Project SPVs are required to carry out regular patrolling and regulate and maintain traffic order within the projects. Emergency telephone systems and emergency helpline numbers are provided at all projects where such systems and numbers are required by the Concession Agreement. There are also patrol vehicles that continuously move on the section of the project that it is assigned to, which will intervene to regulate traffic and carry out surveillance activities.

Traffic and motorway assistance services

Traffic assistance

The Project SPVs would provide emergency assistance to motorists using the toll roads. They station patrol/light recovery vehicles on each toll road, which are deployed to patrol the toll roads on a continuous basis.

In the case of a vehicle breakdown or traffic accident, the Control Room will announce the occurrence via mobile phones or handsets to instruct a mobile supervisor and a recovery supervisor to proceed to the scene immediately, and file relevant reports with the police if personal injury is involved. At the scene of a traffic accident or vehicle breakdown, the mobile supervisor will report to the Control Room on the situation of the incident, ensure safety of the scene and apply first aid to injured persons, if any. The recovery supervisor will determine whether the vehicle can be recovered on site or deploy recovery vehicles for towing. The traffic officer will stop the traffic, close the affected lane where necessary and direct trapped vehicles away to other unaffected lanes.

Safety Measures

Under the Concession Agreement, the concessionaire is obligated to abide by certain safety requirements, which include measures such as road signs, pavement marking, traffic control devices, roadside furniture, highway design elements, enforcement and emergency response. The concessionaire must abide by among others, applicable laws and applicable permits, the Manual for Safety in Road Design as issued by the Ministry of Shipping, Road Transport and Highways, relevant standards and guidelines of the Indian Roads Congress and good industry practice. NHAI also carries out safety audits of the projects by appointing a safety consultant employing a team comprising of, among others, one road safety expert and one traffic planner. These safety requirements apply to all phases of construction, operations and maintenance with emphasis on identification of factors associated with accidents and implementation of appropriate remedial measures.

Management

We are managed by qualified personnel of the Investment Manager and Investment Committee, with members who have management and operational experience in the roads and highways sector. For further details about the Investment Manager, please see the sections headed "*Parties to the Trust*" on page 101 of this Placement Document.

The Investment Manager, in consultation with the Trustee, has appointed a majority of the directors on the board of the Project SPVs in accordance with the InvIT Regulations, and such directors form part of the quorum. The Project SPVs' board of directors have also formed committees, as applicable and required, under the Companies Act, 2013 and rules made thereunder.

Seasonality

Traffic volume tends to decrease during the monsoon season and conversely tends to increase during holiday seasons. While the northern parts of India experience monsoon rains during the period from June or July until September or October every year, the southern parts of India, especially coastal parts of Andhra Pradesh, experience monsoon rains even during the months of October to December. The monsoon season may also restrict the Trust's ability to carry on activities related to its operations and maintenance of toll roads. For further details on risk associated with seasonality, please see the section headed "*Risk Factors*" on page 70 of this Placement Document. Conversely, traffic volume tends to increase during holiday seasons.

Property

The Investment Manager's corporate offices are located in G - 5 & 6, Sector 10, Dwarka, New Delhi – 110075 from which all its administrative and reporting activities are conducted.

Insurance

The Trust's operations are subject to hazards inherent in providing operations and maintenance services, such as risk of equipment failure, work accidents, fire, earthquake, flood and other force majeure events. This includes hazards that may cause injury and loss of life, damage and destruction of property, equipment and environmental damage. NHIPPL, in relation to itself and the Existing Toll Roads, has obtained insurance coverages, including, but not limited to, fire and special perils, loss of profit, fidelity guarantee and burglary. NEPPL shall obtain insurance with respect to the Target Toll Roads, in accordance with the relevant Concession Agreements.

Legal Proceedings

The Project SPVs, the Sponsor, the Investment Manager, the Project Manager and the Trustee may be involved in legal proceedings or claims from time to time. As on date of this Placement Document, certain proceedings or claims involving the Sponsor and certain of its Associates and the Trustee, are currently pending at different levels of adjudication before various courts, tribunals and regulatory authorities. For a description of the material legal proceedings that are outstanding, please see the section entitled "*Legal and other Information*" on page 318 of this Placement Document.

SUMMARY OF THE CONCESSION AGREEMENTS

Except as disclosed herein, for an overview of the summary of R1 and R2 Concession Agreements, please see the section entitled "Summary of the Concession Agreements" on page 152 of the R2 Placement Document available at https://www.bseindia.com/downloads1/NHIT_PD.pdf.

The following are summaries of the concession agreements entered into by the NHIT Eastern Projects Private Limited in relation to R3 Toll Roads. The descriptions and summaries of the agreements below are not, nor do they purport to be complete descriptions or summaries of all terms of such agreements. Certain terms used in this section have the meaning assigned to them in the respective concession agreements. Copies of these concession agreements are also available for inspection at the registered office of the Trust.

1. *Concession Agreement between NEPPL ("Concessionaire") and NHAI dated March 7, 2024 in respect of the Kachugaon - Kaljhar Project*

The Concessionaire has entered into a concession agreement for tolling, operation, maintenance and transfer of Kachugaon - Kaljhar Project (as defined below) on toll, operate and transfer (TOT) basis (the "**Kachugaon - Kaljhar Concession Agreement**"), for a period of 20 years (twenty years) from the the Appointed Date (i.e., the date on which all Conditions Precedent have been satisfied) or such date on which the Kachugaon - Kaljhar Concession Agreement is terminated by a termination notice ("**Kachugaon - Kaljhar Concession Period**").

Certain Definitions

"**Kachugaon - Kaljhar Project**" means the operation and maintenance of the Kachugaon - Kaljhar Project Highway in accordance with the provisions of the Kachugaon- Kaljhar Concession Agreement and includes all works, services and equipment relating to or in respect of the scope of the Kachugaon- Kaljhar Project as set forth in the Kachugaon- Kaljhar Concession Agreement;

"**Kachugaon - Kaljhar Project Assets**" means all physical and other assets relating to and forming part of the Site including (a) rights over the Site in the form of licence, Right of Way or otherwise; (b) tangible assets such as civil works and equipment including foundations, embankments, pavements, road surface, interchanges, bridges, culverts, road overbridges, drainage works, traffic signals, sign boards, kilometre- stones, toll plazas, electrical systems, communication systems, rest areas, relief centers, maintenance depots and administrative offices; (d) all rights of the Concessionaire under the project agreements; (security deposits; (e) insurance proceeds; and (g) Applicable Permits and authorisations relating to or in respect of the Kachugaon - Kaljhar Project Highway, but does not include Additional Facilities; and

"**Kachugaon - Kaljhar Project Highway**" means the Site comprising the existing road comprising:

Stretch	State	Start (Km)	End (Km)	Length
Kachugaon to Rakhaldubi Bus Junction NH-27 (old NH-31C)	Assam	existing Km 30+000	Existing Km 92+671	62.671 km
Rakhaldubi Bus Junction to Kaljhar NH-27 (old NH-31)		Km 961+500	Km 1013+000	51.500km

and all Kachugaon - Kaljhar Project Assets."

Grant of Concession

Subject to and in accordance with the terms and conditions set forth in the Kachugaon - Kaljhar Concession Agreement, NHAI has granted to the Concessionaire, and the Concessionaire has accepted the concession for a period of 20 years (twenty years), including the exclusive right, license and authority during the subsistence of the Kachugaon - Kaljhar Agreement to operate, manage and maintain the Kachugaon- Kaljhar Project Highway. Notwithstanding anything to the contrary in the Kachugaon- Kaljhar Concession Agreement, the parties have expressly agreed that the Concession Period shall not be reduced by more than 5 (five) years, or shall not be increased by more than 10 (ten) years on any account or for any reason whatsoever.

Subject to and in accordance with the terms and conditions set forth in the Kachugaon- Kaljhar Concession Agreement, the Concessionaire is entitled to undertake the following in accordance with the terms of the Kachugaon - Kaljhar Concession Agreement, applicable laws and applicable permits:

i. Right of Way, access and license to the Site for the purpose of and to the extent conferred by the provisions of the

Kachugaon- Kaljhar Concession Agreement;

ii. manage, operate and maintain the Kachugaon- Kaljhar Project Highway and regulate the use thereof by third parties in accordance with the terms of Kachugaon- Kaljhar Concession Agreement;

iii. demand, collect and appropriate the fees from vehicles and persons liable for payment of fees for using the Kachugaon - Kaljhar Project Highway or any part thereof and refuse entry of any vehicle to the Kachugaon- Kaljhar Project Highway if the fee due is not paid;

iv. perform and fulfill all of the Concessionaire's obligations under and in accordance with the Kachugaon - Kaljhar Concession Agreement;

v. bear and pay all costs, expenses and charges in connection with or incidental to the performance of the obligations of the Concessionaire under the Kachugaon - Kaljhar Concession Agreement; and

vi. neither assign, transfer or sublet or create any lien or encumbrance on the Kachugaon - Kaljhar Concession Agreement, or the concession granted thereby, or on the whole or any part of the Kachugaon - Kaljhar Project Highway nor transfer, lease or part possession thereof, save and except as expressly permitted by the Kachugaon - Kaljhar Concession Agreement.

Fees

The Concessionaire is entitled to, during the Kachugaon- Kaljhar Concession Period, levy, collect and appropriate fees from users ("**User Fee**") of the Kachugaon - Kaljhar Project Highway pursuant to and in accordance with the provisions in the Kachugaon - Kaljhar Concession Agreement and the Fee Rules and to appropriate the same. In accordance with the terms of the Kachugaon - Kaljhar Concession Agreement, the Concessionaire shall not collect any fees in relation to exempted vehicles. The fees collected by Concessionaire shall be deposited in the escrow account and appropriated in accordance with the relevant provisions of the Kachugaon - Kaljhar Concession Agreement.

Sub Rule 6(6) of the above-mentioned Fee Rules states,

"*(a) The fee shall be collected by the Central Government or the executing Authority as the case may be and for a specified period in accordance with the terms of agreement entered by the Concessionaire.*
(b) The fee as notified as per Concession Agreement shall be leviable till the end of the concession period and after the Concession Agreement is over, the fee shall be collected by the Central Government executing authority at a reduced rate of 40% of the fee on the date of transfer of such section of National Highways, bridge, tunnel or bypass, as the case may be, to be revised annually in accordance with these rules:

Provided that after the recovery of capital cost through user fee realised, in respect of a public funded project, the fee leviable would be reduced to 40% of the user fee for such section of National Highways, bridge, tunnel or bypass as the case may be, to be revised annually in accordance with these rules."

In respect of the above, NHAI has clarified that Rule 6 of the Fee Rules provides that the user fee to be notified by Government as per the format of Schedule M of Concession Agreement shall be leviable till the end of the concession period. Hence, the rate of User Fee rate shall only be reduced after the concession period is over.

Concession Fees

As consideration for the grant of the Concession, the Concessionaire is required to pay a concession fee to NHAI equivalent to ₹ 13,979.0 million, within 120 (one hundred and twenty) days of the date of execution of the concession agreement or any extended date as agreed by NHAI prior to the Appointed Date as a Condition Precedent. The Concessionaire agrees that payment of the concession fee constitutes essential condition of the Concession Agreement. Further, as communicated by the Authority by way of a letter dated October 31, 2023, any amount raised from the proceeds of the Issue in excess of the base concession fee (being the aggregate of Concession Fees payable to NHAI in terms of the Additional Concession Agreements) shall be paid to the Authority. For further details, see the section titled "*Use of Proceeds – Details of Utilisation of Issue Proceeds - Infusion of debt and/or equity into NEPPL*" on page 273.

For the purposes of stamp duty payment, concession agreements are generally considered to be agreements which are not lease deeds and stamp duty of ₹ 100.00 is typically paid for such concession agreements. However, stamp duty authorities of certain states in India have issued notices to some concessionaires alleging inadequate stamp duty on the concession agreements executed between the concessionaires and the NHAI. The stamp authorities allege that since concession agreements relate to the letting of tolls to the concessionaires in the form of leases, or as development agreements, such agreements were required to be stamped as lease agreements or development agreements, as applicable. The stamp duty for a lease agreement or a development agreement ranges between 1.0% and 11.0% of the annual rent or premium payable or the market value of the property. Furthermore, stamp duty authorities may impose penalties for payment of inadequate stamp duty, which could extend up to ten (10) times the amount of the stamp duty payable. Accordingly, concession agreements that

have not been stamped as such could be considered to be inadequately stamped. The High Courts of Allahabad and Maharashtra have also held that a concession agreement ought to be stamped as a lease agreement and have upheld the imposition of a higher stamp duty on such agreements.

While we have paid stamp duty of ₹ 100.00 on each of our Concession Agreements in accordance with usual practice, if any demand for payment of a higher stamp duty or penalty is imposed, it would increase the costs of the Toll Roads.

In respect of above, NHAI has clarified that:

(i) As on the date of the Kachugaon – Kaljhar Concession Agreement, GST is not applicable on Concession Fee. However, if it becomes applicable at a later stage, this shall be considered as change in law.

(ii) There is no requirement of stamp duty in case of Concession Agreements since Fee Rules provided for levy and collection of user fee and not toll tax. In case, in future any such demand arises, it shall be treated as change in law.

Escrow Account

The provisions in relation to the escrow account in the Kachugaon - Kaljhar Concession Agreement are only applicable if the obligations of the Concessionaire under the Kachugaon- Kaljhar Concession Agreement are financed by the Lenders.

The Concessionaire shall, prior to the Appointed Date, open and establish the escrow account with the escrow bank and all funds constituting the financing package related to the Kachugaon- Kaljhar Project shall be credited to such escrow account. During the Kachugaon - Kaljhar Concession Period all fees and any other revenues including the proceeds of any rentals, deposits, capital receipts or insurance claims from or in respect of the Kachugaon - Kaljhar Project Highway shall be deposited therein. In addition, all payments by NHAI pursuant to the Kachugaon - Kaljhar Concession Agreement, including, if any, in relation to the change of scope in the Kachugaon - Kaljhar Project shall be deposited by NHAI in the escrow account.

Withdrawals from Escrow Account

The Concessionaire shall, at the time of the opening of the escrow account, give irrevocable instructions by way of an escrow agreement substantially in form set forth in the Kachugaon - Kaljhar Concession Agreement to the escrow bank instructing, *inter alia*, that the deposits into the escrow account shall subject to the provisions of the Kachugaon - Kaljhar Concession Agreement, be appropriated in the following order every month and if not due in a month then appropriated proportionately in such month and retained in the escrow account and paid out therefrom in the month when due unless otherwise expressly provided in the instruction letter:

i. all taxes due and payable by the Concessionaire for and in respect of the Kachugaon - Kaljhar Project Highway;

ii. concession fee;

iii. all payments relating to construction of the Kachugaon - Kaljhar Project Highway, subject to and in accordance with the conditions, if any, set forth in the financing agreements;

iv. operation and maintenance expenses;

v. operation and maintenance expenses and other costs and expenses incurred by NHAI in accordance with the provisions of the Kachugaon - Kaljhar Concession Agreement, and certified by NHAI as due and payable to it;

vi. monthly proportionate provision of debt service payment due in an accounting year;

vii. all payments and damages certified by NHAI as due and payable to it by the Concessionaire; and

vii. balance, if any, in accordance with the instructions of the Concessionaire.

Withdrawals upon Termination

Notwithstanding anything to the contrary contained in the escrow agreement and subject to the provisions of the Kachugaon - Kaljhar Concession Agreement, in the case of termination, the amounts standing to the credit of the escrow account shall be appropriated in the following order:

i. all taxes due and payable by the Concessionaire for and in respect of the Kachugaon - Kaljhar Project Highway;

ii. payment due to the lenders;

iii. all payments and damages certified by NHAI as due and payable to it by the Concessionaire;

iv. retention and payments relating to the liability for defects and deficiencies;

v. incurred or accrued operation and maintenance expenses;

vi. any other payments required to be made under the Kachugaon - Kaljhar Concession Agreement; and

vii. balance, if any, in accordance with the instructions of the Concessionaire.

Change of Scope

NHAI may, notwithstanding anything to the contrary contained in the Kachugaon - Kaljhar Concession Agreement, require the Concessionaire to make alterations/ modifications in the scope of the Kachugaon - Kaljhar Project as contemplated by the Kachugaon - Kaljhar Concession Agreement. If the cumulative costs relating to all the change of scope orders exceed 5% (five per cent) of the concession fee in any continuous period of 3 (three) years immediately preceding the date of such change of scope order or if such cumulative costs exceed 25% (twenty five per cent) of the concession fee at any time during the Kachugaon - Kaljhar Concession Period, NHAI may award any works or services, to any person on the basis of open competitive bidding and the Concessionaire shall be entitled to take part in such competitive bidding with a right to match the first-ranked bid in terms of the selection criteria, either by itself where such work requires tolling, operation and maintenance, or through another company where such work requires construction on any part of the Project Highway, subject to payment of 2% (two per cent) of the bid amount to the Authority, and thereupon securing the award of such works or services. For the avoidance of doubt, it is agreed that the Concessionaire shall be entitled to exercise such option only if the Concessionaire has participated in the bidding process either individually or as a consortium or JV with another company and fulfils the eligibility criteria to undertake such work without compromising with its overall liability. All such changes shall be made by NHAI by an order issued in accordance with the procedure set forth in the Kachugaon - Kaljhar Concession Agreement.

Termination of the Kachugaon - Kaljhar Concession Agreement

Termination by either party

Either Party may in its discretion terminate the Kachugaon - Kaljhar Concession Agreement by giving a termination notice to the other party if a force majeure event subsists for a period of 120 (one hundred and twenty) days or more within a continuous period of 365 (three hundred and sixty five) days. Before issuing such termination notice, the party intending to issue the termination notice shall inform the other party of such intention and grant 15 (fifteen) days time to make a representation and may after the expiry of such 15 (fifteen) days period, whether or not it is in receipt of such representation, in its sole discretion issue the termination notice.

Termination by the NHAI

In the event of any of the defaults specified below have occurred, and if the Concessionaire has failed to cure such breach or default within the period provided for the same in the Kachugaon - Kaljhar Concession Agreement, then NHAI shall be entitled to issue a notice of its intention to terminate the Kachugaon - Kaljhar Concession Agreement, with a copy to the lenders. The following events shall constitute an event of default by the Concessionaire (a "**Concessionaire Default**") unless they have occurred as a result of any breach of the Kachugaon - Kaljhar Concession Agreement by NHAI or due to force majeure:

i. the performance security has been encashed and appropriated in accordance with the Kachugaon - Kaljhar Concession Agreement and the Concessionaire has failed to replenish or provide fresh performance security within a cure period of 15 (fifteen) days;

ii. subsequent to the replenishment or furnishing of fresh performance security in accordance with the Kachugaon - Kaljhar Concession Agreement, the Concessionaire fails to cure, within a cure period of 60 (sixty) days, the Concessionaire Default for which whole or part of the performance security was appropriated;

iii. the Concessionaire abandons or manifests intention to abandon the operation and maintenance of the Kachugaon - Kaljhar Project Highway without the prior written consent of NHAI;

iv. the Concessionaire fails to roll over, renew and furnish new bank guarantee performance security subject to and in accordance with terms of the Kachugaon - Kaljhar Concession Agreement, at least three months prior to expiry of subsisting bank guarantee;

v. the Concessionaire is in breach of the Maintenance Requirements or the Safety Requirements, as the case may be;

vi the Concessionaire has failed to make any payment to NHAI within the period specified in the Kachugaon - Kaljhar Concession Agreement;

vii. upon occurrence of a financial default, the lenders' representative has by notice required NHAI to undertake suspension or termination, as the case may be, in accordance with the substitution agreement and the Concessionaire fails to cure the default within the specified cure period;

viii. a breach of any of the project agreements by the Concessionaire causes a material adverse effect;

ix. the Concessionaire creates any encumbrance in breach of the Kachugaon - Kaljhar Concession Agreement;

x. the Concessionaire repudiates the Kachugaon - Kaljhar Concession Agreement or otherwise takes any action or evidences or conveys an intention not to be bound by the Kachugaon - Kaljhar Concession Agreement;

xi. a change in ownership occurs in breach of the provisions of the Kachugaon - Kaljhar Concession Agreement;

xii. there is a transfer, pursuant to law either of (i) the rights and/or obligations of the Concessionaire under any of the project agreements, or of (ii) all or part of the assets or undertaking of the Concessionaire, and such transfer causes a material adverse effect;

xiii. an execution levied on any of the assets of the Concessionaire has caused a material adverse effect;

xiv. the Concessionaire is adjudged bankrupt or insolvent, or if a trustee or receiver is appointed for the Concessionaire or for the whole or material part of its assets that has a material bearing on the Kachugaon - Kaljhar Project;

xv. the Concessionaire has been, or is in the process of being liquidated, dissolved, wound-up, amalgamated or reconstituted in a manner that would cause, in the reasonable opinion of NHAI, a material adverse effect;

xvi. a resolution for winding up of the Concessionaire is passed or any petition for winding up of the Concessionaire is admitted by a court of competent jurisdiction and a provisional liquidator or receiver is appointed and such order has not been set aside within 90 (ninety) days of the date thereof or the Concessionaire is ordered to be wound up by Court except for the purpose of amalgamation or reconstruction; provided that, as part of such amalgamation or reconstruction, the entire property, assets and undertaking of the Concessionaire are transferred to the amalgamated or reconstructed entity and that the amalgamated or reconstructed entity has unconditionally assumed the obligations of the Concessionaire under the Kachugaon - Kaljhar Concession Agreement and the project agreements; and provided that:

    a. the amalgamated or reconstructed entity has the capability and operating experience necessary for the performance of its obligations under the Kachugaon - Kaljhar Concession Agreement and the project agreements;

    b. the amalgamated or reconstructed entity has the financial standing to perform its obligations under the Kachugaon - Kaljhar Concession Agreement and the project agreements and has a credit worthiness at least as good as that of the Concessionaire as at Appointed Date; and

    c. each of the project agreements remains in full force and effect;

xvii. any representation or warranty of the Concessionaire herein contained which is, as of the date of Kachugaon - Kaljhar Concession Agreement, found to be materially false, incorrect or misleading;

xviii. the Concessionaire submits to NHAI any statement, notice or other document, in written or electronic form, which has a material effect on NHAI's rights, obligations or interests and which is false in material particulars;

xix. the Concessionaire has failed to fulfil any obligation, for which failure termination has been specified in the Kachugaon - Kaljhar Concession Agreement;

xx. the Concessionaire commits a default in complying with any other provision of the Kachugaon - Kaljhar Concession Agreement if such default causes a material adverse effect on NHAI;

xxi. an escrow default occurs and the Concessionaire fails to cure the default within a cure period of 15 (fifteen) days;

Termination by Concessionaire

If any of the defaults specified below shall have occurred, and NHAI fails to cure such default within a cure period of 90 (ninety) days or such longer period as has been expressly provided in the Kachugaon - Kaljhar Concession Agreement, NHAI shall be deemed to be in default of the Kachugaon - Kaljhar Concession Agreement, unless the default has occurred as a result of any breach of the Kachugaon - Kaljhar Concession Agreement by the Concessionaire or due to force majeure:

i. NHAI commits a material default in complying with any of the provisions of the Kachugaon - Kaljhar Concession

Agreement and such default has a material adverse effect on the Concessionaire; or

ii. NHAI repudiates the Kachugaon - Kaljhar Concession Agreement or otherwise takes any action that amounts to or manifests an irrevocable intention not to be bound by the Kachugaon - Kaljhar Concession Agreement; or

iii. the State commits a material default in complying with the provisions of the State Support Agreement if such default has a Material Adverse Effect on the Concessionaire and the breach continues for a period of 90 (ninety) days from the date of notice given in this behalf by the Concessionaire to the Authority.

Termination Payments

The termination payment pursuant to the Kachugaon - Kaljhar Concession Agreement becomes due and payable to the Concessionaire by NHAI within 15 (fifteen) days of the Concessionaire furnishing to NHAI an NOC issued by the lenders/ lenders' representative recording/ effecting release/ vacation/ discharge of the charge on Kachugaon - Kaljhar Project receivables (if any) created by Concessionaire for securing repayment of the debt. If NHAI fails to disburse the full termination payment within 15 (fifteen) days, NHAI shall pay interest at a rate equal to 3% (three per cent) above the bank rate on the amount of termination payment remaining unpaid.

Upon termination of the Kachugaon - Kaljhar Concession Agreement by the NHAI on account of occurrence of a Concessionaire Default, the NHAI shall pay the Concessionaire by way of termination payment 70% (seventy per cent) of the Unexpired Cash Flow.

Upon termination of the Kachugaon - Kaljhar Concession Agreement by the Concessionaire on account of occurrence of an NHAI Default, the Concessionaire shall be entitled to receive from NHAI by way of termination payment a sum equal to 105% (one hundred and five per cent) of the Unexpired Cash Flow.

Technical Clarifications on the Concession Agreements

For details in relation to the technical clarifications received from NHAI in relation to the Concession Agreements, please refer to Annexure 1 of the Kachugaon - Kaljhar Concession Agreement.

2. *Concession Agreement between NEPPL ("Concessionaire") and NHAI dated March 7, 2024 in respect of the Kaljhar - Patacharkuchi Project*

The Concessionaire has entered into a concession agreement for tolling, operation, maintenance and transfer of Kaljhar - Patacharkuchi Project Highway (as defined below) on toll, operate and transfer (TOT) basis (the "**Kaljhar - Patacharkuchi Concession Agreement**"), for a period of 20 years (twenty years) from the the Appointed Date (i.e., the date on which all Conditions Precedent have been satisfied) or such date on which the Kaljhar - Patacharkuchi Concession Agreement is terminated by a termination notice ("**Kaljhar - Patacharkuchi Concession Period**").

Certain Definitions

"**Kaljhar - Patacharkuchi Project**" means the operation and maintenance of the Kaljhar - Patacharkuchi Project Highway in accordance with the provisions of the Kaljhar - Patacharkuchi Concession Agreement and includes all works, services and equipment relating to or in respect of the scope of the Kaljhar - Patacharkuchi Project as set forth in the Kaljhar - Patacharkuchi Concession Agreement;

"**Kaljhar - Patacharkuchi Project Assets**" means all physical and other assets relating to and forming part of the Site including (a) rights over the Site in the form of licence, Right of Way or otherwise; (b) tangible assets such as civil works and equipment including foundations, embankments, pavements, road surface, interchanges, bridges, culverts, road overbridges, drainage works, traffic signals, sign boards, kilometre- stones, toll plazas, electrical systems, communication systems, rest areas, relief centers, maintenance depots and administrative offices; (d) all rights of the Concessionaire under the project agreements; (security deposits; (e) insurance proceeds; and (g) Applicable Permits and authorisations relating to or in respect of the Kaljhar - Patacharkuchi Project Highway, but does not include Additional Facilities; and

"**Kaljhar - Patacharkuchi Project Highway**" means the Site comprising the existing road comprising:

Stretch	State	Start (Km)	End (Km)	Length
Kaljhar to Patacharkuchi	Assam	1013+000	1040+000	27.3

and all Kaljhar - Patacharkuchi Project Assets."

Grant of Concession

Subject to and in accordance with the terms and conditions set forth in the Kaljhar - Patacharkuchi Concession Agreement, NHAI has granted to the Concessionaire, and the Concessionaire has accepted the concession for a period of 20 years (twenty years), including the exclusive right, license and authority during the subsistence of the Kaljhar - Patacharkuchi Agreement to operate, manage and maintain the Kaljhar - Patacharkuchi Project Highway. Notwithstanding anything to the contrary in the Kaljhar - Patacharkuchi Concession Agreement, the parties have expressly agreed that the Concession Period shall not be reduced by more than 5 (five) years, or shall not be increased by more than 10 (ten) years on any account or for any reason whatsoever.

Subject to and in accordance with the terms and conditions set forth in the Kaljhar - Patacharkuchi Concession Agreement, the Concessionaire is entitled to undertake the following in accordance with the terms of the Kaljhar - Patacharkuchi Concession Agreement, applicable laws and applicable permits:

i. Right of Way, access and license to the Site for the purpose of and to the extent conferred by the provisions of the Kaljhar - Patacharkuchi Concession Agreement;

ii. manage, operate and maintain the Kaljhar - Patacharkuchi Project Highway and regulate the use thereof by third parties in accordance with the terms of Kaljhar - Patacharkuchi Concession Agreement;

iii. demand, collect and appropriate the fees from vehicles and persons liable for payment of fees for using the Kaljhar - Patacharkuchi Project Highway or any part thereof and refuse entry of any vehicle to the Kaljhar - Patacharkuchi Project Highway if the fee due is not paid;

iv. perform and fulfill all of the Concessionaire's obligations under and in accordance with the Kaljhar - Patacharkuchi Concession Agreement;

v. bear and pay all costs, expenses and charges in connection with or incidental to the performance of the obligations of the Concessionaire under the Kaljhar - Patacharkuchi Concession Agreement; and

vi. neither assign, transfer or sublet or create any lien or encumbrance on the Kaljhar - Patacharkuchi Concession Agreement, or the concession granted thereby, or on the whole or any part of the Kaljhar - Patacharkuchi Project Highway nor transfer, lease or part possession thereof, save and except as expressly permitted by the Kaljhar - Patacharkuchi Concession Agreement.

Fees

The Concessionaire is entitled to, during the Kaljhar - Patacharkuchi Concession Period, levy, collect and appropriate fees from users ("**User Fee**") of the Kaljhar - Patacharkuchi Project Highway pursuant to and in accordance with the provisions in the Kaljhar - Patacharkuchi Concession Agreement and the Fee Rules and to appropriate the same. In accordance with the terms of the Kaljhar - Patacharkuchi Concession Agreement, the Concessionaire shall not collect any fees in relation to exempted vehicles. The fees collected by Concessionaire shall be deposited in the escrow account and appropriated in accordance with the relevant provisions of the Kaljhar - Patacharkuchi Concession Agreement.

Sub Rule 6(6) of the above-mentioned Fee Rules states,

"(a) The fee shall be collected by the Central Government or the executing Authority as the case may be and for a specified period in accordance with the terms of agreement entered by the Concessionaire.
(b) The fee as notified as per Concession Agreement shall be leviable till the end of the concession period and after the Concession Agreement is over, the fee shall be collected by the Central Government executing authority at a reduced rate of 40% of the fee on the date of transfer of such section of National Highways, bridge, tunnel or bypass, as the case may be, to be revised annually in accordance with these rules:

Provided that after the recovery of capital cost through user fee realised, in respect of a public funded project, the fee leviable would be reduced to 40% of the user fee for such section of National Highways, bridge, tunnel or bypass as the case may be, to be revised annually in accordance with these rules."

In respect of the above, NHAI has clarified that Rule 6 of the Fee Rules provides that the user fee to be notified by Government as per the format of Schedule M of Concession Agreement shall be leviable till the end of the concession period. Hence, the rate of User Fee rate shall only be reduced after the concession period is over.

Concession Fees

As consideration for the grant of the Concession, the Concessionaire is required to pay a concession fee to NHAI equivalent to ₹ 2,345.00 million, within 120 (one hundred and twenty) days of the date of execution of the concession agreement or any extended date as agreed by NHAI prior to the Appointed Date as a Condition Precedent. The Concessionaire agrees that payment of the concession fee constitutes essential condition of the Concession Agreement. Further, as communicated by the

Authority by way of a letter dated October 31, 2023, any amount raised from the proceeds of the Issue in excess of the base concession fee (being the aggregate of Concession Fees payable to NHAI in terms of the Additional Concession Agreements) shall be paid to the Authority. For further details, see the section titled "*Use of Proceeds – Details of Utilisation of Issue Proceeds - Infusion of debt and/or equity into NEPPL*" on page 273.

For the purposes of stamp duty payment, concession agreements are generally considered to be agreements which are not lease deeds and stamp duty of ₹ 100.00 is typically paid for such concession agreements. However, stamp duty authorities of certain states in India have issued notices to some concessionaires alleging inadequate stamp duty on the concession agreements executed between the concessionaires and the NHAI. The stamp authorities allege that since concession agreements relate to the letting of tolls to the concessionaires in the form of leases, or as development agreements, such agreements were required to be stamped as lease agreements or development agreements, as applicable. The stamp duty for a lease agreement or a development agreement ranges between 1.0% and 11.0% of the annual rent or premium payable or the market value of the property. Furthermore, stamp duty authorities may impose penalties for payment of inadequate stamp duty, which could extend up to ten (10) times the amount of the stamp duty payable. Accordingly, concession agreements that have not been stamped as such could be considered to be inadequately stamped. The High Courts of Allahabad and Maharashtra have also held that a concession agreement ought to be stamped as a lease agreement and have upheld the imposition of a higher stamp duty on such agreements.

While we have paid stamp duty of ₹ 100.00 on each of our Concession Agreements in accordance with usual practice, if any demand for payment of a higher stamp duty or penalty is imposed, it would increase the costs of the Toll Roads.

In respect of above, NHAI has clarified that:

(i) As on the date of the Kaljhar – Patacharkuchi Concession Agreement, GST is not applicable on Concession Fee. However, if it becomes applicable at a later stage, this shall be considered as change in law.

(ii) There is no requirement of stamp duty in case of Concession Agreements since Fee Rules provided for levy and collection of user fee and not toll tax. In case, in future any such demand arises, it shall be treated as change in law.

Escrow Account

The provisions in relation to the escrow account in the Kaljhar - Patacharkuchi Concession Agreement are only applicable if the obligations of the Concessionaire under the Kaljhar - Patacharkuchi Concession Agreement are financed by the Lenders.

The Concessionaire shall, prior to the Appointed Date, open and establish the escrow account with the escrow bank and all funds constituting the financing package related to the Kaljhar - Patacharkuchi Project shall be credited to such escrow account. During the Kaljhar - Patacharkuchi Concession Period all fees and any other revenues including the proceeds of any rentals, deposits, capital receipts or insurance claims from or in respect of the Kaljhar - Patacharkuchi Project Highway shall be deposited therein. In addition, all payments by NHAI pursuant to the Kaljhar - Patacharkuchi Concession Agreement, including, if any, in relation to the change of scope in the Kaljhar - Patacharkuchi Project shall be deposited by NHAI in the escrow account.

Withdrawals from Escrow Account

The Concessionaire shall , at the time of the opening of the escrow account, give irrevocable instructions by way of an escrow agreement substantially in form set forth in the Kaljhar - Patacharkuchi Concession Agreement to the escrow bank instructing, *inter alia*, that the deposits into the escrow account shall subject to the provisions of the Kaljhar - Patacharkuchi Concession Agreement, be appropriated in the following order every month and if not due in a month then appropriated proportionately in such month and retained in the escrow account and paid out therefrom in the month when due unless otherwise expressly provided in the instruction letter:

i. all taxes due and payable by the Concessionaire for and in respect of the Kaljhar - Patacharkuchi Project Highway;

ii. concession fee;

iii. all payments relating to construction of the Kaljhar - Patacharkuchi Project Highway, subject to and in accordance with the conditions, if any, set forth in the financing agreements;

iv. operation and maintenance expenses;

v. operation and maintenance expenses and other costs and expenses incurred by NHAI in accordance with the provisions of the Kaljhar - Patacharkuchi Concession Agreement, and certified by NHAI as due and payable to it;

vi. monthly proportionate provision of debt service payment due in an accounting year;

vii. all payments and damages certified by NHAI as due and payable to it by the Concessionaire; and

vii. balance, if any, in accordance with the instructions of the Concessionaire.

Withdrawals upon Termination

Notwithstanding anything to the contrary contained in the escrow agreement and subject to the provisions of the Kaljhar - Patacharkuchi Concession Agreement, in the case of termination, the amounts standing to the credit of the escrow account shall be appropriated in the following order:

i. all taxes due and payable by the Concessionaire for and in respect of the Kaljhar - Patacharkuchi Project Highway;

ii. payment due to the lenders;

iii. all payments and damages certified by NHAI as due and payable to it by the Concessionaire;

iv. retention and payments relating to the liability for defects and deficiencies;

v. incurred or accrued operation and maintenance expenses;

vi. any other payments required to be made under the Kaljhar - Patacharkuchi Concession Agreement; and

vii. balance, if any, in accordance with the instructions of the Concessionaire.

Change of Scope

NHAI may, notwithstanding anything to the contrary contained in the Kaljhar - Patacharkuchi Concession Agreement, require the Concessionaire to make alterations/ modifications in the scope of the Kaljhar - Patacharkuchi Project as contemplated by the Kaljhar - Patacharkuchi Concession Agreement. If the cumulative costs relating to all the change of scope orders exceed 5% (five per cent) of the concession fee in any continuous period of 3 (three) years immediately preceding the date of such change of scope order or if such cumulative costs exceed 25% (twenty five per cent) of the concession fee at any time during the Kaljhar - Patacharkuchi Concession Period, NHAI may award any works or services, to any person on the basis of open competitive bidding and the Concessionaire shall be entitled to take part in such competitive bidding with a right to match the first-ranked bid in terms of the selection criteria, either by itself where such work requires tolling, operation and maintenance, or through another company where such work requires construction on any part of the Project Highway, subject to payment of 2% (two per cent) of the bid amount to the Authority, and thereupon securing the award of such works or services. For the avoidance of doubt, it is agreed that the Concessionaire shall be entitled to exercise such option only if the Concessionaire has participated in the bidding process either individually or as a consortium or JV with another company and fulfils the eligibility criteria to undertake such work without compromising with its overall liability. All such changes shall be made by NHAI by an order issued in accordance with the procedure set forth in the Kaljhar - Patacharkuchi Concession Agreement.

Termination of the Kaljhar - Patacharkuchi Concession Agreement

Termination by either party

Either Party may in its discretion terminate the Kaljhar - Patacharkuchi Concession Agreement by giving a termination notice to the other party if a force majeure event subsists for a period of 120 (one hundred and twenty) days or more within a continuous period of 365 (three hundred and sixty five) days. Before issuing such termination notice, the party intending to issue the termination notice shall inform the other party of such intention and grant 15 (fifteen) days' time to make a representation and may after the expiry of such 15(fifteen) days period, whether or not it is in receipt of such representation, in its sole discretion issue the termination notice.

Termination by the NHAI

In the event of any of the defaults specified below have occurred, and if the Concessionaire has failed to cure such breach or default within the period provided for the same in the Kaljhar - Patacharkuchi Concession Agreement, then NHAI shall be entitled to issue a notice of its intention to terminate the Kaljhar - Patacharkuchi Concession Agreement, with a copy to the lenders. The following events shall constitute an event of default by the Concessionaire (a "**Concessionaire Default**") unless they have occurred as a result of any breach of the Kaljhar - Patacharkuchi Concession Agreement by NHAI or due to force majeure:

i. the performance security has been encashed and appropriated in accordance with the Kaljhar - Patacharkuchi Concession Agreement and the Concessionaire has failed to replenish or provide fresh performance security within a cure period of 15 (fifteen) days;

ii. subsequent to the replenishment or furnishing of fresh performance security in accordance with the Kaljhar - Patacharkuchi Concession Agreement, the Concessionaire fails to cure, within a cure period of 60 (sixty) days, the

Concessionaire Default for which whole or part of the performance security was appropriated;

iii. the Concessionaire abandons or manifests intention to abandon the operation and maintenance of the Kaljhar - Patacharkuchi Project Highway without the prior written consent of NHAI;

iv. the Concessionaire fails to roll over, renew and furnish new bank guarantee performance security subject to and in accordance with terms of the Kaljhar - Patacharkuchi Concession Agreement, at least three months prior to expiry of subsisting bank guarantee;

v. the Concessionaire is in breach of the Maintenance Requirements or the Safety Requirements, as the case may be;

vi the Concessionaire has failed to make any payment to NHAI within the period specified in the Kaljhar - Patacharkuchi Concession Agreement;

vii. upon occurrence of a financial default, the lenders' representative has by notice required NHAI to undertake suspension or termination, as the case may be, in accordance with the substitution agreement and the Concessionaire fails to cure the default within the specified cure period;

viii. a breach of any of the project agreements by the Concessionaire causes a material adverse effect;

ix. the Concessionaire creates any encumbrance in breach of the Kaljhar - Patacharkuchi Concession Agreement;

x. the Concessionaire repudiates the Kaljhar - Patacharkuchi Concession Agreement or otherwise takes any action or evidences or conveys an intention not to be bound by the Kaljhar - Patacharkuchi Concession Agreement;

xi. a change in ownership occurs in breach of the provisions of the Kaljhar - Patacharkuchi Concession Agreement;

xii. there is a transfer, pursuant to law either of (i) the rights and/or obligations of the Concessionaire under any of the project agreements, or of (ii) all or part of the assets or undertaking of the Concessionaire, and such transfer causes a material adverse effect;

xiii. an execution levied on any of the assets of the Concessionaire has caused a material adverse effect;

xiv. the Concessionaire is adjudged bankrupt or insolvent, or if a trustee or receiver is appointed for the Concessionaire or for the whole or material part of its assets that has a material bearing on the Kaljhar - Patacharkuchi Project;

xv. the Concessionaire has been, or is in the process of being liquidated, dissolved, wound-up, amalgamated or reconstituted in a manner that would cause, in the reasonable opinion of NHAI, a material adverse effect;

xvi. a resolution for winding up of the Concessionaire is passed or any petition for winding up of the Concessionaire is admitted by a court of competent jurisdiction and a provisional liquidator or receiver is appointed and such order has not been set aside within 90 (ninety) days of the date thereof or the Concessionaire is ordered to be wound up by Court except for the purpose of amalgamation or reconstruction; provided that, as part of such amalgamation or reconstruction, the entire property, assets and undertaking of the Concessionaire are transferred to the amalgamated or reconstructed entity and that the amalgamated or reconstructed entity has unconditionally assumed the obligations of the Concessionaire under the Kaljhar - Patacharkuchi Concession Agreement and the project agreements; and provided that:

a. the amalgamated or reconstructed entity has the capability and operating experience necessary for the performance of its obligations under the Kaljhar - Patacharkuchi Concession Agreement and the project agreements;

b. the amalgamated or reconstructed entity has the financial standing to perform its obligations under the Kaljhar - Patacharkuchi Concession Agreement and the project agreements and has a credit worthiness at least as good as that of the Concessionaire as at Appointed Date; and

c. each of the project agreements remains in full force and effect;

xvii. any representation or warranty of the Concessionaire herein contained which is, as of the date of Kaljhar - Patacharkuchi Concession Agreement, found to be materially false, incorrect or misleading;

xviii. the Concessionaire submits to NHAI any statement, notice or other document, in written or electronic form, which has a material effect on NHAI's rights, obligations or interests and which is false in material particulars;

xix. the Concessionaire has failed to fulfil any obligation, for which failure termination has been specified in the Kaljhar - Patacharkuchi Concession Agreement;

xx. the Concessionaire commits a default in complying with any other provision of the Kaljhar - Patacharkuchi Concession Agreement if such default causes a material adverse effect on NHAI;

xxi. an escrow default occurs and the Concessionaire fails to cure the default within a cure period of 15 (fifteen) days;

Termination by Concessionaire

If any of the defaults specified below shall have occurred, and NHAI fails to cure such default within a cure period of 90 (ninety) days or such longer period as has been expressly provided in the Kaljhar - Patacharkuchi Concession Agreement, NHAI shall be deemed to be in default of the Kaljhar - Patacharkuchi Concession Agreement, unless the default has occurred as a result of any breach of the Kaljhar - Patacharkuchi Concession Agreement by the Concessionaire or due to force majeure:

i. NHAI commits a material default in complying with any of the provisions of the Kaljhar - Patacharkuchi Concession Agreement and such default has a material adverse effect on the Concessionaire; or

ii. NHAI repudiates the Kaljhar - Patacharkuchi Concession Agreement or otherwise takes any action that amounts to or manifests an irrevocable intention not to be bound by the Kaljhar - Patacharkuchi Concession Agreement; or

iii. the State commits a material default in complying with the provisions of the State Support Agreement if such default has a Material Adverse Effect on the Concessionaire and the breach continues for a period of 90 (ninety) days from the date of notice given in this behalf by the Concessionaire to the Authority.

Termination Payments

The termination payment pursuant to the Kaljhar - Patacharkuchi Concession Agreement becomes due and payable to the Concessionaire by NHAI within 15 (fifteen) days of the Concessionaire furnishing to NHAI an NOC issued by the lenders/ lenders' representative recording/ effecting release/ vacation/ discharge of the charge on Kaljhar - Patacharkuchi Project receivables (if any) created by Concessionaire for securing repayment of the debt. If NHAI fails to disburse the full termination payment within 15 (fifteen) days, NHAI shall pay interest at a rate equal to 3% (three per cent) above the bank rate on the amount of termination payment remaining unpaid.

Upon termination of the Kaljhar - Patacharkuchi Concession Agreement by the NHAI on account of occurrence of a Concessionaire Default, the NHAI shall pay the Concessionaire by way of termination payment 70% (seventy per cent) of the Unexpired Cash Flow.

Upon termination of the Kaljhar - Patacharkuchi Concession Agreement by the Concessionaire on account of occurrence of an NHAI Default, the Concessionaire shall be entitled to receive from NHAI by way of termination payment a sum equal to 105% (one hundred and five per cent) of the Unexpired Cash Flow.

Technical Clarifications on the Concession Agreements

For details in relation to the technical clarifications received from NHAI in relation to the Concession Agreements, please refer to Annexure 1 of the Kaljhar - Patacharkuchi Concession Agreement.

3. *Concession Agreement between NEPPL ("Concessionaire") and NHAI dated March 7, 2024 in respect of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project*

The Concessionaire has entered into a concession agreement for tolling, operation, maintenance and transfer of Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project Highway (as defined below) on toll, operate and transfer (TOT) basis (the "**Lakhnadon Mahagaon (Mohgaon) – Khawasa Concession Agreement**"), for a period of 20 years (twenty years) from the the Appointed Date (i.e., the date on which all Conditions Precedent have been satisfied) or such date on which the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement is terminated by a termination notice ("**Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Period**").

Certain Definitions

"**Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project**" means the operation and maintenance of the Lakhnadon - - Mahagaon (Mohgaon) Khawasa Project Highway in accordance with the provisions of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement and includes all works, services and equipment relating to or in respect of the scope of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project as set forth in the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement;

"**Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project Assets**" means all physical and other assets relating to and forming part of the Site including (a) rights over the Site in the form of licence, Right of Way or otherwise; (b) tangible assets such as civil works and equipment including foundations, embankments, pavements, road surface, interchanges,

bridges, culverts, road overbridges, drainage works, traffic signals, sign boards, kilometre- stones, toll plazas, electrical systems, communication systems, rest areas, relief centers, maintenance depots and administrative offices; (d) all rights of the Concessionaire under the project agreements; (security deposits; (e) insurance proceeds; and (g) Applicable Permits and authorisations relating to or in respect of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project Highway, but does not include Additional Facilities; and

"**Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project Highway**" means the Site comprising the existing road comprising:

Stretch	**State**	**Start (Km)**	**End (Km)**	**Length**
Lakhnadon – Mahagaon (Mohgaon) – Khawasa	Madhya Pradesh	546+420	653+770	107.35

and all Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project Assets."

Grant of Concession

Subject to and in accordance with the terms and conditions set forth in the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement, NHAI has granted to the Concessionaire, and the Concessionaire has accepted the concession for a period of 20 years (twenty years), including the exclusive right, license and authority during the subsistence of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Agreement to operate, manage and maintain the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project Highway. Notwithstanding anything to the contrary in the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement, the parties have expressly agreed that the Concession Period shall not be reduced by more than 5 (five) years, or shall not be increased by more than 10 (ten) years on any account or for any reason whatsoever.

Subject to and in accordance with the terms and conditions set forth in the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement, the Concessionaire is entitled to undertake the following in accordance with the terms of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement, applicable laws and applicable permits:

i. Right of Way, access and license to the Site for the purpose of and to the extent conferred by the provisions of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement;

ii. manage, operate and maintain the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project Highway and regulate the use thereof by third parties in accordance with the terms of Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement;

iii. demand, collect and appropriate the fees from vehicles and persons liable for payment of fees for using the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project Highway or any part thereof and refuse entry of any vehicle to the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project Highway if the fee due is not paid;

iv. perform and fulfill all of the Concessionaire's obligations under and in accordance with the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement;

v. bear and pay all costs, expenses and charges in connection with or incidental to the performance of the obligations of the Concessionaire under the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement; and

vi. neither assign, transfer or sublet or create any lien or encumbrance on the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement, or the concession granted thereby, or on the whole or any part of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project Highway nor transfer, lease or part possession thereof, save and except as expressly permitted by the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement.

Fees

The Concessionaire is entitled to, during the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Period, levy, collect and appropriate fees from users ("**User Fee**") of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project Highway pursuant to and in accordance with the provisions in the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement and the Fee Rules and to appropriate the same. In accordance with the terms of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement, the Concessionaire shall not collect any fees in relation to exempted vehicles. The fees collected by Concessionaire shall be deposited in the escrow account and appropriated in accordance with the relevant provisions of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement.

Sub Rule 6(6) of the above-mentioned Fee Rules states,

"(a) The fee shall be collected by the Central Government or the executing Authority as the case may be and for a specified

period in accordance with the terms of agreement entered by the Concessionaire.

(b) The fee as notified as per Concession Agreement shall be leviable till the end of the concession period and after the Concession Agreement is over, the fee shall be collected by the Central Government executing authority at a reduced rate of 40% of the fee on the date of transfer of such section of National Highways, bridge, tunnel or bypass, as the case may be, to be revised annually in accordance with these rules:

Provided that after the recovery of capital cost through user fee realised, in respect of a public funded project, the fee leviable would be reduced to 40% of the user fee for such section of National Highways, bridge, tunnel or bypass as the case may be, to be revised annually in accordance with these rules."

In respect of the above, NHAI has clarified that Rule 6 of the Fee Rules provides that the user fee to be notified by Government as per the format of Schedule M of Concession Agreement shall be leviable till the end of the concession period. Hence, the rate of User Fee rate shall only be reduced after the concession period is over.

Concession Fees

As consideration for the grant of the Concession, the Concessionaire is required to pay a concession fee to NHAI equivalent to ₹ 25,526.00 million, within 120 (one hundred and twenty) days of the date of execution of the concession agreement or any extended date as agreed by NHAI prior to the Appointed Date as a Condition Precedent. The Concessionaire agrees that payment of the concession fee constitutes essential condition of the Concession Agreement. Further, as communicated by the Authority by way of a letter dated October 31, 2023, any amount raised from the proceeds of the Issue in excess of the base concession fee (being the aggregate of Concession Fees payable to NHAI in terms of the Additional Concession Agreements) shall be paid to the Authority. For further details, see the section titled "*Use of Proceeds – Details of Utilisation of Issue Proceeds - Infusion of debt and/or equity into NEPPL*" on page 273.

For the purposes of stamp duty payment, concession agreements are generally considered to be agreements which are not lease deeds and stamp duty of ₹ 100.00 is typically paid for such concession agreements. However, stamp duty authorities of certain states in India have issued notices to some concessionaires alleging inadequate stamp duty on the concession agreements executed between the concessionaires and the NHAI. The stamp authorities allege that since concession agreements relate to the letting of tolls to the concessionaires in the form of leases, or as development agreements, such agreements were required to be stamped as lease agreements or development agreements, as applicable. The stamp duty for a lease agreement or a development agreement ranges between 1.0% and 11.0% of the annual rent or premium payable or the market value of the property. Furthermore, stamp duty authorities may impose penalties for payment of inadequate stamp duty, which could extend up to ten (10) times the amount of the stamp duty payable. Accordingly, concession agreements that have not been stamped as such could be considered to be inadequately stamped. The High Courts of Allahabad and Maharashtra have also held that a concession agreement ought to be stamped as a lease agreement and have upheld the imposition of a higher stamp duty on such agreements.

While we have paid stamp duty of ₹ 100.00 on each of our Concession Agreements in accordance with usual practice, if any demand for payment of a higher stamp duty or penalty is imposed, it would increase the costs of the Toll Roads.

In respect of above, NHAI has clarified that:

(i) As on the date of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement, GST is not applicable on Concession Fee. However, if it becomes applicable at a later stage, this shall be considered as change in law.

(ii) There is no requirement of stamp duty in case of Concession Agreements since Fee Rules provided for levy and collection of user fee and not toll tax. In case, in future any such demand arises, it shall be treated as change in law.

Escrow Account

The Concessionaire shall, prior to the Appointed Date, open and establish the escrow account with the escrow bank and all funds constituting the financing package related to the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project shall be credited to such escrow account. During the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Period all fees and any other revenues including the proceeds of any rentals, deposits, capital receipts or insurance claims from or in respect of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project Highway shall be deposited therein. In addition, all payments by NHAI pursuant to the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement, including, if any, in relation to the change of scope in the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project shall be deposited by NHAI in the escrow account.

Withdrawals from Escrow Account

The Concessionaire shall, at the time of the opening of the escrow account, give irrevocable instructions by way of an escrow

agreement substantially in form set forth in the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement to the escrow bank instructing, *inter alia*, that the deposits into the escrow account shall subject to the provisions of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement, be appropriated in the following order every month and if not due in a month then appropriated proportionately in such month and retained in the escrow account and paid out therefrom in the month when due unless otherwise expressly provided in the instruction letter:

i. all taxes due and payable by the Concessionaire for and in respect of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project Highway;

ii. concession fee;

iii. all payments relating to construction of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project Highway, subject to and in accordance with the conditions, if any, set forth in the financing agreements;

iv. operation and maintenance expenses;

v. operation and maintenance expenses and other costs and expenses incurred by NHAI in accordance with the provisions of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement, and certified by NHAI as due and payable to it;

vi. monthly proportionate provision of debt service payment due in an accounting year;

vii. all payments and damages certified by NHAI as due and payable to it by the Concessionaire; and

vii. balance, if any, in accordance with the instructions of the Concessionaire.

Withdrawals upon Termination

Notwithstanding anything to the contrary contained in the escrow agreement and subject to the provisions of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement, in the case of termination, the amounts standing to the credit of the escrow account shall be appropriated in the following order:

i. all taxes due and payable by the Concessionaire for and in respect of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project Highway;

ii. payment due to the lenders;

iii. all payments and damages certified by NHAI as due and payable to it by the Concessionaire;

iv. retention and payments relating to the liability for defects and deficiencies;

v. incurred or accrued operation and maintenance expenses;

vi. any other payments required to be made under the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement; and

vii. balance, if any, in accordance with the instructions of the Concessionaire.

Change of Scope

NHAI may, notwithstanding anything to the contrary contained in the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement, require the Concessionaire to make alterations/ modifications in the scope of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project as contemplated by the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement. If the cumulative costs relating to all the change of scope orders exceed 5% (five per cent) of the concession fee in any continuous period of 3 (three) years immediately preceding the date of such change of scope order or if such cumulative costs exceed 25% (twenty five per cent) of the concession fee at any time during the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Period, NHAI may award any works or services, to any person on the basis of open competitive bidding and the Concessionaire shall be entitled to take part in such competitive bidding with a right to match the first-ranked bid in terms of the selection criteria, either by itself where such work requires tolling, operation and maintenance, or through another company where such work requires construction on any part of the Project Highway, subject to payment of 2% (two per cent) of the bid amount to the Authority, and thereupon securing the award of such works or services. For the avoidance of doubt, it is agreed that the Concessionaire shall be entitled to exercise such option only if the Concessionaire has participated in the bidding process either individually or as a consortium or JV with another company and fulfils the eligibility criteria to undertake such work without compromising with its overall liability. All such changes shall be made by NHAI by an order issued in accordance with the procedure set forth in the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement.

Termination of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement

Termination by either party

Either Party may in its discretion terminate the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement by giving a termination notice to the other party if a force majeure event subsists for a period of 120 (one hundred and twenty) days or more within a continuous period of 365 (three hundred and sixty five) days. Before issuing such termination notice, the party intending to issue the termination notice shall inform the other party of such intention and grant 15 (fifteen) days' time to make a representation and may after the expiry of such 15 (fifteen) days period, whether or not it is in receipt of such representation, in its sole discretion issue the termination notice.

Termination by the NHAI

In the event of any of the defaults specified below have occurred, and if the Concessionaire has failed to cure such breach or default within the period provided for the same in the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement, then NHAI shall be entitled to issue a notice of its intention to terminate the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement, with a copy to the lenders. The following events shall constitute an event of default by the Concessionaire (a "**Concessionaire Default**") unless they have occurred as a result of any breach of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement by NHAI or due to force majeure:

i. the performance security has been encashed and appropriated in accordance with the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement and the Concessionaire has failed to replenish or provide fresh performance security within a cure period of 15 (fifteen) days;

ii. subsequent to the replenishment or furnishing of fresh performance security in accordance with the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement, the Concessionaire fails to cure, within a cure period of 60 (sixty) days, the Concessionaire Default for which whole or part of the performance security was appropriated;

iii. the Concessionaire abandons or manifests intention to abandon the operation and maintenance of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project Highway without the prior written consent of NHAI;

iv. the Concessionaire fails to roll over, renew and furnish new bank guarantee performance security subject to and in accordance with terms of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement, at least three months prior to expiry of subsisting bank guarantee;

v. the Concessionaire is in breach of the Maintenance Requirements or the Safety Requirements, as the case may be;

vi the Concessionaire has failed to make any payment to NHAI within the period specified in the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement;

vii. upon occurrence of a financial default, the lenders' representative has by notice required NHAI to undertake suspension or termination, as the case may be, in accordance with the substitution agreement and the Concessionaire fails to cure the default within the specified cure period;

viii. a breach of any of the project agreements by the Concessionaire causes a material adverse effect;

ix. the Concessionaire creates any encumbrance in breach of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement;

x. the Concessionaire repudiates the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement or otherwise takes any action or evidences or conveys an intention not to be bound by the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement;

xi. a change in ownership occurs in breach of the provisions of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement;

xii. there is a transfer, pursuant to law either of (i) the rights and/or obligations of the Concessionaire under any of the project agreements, or of (ii) all or part of the assets or undertaking of the Concessionaire, and such transfer causes a material adverse effect;

xiii. an execution levied on any of the assets of the Concessionaire has caused a material adverse effect;

xiv. the Concessionaire is adjudged bankrupt or insolvent, or if a trustee or receiver is appointed for the Concessionaire or for the whole or material part of its assets that has a material bearing on the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project;

xv. the Concessionaire has been, or is in the process of being liquidated, dissolved, wound-up, amalgamated or reconstituted in a manner that would cause, in the reasonable opinion of NHAI, a material adverse effect;

xvi. a resolution for winding up of the Concessionaire is passed or any petition for winding up of the Concessionaire is admitted by a court of competent jurisdiction and a provisional liquidator or receiver is appointed and such order has not been set aside within 90 (ninety) days of the date thereof or the Concessionaire is ordered to be wound up by Court except for the purpose of amalgamation or reconstruction; provided that, as part of such amalgamation or reconstruction, the entire property, assets and undertaking of the Concessionaire are transferred to the amalgamated or reconstructed entity and that the amalgamated or reconstructed entity has unconditionally assumed the obligations of the Concessionaire under the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement and the project agreements; and provided that:

a. the amalgamated or reconstructed entity has the capability and operating experience necessary for the performance of its obligations under the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement and the project agreements;

b. the amalgamated or reconstructed entity has the financial standing to perform its obligations under the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement and the project agreements and has a credit worthiness at least as good as that of the Concessionaire as at Appointed Date; and

c. each of the project agreements remains in full force and effect;

xvii. any representation or warranty of the Concessionaire herein contained which is, as of the date of Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement, found to be materially false, incorrect or misleading;

xviii. the Concessionaire submits to NHAI any statement, notice or other document, in written or electronic form, which has a material effect on NHAI's rights, obligations or interests and which is false in material particulars;

xix. the Concessionaire has failed to fulfil any obligation, for which failure termination has been specified in the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement;

xx. the Concessionaire commits a default in complying with any other provision of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement if such default causes a material adverse effect on NHAI;

xxi. an escrow default occurs and the Concessionaire fails to cure the default within a cure period of 15 (fifteen) days;

Termination by Concessionaire

If any of the defaults specified below shall have occurred, and NHAI fails to cure such default within a cure period of 90 (ninety) days or such longer period as has been expressly provided in the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement, NHAI shall be deemed to be in default of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement, unless the default has occurred as a result of any breach of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement by the Concessionaire or due to force majeure:

i. NHAI commits a material default in complying with any of the provisions of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement and such default has a material adverse effect on the Concessionaire; or

ii. NHAI repudiates the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement or otherwise takes any action that amounts to or manifests an irrevocable intention not to be bound by the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement; or

iii. the State commits a material default in complying with the provisions of the State Support Agreement if such default has a Material Adverse Effect on the Concessionaire and the breach continues for a period of 90 (ninety) days from the date of notice given in this behalf by the Concessionaire to the Authority.

Termination Payments

The termination payment pursuant to the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement becomes due and payable to the Concessionaire by NHAI within 15 (fifteen) days of the Concessionaire furnishing to NHAI an NOC issued by the lenders/ lenders' representative recording/ effecting release/ vacation/ discharge of the charge on Lakhnadon - Mahagaon (Mohgaon) – Khawasa Project receivables (if any) created by Concessionaire for securing repayment of the debt. If NHAI fails to disburse the full termination payment within 15 (fifteen) days, NHAI shall pay interest at a rate equal to 3% (three per cent) above the bank rate on the amount of termination payment remaining unpaid.

Upon termination of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement by the NHAI on account of

occurrence of a Concessionaire Default, the NHAI shall pay the Concessionaire by way of termination payment 70% (seventy per cent) of the Unexpired Cash Flow.

Upon termination of the Lakhnadon - Mahagaon (Mohgaon) – Khawasa Concession Agreement by the Concessionaire on account of occurrence of an NHAI Default, the Concessionaire shall be entitled to receive from NHAI by way of termination payment a sum equal to 105% (one hundred and five per cent) of the Unexpired Cash Flow.

Technical Clarifications on the Concession Agreements

For details in relation to the technical clarifications received from NHAI in relation to the Concession Agreements, please refer to Annexure 1 of the Lakhnadon - - Mahagaon (Mohgaon) Khawasa Concession Agreement.

4. *Concession Agreement between NEPPL ("Concessionaire") and NHAI dated March 7, 2024 in respect of the Chitradurga Bypass – Hubli Project/ Karnataka Project*

The Concessionaire has entered into a concession agreement for tolling, operation, maintenance and transfer of Chitradurga Bypass – Hubli Project/ Karnataka Project Highway (as defined below) on toll, operate and transfer (TOT) basis (the "**Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement**"), for a period of 20 years (twenty years) from the the Appointed Date (i.e., the date on which all Conditions Precedent have been satisfied) or such date on which the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement is terminated by a termination notice ("**Chitradurga Bypass – Hubli Project/ Karnataka Concession Period**").

Certain Definitions

"**Chitradurga Bypass – Hubli Project/ Karnataka Project**" means the operation and maintenance of the Chitradurga Bypass – Hubli Project/ Karnataka Project Highway in accordance with the provisions of the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement and includes all works, services and equipment relating to or in respect of the scope of the Chitradurga Bypass – Hubli Project/ Karnataka Project as set forth in the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement;

"**Chitradurga Bypass – Hubli Project/ Karnataka Project Assets**" means all physical and other assets relating to and forming part of the Site including (a) rights over the Site in the form of licence, Right of Way or otherwise; (b) tangible assets such as civil works and equipment including foundations, embankments, pavements, road surface, interchanges, bridges, culverts, road overbridges, drainage works, traffic signals, sign boards, kilometre- stones, toll plazas, electrical systems, communication systems, rest areas, relief centers, maintenance depots and administrative offices; (d) all rights of the Concessionaire under the project agreements; (security deposits; (e) insurance proceeds; and (g) Applicable Permits and authorisations relating to or in respect of the Chitradurga Bypass – Hubli Project/ Karnataka Project Highway, but does not include Additional Facilities; and

"**Chitradurga Bypass – Hubli Project/ Karnataka Project Highway**" means the Site comprising the existing road comprising:

Stretch	State	Start (Km)	End (Km)	Length (Km)
Chitradurga Bypass	Karnataka	0+000	20+700	20.7
Chitradurga to Davanagere	Karnataka	208+000	260+000	51.98
Davanagere to Haveri	Karnataka	260+000	338+923	78.913
Haveri to Hubli	Karnataka	340+000	403+000	62.877

and all Chitradurga Bypass – Hubli Project/ Karnataka Project Assets."

Grant of Concession

Subject to and in accordance with the terms and conditions set forth in the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement, NHAI has granted to the Concessionaire, and the Concessionaire has accepted the concession for a period of 20 years (twenty years), including the exclusive right, license and authority during the subsistence of the Chitradurga Bypass – Hubli Project/ Karnataka Agreement to operate, manage and maintain the Chitradurga Bypass – Hubli Project/ Karnataka Project Highway. Notwithstanding anything to the contrary in the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement, the parties have expressly agreed that the Concession Period shall not be reduced by more than 5 (five) years, or shall not be increased by more than 10 (ten) years on any account or for any reason whatsoever.

Subject to and in accordance with the terms and conditions set forth in the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement, the Concessionaire is entitled to undertake the following in accordance with the terms of the

Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement, applicable laws and applicable permits:

i. Right of Way, access and license to the Site for the purpose of and to the extent conferred by the provisions of the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement;

ii. manage, operate and maintain the Chitradurga Bypass – Hubli Project/ Karnataka Project Highway and regulate the use thereof by third parties in accordance with the terms of Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement;

iii. demand, collect and appropriate the fees from vehicles and persons liable for payment of fees for using the Chitradurga Bypass – Hubli Project/ Karnataka Project Highway or any part thereof and refuse entry of any vehicle to the Chitradurga Bypass – Hubli Project/ Karnataka Project Highway if the fee due is not paid;

iv. perform and fulfill all of the Concessionaire's obligations under and in accordance with the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement;

v. bear and pay all costs, expenses and charges in connection with or incidental to the performance of the obligations of the Concessionaire under the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement; and

vi. neither assign, transfer or sublet or create any lien or encumbrance on the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement, or the concession granted thereby, or on the whole or any part of the Chitradurga Bypass – Hubli Project/ Karnataka Project Highway nor transfer, lease or part possession thereof, save and except as expressly permitted by the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement.

Fees

The Concessionaire is entitled to, during the Chitradurga Bypass – Hubli Project/ Karnataka Concession Period, levy, collect and appropriate fees from users ("**User Fee**") of the Chitradurga Bypass – Hubli Project/ Karnataka Project Highway pursuant to and in accordance with the provisions in the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement and the Fee Rules and to appropriate the same. In accordance with the terms of the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement, the Concessionaire shall not collect any fees in relation to exempted vehicles. The fees collected by Concessionaire shall be deposited in the escrow account and appropriated in accordance with the relevant provisions of the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement.

Sub Rule 6(6) of the above-mentioned Fee Rules states,

"(a) The fee shall be collected by the Central Government or the executing Authority as the case may be and for a specified period in accordance with the terms of agreement entered by the Concessionaire.
(b) The fee as notified as per Concession Agreement shall be leviable till the end of the concession period and after the Concession Agreement is over, the fee shall be collected by the Central Government executing authority at a reduced rate of 40% of the fee on the date of transfer of such section of National Highways, bridge, tunnel or bypass, as the case may be, to be revised annually in accordance with these rules:

Provided that after the recovery of capital cost through user fee realised, in respect of a public funded project, the fee leviable would be reduced to 40% of the user fee for such section of National Highways, bridge, tunnel or bypass as the case may be, to be revised annually in accordance with these rules."

In respect of the above, NHAI has clarified that Rule 6 of the Fee Rules provides that the user fee to be notified by Government as per the format of Schedule M of Concession Agreement shall be leviable till the end of the concession period. Hence, the rate of User Fee rate shall only be reduced after the concession period is over.

Concession Fees

As consideration for the grant of the Concession, the Concessionaire is required to pay a concession fee to NHAI equivalent to ₹ 49,418.00 million, within 120 (one hundred and twenty) days of the date of execution of the concession agreement or any extended date as agreed by NHAI prior to the Appointed Date as a Condition Precedent. The Concessionaire agrees that payment of the concession fee constitutes essential condition of the Concession Agreement. Further, as communicated by the Authority by way of a letter dated October 31, 2023, any amount raised from the proceeds of the Issue in excess of the base concession fee (being the aggregate of Concession Fees payable to NHAI in terms of the Additional Concession Agreements) shall be paid to the Authority. For further details, see the section titled "*Use of Proceeds – Details of Utilisation of Issue Proceeds - Infusion of debt and/or equity into NEPPL*" on page 273.

For the purposes of stamp duty payment, concession agreements are generally considered to be agreements which are not lease deeds and stamp duty of ₹ 100.00 is typically paid for such concession agreements. However, stamp duty authorities of certain states in India have issued notices to some concessionaires alleging inadequate stamp duty on the concession agreements executed between the concessionaires and the NHAI. The stamp authorities allege that since concession

agreements relate to the letting of tolls to the concessionaires in the form of leases, or as development agreements, such agreements were required to be stamped as lease agreements or development agreements, as applicable. The stamp duty for a lease agreement or a development agreement ranges between 1.0% and 11.0% of the annual rent or premium payable or the market value of the property. Furthermore, stamp duty authorities may impose penalties for payment of inadequate stamp duty, which could extend up to ten (10) times the amount of the stamp duty payable. Accordingly, concession agreements that have not been stamped as such could be considered to be inadequately stamped. The High Courts of Allahabad and Maharashtra have also held that a concession agreement ought to be stamped as a lease agreement and have upheld the imposition of a higher stamp duty on such agreements.

While we have paid stamp duty of ₹ 100.00 on each of our Concession Agreements in accordance with usual practice, if any demand for payment of a higher stamp duty or penalty is imposed, it would increase the costs of the Toll Roads.

In respect of above, NHAI has clarified that:

(i) As on the date of the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement, GST is not applicable on Concession Fee. However, if it becomes applicable at a later stage, this shall be considered as change in law.

(ii) There is no requirement of stamp duty in case of Concession Agreements since Fee Rules provided for levy and collection of user fee and not toll tax. In case, in future any such demand arises, it shall be treated as change in law.

Escrow Account

The Concessionaire shall, prior to the Appointed Date, open and establish the escrow account with the escrow bank and all funds constituting the financing package related to the Chitradurga Bypass – Hubli Project/ Karnataka Project shall be credited to such escrow account. During the Chitradurga Bypass – Hubli Project/ Karnataka Concession Period all fees and any other revenues including the proceeds of any rentals, deposits, capital receipts or insurance claims from or in respect of the Chitradurga Bypass – Hubli Project/ Karnataka Project Highway shall be deposited therein. In addition, all payments by NHAI pursuant to the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement, including, if any, in relation to the change of scope in the Chitradurga Bypass – Hubli Project/ Karnataka Project shall be deposited by NHAI in the escrow account.

Withdrawals from Escrow Account

The Concessionaire shall, at the time of the opening of the escrow account, give irrevocable instructions by way of an escrow agreement substantially in form set forth in the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement to the escrow bank instructing, *inter alia*, that the deposits into the escrow account shall subject to the provisions of the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement, be appropriated in the following order every month and if not due in a month then appropriated proportionately in such month and retained in the escrow account and paid out therefrom in the month when due unless otherwise expressly provided in the instruction letter:

i. all taxes due and payable by the Concessionaire for and in respect of the Chitradurga Bypass – Hubli Project/ Karnataka Project Highway;

ii. concession fee;

iii. all payments relating to construction of the Chitradurga Bypass – Hubli Project/ Karnataka Project Highway, subject to and in accordance with the conditions, if any, set forth in the financing agreements;

iv. operation and maintenance expenses;

v. operation and maintenance expenses and other costs and expenses incurred by NHAI in accordance with the provisions of the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement, and certified by NHAI as due and payable to it;

vi. monthly proportionate provision of debt service payment due in an accounting year;

vii. all payments and damages certified by NHAI as due and payable to it by the Concessionaire; and

vii. balance, if any, in accordance with the instructions of the Concessionaire.

Withdrawals upon Termination

Notwithstanding anything to the contrary contained in the escrow agreement and subject to the provisions of the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement, in the case of termination, the amounts standing to the credit of the escrow account shall be appropriated in the following order:

i. all taxes due and payable by the Concessionaire for and in respect of the Chitradurga Bypass – Hubli Project/ Karnataka Project Highway;

ii. payment due to the lenders;

iii. all payments and damages certified by NHAI as due and payable to it by the Concessionaire;

iv. retention and payments relating to the liability for defects and deficiencies;

v. incurred or accrued operation and maintenance expenses;

vi. any other payments required to be made under the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement; and

vii. balance, if any, in accordance with the instructions of the Concessionaire.

Change of Scope

NHAI may, notwithstanding anything to the contrary contained in the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement, require the Concessionaire to make alterations/ modifications in the scope of the Chitradurga Bypass – Hubli Project/ Karnataka Project as contemplated by the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement. If the cumulative costs relating to all the change of scope orders exceed 5% (five per cent) of the concession fee in any continuous period of 3 (three) years immediately preceding the date of such change of scope order or if such cumulative costs exceed 25% (twenty five per cent) of the concession fee at any time during the Chitradurga Bypass – Hubli Project/ Karnataka Concession Period, NHAI may award any works or services, to any person on the basis of open competitive bidding and the Concessionaire shall be entitled to take part in such competitive bidding with a right to match the first-ranked bid in terms of the selection criteria, either by itself where such work requires tolling, operation and maintenance, or through another company where such work requires construction on any part of the Project Highway, subject to payment of 2% (two per cent) of the bid amount to the Authority, and thereupon securing the award of such works or services. For the avoidance of doubt, it is agreed that the Concessionaire shall be entitled to exercise such option only if the Concessionaire has participated in the bidding process either individually or as a consortium or JV with another company and fulfils the eligibility criteria to undertake such work without compromising with its overall liability. All such changes shall be made by NHAI by an order issued in accordance with the procedure set forth in the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement.

Termination of the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement

Termination by either party

Either Party may in its discretion terminate the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement by giving a termination notice to the other party if a force majeure event subsists for a period of 120 (one hundred and twenty) days or more within a continuous period of 365 (three hundred and sixty five) days. Before issuing such termination notice, the party intending to issue the termination notice shall inform the other party of such intention and grant 15 (fifteen) days' time to make a representation and may after the expiry of such 15 (fifteen) days period, whether or not it is in receipt of such representation, in its sole discretion issue the termination notice.

Termination by the NHAI

In the event of any of the defaults specified below have occurred, and if the Concessionaire has failed to cure such breach or default within the period provided for the same in the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement, then NHAI shall be entitled to issue a notice of its intention to terminate the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement, with a copy to the lenders. The following events shall constitute an event of default by the Concessionaire (a "**Concessionaire Default**") unless they have occurred as a result of any breach of the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement by NHAI or due to force majeure:

i. the performance security has been encashed and appropriated in accordance with the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement and the Concessionaire has failed to replenish or provide fresh performance security within a cure period of 15 (fifteen) days;

ii. subsequent to the replenishment or furnishing of fresh performance security in accordance with the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement, the Concessionaire fails to cure, within a cure period of 60 (sixty) days, the Concessionaire Default for which whole or part of the performance security was appropriated;

iii. the Concessionaire abandons or manifests intention to abandon the operation and maintenance of the Chitradurga Bypass – Hubli Project/ Karnataka Project Highway without the prior written consent of NHAI;

iv. the Concessionaire fails to roll over, renew and furnish new bank guarantee performance security subject to and in accordance with terms of the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement, at least three months prior to expiry of subsisting bank guarantee;

v. the Concessionaire is in breach of the Maintenance Requirements or the Safety Requirements, as the case may be;

vi the Concessionaire has failed to make any payment to NHAI within the period specified in the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement;

vii. upon occurrence of a financial default, the lenders' representative has by notice required NHAI to undertake suspension or termination, as the case may be, in accordance with the substitution agreement and the Concessionaire fails to cure the default within the specified cure period;

viii. a breach of any of the project agreements by the Concessionaire causes a material adverse effect;

ix. the Concessionaire creates any encumbrance in breach of the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement;

x. the Concessionaire repudiates the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement or otherwise takes any action or evidences or conveys an intention not to be bound by the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement;

xi. a change in ownership occurs in breach of the provisions of the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement;

xii. there is a transfer, pursuant to law either of (i) the rights and/or obligations of the Concessionaire under any of the project agreements, or of (ii) all or part of the assets or undertaking of the Concessionaire, and such transfer causes a material adverse effect;

xiii. an execution levied on any of the assets of the Concessionaire has caused a material adverse effect;

xiv. the Concessionaire is adjudged bankrupt or insolvent, or if a trustee or receiver is appointed for the Concessionaire or for the whole or material part of its assets that has a material bearing on the Chitradurga Bypass – Hubli Project/ Karnataka Project;

xv. the Concessionaire has been, or is in the process of being liquidated, dissolved, wound-up, amalgamated or reconstituted in a manner that would cause, in the reasonable opinion of NHAI, a material adverse effect;

xvi. a resolution for winding up of the Concessionaire is passed or any petition for winding up of the Concessionaire is admitted by a court of competent jurisdiction and a provisional liquidator or receiver is appointed and such order has not been set aside within 90 (ninety) days of the date thereof or the Concessionaire is ordered to be wound up by Court except for the purpose of amalgamation or reconstruction; provided that, as part of such amalgamation or reconstruction, the entire property, assets and undertaking of the Concessionaire are transferred to the amalgamated or reconstructed entity and that the amalgamated or reconstructed entity has unconditionally assumed the obligations of the Concessionaire under the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement and the project agreements; and provided that:

a. the amalgamated or reconstructed entity has the capability and operating experience necessary for the performance of its obligations under the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement and the project agreements;

b. the amalgamated or reconstructed entity has the financial standing to perform its obligations under the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement and the project agreements and has a credit worthiness at least as good as that of the Concessionaire as at Appointed Date; and

c. each of the project agreements remains in full force and effect;

xvii. any representation or warranty of the Concessionaire herein contained which is, as of the date of Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement, found to be materially false, incorrect or misleading;

xviii. the Concessionaire submits to NHAI any statement, notice or other document, in written or electronic form, which has a material effect on NHAI's rights, obligations or interests and which is false in material particulars;

xix. the Concessionaire has failed to fulfil any obligation, for which failure termination has been specified in the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement;

xx. the Concessionaire commits a default in complying with any other provision of the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement if such default causes a material adverse effect on NHAI;

xxi. an escrow default occurs and the Concessionaire fails to cure the default within a cure period of 15 (fifteen) days;

Termination by Concessionaire

If any of the defaults specified below shall have occurred, and NHAI fails to cure such default within a cure period of 90 (ninety) days or such longer period as has been expressly provided in the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement, NHAI shall be deemed to be in default of the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement, unless the default has occurred as a result of any breach of the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement by the Concessionaire or due to force majeure:

i. NHAI commits a material default in complying with any of the provisions of the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement and such default has a material adverse effect on the Concessionaire; or

ii. NHAI repudiates the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement or otherwise takes any action that amounts to or manifests an irrevocable intention not to be bound by the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement; or

iii. the State commits a material default in complying with the provisions of the State Support Agreement if such default has a Material Adverse Effect on the Concessionaire and the breach continues for a period of 90 (ninety) days from the date of notice given in this behalf by the Concessionaire to the Authority.

Termination Payments

The termination payment pursuant to the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement becomes due and payable to the Concessionaire by NHAI within 15 (fifteen) days of the Concessionaire furnishing to NHAI an NOC issued by the lenders/ lenders' representative recording/ effecting release/ vacation/ discharge of the charge on Chitradurga Bypass – Hubli Project/ Karnataka Project receivables (if any) created by Concessionaire for securing repayment of the debt. If NHAI fails to disburse the full termination payment within 15 (fifteen) days, NHAI shall pay interest at a rate equal to 3% (three percent) above the bank rate on the amount of termination payment remaining unpaid.

Upon termination of the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement by the NHAI on account of occurrence of a Concessionaire Default, the NHAI shall pay the Concessionaire by way of termination payment 70% (seventy per cent) of the Unexpired Cash Flow.

Upon termination of the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement by the Concessionaire on account of occurrence of an NHAI Default, the Concessionaire shall be entitled to receive from NHAI by way of termination payment a sum equal to 105% (one hundred and five per cent) of the Unexpired Cash Flow.

Technical Clarifications on the Concession Agreements

For details in relation to the technical clarifications received from NHAI in relation to the Concession Agreements, please refer to Annexure 1 of the Chitradurga Bypass – Hubli Project/ Karnataka Concession Agreement.

5. *Concession Agreement between NEPPL ("Concessionaire") and NHAI dated March 7, 2024 in respect of the Chichra - Kharagpur Project*

The Concessionaire has entered into a concession agreement for tolling, operation, maintenance and transfer of Chichara - Kharagpur Project Highway (as defined below) on toll, operate and transfer (TOT) basis (the "**Chichra Kharagpur Concession Agreement**"), for a period of 20 years (twenty years) from the the Appointed Date (i.e., the date on which all Conditions Precedent have been satisfied) or such date on which the Chichra - Kharagpur Concession Agreement is terminated by a termination notice ("**Chichra - Kharagpur Concession Period**").

Certain Definitions

"**Chichra - Kharagpur Project**" means the operation and maintenance of the Chichra - Kharagpur Project Highway in accordance with the provisions of the Chichra - Kharagpur Concession Agreement and includes all works, services and equipment relating to or in respect of the scope of the Chichra - Kharagpur Project as set forth in the Chichra - Kharagpur Concession Agreement;

"**Chichra - Kharagpur Project Assets**" means all physical and other assets relating to and forming part of the Site including (a) rights over the Site in the form of licence, Right of Way or otherwise; (b) tangible assets such as civil works and equipment including foundations, embankments, pavements, road surface, interchanges, bridges, culverts, road

overbridges, drainage works, traffic signals, sign boards, kilometre- stones, toll plazas, electrical systems, communication systems, rest areas, relief centers, maintenance depots and administrative offices; (d) all rights of the Concessionaire under the project agreements; (security deposits; (e) insurance proceeds; and (g) Applicable Permits and authorisations relating to or in respect of the Chichra - Kharagpur Project Highway, but does not include Additional Facilities; and

"**Chichra - Kharagpur Project Highway**" means the Site comprising the existing road comprising:

Stretch	**State**	**Start (Km)**	**End (Km)**	**Length**
Chichra to Kharagpur	West Bengal	existing KM 185 + 150 (Design Km 16+130)	existing Km 129+000 (Design Km 72+250)	56.120

and all Chichra - Kharagpur Project Assets."

Grant of Concession

Subject to and in accordance with the terms and conditions set forth in the Chichra - Kharagpur Concession Agreement, NHAI has granted to the Concessionaire, and the Concessionaire has accepted the concession for a period of 20 years (twenty years), including the exclusive right, license and authority during the subsistence of the Chichra - Kharagpur Agreement to operate, manage and maintain the Chichra - Kharagpur Project Highway. Notwithstanding anything to the contrary in the Chichra - Kharagpur Concession Agreement, the parties have expressly agreed that the Concession Period shall not be reduced by more than 5 (five) years, or shall not be increased by more than 10 (ten) years on any account or for any reason whatsoever.

Subject to and in accordance with the terms and conditions set forth in the Chichra - Kharagpur Concession Agreement, the Concessionaire is entitled to undertake the following in accordance with the terms of the Chichra - Kharagpur Concession Agreement, applicable laws and applicable permits:

i. Right of Way, access and license to the Site for the purpose of and to the extent conferred by the provisions of the Chichra - Kharagpur Concession Agreement;

ii. manage, operate and maintain the Chichra - Kharagpur Project Highway and regulate the use thereof by third parties in accordance with the terms of Chichra - Kharagpur Concession Agreement;

iii. demand, collect and appropriate the fees from vehicles and persons liable for payment of fees for using the Chichra - Kharagpur Project Highway or any part thereof and refuse entry of any vehicle to the Chichra - Kharagpur Project Highway if the fee due is not paid;

iv. perform and fulfill all of the Concessionaire's obligations under and in accordance with the Chichra - Kharagpur Concession Agreement;

v. bear and pay all costs, expenses and charges in connection with or incidental to the performance of the obligations of the Concessionaire under the Chichra - Kharagpur Concession Agreement; and

vi. neither assign, transfer or sublet or create any lien or encumbrance on the Chichra - Kharagpur Concession Agreement, or the concession granted thereby, or on the whole or any part of the Chichra - Kharagpur Project Highway nor transfer, lease or part possession thereof, save and except as expressly permitted by the Chichra - Kharagpur Concession Agreement.

Fees

The Concessionaire is entitled to, during the Chichra - Kharagpur Concession Period, levy, collect and appropriate fees from users ("**User Fee**") of the Chichra - Kharagpur Project Highway pursuant to and in accordance with the provisions in the Chichra - Kharagpur Concession Agreement and the Fee Rules and to appropriate the same. In accordance with the terms of the Chichra - Kharagpur Concession Agreement, the Concessionaire shall not collect any fees in relation to exempted vehicles. The fees collected by Concessionaire shall be deposited in the escrow account and appropriated in accordance with the relevant provisions of the Chichra - Kharagpur Concession Agreement.

Sub Rule 6(6) of the above-mentioned Fee Rules states,

"(a) The fee shall be collected by the Central Government or the executing Authority as the case may be and for a specified period in accordance with the terms of agreement entered by the Concessionaire.
(b) The fee as notified as per Concession Agreement shall be leviable till the end of the concession period and after the Concession Agreement is over, the fee shall be collected by the Central Government executing authority at a reduced rate of

40% of the fee on the date of transfer of such section of National Highways, bridge, tunnel or bypass, as the case may be, to be revised annually in accordance with these rules:

Provided that after the recovery of capital cost through user fee realised, in respect of a public funded project, the fee leviable would be reduced to 40% of the user fee for such section of National Highways, bridge, tunnel or bypass as the case may be, to be revised annually in accordance with these rules."

In respect of the above, NHAI has clarified that Rule 6 of the Fee Rules provides that the user fee to be notified by Government as per the format of Schedule M of Concession Agreement shall be leviable till the end of the concession period. Hence, the rate of User Fee rate shall only be reduced after the concession period is over.

Concession Fees

As consideration for the grant of the Concession, the Concessionaire is required to pay a concession fee to NHAI equivalent to ₹12,761.00 million, within 120 (one hundred and twenty) days of the date of execution of the concession agreement or any extended date as agreed by NHAI prior to the Appointed Date as a Condition Precedent. The Concessionaire agrees that payment of the concession fee constitutes essential condition of the Concession Agreement. Further, as communicated by the Authority by way of a letter dated October 31, 2023, any amount raised from the proceeds of the Issue in excess of the base concession fee (being the aggregate of Concession Fees payable to NHAI in terms of the Additional Concession Agreements) shall be paid to the Authority. For further details, see the section titled "*Use of Proceeds – Details of Utilisation of Issue Proceeds - Infusion of debt and/or equity into NEPPL*" on page 273.

For the purposes of stamp duty payment, concession agreements are generally considered to be agreements which are not lease deeds and stamp duty of ₹ 100.00 is typically paid for such concession agreements. However, stamp duty authorities of certain states in India have issued notices to some concessionaires alleging inadequate stamp duty on the concession agreements executed between the concessionaires and the NHAI. The stamp authorities allege that since concession agreements relate to the letting of tolls to the concessionaires in the form of leases, or as development agreements, such agreements were required to be stamped as lease agreements or development agreements, as applicable. The stamp duty for a lease agreement or a development agreement ranges between 1.0% and 11.0% of the annual rent or premium payable or the market value of the property. Furthermore, stamp duty authorities may impose penalties for payment of inadequate stamp duty, which could extend up to ten (10) times the amount of the stamp duty payable. Accordingly, concession agreements that have not been stamped as such could be considered to be inadequately stamped. The High Courts of Allahabad and Maharashtra have also held that a concession agreement ought to be stamped as a lease agreement and have upheld the imposition of a higher stamp duty on such agreements.

While we have paid stamp duty of ₹ 100.00 on each of our Concession Agreements in accordance with usual practice, if any demand for payment of a higher stamp duty or penalty is imposed, it would increase the costs of the Toll Roads.

In respect of above, NHAI has clarified that:

(i) As on the date of the Chichra - Kharagpur Concession Agreement, GST is not applicable on Concession Fee. However, if it becomes applicable at a later stage, this shall be considered as change in law.

(ii) There is no requirement of stamp duty in case of Concession Agreements since Fee Rules provided for levy and collection of user fee and not toll tax. In case, in future any such demand arises, it shall be treated as change in law.

Escrow Account

The provisions in relation to the escrow account in the Chichra - Kharagpur Concession Agreement are only applicable if the obligations of the Concessionaire under the Chichra - Kharagpur Concession Agreement are financed by the Lenders.

The Concessionaire shall, prior to the Appointed Date, open and establish the escrow account with the escrow bank and all funds constituting the financing package related to the Chichra - Kharagpur Project shall be credited to such escrow account. During the Chichra - Kharagpur Concession Period all fees and any other revenues including the proceeds of any rentals, deposits, capital receipts or insurance claims from or in respect of the Chichra - Kharagpur Project Highway shall be deposited therein. In addition, all payments by NHAI pursuant to the Chichra - Kharagpur Concession Agreement, including, if any, in relation to the change of scope in the Chichra - Kharagpur Project shall be deposited by NHAI in the escrow account.

Withdrawals from Escrow Account

The Concessionaire shall, at the time of the opening of the escrow account, give irrevocable instructions by way of an escrow agreement substantially in form set forth in the Chichra - Kharagpur Concession Agreement to the escrow bank instructing, *inter alia*, that the deposits into the escrow account shall subject to the provisions of the Chichra - Kharagpur Concession Agreement, be appropriated in the following order every month and if not due in a month then appropriated proportionately in such month and retained in the escrow account and paid out therefrom in the month when due unless otherwise expressly

provided in the instruction letter:

i. all taxes due and payable by the Concessionaire for and in respect of the Chichra - Kharagpur Project Highway;

ii. concession fee;

iii. all payments relating to construction of the Chichra - Kharagpur Project Highway, subject to and in accordance with the conditions, if any, set forth in the financing agreements;

iv. operation and maintenance expenses;

v. operation and maintenance expenses and other costs and expenses incurred by NHAI in accordance with the provisions of the Chichra - Kharagpur Concession Agreement, and certified by NHAI as due and payable to it;

vi. monthly proportionate provision of debt service payment due in an accounting year;

vii. all payments and damages certified by NHAI as due and payable to it by the Concessionaire; and

vii. balance, if any, in accordance with the instructions of the Concessionaire.

Withdrawals upon Termination

Notwithstanding anything to the contrary contained in the escrow agreement and subject to the provisions of the Chichra - Kharagpur Concession Agreement, in the case of termination, the amounts standing to the credit of the escrow account shall be appropriated in the following order:

i. all taxes due and payable by the Concessionaire for and in respect of the Chichra - Kharagpur Project Highway;

ii. payment due to the lenders;

iii. all payments and damages certified by NHAI as due and payable to it by the Concessionaire;

iv. retention and payments relating to the liability for defects and deficiencies;

v. incurred or accrued operation and maintenance expenses;

vi. any other payments required to be made under the Chichra - Kharagpur Concession Agreement; and

vii. balance, if any, in accordance with the instructions of the Concessionaire.

Change of Scope

NHAI may, notwithstanding anything to the contrary contained in the Chichra - Kharagpur Concession Agreement, require the Concessionaire to make alterations/ modifications in the scope of the Chichra - Kharagpur Project as contemplated by the Chichra - Kharagpur Concession Agreement. If the cumulative costs relating to all the change of scope orders exceed 5% (five per cent) of the concession fee in any continuous period of 3 (three) years immediately preceding the date of such change of scope order or if such cumulative costs exceed 25% (twenty five per cent) of the concession fee at any time during the Chichra - Kharagpur Concession Period, NHAI may award any works or services, to any person on the basis of open competitive bidding and the Concessionaire shall be entitled to take part in such competitive bidding with a right to match the first-ranked bid in terms of the selection criteria, either by itself where such work requires tolling, operation and maintenance, or through another company where such work requires construction on any part of the Project Highway, subject to payment of 2% (two per cent) of the bid amount to the Authority, and thereupon securing the award of such works or services. For the avoidance of doubt, it is agreed that the Concessionaire shall be entitled to exercise such option only if the Concessionaire has participated in the bidding process either individually or as a consortium or JV with another company and fulfils the eligibility criteria to undertake such work without compromising with its overall liability. All such changes shall be made by NHAI by an order issued in accordance with the procedure set forth in the Chichra - Kharagpur Concession Agreement.

Termination of the Chichra - Kharagpur Concession Agreement

Termination by either party

Either Party may in its discretion terminate the Chichra - Kharagpur Concession Agreement by giving a termination notice to the other party if a force majeure event subsists for a period of 120 (one hundred and twenty) days or more within a continuous period of 365 (three hundred and sixty five) days. Before issuing such termination notice, the party intending to issue the termination notice shall inform the other party of such intention and grant 15 (fifteen) days time to make a representation and may after the expiry of such 15 (fifteen) days period, whether or not it is in receipt of such representation,

in its sole discretion issue the termination notice.

Termination by the NHAI

In the event of any of the defaults specified below have occurred, and if the Concessionaire has failed to cure such breach or default within the period provided for the same in the Chichra - Kharagpur Concession Agreement, then NHAI shall be entitled to issue a notice of its intention to terminate the Chichra - Kharagpur Concession Agreement, with a copy to the lenders. The following events shall constitute an event of default by the Concessionaire (a "**Concessionaire Default**") unless they have occurred as a result of any breach of the Chichra - Kharagpur Concession Agreement by NHAI or due to force majeure:

i. the performance security has been encashed and appropriated in accordance with the Chichra - Kharagpur Concession Agreement and the Concessionaire has failed to replenish or provide fresh performance security within a cure period of 15 (fifteen) days;

ii. subsequent to the replenishment or furnishing of fresh performance security in accordance with the Chichra - Kharagpur Concession Agreement, the Concessionaire fails to cure, within a cure period of 60 (sixty) days, the Concessionaire Default for which whole or part of the performance security was appropriated;

iii. the Concessionaire abandons or manifests intention to abandon the operation and maintenance of the Chichra - Kharagpur Project Highway without the prior written consent of NHAI;

iv. the Concessionaire fails to roll over, renew and furnish new bank guarantee performance security subject to and in accordance with terms of the Chichra - Kharagpur Concession Agreement, at least three months prior to expiry of subsisting bank guarantee;

v. the Concessionaire is in breach of the Maintenance Requirements or the Safety Requirements, as the case may be;

vi the Concessionaire has failed to make any payment to NHAI within the period specified in the Chichra - Kharagpur Concession Agreement;

vii. upon occurrence of a financial default, the lenders' representative has by notice required NHAI to undertake suspension or termination, as the case may be, in accordance with the substitution agreement and the Concessionaire fails to cure the default within the specified cure period;

viii. a breach of any of the project agreements by the Concessionaire causes a material adverse effect;

ix. the Concessionaire creates any encumbrance in breach of the Chichra - Kharagpur Concession Agreement;

x. the Concessionaire repudiates the Chichra - Kharagpur Concession Agreement or otherwise takes any action or evidences or conveys an intention not to be bound by the Chichra - Kharagpur Concession Agreement;

xi. a change in ownership occurs in breach of the provisions of the Chichra - Kharagpur Concession Agreement;

xii. there is a transfer, pursuant to law either of (i) the rights and/or obligations of the Concessionaire under any of the project agreements, or of (ii) all or part of the assets or undertaking of the Concessionaire, and such transfer causes a material adverse effect;

xiii. an execution levied on any of the assets of the Concessionaire has caused a material adverse effect;

xiv. the Concessionaire is adjudged bankrupt or insolvent, or if a trustee or receiver is appointed for the Concessionaire or for the whole or material part of its assets that has a material bearing on Chichra - Kharagpur Project;

xv. the Concessionaire has been, or is in the process of being liquidated, dissolved, wound-up, amalgamated or reconstituted in a manner that would cause, in the reasonable opinion of NHAI, a material adverse effect;

xvi. a resolution for winding up of the Concessionaire is passed or any petition for winding up of the Concessionaire is admitted by a court of competent jurisdiction and a provisional liquidator or receiver is appointed and such order has not been set aside within 90 (ninety) days of the date thereof or the Concessionaire is ordered to be wound up by Court except for the purpose of amalgamation or reconstruction; provided that, as part of such amalgamation or reconstruction, the entire property, assets and undertaking of the Concessionaire are transferred to the amalgamated or reconstructed entity and that the amalgamated or reconstructed entity has unconditionally assumed the obligations of the Concessionaire under the Chichra - Kharagpur Concession Agreement and the project agreements; and provided that:

    a. the amalgamated or reconstructed entity has the capability and operating experience necessary for the performance of its obligations under the Chichra - Kharagpur Concession Agreement and the project

agreements;

b. the amalgamated or reconstructed entity has the financial standing to perform its obligations under the Chichra - Kharagpur Concession Agreement and the project agreements and has a credit worthiness at least as good as that of the Concessionaire as at Appointed Date; and

c. each of the project agreements remains in full force and effect;

xvii. any representation or warranty of the Concessionaire herein contained which is, as of the date of Chichra - Kharagpur Concession Agreement, found to be materially false, incorrect or misleading;

xviii. the Concessionaire submits to NHAI any statement, notice or other document, in written or electronic form, which has a material effect on NHAI's rights, obligations or interests and which is false in material particulars;

xix. the Concessionaire has failed to fulfil any obligation, for which failure termination has been specified in the Chichra - Kharagpur Concession Agreement;

xx. the Concessionaire commits a default in complying with any other provision of the Chichra - Kharagpur Concession Agreement if such default causes a material adverse effect on NHAI;

xxi. an escrow default occurs and the Concessionaire fails to cure the default within a cure period of 15 (fifteen) days;

Termination by Concessionaire

If any of the defaults specified below shall have occurred, and NHAI fails to cure such default within a cure period of 90 (ninety) days or such longer period as has been expressly provided in the Chichra - Kharagpur Concession Agreement, NHAI shall be deemed to be in default of the Chichra - Kharagpur Concession Agreement, unless the default has occurred as a result of any breach of the Chichra - Kharagpur Concession Agreement by the Concessionaire or due to force majeure:

i. NHAI commits a material default in complying with any of the provisions of the Chichra - Kharagpur Concession Agreement and such default has a material adverse effect on the Concessionaire; or

ii. NHAI repudiates the Chichra - Kharagpur Concession Agreement or otherwise takes any action that amounts to or manifests an irrevocable intention not to be bound by the Chichra - Kharagpur Concession Agreement; or

iii. the State commits a material default in complying with the provisions of the State Support Agreement if such default has a Material Adverse Effect on the Concessionaire and the breach continues for a period of 90 (ninety) days from the date of notice given in this behalf by the Concessionaire to the Authority.

Termination Payments

The termination payment pursuant to the Chichra - Kharagpur Concession Agreement becomes due and payable to the Concessionaire by NHAI within 15 (fifteen) days of the Concessionaire furnishing to NHAI an NOC issued by the lenders/ lenders' representative recording/ effecting release/ vacation/ discharge of the charge on Chichra - Kharagpur Project receivables (if any) created by Concessionaire for securing repayment of the debt. If NHAI fails to disburse the full termination payment within 15 (fifteen) days, NHAI shall pay interest at a rate equal to 3% (three per cent) above the bank rate on the amount of termination payment remaining unpaid.

Upon termination of the Chichra - Kharagpur Concession Agreement by the NHAI on account of occurrence of a Concessionaire Default, the NHAI shall pay the Concessionaire by way of termination payment 70% (seventy per cent) of the Unexpired Cash Flow.

Upon termination of the Chichra - Kharagpur Concession Agreement by the Concessionaire on account of occurrence of an NHAI Default, the Concessionaire shall be entitled to receive from NHAI by way of termination payment a sum equal to 105% (one hundred and five per cent) of the Unexpired Cash Flow.

Technical Clarifications on the Concession Agreements

For details in relation to the technical clarifications received from NHAI in relation to the Concession Agreements, please refer to Annexure 1 of the Chichra - Kharagpur Concession Agreement.

6. *Concession Agreement between NEPPL ("Concessionaire") and NHAI dated March 7, 2024 in respect of the Orai - Barah Project*

The Concessionaire has entered into a concession agreement for tolling, operation, maintenance and transfer of Orai - Barah Project Highway (as defined below) on toll, operate and transfer (TOT) basis (the "**Orai - Barah Concession Agreement**"), for a period of 20 years (twenty years) from the the Appointed Date (i.e., the date on which all Conditions Precedent have

been satisfied) or such date on which the Orai - Barah Concession Agreement is terminated by a termination notice ("Orai - Barah **Concession Period**").

Certain Definitions

"**Orai - Barah Project**" means the operation and maintenance of the Orai - Barah Project Highway in accordance with the provisions of the Orai - Barah Concession Agreement and includes all works, services and equipment relating to or in respect of the scope of the Orai - Barah Project as set forth in the Orai - Barah Concession Agreement;

"**Orai - Barah Project Assets**" means all physical and other assets relating to and forming part of the Site including (a) rights over the Site in the form of licence, Right of Way or otherwise; (b) tangible assets such as civil works and equipment including foundations, embankments, pavements, road surface, interchanges, bridges, culverts, road overbridges, drainage works, traffic signals, sign boards, kilometre- stones, toll plazas, electrical systems, communication systems, rest areas, relief centers, maintenance depots and administrative offices; (d) all rights of the Concessionaire under the project agreements; (security deposits; (e) insurance proceeds; and (g) Applicable Permits and authorisations relating to or in respect of the Orai - Barah Project Highway, but does not include Additional Facilities; and

"**Orai Barah Project Highway**" means the Site comprising the existing road comprising:

Stretch	**State**	**Start (Km)**	**End (Km)**	**Length**
Orai to Barah Section NH 25 (New NH – 27)	Uttar Pradesh	1515+713	1578+872	62.903 km

and all Orai - Barah Project Assets."

Grant of Concession

Subject to and in accordance with the terms and conditions set forth in the Orai - Barah Concession Agreement, NHAI has granted to the Concessionaire, and the Concessionaire has accepted the concession for a period of 20 years (twenty years), including the exclusive right, license and authority during the subsistence of the Orai - Barah Agreement to operate, manage and maintain the Orai - Barah Project Highway. Notwithstanding anything to the contrary in the Orai - Barah Concession Agreement, the parties have expressly agreed that the Concession Period shall not be reduced by more than 5 (five) years, or shall not be increased by more than 10 (ten) years on any account or for any reason whatsoever.

Subject to and in accordance with the terms and conditions set forth in the Orai - Barah Concession Agreement, the Concessionaire is entitled to undertake the following in accordance with the terms of the Orai - Barah Concession Agreement, applicable laws and applicable permits:

i. Right of Way, access and license to the Site for the purpose of and to the extent conferred by the provisions of the Orai - Barah Concession Agreement;

ii. manage, operate and maintain the Orai - Barah Project Highway and regulate the use thereof by third parties in accordance with the terms of Orai - Barah Concession Agreement;

iii. demand, collect and appropriate the fees from vehicles and persons liable for payment of fees for using the Orai - Barah Project Highway or any part thereof and refuse entry of any vehicle to the Orai - Barah Project Highway if the fee due is not paid;

iv. perform and fulfill all of the Concessionaire's obligations under and in accordance with the Orai - Barah Concession Agreement;

v. bear and pay all costs, expenses and charges in connection with or incidental to the performance of the obligations of the Concessionaire under the Orai - Barah Concession Agreement; and

vi. neither assign, transfer or sublet or create any lien or encumbrance on the Orai - Barah Concession Agreement, or the concession granted thereby, or on the whole or any part of the Orai - Barah Project Highway nor transfer, lease or part possession thereof, save and except as expressly permitted by the Orai Barah Concession Agreement.

Fees

The Concessionaire is entitled to, during the Orai - Barah Concession Period, levy, collect and appropriate fees from users ("**User Fee**") of the Orai - Barah Project Highway pursuant to and in accordance with the provisions in the Orai - Barah

Concession Agreement and the Fee Rules and to appropriate the same. In accordance with the terms of the Orai - Barah Concession Agreement, the Concessionaire shall not collect any fees in relation to exempted vehicles. The fees collected by Concessionaire shall be deposited in the escrow account and appropriated in accordance with the relevant provisions of the Orai - Barah Concession Agreement.
Sub Rule 6(6) of the above-mentioned Fee Rules states,

"(a) The fee shall be collected by the Central Government or the executing Authority as the case may be and for a specified period in accordance with the terms of agreement entered by the Concessionaire.
(b) The fee as notified as per Concession Agreement shall be leviable till the end of the concession period and after the Concession Agreement is over, the fee shall be collected by the Central Government executing authority at a reduced rate of 40% of the fee on the date of transfer of such section of National Highways, bridge, tunnel or bypass, as the case may be, to be revised annually in accordance with these rules:

Provided that after the recovery of capital cost through user fee realised, in respect of a public funded project, the fee leviable would be reduced to 40% of the user fee for such section of National Highways, bridge, tunnel or bypass as the case may be, to be revised annually in accordance with these rules."

In respect of the above, NHAI has clarified that Rule 6 of the Fee Rules provides that the user fee to be notified by Government as per the format of Schedule M of Concession Agreement shall be leviable till the end of the concession period. Hence, the rate of User Fee rate shall only be reduced after the concession period is over.

Concession Fees

As consideration for the grant of the Concession, the Concessionaire is required to pay a concession fee to NHAI equivalent to ₹ 17,060.00 million, within 120 (one hundred and twenty) days of the date of execution of the concession agreement or any extended date as agreed by NHAI prior to the Appointed Date as a Condition Precedent. The Concessionaire agrees that payment of the concession fee constitutes essential condition of the Concession Agreement. Further, as communicated by the Authority by way of a letter dated October 31, 2023, any amount raised from the proceeds of the Issue in excess of the base concession fee (being the aggregate of Concession Fees payable to NHAI in terms of the Additional Concession Agreements) shall be paid to the Authority. For further details, see the section titled "*Use of Proceeds – Details of Utilisation of Issue Proceeds - Infusion of debt and/or equity into NEPPL*" on page 273.

For the purposes of stamp duty payment, concession agreements are generally considered to be agreements which are not lease deeds and stamp duty of ₹ 100.00 is typically paid for such concession agreements. However, stamp duty authorities of certain states in India have issued notices to some concessionaires alleging inadequate stamp duty on the concession agreements executed between the concessionaires and the NHAI. The stamp authorities allege that since concession agreements relate to the letting of tolls to the concessionaires in the form of leases, or as development agreements, such agreements were required to be stamped as lease agreements or development agreements, as applicable. The stamp duty for a lease agreement or a development agreement ranges between 1.0% and 11.0% of the annual rent or premium payable or the market value of the property. Furthermore, stamp duty authorities may impose penalties for payment of inadequate stamp duty, which could extend up to ten (10) times the amount of the stamp duty payable. Accordingly, concession agreements that have not been stamped as such could be considered to be inadequately stamped. The High Courts of Allahabad and Maharashtra have also held that a concession agreement ought to be stamped as a lease agreement and have upheld the imposition of a higher stamp duty on such agreements.

While we have paid stamp duty of ₹ 100.00 on each of our Concession Agreements in accordance with usual practice, if any demand for payment of a higher stamp duty or penalty is imposed, it would increase the costs of the Toll Roads.

In respect of above, NHAI has clarified that:

(i) As on the date of the Orai - Barah Concession Agreement, GST is not applicable on Concession Fee. However, if it becomes applicable at a later stage, this shall be considered as change in law.

(ii) There is no requirement of stamp duty in case of Concession Agreements since Fee Rules provided for levy and collection of user fee and not toll tax. In case, in future any such demand arises, it shall be treated as change in law.

Escrow Account

The provisions in relation to the escrow account in the Orai - Barah Concession Agreement are only applicable if the obligations of the Concessionaire under the Orai - Barah Concession Agreement are financed by the Lenders.

The Concessionaire shall, prior to the Appointed Date, open and establish the escrow account with the escrow bank and all funds constituting the financing package related to the Orai - Barah Project shall be credited to such escrow account. During the Orai - Barah Concession Period all fees and any other revenues including the proceeds of any rentals, deposits, capital receipts or insurance claims from or in respect of the Orai - Barah Project Highway shall be deposited therein. In addition, all payments by NHAI pursuant to the Orai - Barah Concession Agreement, including, if any, in relation to the change of scope

in the Orai - Barah Project shall be deposited by NHAI in the escrow account.

Withdrawals from Escrow Account

The Concessionaire shall, at the time of the opening of the escrow account, give irrevocable instructions by way of an escrow agreement substantially in form set forth in the Orai - Barah Concession Agreement to the escrow bank instructing, *inter alia*, that the deposits into the escrow account shall subject to the provisions of the Orai - Barah Concession Agreement, be appropriated in the following order every month and if not due in a month then appropriated proportionately in such month and retained in the escrow account and paid out therefrom in the month when due unless otherwise expressly provided in the instruction letter:

i. all taxes due and payable by the Concessionaire for and in respect of the Orai - Barah Project Highway;

ii. concession fee;

iii. all payments relating to construction of the Orai - Barah Project Highway, subject to and in accordance with the conditions, if any, set forth in the financing agreements;

iv. operation and maintenance expenses;

v. operation and maintenance expenses and other costs and expenses incurred by NHAI in accordance with the provisions of the Orai - Barah Concession Agreement, and certified by NHAI as due and payable to it;

vi. monthly proportionate provision of debt service payment due in an accounting year;

vii. all payments and damages certified by NHAI as due and payable to it by the Concessionaire; and

vii. balance, if any, in accordance with the instructions of the Concessionaire.

Withdrawals upon Termination

Notwithstanding anything to the contrary contained in the escrow agreement and subject to the provisions of the Orai - Barah Concession Agreement, in the case of termination, the amounts standing to the credit of the escrow account shall be appropriated in the following order:

i. all taxes due and payable by the Concessionaire for and in respect of the Orai - Barah Project Highway;

ii. payment due to the lenders;

iii. all payments and damages certified by NHAI as due and payable to it by the Concessionaire;

iv. retention and payments relating to the liability for defects and deficiencies;

v. incurred or accrued operation and maintenance expenses;

vi. any other payments required to be made under the Orai - Barah Concession Agreement; and

vii. balance, if any, in accordance with the instructions of the Concessionaire.

Change of Scope

NHAI may, notwithstanding anything to the contrary contained in the Orai - Barah Concession Agreement, require the Concessionaire to make alterations/ modifications in the scope of the Orai - Barah Project as contemplated by the Orai - Barah Concession Agreement. If the cumulative costs relating to all the change of scope orders exceed 5% (five per cent) of the concession fee in any continuous period of 3 (three) years immediately preceding the date of such change of scope order or if such cumulative costs exceed 25% (twenty five per cent) of the concession fee at any time during the Orai - Barah Concession Period, NHAI may award any works or services, to any person on the basis of open competitive bidding and the Concessionaire shall be entitled to take part in such competitive bidding with a right to match the first-ranked bid in terms of the selection criteria, either by itself where such work requires tolling, operation and maintenance, or through another company where such work requires construction on any part of the Project Highway, subject to payment of 2% (two per cent) of the bid amount to the Authority, and thereupon securing the award of such works or services. For the avoidance of doubt, it is agreed that the Concessionaire shall be entitled to exercise such option only if the Concessionaire has participated in the bidding process either individually or as a consortium or JV with another company and fulfils the eligibility criteria to undertake such work without compromising with its overall liability. All such changes shall be made by NHAI by an order issued in accordance with the procedure set forth in the Orai - Barah Concession Agreement.

Termination of the Orai - Barah Concession Agreement

Termination by either party

Either Party may in its discretion terminate the Orai - Barah Concession Agreement by giving a termination notice to the other party if a force majeure event subsists for a period of 120 (one hundred and twenty) days or more within a continuous period of 365 (three hundred and sixty five) days. Before issuing such termination notice, the party intending to issue the termination notice shall inform the other party of such intention and grant 15 (fifteen) days' time to make a representation and may after the expiry of such 15 (fifteen) days period, whether or not it is in receipt of such representation, in its sole discretion issue the termination notice.

Termination by the NHAI

In the event of any of the defaults specified below have occurred, and if the Concessionaire has failed to cure such breach or default within the period provided for the same in the Orai - Barah Concession Agreement, then NHAI shall be entitled to issue a notice of its intention to terminate the Orai - Barah Concession Agreement, with a copy to the lenders. The following events shall constitute an event of default by the Concessionaire (a "**Concessionaire Default**") unless they have occurred as a result of any breach of the Orai - Barah Concession Agreement by NHAI or due to force majeure:

i. the performance security has been encashed and appropriated in accordance with the Orai - Barah Concession Agreement and the Concessionaire has failed to replenish or provide fresh performance security within a cure period of 15 (fifteen) days;

ii. subsequent to the replenishment or furnishing of fresh performance security in accordance with the Orai Barah Concession Agreement, the Concessionaire fails to cure, within a cure period of 60 (sixty) days, the Concessionaire Default for which whole or part of the performance security was appropriated;

iii. the Concessionaire abandons or manifests intention to abandon the operation and maintenance of the Orai - Barah Project Highway without the prior written consent of NHAI;

iv. the Concessionaire fails to roll over, renew and furnish new bank guarantee performance security subject to and in accordance with terms of the Orai - Barah Concession Agreement, at least three months prior to expiry of subsisting bank guarantee;

v. the Concessionaire is in breach of the Maintenance Requirements or the Safety Requirements, as the case may be;

vi the Concessionaire has failed to make any payment to NHAI within the period specified in the Orai - Barah Concession Agreement;

vii. upon occurrence of a financial default, the lenders' representative has by notice required NHAI to undertake suspension or termination, as the case may be, in accordance with the substitution agreement and the Concessionaire fails to cure the default within the specified cure period;

viii. a breach of any of the project agreements by the Concessionaire causes a material adverse effect;

ix. the Concessionaire creates any encumbrance in breach of the Orai Barah Concession Agreement;

x. the Concessionaire repudiates the Orai - Barah Concession Agreement or otherwise takes any action or evidences or conveys an intention not to be bound by the Orai Barah Concession Agreement;

xi. a change in ownership occurs in breach of the provisions of the Orai - Barah Concession Agreement;

xii. there is a transfer, pursuant to law either of (i) the rights and/or obligations of the Concessionaire under any of the project agreements, or of (ii) all or part of the assets or undertaking of the Concessionaire, and such transfer causes a material adverse effect;

xiii. an execution levied on any of the assets of the Concessionaire has caused a material adverse effect;

xiv. the Concessionaire is adjudged bankrupt or insolvent, or if a trustee or receiver is appointed for the Concessionaire or for the whole or material part of its assets that has a material bearing on the Orai - Barah Project;

xv. the Concessionaire has been, or is in the process of being liquidated, dissolved, wound-up, amalgamated or reconstituted in a manner that would cause, in the reasonable opinion of NHAI, a material adverse effect;

xvi. a resolution for winding up of the Concessionaire is passed or any petition for winding up of the Concessionaire is admitted by a court of competent jurisdiction and a provisional liquidator or receiver is appointed and such order has

not been set aside within 90 (ninety) days of the date thereof or the Concessionaire is ordered to be wound up by Court except for the purpose of amalgamation or reconstruction; provided that, as part of such amalgamation or reconstruction, the entire property, assets and undertaking of the Concessionaire are transferred to the amalgamated or reconstructed entity and that the amalgamated or reconstructed entity has unconditionally assumed the obligations of the Concessionaire under the Orai - Barah Concession Agreement and the project agreements; and provided that:

a. the amalgamated or reconstructed entity has the capability and operating experience necessary for the performance of its obligations under the Orai - Barah Concession Agreement and the project agreements;

b. the amalgamated or reconstructed entity has the financial standing to perform its obligations under the Orai - Barah Concession Agreement and the project agreements and has a credit worthiness at least as good as that of the Concessionaire as at Appointed Date; and

c. each of the project agreements remains in full force and effect;

xvii. any representation or warranty of the Concessionaire herein contained which is, as of the date of Orai - Barah Concession Agreement, found to be materially false, incorrect or misleading;

xviii. the Concessionaire submits to NHAI any statement, notice or other document, in written or electronic form, which has a material effect on NHAI's rights, obligations or interests and which is false in material particulars;

xix. the Concessionaire has failed to fulfil any obligation, for which failure termination has been specified in the Orai - Barah Concession Agreement;

xx. the Concessionaire commits a default in complying with any other provision of the Orai - Barah Concession Agreement if such default causes a material adverse effect on NHAI;

xxi. an escrow default occurs and the Concessionaire fails to cure the default within a cure period of 15 (fifteen) days;

Termination by Concessionaire

If any of the defaults specified below shall have occurred, and NHAI fails to cure such default within a cure period of 90 (ninety) days or such longer period as has been expressly provided in the Orai Barah Concession Agreement, NHAI shall be deemed to be in default of the Orai - Barah Concession Agreement, unless the default has occurred as a result of any breach of the Orai - Barah Concession Agreement by the Concessionaire or due to force majeure:

i. NHAI commits a material default in complying with any of the provisions of the Orai - Barah Concession Agreement and such default has a material adverse effect on the Concessionaire; or

ii. NHAI repudiates the Orai - Barah Concession Agreement or otherwise takes any action that amounts to or manifests an irrevocable intention not to be bound by the Orai - Barah Concession Agreement; or

iii. the State commits a material default in complying with the provisions of the State Support Agreement if such default has a Material Adverse Effect on the Concessionaire and the breach continues for a period of 90 (ninety) days from the date of notice given in this behalf by the Concessionaire to the Authority.

Termination Payments

The termination payment pursuant to the Orai - Barah Concession Agreement becomes due and payable to the Concessionaire by NHAI within 15 (fifteen) days of the Concessionaire furnishing to NHAI an NOC issued by the lenders/ lenders' representative recording/ effecting release/ vacation/ discharge of the charge on Orai - Barah Project receivables (if any) created by Concessionaire for securing repayment of the debt. If NHAI fails to disburse the full termination payment within 15 (fifteen) days, NHAI shall pay interest at a rate equal to 3% (three per cent) above the bank rate on the amount of termination payment remaining unpaid.

Upon termination of the Orai - Barah Concession Agreement by the NHAI on account of occurrence of a Concessionaire Default, the NHAI shall pay the Concessionaire by way of termination payment 70% (seventy per cent) of the Unexpired Cash Flow.

Upon termination of the Orai - Barah Concession Agreement by the Concessionaire on account of occurrence of an NHAI Default, the Concessionaire shall be entitled to receive from NHAI by way of termination payment a sum equal to 105% (one hundred and five per cent) of the Unexpired Cash Flow.

Technical Clarifications on the Concession Agreements

For details in relation to the technical clarifications received from NHAI in relation to the Concession Agreements, please

refer to Annexure 1 of the Orai - Barah Concession Agreement.

7. *Concession Agreement between NEPPL ("Concessionaire") and NHAI dated March 7, 2024 in respect of the Rewa – Lakhnadon Project*

The Concessionaire has entered into a concession agreement for tolling, operation, maintenance and transfer of Rewa – Lakhnadon Project Highway (as defined below) on toll, operate and transfer (TOT) basis (the "**Rewa - Lakhnadon Concession Agreement**"), for a period of 20 years (twenty years) from the the Appointed Date (i.e., the date on which all Conditions Precedent have been satisfied) or such date on which the Rewa – Lakhnadon Concession Agreement is terminated by a termination notice ("**Rewa – Lakhnadon Concession Period**").

Certain Definitions

"**Rewa – Lakhnadon Project**" means the operation and maintenance of the Rewa - Lakhnadon Project Highway in accordance with the provisions of the Rewa – Lakhnadon Concession Agreement and includes all works, services and equipment relating to or in respect of the scope of the Rewa – Lakhnadon Project as set forth in the Rewa – Lakhnadon Concession Agreement;

"**Rewa – Lakhnadon Project Assets**" means all physical and other assets relating to and forming part of the Site including (a) rights over the Site in the form of licence, Right of Way or otherwise; (b) tangible assets such as civil works and equipment including foundations, embankments, pavements, road surface, interchanges, bridges, culverts, road overbridges, drainage works, traffic signals, sign boards, kilometre- stones, toll plazas, electrical systems, communication systems, rest areas, relief centers, maintenance depots and administrative offices; (d) all rights of the Concessionaire under the project agreements; (security deposits; (f) insurance proceeds; and (g) Applicable Permits and authorisations relating to or in respect of the Rewa – Lakhnadon Project Highway, but does not include Additional Facilities; and

"**Rewa – Lakhnadon Project Highway**" means the Site comprising the existing road comprising:

Stretch	**State**	**Start (Km)**	**End (Km)**	**Length**
Rewa to Katni Section Package 1	Madhya Pradesh	Km 656+000 of NH 30 (Km 242+400 of old NH 7)	Km 725+185 of NH 30 (Km 311+585 of old NH 7)	69.185 km
Rewa to Katni Section Package 2	Madhya Pradesh	Km 725+185 of NH-30	Km 813+257 of NH-30	88.072 km
Rewa – Katni Jabalpur Section 4	Madhya Pradesh	Km 813+257 NH – 30 (old NH-7)	Km 880+600 NH – 30 (old NH-7)	67.343 km
Jabalpur Lakhnadon	Madhya Pradesh	Km 880+600 (NH 30)	Km 891+780 (NH 30)	81.737 km
		Km 1358+000 (NH 34)	Km 1428+557 (NH 34)	

and all Rewa - Lakhnadon Project Assets."

Grant of Concession

Subject to and in accordance with the terms and conditions set forth in the Rewa – Lakhnadon Concession Agreement, NHAI has granted to the Concessionaire, and the Concessionaire has accepted the concession for a period of 20 years (twenty years), including the exclusive right, license and authority during the subsistence of the Rewa – Lakhnadon Agreement to operate, manage and maintain the Rewa – Lakhnadon Project Highway. Notwithstanding anything to the contrary in the Rewa – Lakhnadon Concession Agreement, the parties have expressly agreed that the Concession Period shall not be reduced by more than 5 (five) years, or shall not be increased by more than 10 (ten) years on any account or for any reason whatsoever.

Subject to and in accordance with the terms and conditions set forth in the Rewa – Lakhnadon Concession Agreement, the Concessionaire is entitled to undertake the following in accordance with the terms of the Rewa – Lakhnadon Concession Agreement, applicable laws and applicable permits:

i. Right of Way, access and license to the Site for the purpose of and to the extent conferred by the provisions of the Rewa – Lakhnadon Concession Agreement;

ii. manage, operate and maintain the Rewa – Lakhnadon Project Highway and regulate the use thereof by third parties in accordance with the terms of Rewa – Lakhnadon Concession Agreement;

iii. demand, collect and appropriate the fees from vehicles and persons liable for payment of fees for using the Rewa – Lakhnadon Project Highway or any part thereof and refuse entry of any vehicle to the Rewa – Lakhnadon Project Highway if the fee due is not paid;

iv. perform and fulfill all of the Concessionaire's obligations under and in accordance with the Rewa - Lakhnadon Concession Agreement;

v. bear and pay all costs, expenses and charges in connection with or incidental to the performance of the obligations of the Concessionaire under the Rewa – Lakhnadon Concession Agreement; and

vi. neither assign, transfer or sublet or create any lien or encumbrance on the Rewa - Lakhnadon Concession Agreement, or the concession granted thereby, or on the whole or any part of the Rewa – Lakhnadon Project Highway nor transfer, lease or part possession thereof, save and except as expressly permitted by the Rewa – Lakhnadon Concession Agreement.

Fees

The Concessionaire is entitled to, during the Rewa – Lakhnadon Concession Period, levy, collect and appropriate fees from users ("**User Fee**") of the Rewa – Lakhnadon Project Highway pursuant to and in accordance with the provisions in the Rewa – Lakhnadon Concession Agreement and the Fee Rules and to appropriate the same. In accordance with the terms of the Rewa – Lakhnadon Concession Agreement, the Concessionaire shall not collect any fees in relation to exempted vehicles. The fees collected by Concessionaire shall be deposited in the escrow account and appropriated in accordance with the relevant provisions of the Rewa – Lakhnadon Concession Agreement.

Sub Rule 6(6) of the above-mentioned Fee Rules states,

"(a) The fee shall be collected by the Central Government or the executing Authority as the case may be and for a specified period in accordance with the terms of agreement entered by the Concessionaire.
(b) The fee as notified as per Concession Agreement shall be leviable till the end of the concession period and after the Concession Agreement is over, the fee shall be collected by the Central Government executing authority at a reduced rate of 40% of the fee on the date of transfer of such section of National Highways, bridge, tunnel or bypass, as the case may be, to be revised annually in accordance with these rules:

Provided that after the recovery of capital cost through user fee realised, in respect of a public funded project, the fee leviable would be reduced to 40% of the user fee for such section of National Highways, bridge, tunnel or bypass as the case may be, to be revised annually in accordance with these rules."

In respect of the above, NHAI has clarified that Rule 6 of the Fee Rules provides that the user fee to be notified by Government as per the format of Schedule M of Concession Agreement shall be leviable till the end of the concession period. Hence, the rate of User Fee rate shall only be reduced after the concession period is over.

Concession Fees

As consideration for the grant of the Concession, the Concessionaire is required to pay a concession fee to NHAI equivalent to ₹ 35,161.00 million, within 120 (one hundred and twenty) days of the date of execution of the concession agreement or any extended date as agreed by NHAI prior to the Appointed Date as a Condition Precedent. The Concessionaire agrees that payment of the concession fee constitutes essential condition of the Concession Agreement. Further, as communicated by the Authority by way of a letter dated October 31, 2023, any amount raised from the proceeds of the Issue in excess of the base concession fee (being the aggregate of Concession Fees payable to NHAI in terms of the Additional Concession Agreements) shall be paid to the Authority. For further details, see the section titled "*Use of Proceeds – Details of Utilisation of Issue Proceeds - Infusion of debt and/or equity into NEPPL*" on page 273.

For the purposes of stamp duty payment, concession agreements are generally considered to be agreements which are not lease deeds and stamp duty of ₹ 100.00 is typically paid for such concession agreements. However, stamp duty authorities of certain states in India have issued notices to some concessionaires alleging inadequate stamp duty on the concession agreements executed between the concessionaires and the NHAI. The stamp authorities allege that since concession agreements relate to the letting of tolls to the concessionaires in the form of leases, or as development agreements, such agreements were required to be stamped as lease agreements or development agreements, as applicable. The stamp duty for a lease agreement or a development agreement ranges between 1.0% and 11.0% of the annual rent or premium payable or the market value of the property. Furthermore, stamp duty authorities may impose penalties for payment of inadequate stamp duty, which could extend up to ten (10) times the amount of the stamp duty payable. Accordingly, concession agreements that have not been stamped as such could be considered to be inadequately stamped. The High Courts of Allahabad and Maharashtra have also held that a concession agreement ought to be stamped as a lease agreement and have upheld the imposition of a higher stamp duty on such agreements.

While we have paid stamp duty of ₹ 100.00 on each of our Concession Agreements in accordance with usual practice, if any

demand for payment of a higher stamp duty or penalty is imposed, it would increase the costs of the Toll Roads.

In respect of above, NHAI has clarified that:

(i) As on the date of the Rewa – Lakhnadon Concession Agreement, GST is not applicable on Concession Fee. However, if it becomes applicable at a later stage, this shall be considered as change in law.

(ii) There is no requirement of stamp duty in case of Concession Agreements since Fee Rules provided for levy and collection of user fee and not toll tax. In case, in future any such demand arises, it shall be treated as change in law.

Escrow Account

The provisions in relation to the escrow account in the Rewa – Lakhnadon Concession Agreement are only applicable if the obligations of the Concessionaire under the Rewa - Lakhnadon Concession Agreement are financed by the Lenders.

The Concessionaire shall, prior to the Appointed Date, open and establish the escrow account with the escrow bank and all funds constituting the financing package related to the Rewa – Lakhnadon Project shall be credited to such escrow account. During the Rewa – Lakhnadon Concession Period all fees and any other revenues including the proceeds of any rentals, deposits, capital receipts or insurance claims from or in respect of the Rewa – Lakhnadon Project Highway shall be deposited therein. In addition, all payments by NHAI pursuant to the Rewa – Lakhnadon Concession Agreement, including, if any, in relation to the change of scope in the Rewa – Lakhnadon Project shall be deposited by NHAI in the escrow account.

Withdrawals from Escrow Account

The Concessionaire shall, at the time of the opening of the escrow account, give irrevocable instructions by way of an escrow agreement substantially in form set forth in the Rewa – Lakhnadon Concession Agreement to the escrow bank instructing, *inter alia*, that the deposits into the escrow account shall subject to the provisions of the Rewa – Lakhnadon Concession Agreement, be appropriated in the following order every month and if not due in a month then appropriated proportionately in such month and retained in the escrow account and paid out therefrom in the month when due unless otherwise expressly provided in the instruction letter:

i. all taxes due and payable by the Concessionaire for and in respect of the Rewa - Lakhnadon Project Highway;

ii. concession fee;

iii. all payments relating to construction of the Rewa – Lakhnadon Project Highway, subject to and in accordance with the conditions, if any, set forth in the financing agreements;

iv. operation and maintenance expenses;

v. operation and maintenance expenses and other costs and expenses incurred by NHAI in accordance with the provisions of the Rewa – Lakhnadon Concession Agreement, and certified by NHAI as due and payable to it;

vi. monthly proportionate provision of debt service payment due in an accounting year;

vii. all payments and damages certified by NHAI as due and payable to it by the Concessionaire; and

vii. balance, if any, in accordance with the instructions of the Concessionaire.

Withdrawals upon Termination

Notwithstanding anything to the contrary contained in the escrow agreement and subject to the provisions of the Rewa – Lakhnadon Concession Agreement, in the case of termination, the amounts standing to the credit of the escrow account shall be appropriated in the following order:

i. all taxes due and payable by the Concessionaire for and in respect of the Rewa - Lakhnadon Project Highway;

ii. payment due to the lenders;

iii. all payments and damages certified by NHAI as due and payable to it by the Concessionaire;

iv. retention and payments relating to the liability for defects and deficiencies;

v. incurred or accrued operation and maintenance expenses;

vi. any other payments required to be made under the Rewa – Lakhnadon Concession Agreement; and

vii. balance, if any, in accordance with the instructions of the Concessionaire.

Change of Scope

NHAI may, notwithstanding anything to the contrary contained in the Rewa – Lakhnadon Concession Agreement, require the Concessionaire to make alterations/ modifications in the scope of the Rewa - Lakhnadon Project as contemplated by the Rewa – Lakhnadon Concession Agreement. If the cumulative costs relating to all the change of scope orders exceed 5% (five per cent) of the concession fee in any continuous period of 3 (three) years immediately preceding the date of such change of scope order or if such cumulative costs exceed 25% (twenty five per cent) of the concession fee at any time during the Rewa – Lakhnadon Concession Period, NHAI may award any works or services, to any person on the basis of open competitive bidding and the Concessionaire shall be entitled to take part in such competitive bidding with a right to match the first-ranked bid in terms of the selection criteria, either by itself where such work requires tolling, operation and maintenance, or through another company where such work requires construction on any part of the Project Highway, subject to payment of 2% (two per cent) of the bid amount to the Authority, and thereupon securing the award of such works or services. For the avoidance of doubt, it is agreed that the Concessionaire shall be entitled to exercise such option only if the Concessionaire has participated in the bidding process either individually or as a consortium or JV with another company and fulfils the eligibility criteria to undertake such work without compromising with its overall liability. All such changes shall be made by NHAI by an order issued in accordance with the procedure set forth in the Rewa – Lakhnadon Concession Agreement.

Termination of the Rewa – Lakhnadon Concession Agreement

Termination by either party

Either Party may in its discretion terminate the Rewa – Lakhnadon Concession Agreement by giving a termination notice to the other party if a force majeure event subsists for a period of 120 (one hundred and twenty) days or more within a continuous period of 365 (three hundred and sixty five) days. Before issuing such termination notice, the party intending to issue the termination notice shall inform the other party of such intention and grant 15 (fifteen) days' time to make a representation and may after the expiry of such 15 (fifteen) days period, whether or not it is in receipt of such representation, in its sole discretion issue the termination notice.

Termination by the NHAI

In the event of any of the defaults specified below have occurred, and if the Concessionaire has failed to cure such breach or default within the period provided for the same in the Rewa – Lakhnadon Concession Agreement, then NHAI shall be entitled to issue a notice of its intention to terminate the Rewa – Lakhnadon Concession Agreement, with a copy to the lenders. The following events shall constitute an event of default by the Concessionaire (a "**Concessionaire Default**") unless they have occurred as a result of any breach of the Rewa - Lakhnadon Concession Agreement by NHAI or due to force majeure:

i. the performance security has been encashed and appropriated in accordance with the Rewa – Lakhnadon Concession Agreement and the Concessionaire has failed to replenish or provide fresh performance security within a cure period of 15 (fifteen) days;

ii. subsequent to the replenishment or furnishing of fresh performance security in accordance with the Rewa – Lakhnadon Concession Agreement, the Concessionaire fails to cure, within a cure period of 60 (sixty) days, the Concessionaire Default for which whole or part of the performance security was appropriated;

iii. the Concessionaire abandons or manifests intention to abandon the operation and maintenance of the Rewa – Lakhnadon Project Highway without the prior written consent of NHAI;

iv. the Concessionaire fails to roll over, renew and furnish new bank guarantee performance security subject to and in accordance with terms of the Rewa – Lakhnadon Concession Agreement, at least three months prior to expiry of subsisting bank guarantee;

v. the Concessionaire is in breach of the Maintenance Requirements or the Safety Requirements, as the case may be;

vi the Concessionaire has failed to make any payment to NHAI within the period specified in the Rewa – Lakhnadon Concession Agreement;

vii. upon occurrence of a financial default, the lenders' representative has by notice required NHAI to undertake suspension or termination, as the case may be, in accordance with the substitution agreement and the Concessionaire fails to cure the default within the specified cure period;

viii. a breach of any of the project agreements by the Concessionaire causes a material adverse effect;

ix. the Concessionaire creates any encumbrance in breach of the Rewa – Lakhnadon Concession Agreement;

x. the Concessionaire repudiates the Rewa – Lakhnadon Concession Agreement or otherwise takes any action or evidences or conveys an intention not to be bound by the Rewa – Lakhnadon Concession Agreement;

xi. a change in ownership occurs in breach of the provisions of the Rewa – Lakhnadon Concession Agreement;

xii. there is a transfer, pursuant to law either of (i) the rights and/or obligations of the Concessionaire under any of the project agreements, or of (ii) all or part of the assets or undertaking of the Concessionaire, and such transfer causes a material adverse effect;

xiii. an execution levied on any of the assets of the Concessionaire has caused a material adverse effect;

xiv. the Concessionaire is adjudged bankrupt or insolvent, or if a trustee or receiver is appointed for the Concessionaire or for the whole or material part of its assets that has a material bearing on the Rewa – Lakhnadon Project;

xv. the Concessionaire has been, or is in the process of being liquidated, dissolved, wound-up, amalgamated or reconstituted in a manner that would cause, in the reasonable opinion of NHAI, a material adverse effect;

xvi. a resolution for winding up of the Concessionaire is passed or any petition for winding up of the Concessionaire is admitted by a court of competent jurisdiction and a provisional liquidator or receiver is appointed and such order has not been set aside within 90 (ninety) days of the date thereof or the Concessionaire is ordered to be wound up by Court except for the purpose of amalgamation or reconstruction; provided that, as part of such amalgamation or reconstruction, the entire property, assets and undertaking of the Concessionaire are transferred to the amalgamated or reconstructed entity and that the amalgamated or reconstructed entity has unconditionally assumed the obligations of the Concessionaire under the Rewa – Lakhnadon Concession Agreement and the project agreements; and provided that:

    a. the amalgamated or reconstructed entity has the capability and operating experience necessary for the performance of its obligations under the Rewa – Lakhnadon Concession Agreement and the project agreements;

    b. the amalgamated or reconstructed entity has the financial standing to perform its obligations under the Rewa – Lakhnadon Concession Agreement and the project agreements and has a credit worthiness at least as good as that of the Concessionaire as at Appointed Date; and

    c. each of the project agreements remains in full force and effect;

xvii. any representation or warranty of the Concessionaire herein contained which is, as of the date of Rewa – Lakhnadon Concession Agreement, found to be materially false, incorrect or misleading;

xviii. the Concessionaire submits to NHAI any statement, notice or other document, in written or electronic form, which has a material effect on NHAI's rights, obligations or interests and which is false in material particulars;

xix. the Concessionaire has failed to fulfil any obligation, for which failure termination has been specified in the Rewa – Lakhnadon Concession Agreement;

xx. the Concessionaire commits a default in complying with any other provision of the Rewa – Lakhnadon Concession Agreement if such default causes a material adverse effect on NHAI;

xxi. an escrow default occurs and the Concessionaire fails to cure the default within a cure period of 15 (fifteen) days;

Termination by Concessionaire

If any of the defaults specified below shall have occurred, and NHAI fails to cure such default within a cure period of 90 (ninety) days or such longer period as has been expressly provided in the Rewa - Lakhnadon Concession Agreement, NHAI shall be deemed to be in default of the Rewa – Lakhnadon Concession Agreement, unless the default has occurred as a result of any breach of the Rewa – Lakhnadon Concession Agreement by the Concessionaire or due to force majeure:

i. NHAI commits a material default in complying with any of the provisions of the Rewa – Lakhnadon Concession Agreement and such default has a material adverse effect on the Concessionaire; or

ii. NHAI repudiates the Rewa – Lakhnadon Concession Agreement or otherwise takes any action that amounts to or manifests an irrevocable intention not to be bound by the Rewa – Lakhnadon Concession Agreement; or

iii. the State commits a material default in complying with the provisions of the State Support Agreement if such default has a Material Adverse Effect on the Concessionaire and the breach continues for a period of 90 (ninety) days from

the date of notice given in this behalf by the Concessionaire to the Authority.

Termination Payments

The termination payment pursuant to the Rewa – Lakhnadon Concession Agreement becomes due and payable to the Concessionaire by NHAI within 15 (fifteen) days of the Concessionaire furnishing to NHAI an NOC issued by the lenders/ lenders' representative recording/ effecting release/ vacation/ discharge of the charge on Rewa – Lakhnadon Project receivables (if any) created by Concessionaire for securing repayment of the debt. If NHAI fails to disburse the full termination payment within 15 (fifteen) days, NHAI shall pay interest at a rate equal to 3% (three per cent) above the bank rate on the amount of termination payment remaining unpaid.

Upon termination of the Rewa – Lakhnadon Concession Agreement by the NHAI on account of occurrence of a Concessionaire Default, the NHAI shall pay the Concessionaire by way of termination payment 70% (seventy per cent) of the Unexpired Cash Flow.

Upon termination of the Rewa – LakhnadonConcession Agreement by the Concessionaire on account of occurrence of an NHAI Default, the Concessionaire shall be entitled to receive from NHAI by way of termination payment a sum equal to 105% (one hundred and five per cent) of the Unexpired Cash Flow.

Technical Clarifications on the Concession Agreements

For details in relation to the technical clarifications received from NHAI in relation to the Concession Agreements, please refer to Annexure 1 of the Rewa – Lakhnadon Concession Agreement.

Differences between the R1 Concession Agreements, R2 Concession Agreements and R3 Concession Agreements

The significant differences amongst the R1 Concession Agreements, R2 Concession Agreements and R3 Concession Agreements are provided below:

Category	**R1 Concession Agreements**	**R2 Concession Agreements**	**R3 Concession Agreements**
Concession Period	30 years	20 years	20 years
Capacity Augmentation	The Sponsor shall not compensate the relevant Concessionaire for any reduction in toll rates due to capacity augmentation.	The Sponsor shall compensate the relevant Concessionaire on a quarterly basis for any reduction in toll rates due to capacity augmentation.	The Sponsor shall compensate the relevant Concessionaire on a quarterly basis for any reduction in toll rates due to capacity augmentation.
	The EPC contractor, undertaking capacity augmentation, shall be liable for all the defects and deficiencies for the Defect Liability Period (*as defined in the relevant Concession Agreements*).	The EPC contractor, undertaking capacity augmentation, shall additionally be liable for all the defects and deficiencies, maintenance and other operational responsibilities such as incident management, traffic management, routine maintenance etc. for the Defect Liability Period.	The EPC contractor, undertaking capacity augmentation, shall additionally be liable for all the defects and deficiencies, maintenance and other operational responsibilities such as incident management, traffic management, routine maintenance etc. for the Defect Liability Period.
	The Detailed Project Report (*as defined in the relevant Concession Agreements*) may be commenced once the average daily traffic exceeds the target traffic and continues to exceed the designed capacity for three consecutive accounting years following thereafter.	The Detailed Project Report (*as defined in the relevant Concession Agreements*) may be commenced immediately once the average daily traffic has met the target traffic.	The Detailed Project Report (*as defined in the relevant Concession Agreements*) may be commenced immediately once the average daily traffic has met the target traffic.

INFORMATION CONCERNING THE UNITS

Details of Unitholding of the Trust as on the last quarter ended December 31, 2023

All units are held in dematerialised form.

Category	Category of Unit holder	No. of Units held	As a % of total outstanding Units	No. of Units mandatorily held		Number of Units pledged or otherwise encumbered	
				No. of Units	As a % of total Units held	No. of Units	As a % of total Units held
(A)	**Sponsor(s) / Investment Manager / Project Manager(s) and their Associates / related parties, and the Sponsor Group**						
(1)	**Indian**						
(a)	Individuals / HUF	-	0	-	0	-	0
(b)	Central/State Govt.	11,52,02,600	15.86	10,88,82,600	94.51	-	0
(c)	Financial Institutions/Banks	-	0	-	0	-	0
(d)	Any other	-	0	-	0	-	0
	Bodies Corporates	-	0	-	0	-	0
	Sub-Total (A) (1)	**11,52,02,600**	**15.86**	**10,88,82,600**	**94.51**	**-**	**0**
(2)	**Foreign**						
(a)	Individuals (Non Resident Indians / Foreign Individuals)		0	-	0	-	0
(b)	Foreign government	-	0	-	0	-	0
(c)	Institutions	-	0	-	0	-	0
(d)	Foreign Portfolio Investors	-	0	-	0	-	0
(e)	Any Other (Bodies Corporates)	-	0	-	0	-	0
	Sub-Total (A) (2)	**-**	**0**	**-**	**0**	**-**	**0**
	Total Unitholding of Sponsor and Sponsor Group (A) = (A)(1)+(A)(2)	**11,52,02,600**	**15.86**	**10,88,82,600**	**94.51**	**-**	**-**
(B)	**Public Holding**						
(1)	**Institutions**						
(a)	Mutual Funds	7,05,60,260	9.71				
(b)	Financial Institutions/Banks	35,13,140	0.48				
(c)	Central/State Govt.	-	0				
(d)	Venture Capital Funds	-	0				
(e)	Insurance Companies	2,31,52,300	3.19				
(f)	Provident/pension funds	1,90,00,000	2.62				
(g)	Foreign Portfolio Investors	-	0				
(h)	Foreign Venture Capital investors	-	0				
(i)	Any Other		0				

Category	Category of Unit holder	No. of Units held	As a % of total outstanding Units	No. of Units mandatorily held		Number of Units pledged or otherwise encumbered	
				No. of Units	As a % of total Units held	No. of Units	As a % of total Units held
	(specify)						
	Bodies Corporates	36,32,02,600	50.00				
	Alternative Investment Fund	-	0.00				
	Sub-Total (B) (1)	**47,94,28,300**	**66.00**				
(2)	**Non-Institutions**						
(a)	Central Government / State Governments(s) / President of India	34,09,200	0.47				
(b)	Individuals	1,84,07,326	2.53			85,44,100	1.18
(c)	NBFCs registered with RBI	-	0			-	0
(d)	Other Non-Institutions Unit Holding	10,99,57,774	15.14			1,69,43,417	2.33
	TRUSTS	5,43,29,167	7.48				
	Non-Resident Indians	2,16,883	0.03				
	Clearing Members	-	0				
	Bodies Corporates	5,54,11,724	7.63			1,69,43,417	2.33
			0				
	Sub-Total (B) (2)	**13,17,74,300**	**18.14**			**2,54,87,517**	**3.51**
	Total Public Unit holding (B) = (B)(1)+(B)(2)	**61,12,02,600**	**84.14**			**2,54,87,517**	**3.51**
	Total Units Outstanding (C) = (A) + (B)	**72,64,05,200**	**100.00**	**10,88,82,600**	**94.51**	**2,54,87,517**	**3.51**

Details of Unitholding pre and post- Issue

Particulars	Number of Units
Units issued and outstanding prior to this Issue	726,405,200
Units issued and outstanding after this Issue	131,22,00,600*#

** The IM Board by way of its resolution dated February 10, 2024 and the Unitholders of the Trust by way of their resolution dated March 4, 2024, have approved the Issue of upto 497,926,090 Units at or above ₹ 122.86 per Unit ("**Base Price**"). The Trust proposes to undertake the issue of up to 117,159,080 Units to the Sponsor, on a preferential basis ("**Preferential Issue**"), in accordance with the SEBI Institutional Placement Guidelines and the InvIT Regulations. The Unitholders by way of a resolution dated March 4, 2024 have approved the Preferential Issue. The Sponsor, by way of its letter dated March 6, 2024, has confirmed its willingness to subscribe to atleast 87,869,310 Units, at a base offer price of ₹ 122.86 per Unit plus premium payable, if any. Further, the Sponsor, by way of its letter dated March 14, 2024 has agreed to subscribe to 87,869,400 Units at a price of ₹ 124.14 per Unit pursuant to the Preferential Issue.*

#Subject to completion of the allotment against subscription by the Sponsor pursuant to the Preferential Issue.

Unitholders holding more than 5% of the Units as on December 31, 2023

Sr. No.	Name of Unit Holders	Pre- Issue		Post- Issue#	
		Number of Units	Percentage of holding (%)	Number of Units*	Percentage of holding (%)*
1.	2452991 Ontario Limited	181,601,300	25.000	328,050,150	25.000
2.	CPP Investment Board Private Holdings 4 Inc	181,601,300	25.000	328,050,150	25.000
3.	National Highways Authority of India	115,202,600	15.859	203,072,000	15.476
4.	SBI Infrastructure Fund	70,560,260	9.714	126,943,650	9.674
5.	SBI Magnum Children's Benefit Fund – Investment Plan				
6.	SBI Retirement Benefit				

Sr. No.	Name of Unit Holders	Pre- Issue		Post- Issue[#]	
		Number of Units	Percentage of holding (%)	Number of Units*	Percentage of holding (%)*
	Fund – Aggressive Hybrid Plan				
7.	SBI Balanced Advantage Fund				
8.	SBI Equity Savings Fund	-	-		
9.	SBI Equity Hybrid Fund	-	-		

** The IM Board by way of its resolution dated February 10, 2024 and the Unitholders of the Trust by way of their resolution dated March 4, 2024, have approved the Issue of upto 497,926,090 Units at or above ₹ 122.86 per Unit ("**Base Price**"). The Trust proposes to undertake the issue of up to 117,159,080 Units to the Sponsor, on a preferential basis ("**Preferential Issue**"), in accordance with the SEBI Institutional Placement Guidelines and the InvIT Regulations. The Unitholders by way of a resolution dated March 4, 2024 have approved the Preferential Issue. The Sponsor, by way of its letter dated March 6, 2024, has confirmed its willingness to subscribe to atleast 87,869,310 Units, at a base offer price of ₹ 122.86 per Unit plus premium payable, if any. Further, the Sponsor, by way of its letter dated March 14, 2024 has agreed to subscribe to 87,869,400 Units at a price of ₹ 124.14 per Unit pursuant to the Preferential Issue.*

[#]Subject to completion of the allotment against subscription by the Sponsor pursuant to the Preferential Issue.

Unitholding of the Sponsor, Sponsor Group, Investment Manager, Project Manager and Trustee

The Sponsor and the Sponsor Group hold 11,52,02,600 Units as on December 31, 2023, as disclosed above. The Trustee, Project Manager and the Investment Manager do not hold any Units and shall not acquire any Units in this Issue.

Unitholding of the directors of the Investment Manager

As on the date of this Placement Document, none of the directors of the Investment Manager hold any Units or propose to hold any Units.

Sponsor and Sponsor Group

In accordance with Regulation 12(3), read with Regulation 12(3A) of the InvIT Regulations, the Sponsor and Sponsor Group, shall, at all times hold not less than 15% of total outstanding Units for a period of three years from the date of listing pursuant to the initial offering of the Units.

Further, in accordance with the InvIT Regulations, the Sponsor and the Sponsor Group are required to hold certain number of Units, from the beginning of 4th year after the date of listing pursuant to the initial offer as follows:

From the beginning of 4th year after the date of listing pursuant to the initial offer and till the end of 5th year from the date of listing pursuant to the initial offer	5% of total Units or ₹ 500 crores, whichever is lower*
From the beginning of 6th year after the date of listing pursuant to the initial offer and till the end of 10th year from the date of listing pursuant to the initial offer	3% of total Units or ₹ 500 crores, whichever is lower*
From the beginning of 11th year after the date of listing pursuant to the initial offer and till the end of 20th year from the date of listing pursuant to the initial offer	2% of total Units or ₹ 500 crores, whichever is lower*
After completion of the 20th year from the date of listing pursuant to the initial offer	1% of total Units or ₹ 500 crores, whichever is lower*

** Provided that the maximum value of Units to be held by the Sponsor and Sponsor Group for compliance with the above shall not exceed ₹500 crores or such other value as may be decided by SEBI from time to time wherein such valuation shall be based on the latest available net asset value of the Trust*

The above lock-in requirements shall be applicable only to the additional Units issued by the Trust in terms with Regulation 12(3A) of the InvIT Regulations.

Additionally, the Units proposed to be allotted to the Sponsor by way of Preferential Issue and not in excess of 25% of the total Unit capital of the Trust, shall be locked-in for a period of three years from the date of trading approval granted for the Units allotted pursuant to the Preferential Issue and Units allotted to the Sponsors in excess of 25% of the total Unit capital of the Trust pursuant to the Preferential Issue shall be locked-in for a period of one year from the date of trading approval granted for the Units allotted pursuant to the Preferential Issue, as specified in the SEBI Institutional Placement Guidelines. Further, the entire pre-Preferential Issue unitholding of the Sponsor, shall be locked-in from the relevant date up to a period of six months from the date of trading approval for the proposed Preferential Issue, as specified in the SEBI Institutional Placement Guidelines.

USE OF PROCEEDS

The gross proceeds of the Issue aggregates to approximately ₹ 61,812.53 million ("**Issue Proceeds**"). The net proceeds from the Issue, after deducting issue expenses (of approximately ₹ 464.50 million) is ₹ 61,348.03 million ("**Net Proceeds**").

Purpose of the Issue

Subject to compliance with applicable laws and regulations, the Net Proceeds will be utilised towards the following objects:

- Infusion of debt and/or equity into NEPPL: The proceeds of the debt and/or equity infused into the NEPPL shall be utilized by NEPPL for: (a) part payment of (i) initial estimated concession value to the Sponsor; (ii) initial improvement cost; (iii) major maintenance cost; (iv) upfront fees to various agencies, as applicable; if any; and/or (b) creation and maintenance of major maintenance reserve, if any;
- Part payment for creation and maintenance of debt service reserve account at Trust level;
- Additional concession fee; and
- General corporate purposes.

(collectively, referred to hereinafter as "**Objects**")

The details of the Net Proceeds are set forth in the following table:

(in ₹ million)

Particulars	Estimated Amount
Gross proceeds of the Issue	61,812.53
Less: Issue related and other expenses to be borne by the Trust	464.50
Net Proceeds	61,348.03

Requirements of Funds

The Net Proceeds are proposed to be used in accordance with the details provided in the following table:

(in ₹ million)

Sr. No.	Particulars	Amount
1.	Infusion of debt and/or equity into NEPPL: The proceeds of the debt and/or equity infused into the NEPPL shall be utilized by NEPPL for: (a) part payment of (i) initial estimated concession value to the Sponsor; (ii) initial improvement cost; (iii) major maintenance cost; (iv) upfront fees to various agencies, as applicable; if any; and/or (b) creation and maintenance of major maintenance reserve, if any	60,365.19
2.	Part payment for creation and maintenance of debt service reserve account at Trust level**	10.00
3.	General corporate purposes	335.50
4.	Additional concession fee	637.35*
	Total	**61,348.03**

** The Trust shall utilize ₹ 637.35 million for infusion of debt and/ or equity into NEPPL for payment of additional concession fee to the Authority.*

We believe that the infusion of the funds into NEPPL, in order to meet its obligations under the NEPPL Concession Agreements, will enable NEPPL to acquire the necessary rights under the NEPPL Concession Agreements. Further, we believe that the proposed infusion of funds will be beneficial to the Trust and to Unitholders.

The fund requirements mentioned above and the proposed deployment are based on the estimates of the Investment Manager and have not been appraised by any bank, financial institution or any other external agency. The fund requirements may vary due to factors beyond the Investment Manager's control, such as market conditions and competitive environment. Consequently, the fund requirements are subject to revisions in the future at the discretion of the Investment Manager. In the event of any shortfall of funds for the activities proposed to be financed out of the Issue Proceeds as stated above, the Investment Manager may re-allocate the Issue Proceeds to the activities where such shortfall has arisen, subject to compliance with applicable law.

Details of Utilisation of Issue Proceeds

The details of utilisation of the Issue Proceeds are set forth herein below:

Infusion of debt and/or equity into NEPPL

The Trust proposes to utilise an estimated aggregate amount of ₹ 60,365.19 million from the Issue Proceeds to infuse debt and/or equity in NEPPL.

NEPPL proposed to utilize the proceeds for: (a) part payment of (i) initial estimated concession value to the Sponsor; (ii) initial improvement cost; (iii) major maintenance cost; (iv) upfront fees to various agencies, as applicable; if any; and/or (b) creation and maintenance of major maintenance reserve, if any.

The Target Toll Roads have been valued at a base value of ₹ 15,624.9 million by RBSA Valuation Advisors LLP, the independent valuer appointed by the Investment Manager on behalf of the Trust. The Unitholders have approved the base valuation for the Target Toll Roads by way of a resolution passed at the meeting held on March 4, 2024. It may be noted that the baseline valuation for the Target Toll Roads is for the purpose of establishing a price discovery mechanism for the Target Toll Roads and that the final amounts paid as concession fees to the Sponsor under the NEPPL Concession Agreements for the Target Toll Roads may be higher than the base valuation. The concession fee for the Target Toll Roads shall be paid through a combination of the proceeds of the Issue and debt financing to be obtained by the Trust / NEPPL. The base valuation range for the Target Toll Roads, has been accepted by NHAI, subject to payment of additional amounts to be raised pursuant to the Issue.

The actual amount to be invested into NEPPL by way of equity or equity like infusion or debt, if any, may be decided by the IM Board, in their discretion.

Part payment for creation and maintenance of debt service reserve account at Trust level

We propose to utilize an aggregate amount of ₹ 10.00 million for part payment towards the creation and maintenance of debt service reserve account at Trust level from the Net Proceeds.

Additional concession fee

In terms of the R3 Concession Agreements read with the letter dated October 31, 2023, from the Authority, any amount raised from the proceeds of this Issue in excess of the base concession fee (being the aggregate of Concession Fees payable to NHAI in terms of the Additional Concession Agreements for R3 Toll Roads) shall be paid to the Authority. The base concession fee has been calculated on the Base Price of ₹ 122.86. As the Issue Price is higher than the Base Price, the entire differential amount is required to be paid to the Authority, as additional concession fee. The Trust shall utilize ₹ 637.35 million for infusion of debt and/ or equity into NEPPL for payment of additional concession fee to the Authority.

General Corporate Purposes

In terms of the InvIT Regulations, the Investment Manager shall, at its discretion, deploy the balance Net Proceeds aggregating to ₹ 335.50 million towards general expenses for the operation of the Trust, subject to such utilization not exceeding 10% of the Gross Proceeds, in compliance with the InvIT Regulations. The general purposes for which the Trust proposes to utilize Issue Proceeds include meeting exigencies, creation and maintenance of debt service reserve and expenses incurred, by way of the Trust in the ordinary course of business. In addition, the Trust may utilize the Issue Proceeds towards other expenditure (in the ordinary course of business) considered expedient and as approved by the Investment Manager or the Trustee, as the case may be, subject to compliance with applicable law.

In case of a shortfall in Net Proceeds, the Investment Manager may, in compliance with the InvIT Regulations, have the flexibility to meet such shortfall including, by utilising the Trust's internal accruals or availing facilities from lenders. The Investment Manager will have flexibility in utilizing the proceeds earmarked for general purposes. The Investment Manager, in accordance with the investment objectives of the Trust, policies of its board of directors and the InvIT Regulations, will have flexibility in utilising any surplus amounts.

Issue Expenses

The total expenses of this Issue are estimated to be approximately ₹ 464.50 million. The Issue expenses consist of fee and commissions payable to the Lead Managers, fee payable to legal counsels, fee payable to Escrow Bank and Registrar to the Issue, printing and stationery expenses, and all other incidental and miscellaneous expenses for listing the Units on the Stock Exchanges. The Issue Expenses shall be met from distributions received by the Trust and/ or other sources available to the Trust.

FINANCIAL INDEBTEDNESS AND DEFERRED PAYMENTS

As of December 31, 2023, except as stated below, the Trust or the Project SPVs does not have any outstanding or sanctioned fund-based facilities.

The details of indebtedness of Trust (on consolidated basis) as at December 31, 2023 and the post- Issue principal amount outstanding, are provided below:

Category of borrowing	Principal Amount outstanding as on December 31, 2023 (in Rs million)	Post- Issue Principal Amount outstanding (in Rs million)
Trust		
Particulars		
Non-convertible debentures	15,000.00	15,000.00
Indian rupee loan from banks	15,150.63	15,500.63*
Total Borrowings	30,150.63	30,500.63

**Includes additional borrowings of Rs. 350.00 million availed by the Trust post December 31, 2023.*

Additionally, the concession fee for the Target Toll Roads shall be paid through a combination of the proceeds of the Issue and debt financing to be obtained by the Trust and/or the NEPPL. The Trust proposes to avail debt financing with certain lenders for availing loans amounting to approximately ₹ 90,000.00 million ("**Trust Loan 3**") and has obtained letters from certain lenders in relation to the same. The terms and conditions of such debt financing remain subject to the finalisation of definitive documents.

Status of lender consents

The Trust has availed debt from certain third-party lenders and consents from the respective lenders are required in connection with the Issue. As on the date of this Placement Document, the Project SPVs have obtained the required consents from such lenders for the purposes of this Issue. For further details, please see the section titled *"Risk Factors"* on page 70.

Borrowings of the Trust

The Trust has entered into a loan agreement dated September 29, 2021, with certain lenders for availing loans amounting to approximately ₹ 20,000.00 million ("**Trust Loan 1**"). The principal terms of the Trust Loans availed by the Trust are as follows :

Parameter	Description
Borrower	National Highways Infra Trust (Trust)
Sponsor	National Highways Authority of India
Project Manager	National Highways Invit Project Managers Private Limited
Investment Manager	National Highways Infra Investment Managers Private Limited
Project SPV	National Highways Infra Projects Private Limited
Lenders	State Bank of India, Axis Bank Limited and Bank of Maharashtra
Facility Agent	State Bank of India
Security Trustee	SBICAP Trustee Company Limited
Obligors	(a) the Trust; (b) the Project SPV; and (c) any other person who provides any Security or guarantee or any other contractual comfort in terms of the Finance Documents.
Facilities	Collectively, Facility A, Facility B and the Working Capital Facilities, for an aggregate principal amount not exceeding INR 2000,00,00,000 (Indian Rupees Two Thousand Crores only)
Facility A	Rupee facility for an aggregate principal amount not exceeding INR 1480,00,00,000 (Indian Rupees One Thousand Four Hundred and Eighty Crores only) to be availed by the Trust from the Lenders.
Facility B	Rupee facility for an aggregate principal amount not exceeding INR 520,00,00,000 (Indian Rupees Five Hundred and Twenty Crores only) to be availed by the Trust from Axis Bank Limited and Bank of Maharashtra with the Working Capital Facilities, as its sub-limits.
Working Capital Facilities	Collectively, the BG Facility and the LC Facility.
LC/BG Facility	the letter of credit/ bank guarantee facility aggregating up to INR 20,00,00,000 (Indian Rupees Twenty Crores only) being extended as a sub-limit of Facility B.

Parameter	Description
Facility Agreement	The facility agreement dated September 29, 2021 executed between the Trust, the Facility Agent and the Lenders with respect to the Facilities.
Facility Agreement Date	29.09.2021
Availability Period of Facilities	(a) with respect to Facility A, unless extended by the respective Lenders, the period commencing from the Facility Agreement Date and terminating on the earlier of: (i) 30 September 2021, or such other extended date as may be extended in writing by the respective Lenders; or (ii) the date on which Facility A is fully drawn down/utilized; or (iii) the date on which Facility A is canceled or terminated in accordance with the provisions of the Facility Agreement. (b) with respect to Facility B, unless extended by the respective Lender, the period commencing from the first drawdown date of Facility A and terminating on the earlier of: (i) 24 (twenty-four) months from the date of first drawdown date of Facility A, or such other extended date as may be extended in writing by the respective Lenders; or (ii) the date on which Facility B is fully drawn down; or (iii) the date on which Facility B is cancelled or terminated in accordance with the provisions of the Facility Agreement. (c) with respect to the Working Capital Facilities, the dates or timelines as specified in the agreement(s) to be entered into between the Trust and the Working Capital Facility Lender, prior to availing any of the WC Product Schedule renewed from time to time pursuant to the same being mutually agreed in writing between the Trust and the Working Capital Facility Lender.
Maturity Date	Earlier of (i) the date falling 19 years 6 months from the first drawdown date; and (ii) March 31, 2041.
Repayment	In 78 (seventy eight) structured quarterly installments
Project(s)	Following projects housed by the Project SPV: (a) Maharashtra – Karnataka Border to Belgaum section of the National Highway no. 48 (old National Highway no. 4) from 515.00 kms to 592.705 kms (total 77.705 kms) in the state of Karnataka; (b) Palanpur – Abu Road section of the National Highway no. 27 from 601.000 kms to 646.000 kms (total 45.000 kms) in the states of Gujarat/Rajasthan; (c) Abu Road – Swaroopganj section of the National Highway no. 27 from 646.000 kms to 676.000 (total 31.000 kms) in the state of Rajasthan; (d) Chittorgarh – Kota and Chittorgarh Bypass section of the National Highway no. 27 from 891.929 kms to 1052.429 kms (total 160.500 kms) in the state of Rajasthan; and (e) Kothakota Bypass – Kurnool section of the National Highway no. 44 from 135.469 kms to 211.000 kms (total 74.622 kms) in the state of Telangana.
Lenders' Consultants	The Lenders shall have the right to appoint lender traffic Consultants (if any), Lender independent engineer, the lender insurance advisors, lender environment consultants and lender legal counsel, and any other consultants as may be required by the Lenders during the currency of the Facilities. Any costs and expenses, fees and other moneys that are payable in relation to such appointment will be required to be borne by the Trust
Escrow Bank for the Project SPV	State Bank of India
Escrow Bank for the Trust	State Bank of India
Trust Escrow Account	Account(s) maintained with the Trust Escrow Bank where all amounts received from the Project SPV shall be deposited.
Purpose	The Facilities shall be utilized by the Trust in the following manner: (a) Facility A shall be utilised by the Trust for on lending to the Project SPV. (b) Facility B shall be utilised by the Trust for the following purposes: i. towards initial capital expenditure incurred by the Trust; ii. towards providing loans and advances to the Project SPV; iii. towards funding the major maintenance reserve and for on lending to the Project SPV which the Project SPV shall utilise towards any expenses that it may incur other expenses that may be incurred by the Project SPV; iv. towards funding the DSRA required to be maintained by the Trust in terms of the Facility Agreement; and v. towards meeting the transaction-related expenses. (c) BG Facility being provided by the Working Capital Facility Lender shall be utilised by the Trust towards any performance bank guarantee. (d) LC Facility being provided by the Working Capital Facility Lender shall be utilised by the Trust

Parameter	Description
	towards any letter of credit requirements for purchase of equipment (such as toll equipment) for the purpose of the Projects and any other requirements as per the Concession Agreements.
Interest	Effective rate of interest of 7.20% p.a. linked to the MCLR of respective Lenders plus spread, with monthly rests
Security	The obligations of the Trust under the Facilities, all interest and other monies in respect thereof shall be secured on a pari-passu basis, amongst the Lenders participating in the Facilities, by a first ranking security interest including, but not limited to following: a) a first ranking pari passu charges over the Trust's immovable assets (if any), both present and future; b) a first ranking pari passu charge over: (i) all tangible movable assets of the Trust, including moveable plant and machinery, machinery spares, tools and accessories, furniture, fixtures, vehicles, all other movable assets, inventories, securities, equipment, book debts, operating cash flows, scheduled and unscheduled receivables and revenues, commissions, revenues of whatsoever nature and wherever arising both present and future; (ii) all receivables of the Trust, both present and future; (iii) the intellectual property rights of the Trust, both present and future; (iv) all rights, titles, interests, benefits, claims and demands, whatsoever of the Trust in any real estate and leasehold rights held by the Trust, both present and future; (v) all rights, title, interest, benefits, claims and demands whatsoever of the Trust under all insurance contracts and insurance proceeds, both present and future; (vi) all rights, titles, interests, benefits, claims and demands, whatsoever of the Trust in respect of the escrow account and all subaccounts thereunder, and all other assets, and securities which represent amounts lying in or to be credited in such accounts / sub-accounts and any amounts lying therein; (vii) all rights, titles, interest, benefits, claims and demands, whatsoever of the Trust against the Project SPV and/or the Projects including in all facilities to be granted by the Trust to the Project SPV (including the interest and principal repayments 229 Parameter Description thereof) and the rights of substitution and termination available to the Trust in relation to the Projects; and c) a first ranking pari passu charge over the equity shares held by the Trust in the Project SPV, subject to compliance of Sections 19(2) and (3) of the Banking Regulations Act, 1949.
Undertakings from the Trust	The Trust is required to undertake, inter alia, the following: a) save and except for any sale or disposal of any assets of the Project SPV as permitted under the Finance Documents, the Trust shall neither sell, assign, mortgage or otherwise dispose of any of the assets of the Trust without the prior approval from the Lenders; b) the Trust shall create and perfect (if required) the Security Interest over the Security in accordance with the timelines stipulated under the Facility Agreement; c) the Trust shall not effect any change in the shareholding and exercise direct control over the Project SPV; d) the Trust shall not create any Security Interest (save and except for any permitted security interest) over its assets nor provide any guarantee without the prior written approval of the Lenders. Provided that the Trust may provide guarantees for securing any financial indebtedness availed by any new project SPV that it may acquire in compliance with the terms of the Finance Documents, without any recourse to the cash flows of the Trust and/or the Project SPV, the secured assets, the Project SPV secured assets and the Projects; e) the Trust shall ensure that its cash flows (including all receivables) shall be exclusively deposited in the Trust escrow account in accordance with the terms of the Trust escrow agreement and the Trust shall ensure that the cash flows of Project SPV shall be deposited in the Project SPV escrow account(s) in accordance with the terms of the escrow agreements; f) it shall ensure that the Project SPV shall not abandon the Projects during the subsistence of the Facilities; g) upon any default by the Project SPV leading to a termination or substitution in relation to any or all of the Projects as per the provisions of the relevant Concession Agreement(s), the Trust in its capacity as the representative (as defined in the respective Concession Agreement) shall act on the instructions of the Lenders or any trustee or agent acting for and on behalf of the Lenders) for exercising rights of termination or substitution as available to it as a lender of the Project SPV, in accordance with the Project SPV Financing Agreements, subject to the terms of the respective Concession Agreement; h) for undertaking any withdrawals from the Trust Escrow Account, the Trust shall comply with the waterfall mechanism as set out in the Trust escrow agreement; i) except as may be provided in the terms of the Finance Documents, no Person has any security interest over the assets and/or the cash flows of the Project SPV other than the Trust or its agent, trustee or nominee under the Project SPV Facility Agreements; j) unless otherwise expressly permitted by the Facility Agent in writing, the Trust shall not make any restricted payments at any time, unless each of the restricted payment conditions (as set out in the Finance Documents) are complied with to the satisfaction of the Facility

Parameter	Description
	Agent and in the manner set out in the Finance Documents; k) the debt cap shall not be more than 49% (forty nine percent); l) the Trust shall comply with the provisions of the InvIT Regulations in accordance with the timelines stipulated thereunder. m) the Trust shall not undertake a change of the Project Manager, the Investment Manager, the Trustee and/or the Sponsor without the prior written approval of the Lenders; n) the Trust per the scope of services approved by the Lenders. All costs and expenses will be borne by the Trust; o) the Trust shall and shall ensure that the Obligors comply with their obligations under the Finance Documents; p) the Trust shall not exercise any right to call an event of default in relation to the Project SPV Facilities extended by it; q) the Trust shall not file and/or initiate any recovery suit, insolvency proceeding, liquidation proceeding, resolution process or any other similar process under the IBC or any other Law, against itself, until the Final Settlement Date; r) the Trust shall immediately (unless otherwise provided under the Facility Agreement) provide the Lenders such information, certification and data as may be required by the Lenders or any agency appointed by the Lenders; s) the Trust shall not make any modifications/alterations to the Trust Documents which are inconsistent with the terms of the Finance Documents and may adversely affect the rights of the Lenders; t) save and except as set out in the Base Case Business Plan, the Trust shall not and shall ensure that the Project SPV does not undertake any expansion of any of the Projects without the prion approval of the Lenders; u) the Trust shall open and maintain the DSRA with the Trust Escrow Bank in accordance with the Finance Documents; v) the Trust shall not undertake any acquisition of any new project and/or new project SPV, if such proposed acquisition is not in compliance with the acquisition conditions set out in the Finance Documents. Further, any permitted indebtedness required to be incurred for undertaking any such acquisition shall be in compliance with the conditions set out in the Finance Documents; w) the Trust shall ensure that no person whose name appears in the list of wilful defaulters (in accordance with the extant guidelines issued by the RBI or any credit information companies) shall be inducted on the governing board of the Trust, and if such a person is found on the governing board, the Trust shall take expeditious and effective steps for removal of the person from its governing board. Notwithstanding anything contained herein, Clause 7.6(y) shall not apply to any nominee director appointed by the Lenders in accordance with the terms of the Finance Documents; x) upon the occurrence of default under the Project SPV Facility Agreements, such that the said default results in an event of default, the Trust agrees that the Lenders shall have the right to instruct the Trust to enforce the Security Interest (if any) created pursuant to such Project SPV Facility Agreements and the Trust agrees to act in accordance with the instructions given by the Lenders in this regard; y) the Trust shall ensure that any financial obligation of the Trust associated with the Project which is payable in foreign currency in any form at present or in future shall at all times be fully hedged; z) the Trust shall ensure that the Project SPV secured assets shall be held exclusively for the benefit of the Lenders and it shall not enforce the security interest created over the Project SPV secured assets, unless expressly requested by the Lenders and any enforcement proceeds received in relation thereto shall be held by the Trust in trust for the benefit of the Lenders; and aa) the Trust shall ensure, among other things that: (A) the Sponsor shall continue to act as the sponsor as per Regulation 2(zz) of the InvIT Regulations and that there shall be no change in the Sponsor, without the prior approval of the Lenders; (B) the Sponsor shall continue to hold at least 51% (fifty one percent) of the shareholding in the Investment Manager; (C) the Sponsor and the Project SPV do not abandon the Projects; (D) any liability (including in relation to any group contribution) of the Trust and/or the Project SPV towards the Sponsor or any other Unit Holders shall be subordinated to the Facilities; and (E) the Project SPV shall enter into requisite EPC Contracts, operations and maintenance agreements and major maintenance agreements as required pursuant to the Concession Agreements.
Undertakings from the Project SPV	The Project SPV is required to undertake, inter alia, the following: (a) To open the Escrow Account with the Project SPV account bank prior to the first Drawdown Date; (b) To not incur any financial indebtedness (without the prior approval of the Lenders) except the indebtedness permitted under the Finance Documents and any bank guarantee facilities to be issued in favour of a telecom authority or as performance security in favour of the Sponsor, and

Parameter	Description
	any letter(s) of credit to be issued for the purchase of any toll equipment; (c) To ensure that the Project SPV Escrow Bank transfers the amounts from the Project SPV escrow account(s) to the Trust on the terms set out in the Finance Documents. (d) To ensure that the prior approval of the Lenders is procured before undertaking any amendment to the Project Documents, which results in (A) a material amendment or material modification to the Project Documents; (B) non-compliance with the Base Case Business Plan; (C) affects the ability of the Obligors to perform their obligations and/or or enforce any right, benefit, privilege or remedy under the Finance Documents and / or Project Documents, to which they are a party; or (D) affects the ability of any Secured Party to exercise its rights or enforce any remedies available to it under any of the Finance Documents; (e) The Project SPV Facility Agreements entered into between the Trust and the Project SPVs shall have a definite repayment schedule. (f) Upon the occurrence of any default by the Project SPV leading to a termination or substitution in relation to any or all of the Projects as per the provisions of the relevant Concession Agreement(s), the Trust in its d in the respective Concession Agreement)) shall act on the instructions of the Lenders or any trustee or agent acting for and on behalf of the Lenders) for exercising rights of termination or substitution as available to it as a lender of the Project SPV, in accordance with the financing documents executed by, inter alios, the Project SPV; (g) The amount of Project SPV Facilities lent by the Trust to the Project Agreements) shall be higher than the Secured Obligations payable by the Trust in relation to the Facilities; and (h) The Project SPV escrow agreements to be executed by all parties (except NHAI) prior to the first Drawdown Date of Facility A. The Project SPV shall ensure that the Substitution Agreements are executed within 90 (ninety) days from the first Drawdown Date of Facility A. Further, the Project SPV shall ensure that NHAI shall execute the Escrow Agreements within 90 (ninety) days from the first drawdown date of Facility A.
Base Case Business Plan	The consolidated business plan of the Trust (including the cash flows from the Project SPV) setting out, inter alia the Project SPV, updated from time to time in accordance with the Facility Agreement, which shall be in line with the requirements under the Project Documents and mutually agreed between the Trust and the Facility Agent.
Project Documents	collectively, the following documents: (a) the concession agreements of the Project SPV; (b) the substitution agreements executed between the Project SPV, the Sponsor and the Trust; (c) the escrow agreements executed between the Project SPV, the Sponsor and the Project SPV Escrow Bank; (d) all the insurance contracts of the Project SPV in relation to the respective Projects; (e) documents of title in relation to the Projects, if any; (f) engineering, procurement and construction contracts in relation to the Projects; (g) all authorisations in relation to the Projects; (h) operation and maintenance agreements and major maintenance agreements for routine as well as periodic maintenance, if any; (i) any bonds, guarantees, letters of credit or any other security issued in relation to any of the Project Documents set out in points (a)-(h) above; (j) any other agreements, documents or instruments entered into by the Project SPV or by any person in its favour in respect of the Projects and Facility Agent and the Trust.
Trust Documents	collectively, the following: a) the trust deed dated October 19, 2020 executed between the Sponsor and IDBI Trusteeship Services Limited (**Trustee**) as amended and modified from time to time (**Trust Deed**) b) the investment management agreement dated October 21, 2020 executed between, inter alios, the Trustee and the Investment Manager, as amended and modified from time to time; c) the project implementation agreement dated March 30, 2021 entered into by the Trustee (on behalf of the Trust), the Investment Manager and the Project Manager, with the Project SPV, which sets out the obligations of the Project Manager with respect to operation, maintenance, implementation and management of the Project SPV, as may be amended, modified and/or supplemented from time to time; and d) such other documents as may be required to be executed by the Trust from time to time and mutually designated as such by the Lenders and the Trust.
Finance Documents	collectively, the following: (a) the Facility Agreement; (b) the Security trustee agreement for appointment of the Security Trustee; (c) the Security documents in relation to the Security mentioned in the Security clause of this term sheet; (d) agreement for assignment; (e) the escrow agreement to be executed by the Trust (f) the Trust confirmation to the inter-creditor agreement of the lenders if any. (g)the undertaking from Investment Manager; (h) the undertaking from the Project SPV; (i) the negative lien undertaking from the Project SPV; (j) the corporate guarantee to be issued by the Project SPV;

Parameter	Description
	(k) any assignment/novation deed; (l) the WC Product Schedule; and (m) any other document Facility Agreement and/or mutually designated as such by the Facility Agent and the Trust.
Transaction Documents	collectively, the Project Documents, the Trust Documents and the Finance Documents
Voluntary Prepayment	a) The Trust shall be entitled to prepay the outstandings with respect to the Facilities, in full or in part, at any time during the term of the Facilities, subject to prior written notice of at least 30 (Thirty) days being provided to the Lenders. Prepayment premium at the rate of 0.5% (zero point five percent) shall be payable on such voluntary prepayment. b) If the increase in the spread in accordance with the terms of the Facility Agreement is not acceptable to the Trust, the Trust shall be entitled to prepay the outstanding Facilities without any prepayment premium provided the Trust has issued an irrevocable notice (within 30 (thirty days from the date on which the Spread was increased) to prepay the loan within 180 (One Hundred and Eighty) days commencing from the date on which the spread was increased. c) No prepayment premium will be payable if prepayment is made out of the cash accruals of the Project SPV, provided the Trust has issued an irrevocable notice (of at least 15 (fifteen) days prior to the date of such prepayment) to prepay the loans. d) The Trust may prepay the outstandings in full or in part, without being required to pay any prepayment premium, if the same is being made at the instance of the Lenders. e) The Trust may prepay the outstandings in full or in part, without being required to pay any prepayment premium, if the same is being made from any internal accruals of the Trust or from the funds of the Unit Holders, provided the Trust has issued an irrevocable notice (of at least 30 (thirty) days from the date of such prepayment) to prepay the loans. f) If any Lender does not consent to the sharing of the Security with the lenders of any Permitted Indebtedness (except for the Facilities) that may be availed by the Borrower in compliance with the terms of this Agreement and the Permitted Indebtedness Conditions, then the Borrower may prepay the Loans of such Lender in full, without being required to pay any Prepayment Premium provided the Borrower has issued an irrevocable notice (of at least 30 (thirty) days prior to the date of such prepayment) to prepay such Loans. Any amounts prepaid in the manner above (other than pursuant to (b) and (c) above shall be paid to all the Lenders on a pro rata basis, except that if any particular Lender entitled to a prepayment specifically notifies the Trust waiving such right of prepayment ("**Waiving Lender**"), then the Trust shall not be required to make any prepayment to such Lender and the Trust will be required to prepay only such amounts to the other Lenders, which would have been payable to them had the Waiving Lender not waived its right of prepayment otherwise provided under the terms of this Agreement. Any amounts pursuant to above shall be paid to the relevant Lenders shall be applied in inverse order of maturity.
Mandatory Prepayment	The Trust shall be required to mandatorily prepay the outstanding Facilities (in full or part, as the context may require), without being required to pay any prepayment premium , immediately upon receipt of the following amounts received by and on behalf of the Project SPV, and/or the Trust, and in any case no later than within 15 (fifteen) days from the occurrence of the events set out below, including in accordance with the Trust escrow agreement: (a) any insurance proceeds received by the Project SPV pursuant to the insurance contracts, and if such insurance proceeds are of an amount which is in excess of INR 1,00,00,000 (Indian Rupees One Crore only) (and as certified by an independent practicing chartered accountant) and which are not utilized towards the repair, renovation, restoration or reinstatement of the affected Project assets; (b) any proceeds from the disposal of any assets of the Project SPV (such disposal being subject to the terms of the Finance Documents or upon the Trust obtaining the prior written consent from the Lenders), if such proceeds, whether in aggregate in the Financial Year or individually, are in an amount which is in excess of INR 1,00,00,000 (Indian Rupees One Crore only) and which are not utilized for replacement of such assets of the Project SPV pursuant to which they were received; (c) amounts in the nature of liquidated damages or penalties received by the Project SPV under any Project Documents after adjusting for the additional interest payable to the Lenders, liquidated damages required to be paid under any Project Documents to the extent that such amounts are not applied for meeting any performance rectification arising on account of non-performance by various contractors under the Project Documents; (d) the proceeds resulting from an arbitral award or judicial order in connection with any of the Project Documents and the Trust Documents; (e) any proceeds in connection with a breach of warranty or guarantee under any Project Document to the extent not applied to repair or defect that is the subject of such warranty; (f) any proceeds resulting from the expiration, termination or revocation of any authorisation under the Project Documents or from any termination payments received from the Sponsor under the Project Documents; (g) any proceeds from nationalisation, compulsory acquisition, expropriation, seizure or other

Parameter	Description
	similar events with respect to any part of the Projects or the Project assets, unless the Lenders approve that such proceeds shall be utilised towards the reinstatement of such part of the Projects. Any amounts prepaid in the manner above (other than pursuant to (i) above shall be paid to all the Lenders on a pro rata basis, except that if any particular Lender entitled to a prepayment specifically notifies the Trust waiving such right of prepayment ("**Waiving Lender**"),then the Trust shall not be required to make any prepayment to such Lender and the Trust will be required to prepay only such amounts to the other Lenders, which would have been payable to them had the Waiving Lender not waived its right of prepayment otherwise provided under the terms of this Agreement. Any amounts pursuant to above shall be applied in the inverse order of maturity
Restricted Payment	The following have been identified as restricted payments in the Facility Agreement: (a) the authorisation, declaration or payment of any distributions including dividends, interest, pass through income to a Unit Holder or any other form of cash flows on share capital, shareholder units, inter-corporate deposits, quasi equity availed from the Sponsor, Unit Holders, associate companies and/or any strategic investors; and (b) capital reduction, all of which may, in any event, be made on a quarterly basis on an RPC Compliance Date, in accordance with and subject to the provisions of the Facility Agreement and the Trust escrow agreement, as the case may be. Provided however that any payment in relation to the Project SPV Facilities, or payment of any fees payable to the Investment Manager and/or the Security Trustee shall be permitted and not fall within the definition of Restricted Payments. The above-mentioned restricted payments shall be permitted on a quarterly basis subject to compliance with certain restricted payment conditions which include the following: (a) the Trust has paid the interest and/or repayment instalments and/or other charges due and payable under the Finance Documents; (b) the Trust has demonstrated the availability of liquidity equivalent for major maintenance funding requirements for all Projects being operated by the Project SPV, either in the form of earmarked cash or availability on credit facilities for the said amounts as mandated in cash flow waterfall mechanism set out in the Project SPV escrow agreement; (c) all reserves, including the DSRA Amount and the major maintenance reserve (in accordance with the Base Case Business Plan) as required on the immediately succeeding due date, are maintained and replenished in accordance with the Finance Documents and the Trust escrow agreement, to the satisfaction of the Lenders; (d) no Event of Default has occurred and is continuing or will be caused due to the making of the relevant Restricted Payment. (e) no Material Adverse Effect in respect of the Project SPV has occurred or continuing or will be cause due to making of the relevant Restricted Payment; (f) no breach of Financial Covenants has occurred or is continuing or will be caused due to making of the relevant Restricted Payment; (g) the relevant Restricted Payment is permitted by Law; and (h) the cash sweep pursuant to the occurrence of any Cash Sweep Trigger Event has been completed in accordance with the Finance Documents prior to the payment of the relevant Restricted Payment. Any payment in relation to the Project SPV Facilities, or payment of any fees payable to the Investment Manager and/or the Security Trustee shall be permitted and not fall within the definition of Restricted Payments
Events of Default	The occurrence of, inter alia, any one of the following events shall constitute an event of default: (a) Any default by the Trust in the payment of the principal amounts on any due date, subject to a cure period of 3 days in case such default is due to a technical issue (b) Breach or default by the Obligors in the performance or observance of material terms and covenants of the Finance Documents, subject to a cure period of 30 days. (c) Occurrence of any material event or circumstance that is prejudicial to or materially imperils or materially depreciates or jeopardizes the Security created or to be created in favour of the Lenders, subject to a cure period of 30 days. (d) Any breach or default in the performance and/or observation of a financial covenant for 2 consecutive years. (e) - by any credit rating agency, where such downgrade if capable of being cured is not cured within a period of 180 (one hundred and eighty) days. (f) The Trust fails to obtain the final initial credit rating in relation to the Facilities and the proposed exposure within 6 months from the first drawdown date. (g) Any material misrepresentation, warranty or statement made by any Obligor in connection with any Finance Document to which it is party or in any other document delivered by or on behalf or if under or in connection with any Finance Document, is or proves to have been substantially incorrect, untrue or misleading when made or deemed to be made, subject to a cure period of 30 days. (h) Any execution or distress being enforced or levied against whole or substantial part of the Trust's assets and any order obtained in relation thereto is not discharged, vacated or stayed within 30 days from the date of such enforcement or levy. (i) Abandonment of material activities being carried out by the Project SPV or abandonment of the Projects which materially impacts the obligation of the Trust under the Finance Documents.

Parameter	Description
	(j) Change in material activities being carried out by the Project SPV or a seizure of, or a change in, the Projects which materially impact the obligation of the Trust under the Finance Documents. (k) Occurrence of any event or circumstance which has or is likely to have a Material Adverse Effect, subject to a cure period of 30 days.
Consequences of Event of Default	On and at any time after the occurrence of an Event of Default, the Lenders will be entitled to one or all of, including but not limited to, the following rights: (a) declare all or any part of the outstandings to be immediately due and payable; (b) cancel the commitments (in part or in full) and accelerate all or a part of the payment obligations of the Trust under the Facility Agreement; (c) exercise their right to reset the spread, in addition to the right available to reset the spread on the relevant reset date under the terms of the Facility Agreement; (d) sue for creditor's process and/or exercise all or any rights (including the right to substitute/terminate assigned in their favour or the rights available to secured creditors or their agents and trustees under the Securitisation Act) in accordance with the Finance Documents, including any enforcement of any Security towards repayment of the outstanding; e) exercise any or all of its rights, remedies, powers or discretions under the Finance Documents, the inter-creditor agreement, Law or equity (including pursuant to any guidelines which may be stipulated by the RBI from time to time); (f) subject to laws (including the InvIT Regulations), convert the outstanding outstandings into Units of the Trust. The Trust shall facilitate the Lenders (including by way of obtaining the requisite consent of the unit holders); (g) circulars. (h) appoint 1 (one) Nominee Director on the board of directors of the Project SPV (subject to Laws and the terms of the Concession Agreements) or appoint a nominee on the board of directors of the Trust (subject to Laws) to protect the interests of the Lenders, till the event of default is cured, on the terms and conditions as more particularly set out under the Facility Agreement. (i) instruct the Trust to enforce the security interest created over the Project SPV secured assets in case of any default in the Project SPV Facilities.
Conditions Precedent to Execution of the Facility Agreement	The following conditions, inter alia, are required to be fulfilled by the Trust prior to execution of the Facility Agreement: (a) The Trust shall have provided certified true copies of the Trust Documents, certificate of registration as an InvIT. (b) The Trust shall have provided constitutional documents of the Investment Manager, certified true copy of the board resolution and specimen signatures of authorised signatories. (c) The Trust shall have provided constitutional documents of the Trustee, certified true copy of the board resolution and specimen signatures of authorised signatories. (d) The Trust shall have provided the credit rating letter issued by the credit rating agency along with a copy of the cover letter in relation thereto. (e) The Trust shall have provided evidence that of tying up the envisaged loan requirements.
Conditions Precedent to first Drawdown of Facility A and Facility B	The following conditions, inter alia, are required to be fulfilled by the Trust prior to drawdown of Facility A and Facility B: (a) The Obligors shall have submitted all documents required as per the know your customer policy of the lenders, (b) The Trust and the Project SPV shall have provided certificates from their respective authorized signatory, statutory auditor, independent chartered accountant, company secretary, key managerial personnel in the manner stipulated in the Facility Agreement. (c) The Finance Documents (other than the documents required to be executed subsequently) shall have been executed. (d) a legal opinion from the Lenders counsel address shall have been issued on the validity and enforceability of the Finance Documents. (e) Documents evidencing security creation and perfection (if any) shall have been submitted. (f) The Trust shall have provided a certified copy of the comments / deemed approval obtained from the Sponsor for creation of the Corporate Guarantee, Negative Lien Undertaking and Project SPV Undertaking. (g) The Trust shall have paid all necessary fees, costs and expenses payable pursuant to the Finance Documents. (h) The Trust shall have provided evidence that all Concession Agreements in relation to the Projects shall have been executed. (i) The Trust and Project SPV escrow accounts shall have been opened and the Unit Holders shall have deposited funds for their total commitment (in full) for an amount not less than INR 5870,00,00,000 (Indian Rupees Five Thousand Eight Hundred Seventy Crores only) into the Trust escrow account in accordance with the Trust escrow agreement. (j) The Lenders shall have carried out a pre-disbursement visit of the Trust premises. k) Modification required by the Lenders legal counsel to the Project SPV Facility Agreements shall have been carried out. (l) The Trust shall have submitted an acknowledged copy of the application letter for certificate under Section 281 of the Income Tax Act, 1961 for itself and the Project SPV. (m) Certified true copy of the resolution passed by the unit holders of the Trust pursuant to

Parameter	Description
	Regulation 20, Regulation 22 and the other applicable regulations of the InvIT Regulations with respect to the Facilities and the Finance Documents.
Additional Conditions Precedent to Drawdown of Facility B	The following additional conditions, inter alia, are required to be fulfilled by the Trust prior to drawdown of Facility B: a) Appointment of the Lenders consultants (other than the legal counsel) in consultation with the Lenders for such scope of work as may be decided by the Lenders. b) Due diligence report from the lenders, Independent engineers, Lenders, Insurance advisors, lender environment consultant and the lender legal counsel shall have been submitted by the Trust and all issues/concerns raised in such reports shall have been addressed to the satisfaction of the Lenders. c) Evidence that all actions as per the environmental and social management system (ESMS) guidelines have been completed. d) Certificate obtained from the Lenders independent engineers validating the reasonableness of the operations and maintenance and the major maintenance assumptions made in relation to the Base Case Business Plan. e) Evidence that the EPC Contracts and operations and maintenance contracts as required by the Lenders have been entered into between the Project SPV and the contractors.
Conditions Subsequent	The Trust shall fulfil certain conditions including but not limited to the following: a) Execution of the share pledge agreement and the power of attorney in relation thereto within 90 (ninety) days from the first drawdown date b) Execution of the corporate guarantee and the substitution agreements, within 90 (ninety) days from the first drawdown date. c) Execution of the escrow agreement by NHAI within 90 (ninety) days from the first drawdown date. d) To obtain the final initial credit rating within 30 (ninety) days from the first drawdown date. e) Provide a certified true copy of the no-objection certificate/permission of the assessing officer granted to the Trust under Section 281(1) of the Income Tax Act, 1961, immediately upon receipt thereof. f) Evidence of the major maintenance reserve having been created as per the Base Case Business Plan and the Finance Documents.
End Use Certificate	The Trust shall furnish an end use certificate from the statutory auditor to the Facility Agent confirming that the proceeds have been utilised solely in accordance with the Purpose, no later than 30 (thirty) days from the respective drawdown.
Unconditional Cancellability Clause	The Lenders will have the absolute and the unconditional right to cancel the undrawn, unavailed and the unused commitments under the Facilities, in whole or in part, at any time during the Availability Period, without giving any prior notice to the Trust, for any reason whatsoever, including but not limited to, on the occurrence of: (a) in case of deterioration in the creditworthiness of the loan accounts of the Trust in any manner whatsoever; (b) in case the Facilities are not utilized by the Trust (in part or in full) within the Availability Period; and (c) in case of any non-compliance of any terms and conditions of the Finance Documents.
Governing Law and Jurisdiction	The Finance Documents shall be governed by the laws of India. Courts of Delhi shall have exclusive jurisdiction.
Increased Costs	The Trust is required to pay the Lenders, within 15 (fifteen) days of a demand made by the Lenders, unless required to be paid immediately by the Laws, any increased costs arising due to the implementation or imposition of any new reserve requirements or other measures by Government Agencies, including any change in capital adequacy norms, save and except for any change which is not otherwise factored in the applicable interest rate revised pursuant to the Facility Agreement.
Documentation	In addition to the terms and conditions contained in this term sheet, the final documentation will contain other customary/ additional stipulation/ clauses including but not limited to representations and warranties, affirmative covenants, negative covenants by the Obligors, indemnity, Security related clauses, assignability / transferability, illegality, taxations, costs and expenses, Consultants, etc.
Business Opportunity	State Bank of India, Axis Bank Limited and Bank of Maharashtra to be given preference (on a first right of offer basis) at least pro rata business relating, inter alia, to deposit, to undertake remittances, non-fund based transactions including any letters of credit/BGs, bills/cheque purchase, forex transactions and any interest rate or currency hedging business, merchant banking, any banking related business related to an IPO or an FPO, or other capital market transactions, services in relation cash management products, and availing of loans in relation to motor vehicles.

Additionally, the Trust has issued secured, rated, listed, redeemable non-convertible debentures aggregating to an amount of upto Rs. 15,000 million ("**NCDs**")

The principal terms of the NCDs issued by the Trust are as follows:

Parameter	Description
Security Name	7.90% NHIT STRPP A, 7.90% NHIT STRPP B, 7.90% NHIT STRPP C
Issuer	National Highways Infra Trust
Debenture Trustee	SBICAP Trustee Company Limited
Registrar to the Issue	KFin Technologies Limited (formerly known as KFin Technologies Private Limited).
Type and nature of instrument	Secured, Rated, Listed, Redeemable, Non-Convertible Debentures
Mode of Issue	Public Issue
Issue	Public issue by the Issuer of secured, rated, listed, redeemable non-convertible debentures of face value of Rs. 1,000/- each, (comprising of 3 (three) separately transferrable and redeemable principal parts (**"STRPP"**) namely 1 STRPP A of face value of Rs.300/- , 1 STRPP B of face value of Rs. 300/- and 1 STRPP C of face value of Rs. 400/-, for an amount aggregating to Rs. 15,000 million **("Total Issue Size")**
Total Issue Size	Up to Rs. 15,000 million.
In multiples of	Rs. 1,000 (1 NCD comprising of 1 STRPP A, 1 STRPP B, 1 STRPP C) thereafter.
Stock Exchange/s proposed for listing of the NCDs	BSE Limited and National Stock Exchange of India Limited.
Security	The principal amount of the NCDs to be issued in terms of this Prospectus together with all interest/coupon due on the NCDs, subject to any obligations under applicable statutory and/or regulatory requirements shall be secured by: a. a first ranking pari passu security interest over the issuer's immovable assets (if any), both present and future. The Issuer does not own any immoveable property at the present time. In the event, the Issuer acquires any immovable property in future, the Issuer shall mortgage said property within 180 (one hundred eighty) days from the date of acquisition of such immovable assets. The Debenture Trustee shall be authorised to do all acts, deeds, and enter into necessary documents, agreement, amendments and/or modifications, as may be required to give effect the same, including carrying out the due diligence as may be required by Debenture Trustee; b. a first ranking pari passu Security Interest over the Hypothecated Assets (including Receivables), both present and future; and c. Negative Lien Undertaking; d. corporate guarantee executed or to be executed by the Project SPV in favor of the Debenture Trustee for guaranteeing the due repayment of the secured obligations in accordance with the terms in the Debenture Trust Deed. The security interest/ security documents stipulated above shall be collectively referred to as the **"security"** **Security Creation Timelines** (a) The Security shall be created prior to making the listing application for the NCDs with the Stock Exchange(s). (b) Unless otherwise agreed to by the Debenture Trustee, in the event the above stipulated Security is not created and/or perfected within the timelines as mentioned above or any extended timeline as may be approved by the Debenture Trustee in writing, (i) the NCDs shall carry additional interest, over and above the Coupon Rate, at the rate of 2.0% (two percent) per annum, if any, on the NCDs, computed from the date falling after the expiry of the time period provided above, till creation and perfection of the relevant Security and/or till the execution of the relevant Security Documents. **Ranking** The Security created or to be created to secure the NCDs shall be first ranking pari passu security interest inter se the Existing Lenders, the Debenture Trustee (acting on behalf of the NCD Holders) and the Additional Lenders. The Issuer is permitted to provide and/or share any Security with the Additional Lenders for the purpose of securing the Additional Debt, provided that the availing of the Additional Debt is in the compliance with the Additional Debt Conditions and a 15 (fifteen) written intimation is provided to the Debenture Trustee. The Issuer shall maintain a minimum 100% security cover on the outstanding principal of the NCDs plus accrued interest/coupon thereon, at all the times.
Coupon, Interest rate, Interest payment date, Interest type	STRPP A of an NCD 7.90% p.a. payable semi-annually STRPP B of an NCD 7.90% p.a. payable semi-annually STRPP C of an NCD 7.90% p.a. payable semi-annually

and redemption premium/discount	
Tenor	STRPP A of an NCD 13 years STRPP B of an NCD 18 years STRPP C of an NCD 25 years
Default Coupon Rate	The Issuer shall pay interest, over and above the agreed coupon rate, in connection with any delay in allotment, refunds, dematerialized credit, payment of interest, redemption of principal amount beyond the time limits prescribed under applicable statutory and/or regulatory requirements, at such rates as stipulated/ prescribed under Applicable Law. The Issuer shall pay up to 2% per annum to the NCD holders, over and above the agreed coupon rate, till the execution of the debenture trust deed if the Issuer fails to execute the debenture trust deed within such period as prescribed under Applicable Law.
Maturity Date	(i) the 13th anniversary of the Deemed Date of Allotment for STRPP A, (ii) the 18th anniversary of the Deemed Date of Allotment for STRPP B and (iii) the 25th anniversary of the Deemed Date of Allotment for STRPP C.

Further, the Trust has entered into a loan agreement dated October 18, 2023 with Axis Bank for availing loans amounting to approximately Rs. 8,770.00 million ("**Trust Loan 2**").

The principal terms of the Trust Loan 2 availed by the Trust are as follows:

Parameter	Description
Borrower	National Highways Infra Trust (Trust)
Sponsor	National Highways Authority of India
Project Manager	National Highways Invit Project Managers Private Limited
Investment Manager	National Highways Infra Investment Managers Private Limited
Project SPV	National Highways Infra Projects Private Limited
Lender/Facility Lender	Axis Bank Limited
Security Trustee	SBICAP Trustee Company Limited
Obligors	Means each of the following, and the term "Obligors" shall be construed accordingly: - (a) the Borrower ; (b) the Project SPV; and (c) any other person who provides any Security or guarantee or any other contractual comfort in terms of the Finance Documents (other than the Secured Parties).
Facilities	Collectively, the Rupee Facility and the Working Capital facilities, for an aggregate principal amount not exceeding INR 877,00,00,000 (Indian Rupees Eight Hundred Seventy-Seven Crores only).
Working Capital Facilities	The non-fund based facilities aggregating up to Rs. 20,00,00, 000'- (Rupees Twenty Crores only) in the form of LC Facility or BG Facility
LC/BG Facility	the letter of credit/ bank guarantee facility aggregating up to INR 20,00,00,000 (Indian Rupees Twenty crores only) being extended as a sub-limit of Facility.
Facility Agreement	The facility agreement dated October 18, 2023, executed between the Trust and the Lender with respect to the Facilities.
Facility Agreement Date	October 18, 2023
Availability Period of Facilities	(a) with respect to the Rupee Facility, unless extended by the Rupees Facility Lender, the period commencing from the Facility Agreement Date and terminating on the earlier of: (i) 31 March 2025, or such other extended date as may be extended in writing by the Rupee Lender: or (ii) the date on which Rupee Facility is fully drawn down/utilized; or (iii) the date on which Rupees Facility is canceled or terminated in accordance with the provisions of the Facility Agreement. (b) with respect to the Working Capital Facilities, the dates or timelines as specified in this Agreement, and as may be renewed from time to time pursuant to the same being mutually agreed in writing between the Borrower and the Working Capital Facility Lender.

Parameter	Description
Maturity Date	Earlier of (i) the date falling at the expiry of 20 years from the first drawdown date under the facilities; and (ii) March 31, 2042.
Amortization Schedule	The Structured Amortization Schedule is as below:- Repayment Start – Qtr 1 i.e. Dec 31, 2023 Repayment End – Qtr 74 i.e. March 31, 2042 Amortization:- 18.5 years
Project(s)	Following projects housed by the Project SPV: (a) Borkhedi to Kelapur section of the National Highway no. 44 from 36.60 kms to 175 kms (total 139.40 kms) in the state of Maharashtra; (b) Entire Agra bypass, i.e., the National Highway no. 19 for a total stretch of 32.80 kms in the state of Uttar Pradesh; and (c) Shivpuri to Jhansi section of the National Highway no. 27 from 1.305.08 kms to 1380.38 kms (total 75.30 kms) in the state of Madhya Pradesh.
Purpose	The Facilities shall be utilised by the Borrower only for the following purposes: (a) for on lending to the Project SPV, who shall utilise the same towards the initial capital expenditure of the Projects: (b) funding MMRA, DSRA of the Borrower and other expenses of the Project SPV; (c) meeting transaction expenses, if any; (d) issuance of fresh/ replacement of existing performance bank guarantee as per regulatory requirements and issuance of LC/LC sublimit for equipment purchase like toll equipment, advance payments io contractors, etc of Project SPV and Borrower, (e) Initial capital expenditure for existing concession agreements and future concession agreements to be executed for future acquisitions; and (f) refinancing of high-cost debt availed by the Borrower.
Interest	Repo Rate + 1.50% (presently 8% per annum) payable at monthly intervals. The benchmark REPO would be as prevalent on the date of the 1st disbursement. The interest rate reset under REPO may be done once in three months or as decided by the bank, whichever is earlier, as per Bank's extant guidelines in force.
Security	In consideration of the Lenders making available the Facilities to the Borrower and to secure the due discharge by the Borrower of all the Secured Obligations in relation to the Facilities under the Finance Documents, the Borrower agrees that the following Security Interests shall be created and perfected (if required under Law) in favour the Security Trustee: a) a first ranking pari passu Security Interest over the Borrower's immovable assets (if any), both present and future; b) a first ranking pari passu Security Interest over the Hypothecated Properties, both present and future; and c) a first ranking pari passu Security Interest over the Pledged Securities, subject to compliance with the terms of the Share Pledge Agreement.
Project Documents	collectively, the following documents: (a) the concession agreements; (b) the substitution agreements; (c) the escrow agreements; (d) all the insurance contracts of the Project SPV in relation to the respective Projects; (e) documents of title in relation to the Projects, if any; (f) engineering, procurement and construction contracts in relation to the Projects; (g) all authorizations in relation to the Projects; (h) operation and maintenance agreements and major maintenance agreements for routine as well as periodic maintenance, if any; (i) any bonds, guarantees, letters of credit or any other security issued in relation to any of the Project Documents set out in points (a)-(h) above; (j) any other agreements, documents or instruments entered into by the Project SPV or by any person in its favour in respect of the Projects and mutually designated as Project Documents by the Lenders and the Borrower and each such Project Document as amended from time to time.
Trust Documents	collectively, the following: a) the trust deed dated October 19, 2020 executed between the Sponsor and IDBI Trusteeship Services Limited (**Trustee**) as amended and modified from time to time (**Trust Deed**) b) the investment management agreement dated October 21, 2020 executed between, inter alios, the Trustee and the Investment Manager, as amended and modified from time to time; c) the project implementation and Management agreement; and d) such other documents as may be required to be executed by the Trust from time to time and mutually designated as such by the Lenders and the Trust.
Finance Documents	Collectively, the following: a) the Facility Agreement;

Parameter	Description
	b) the Security trustee agreement; c) the Security documents; d) the InvIT Escrow Account Agreement e) the Trust confirmation to the inter-creditor agreement of the lenders if any. f) the Project SPV Undertaking; g) the Corporate Guarantees; h) each Assignment / Novation Deed; i) the Negative Lien Undertaking; j) the Agreement for Assignment; k) the Deed of Assignment l) the Product Schedule; m) the Sanction Letter; and n) any other document mutually designated as such by the Lenders and the Borrower.
Transaction Documents	Collectively, means the Finance Documents, the Trust Documents and the Project Documents.
Events of Default	The occurrence of, inter alia, any one of the following events shall constitute an event of default: (a) **Non-Payment** - Any default by the Trust in the payment of the principal amount of any Loan, Interest or the Additional Interest on any due date. Provided if the payment defaults mentioned above, by the Borrower are due to technical issues and the Borrower is able to cure the said payment defaults within a period 3 (three) days from the date of such payment default then it shall not amount to an Event of Default. (b) **No Breach of Finance Documents** - The Obligors are in breach or default in the performance or observance of material terms and covenants of the Finance Documents (other than those expressly specified as an event of default under this Clause 10 (Events of Default) or elsewhere in the Finance Documents), to which they are a party, and where such breach or default if capable of being remedied has not been remedied within a period of 30 (thirty) days from the occurrence of such default and/or breach. (c) **Security** - The occurrence of any material event or circumstance that is prejudicial to or materially imperils or materially depreciates or jeopardizes the Security created or to be created in favour of the Lenders and if such event if capable of being remedied is not remedied within 30 (thirty) days from lite occurrence of such event. (d) **Financial Covenants** - Any breach or default in the performance and/or observation of a Financial Covenant as specified in Clause 9.2 (Financial Covenants) for 2 (two) consecutive Financial Years. (e) **Credit Rating** – (a) Any downgrade in the Borrower's credit rating to below AA- by any Credit Rating Agency, where such downgrade if capable of being cured is not cured within a period of 240 (two hundred and forty) days. (b) The Borrower fails to obtain the Final Initial Credit Rating in relation to the Facilities and the proposed exposure within 6 (six) months from the first Drawdown Date. (f) **Misrepresentation** - Any material representation, warranty or statement made by any Obligor in connection with any Finance Document to which it is a party, or in any other document delivered by or on behalf of it under or in connection with any Finance Document, is or proves to have been substantially incorrect, untrue or misleading when made or deemed to be made, and where any non -deliberate misrepresentation or statement if capable of being remedied has not been remedied within 30 (thirty) days of such misrepresentation/statement being made. (g) **Judgment, creditor's process** - Any execution or distress being enforced or levied against whole or substantial part of the Borrower's assets and any order obtained in relation thereto is not discharged, vacated or stayed within 30 (thirty) days from the date of such enforcement or levy. (h) **Cessation of Business** – (a) Abandonment of any material activities being carried out by the Project SPV, or an Abandonment of the Projects which materially impact the obligation of the Borrower under the Finance Documents. (b) Change in the material activities being carried out by the Project SPV or a seizure of, or a change in, the Projects which materially impact the obligation of the Borrower under the Finance Documents. (i) **Material adverse Effect** - Notwithstanding any other event in Clause 10.1 (Event of Default), the Lenders determine the occurrence of any event or circumstance which has or is likely to have a Material Adverse Effect and if such Material Adverse Effect if capable of being remedied is not remedied within a period of 30 (thirty) days from the date of such determination. (j) **Cross Default** – (a) Any default by the Borrower, under any finance document (except for the Finance Documents) entered into by the Borrower in relation any Financial Indebtedness availed by the Borrower from Lender, and where such event if capable of being remedied is not remedied within a period of 30 (thirty) days from the date of occurrence of such event. (b) The occurrence of an event of default or otherwise described as an event of default of any associate, Subsidiary, and/or sister concern, of the Borrower (including a default in the

Parameter	Description
	payment cither of principal, or interest or any other money due or payable on any of its Financial Indebtedness (whether by scheduled maturity, required prepayment, acceleration, demand or otherwise}) under any loan agreement entered into by the associate. Subsidiary, and/or sister concern, of the Borrower with any of the Lenders in relation to any of their Financial Indebtedness, and where such event if capable of being remedied is not remedied within a period of 30 (thirty') days from the date of occurrence of such event. (c) The occurrence of an event of default or otherwise described as an event of default of any associate, Subsidiary, and/or sister concern, of the Borrower (including a default in die payment cither of principal, or interest or any other money due or payable on any of its Financial Indebtedness (whether by scheduled maturity, required prepayment, acceleration, demand or otherwise)) under any loan agreement entered into by the associate, Subsidiary, and/or sister concern, of the Borrower with any of the bank and/or financial institution (other than the Lenders) in relation to any of their Financial Indebtedness, and where such event if capable of being remedied is not remedied within a period of 30 (thirty) days from the date of occurrence of such event.
Consequences of Event of Default	On and at any time alter the occurrence of an Event of Default which has not been waived by the Secured Parties or is not cured within the cure period provided herein, the Lenders may severally exercise one or all of the following rights: (a) declare all or any part of the Secured Obligations to be immediately due and payable; (b) cancel the commitments (in part or in full) and accelerate all or a part of the payment obligations of the Trust under the Facility Agreement; (c) exercise their right to reset the spread, in addition to the right available to reset the spread on the relevant reset date under the terms of the Facility Agreement; (d) sue for creditor's process and/or exercise all or any rights (including the right to substitute/terminate assigned in their favour or the rights available to secured creditors or their agents and trustees under the Securitization Act) in accordance with the Finance Documents, including any enforcement of any Security towards repayment of the Secured Obligations; e) exercise any or all of its rights, remedies, powers or discretions under the Finance Documents, the inter-creditor agreement, Law or equity (including pursuant to any guidelines which may be stipulated by the RBI from time to time); (f) subject to laws (including the InvIT Regulations), convert the outstanding outstandings into Units of the Trust. The Trust shall facilitate the Lenders (including by way of obtaining the requisite consent of the unit holders) in the conversion of the outstanding secured obligation into its units; (g) after the provisioning for Taxes and other governmental levies, the Lenders shall have the first ranking pari passu right to appropriate the profits of the Borrower towards the repayment of the Secured Obligations; (h) take all such actions as may be provided in the Restructuring Circulars. The Borrower shall, if required and subject to mutual discussions between the Borrower and the Lenders, execute necessary agreement with the Lenders for giving effect to the terms and conditions subject to which the debt restructuring may be considered by the Lenders. A restructuring undertaken by the Lenders may include inter alia alteration of the terms of the Facilities, including modification in relation to the repayment period/repayable amount/the amount of instalments/rate of interest/rollover of credit facilities/sanction of additional credit facilities/enhancement of existing credit limits and compromise settlements where lime for payment of settlement amount exceed 3 (three) months; (i) instruct the Borrower to appoint 1 (one) Nominee Director on the board of directors of the Project SPV (subject to Laws and the terms of the Concession Agreements) or appoint a nominee on the board of directors of the Borrower (if any and subject to Laws) to protect the interests of the Lenders, till the Event of Default is cured; and; (j) instruct the Borrower to enforce the Security Interest created over the Project SPV Secured Assets; (k) instruct the Borrower to demand payment/repayment from the Project SPV of all outstanding amounts which are accrued or due by the Project SPV under the InvIT to SPV Loan Documents. Upon a failure by the Project SPV to make such payment/repayment under an InvIT to SPV Loan Agreement within 15 (fifteen) days from the occurrence of an Event of Default, the Lenders shall have the right to instruct the Borrower to immediately accelerate such InvIT to SPV Loan in respect of which the Project SPV has failed to make such payment/repayment (i.e. to declare that all outstanding amounts under the InvIT to SPV loan are immediately due and payable) and the Borrower shall immediately comply with such instructions. If the Project SPV fails to immediately make payments of all amounts demanded by the Borrower pursuant to such acceleration, then it shall result in an event of default (howsoever described) under the relevant InvIT to SPV Loan Document and the Borrower (acting on the instructions of the Lenders) shall immediately declare a financial Default (as defined under the Concession Agreement) in respect of the InvIT to SPV Loans and the Borrower (acting on the instructions of the Lenders) shall initiate necessary actions Lu terminate the relevant Concession Agreement(s), and immediately take all other relevant actions (and exercise all rights that it has as a lender under the InvIT to SPV loan Documents including the rights of substitution as per the terms of the Substitution Agreement) as instructed by the Lender in that regard thereafter;
End Use Certificate	(a) The Borrower unconditionally agrees, undertakes and acknowledges that the Borrower shall

Parameter	Description
	utilise the Facilities exclusively for the purpose mentioned in Clause 2.2 (Purpose) of this Agreement. Any deviation in the utilisation of the Facilities by the Borrower, in accordance with the relevant purpose for which a said Facility is lent, will be dealt with in accordance with the Master Circular- Loans and Advances Statutory and Other Restrictions issued by die RBI dated 1 July 2015, as may be amended, replaced or supplemented from time to time and the provisions of the Finance Documents. (b) The Borrower shall furnish an end use certificate from the Statutory Auditor, 10 the Lenders confirming that the proceeds of each Loan have been utilised solely in accordance with Clause 2,2 (Purpose) of this Agreement, no later than 180 (one hundred eighty) days from the respective Drawdown.
Increased Costs	The Borrower will pay the Lenders, within 15 (fifteen) days of a demand made by the Lenders, unless required to be paid immediately by the Laws, any increased costs arising due to the implementation or imposition of any new reserve requirements or other measures by Government Agencies, including any change in capital adequacy norms, save and except for any change which is not otherwise factored in the revised Applicable Interest Rate, revised pursuant to agreement.

MANAGEMENT'S DISCUSSION AND ANALYSIS OF FACTORS BY THE DIRECTORS OF THE INVESTMENT MANAGER AFFECTING THE FINANCIAL CONDITION, RESULTS OF OPERATIONS AND CASH FLOWS

Due to the nature of the Project SPVs and the Target Toll Roads, there is limited financial information available in respect of us which can be presented in this Placement Document. The following discussion of our financial condition and results of operations should be read in conjunction with our audited standalone financial information of the Trust, for the period from its date of settlement, i.e. October 19, 2020, up to March 31, 2021, audited consolidated financial information as on March 31, 2022, audited consolidated financial information as on March 31, 2023 and audited interim financial statements of the Trust for the nine months period ended December 31, 2023, prepared in accordance with Ind AS, enclosed as Annexure A. No separate financial information, including actual revenue data for the Target Toll Roads, are currently available, which could be used to clearly assess financial information, including revenue and expenses, in respect of each of the Target Toll Roads. Accordingly, in lieu of financial statements of the Trust, the Target Toll Roads and/or Project SPVs, the revenue data that NHAI has historically collected through toll collection and maintenance contracts has been included in the section entitled "Asset Revenue Information" on page 364.

Furthermore, this limited historical revenue data available in respect of the Target Toll Roads may not reflect their operation in the future and are not indicative of our expected future financial condition, results of operations or cash flows. Investors are cautioned that the lack of financial information in this Placement Document may make it difficult to assess our financial position or future prospects or results of operations.

The following discussion is intended to convey management's perspective on our expected financial condition and results of operations.

This discussion contains forward-looking statements and reflects our current views with respect to future events and financial performance that involve risks and uncertainties. Actual results may differ materially from those discussed in or implied by any of the forward-looking statements as a result of various factors, including those listed under "Risk Factors" and "Forward- Looking Statements".

Overview

We are a registered infrastructure investment trust under the InvIT Regulations. We currently have a right to toll, operate and maintain a portfolio of eight Existing Toll Roads (*defined below*) in the Indian states of Gujarat, Rajasthan, Telangana, Karnataka, Maharashtra, Uttar Pradesh and Madhya Pradesh and intend to toll, operate and maintain a portfolio of seven Target Toll Roads (*defined below*) in the Indian states of, Assam, Madhya Pradesh, Uttar Pradesh, West Bengal and Karnataka under the Toll Operate Transfer ("**TOT**") model conceived by NHAI. These Toll Roads (*defined below*) are operated and maintained pursuant to concessions granted by the NHAI. The Existing Toll Roads comprise eight stretches spanning a total length of approximately 635 kms and the Target Toll Roads comprise seven stretches spanning a total length of approximately 887 kms.

Our Sponsor is NHAI, an autonomous authority of the GoI under the MoRTH constituted on June 15, 1989 by an Act of the Indian Parliament titled - The National Highways Authority of India Act, 1988 (the "**NHAI Act**"). NHAI was operationalised in February 1995 with the appointment of a full-time Chairman and other members of the board. The functioning of NHAI is governed by the NHAI Act and the rules, and regulations framed thereunder.

The Project SPVs have entered into 15 independent Concession Agreements with the NHAI for concessions of each of the Toll Roads. We have satisfied all conditions precedent and commenced our Concessions on December 16, 2021 for R1 Toll Roads and on October 29, 2022 for R2 Toll Roads in accordance with the terms of the Concession Agreements for the Existing Toll Roads and expect to satisfy all conditions precedent and commence our Concessions for the Target Toll Roads in accordance with the terms of the Concession Agreements for the Target Toll Roads. For further details, please see the section entitled "*Summary of the Concession Agreements*", "*Management's Discussion and Analysis of Factors by the Directors of the Investment Manager Affecting the Financial Condition, Results of Operations and Cash Flows*" and "*Use of Proceeds*" on pages 232, 290 and 273, respectively.

The Concession Agreements provide the Project SPVs the right to collect tolls for a period of 20 years or 30 years (as applicable under the relevant Concession Agreement) from users of each Toll Road, with certain overlay activities and the construction of additional toll lanes in respect of certain of the Toll Roads (the "**Initial Improvement Works**") to be completed by the Project SPVs within 12 to 18 months from the Appointed Date (as defined in the section entitled "*Summary of the Concession Agreements*"). Responsibility for the supervision of the operations and maintenance of the Toll Roads also vests with us. In return, the Project SPVs are required to pay the concession fee to the NHAI prior to the commencement of the Concession, as set out in the respective Concession Agreements. For further information on the provisions of the Concession Agreements, see "*Summary of the Concession Agreements".*

NHIPPL has a right to toll, operate and maintain the following toll road assets (the "**Existing Toll Roads**").

- Palanpur/Khemana – Abu Road Project ("**Asset 1**"): Abu Road section of NH 27 with a total length of 45 kms, connecting the states of Gujarat and Rajasthan;

- Abu Road – Swaroopganj Project ("**Asset 2**"): Swaroopganj section of NH 27 with a total length of 31 kms, in the state of Rajasthan;

- Maharashtra/ Karnataka Border (Kagal) – Belgaum Project ("**Asset 3**"): Belgaum – Kagal section of NH 48 with a total length of 77.7 kms, connecting the states of Karnataka and Maharashtra;

- Chittorgarh – Kota & Chittorgarh Bypass Project ("**Asset 4**"): Chittorgarh – Kota section of NH 27 with a total length of 160.5 kms, in the state of Rajasthan;

- Kothakota Bypass – Kurnool Project ("**Asset 5**"): Kothakota bypass – Kurnool section of NH 44 with a total length of 74.6 kms, connecting the states of Telangana to Andhra Pradesh;

- Agra Bypass Project ("**Asset 6**"): Agra Bypass section with a total length of 32.80 kms, connecting NH19 (old NH2) to NH44 (old NH7) in Uttar Pradesh;

- Borkhedi - Kelapur Project ("**Asset 7**"): Borkhedi-Kelapur-Maharashtra/Telangana border section of NH44 (old NH7) with a total length of 138.15 kms, in the state of Maharashtra; and

- Shivpuri – Jhansi Project ("**Asset 8**"): Jhansi-Shivpuri section of NH 27 with a total length of 75.30 kms, connecting the districts of Jhansi in the state of Uttar Pradesh and Shivpuri in the state of Madhya Pradesh.

From the Appointed Date, NEPPL will have the right to toll, operate and maintain the following toll road assets (the "**Target Toll Roads**"):

- Chichra - Kharagpur Project ("**Asset 9**"): Chichra - Kharagpur section of NH 49 with a total length of 56.12 kms, in the state of West Bengal;

- Rewa –Lakhnadon Project ("**Asset 10**"): Rewa – Katni – Jabalpur – Lakhnadon section of NH 30 and NH 34 with a total length of 306.34 kms, in the state of Madhya Pradesh;

- Kachugaon - Kaljhar Project ("**Asset 11**"): Kachugaon - Rakhaldubi Bus Junction – Kaljhar section of NH 27 with a total length of 114.17 kms, in the state of Assam;

- Kaljhar – Patacharkuchi Project ("**Asset 12**"): Kaljhar – Patacharkuchi section of NH 27 with a total length of 27.30 kms, in the state of Assam;

- Lakhnadon – Mahagaon (Mohgaon) – Khawasa ("**Asset 13**"): Lakhnadon – Mahagaon (Mohgaon) – Khawasa section of NH 44 with a total length of 107.35 kms, in the state of Madhya Pradesh;

- Orai – Barah Project ("**Asset 14**"): Orai – Barah section of NH 27 with a total length of 62.90 kms, in the state of Uttar Pradesh; and

- Chitradurga Bypass – Hubli Project/ Karnataka Project ("**Asset 15**"): Chitradurga Bypass - Chitradurga - Davanagere - Haveri – Hubli section of NH 48 with a total length of 214.47 kms, in the state of Karnataka.

The following map depicts locations of the Toll Roads:

Note:

(1) This map is for illustrative purposes only, is not to scale and is subject to change at any time.

SEBI Exemptions

For the purposes of the Issue, the Investment Manager requested SEBI for certain exemptions by way of letter dated March 6, 2024 to allow for the relaxation of strict application of financial disclosure rules per the InvIT Regulations for the Sponsor and the NEPPL ("**SEBI Exemption Request**"). The SEBI Exemption Request was made on the basis that the Sponsor is incorporated under the NHAI Act and no historical consolidated financials are available for presentation in this Placement Document. Further, considering that the project SPVs are typically held directly by the Authority and are not held as, or through, separate special purpose vehicles ("SPVs") or business units, NHAI typically operates these roads through third party contracts for collection of revenue and maintenance, and the profit and loss and the balance sheets are prepared only at the consolidated NHAI level. Upon transfer to the SPV(s) owned by the Trust, the respective concession agreements become applicable to them. SEBI accepted the request and granted an exemption through its letter dated March 6, 2024.

Accordingly, only the following information is presented in this Placement Document:

- The unaudited financial information of the Sponsor for FY – 2022 and 2023, and period till the quarter ended prior to the proposed placement in the placement document.
- Revenue of the assets for the preceding three financial years and stub period, being, till the completed month prior to filing of the placement document.
- Operating cash flows of the Project SPVs for the period subsequent to transfer of assets to the Trust ill March 31, 2023 in the placement document.

The absence of meaningful historical operating data or financial statements may make it difficult for investors to evaluate our

ability to operate, manage and maintain the Toll Roads and assess our financial position or future prospects or results of operations.

Standalone

1. **Basis of Preparation**

The Consolidated financial statements comprises of the Consolidated Balance Sheet, Consolidated Statement of Profit and Loss, Consolidated Cash Flow Statement, Consolidated Statement of Changes in Equity and Consolidated explanatory notes thereon of National Highways Infra Trust, for the nine months ended 31 December 2023 ("Interim Financial Information"). The Interim financial Information has been prepared in accordance with recognition and measurement principles laid down in Indian Accounting Standard 34- Interim Financial Reporting (Ind AS 34), as prescribed in Rule 2(1)(a) of the Companies (Indian Accounting Standards) Rules, 2015 (as amended) and other accounting principles generally accepted in India, to the extent not inconsistent with the Securities and Exchange Board of India (Infrastructure Investment Trusts) Regulations, 2014, as amended, the additional disclosures as required in Chapter 4 of SEBI Master Circular No. SEBI/HO/DDHS- PoD 2/P/C1R/2023/115 dated 06 July 2023 as amended including any guidelines and circulars issued thereunder ("SEBI Circulars/InvIT Regulations")

The Consolidated financial statements were authorised for issue in accordance with resolution passed by the board of directors of the Investment Manager on 04.03.2024.

The audit of these Interim Financials for the Nine months ended December 31, 2023 of NHIT has been carried out by the Statutory Auditors of NHIT.

New amendments adopted during the period

The Ministry of Corporate Affairs has notified Companies (Indian Accounting Standards) Amendment Rules, 2023 dated 31 March 2023 to amend the following Ind AS:

Ind AS 8, Accounting Policies, Changes in Accounting Estimates and Errors

Ind AS 1, Presentation of Financial Statements

Ind AS 12, Income Taxes

The amendments are applicable for annual periods beginning on or after the April 1, 2023, however, these do not have material impact on the financial statements of the Group.

2. **Material accounting policies and key sources of estimation uncertainties and critical judgements**

A Material accounting policies

The accounting policies adopted in preparation of these financial statements are consistent with those followed in preparation of the Group's latest Annual Consolidated Financial Statements.

B Key sources of estimation uncertainties and critical judgements

The preparation of the consolidated financial statements requires use of certain critical accounting estimates and judgements. It also requires the management to exercise judgement in the process of applying the Group's accounting policies. The areas where judgements and estimates are significant to the financial statements or areas involving a higher degree of judgement or complexity are the same as those applied to the Group's latest Annual Consolidated Financial Statements.

Consolidated

1. **Basis of Preparation**

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Significant Factors Affecting Our Results of Operations

We expect our results of operations, financial condition and liquidity to be influenced by the following events, facts, developments and market characteristics.

The terms of the Concession Agreements and traffic volumes

Toll fees are typically pre-determined with the relevant government entity and cannot be modified to reflect prevailing circumstances, other than annual adjustments to account for inflation as specified in the Concession Agreements. Accordingly, our profitability is largely a function of how effectively we manage costs during the concession period. Significant costs during the concession period include operating and maintenance expenses such as periodic maintenance which is required to be performed as specified in the Concession Agreement. Periodic maintenance involves the repair of wear and tear of the roads and highways, including overlaying the surface of the roads and highways, if required. For further details on the maintenance requirements for each of our projects, see the section entitled "*Our Business"* in this Placement Document. Our inability to effectively manage such operating and maintenance expenses during the concession period may have a material adverse effect on our profitability, financial condition and results of operations.

We are substantially dependent on the accuracy of the traffic volume forecasts for the respective Toll Road projects. Projects undertaken on a TOT basis involve Concession Agreements that are long-term in nature, usually between 20 to 30 years. The agreed consideration for the toll road projects is based on, amongst other factors, forecasts of traffic volumes and expected revenues over the concession period. Any material shortfall between the actual traffic volume and the forecast traffic volume for a project could have a material adverse effect on our cash flows, results of operations and financial condition.

Our projects involve agreements that are long-term in nature. All long-term projects have inherent risks associated with them and involve variables that may not necessarily be within our control. Accordingly, we may be exposed to a variety of operation and maintenance and other risks, including unanticipated cost increases and overruns, inability to negotiate satisfactory arrangements with third parties, and disagreements with third parties. In addition, the long-term nature of our contracts may expose us to increased risk of unforeseen business and industry changes and developments which could have a material adverse effect on their business, financial condition and results of operations.

Toll revenues

The operation of toll roads principally involves collection of tolls and maintenance. Revenues from the Toll Roads will substantially comprise receipts collected at toll plazas from vehicles passing through the Toll Roads. Toll revenues generated by each of the Toll Roads will be subject to a number of factors, including traffic volume by vehicle categories, weight of the vehicle, applicable toll rates and distance travelled. The volume can vary with the location of the asset and the period of operation, as well as seasonal effects. Meanwhile, toll rates are ultimately determined by the Indian government in accordance with certain national laws and regulations. We anticipate a continuing increase in toll rates for the Toll Roads

given the annual inflation-linked adjustment.

Operation and maintenance costs

We will be responsible for the operation and maintenance of the Toll Roads upon commencement of the respective concession. Pursuant to each of the Concession Agreements, we will be required to ensure that the relevant Toll Road conforms to the maintenance requirements set forth in the Concession Agreements. For each Toll Road, we will be required to prepare an annual program of preventive, urgent and other scheduled maintenance to comply with the standards and requirements set out in the Concession Agreements.

Local state economies

We expect our financial results from the Toll Road to be dependent upon growth in the local state economies in which they are operated, namely Rajasthan, Gujarat, Telangana, Assam, Madhya Pradesh, Maharashtra, Uttar Pradesh, West Bengal and Karnataka. We expect trends in the economic development and population growth of each of these states to have a direct impact on the traffic utilizing the Toll Road.

Access to and cost of financing

Our ability to obtain financing, as well as the cost of such financing, affects our business. Our ability to access such additional financing is subject to a variety of factors, including interest rates and other funding costs and market conditions. Any lack of access or higher costs in relation to additional financing that may be required by us could negatively impact our results of operations.

Arrangement with respect to future assets

We plan to make significant investments in toll road assets so as to expand our portfolio over the next several years. In accordance with the approval granted by the Chairman of NHAI, by way of communication dated March 29, 2021, the Sponsor will offer around 1,500 km of roads in three years to the Trust ("**Future Assets**").

The process of identification of Future Assets, offer of Future Assets to Trust and completion of transfer of Future Assets to the Trust including valuation mechanism may be refined and/or modified in line with the internal policies of NHAI. Furthermore, the success of our portfolio expansion is limited by the availability of, and competition for, suitable projects, by our financial resources, including our available cash and borrowing capacity, by our ability to integrate such acquired projects into our business and by other factors, some of which may be beyond our control. For more details, please see the section entitled "*Risk Factors—The Sponsor is under no obligation to provide the Trust with access to future assets, and the Trust may be unable to bid effectively for them"* in this Placement Document.

Competition

We operate in a competitive environment. The competition for toll road and other infrastructure projects varies depending on the size, nature and complexity of the project and on the geographical region in which the project is to be executed. Some of our competitors have greater financial resources, economies of scale and operating efficiencies than we do. There can be no assurance that we can effectively compete with its competitors in the future, and this failure to compete effectively may have a material adverse effect on our financial condition and results of operations.

Exchange rate fluctuations

Financial information disclosed in this Placement Document and the Asset Revenue Information will be presented in Rupees, and our functional currency is Rupees. However, while we generate revenue in Rupees, we may purchase our equipment in both Rupees and foreign currency, including U.S. dollars. Additionally, if we incur external borrowings in currencies other than Rupees, we will be exposed to foreign currency exchange risk and, depending on the cross-currency issues of these foreign currencies and the Rupee, our combined financial statements may include distorted figures of expenses and, consequentially, profits or loss. Accordingly, our results of operations will be impacted by the strength of the U.S. dollar and other currencies as measured against the Rupee due to translational effect. To the extent that the Rupee strengthens or weakens against the U.S. dollar, or other currencies in which we interact, our combined results of operations will be affected.

Results of Operations

The following table sets forth certain information with respect to our results of operations based on the Audited Financial Information:

Audited Consolidated Interim Statement of Profit & Loss for the period ended December 31, 2023

Particulars	For the period ended
	December 31, 2023*(₹ in lakh)*
Income	
Revenue from operations	70,334.10
Other income	1491.61
Total income	**71,825.71**
Expenses	
Investment Manager fees	1356.16
Trustee fees	8.73
Valuation Fee	5.40
Annual Listing fee	40.53
Rating Fee	6.35
Insurance Expenses	573.32
Custodian Fee	2.38
Operating expenses	10,770.38
Project management fees	743.40
Employee benefits expenses	843.96
Finance charges	19,565.51
Depreciation and amortization expense	17,660.65
Other expenses	1602.61
Audit Expenses	14.48
Total expenses	**53,193.86**
Profit / (Loss) before exceptional items and tax	**18,631.85**
Tax expense	
Current tax	408.31
Current tax - earlier years	(2.52)
Deferred tax expense/(credit)	(4,620.23)
Total tax	**(4,214.44)**
Profit / (Loss) for the period	**22,846.29**
Other comprehensive income	
Items that will not be reclassified to Profit and Loss	(2.24)
Items that will be reclassified to Profit and Loss	0.45
Total comprehensive income for the period	**22,844.50**

Consolidated Results of Operations for the nine month period ended December 31, 2023

Income

The total income for the nine month period ended December 31, 2023 was ₹ 71,825.71 lakh, which primarily consisted of revenue from collection of tolls from R1 Toll Roads and R2 Toll Roads.

Revenue from operation

The revenue from operations for the nine month period ended December 31, 2023 was ₹ 70,334.10 lakh, which was on the account of revenue from toll collections from R1 Toll Roads and R2 Toll Roads.

Other income

The revenue from other income for the nine month period ended December 31, 2023 was ₹ 1491.61 lakh, which comprised interest income on fixed deposit receipts, gain on sale of mutual funds and other miscellaneous income.

Expenses

The total expenses for the nine month period ended December 31, 2023 was ₹ 53,193.86 lakh, which primarily consisted of depreciation and amortization expense, finance charges and operating expenses.

Investment Manager fees

The total Investment Manager fees for the nine month period ended December 31, 2023 was ₹ 1356.16 lakh, which was on the account of the fees paid to the Investment Manager pursuant to the Investment Management Agreement.

Trustee fees

The total Trustee fees for the nine month period ended December 31, 2023 was ₹ 8.73 lakh, which was on the account of fee paid to the Trustee pursuant to the Trust Deed.

Operating expenses

The total operating expenses for the nine month period ended December 31, 2023 was ₹ 10,770.38 lakh, which was on the account of provision for major maintenance obligation and operation and maintenance expenses.

Project management fees

The total project management fees for the nine month period ended December 31, 2023 was ₹ 743.40 lakh, which was on the account of fee paid to the Project Manager pursuant to Project Implementation and Management Agreement.

Employee benefits expenses

The total employee benefit expenses for the nine month period ended December 31, 2023 was ₹ 843.96 lakh, which was on the account of salary and wage expenses.

Finance charges

The total finance charges for the nine month period ended December 31, 2023 was ₹ 19,565.51 lakh, which was on the account of interest paid to senior lenders.

Depreciation and amortization expense

The total depreciation and amortization expense for the nine month period ended December 31, 2023 was ₹ 17,660.65 lakh, which was on the account of amortization of the intangible assets toll rights.

Other expenses

The total other expenses for the nine month period ended December 31, 2023 was ₹1,602.61 lakh, which was on the account of legal and professional fees, independent consultant fee, vehicle hire charges, power & fuel expenses and tour & travel, etc.

Results of Operations for the Financial Year ended March 31, 2023, March 31, 2022 and for the period from October 19, 2020 to March 31, 2021

Particulars	For the Financial Year ended (in lakhs) March 31, 2021	For the Financial Year ended (in lakhs) March 31, 2022	For the Financial Year ended (in lakhs) March 31, 2023
Income			
Revenue from operations	-	13,960.55	68,717.20
Other income	-	1,014.53	1,370.71
Total income		**14,975.08**	**70,087.91**
Expenses			
Investment Manager fees	-	1931.71	1,263.70
Trustee fees	4.21	3.73	9.6
Valuation Fee	-	-	4.00
Annual Listing fee	-	-	20.00
Rating Fee	-	0.57	0.20
Insurance Expenses	-	166.04	628.74
Custodian Fee	-	-	0.84
Operating expenses	-	849.77	9,025.05
Project management fees	-	290.43	991.20
Employee benefits expenses	-	2.12	296.22
Finance charges	-	3154.43	16,621.32
Depreciation and amortization expense	-	1055.65	17,560.63
Other expenses	63.69	504.87	1,917.06
Audit Expenses	-	5.38	8.66
Total expenses	**67.90**	**7,964.71**	**48,347.22**
Profit / (Loss) before exceptional items and tax	**(67.90)**	**7010.37**	**21,740.69**
Tax expense			
Current tax	-	436.36	473.89
Current tax – earlier years	-	-	0.01
Deferred tax expense/(credit)	-	-262.32	-4,422.79
Total tax	**-**	**174.04**	**-3,948.89**

Particulars	For the Financial Year ended (in lakhs)	For the Financial Year ended (in lakhs)	For the Financial Year ended (in lakhs)
Profit / (Loss) for the period	**(67.90)**	**6836.33**	**25,689.57**
Other comprehensive income			
Items that will not be reclassified to Profit and Loss	-	-	-
Items that will be reclassified to Profit and Loss	-	-	-
Total comprehensive income for the period	(67.90)	**6836.33**	**25,689.57**

Comparison Fiscal 2023 with Fiscal 2022

Income

The total income for the Financial Year ended March 31, 2023 was ₹ 70,087.91 lakh, which primarily consisted of revenue from operations. Income increased by ₹ 55,112.83 lakh from March 31, 2022. The reason for change is, in previous period toll revenue income was from 5 operational projects, however for Financial Year ended March 31, 2023 three additional toll roads were acquired and consequently, toll revenue income was from 8 operational projects.

Revenue from operations

Revenue from operations for the Financial Year ended March 31, 2023 was ₹ 68,717.20 lakh, which was on the account of revenue from toll collection. Revenue increased by ₹ 54,756.65 lakh from March 31, 2022. The reason for change is, in previous period toll revenue income was from 5 operational projects, however for Financial Year ended March 31, 2023 three additional toll roads were acquired and consequently, toll revenue income was from 8 operational projects.

Other income

Revenue from other income for the Financial Year ended March 31, 2023 was ₹ 1,370.71 lakh, which was on the account of interest income on fixed deposit receipts, gain on sale of mutual funds and other miscellaneous income. Other Income increased by ₹ 356.18 lakh from March 31, 2022. The reason for change is, there is excess surplus with the Trust due to increase in revenue, and same is further invested in FDR and Mutual funds.

Expenses

The total expenses for the Financial Year ended March 31, 2023 was ₹ 48,347.23 lakh, which primarily consisted of depreciation and amortization expense, finance charges and Investment Manager fees. Total expense increases by ₹ 40,382.52 lakh from March 31, 2022. The reason for change is, in previous period toll revenue income was from 5 operational projects, however for Financial Year ended March 31, 2023 three additional toll roads were acquired and consequently, toll revenue income was from 8 operational projects.

Investment Manager fees

The total Investment Manager fees for the Financial Year ended March 31, 2023 was ₹ 1,263.70 lakh, which was on the account of fee paid to the Investment Manager pursuant to Investment Management Agreement. IM Fee decreased by ₹ 668.01 lakh from March 31, 2022. The reason for change is, in FY 21-22 IM Fees for two Financial year, i.e. FY 20-21 and FY21-22 was accounted.

Trustee fees

The total Trustee fees for the Financial Year ended March 31, 2023 was ₹ 9.60 lakh, which was on the account of fee paid to the Trustee pursuant to Trust Deed. No major change in trustee fee as compared with previous year.

Operating expenses

The total operating expenses for the Financial Year ended March 31, 2023 was ₹ 9,025.05 lakh, which was on the account of provision for major maintenance obligation, operation and maintenance expenses. Operating expense increased by to ₹ 8,175.28 lakh from March 31, 2022. The reason for change is, in previous period toll revenue income was from 5 operational projects, however for Financial Year ended March 31, 2023 three additional toll roads were acquired and consequently, toll revenue income was from 8 operational projects.

Project management fees

The total project management fees for the Financial Year ended March 31, 2023 was ₹ 991.20 lakh, which was on the account of fee paid to the Project Manager pursuant to Project Implementation and Management Agreement. PM Fee increased by ₹ 700.77 lakh from March 31, 2022. The reason for change is, in previous period toll revenue income was from 5 operational projects, however for Financial Year ended March 31, 2023 three additional toll roads were acquired and consequently, toll

revenue income was from 8 operational projects.

Employee benefits expenses

The total employee benefit expenses for the Financial Year ended March 31, 2023 was ₹ 296.22 lakh, which was on the account of salary and wage expenses. Employee benefits expenses increases by amounting to ₹ 294.10 lakh from March 31, 2022. The reason for the change is, increment in salary & headcount as there are more operational projects in Financial Year ended March 31, 2023 as compared to previous period.

Finance charges

The total finance charges for the Financial Year ended March 31, 2023 was ₹ 16,621.32 lakh, which was on the account of interest paid to senior lenders. Finance charges increases by amounting to ₹ 13,466.89 lakh from March 31, 2022. The reason for the change is, increase in additional borrowing and interest cost during the current period.

Depreciation and amortization expense

The total depreciation and amortization expense for the Financial Year ended March 31, 2023 was ₹ 17,560.63 lakh, which was on the account of amortization of the intangible assets toll rights. Depreciation and amortization expense increased by ₹ 16,504.98 lakh from March 31, 2022. The reason for change is, in previous period toll revenue income was from 5 operational projects, however for Financial Year ended March 31, 2023 three additional toll roads were acquired and consequently, toll revenue income was from 8 operational projects.

Other expenses

The total other expenses for the Financial Year ended March 31, 2023 was ₹ 1,917.06 lakh, which was on the account of legal and professional fees, vehicle hire charges, power & fuel expenses and tour & travel etc. Other expenses increased by ₹ 1,412.19 lakh from March 31, 2022. The reason for the change is increase in Legal and Professional fee, Power & Fuel, Environment Health and Safety expenses, vehicle hire charges, repair and maintenance etc. In previous period toll revenue income was from 5 operational projects, however for Financial Year ended March 31, 2023 three additional toll roads were acquired and consequently, toll revenue income was from 8 operational projects.

Comparison Fiscal 2022 with Fiscal 2021

Income

The total income for the Financial Year ended March 31, 2022 was ₹ 14,975.08 lakh, which primarily consisted of revenue from operations. Income for Financial Year ended March 31, 2021 was Nil. The reason for change is, in previous period there were no operational projects as the R1 Toll Roads were acquired w.e.f. December 16, 2021.

Revenue from operations

Revenue from operations for Fiscal 2022was ₹ 13,960.55 lakh, which was on the account of revenue from toll collection from R1 Toll roads. The revenue for Fiscal 2021was Nil as NHIPPL was not operational in Fiscal 2021.

Other income

Revenue from other income for the Financial Year ended March 31, 2022 was ₹ 1,014.53 lakh, which was on the account of interest income on fixed deposit receipts, gain on sale of mutual funds and other miscellaneous income. Other Income for Financial Year ended March 31, 2021 was Nil. The reason for change is, there was excess surplus with the Trust due to increase in revenue, and same is further invested in FDR and Mutual funds.

Expenses

The total expenses for the Financial Year ended March 31, 2022 was ₹ 7,964.71 lakh, which primarily consisted of depreciation and amortization expense, finance charges and Investment Manager fees. Total expense increased by more than 100% from for Financial Year ended March 31, 2021. The reason for change is, in previous period there were no operational projects. Projects were acquired w.e.f. December 16, 2021.

Investment Manager fees

The total Investment Manager fees for the Financial Year ended March 31, 2022 was ₹ 1,931.71 lakh, which was on the account of fee paid to the Investment Manager pursuant to Investment Management Agreement. IM Fee for Financial Year ended March 31, 2021 was Nil. The reason for change is, the IM Fee related to FY 20-21 was paid in FY 21-22 since the projects under R1 was acquired w.e.f. December 16, 2021.

Trustee fees

The total Trustee fees for the Financial Year ended March 31, 2022 was ₹ 3.73 lakh, which was on the account of fee paid to the Trustee pursuant to Trust Deed. Trustee Fee for Financial Year ended March 31, 2021 was Nil. The reason for change was, in previous period there were no operational projects. Projects were acquired w.e.f. December, 16 2021.

Operating expenses

The total operating expenses for the Financial Year ended March 31, 2022 was ₹ 849.77 lakh, which was on the account of provision for major maintenance obligation and operation and maintenance expenses. Operating expense for Financial Year ended March 31, 2021 was Nil. The reason for change was, in previous period there were no operational projects. Projects were acquired w.e.f. December 16, 2021

Project management fees

The total project management fees for the Financial Year ended March 31, 2022 was ₹ 290.43 lakh, which was on the account of fee paid to the Project Manager pursuant to Project Implementation and Management Agreement. PM Fee for Financial Year ended March 31, 2021 was Nil. The reason for change was, in previous period there were no operational projects. Projects were acquired w.e.f. December 16, 2021

Employee benefits expenses

The total employee benefit expenses for the Financial Year ended March 31, 2022 was ₹ 2.12 lakh, which was on the account of salary and wage expenses. Employee benefits expenses for Financial Year ended March 31, 2021 was Nil. The reason for change was, no employees were there in previous period.

Finance charges

The total finance charges for the Financial Year ended March 31, 2022 was ₹ 3,154.43 lakh, which was on the account of interest paid to senior lenders. Finance charges in March 31, 2021 was Nil. The reason for change is, no borrowings were there in previous period.

Depreciation and amortization expense

The total depreciation and amortization expense for the Financial Year ended March 31, 2022 was ₹ 1,055.65 lakh, which was on the account of amortization of the intangible assets toll rights. Depreciation and amortization expense for Financial Year ended March 31, 2022 was Nil. The reason for change is, in previous period there were no operational projects. Projects were acquired w.e.f. December 16, 2021.

Other expenses

The total other expenses for the Financial Year ended March 31, 2022 was ₹ 504.87 lakh, which was on the account of legal and professional fees, vehicle hire charges, power & fuel expenses and tour & travel etc. Other expenses increased by ₹ 441.18 lakh for Financial Year ended March 31, 2021. The reason for change is, in previous period there were no operational projects. Projects were acquired w.e.f. December 16, 2021.

Impact of COVID-19 on Toll Road projects

Following the lockdown as per Ministry of Home Affairs (MHA) guidelines, the Ministry of Road Transportation and Highways (MORTH) had suspended tolling on all national highways for a 21-day period that ended on April 14, 2020. The constrained vehicular movement in the run up to the lockdown due to Covid-19 followed by suspension of tolling pushed the toll collections into negative territory for financial year ended 2020. As India might face subsequent waves of the pandemic, and the impact is not yet fully ascertainable, potential lockdowns across states in India, may constrain vehicular movements that will negatively impact toll collections at the Toll Roads.

Liquidity and Capital Resources

Pursuant to the Concession Agreements, we are required to pay certain concession fees and make certain improvement works to each of the Toll Road relating to overlay activities and construction of additional toll lanes, among other things. We expect to finance our operations for the next 12 months primarily from cash flow from the operation of the Toll Roads and debt financing. We may also from time to time seek additional sources of funding, which may include debt or equity financings, depending on our financing needs and market conditions.

Qualitative Disclosures About Market Risk

Market risk is the risk of loss arising from adverse changes in market rates and prices, such as foreign currency exchange rates and commodity prices. We do not hold or issue financial instruments for trading purposes and does not enter into derivative transactions that would be considered speculative positions. We intend to minimize our exposure to currency risk by minimizing our non-Rupee borrowings.

Interest Rate Risk

As the infrastructure development and construction business is capital intensive, we are exposed to interest rate risk. Our borrowings are exposed to market risk relating to changes in interest rates upon any refinancing or additional financing. The debt financing provided by the Trust to the NHIPPL is classified as senior debt under the Concession Agreements. This exposure to debt by NHIPPL could further lead to an increase in interest expense and could have an adverse effect on the results of operations and financial condition. Although from time to time, we may exercise any rights available to us under these financing arrangements to terminate the existing debt financing arrangement on the respective reset dates and enter into new financing arrangements, there can be no assurance that we will be able to do so on commercially reasonable terms, that our counterparties will perform their obligations, or that these agreements, if entered into, will protect us adequately against interest rate risks.

Foreign currency exchange rate risk

Our foreign exchange risk primarily arises from movements of the Rupee against the U.S. dollar. Approximately 100% of our capital expenditures are denominated in Rupees. In addition, 100% of our borrowings are denominated in Rupees. Accordingly, our operating and financial results would be negatively affected when the Rupee depreciates against the U.S. dollar and interest rates in U.S. dollar increase. In addition, we may in the future enter into financing arrangements for foreign currency borrowings. We cannot assure you that we will be able to effectively mitigate the adverse impact of currency fluctuations and increases in international interest rates on our results of operation.

Liquidity Risk

We may not have sufficient cash flows to meet our operation and maintenance expense requirements and our financing obligations when they come due. We manage liquidity risks by forecasting projected cash flows. Management closely monitors our future and contingent obligations and set up required cash reserves as necessary in accordance with internal requirement.

Significant developments since December 31, 2023

Except as disclosed above and elsewhere in this Placement Document, to our knowledge no material developments other than the following have taken place since December 31, 2023 being the last date of financial statements as disclosed in the Placement Documents to be filed by Trust which adversely affect or are likely to affect the revenue or profitability of the Trust, or the value of its assets, or its ability to pay its liabilities within next 12 months.

DISTRIBUTION

Statements contained in this section entitled "Distribution" that are not historical facts are forward-looking statements. Such statements are subject to certain risks and uncertainties that could cause actual results to differ materially from those that may be projected. Under no circumstances should the inclusion of such information herein be regarded as a representation, warranty or prediction with respect to the accuracy of the underlying assumptions by the Trust, the Trustee, the Sponsor, the Investment Manager, the Lead Managers or any other person. Bidders are cautioned not to place undue reliance on these forward-looking statements that are stated only as at the date of this Placement Document. For details, please see the section entitled "Forward-Looking Statements" on page 20. For details on the risks relating to distribution, please see the section entitled "Risk Factors" on page 70.

A. **Preamble**

The Distribution Policy (the "**Policy**") aims to outline the process and procedure for distribution in relation to the Trust.

B. The net distributable cash flows of the Trust (the "**Distributable Income**") shall be based on the cash flows generated from the underlying operations undertaken by the Project SPVs (being National Highways Infra Projects Private Limited and NHIT Eastern Projects Private Limited and other SPVs incorporated/ acquired from time to time by the Trust) held by the Trust.

C. Distributions may be made from the monies received by the Trust, in accordance with the provisions of the InvIT documents and applicable law.

D. In terms of the InvIT Regulations, the Project SPVs shall distribute not less than 90% of the net distributable cash flows to the Trust in the proportion of its holding in the Project SPV, subject to applicable provisions of the Companies Act, 2013 or Limited Liability Partnership Act, 2008, each as amended.

E. In the event any infrastructure assets is sold by the Trust or any Project SPVs or if the equity shares or interest in any Project SPVs is sold by the Trust, then in accordance with the InvIT Regulations:

- if the Trust proposes to re-invest the sales proceeds into any other infrastructure asset, it shall not be required to distribute any sales proceeds to the Unitholders or the Trust; and

- if the Trust proposes not to invest the sales proceeds into any other infrastructure asset within a period of one year, it shall be required to distribute the same in accordance with the InvIT Regulations.

F. The Trust shall distribute at least 90% of the Distributable Income to its unitholders ("**Unitholders**"). Such distribution shall be declared and made such that the time period between any two declarations of distribution shall not exceed one year. In accordance with the InvIT Regulations, distributions by the Trust shall be made no later than 15 days from the date of such declarations. The distribution, when made, shall be made in Indian Rupees.

G. All distributions to the Unitholders shall be made in compliance with the InvIT Regulations, Income-tax Act, 1961 ("**IT Act**") and other applicable laws.

H. The Distributable Income and the net distributable cash flows of any Project SPVs shall be calculated in accordance with the InvIT Regulations and circulars issued thereunder, as amended from time to time. The indicative method of calculating net distributable cash flows for the Project SPVs and the Trust is provided below:

Computation of net distributable cash flows at any HoldCo and/or SPV level: -

Particulars
Cash flow from operating activities as per Cash Flow Statement of HoldCo/ SPV
(+) Cash Flows received from SPV's which represent distributions of NDCF computed as per relevant framework
(+) Treasury income/ income from investing activities (interest income received from FD, tax refund, any other income in the nature of interest, profit on sale of Mutual funds, investments, assets etc., dividend income etc., excluding any Ind AS adjustments. Further clarified that these amounts will be considered on a cash receipt basis)
(+) Proceeds from sale of infrastructure investments, infrastructure assets or shares of SPVs or Investment Entity adjusted for the following • Applicable capital gains and other taxes • Related debts settled or due to be settled from sale proceeds • Directly attributable transaction costs • Proceeds reinvested or planned to be reinvested as per Regulation 18(7) of InvIT Regulations or any other relevant provisions of the InvIT Regulations
(+) Proceeds from sale of infrastructure investments, infrastructure assets or sale of shares of SPVs or Investment Entity not distributed pursuant to an earlier plan to re-invest as per Regulation 18(7) of InvIT Regulations or any other relevant provisions of the InvIT Regulations, if such proceeds are not intended to be invested subsequently

(-) Finance cost on Borrowings, excluding amortisation of any transaction costs as per Profit and Loss Account and any shareholder debt/ loan from Trust
(-) Debt repayment (to include principal repayments as per scheduled EMI's except if refinanced through new debt including overdraft facilities and to exclude any debt repayments/ debt refinanced through new debt, in any form or equity raise as well as repayment of any shareholder debt/ loan from Trust)
(-) any reserve required to be created under the terms of, or pursuant to the obligations arising in accordance with, any: (i). loan agreement entered with banks / financial institution from whom the Trust or any of its SPVs/ HoldCos have availed debt, or (ii). terms and conditions, covenants or any other stipulations applicable to debt securities issued by the Trust or any of its SPVs/ HoldCos, or (iii). terms and conditions, covenants or any other stipulations applicable to external commercial borrowings availed by the Trust or any of its SPVs/ HoldCos, (iv). agreement pursuant to which the SPV/ HoldCo operates or owns the infrastructure asset, or generates revenue or cashflows from such asset (such as, concession agreement, transmission services agreement, power purchase agreement, lease agreement, and any other agreement of a like nature, by whatever name called); or (v). statutory, judicial, regulatory, or governmental stipulations; or –
(-) any capital expenditure on existing assets owned / leased by the SPV or Holdco, to the extent not funded by debt / equity or from reserves created in the earlier years
NDCF for HoldCo/SPV's

Computation of net distributable cash flows at the consolidated Trust level

Particulars
Cashflows from operating activities of the Trust
(+) Cash flows received from SPV's/ Investment entities which represent distributions of NDCF computed as per relevant framework
(+) Treasury income/ income from investing activities of the Trust (interest income received from FD, any investment entities as defined in Regulation 18(5), tax refund, any other income in the nature of interest, profit on sale of Mutual funds, investments, assets etc., dividend income etc., excluding any Ind AS adjustments. Further clarified that these amounts will be considered on a cash receipt basis)
(+) Proceeds from sale of infrastructure investments, infrastructure assets or shares of SPVs/ Holdcos or Investment Entity adjusted for the following • Applicable capital gains and other taxes • Related debts settled or due to be settled from sale proceeds • Directly attributable transaction costs
Proceeds reinvested or planned to be reinvested as per Regulation 18(7) of InvIT Regulations or any other relevant provisions of the InvIT Regulations
(+) Proceeds from sale of infrastructure investments, infrastructure assets or sale of shares of SPVs/ Hold cos or Investment Entity not distributed pursuant to an earlier plan to re-invest as per Regulation 18(7) of InvIT Regulations or any other relevant provisions of the InvIT Regulations, if such proceeds are not intended to be invested subsequently
(-) Finance cost on Borrowings, excluding amortisation of any transaction costs as per Profit and Loss account of the Trust
(-) Debt repayment at Trust level (to include principal repayments as per scheduled EMI's except if refinanced through new debt including overdraft facilities and to exclude any debt repayments/ debt refinanced through new debt in any form or funds raised through issuance of units)
(-) any reserve required to be created under the terms of, or pursuant to the obligations arising in accordance with, any: (i). loan agreement entered with financial institution, or (ii). terms and conditions, covenants or any other stipulations applicable to debt securities issued by the Trust or any of its SPVs/ HoldCos, or (iii). terms and conditions, covenants or any other stipulations applicable to external commercial borrowings availed by the Trust or any of its SPVs/ HoldCos, or (iv). agreement pursuant to which the Trust operates or owns the infrastructure asset, or generates revenue or cashflows from such asset (such as, concession agreement, transmission services agreement, power purchase agreement, lease agreement, and any other agreement of a like nature, by whatever name called); or (v). statutory, judicial, regulatory, or governmental stipulations; or
(-) any capital expenditure on existing assets owned/ leased by the InvIT, to the extent not funded by debt/ equity or from contractual reserves created in the earlier years
NDCF at Trust level

I. For the purposes of the IT Act, any income distributed by the Trust to the Unitholders shall be deemed to be of the same nature and in the same proportion in the hands of the Unitholder as it had been received by, or accrued to, the Trust. Accordingly, the Trust may follow either the receipt approach or the accrual approach subject to the provisions of the IT Act and applicable accounting standard, however the same shall be followed since the beginning and on a consistent basis.

J. In terms of the InvIT Regulations, if the distribution is not made within 15 days of declaration, the Investment Manager shall be liable to pay interest to the Unitholders at the rate of 15% per annum or such other rate as may be specified under applicable law, until the distribution is made. Such interest shall not be recovered in the form of fees or any other form payable to the Investment Manager by the Trust.

K. Notwithstanding the above, this Policy will stand amended to the extent of any change in applicable law, including any amendment to the InvIT Regulations, without any action from the Investment Manager or approval of the Unitholders of the Trust.

L. ***In-specie Distribution***: Subject to the approval of the Unitholders, in accordance with the Trust Deed and provisions of applicable law, the Trustee, in consultation with the Investment Manager, may at any time during the life of the InvIT make in-specie distributions of the assets of the Trust on such terms and conditions and in such manner that is in accordance with the Trust Deed, the Investment Management Agreement, the Project Implementation and Management Agreement and other documents for the purpose of the Trust (including the offer documents) and applicable law.

Distributions made by the Trust

The table below provides the Distributions made by the Trust, in accordance with the Distribution Policy in the last three financial years and for the period from April 1, 2023 to the date of this Placement Document.

S. No.	Financial Year/Period ended	Distribution made per Unit	Nature of Distribution
1.	Fiscal 2021	Not Applicable	Not Applicable
2.	Fiscal 2022*	Rs 0.79**	Refer** note below
3.	Fiscal 2023	Rs 6.3714***	Refer*** note below
4.	For the period from April 1, 2023 to the date of this Placement Document	Rs 5.898^	Refer^ note below

**from the date of listing of the Trust on the Stock Exchanges, i.e. November 10, 2021.*

***The distribution of Rs. 0.79 per unit comprises of Rs. 0.71 per unit as interest pass through, Rs. 0.08 per unit as other income on surplus funds at Trust.*

**** The distribution of Rs. 6.3714 per unit comprises of Rs. 6.3108 per unit as interest pass through, Rs. 0.0606 per unit as other income on surplus funds at Trust.*

^ The distribution of Rs. 5.898 per unit comprises of Rs. 5.815 per unit as interest pass through, Rs. 0.083 per unit as other income on surplus funds at Trust.

RELATED PARTY TRANSACTIONS

In terms of Regulation 2(1)(zv) of the SEBI InvIT Regulations, related party shall be as defined as under the Companies Act, 2013 or under the applicable accounting standards and shall also include: (i) Parties to the InvIT; and (ii) promoters, directors, members and partners of the Parties to the InvIT. Further, related parties also include such persons and entities as defined in terms of the applicable accounting standards, being Ind AS 24 on "Related Party Disclosures" in relation to related party transactions (collectively, "**Related Parties**").

For further details in relation to the related party transactions for the nine month period ended December 31, 2023 and Financial Years ended March 31, 2023, 2022 and 2021 as per Ind AS 24 read with the SEBI InvIT Regulations, see 'Audited Financial Information' enclosed as Annexure A. The Parties to the InvIT, may, from time to time, enter into related party transactions, in accordance with applicable law.

Procedure for dealing with Related Party Transactions

The board of directors of the Investment Manager has adopted the policy on related party transactions of the Trust (the "RPT Policy") pursuant to its resolution dated February 3, 2021.

The key terms of the RPT Policy are provided below:

(i). In accordance with the InvIT Regulations, the Investment Manager will ensure that all future Related Party Transactions shall be:

(a). on an arm's length basis;

(b). in accordance with the relevant accounting standards;

(c). in the best interest of the Unitholders;

(d). consistent with the strategy and investment objectives of the Trust; and

(e). compliant with applicable law.

(ii) Review and approval of Related Party Transactions:

(a). Each transaction which is identified as a Related Party Transaction shall be pre-approved by the Audit Committee prior to entering into such transaction;

(b) The Audit Committee shall grant omnibus approval for Related Party Transactions. Each such omnibus approval shall be valid for a period not exceeding one year from the date of such approval, and Related Party Transactions undertaken after the expiry of such period shall require fresh approval of the Audit Committee. The Audit Committee shall review, on a quarterly basis, the details of Related Party Transactions entered into by the Trust pursuant to the omnibus approval.

(ii). The Investment Manager will establish an internal control system so as to ensure that all future Related Party Transactions are compliant with the InvIT Regulations and applicable accounting standards. Further, the Investment Manager shall convene meetings of the Unitholders in accordance with Regulation 22 of the InvIT Regulations, and maintain records pertaining to such meetings in the manner prescribed. The Investment Manager shall also ensure compliance with any additional guidelines issued in this regard by Securities and Exchange Board of India and other relevant regulatory, statutory or governmental authorities from time to time.

(iii). In addition to any other requirement that may be prescribed in terms of the InvIT Regulations or other applicable laws, all Related Party Transactions to be entered into in the future will be decided by the Board after the examination of the nature of the transaction and its supporting documents, as available, or such other data as may be deemed necessary by the Board.

(iv). The Investment Manager will ensure that if the value of funds borrowed from Related Parties in a financial year exceeds 5% of the total consolidated borrowings of the Trust, any holding company and the SPVs, or any other threshold prescribed by the InvIT Regulations, approval from the Unitholders shall be obtained prior to entering into any such subsequent transaction with any Related Party, in accordance with Regulation 22 of the InvIT Regulations.

(v). The Investment Manager will ensure that if the total value of all the Related Party Transactions in a financial year pertaining to acquisition or sale of assets, whether directly or through a holding company or SPV, or investments into securities, exceeds 5% of the value of the assets of the Trust or any other threshold prescribed by the InvIT Regulations, approval from the Unitholders shall be obtained prior to entering into any such subsequent transaction with any Related Party, in accordance with Regulation 22 of the InvIT Regulations.

(vi). As a general rule, the Investment Manager must demonstrate to the Board that future Related Party Transactions satisfy the criteria set out in Paragraph D(i) at the time of recommending the same for the approval of the Board.

(vii). The Investment Manager will maintain a register to record all Related Party Transactions entered into by the Trust and the basis on which they are entered into.

(viii). The Investment Manager will also incorporate into its internal audit plan a review of all Related Party Transactions entered into by the Trust during each financial year, including a review of the implementation of the agreements.

(ix). The Board shall review at least quarterly in each financial year the Related Party Transactions entered into during such quarter to ascertain that the guidelines and procedures established to monitor the Related Party Transactions have been complied with.

(x). The review by the Board will include the examination of the nature of the transaction and its supporting documents or such other data as may be deemed necessary by the Board.

(xi). The Investment Manager shall ensure that all the incomes and expenses from Related Party Transactions have arisen from legitimate business transactions.

(xii). While considering a Related Party Transaction, any director on the Board who has a potential interest in any Related Party Transaction will recuse himself or herself and abstain from discussion, review and voting on the Related Party Transaction.

Potential Conflict of Interest

(i). Subject to applicable law and this Policy, all resolutions in writing of the Board in relation to matters concerning related party transactions of the Trust must be approved by a majority of the Directors.

(ii). Where matters concerning the Trust relate to transactions entered into or to be entered into by the Investment Manager for and on behalf of Trust with a Related Party, the Board is required to consider the terms of the transactions to satisfy itself that the transactions are conducted in accordance with the parameters set out in paragraph D(i).

(iii). While acquiring assets in the future from the Sponsor, the Investment Manager will maintain a register of all opportunities and transactions arising from the implementation of agreements to acquire assets from the Sponsor.

(iv). The Investment Manager will incorporate in its internal audit plan, a review of the implementation of the agreements to acquire assets from the Sponsor.

(v). As part of its review of the internal audit reports at least quarterly in each financial year, the Board will review the internal audit reports of the implementation of the agreements to acquire assets from the Sponsor to ensure compliance. The review will include an examination of supporting documents and such other data deemed necessary to the Board. If a director on the Board has an interest in a transaction arising from the implementation of the agreements to acquire assets from the Sponsor, he or she is to abstain from participating in the review and approval process in relation to that transaction.

B. **Disclosure and Reporting**

The Investment Manager shall submit to the Trustee, quarterly reports on the activities of the Trust, including the status of compliance with the requirements specified under the InvIT Regulations in relation to Related Party Transactions, within such time as may be prescribed in the InvIT Regulations and applicable law.

Related Party Transactions shall be disclosed: (a) in the offer document with respect to any such transactions entered into prior to the offer of units and any such proposed transactions subsequent to the offer; and (b) to the stock exchanges and the Unitholders periodically, in accordance with the InvIT Regulations and the agreements to be entered into with the stock exchanges in relation to the listing of the Units. The Investment Manager shall adequately disclose the details of any fees or commissions received or to be received by such related party(ies) to the stock exchanges.

In terms of the InvIT Regulations, the annual report to be submitted by the Investment Manager to all Unitholders, electronically or by physical copies, shall contain, inter alia, details of all related party transactions, including acquisitions or disposal of any projects, directly or through SPVs during the year, the value of which exceeded five percent of value of the assets of the Trust.

Notwithstanding the above, this Policy will stand amended to the extent of any change in applicable law, including any amendment to the InvIT Regulations, without any action from the Investment Manager or approval of the Unitholders of the Trusts

Present and On-going Related Party Transactions

A number of present and on-going transactions with certain related parties have been, or will be, entered into in relation to the setting up of the Trust. The Trustee and the Investment Manager confirm that the following related party transactions have been, or shall be, entered into, on an arm's length basis in accordance with the relevant accounting standards, in the best interest of the Unitholders, consistent with:

A. Concession Agreement

Please see the section entitled "*Summary of the Concession Agreements*" on page 232 for a description of the terms of the Concession Agreements.

B. Amended and Restated Project Implementation and Management Agreement

Please see the section entitled "*Parties to the Trust –Key Terms of the Amended and Restated Project Implementation and Management Agreement*" on page 121 for a description of the terms of the Amended and Restated Project Implementation and Management Agreement

C. Transitional Support Agreement

The Sponsor, Project Manager and the Project SPV have entered into a transitional support agreement dated March 7, 2024, for the purpose of the Sponsor providing the transitional support to (i) the Project Manager in respect of its obligations under the Project Implementation and Management Agreement, and (ii) the Target Toll Roads in respect of its O&M obligations and tolling obligations (as provided under the R3 Concession Agreements). The terms and conditions of the transitional support agreement shall, in respect of each R3 Concession Agreement and the Project Implementation and Management Agreement, be effective and binding on the Parties for a period of three months commencing from the appointed date of the respective R3 Concession Agreements, unless terminated earlier by mutual consent. As per the transitional support agreement, the Sponsor's fee for the services provided under the transitional support agreement shall be such amount as may be mutually agreed amongst Sponsor, Project Manager and the Project SPV.

D. Trust Deed

Please see the section entitled "*Parties to the Trust - Key terms of the Trust Deed*" on page 102 for a description of the terms of the Trust Deed

E. Investment Management Agreement

Please see the section entitled "*Parties to the Trust - Key terms of the Investment Management Agreement*" on page 112 for a description of the terms of the Investment Management Agreement

F. Trademark license Agreement

Our Trustee (on our behalf) has entered into a trademark license agreement dated March 5, 2024, with our Sponsor (the "Trademark License Agreement"). As per the terms of the Trademark License Agreement, our Sponsor has granted us a non-exclusive, non-transferable, royalty-free and non – assignable license (without the right of sub-license) to use the trademarks of the Sponsor in relation to our business throughout India and the rest of the world, including for the purposes of our logos. The license granted to the Trust in terms of the Trademark License Agreement shall be for a term of 1 (one) year the effective date of the Trademark License Agreement or such shorter period as may be mutually agreed to between the parties."

Details of Related Party Transactions

(*₹ in lakhs*)

S. No.	Name of Entity	Particulars	For the period ended March 31, 2023	For the period ended March 31, 2022	For the period ended March 31, 2021
1.	National Highways Infra Investment Managers Private Limited (NHIIMPL)	Payment of Investment Manager Fee	1,491.17	1,931.71	-
		Advance Investment Manger Fee	86.06	-	-

S. No.	Name of Entity	Particulars	For the period ended March 31, 2023	For the period ended March 31, 2022	For the period ended March 31, 2021
		Reimbursement of expenses to NHIIMPL	39.79	214.80	-
2.	National Highways Authority of India (NHAI)	Reimbursement of Pre-Issue expenses of NHIT by NHAI	-	578.02	-
		Purchase of equity shares of Project SPV (NHIPPL) by the Trust from NHAI	-	10,153.52	-
		Issue of units of Trust to NHAI	21,366.83	96,556.00	-
		Interest and Other Income Distribution	5,589.34	-	-
		O & M Expenses	1,152.32	-	-
		Payment for acquiring intangible assets	2,84,966.66	7,35,040.00	-
		Double Toll Fee	679.17	-	-
		Independent engineers fee	345.38	-	-
3	National Highways InvIT Project Managers Private Limited (NHIPMPL)	Project Managers Fees	991.20	290.43	-
3.	IDBI Trusteeship Services Limited	Payment of Trustee Fee	12.73	12.15	4.21
		Initial Settlement Amount	3.54	-	62.92

***Note**: For further details in relation to the Related Party Transactions of the Trust, please refer to the "Audited Financial Information" enclosed as Annexure A.*

REGULATIONS AND POLICIES

The following description is a summary of certain sector specific laws currently in force in India, which are applicable to the operations of the Trust and the Project SPVs. The information detailed in this section has been obtained from statutes, regulations, sector-specific policies and publications available in the public domain. The description below may not be exhaustive, and is only intended to provide general information and is neither designed as, nor intended to substitute, professional legal advice. The information in this section is based on the current provisions of applicable law that are subject to change or modification by subsequent legislative, regulatory, administrative or judicial decisions in India. For information regarding regulatory approvals obtained by the Project SPVs, please see the section titled "Regulatory Approvals" on page 317.

Laws Relating to the Business and Operations of the Trust and the Project SPVs

The regulatory framework in India in the highways sector, implemented on a public-private partnership ("**PPP**") basis, mainly derives its source from the primary legislations of National Highways Authority of India Act, 1988 (the "**NHAI Act**") and the National Highways Act, 1956 (the "**NH Act**") enacted by the Indian parliament, each as amended or supplemented.

The National Highways Act, 1956

The policy of the MoRTH, in implementing the NH Act, is to vest the MoRTH with the power to declare a national highway and for acquisition of land for this purpose. The GoI, by notification, can declare the intention to acquire any land for a 'public purpose' as envisaged by the law and such land can be used for the purposes of building, maintenance and operation of the declared national highways throughout the country. The NH Act prescribes the procedure for such land acquisition. The procedure includes, *inter alia*, a declaration of an intention to acquire, entering and inspecting such land, hearing of objections, a declaration of the acquisition and the power to take possession. The NH Act also provides for payment of compensation to owners and any other person whose right of enjoyment or ownership in the land has been affected. The NH Act vests MoRTH with the power to appoint a competent authority for the effective implementation of the NH Act and its policies. The said appointed authority retains the right and power to (a) survey, make any inspection, valuation or enquiry; (b) take levels; (c) dig or bore into sub-soil; (d) set out boundaries and intended lines of work; (e) mark such levels, boundaries and lines placing marks and cutting trenches; or (f) do such other acts or things as may be laid down by rules made in this behalf by that government. All the notified national highways shall vest in the name of the Union and for the purposes, shall include all lands appurtenant thereto and all the bridges, culverts, tunnels and other enlisted constructions under the said NH Act. The Central Government shall assume the responsibility of maintaining and construction of national highways in proper condition in accordance to the law. The Central Government also retains the right to levy fee over the services and benefits rendered in relation to the use of such national highways.

The GoI is responsible for the development and maintenance of national highways. However, it may direct that such functions may also be exercised by the government of a state in which the highway is located or by any officer or authority subordinate to the GoI or to the state government. Further, the GoI has the power to enter into an agreement with any person for the development and maintenance of a part or whole of the highway. Such person would have the right to collect and retain fees at such rates as may be notified by the GoI and will also have the powers to regulate and control the traffic, for proper management of the highway, in accordance with the provisions of the Motor Vehicles Act, 1988, as amended. The GoI also has the power to make rules for carrying out the purposes of the NH Act.

The National Highways (Amendment) Act, 2017, entails the competent authority to issue reports to the Central Government in respect of any land (either acquired or proposed to be acquired) which is, either under incorrect revenue record or which is not required due to change in geometry or alignment of the construction, to issue order for the de-notification of such land from the acquisition for development and maintenance of the national highway. In pursuance of the foregoing amendment to the statute, the National Highways Rules, 1957, have been amended to ensure the exercise of the power under the NH Act. These rules provide for periodic regulatory compliance and reporting standards to be followed by the competent authority in reporting to the Central Government.

The National Highways Authority of India Act, 1988

The NHAI Act was enacted in pursuance of the powers of the Central Government for appointing a competent authority under the NH Act and provides for the constitution of an authority for the development, maintenance and management of national highways and for matters connected therewith or incidental thereto. In accordance with the NHAI Act, the GoI carries out development and maintenance of the national highways through NHAI. Subject to the provisions of the NHAI Act, the NHAI has the power to enter into and perform any contract necessary for the discharge of its functions. The NHAI has the power to acquire any land to discharge its functions, and such acquired land will be deemed to be land needed for a 'public purpose'. The NHAI Act prescribes a limit in relation to the value of the contracts that may be entered into by NHAI. However, the NHAI may enter into contracts exceeding the specified value, on obtaining prior approval of the GoI. The NHAI Act provides that the contracts for acquisition, sale, or lease of immovable property on behalf of the NHAI cannot exceed a term of 30 years unless previously approved by the GoI. NHAI's objective is to ensure that all contract awards and procurements conform to the best industry practices with regard to transparency of process, adoption of bid criteria to ensure healthy competition in award of contracts. In accordance with the NHAI Act, the NHAI shall consist of a full time chairman, not more than six full time members and not more than six part time members who are being appointed by the Central

Government. Additionally, various project implementation units headed by project director have been set at various sites to oversee timely completion of the projects.

In view of the challenging task of construction, development, and management of national highways being undertaken by NHAI, the Committee on Public Undertakings selected the subject "National Highways Authority of India (NHAI)" for comprehensive examination and report. The National Highways Authority of India (Amendment) Act, 2013, received the assent of the President of India on September 10, 2013, and aimed at increasing the institutional capacity of NHAI to help execute the powers delegated to it. National Highways Development Project ("**NHDP**") was launched in 1998 with the objective of developing roads of international standards which facilitate smooth flow of traffic. The NHDP envisages creation of roads with enhanced safety features, better riding surface, grade separator and other salient features.

As per the NHAI Works Manual, 2006, NHAI's mandate is the time and cost bound implementation of the NHDP. The sources of finance available to the NHAI include fund assistance from external funding agencies like the International Bank of Reconstruction and Development and the Asian Development Bank. NHAI's role encompasses involving the private sector in provision, maintenance, and operation of the national highways.

Financing of the NHDP

The GoI, under the Central Road and Infrastructure Fund Act, 2000 created a fund which is required to be utilized for the development and maintenance of national highways (the "**Central Road Fund**"). Section 18 of the NHAI Act also provides for the creation of a separate NHAI Fund. Any capital grant or aid received, loan taken, borrowing made, or any other sum received by the NHAI is credited to the NHAI Fund. Certain sources for financing of the NHDP are through dedicated accruals under the Central Road Fund by levy of cess on fuel as well as involving the private sector and encouraging public private partnerships. The NHDP is also financed through long-term external loans from the International Bank of Reconstruction and Development, the Asian Development Bank and the Japan Bank for International Cooperation as well as through tolling of roads for different projects undertaken by the NHAI.

Private Participation in NHDP

In an effort to attract private sector participation in the NHDP, the NHAI has issued model concession agreements ("**MCAs**") which have been formulated by Planning Commission of India or NITI Aayog and other departments of Central Government where a private entity, being the concessionaire, is, through an international competitive bidding process, awarded a concession (in form of a license) to build, own, operate and collect toll on a highway for a specified period of time. The concession to develop highway projects is given by the NHAI or other governmental authorities under various models of PPP like:

(i) Build, Operate, Transfer (BOT)/ Design, Build, Finance, Operate and Transfer (DBFOT) – In this model, the entire designing, financing and construction is undertaken by the concessionaire at its own cost. The concessionaire is entitled to collect toll or receive annuity payments from the NHAI, as the case may be, during the concession period after the construction of the highway project. The bid for the project may either be selected basis the lowest grant wanted by the private developer from the NHAI or the highest premium the private developer is willing to pay to NHAI, in the form of additional concession fee. The concessionaire at the end of the concession period transfers the highway project to the NHAI (free of charge and clear of all encumbrances). The concessionaire's investment in the highway project is recovered directly through user fees collected by way of tolls. Under the BOT model, the projects which are generally not viable based on toll revenue alone, the NHAI or the relevant governmental authority provides concessionaire with a capital grant upto certain percentage of the project cost to increase the viability of projects and the quantum of such grant is determined on a case to case basis. For certain projects with high traffic volumes, concessionaire also offers a negative grant (i.e., premium) to the NHAI.

(ii) Hybrid Annuity Model (HAM) – In this model, the NHAI or the relevant governmental authority invests 40% (forty percent) of the construction cost of the project in (five) equal instalments and the balance amount is infused by the private developer. The private developer recovers his investment in the form of annuity payments received by it over a period of 15 (fifteen) years. Additionally, there is no revenue risk for the private developer under HAM model because the toll is collected by the NHAI or relevant governmental authorities unlike the BOT model where the private developer collects it.

(iii) Toll, Operate and Transfer (TOT) – In this model, the road projects which are in operational phase are awarded by the NHAI or relevant governmental authorities to the concessionaire. The NHAI passes on the toll collection rights and operation and maintenance obligations to the concessionaire against payment of upfront concession fees quoted by the concessionaire as a part of the bidding process.

The bidding for the projects takes place in two stages as per the process provided below:

1. in the qualification (RFQ) stage, the NHAI selects certain applicants on the basis of technical and financial expertise, prior experience in implementing similar projects and previous track record; and

2. in the proposal (RFP) stage, the NHAI invites financial bids from the applicants qualified at the RFQ stage on the basis of which the concession is awarded to the successful bidder by the NHAI for implementation of the project.

Exit Policy

The CCEA in May 2015 approved a comprehensive exit policy framework with the objective to mobilize funds in the market. In pursuance thereto, NHAI, vide Circular No. NHAI/1103/CGM(FA)/4/2015 dated June 9, 2015 permitted divestment of 100% equity by concessionaires/developers after two years of completion of construction to facilitate unlocking of funds for new infrastructure projects. The equity divested is required to be invested by promoters in their new projects. This comprehensive exit policy framework is expected to harmonize certain conditions across all concessions signed prior to 2009 with the policy framework for post 2009 contracts which permit divestment of equity up to 100%, two years after completion of construction. In line with the spirit of quoted circular, the NHAI issued another circular dated September 9, 2015 followed by the circular dated November 19, 2015, on the same subject, allowing the promoter to use the proceeds from the sale of divested equity of the concessionaire in one or more of the following:

(i) to reinvest in incomplete NHAI projects;

(ii) To reinvest any other highway projects;

(iii) any other power sector projects; or

(iv) to retire their debt to financial institutions in any other infrastructure projects.

Relaxation in the 'change in ownership' clause in Hybrid Annuity Model (HAM) projects

The MoRTH, *vide* circular dated November 10, 2020 and November 27, 2020, read along with the NHAI circular dated December 31, 2020, amended the MCAs in respect of project implemented under the HAM model, and permitted the selected bidder/consortium members, for the new as well as subsisting national highways project under the HAM-model, to dilute their equity six months after COD is achieved for the respective project.

Rationalized Compensation

The CCEA in November 2015 approved a policy for rationalized compensation to concessionaires for languishing national highway projects in BOT mode for delays that are not attributable to the concessionaires. Under the policy, the NHAI is authorized to allow an extension of the concession period for BOT (Toll) projects while the tenure for the operations period as envisaged originally in the concession agreement may remain unchanged which would result in a corresponding increase in concession period. The NHAI has also been authorised to pay compensatory annuities to the concessionaire corresponding to the actual period of delay that is not attributable to the concessionaire upon successful completion of the project.

One Time Fund Infusion Scheme

The CCEA in October 2015 gave its approval to the NHAI for a one-time infusion of funds with the purpose of reviving and physically completing stalled projects in the advanced stages of completion. As per the policy, the amount of funds required in each case shall be approved by NHAI on a case to case basis.

Bidder Information

MoRTH has developed the Bidder Information Management System ("**BIMS**") to streamline the process of pre- qualification of bidders for EPC mode of contracts for all national highway works, with enhanced transparency and objectivity. BIMS works as a data base of bidder information that covers basic details, civil works experience, cash accruals and network, and annual turnover so that bidders' pre-qualification can be assessed based on evaluation parameters like threshold capacity and bid capacity from already stored data and the technical evaluation can be carried out in a faster manner.

Land Acquisition

While land is acquired for national highway projects under the NH Act, the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (the "**Land Acquisition Act**") must also be complied with. MoRTH has issued comprehensive guidelines on land acquisition for national highways taking into account the applicability of the Land Acquisition Act.

Arbitral Awards

CCEA on August 31, 2016 approved various measures to revive the construction sector. An office memorandum dated September 5, 2016 was issued by the National Institute for Transforming India with certain proposals. On November 20, 2019, the CCEA approved certain proposals in relation to the arbitrations by or against government entities, for the effective implementation of the CCEA's decision on August 31, 2016 on its initiatives to revive the construction sector. Initially, the CCEA had approved the proposal that government agencies will be required to pay 75% of the arbitral award to the concessionaire against a bank guarantee, in cases where the award already announced is challenged. However, pursuant to a press release dated November 20, 2019, the CCEA approved, inter-alia, that where a government entity has challenged an arbitral award, resultant of which the amount of the arbitral award has not been paid, 75% of such award will be paid by the government entity to the contractor or the concessionaire against a bank guarantee only for the said 75% and not for its interest component. In relation to interest payable to the government entity, if a subsequent court order required the refund of

75% of the amount, the payment of such amounts will be required to be made as per the court orders.

Applicable Rules

As per the NH Act and the NHAI Act, the Central Government is empowered to make rules in order to further the objects of NH Act and NHAI Act. In exercise of such power, the Central Government has framed certain rules which are as follows:

- The National Highways Rules, 1957, as amended;
- National Highways Authority of India (Budget, Accounts Audit, Investment of Funds and Powers to enter Premises) Rules, 1990, as amended;
- The National Highways (Manner of Depositing the Amount by the Central Government with Competent Authority for Acquisition of Land) Rules, 1998;
- The National Highways Tribunal (Procedure for Appointment as Presiding Officer of the Tribunal) Rules, 2003, as amended;
- The Central Road Fund (State Roads) Rules, 2007;
- The National Highways Tribunal (Procedure) Rules 2003;
- National Highways Authority of India (The Term of Office and Other Conditions of Service of Members) Rules, 2003, as amended;
- The National Highways Tribunal (Financial and Administrative Powers) Rules, 2004;
- The National Highways Tribunal (Procedure for Investigation of Misbehaviour or Incapacity of Presiding Officer) Rules, 2003;
- The National Highways Fee (Determination of Rates and Collection) Rules, 2008, as amended;
- The Highway Administration Rules, 2004;
- The National Highways (Collection of Fees by any person for the use of Section of National Highways/Permanent Bridges/Temporary bridge on National Highways) Rules, 1997;
- The National Highways (Fee for the use of National Highways and Permanent Bridge public Funded Project) Rules, 1997; and
- The National Highways (Rate of Fee) Rules, 1997.
- Construction Workers (Regulation of Employment and Conditions of Services) Act, 1996 and Central Rule, 1998
- C.E.A. (Measures Relating to Safety and Electric Supply) Regulations, 2010
- Central Electronical Authority (Measures Relating to Safety and Electric Supply) Regulations, 2020
- Indian Electricity Rules, 1956

Other legislations relevant to the road sector

In addition to the above, there are also certain other legislations that are relevant to the road sector which include the Road Transport Corporation Act, 1950, Central Road and Infrastructure Act, 2000, etc.

Environmental Compliances and Regulations

Infrastructure projects must also ensure compliance with environmental legislations such as the Water (Prevention and Control of Pollution) Act, 1974 ("**Water Pollution Act**"), the Air (Prevention and Control of Pollution) Act, 1981 ("**Air Pollution Act**") and the Environment Protection Act, 1986 ("**Environment Act**", together with the Water Pollution Act and the Air Pollution Act, the "**Environment Protection Acts**"). The Water Pollution Act aims to prevent and control water pollution. This legislation provides for the constitution of a central pollution control board ("**Central Pollution Control Board**" or "**CPCB**") at the Central level and state pollution control boards ("**State Pollution Control Boards**" or "**SPCBs**", together with the Central Pollution Control Board, the "**PCBs**") at the State levels. The functions of the CPCB includes, among other things, coordination of activities of the SPCBs, collecting data relating to water pollution and the measures devised for the prevention and control of water pollution and prescription of standards for streams or wells. The SPCBs are responsible for, among other things, the planning for programmes for prevention and control of pollution of streams and wells, collecting and disseminating information relating to water pollution and its prevention and control, inspection of

sewage or trade effluents, works and plants for their treatment and to review the specifications and data relating to plants set up for treatment and purification of water, laying down or annulling the effluent standards for trade effluents and for the quality of the receiving waters, and laying down standards for treatment of trade effluents to be discharged. These authorities issue consent to establish and consent to operate which are to be required to be renewed periodically. These authorities also have the power of search, seizure and investigation if the authorities are aware of or suspect violation of such regulations. This legislation prohibits any person from establishing any industry, operation or process or any treatment and disposal system, which is likely to discharge trade effluent into a stream, well or sewer, or bring into use any new or altered outlet for discharge of sewage, or begin to make any new discharge of sewage without taking prior consent of the SPCBs.

In context of the environmental compliances and regulations, the National Green Tribunal Act, 2010 (the "**NGT Act**") is an important legislation which provides for the establishment of a National Green Tribunal ("**NGT**") for the effective and expeditious disposal of cases relating to environmental protection and conservation of forests and other natural resources including enforcement of any legal right relating to environment and giving relief and compensation for damages to persons and property and for matters connected therewith or incidental thereto. In accordance with the Forest (Conservation) Act, 1980, state governments are not permitted to make any order directing the use of forest land for a non-forest purpose, or assignment of any forest land through lease or otherwise to any private person or corporation without the approval of the GoI. The Ministry of Environment, Forest and Climate Change ("**MoEF**") mandates the Environment Impact Assessment ("**EIA**") must be conducted for specified projects. In the process, the MoEF receives proposals or the setting up of projects and assesses their impact on the environment before granting clearances to the projects. The EIA Notification S.O. 1533, issued on September 14, 2006 (the "**EIA Notification**") and amended from time to time, under the provisions of the Environment Protection Act, prescribes that new construction of specified projects require prior environmental clearance from the MoEF. The environment clearance must be obtained from MoEF according to the procedure specified in the EIA Notification. No construction work or preparation of land by the project management except for securing the land, relating to the setting up of a specified project can be undertaken until such clearance is obtained. Under the EIA Notification, the environmental clearance process for new projects consists of four stages – screening, scoping, public consultation and appraisal. After completion of public consultation, the applicant is required to make appropriate changes in the draft 'EIA Report' and the 'Environment Management Plan.' The final EIA Report has to be submitted to the concerned regulatory authority for appraisal. The regulatory authority is required to give its decision within 105 days of the receipt of the final EIA Report. The EIA Guidance Manual for Highways, 2010 explains the four stages of the environmental clearance process and the contents of the EIA Report required to be submitted by highway projects.

Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016

The Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, impose an obligation and duty on the owners and operators of any facility or industry with a capability to create hazardous materials to safely dispose of such material in transport and other means of collecting and storing. Each occupier and operator of any facility generating hazardous waste is required to obtain an approval from the relevant state pollution control board for collecting, storing and treating the hazardous waste.

Green Highways (Plantation, Transplantation, Beautification and Maintenance) Policy, 2015

In September 2015, MoRTH has launched Green Highways (Plantation, Transplantation, Beautification and Maintenance) Policy, 2015, which will require road developers to earmark 1% of a project's total cost for planting of trees and shrubs along the national highways. Under this policy, the maintenance of such plantations will be outsourced through a bidding process to plantation agencies. MoRTH/NHAI will appoint the authorized agency for empanelment of such plantation agencies.

Public Liability Insurance Act, 1991

The Public Liability Insurance Act, 1991 (the "**Public Liability Act**"), imposes liability on the owner or controller of hazardous substances for any damage arising out of an accident involving such hazardous substances. A list of 'hazardous substances' covered by the legislation has been enumerated by the GoI by way of a notification. The owner or handler is also required to take out an insurance policy insuring against liability under the legislation. The rules made under the Public Liability Act mandate that the employer has to contribute towards the Environment Relief Fund, a sum equal to the premium paid on the insurance policies. This amount is payable to the insurer.

Other applicable law

The Motor Vehicles Act, 1988

The development, maintenance and management as well as control of the National Highways are regulated by the NH Act and the NHAI Act. Under the Motor Vehicles Act, 1988, some powers have been delegated to the Transport Department of the State Governments. Section 138 of the Motor Vehicles Act, 1988 further empowers the State Governments to make rules for the control of traffic, including for the purpose of the removal and the safe custody of vehicles including their loads which have broken down or which have been left standing or have been abandoned on roads; the installation and use of weighing devices; the maintenance and management of wayside amenities complexes; the exemption from all or any of the provisions of relating to fire brigade vehicles, ambulances and other special classes or descriptions of vehicle, subject to such conditions as may be prescribed; the maintenance and management of parking places and stands and the fee, if any, which may be charged for their use; prohibiting the taking hold of or mounting of a motor vehicle in motion; prohibiting the use of foot-

paths or pavements by motor vehicles, generally, the prevention of danger, injury or annoyance to the public or any person, or of danger or injury to property or of obstruction to traffic. The Motor Vehicles (Amendment) Act, 2019 is targeted towards bringing changes in the transport sector to encourage safer driving practices among Indian motor vehicle drivers. The draft for the amendment was put forward in the lower house of the Parliament, with a proposal to impose strict fines on the violators of traffic rules. The Act proposes to create a National Road Safety Board to be created by the Central Government through a notification. The Board will advise the Central and State governments on all aspects of road safety and traffic management.

Indian Trusts Act, 1882

The Indian Trusts Act, 1882 ("**Trusts Act**") governs all private trusts in India. The Trusts Act sets out the purpose for which private trusts can be established, the manner in which they may be created, executed and extinguished. The person creating a trust under the Trusts Act is the author of such trust, the person to whom the author grants the power and authority to regulate the trust is the trustee and the persons for whose benefit such trust has been created are the beneficiaries of such trust. The Trust Act sets out the rights, duties, liabilities and powers of the trustees and the beneficiaries *vis-a-vis* the trust. The Trust has been settled in accordance with the provisions of the Trusts Act.

Control of National Highways (Land and Traffic) Act, 2002

The Control of National Highways (Land and Traffic) Act, 2002 (the "**Control of NH Act**") provides for control of land within national highways, right of way and traffic moving on national highways and also for removal of unauthorised occupation thereon.

In accordance with the provisions of the Control of NH Act, the Central Government has established Highway Administrations. Under the Control of NH Act, all land that forms part of a highway which vests in the Central Government, or that which does not already vest in the Central Government but has been acquired for the purpose of highways shall be deemed to be the property of the Central Government. The Control of NH Act prohibits any person from occupying any highway land or discharging any material through on such land without the permission of the Highway Administration or any officer authorised by such administration. The Control of NH Act permits the grant of lease and license for use of highway land for temporary use.

Indian Tolls Act, 1851

In accordance with the Indian Tolls Act, 1851 (the "**Tolls Act**"), the state governments have been vested with the power to levy tolls at such rates as they deem fit, to be levied upon any road or bridge, made or repaired at the expense of the Central or any state government. The tolls levied under the Tolls Act, are deemed to be 'public revenue' and the collection of tolls can be placed under any person the State governments' deem fit. Such persons are enjoined with the same responsibilities as if they were employed in the collection of land revenue. Further, all police officers are bound to assist the toll collectors when required in the implementation of the Tolls Act. The Tolls Act further gives power for recovery of toll and exempts certain category of people from payment of toll.

National Highways Fee (Determination of Rates and Collection) Rules, 2008

The National Highways Fee (Determination of Rates and Collection) Rules, 2008 (the "**NH Fee Rules**"), regulates the collection of fee for the use of national highways. In accordance with the NH Fee Rules, the GoI may, by a notification, levy fee for use of any section of a national highway, permanent bridge, bypass or tunnel forming part of a national highway, as the case may be. However, the GoI may, by notification, exempt any section of a national highway, permanent bridge, bypass or tunnel constructed through a public funded project from levy of such fee. The NH Fee Rules supersede the National Highways (Temporary Bridges) Rules, 1964, the National Highways (Collection of Fees by any Person for the Use of Section of National Highways/ Permanent Bridge/ Temporary Bridge on National Highways) Rules, 1997, the National Highways (Fees for the use of National Highways Section and Permanent Bridges Public Funded Project) Rules, 1997 and the National Highways (Rate of Fees) Rules, 1997 other than in respect of things done or omitted to be done under such rules prior to supersession. The NH Fee Rules do not apply to agreements and contracts executed or bids invited prior to the publication of such rules i.e. prior to December 5, 2008. The collection of fee in case of a public funded project shall commence within 45 days from the date of completion of the project. The NH Fee Rules further provide for the base rate of fee applicable for the use of a section of the national highway for different categories of vehicles and the fees collected by the executing authority shall be remitted to the GoI. However, the GoI may, by notification, allow any or all of the executing authorities to appropriate the whole, or part of such fees for purposes as may be specified.

FASTag lanes on fee plazas is an initiative of the GoI in which there is an exclusive lane in the fee plaza for movement of vehicles fitted with FASTag. The FASTag is a device which is fitted on the front windscreen of vehicles to indicate online toll payment. The amended NH Fee Rules impose a penalty equivalent to two times the fee applicable if a vehicle not fitted with FASTag enters the exclusive FASTag lane. However, in case a user is unable to pay, due to malfunctioning electronic toll collection infrastructure, the user will be permitted to pass the fee plaza without payment. The NH Fee rules were also amended to provide that the driver or owner of a mechanical vehicle which is loaded in excess of permissible load specified for its category, (i) shall be liable to pay fee at such rate which is applicable for the next higher category of mechanical vehicles, and (ii) Payment of such fee shall not entitle the driver or owner, to use the national highway until the excess load has been remove from such mechanical vehicle. However, in case no weighbridge has been installed at the toll plaza, no fee for overloading shall be levied.

The National Highways Rules, 1957 (the "NH Rules")

The NH Rules provide that in situations where the estimate cost of the execution of any original work on a national highway exceeds ₹ 1,000,000, a detailed estimated of the cost is to be forwarded to the GoI. An application for allotment of funds for meeting expenditure on an original work on a national highway must also be made to the GoI. The executing agency of the highway is required to furnish monthly progress reports and a completion report on the conclusion of the work. The NH Rules also give the consulting engineer of the GoI the right to inspect the work while it is in progress or after completion. Provisions under the Constitution of India and other legislations in relation to collection of toll Entry 59, List II of Schedule VII read with Article 246 of the Constitution of India vests state governments with the power to levy tolls. Further, in accordance with the Tolls Act, state governments have been vested with the power to levy tolls at such rates as they deem fit.

National Monetisation Pipeline (NMP)

NITI Aayog has developed the pipeline, in consultation with infrastructure line ministries, based on the mandate for 'Asset Monetisation' for roads and highways, amongst others, under Union Budget 2021-22. The framework for monetisation of core asset monetisation has three key imperatives: (i) monetization of 'rights' not 'ownership' i.e. assets will be handed back to the government at the end of transaction life; (ii) brownfield de-risked assets and stable revenue streams; and (iii) structured partnerships under defined contractual frameworks with strict performance standards. This shall include selection of de-risked and brownfield assets with stable revenue generation profile with the overall transaction structured around revenue rights. The primary ownership of the assets under these structures shall be with the government.

Foreign Investment Regulations

Foreign investment in Indian securities is governed by the provisions of the FEMA, read with the applicable FEMA Rules, the FEMA (Mode of payment and Reporting of Non-Debt Instruments) Regulations, 2019 and the consolidated FDI Policy issued by the Department for Promotion of Industry and Internal Trade, Ministry of Commerce and Industry, Government. Foreign investment is permitted (except in the prohibited sectors) either through the automatic route or the approval route, depending upon the sector in which foreign investment is sought to be made. Under the FEMA Rules and the current consolidated FDI Policy, effective from October 15, 2020, an infrastructure investment trust registered and regulated by the SEBI under the InvIT Regulations, being an 'investment vehicle', is permitted to receive foreign investment from a person resident outside India (subject to Press Note 3 (2020 series)), including an FPI or an NRI subject to the terms and conditions specified in the FEMA Rules.

Downstream investment by an infrastructure investment trust shall be regarded as indirect foreign investment if neither the sponsor nor the investment manager of such an infrastructure investment trust is Indian 'owned and controlled' as defined in FEMA Rules.

Downstream investment by an 'investment vehicle' shall have to conform to the sectoral caps and conditions/restrictions, if any, as applicable to the company in which the downstream investment is made as per the FDI Policy. Foreign investment of up to 100% through the automatic route is permitted in the infrastructure sector in India. An infrastructure investment trust that receives foreign investment shall be required to make such report and in such format to the RBI or to the SEBI as may be prescribed by them from time to time.

The payment for the units of an infrastructure investment trust acquired by a person resident or registered/ incorporated outside India shall be made by an inward remittance from abroad through banking channels or by way of swap of shares of an SPV, or out of funds held in a Non-resident External ("**NRE**") or Foreign Currency Non-resident Bank ("**FCNR(B)"**) account maintained in accordance with the Foreign Exchange Management (Deposit) Regulations, 2016.

Further, any person who is a non-resident and holds units of an infrastructure investment trust in accordance with the FEMA Rules may pledge such units (i) in favour of a bank in India to secure the credit facilities being extended to the Indian company for bona fide purposes; (ii) in favour of an overseas bank to secure the credit facilities being extended to the person, or a person resident outside India who is the promoter of the Indian company or the overseas group company of the Indian company; (iii) in favour of a Non-Banking Financial Company registered with the RBI to secure credit facilities being extended to the Indian company for bona fide purposes; and (iv) subject to the authorized dealer bank satisfying itself of the compliance of the conditions stipulated by the RBI in this regard.

Other Laws and Regulations

In addition to the aforementioned, the other laws and regulations that may be applicable to the Trust and the Project SPVs include the following:

- *Factories Act, 1948*[*]
- *The Contract Labour (Regulation and Abolition) Act, 1970*[*]
- *The Child Labour (Prohibition and Regulation) Act, 1986*
- *The Employees' Compensation Act, 1923*[**]

- *The Employees' State Insurance Act, 1948*[**]
- *The Employee's Provident Fund and Miscellaneous Provisions Act, 1952*[**]
- *The Equal Remuneration Act, 1976*[***]
- *The Maternity Benefit Act, 1961*[**]
- *The Minimum Wages Act, 1948*[***]
- *The Payment of Gratuity Act, 1972*[**]
- *The Payment of Bonus Act, 1965*[***]
- *The Payment of Wages Act, 1936*[***]
- *The Sexual Harassment of Women at Workplace (Prevention, Prohibition, and Redressal) Act, 2013*
- *Industrial Disputes Act, 1917*
- *Shops and Commercial Establishments Acts, where applicable*

[*] *The Occupational Safety, Health and Working Conditions Code, 2020 (enacted by the Parliament of India and assented to by the President of India on September 28, 2020) will come into force on such date as may be notified in the official gazette by the Central Government and different dates may be appointed for different provisions of the Occupational Safety, Health and Working Conditions Code, 2020. Once effective, it will subsume, inter alia, the Factories Act, 1948 and the Contract Labour (Regulation and Abolition) Act, 1970.*

[**] *The Code on Social Security, 2020 (enacted by the Parliament of India and assented to by the President of India on September 28, 2020) has been notified to the extent of Section 142 of the Code and will come into force in its entirety on such date as may be notified in the official gazette by the Central Government and different date may be appointed for different provisions of the Code on Social Security, 2020. Once effective, it will subsume, inter alia, the Employees' Compensation Act, 1923, the Employees' State Insurance Act, 1948, the Employee's Provident Fund and Miscellaneous Provisions Act, 1952, the Maternity Benefit Act, 1961 and the Payment of Gratuity Act, 1972.*

[***] *The Code on Wages, 2019 (enacted by the parliament of India and assented to by the President of India on August 8, 2019) was notified in the official gazette by the Central Government on September 28, 2020 to the extent of the rules governing the constitution and functions of the central advisory board under the Code on Wages once notified and effective in its entirety, it will subsume the Equal Remuneration Act, 1976, the Minimum Wages Act, 1948, the Payment of Bonus Act, 1965 and the Payment of Wages Act, 1936.*

In addition to the above, compliance with the provisions of various tax-related legislations, intellectual-property related legislations and other applicable law for our day-to-day operations is also required.

REGULATORY APPROVALS

Other than as stated in this section, the Trust have obtained necessary consents, licenses, permissions, registrations and approvals from various governmental, statutory and regulatory authorities, required for the registration as an infrastructure investment trust and for carrying out its present business, as applicable.

In view of the approvals listed below, the Trust can undertake the Issue as well as its current business, as applicable, and no further major approvals from any governmental or regulatory authority are required to undertake the Issue or to continue its business, as applicable. Unless otherwise stated, these approvals are all valid as on date of this Placement Document.

For details of approvals relating to existing assets of the Trust (other than R3 Toll Roads), please see the section entitled "*Regulatory Approvals*" on page 210 of the R2 Placement Document available at https://www.bseindia.com/downloads1/NHIT_PD.pdf.

I. Approvals in relation to the Issue

1. In-principle approval from the NSE dated March 11, 2024; and

2. In-principle approval from the BSE dated March 11, 2024.

II. Approvals in respect of the R3 Toll Roads

The Sponsor, by way of its letter dated March 6, 2024 has confirmed that it had obtained all the necessary approvals and clearances required for the R3 Toll Roads as on the date of the letter.

III. Material Approvals applied for but not yet received

As on the date of this Placement Document, there are no material approvals required to be obtained by National Highways Infra Trust, for which applications have been made, but approvals have not been received.

IV. Material Approvals for which applications are yet to be made

As on the date of this Placement Document, there are no material approvals required to be obtained by National Highways Infra Trust, for which applications are yet to be made.

LEGAL AND OTHER INFORMATION

Except as stated in this section, there are no material litigations and actions by regulatory authorities, in each case against the Trust, the Project SPVs, the Sponsor, the Sponsor Group, the Investment Manager, the Project Manager and the Trustee as on the date of this Placement Document. Further, since (i) the Sponsor is a body corporate whose capital is funded by the Central Government and members are appointed and executive decisions taken by the President of India (acting through the Department of Personnel and Training and MoRTH), and (ii) the President of India is the Promoter of the Investment Manager, persons or entities that may be classified as "associates" of the Sponsor and Investment Manager in terms of Regulation 2(1)(b)(ii) and Regulation 2(1)(b)(iii) of the InvIT Regulations, it has not been identified as 'associates' of the Sponsor and the Investment Manager. Additionally, since the Project Manager is a is a wholly-owned subsidiary of the Sponsor, it has not been identified as 'associates' of the Sponsor and the Investment Manager.

For the purpose of this section, details of all regulatory actions and criminal matters involving the Trust, the Project SPVs, the Sponsor, the Investment Manager, the Project Manager, and the Trustee, that are currently pending, have been disclosed. Further, any matter involving an amount equivalent to, or more than, the amount as disclosed below, in respect of the Trust, the Sponsor, the Investment Manager, the Project Manager and each of their Associates, and the Trustee has been disclosed.

In respect of the Sponsor, the Sponsor Group, all outstanding civil matters which involve an amount exceeding ₹ 5,000 million, have been considered material. All cases where the amount is not ascertainable, but considered material, have been disclosed.

For the Investment Manager, all outstanding civil matters which involve an amount exceeding ₹ 10 million, have been considered material. However, the Investment Manager does not have any outstanding litigation.

For the Project Manager, all outstanding civil matters which involve an amount exceeding ₹ 1 million, have been considered material. However, the Project Manager does not have any outstanding litigation.

For NEPPL, all outstanding civil matters which involve an amount which is or exceeds 1% of the net-worth of the Trust, as per the latest audited financial statements, have been considered material. However, NEPPL does not have any outstanding litigation.

For NHIPPL, all outstanding civil matters which involve an amount exceeding ₹ 500 million or 5 per cent of the total revenue of NHIPPL as per its latest annual audited financial statements of the Company, whichever is higher, have been considered material. However, NHIPPL does not have any outstanding litigation.

For the Trustee, all outstanding cases involving the Trustee have been disclosed.

Further, all pending cases, where the amount is not ascertainable but considered material by the Trust, the Sponsor, the Investment Manager, the Project Manager or any of their Associates and the Trustee as on the date of this Placement Memorandum have been disclosed. Also, in cases where outcome of one litigation impacts one or more other litigations, which individually are below materiality threshold, but collective above, such cases have also been disclosed.

I. Litigation involving the Trust

There are no pending criminal, regulatory or other material litigations involving the Trust as on the date of this Placement Document.

II. Litigation involving Associates of the Trust

As on the date of this Placement Document, the Trust does not have any Associate.

III. Litigations involving the Project SPVs

There are no pending criminal, regulatory or other material litigations involving the Project SPVs as on the date of this Placement Document.

Regulatory matters

1. NHIPPL received a notice dated June 12, 2023 from the Deputy Registrar of Stamps, Government of Karnataka ("**GOK**") under article 32(A)(i) of the Karnataka Stamp Act, 1957, informing NHIPPL to pay the deficit stamp duty amounting to Rs. 699.00 million on the license agreement entered into between NHIPL with NHAI ("**Concession Agreement**"). Pursuant to receipt of such notice NHIPPL vide letter dated July 4, 2023 sought additional information to ascertain the basis of seeking additional stamp duty on the Concession Agreement. Subsequently, NHIPPL vide letter date July 4, 2023, informed NHAI of receipt of such letter from GOK. NHAI with several letters informed GOK that the Concession Agreement was adequately stamped and requested them to withdraw all claims. Pursuant to these clarifications GOK reiterated that the NHIPPL was liable to pay the deficit stamp duty amount of Rs. 699.00 million.

Further, NHIPPL has with letter dated March 5, 2024 clarified that they are not liable to pay the deficit stamp duty as GOK's reasoning is contrary to the law. The matter is currently pending.

IV. Litigations involving the Associates of the Project SPVs

Please see the section entitled " – *Litigations involving the Associates of the Sponsor*" below.

V. Litigations involving the Sponsor and the Sponsor Group

Criminal matters

There are no pending criminal litigations involving the Sponsor or the Sponsor Group as on the date of this Placement Document.

Regulatory matters

1. An application was filed by Amresh Singh against Union of India and others including NHAI before the National Green Tribunal ("**Tribunal**") alleging the rampant dumping of soil by NHAI contractors directly in the river Chenab and Tawi without prior environmental clearance. After considering all the documents placed on record, while referring the report of Monitoring Committee, the Tribunal was not satisfied with the actions taken by NHAI, and accepted the recommendations of the Monitoring Committee and directed the J&K Pollution Control Board to take appropriate actions in consultation with CPCB against the names mentioned in the report of the Monitoring Committee. The Bench also directed NHAI to take strict actions against the non-compliant contractors and sub-contractors at the HQ level. The matter is currently pending.

2. An application was filed before the National Green Tribunal Principal Bench, New Delhi regarding the Ghazipur Dump Site and the environmental problems that are caused due to the unsegregated, un-recycled large mountain of dump. The Sponsor was not a party to these proceedings till 2017 and East Delhi Municipal Corporation ("**EDMC**") had been exploring the implementation of a project to undertake the removal and processing of the municipal solid waste dumped at the site. In view of the same, the EDMC held discussions with the Sponsor for use of solid waste for construction of embankments in the expansion of NH-24 or other National Highway projects undertaken by the Sponsor. In view of our role, we were impleaded in the case in 2017. The matter is currently pending.

Material civil matters

The following material civil cases are initiated by Contractors/Concessionaires (hereinafter mentioned as the "**Claimant**") against the Sponsor in relation to various projects across India:

Arbitrations

1. Abhijeet Angul Sambalpur Toll Road Limited has initiated arbitration proceedings against the Sponsor in relation to the rehabilitation and up-gradation of four laning of the Angul-Sambalpur section of NH-42 in the State of Odisha. The claims raised relate to the compensation for losses suffered by the Claimant on account of delay in procurement of site and necessary approvals, wrongful termination of the concession agreement and debarment from participation in bidding for future projects of the Sponsor. The claims raised by the Claimant amount to ₹ 21070 million. The Sponsor has also filed counter claim for ₹1,282,7.20 million. The matter is currently pending.

2. Madhucon Projects Ltd. (Barasat Krishnagar Expressway Limited) has initiated arbitration proceedings against the Sponsor in relation to Barasat-Krishnagar Section BOT (Annuity) in the State of West Bengal. The claims filed by the Claimant for loss due to interest on debt, loss due to interest on equity infused into the project, losses due to idling/underutilisation of machinery and equipment, losses due to idling/underutilisation of manpower, losses due to miscellaneous expenditure incurred at site, compensation due to delay in handing over of site, losses due to price escalation on the works already executed, losses due to expenses incurred on the works executed, loss of overheads and profit and total termination payment. The Claimant has raised a claim for ₹ 2,1398.90 million. The Sponsor has also filed counter claims against the Claimant for ₹ 10,606.80 Million. The matter is currently pending.

3. M/s Raipur Expressway Limited has initiated arbitration proceedings against the Sponsor in relation to improvement, operation, maintenance and strengthening of existing 2-lane road and widening to 4-lane divided highway from Km 239.000 to Km 281.000 of NH-6 (Raipur- Aurung Section) in the state of Chhattisgarh on BOT basis. The claims were filed by the Claimant for compensation due to delay in declaration of appointed date, compensation due to extension of time for project completion, damages for delay in providing right of way (ROW), claim on account of change of scope, claim for interest on delayed payments by the respondent, claim for loss of bonus due to arbitrary withdrawal of provisional completion certificate, claim on account of delay in releasing bank guarantees for retention money and claim for expenses and loss of profit due to delay in release of performance security. The Claimant has raised a claim for ₹ 10,121.00 million. The Sponsor has also filed counter claims against the Claimant for ₹ 4,231.70 million. The matter is currently pending.

4. M/s Ashoka Highway (Durg) Limited has initiated arbitration proceedings against the Sponsor in relation to design, engineering, finance, construction, operation & maintenance of end of Durg Bypass- Chhattisgarh/Maharashtra Border from Km 322.400 to Km 405.000 of NH-6 under NHDP. The Claimant has raised a claim for ₹ 2866.10 million. The Sponsor has also filed counter claims against the Claimant for ₹ 56.60 million. The matter is currently pending before arbitral tribunal. However, as both the parties want to settle the disputes, the matter has now been referred to conciliation committee (CCIE), with the consent of the parties, in terms of the policy circular dated June 2, 2017.

5. Jetpur Somnath Tollways Limited has initiated arbitration proceedings against the Sponsor in relation to Jetpur Somnath Section BOT (Toll). The claims filed by the Claimant for damages under the respective concession agreement for delay in non-fulfilment of all conditions precedent set forth in the concession agreement, Compensation for additional costs incurred by the Claimant towards deployment of plants, machineries and equipment during the extended construction period from October 1, 2014, up to November 10, 2016, compensation for additional cost incurred on account of inflation/price escalation of major input costs during the extended construction period from October 1, 2014, up to November 10, 2016, additional interest liability towards lenders (IDC) during construction period on account of extended construction period, compensation for additional cost incurred on account of EPC overheads during the extended construction period from October 1, 2014, up to November 10, 2016, additional compensation for delay (as per actuals/anticipated in the financial model) for the project period till September, 2016 on account of inability to collect toll fee for the entire stretch resulting from various material defaults by respondent, additional SPV incorporation charges resulting due to infusion of increased equity by the shareholders on account of material defaults by the respondent and interest cost on such shareholder's equity (unsecured debt from shareholders). The Claimant had raised a claim for ₹ 13,096.00 million. The Sponsor had also filed counter claims against the Claimant for ₹ 8,472.10 million. An award of ₹ 12,130 million in favour of the Claimant in the matter has been passed on July 31, 2021. The matter is no more pending in Arbitration.

6. Gwalior Jhansi Expressways Limited has initiated an arbitration proceeding against the Sponsor in relation to the designing, development and maintenance of certain sections of NH-75 in the States of Uttar Pradesh and Madhya Pradesh. The claims relate to compensation for non-payment of annuities and interest, for additional direct costs incurred by the Claimant due to material breach of the concession agreement and additional costs incurred by the Claimant in respect of interest payments during the construction period beyond the scheduled project completion date. The claims raised by the Claimant amount to ₹ 20,611.5 million. The Sponsor has also filed a counter claim against the Claimant for the failure relating to compliance of the maintenance obligation, reimbursement of one-half of remuneration, costs and expenses of the independent consultant, delayed cost due to time overrun and also on account of loss of toll revenue due to delay. The counter claim is for an amount of ₹ 13980.00 million. The said matter is currently pending.

7. M/s Indore Dewas Tollways Limited. has initiated arbitration proceedings against the Sponsor in relation to 6-laning of Indore-Dewas Section of Nh-3 from Km 577.550 to Km 610.000 and Km 0.000 to Km 12.600 (approx. length 45.05Km) in the State of Madhya Pradesh under NHDP Phase-V to be executed as BOT(Toll) project on DBFOT pattern. The claims filed by the Claimant for claim for utilization of resources beyond the scheduled 6-laning date, as envisaged in the respective concession agreement, compensation for Claimant's loss towards additional interest during construction, compensation towards Claimants loss of toll revenue attributable to respondents misrepresentation and subsequent default in maintaining feeder roads, refund of additional concession fee/premium paid by the Claimant, compensation/indemnification towards loss of profit claimants EPC contractor. The Claimant has raised a claim for ₹ 10709.60 million. The Sponsor has also filed counter claims against the Claimant for ₹ 5353.40 million. The matter is currently pending.

8. GVK Shivpuri Dewas Expressway Private Limited has initiated arbitration proceedings against the Sponsor in relation to the designing, development and maintenance of the Shivpuri-Dewas Section of NH-3 in the State of Madhya Pradesh. The claims raised by the Claimant relate to the return of the performance bank guarantee upon termination of the contract by us and compensation for the losses suffered by the Claimant due to delay in receiving environmental clearances. The claims raised by the Claimant amount to ₹ 5,521.40 million. The Sponsor has also filed a counter claim against the Claimant for amounts incurred on account of maintenance and management of the existing stretch, estimated expenses on account of retendering and on account of loss of premium. The counter claim is for an amount of ₹ 10,761.00 million. The matter has now been settled for release of Performance Bank Guarantee by NHAI amounting to ₹ 281.50 vide settlement agreement dated 16.09.2021.

9. M/s GVK Deoli Kota Expressway Private Limited has initiated arbitration proceedings against the Sponsor in relation to design, construction, development, finance, operation and maintenance of four laning of Deoli- Kota Section of NH-12 from Km 165.000 to Junction of NH-76 on Kota Bypass (approx. length 83.04 Kms) in the State of Rajasthan on BOT(Toll) project on DBFOT pattern under NHDP phase–II. The claims filed by the Claimant for claim on account of prolongation costs and extended stay at the site, loss suffered on account of additional overhead and loss of profit, loss of toll revenue, claim on account of increase in cost of the project due additional works done by the Claimant owing to the change of scope, claim on account of additional expenses incurred by the Claimant towards tunnel work, claim on account of excessive repair and prolonged maintenance duration of existing road, claim on account of the Respondent in making the termination payment and claim on account of future loss to Claimant. The Claimant has raised a claim

for ₹ 60130.00 Million . The Sponsor has also filed counter claims against the Claimant for ₹ 5,657.60 million. The matter is currently pending.

10. Soma Isolux Kishangarh-Beawar Tollway Private Limited has initiated arbitration proceedings against the Sponsor in relation to the "improvement, operation and maintenance, rehabilitation and strengthening of the existing 2 lane road and widening it to six-lane divided highway from km 364.125 to km 58.245 (approximately 93.56 km) on the Krishangarh-Ajmer-Beawer section of National Highway". The claim relates to compensation for increase in overheads due to extended construction period, for additional cost due to loss of productivity, idling and under-utilization of plant & equipment during the extended period and for costs incurred towards interest payments on debt during the extended construction period. The claims raised by Claimant amounts to ₹ 11,968.00 million. The Sponsor has also filed counter claims against Claimant for ₹ 3,109.5 million. The matter is currently pending.

11. Panipat Jalandhar NH One Tollway Private Limited has initiated arbitration proceedings against the Sponsor in relation to six laning of Panipat-Jalandhar section of NH-1 (km 96.00 to km 387.100) in the state of Haryana and Punjab. The claims filed by the Claimant were in relation to delay in finalization of toll plaza and commencement of toll operations at approved locations, loss of fee revenue on account of defaults, extension of project completion schedule and change in scope and other claims. The Claimant has raised a claim for ₹ 70,359.00 million. The Sponsor has also filed counter claims against Claimant for ₹ 32,847.00 million. The matter is currently pending.

12. M/s. Shapoorji Pallonji & Company Private Limited has initiated arbitration proceedings against the Sponsor in relation to Jammu-Udhampur section BOT (Annuity). The claims filed by the Claimant in relation to declaration of provisional completion certificate date as June 1, 2014 with consequential reliefs of bonus for the period from January 7, 2014 to May 31, 2014, determination of appointed date and payment of bonus from July 5, 2014, compensation for additional cost arising out of change in methodology of rock excavation due from July 10, 2014, and compensation for additional cost arising out of change in methodology of tunnel rock excavation from October 17, 2014. The Claimant has raised a claim for ₹ 9,383.40 million. The Sponsor has also filed counter claims against the Claimant for ₹ 14,940.00 million. The matter has now been settled for ₹ 2826.7 million vide agreement dated 28.02.2022.

13. M/s Bareilly Highways Project Limited has initiated arbitration proceedings against the Sponsor in relation to four laning of Bareilly-Sitapur section of NH-24 from Km 262.000 to Km 413.200 (approx. 151.200km) in the State of Uttar Pradesh under NHDP Phase-III of DBFOT basis. The claims filed by the Claimant were in relation to claim for additional interest on debt beyond SPCD (i.e. between August 23, 2013 to January 31, 2019), interest for additional interest on debt beyond SPCD, claim for interest due on additional promoters contribution infused in the project, claim for interest due on delay release of grant, claim for expenses incurred by SPV company beyond SPCD, claim for interest for cost of land compensation, claim for net revenue loss from SPCD till January 31, 2019, interest for net revenue loss from SPCD till January 31, 2019, claim for interest on excess 50% independent engineering cost debit by the Sponsor, claim for reimbursement of GST on regular EPC invoices-change of law, claim for interest on claim of GST on change of scope & utility shifting, claim for direct expenses incurred by EPC contractor beyond SPCD, claim for plant and machinery rental/rehandling for extended period, claim for interest for plant and machinery/rental/rehandling for extended period, claim for price escalation during the extended period, claim for interest for price escalation during the extended period, claim for expenses incurred on change of scope/variation items, claim for interest for change of scope/variation items, claim for additional transportation cost due to ban in local mining at sites, claim for interest for additional transportation cost due to ban in local mining at sites. The Claimant has raised a claim for ₹ 37,211.40 million. The Sponsor has also filed counter claims against the Claimant for ₹ 35359.80 million. The matter is currently pending.

14. M/s Lucknow-Sitapur Expressways Limited has initiated arbitration proceedings against the Sponsor in relation to improvement, operation and maintenance including strengthening and widening of existing two lane road to four lane dual carriageway from km 488.270 – Km. 413.200 of NH -24 (Lucknow Sitapur Section) in the State of Uttar Pradesh on BOT basis. The claims filed by the Claimant for revenue loss, revenue loss due to delay in COD, revenue loss from start of toll collection, EPC escalation, EPC additional overhead, EPC overstay of plant and equipment, additional maintenance cost of EPC, loss of profit earning capacity, extra cost IDC, revenue loss due to overloading and claims for underpasses. The Claimant has raised a claim for ₹ 7,470 million. The Sponsor has also filed counter claims against the Claimant for ₹ 3270.00 million. The matter is currently pending.

15. M/s Tantia Raxaul Private Limited has initiated arbitration proceedings against the Sponsor in relation to two laning with paved shoulder of Pioprakothi to Raxaul Section of NH-28A from Km 0.600 to Km 62.064 in the state of Bihar. The claims filed by the Claimant were in relation to claim for termination payment for default of respondent , claim for non-finalisation of location and correct notification for toll plaza (along with interest at the rate of 18%) , claim for delay in handover for land/ right of way/ site (along with interest at the rate of 18%) , claim for additional interest during construction on account of extended construction period, claim for increased distance/lead for stone aggregate, claim for inflation/ price escalation (along with interest at the rate of 18%), claim for additional cost of maintenance, claim for increased overheads of concessionaire (along with interest at the rate of 18%), claim for increased overheads of EPC contractor (along with interest at the rate of 18%), claim for idling/underutilisation of plant, machinery & equipment, and claim for loss of profits of EPC contractor. The Claimant has raised a claim for ₹ 9,861.70 million. The Sponsor has also filed counter claims against the Claimant for ₹ 2,873.60 million. The matter is currently pending.

16. M/s Haridwar Highways Project Limited has initiated arbitration proceedings against the Sponsor in relation to the four laning of Muzaffarnagar-Haridwar Section from Km 131.00 to Km 211.000 of NH-28 in the state of UP and Uttarakhand under NHDP Phase-II as BOT (Toll) on DBFOT pattern. The claims filed by the Claimant were in relation to financial expenses incurred by the Claimant beyond the scheduled commercial operation date till February 2019, interest payable on compensation for delay in handing over of the land form from appointed date till February, 2019, interest due on delay towards release of grant from February 7, 2013, up to February, 2019, claim for reimbursement of GST on regular bills/invoices of the Claimant from July, 2016, claims for expenses incurred by the Claimant on rentals of plants and machinery beyond SCOD, claims for expenses incurred by the Claimant on rentals of plants and machinery beyond SCOD till February 2019, claim for expenses incurred by the Claimant due to price escalation beyond the SCOD up to February 2019, additional transportation cost due to ban on mining at sites, claim for direct expenses incurred beyond SCOD up to February 2019, expenses incurred on existing road maintenance beyond SCOD and claim on account of amount recovered for Dehradun Highway Project Limited. The Claimant has raised a claim for ₹ 22,060.00 million. The Sponsor has also filed counter claims against the Claimant for ₹ 22,260.00 million. The matter is currently pending.

17. Madhucon (Madurai-Tuticorin Expressways Limited) has initiated arbitration proceedings against the Sponsor in relation to the "Design, Engineering, Finance, Construction, Operation and Maintenance of Madurai-Tuticorn Section from km 138.800 to km 264.50 of NH-45B in the State of Tamil Nadu under NHDP Phase IIIA". The claims relate to compensation payable due to prolongation of the project, refund of liquidated damages, change of scope of work, loss of business opportunity, loss on account of shortfall in revenue from the project and amount payable on account of price escalation during the extended period of construction. The claim raised by Claimant amounts to ₹ 81,993.10 million. The Sponsor has also filed counter claims against the Claimant for ₹ 2,902.60 million. The said matter is currently pending.

18. M/s Chennai Elevated Toll Way Limited has initiated arbitration proceedings against the Sponsor in relation to the new four lanes elevated road from Chennai Port to Maduravoyal (NH-4) in the State of Tamil Nadu under NHDP Phase-VII on BOT(Toll) basis. The claims filed by the Claimant were in relation to termination payment, claims payable to the EPC contractor, claim for additional cost due to idling/ underutilization/ prolongation of plants & equipment, loss of profit payable to the EPC contractor due to delay and termination of the contract, loss of opportunity to the EPC contractor due to delay and termination of the contract, claims for infructuous expenditure for setting up camps, site approach, road development etc. The Claimant has raised a claim for ₹ 41,071.80 million. The Sponsor has also filed counter claims against the Claimant for ₹21,632.70 million. The award of has been pronounced in this arbitration. The claimant has been awarded an amount of ₹21170.95 million and the sponsor has been awarded an amount of ₹260.10 million.

19. M/s MEP Chennai Bypass Toll Road Private Limited has initiated arbitration proceedings against the Sponsor in relation to operation and maintenance of Chennai Bypass section from Km 0.000 to Km 32.600 of NH-4 & 5 in the State of Tamil Nadu on OMT basis. The claims filed by the Claimant were in relation to amount due towards concession fee (up to April 8, 2016), damages for non-completion of project facilities calculated up to April 8, 2016, amount due towards non-fulfilment of condition precedent and damages for non-maintenance of project highway calculated up to April 8, 2016. The Claimant has raised a claim for ₹ 5,033.00 million. The Sponsor has also filed counter claims against the Claimant for ₹ 8,704.30 million. The matter is currently pending.

20. M/s Kurukshetra Expressway Private Limited has initiated arbitration proceedings against the Sponsor in relation to four laning of Rohtak-Bawal section of NH-352 (Old NH-71) from Km 363.300 (Design Km. 363.300) to Km 450.800 (Design Km 445.553) under NHDP-III in the State of Haryana on DBFOT basis. The claims were raised under the terms of the relevant concession agreement. The Claimant has raised a claim for ₹ 9,150.00 million. The matter is currently pending.

21. M/s JSR Mulbagal Tollways Private Limited has initiated arbitration proceedings against the Sponsor in relation to 4-laning of Mulbagal-AP/Karnataka Border Section of NH-75 (Old NH-4) from Km 216.912 to Km 239.100 in the state of Karnataka to be executed on design, build, finance, operate and transfer (DBFOT/BOT) basis in BOT (Toll) mode under NHDP Phase-III. The claims filed by the Claimant are in relation to the amount payable to the Claimant in the event of termination by concessionaire and / or by the authority, the interest on the capital/equity of the concessionaire, loss for underutilization / idle of resources deployed in the way of man power, towards machineries, plant and equipment beyond the date of completion for about 29 months, loss of profit, loss of return envisaged by the concessionaire as a result of default of the authority, amount spent towards the short fall of subsistence revenue, losses due to price escalation, revenue that might have generated by the Claimant through advertisements and loss due COVID-19. The Claimant has raised a claim for ₹ 21,332.50 million. The Sponsor has also filed counter claims against the Claimant for ₹ 119.30 million. The award of ₹1060.47 million has been pronounced in favour of claimant.

22. M/s Rohtak Panipat Tollway Private Limited has initiated arbitration proceedings against the Sponsor in relation to the four laning of Rohtak-Panipat Section of NH-71A from Km 0.00 (Km 63.300) of NH-10 to Km 80.58 (Km 83.500 of NH-1) in the State of Haryana on DBFOT basis under NHDP Phase-III. The claims filed by the Claimant were raised in terms of the relevant concession agreement. The Claimant has raised a claim for ₹ 11,509.30 million. The matter is

currently pending and is under Conciliation.

23. M/s Ranchi Expressway Limited has initiated arbitration proceedings against the Sponsor in relation to the four laning of Ranchi- Rargaon-Jamshedpur Section from Km 114.00 to Km 277.500 of NH-33 in the State of Jharkhand on BOT(Annuity) basis under NHDP Phase-II. The claims filed by the Claimant were in relation to payment towards value of work done, amount payable towards maintenance of existing road, refund of amount expended on interest during construction, compensation payable due to delay in handling over of land, extra expenditure due to escalation of cost of work done, loss incurred due to idling of machinery due to prolongation of project, loss of overheads due to prolongation of project, loss of overheads and profits on value of work done due to illegal termination and claim for amount of revenue loss (loss of annuity). The Claimant has raised a claim for ₹ 89402.50 million. The Sponsor has also filed counter claims against the Claimant for ₹ 2,6281.80 million. The matter is currently pending.

24. M/s Navayuga Bangaluru Tollways Pvt. Ltd. has initiated arbitration proceedings against the Sponsor in relation to the Designing, Engineering, Finance, Construction, Operation and Maintenance of Access controlled highway project namely, the development and the capacity improvement of the existing carriageways from km 10.000 to 29.500, on the Bangalore Nelamangala section of the National Highway No.4 (NH-4) in the State of Karnataka on BOT basis. The claims filed by the Claimant were in relation to Loss of Toll Revenue, Force free run, Change in Law, Loss of Toll Revenue – Non Revision of Toll rates, Termination payment & Compensation, BG Charges, COVID. The Claimant has raised a claim for ₹ 15000.00 million. The Sponsor is yet to file its counter claims against the Claimant. The matter has been settled.

25. M/s Millennium City Expressways Pvt. Ltd. has initiated arbitration proceedings against the Sponsor in relation to the 8/6 lane highway from Km.14.300 to km. 42.000 at Delhi-Gurgaon section of NH-8 on BOT basis. The claims filed by the Claimant were in relation to the Loss of profit on account of closure of the Km. 24 Toll Plaza (such amount calculated until 24.06.2021), Loss of profit on account of commissioning of the competing/alternate road facilities alternatively, extend Concession Period by a period of ninety four (94) months, Loss of profit suffered due to failure to provide requisite security at the Main Toll Plaza, thereby resulted in loss of toll revenue from the residents of nearby 31 villages, Various works carried out by the Claimant as change of scope, which were over and above the Project Agreements, payment for which remains pending despite the Claimant having already completed such additional works, Compensation/extension due to Demonetization, Compensation/extension due to Pandemic/Covid, On account of additional compliance with the Joint Action Plan that was over and above the Project Agreements. The Claimant has raised a claim for ₹ 24160.00 million. The Sponsor has also filed counter claims against the Claimant for ₹ 10440.00 million. The matter is currently pending.

26. M/s AE Tollway Ltd. has initiate arbitration proceedings against the Sponsor in relation to the 6-laning of Agra-Etawah Bypass Section of NH-2 from km. 199.660 to km, 323.525 under NHDP Phase-V in the State of UP on BOT (Toll) basis. The claims filed by the Claimant were in relation to the Additional cost incurred towards Interest during Construction (IDC) for the delayed Period, Additional direct cost incurred during the delayed period, Fixed Overhead (FOH) payable to EPC Contractor, Escalation cost. The Claimant has raised a claim for ₹ 13179.80 million. The Sponsor has filed a Counter-claims of ₹ 11875.10 million against the Claimant. The matter is currently pending before the Arbitral Tribunal.

27. Pink City Expressway Pvt. Ltd. has initiate arbitration proceedings against the Sponsor in relation to the 6 laning of Gurgaon-Kotputli-Jaipur Section of NH-8 from Km 42.700 to Km 273.00 (Length 225.60 Km.) in the State of Haryana & Rajasthan to be executed as BOT (Toll) on DBFOT pattern under NHDP PH-V. (Ref-III). The claims filed by the Claimant were in relation to the delay in handing over of ROW, idle of resources deployed in the way of man power, towards machineries, plant and equipment beyond the date of completion. The Claimant has raised a claim for ₹ 42870 million. The Sponsor has filed the Counter-claims of ₹ 149524.50 million against the Claimant. The matter is currently pending before the Arbitral Tribunal.

28. VIL Limited has initiated arbitration proceedings against the Sponsor in relation to the Two Laning with paved shoulders of Sitarganj-Bareilly section of NH-74 from Km254.820 to Km329.280 in State of Uttar Pradesh & Uttarakhand under NHDP Phase-IV on EPC Mode. The claims filed by the Claimant were in relation to the delay in handing over of ROW, idle of resources deployed in the way of man power, towards machineries, plant and equipment beyond the date of completion. The Claimant has raised a claim for ₹ 10058.60 million. The Sponsor has filed the Counter-claims of ₹ 2621 million against the Claimant. The matter is currently pending before the Arbitral Tribunal. The claimant has been awarded an amount ₹1170.99 million has been and the sponsor has been awarded an amount of ₹10 million in this matter. The matter has been challenged in the High Court.

29. KM Toll Road Private Limited has initiated arbitration proceedings against the Sponsor in relation to the Construction, operation and maintenance of National Highway No. 8A extension including section from km 0.00 to km 71.40 (approximately 71.40 km) on the Gandhidham (Kandla) – Mundra Port section of National Highway No. 8A Extension in the state of Gujarat by Four-Laning and subsequent Six-Laning thereof on design, build, finance, operate and transfer ("DBFOT") basis. The claims filed by the Claimant for declaration for valid termination of the Concession Agreement by the Claimant, Termination Payment, refund to the Claimant of sum wrongfully deducted purportedly towards non-compliance of Punch List items, pay towards Change in Law etc. The Claimant has raised a claim for ₹

18730.00 million. The Sponsor has filed the Counter-claims of ₹ 1572.40 million against the Claimant. The matter is currently pending before the Arbitral Tribunal.

30. GMR Hyderabad Vijaywada Expressway Pvt Ltd has initiated arbitration proceedings against the Sponsor in relation to 4/6 laning of Hyderabad- Vijaywada Section from Km 40.000 to Km 221.500 of NH-9 (New NH-65) in the State of Andhra Pradesh (BOT). The claims filed by the Claimant were in relation to the extension of the Concession period, damages in lieu of the extension of the Concession period. The Claimant has raised a claim for ₹ 12659.40 million. The Sponsor has filed the Counter-claims of ₹ 5900.00 million against the Claimant. The matter is currently pending before the Arbitral Tribunal.

31. Supreme Panvel Indapur Tollway Pvt Ltd has initiated arbitration proceedings against the Sponsor in relation to Four laning of Panvel-Indapur Section of NH-17 from km 0.00 to km 84.00 under NHDP Phase III on BOT Basis on design, build, finance, operate and transfer (DBFOT) pattern in the State of Maharashtra. The Claimant has raised a claim for ₹16189.70 million. The Sponsor is yet to file the Counter-claim against the Claimant. The matter is currently pending before the Arbitral Tribunal.

32. Gorakhpur Infrastructure Co. Pvt. Ltd.has initiated arbitration proceedings against the Sponsor in relation to Design construction Finance Operation and Maintenance of Km.0.000 to Km. 32.270 of Gorakhpur Bypass on NH-28 (existing Km. 255.700 to Km. 279.800) in the State of Uttar Pradesh on BOT (Annuity) basis. The Claimant has raised a claim for ₹ 7101.30 million. The Sponsor is yet to file the Counter-claim against the Claimant. The matter is currently pending before the Arbitral Tribunal.

33. M/s Raebareilly Allahabad Highway Private Limited has initiated arbitration proceedings against the Sponsor in relation to Two Laning with Paved shoulder of Raebareli to Alahabad section of NH-24B from kn. 82.000 to km. 188.600 in the state of Uttar Pradesh through Public Private Partnership on Design, Build, Finance, Operate and Transfer on the Toll Basis under NHDP-IVA. The Claimant has raised a claim for ₹ 6842.40 million. The Sponsor has filed the Counter-claim of ₹ 782.30 million against the Claimant. The matter is currently pending before the Arbitral Tribunal.

34. Solapur Tollways Pvt. Ltd. has initiated arbitration proceedings against the Four laning of Solapur-Mah/Knt border Section of NH-9 from Km. 249+000 to Km.348.800 in the State of Maharashtra is being executed on DBFOT basis. The Claimant has raised a claim for ₹ 8265.80 million. The Sponsor has filed the Counter-claim of ₹ 8100.00 million against the Claimant. The matter is currently pending before the Arbitral Tribunal.

35. M/s Solapur Yedeshi Tollway Ltd has initiated arbitration proceedings against the Four laning of Solapur- Yedeshi section of NH-21 from km.0.000 to km 100.000 (Design Length -98.717 km) in the state of Maharashtra to be executed for BOT (Toll) on DBFOT pattern under NHDP Phase IV. The Claimant has raised a claim for ₹ 7900.00 million. The Sponsor has filed the Counter-claim of ₹ 1400.00 million against the Claimant. The matter is currently pending before the Arbitral Tribunal.

36. Madhucon Projects Ltd. has initiated arbitration proceedings against the Widening & Strengthening of existing NH from 2-lane to 4-lane from km.255.00 to km 230.500 of Raha to Dharmatul Section of NH-37 in Assam on East-West Corridor under Phase-II programme of NHDP Contract Package EW-II (AS-02). The Claimant has raised a claim for ₹ 6762.60 million. The Sponsor has filed the Counter-claim of ₹ 950.80 million against the Claimant. The matter is currently pending before the Arbitral Tribunal.

37. Kishangarh Gulabpura Tollway Ltd has initiated arbitration proceedings against the Six Lanning of Kishangarh to Gulabpura Section of NH 79A and NH 79 in the State of Rajasthan (Length 90.000 KM) on DBFOT (Toll) IRB-ARBITRATION Ref NO.3. The Claimant has raised a claim for ₹ 8689.60 million. The Sponsor has filed the Counter-claim of ₹ 3560.00 million against the Claimant. The matter is currently pending before the Arbitral Tribunal.

38. Transstroy Dindigul-Theni-Kumli Tollways Pvt Ltd has initiated arbitration proceedings against Two laning with paved shoulder of Dindigul-Theni Section from Km 2.750 to Km 73.400 of NH-45 (Extn.) and Theni-Kumli section of NH-220 from Km 215.500 to Km 273.600 in the State of Tamil Nadu under DBFOT Annuity basis. The Claimant has raised a claim for ₹ 5258.40 million. The Sponsor is yet to file the Counter-claim against the Claimant. The matter is currently pending before the Arbitral Tribunal.

39. JR Toll Road Pvt. Ltd. has initiated arbitration proceedings against the Sponsor in relation to the Design, Engineering, Construction, Development, Finance, Operation and Maintenance of Jaipur to Reengus Section of NH-11 (KM 246.300 to Km 298.075) in the state of Rajasthan under NHDP Phase-III on Design, Build, Finance, Operate and Transfer (DBFOT) Basis. The claims raised by the Claimant amount to ₹ 8440 million. The Sponsor has also filed counter claim for ₹ 8200 million. The matter is currently pending.

40. M/s Dilip Buildcon Ltd. has initiated arbitration proceedings against the Sponsor in relation to the Six Laning of Gorhar to Khairtunda Section of NH-2 from km. 320.810 to km. 360.300 section on HAM in the State of Jharkhand under NHDP phase V. The claims raised by the Claimant amount to ₹ 360.31 million. The Sponsor is yet to file the

Counter-Claim against the Claimant. The matter is currently pending before the Arbitral Tribunal.

41. M/S VRC-SPIDPL has initiated arbitration proceedings against the Sponsor in relation to the 4-Laning of Rohtak-Jind section from km.307+000 to km 347+800 of NH-71 and connecting link from Km. 347.800 of NH-71 to km.9+400 of NH-71A (Balance work) on EPC mode under Bharatmala (Left out in NHDP) in the State of Haryana. The claims raised by the Claimant amount to ₹4600.02 million. The Sponsor is yet to file the Counter-Claim against the Claimant. The matter is currently pending before the Arbitral Tribunal.

42. Sadbhav Engineering Limited initiated arbitration proceedings against the Sponsor in relation to the 4 Laning of Rohtak-Panipat Section of NH-71A from Km 0.00 (Km 63.300) of NH-10 to Km 80.58 (Km 83.500 of NH-1) in the State of Haryana of DBFOT basis under NHDP Phase-III.(BOT) (Ref II). The claims raised by the Claimant amount to ₹19370.92 million. The Sponsor has also filed counter claim for ₹6220.70 million. The matter is currently pending before the Arbitral Tribunal.

43. M/s TPF Getinsa Eurostudies Limited initiated arbitration proceedings against the Sponsor in relation to the Rehabilitation & upgradation of existing 2-lane to 4-lane standards from Duburi to Chandilkhole section (km.338.376-km. 428.074) of NH-200 (new NH-53) in the state of Odisha under NHDP-III on EPC mode (Pkg-III). The claims raised by the Claimant amount to ₹100 million. The Sponsor is yet to file counter claim. The matter is currently pending before the Arbitral Tribunal

44. M/s PRS Tolls Private Limited initiated arbitration proceedings against the Sponsor in relation to the Tolling, Operation, Maintenance & Transfer of Palanpur- Radhanpur- Samkhiyali section of NH-27 from km 536+000 to km 589+600 in the State of Gujarat (TOT Bundle 5 (A-1). The claims raised by the Claimant amount to ₹3140 million. The Sponsor is yet to file counter claim. The matter is currently pending before the Arbitral Tribunal.

45. M/s Simplex Infrastructures Ltd initiated arbitration proceedings against the Sponsor in relation to the Rehabilitation and up-gradation to 4-laning of NH-31D from Km 113+200 to Km 154+854 (Pkg-2A) Falakata-Salsalabari Section in the State of West Bengal on EPC Basis. The claims raised by the Claimant amount to ₹9000 million. The Sponsor is yet to file counter claim. The matter is currently pending before the Arbitral Tribunal.

46. M/s Sahakar Global Ltd. initiated arbitration proceedings against the Sponsor in relation to the user fee collection at Palsit Toll Plaza located at Km.585.692 for the section from Km. 520.103 to Km. 587.853 (Panagarh to Palsit) of NH-2 in the State of West Bengal and Supplementary Agreement dated 03.06.2019 (2nd ref.). The claims raised by the Claimant amount to ₹360.43 million. The Sponsor is yet to file counter claim. The matter is currently pending before the Arbitral Tribunal.

47. M/S IL&FS Engineering & Construction Company Ltd. initiated arbitration proceedings against the Sponsor in relation to the Balance work of Patna-Gaya-Dobhi Section of NH-83 from Km.83.000 to Km.127.217 (Pkg-III) on EPC (Item Rate) in the State of Bihar executed under JICA ODA Loan Assistance. The claims raised by the Claimant amount to ₹600 million. The Sponsor has also filed counter claim for ₹22780 million. The matter is currently pending before the Arbitral Tribunal.

Material civil matters filed by the Sponsor

48. Essel Walajahpet Poonamalle Toll Road Private Limited has filed a petition before the High Court of Delhi (challenging the award of the arbitral tribunal). The claims challenged are for compensation for adjusted equity as termination payments, compensation for repayment of the debt borrowed from the lenders/creditors, compensation for loss of profit payable to EPC contractor, compensation for internal rate of return and mobilisation and de-mobilisation. The amount challenged before the High Court of Delhi is ₹ 6532.90 million. The matter is currently pending.

49. The Sponsor has filed a petition before the High Court of Delhi (challenging the award of the arbitral tribunal) against Oriental Nagpur Betul Highways Limited. The claims challenged are for date of PCOD to be declared as January 7, 2014, and grant bonus of additional 91 d^{ay}s including 9th instalment of annuity payment. The amount challenged before the High Court of Delhi is ₹ 8220.70 million. The matter is currently pending.

50. The Sponsor has filed a petition before the High Court of Delhi (challenging the award of the arbitral tribunal) against West Haryana Highway Private Limited. The claims challenged are interest due on additional promoter contribution infused in the project, price escalation during the extended period, plant and machinery idling/rental/rehandling for extended period and interest on plant and machinery idling/rental. The amount challenged before the High Court of Delhi is ₹ 5,478.90 million. The matter is currently pending.

51. The Sponsor has filed a petition before the High Court of Delhi (challenging the award of the arbitral tribunal) against Gwalior Bypass Project Limited. The claims challenged are claim for interest on delayed release of annuity amount along with interest due to delayed payment of regular annuity, claim for interest on debt after COD till December 31, 2016 and interest incurred on price escalation form PCOD till October 31, 2016. The amount challenged before the High Court of Delhi is ₹ 5,328.10 million. The matter is currently pending.

52. The Sponsor has filed a petition before the High Court of Delhi (challenging the award of the arbitral tribunal) against Pune Solapur Expressways Pvt. Ltd. The Sponsor has challenged the entire award w.r.t to extension of Concession Period by 928 days vide the petition marked as Diary No. 990741/2022. The amount challenged before the High Court of Delhi is ₹ 224.60 million. The matter is currently pending.

53. The Sponsor has filed a petition before the High Court of Delhi (challenging the award of the arbitral tribunal) against M/s GMR. The Sponsor has challenged the Final Report released by Sole Arbitrator on 28.02.2022 which has determined the loss in terms of Article 41 amounting to ₹ 16722.00 million in favour of the Concessionaire. The petition is marked as FAO (OS) 108/2020 109/2020 110/2020. The matter is currently pending.

54. The Sponsor has filed a petition before the High Court of Delhi (challenging the award of the arbitral tribunal) against the M/s BSCPL Aurang Tollway Ltd. The Sponsor has challenged the entire award of the Arbitral Tribunal. The challenge include the claims with respect to the Right of Way, Payment for idealing of plant and machinery vide petition marked as OMP (Comm) 341/2022. The amount challenged before the High Court of Delhi is ₹ 2819.4 million. The matter is currently pending.

55. The Sponsor has filed a petition before the High Court of Delhi (challenging the award of the arbitral tribunal) against the M/s L&T Ltd. The sponsor has challenged the entire award awarded by the Arbitral Tribunal vide petition marked as OMP (Comm) 363/2022 before the High Court of Delhi. The amount challenged before the High Court of Delhi is ₹ 294.6 million. The matter is currently pending.

56. The sponsor has filed a petition before the High Court of Delhi challenging the award of the Arbitral Tribunal against TK Toll Pvt. Ltd. The Sponsor has challenged the entire award passed by the Arbitral Tribunal vide petition numbered OMP Comm 24/2023 before the Hon'ble High Court of Delhi. The amount challenged before the Hon'ble High Court of Delhi is ₹ 5870 million. The matter is currently pending.

57. The sponsor has filed a petition before the Hon'ble High Court of Delhi challenging the award of the Arbitral Tribunal against the GMR-HVEPL. The Sponsor has challenged the entire award passed by the Arbitral Tribunal vide petition numbered as O.M.P. (Comm) 319/2022 before the Hon'ble High Court of Delhi. The amount challenged before the Hon'ble High Court of Delhi is ₹ 16720 million. The matter is currently pending.

58. The sponsor has filed a petition before the Hon'ble High Court of Delhi challenging the award of the Arbitral Tribunal against the Jetpur Somnath Tollways Pvt. Ltd. The Sponsor has challenged the entire award passed by the Arbitral Tribunal vide petition numbered as OMP (Comm) 5/2022 before the Hon'ble High Court of Delhi. The amount challenged before the Hon'ble High Court of Delhi is ₹ 14817 million. The matter is currently pending.

59. The sponsor has filed a petition before the Hon'ble High Court of Delhi challenging the award of the Arbitral Tribunal against the M/s Surat Hazira NH-6 Tollway Pvt Ltd. The Sponsor has challenged the entire award passed by the Arbitral Tribunal vide petition numbered as OMP (Comm) 237/2021 before the Hon'ble High Court of Delhi. The amount challenged before the Hon'ble High Court of Delhi is ₹ 32327 million. The matter is currently pending.

Other material litigation

Considering the business and purpose of the Sponsor, it is imperative for the Sponsor to have an effective mechanism for the acquisition of land for building roads. Taking this need of the Sponsor into account, the parliament has enacted the NH Act, a special enactment which overrides the Land Acquisition Act, 1894 in cases where the land is acquired for the purposes of building National Highways. The Parliament has enacted the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013, which is applicable to land acquisitions under NH Act with effect from January 1, 2015 (i.e. one year from the date of commencement of the Act, subject to notification by Central Government). The process of acquiring land is a very cumbersome process and it leads to a large number of disputes. At present there are approximately 72,000 land acquisition cases pending before various Courts/Tribunals/Competent Authorities for adjudication.

VI. Litigations involving the Associates of the Sponsor

Except as disclosed below, as on the date of this Placement Document, there are no pending criminal or material litigations or regulatory actions involving the Associates of the Sponsor.

Sr. No	Name of Associate	Number of proceedings outstanding	Amount involved (₹ in million)
	Direct Tax		
1.	Paradip Port Road Company Limited	5	7.74
2.	Tuticorin Port Road Company Limited	3	1.97

Sr. No	Name of Associate	Number of proceedings outstanding	Amount involved (₹ in million)
3.	Vishakhapatnam Port Road Company Limited	3	1.73
4.	Calcatta Haldia Port Road Company Limited	3	-
5.	Mumbai JNPT Port Road Company Limited	2	-
6.	New Mangalore Port Road Company Limited	2	-
7.	Chennai Ennore Port Road Company Limited	1	-
8.	Ahmedabad Vadodara Expressway Company Limited	7	112.14

VII. Litigations involving the Project Manager

There are no pending criminal, regulatory or other material litigations involving the Project Manager as on the date of this Placement Document.

VIII. Litigations involving the Associates of the Project Manager

Please see the section entitled " – *Litigations involving the Associates of the Sponsor*" above.

IX. Litigations involving the Investment Manager

There are no pending criminal, regulatory or other material litigations involving the Investment Manager as on the date of this Placement Document.

X. Litigations involving the Associates of the Investment Manager

As the President of India is the Promoter of the Investment Manager, persons or entities that may be classified as 'associates' of the Investment Manager in terms of Regulation 2(1)(b)(ii) and Regulation 2(1)(b)(iii) of the InvIT Regulations, have not been identified as 'associates' of the Investment Manager. Consequently, information or disclosures required to be included with respect to such persons or entities pursuant to the InvIT Regulations has not been included in this Placement Document.

XI. Litigations involving the Trustee

1. SBICAP Trustee Company Limited (the "**Plaintiff**") had filed a suit before the City Civil Court, Bangalore against the Trustee and others (the "**Defendants**") requiring sale of pledged shares for a particular price by SREI Fund/Investors, for whom the Trustee was acting as the share pledge trustee. The Plaintiff was acting for a consortium of lenders and has residual interest. The aggregate claim amount is ₹1,550.30 million. The Trustee had filed an application seeking its removal from the suit and deletion of its name from the array of parties. Further, the Plaintiff had filed an interlocutory application before the City Civil Court, Bangalore ("Interlocutory Application") seeking recovery of complete residual dues received by the Defendants 2& 3 while selling the pledged shares, and which was dismissed. The Plaintiff has filed a writ petition before High Court of Karnataka challenging the dismissal of the Interlocutory Application, and the Trustee has not been impleaded as a party to such writ petition. The matter is currently pending.

2. Pursuant to receipt of information against Trustees Association of India and three of its members, *i.e.*, the Trustee, Axis Trustee Services Limited, and SBI CAP Trustee Company Limited (collectively, the "**Respondents**") for alleged contravention of Sections 3(3) and 4 of the Competition Act, 2002, *i.e.*, for entering into anti-competitive agreements and formation of cartel, the Competition Commission of India (the "**CCI**") passed an order dated December 23, 2021 under Section 26(1) of the Competition Act, 2002 directing the Director General to investigate the conduct of the Respondents and its office bearers for *prima facie* violating Section 3(1) read with Section 3(3) of the Competition Act, 2002.
   In response to the above order, the Respondents filed writ petitions before the High Court of Bombay challenging the jurisdiction of the CCI to decide the matter as SEBI is the sectoral regulator regulating the Respondents. The High Court of Bombay has directed CCI to decide on the jurisdictional issue. The Trustee had filed an application before the CCI for the same, and has subsequently filed additional written submissions before the CCI. The matter is currently pending.

3. R. K. Mohata Family Trust has filed a commercial suit before the High Court of Bombay against the Trustee praying for a meeting of the debenture holders of Reliance Home Finance Limited ("**RHFL**") to be held and also for damages worth ₹10.55 million from the Trustee. Pursuant to an order dated March 31, 2022 read with the orders dated April 6, 2022 and May 10, 2022 from the High Court of Bombay, the Trustee has convened a meeting of the debenture holders of RHFL and the results of the voting on matters taken up at such meeting have been placed before the High Court of Bombay. The matter is currently pending.

Further, pursuant to a special leave petition filed by Authum Investments & Infrastructure Limited **("AIIL")** before the Supreme Court of India, the Supreme Court of India had allowed the resolution plan submitted by AIIL and had directed AIIL to make the necessary payments within the prescribed period. AIIL has complied with such direction of the Supreme Court of India.
Subsequent to the above, a petition of contempt has been filed by Praduman Tandon and others against the order of the Supreme Court of India alleging that that the resolution plan and the distribution mechanism was not known. The matter is currently pending.

4. A suit was instituted before the Supreme Court of Mauritius (the "**Court**") in 2014 against Dynamic India Fund III ("**DIF III**"), International Financial Services Limited ("**IFS**"), ICICI Venture Funds Management Company Limited ("**ICICI Venture**"), ICICI Bank Limited ("**ICICI Bank**") and the Trustee (collectively, the "**Defendants**"), by certain investors of DIF III claiming damages to the tune of $103.69 million for the loss of their investments in DIF III.
The Defendants have raised various preliminary objections to the suit, including on the jurisdiction of the Court to decide on disputes involving non-residents of Mauritius. By way of an order dated June 9, 2020, the Court stayed the proceedings against ICICI Venture and ICICI Bank on the grounds that the allegations made against these entities did not take place in Mauritius and therefore, the Court lacked jurisdiction to adjudicate on such matters. Subsequently, the plaintiffs informed that the Court of their decision not to appeal against such order. Thereafter, by way of an order dated June 3, 2022, the Court deleted ICICI Venture and ICICI Bank from the array of parties involved in the suit, thereby allowing the suit to continue against DIF III, IFS and the Trustee. The plaintiffs have filed an appeal against the order dated June 3, 2022. ICICI Venture, the investment manager of DIF III, is handling and taking care of the matter on behalf of the Trustee, who was acting as a trustee to DIF III. The matter is currently pending.

5. In the matter involving Karvy Data Management Services Limited **("KDMSL")**, Pawan Kapoor and Amri Resorts Private Limited (in their capacities as debenture holders) filed a writ petition before the High Court of Delhi against the Trustee and others alleging certain non-compliances including inaction against KDMSL for defaults in payment of interest and principal. The High Court of Delhi has directed the Ministry of Corporate Affairs, Government of India to investigate the complaint and such investigation is ongoing. The matter is currently pending.

6. Kamalakar B. P ("Plaintiff") has filed declaratory civil suit before the Court of Civil Judge (Senior Division), Thane, pursuant to which the Trustee has received a notice dated July 28, 2023. The Plaintiff has sought for (i) declaration of deed of mortgage by a defendant to another in favour of the Trustee as void, illegal, invalid, non-est, not binding on the Plaintiff; (ii) permanent injunction from entering into the suit property, sale in auction and/ or agreeing to sell the suit property in auction; and (iii) temporary injunction from the sale of the suit property. Written statements and affidavit in reply have been filed before the court. The matter is currently pending.

7. CBM Constructions LLP, a holder of debentures issued by Three C Green Developers Private Limited, has filed a suit dated August 23, 2023 before the Senior Civil Judge cum RC, South East, Saket, New Delhi, praying for, inter alia, the Trustee to transfer pledged shares of certain defendants. The Trustee has complied with such prayer and filed an application for the deletion of its name from the array of parties. The matter is currently pending.

8. DSP Asset Managers Private Limited (the "**Plaintiff**") has filed a company application dated January 16, 2024 before the Mumbai Bench of the National Company Law Tribunal praying for condonation of delay in filing claims against Infrastructure Leasing & Financial Services Limited. The Trustee is acting as the debenture trustee in relation to certain debentures issued by IL&FS Transportations Networks Limited, a subsidiary of Infrastructure Leasing & Financial Services, and the Plaintiff has alleged that the Trustee has delayed in filing their claim with Grant Thornton (Bharat) LLP for admission. The Trustee is in the process of filing its written statement in response to the application. The matter is currently pending.

SECURITIES MARKET OF INDIA

The information in this section has been extracted from documents available on the website of SEBI and the Stock Exchange and has not been prepared or independently verified by the Parties to the InvIT or the Lead Managers or any of their respective affiliates or advisors.

The Indian Securities Market

India has a long history of organized securities trading. In 1875, the first stock exchange was established in Mumbai. BSE and NSE together hold a dominant position among the stock exchanges in terms of the number of listed companies, market capitalisation and trading activity.

Stock Exchange Regulation

Indian stock exchanges are regulated primarily by SEBI, as well as by the Government acting through the Ministry of Finance, Capital Markets Division, under the SCRA and the SCRR. SEBI, in exercise of its powers under the SCRA and the SEBI Act, notified Securities Contract (Regulation) (Stock Exchanges and clearing Corporations) Regulations, 2018 (the "**SCR (SECC) Regulations**"), which regulate *inter alia* the recognition, ownership and internal governance of stock exchanges and clearing corporations in India together with providing for minimum capitalisation requirements for stock exchanges. The SCRA, the SCRR and the SCR (SECC) Regulations along with various rules, bye-laws and regulations of the respective stock exchanges, regulate the recognition of stock exchanges, the qualifications for membership thereof and the manner, in which contracts are entered into, settled and enforced between members of the stock exchanges.

The SEBI Act empowers SEBI to regulate the Indian securities markets, including stock exchanges and intermediaries in the capital markets, promote and monitor self-regulatory organisations and prohibit fraudulent and unfair trade practices. Regulations concerning minimum disclosure requirements by public companies, rules and regulations concerning investor protection, insider trading, substantial acquisitions of shares and takeover of companies, buy-backs of securities, employee stock option schemes, stockbrokers, merchant bankers, underwriters, mutual funds, foreign institutional investors, credit rating agencies and other capital market participants have been notified by the relevant regulatory authority.

Listing and Delisting of Securities

The InvIT Regulations provide for listing and delisting of units of InvITs on and from the stock exchanges.

BSE

Established in 1875, it is the oldest stock exchange in India. In 1956, it became the first stock exchange in India to obtain permanent recognition from the Government under the SCRA. It has evolved over the years into its present status as one of the premier stock exchanges of India. Pursuant to the BSE (Corporatization and Demutualization) Scheme 2005 of SEBI, with effect from August 19, 2005, BSE was incorporated as a company under the Companies Act, 1956. The equity shares of BSE were listed on NSE on February 3, 2017.

NSE

NSE was established by financial institutions and banks to provide nationwide online, satellite-linked, screen-based trading facilities with market-makers and electronic clearing and settlement for securities including government securities, debentures, public sector bonds and units. It has evolved over the years into its present status as one of the premier stock exchanges of India. NSE was recognised as a stock exchange under the SCRA in April 1993 and commenced operations in the wholesale debt market segment in June 1994. The capital market (equities) segment commenced operations in November 1994 and operations in the derivatives segment commenced in June 2000.

Internet-based Securities Trading and Services

Internet trading takes place through order routing systems, which route client orders to exchange trading systems for execution. Stockbrokers interested in providing this service are required to apply for permission to the relevant stock exchange and also have to comply with certain minimum conditions stipulated by SEBI. NSE became the first exchange to grant approval to its members for providing internet-based trading services. Internet trading is possible on both the "equities" as well as the "derivatives" segments of NSE.

Trading Hours

Trading on both NSE and BSE occurs from Monday to Friday, between 9:15 a.m. and 3:30 p.m. 1ST (excluding the 15 minutes pre-open session from 9:00 a.m. to 9:15 a.m. that has been introduced recently). BSE and NSE are closed on public holidays. The recognised stock exchanges have been permitted to set their own trading hours (in the cash and derivatives segments) subject to the condition that (i) the trading hours are between 9.00 a.m. and 5.00 p.m.; and (ii) the stock exchange has in place a risk management system and infrastructure commensurate to the trading hours.

Trading Procedure

This totally automated screen based trading in securities was put into practice nationwide. This has enhanced transparency in dealings and has assisted considerably in smoothening settlement cycles and improving efficiency in back-office work. In the year 2004, BSE introduced its new generation trading platform, BOLT Plus.

NSE has introduced a fully automated trading system called National Exchange for Automated Trading ("**NEAT**"), which operates on strict time/price priority besides enabling efficient trade. NEAT has provided depth in the market by enabling large number of members all over India to trade simultaneously, narrowing the spreads.

Depositories

The Depositories Act provides a legal framework for the establishment of depositories to record ownership details and effect transfer in book-entry form. Further, SEBI framed regulations in relation to the registration of such depositories, the registration of participants as well as the rights and obligations of the depositories, participants, companies and beneficial owners. The depository system has significantly improved the operation of the Indian securities markets.

SELLING AND TRANSFER RESTRICTIONS

The distribution of this Placement Document and the offer, sale or delivery of the Units is restricted by law in certain jurisdictions. Persons who may come into possession of this Placement Document are advised to consult with their own legal advisors as to what restrictions may be applicable to them and to observe such restrictions. This Placement Document may not be used for the purpose of an offer or invitation in any circumstances. Due to the following restrictions, investors are advised to consult legal counsel prior to purchasing or subscribing to the Units or making any resale, pledge or transfer of the Units.

Republic of India

This Placement Document may not be distributed directly or indirectly in India or to residents of India and any Units may not be offered or sold directly or indirectly in India to, or for the account or benefit of, any resident of India except as permitted by applicable Indian laws and regulations.

The Units may not be offered or sold, directly or indirectly, and this Placement Document, any offering materials and any advertisements in connection with the offering of the Units may be distributed or published in or from any country or jurisdiction except under circumstances that will result in compliance with any applicable rules and regulations of any such country or jurisdiction. The Issue will be made in compliance with the applicable SEBI InvIT Regulations.

Australia

This Placement Document:

1. does not constitute a product disclosure document or prospectus under Chapter 6D.2 of the Corporations Act, 2001 (Cth) ("**Australian Corporations Act**");
2. has not been, and will not be, lodged with the Australian Securities and Investments Commission ("**ASIC**"), as a disclosure document for the purposes of the Corporations Act and does not purport to include the information required of a disclosure document under Chapter 6D of the Australian Corporations Act;
3. does not constitute or involve a recommendation to acquire, an offer or invitation for issue or sale, an offer or invitation to arrange the issue or sale, or an issue or sale, of interests to a "retail client" (as defined in section 761G of Australian Corporations Act and applicable regulations) in Australia; and
4. may only be provided in Australia to select investors who are able to demonstrate that they fall within one or more of the categories of investors, or Exempt Investors, available under section 708 of the Australian Corporations Act.

The Units may not be directly or indirectly offered for subscription or purchased or sold, and no invitations to subscribe for or buy the Units may be issued, and no draft or definitive Placement Document, advertisement or other offering material relating to any Units may be distributed in Australia, except where disclosure to investors is not required under Chapter 6D of the Australian Corporations Act or is otherwise in compliance with all applicable Australian laws and regulations. By submitting an application for the Units, you represent and warrant to us that you are an Exempt Investor.

As any offer of Units under this Placement Document will be made without disclosure in Australia under Chapter 6D.2 of the Australian Corporations Act, the offer of those securities for resale in Australia within 12 months may, under section 707 of the Australian Corporations Act, require disclosure to investors under Chapter 6D.2 if none of the exemptions in section 708 applies to that resale. By applying for the Units you undertake to the Trust, the Investment Manager and the Lead Managers that you will not, for a period of 12 months from the date of issue of the Units, offer, transfer, assign or otherwise alienate those securities to any person in Australia except in circumstances where disclosure to such person is not required under Chapter 6D.2 of the Australian Corporations Act or where a compliant disclosure document is prepared and lodged with ASIC.

British Virgin Islands

The Units are not being, and may not be offered to the public or to any person in the British Virgin Islands for purchase or subscription by or on the behalf. The Units may be offered to companies incorporated under the BVI Business Companies Act, 2004 (British Virgin Islands) (each a "**BVI Company**"), but only where the offer will be made to, and received by, the relevant BVI Company entirely outside of the British Virgin Islands.

The Placement Document has not been, and will not be, registered with the Financial Services Commission of the British Virgin Islands. No registered prospectus has been or will be prepared in respect of the Units for the purposes of the Securities and Investment Business Act, 2010 or the Public Issuers Code of the British Virgin Islands.

Canada

Units may be sold in Canada only to purchasers purchasing, or deemed to be purchasing, as principal that are both accredited investors, as defined in National Instrument 45-106 *Prospectus Exemptions* or subsection 73.3(1) of the *Securities Act* (Ontario), and are permitted clients, as defined in National Instrument 31-103 *Registration Requirements, Exemptions and Ongoing Registrant Obligations*. Any resale of the Units must be made in accordance with an exemption from, or in a

transaction not subject to, the prospectus requirements of applicable Canadian securities laws.

Securities legislation in certain provinces or territories of Canada may provide a purchaser with remedies for rescission or damages if this Placement Document (including any amendment hereto) contains a misrepresentation, provided that the remedies for rescission or damages are exercised by the purchaser within the time limit prescribed by the securities legislation of the purchaser's province or territory. The purchaser should refer to any applicable provisions of the securities legislation of the purchaser's province or territory for particulars of these rights or consult with a legal advisor.

Under Canadian securities laws, National Instrument 33-105 *Underwriting Conflicts* ("**NI 33-105**") provides disclosure requirements with respect to potential conflicts of interest between an issuer and underwriters, dealers or placement agents, as the case may be. To the extent any conflict of interest between us and any of the underwriters (or any other placement agent acting in connection with this offering) may exist in respect of this offering, the applicable parties to this offering are relying on the exemption from these disclosure requirements provided to them by section 3A.3 of NI 33-105 (Exemption based on U.S. disclosure).

Upon receipt of this Placement Document, each Canadian purchaser is hereby deemed to confirm that it has expressly requested that all documents evidencing or relating in any way to the sale of the Units described herein (including, for the avoidance of doubt, any purchase confirmation or any notice) be drawn up in the English language only.

Cayman Islands

No offer or invitation to subscribe for Units may be made to the public in the Cayman Islands to subscribe for any of the Units but an invitation or offer may be made to sophisticated persons (as defined in the Cayman Islands Securities Investment Business Law (the "**SIBL**"), high net worth persons (as defined in the SIBL) or otherwise in accordance with the SIBL.

Hong Kong

Each Lead Manager has represented, warranted and agreed that:

(i) it has not offered or sold and will not offer or sell in Hong Kong, by means of any document, any Units other than (a) to "professional investors" as defined in the Securities and Futures Ordinance (Cap. 571) of Hong Kong (the "**SFO**") and any rules made under the SFO; or (b) in other circumstances which do not result in the document being a "prospectus" as defined in the Companies (Winding Up and Miscellaneous Provisions) Ordinance (Cap. 32) of Hong Kong (the "**CWUMPO**") or which do not constitute an offer to the public within the meaning of the CWUMPO; and

(ii) it has not issued or had in its possession for the purposes of issue, and will not issue or have in its possession for the purposes of issue, whether in Hong Kong or elsewhere any advertisement, invitation or document relating to the Units, which is directed at, or the contents of which are likely to be accessed or read by, the public of Hong Kong (except if permitted to do so under the securities laws of Hong Kong), other than with respect to Units which are or are intended to be disposed of only to persons outside Hong Kong or only to "professional investors" as defined in the SFO and any rules made under the SFO.

Indonesia

The Units have not been, and will not be, registered with the Indonesia Financial Service Authority (Otoritas Jasa Keuangan or OJK) in Indonesia, and therefore, the Units may not be offered and/or sold within the territory of Indonesia or to Indonesian citizens or entities, wherever domiciled, or to Indonesian residents, in a manner which constitutes a public offering under Law No. 8 of 1995 on Capital Markets and the implementing regulations or private placement under OJK Regulation No. 30/POJK.04/2019 on the Privately Issued Debt-Linked Securities and/or Sukuk.

Japan

The Units offered hereby have not been and will not be registered under the Financial Instruments and Exchange Act of Japan (Law. No. 25 of 1948 as amended) (the "**FIEA**"). Accordingly, no Units have, directly or indirectly, been offered or sold, and may not, directly or indirectly, be offered or sold in Japan including for the benefit of any resident of Japan (which term as used herein means any person resident in Japan, including any corporation or other entity organised under the laws of Japan) or to others for re-offering or re-sale, directly or indirectly, in Japan or to, or for the benefit of, any resident of Japan, except pursuant to an exemption from the registration requirements of, and otherwise in compliance with, the FIEA and other relevant laws and regulations of Japan.

Kuwait

This Placement Document is not for general circulation to the public in Kuwait. The Units have not been licensed for offering in Kuwait by the Kuwait Capital Markets Authority or any other relevant Kuwaiti government agency. The offering of the Units in Kuwait on the basis a private placement or public offering is, therefore, restricted in accordance with Law No. 7 of 2010 and the bylaws thereto (as amended). No private or public offering of the Units is being made in Kuwait, and no agreement relating to the sale of the Units will be concluded in Kuwait. No marketing or solicitation or inducement activities are being used to offer or market the Units in Kuwait.

Malaysia

No prospectus or other offering material or document in connection with the offer and sale of the Units has been or will be registered with the Securities Commission of Malaysia ("**Commission**") for the Commission's approval pursuant to the Capital Markets and Services Act 2007. Accordingly, this Placement Document, and any other document or material in connection with the offer or sale, or invitation for subscription or purchase, of the Units may not be circulated or distributed, nor may the Units be offered or sold, or be made the subject of an invitation for subscription or purchase, whether directly or indirectly, to persons in Malaysia other than (i) a closed end fund approved by the Commission; (ii) a holder of a Capital Markets Services Licence; (iii) a person who acquires the Units, as principal, if the offer is on terms that the Units may only be acquired at a consideration of not less than RM250,000 (or its equivalent in foreign currencies) for each transaction; (iv) an individual whose total net personal assets or total net joint assets with his or her spouse exceeds RM3 million (or its equivalent in foreign currencies), excluding the value of the primary residence of the individual; (v) an individual who has a gross annual income exceeding RM300,000 (or its equivalent in foreign currencies) per annum in the preceding twelve months; (vi) an individual who, jointly with his or her spouse, has a gross annual income of RM400,000 (or its equivalent in foreign currencies), per annum in the preceding twelve months; (vii) a corporation with total net assets exceeding RM10 million (or its equivalent in a foreign currencies) based on the last audited accounts; (viii) a partnership with total net assets exceeding RM10 million (or its equivalent in foreign currencies); (ix) a bank licensee or insurance licensee as defined in the Labuan Financial Services and Securities Act 2010; (x) an Islamic bank licensee or takaful licensee as defined in the Labuan Financial Services and Securities Act 2010; and (xi) any other person as may be specified by the Commission; provided that, in the each of the preceding categories (i) to (xi), the distribution of the Units is made by a holder of a Capital Markets Services Licence who carries on the business of dealing in securities. The distribution in Malaysia of this Placement Document is subject to Malaysian laws. This Placement Document does not constitute and may not be used for the purpose of public offering or an issue, offer for subscription or purchase, invitation to subscribe for or purchase any securities requiring the registration of a prospectus with the Commission under the Capital Markets and Services Act 2007.

Mauritius

The Units may not be offered or sold, directly or indirectly, to the public in Mauritius. Neither this Placement Document nor any offering material or information contained herein relating to the offer of the Units may be released or issued to the public in Mauritius or used in connection with any such offer. This Placement Document does not constitute an offer to sell the Units to the public in Mauritius and is not a prospectus as defined under the Companies Act 2001.

New Zealand

This Placement Document is not a prospectus. It has not been prepared or registered in accordance with the Securities Act 1978 of New Zealand (the "**New Zealand Securities Act**"). This Placement Document is being distributed in New Zealand only to persons whose principal business is the investment of money or who, in the course of and for the purposes of their business, habitually invest money, within the meaning of section 3(2)(a)(ii) of the New Zealand Securities Act ("**Habitual Investors**"). By accepting this Placement Document, each investor represents and warrants that if they receive this Placement Document in New Zealand they are a Habitual Investor and they will not disclose this Placement Document to any person who is not also a Habitual Investor.

Singapore

This Placement Document has not been registered as a prospectus with the Monetary Authority of Singapore. Accordingly, this Placement Document and any other document or material in connection with the offer or sale, or invitation for subscription or purchase, of the Units may not be circulated or distributed, nor may the Units be offered or sold, or be made the subject of an invitation for subscription or purchase, whether directly or indirectly, to any person in Singapore other than (i) to an institutional investor (as defined in Section 4A of the Securities and Futures Act 2001 of Singapore as modified and amended from time to time (the "**SFA**")) pursuant to Section 274 of the SFA, (ii) to a relevant person (as defined in Section 275(2) of the SFA) pursuant to Section 275(1) of the SFA, or any person pursuant to Section 275(1A) of the SFA, and in accordance with the conditions specified in Section 275 of the SFA, or (iii) otherwise pursuant to, and in accordance with the conditions of, any other applicable provision of the SFA.

*Singapore SFA Product Classification: In connection with Section 309B of the SFA and the Securities and Futures (Capital Markets Products) Regulations 2018 of Singapore (the "**CMP Regulations 2018**"), the Trust has determined, and hereby notifies all relevant persons (as defined in Section 309A(1) of the SFA) that the Units are: 'prescribed capital markets products' (as defined in the CMP Regulations 2018) and Excluded Investment Products (as defined in MAS Notice SFA 04-N12: Notice on the Sale of Investment Products and MAS Notice FAAN16: Notice on Recommendations on Investment Products).*

South Korea

We are not making any representation with respect to the eligibility of any recipients of this document to acquire the Units therein under the laws of Korea, including, but without limitation, the Foreign Exchange Transaction Law and Regulations thereunder. The Units have not been and will not be registered under the Financial Investment Services and Capital Markets Act of Korea (the "**FSCMA**"). Accordingly, the Units may not be offered, sold or delivered, or offered or sold to any person for re-offering or resale, directly or indirectly, in Korea or to, or for the account or benefit of, any resident of Korea (as such

term is defined under the Foreign Exchange Transaction Law of Korea and its Enforcement Decree), for a period of one year from the date of issuance of the Units, except (i) where relevant requirements are satisfied, the Units may be offered, sold or delivered to or for the account or benefit of a Korean resident which falls within certain categories of qualified professional investors as specified in the FSCMA, its Enforcement Decree and the Regulation on Securities Issuance and Disclosure promulgated thereunder, or (ii) as otherwise permitted under applicable Korean laws and regulations.

Furthermore, the Units may not be re-sold to Korea residents unless the purchaser of the Units complies with all applicable regulatory requirements (including, but not limited to, governmental approval requirements under the Foreign Exchange Transaction Law and its subordinate decrees and regulations) in connection with purchase of the Units.

Taiwan

The Units have not and will not be registered with the Financial Supervisory Commission of Taiwan pursuant to relevant securities laws and regulations and may not be sold, issued or offered within Taiwan through a public offering or in circumstances which constitutes an offer within the meaning of the Securities and Exchange Act of Taiwan that requires a registration or approval of the Financial Supervisory Commission of Taiwan. No person or entity in Taiwan has been authorized to offer, sell, give advice regarding or otherwise intermediate the offering and sale of the Units in Taiwan.

United States of America

Each purchaser acknowledges and represents that:

i. it understands and agrees that the Units have not been and will not be registered under the Securities Act or with any securities regulatory authority of any state, territory or other jurisdiction of the United States and may not be offered, resold, pledged or otherwise transferred, except (1) in an offshore transaction complying with Rule 903 or Rule 904 of Regulation S, (2) pursuant to an exemption from the registration requirements of the Securities Act, or (3) pursuant to an effective registration statement under the Securities Act and (4) in accordance with all applicable securities laws of any state, territory or other jurisdiction of the United States;

ii. it understands that in the event Units are held in certificated form, such certificated Units will bear a legend substantially to the following effect:

"THE SECURITY EVIDENCED HEREBY HAS NOT BEEN AND WILL NOT BE REGISTERED UNDER THE UNITED STATES SECURITIES ACT OF 1933, AS AMENDED (THE "**SECURITIES ACT**"), ANY STATE SECURITIES LAWS IN THE UNITED STATES OR THE SECURITIES LAWS OF ANY OTHER JURISDICTION AND MAY NOT BE OFFERED, SOLD, PLEDGED OR OTHERWISE TRANSFERRED, EXCEPT: (A) IN AN OFFSHORE TRANSACTION IN ACCORDANCE WITH RULE 903 OR RULE 904 OF REGULATION S UNDER THE SECURITIES ACT; (B) PURSUANT TO AN EXEMPTION FROM THE REGISTRATION REQUIREMENTS OF THE SECURITIES ACT; OR (C) PURSUANT TO AN EFFECTIVE REGISTRATION STATEMENT UNDER THE SECURITIES ACT, IN EACH CASE IN ACCORDANCE WITH ANY APPLICABLE SECURITIES LAWS OF ANY STATE OF THE UNITED STATES. NO REPRESENTATION CAN BE MADE AS TO THE AVAILABILITY OF THE EXEMPTION PROVIDED UNDER THE SECURITIES ACT FOR RESALES OF THIS SECURITY.";

iii. any resale made other than in compliance with the above stated restrictions shall not be recognised by the Trust;

iv. it agrees that it will give to each person to whom it transfers Units notice of any restrictions on transfer of such Units; and

v. it acknowledges that the Trust, the Investment Manager, the Sponsor and the Lead Managers and others will rely upon the truth and accuracy of the foregoing acknowledgements, representations and agreements and agrees that, if any of such acknowledgements, representations or agreements deemed to have been made by virtue of its purchase of Units are no longer accurate, it will promptly notify the Trust, the Investment Manager, the Sponsor and the Lead Managers, and if it is acquiring any Units as a fiduciary or agent for one or more accounts, it represents that it has sole investment discretion with respect to each such account and that it has full power to make the foregoing acknowledgements, representations and agreements on behalf of each such account.

Other Jurisdictions

The distribution of Placement Document and the offer and sale of the Units may be restricted by law in certain jurisdictions. Persons into whose possession this Placement Document comes are required to inform themselves about, and to observe, any such restrictions to the extent applicable.

RIGHTS OF UNITHOLDERS

The rights and interests of Unitholders are included in this Placement Document and the InvIT Regulations. Under the Trust Deed and the Investment Management Agreement, these rights and interests are safeguarded by the Trustee and the Investment Manager, respectively. Any rights and interests of Unitholders as specified in this Placement Document would be deemed to be amended to the extent of any amendment to the InvIT Regulations.

Beneficial Interest

Each Unit represents an undivided beneficial interest in the Trust. A Unitholder has no equitable or proprietary interest in the InvIT Assets and is not entitled to transfer of the InvIT Assets (or any part thereof) or any interest in the InvIT Assets (or any part thereof) of the Trust. A Unitholder's right is limited to the right to require due administration of the Trust in accordance with the provisions of the Trust Deed and the Investment Management Agreement.

Ranking

No Unitholder of the Trust shall enjoy superior voting or any other rights over another Unitholder. Further, the Units shall not have multiple classes, except for any subordinate Units that may be issued only to the Sponsor and its Associates, where such subordinate units carry only inferior voting or any other rights compared to other Units in the future in accordance with Regulation 4(2)(h) of the InvIT Regulations.

Redressal of grievances

The Investment Manager shall ensure adequate and timely redressal of all Unitholders' grievances pertaining to the activities of the Trust, and the Trustee shall periodically review the status of Unitholders' complaints and their redressal undertaken by the Investment Manager. The Stakeholders' Relationship Committee of the Investment Manager shall monitor the status of complaints and their redressal, and maintain records of grievances and actions taken for the same. For details, please see the section entitled "*Corporate Governance*" on page 125.

Distribution

The Unitholders shall have the right to receive distribution in accordance with the InvIT Regulations, the Distribution Policy and in the manner provided in this Placement Document. For details, please see the section entitled "*Distribution*" on page 302.

Nominee Directors

Unitholder(s), holding not less than 10% of the total outstanding Units, either individually or collectively, shall be entitled to nominate one director on the board of directors of the Investment Manager. In this regard, we shall undertake the relevant actions in due course in accordance with the SEBI Circular dated September 11, 2023 entitled "SEBI/HO/DDHS-PoD-2/P/CIR/2023/153"and the InvIT Regulations. We have also adopted the Policy on Unitholder Nominee Directors on December 14, 2023, and such policy has been uploaded on the website of the Trust.

Meeting of Unitholders

Meetings of Unitholders will be conducted in accordance with the InvIT Regulations.

Passing of resolutions

1. With respect to any matter requiring approval of the Unitholders:

    (i). a resolution shall be considered as passed when the votes cast by Unitholders, so entitled and voting, in favour of the resolution exceed a certain percentage as specified in the InvIT Regulations, of votes cast against;

    (ii). the voting may be done by postal ballot or electronic mode;

    (iii). a notice of not less than 21 (twenty one) days shall be provided to the Unitholders;

    (iv). voting by any person who is a related party in such transaction, as well as associates of such person(s) shall not be considered on the specific issue; and

    (v). the Investment Manager shall be responsible for all the activities pertaining to conducting of meeting of the Unitholder, subject to oversight by the Trustee.

    However, for issues pertaining to the Investment Manager, including a change in Investment Manager, removal of Investment Manager or change in control of Investment Manager; the Trustee shall convene and handle all activities pertaining to conduct of the meetings. Additionally, for issues pertaining to the Trustee, including change in Trustee,

the Trustee shall not be involved in any manner in the conduct of the meeting.

2. For the Trust:

   (i). an annual meeting of all Unitholders shall be held not less than once a year within 120 days from the end of each financial year and the time between two meetings shall not exceed 15 months;

   (ii). with respect to the annual meeting of Unitholders,

      (a). any information that is required to be disclosed to the Unitholders and any issue that, in the ordinary course of business, may require approval of the Unitholders may be taken up in the meeting including:

         - latest annual accounts and performance of the Trust;
         - approval of auditors and fee of such auditors, as may be required;
         - latest valuation reports;
         - appointment of valuer, as may be required; and
         - any other issue;

      (b). for any issue taken up in such meetings which require approval from the Unitholders other than as specified in Regulation 22(6) of the InvIT Regulations and paragraph 4 below, votes cast in favour of the resolution shall be more than the votes cast against the resolution.

3. In case of the following, approval from the Unitholders shall be required where the votes cast in favour of the resolution shall be more than the votes cast against the resolution:

   (i). any approval from the Unitholders required in terms of Regulation 18 (*Investment conditions and dividend policy)*, Regulation 19 (*Related Party Transactions*) and Regulation 21 *(Valuation of assets*) of the InvIT Regulations;

   (ii). any borrowings, in excess of the limits specified under Regulation 20(3)(a) of the InvIT Regulations;

   (iii). any transaction, other than any borrowing, the value of which is equal to or greater than 25% (twenty five per cent) of the InvIT Assets;

   (iv). increasing period for compliance with investment conditions to one year in accordance with Regulation 18(5)(c) of the InvIT Regulations;

   (v). any issue, in the ordinary course of business, which in the opinion of the Sponsors or the Trustee or the Investment Manager, is material and requires approval of the Unitholders, if any; and

   (vi). any issue for which SEBI or the stock exchanges requires approval;

4. In case of the following, approval from the Unitholders shall be required where the votes cast in favour of the resolution shall not be less than one and a half times the votes cast against the resolution:

   (i). any change in Investment Manager including removal of the Investment Manager or change in control of the Investment Manager;

   (ii). the Trustee and Investment Manager proposing to seek delisting of units of the Trust under clause (e) of sub-regulation (1) of regulation 17 of the InvIT Regulations;

   (iii). any issue, not in the ordinary course of business, which in the opinion of the Sponsors or Investment Manager or Trustee requires approval of the Unitholders;

   (iv). any material change in investment strategy or any change in the management fees of the Trust;

   (v). any issue for which SEBI or the designated stock exchanges require approval;

   (vi). any issue taken up on request of the Unitholders including:

      (a). removal of the Investment Manager and appointment of another investment manager to the Trust;

      (b). removal of the Auditors and appointment of another auditors to the Trust;

      (c). removal of the Valuer and appointment of another valuer to the Trust;

(d). any issue which the Unitholders have sufficient reason to believe that is detrimental to the interest of the Unitholders;

(e). change in the Trustee, if Unitholders have sufficient reason to believe that acts of the Trustee are detrimental to the interest of Unitholders; and

(f). delisting of the Trust, if the Unitholders have sufficient reason to believe that such delisting would act in the interest of the Unitholders

With respect to the rights of the Unitholders under clause 4(vi) above:

(i). not less than 25% of the Unitholders by value, other than any party related to the transactions and its associates, shall apply, in writing, to the Trustee for the purpose;

(ii). on receipt of such application, the Trustee shall require, with the Investment Manager to place the issue for voting in the manner as specified in the InvIT Regulations;

(iii). with respect to clause 4(iv)(e) above, not less than 60% of the Unitholders by value shall apply, in writing, to the Trustee for the purpose.

5. In case of the following, approval from 75% of Unitholders by value shall be required:

(i) In case of any borrowing by the Trust in terms of limit specified in clause (b) of sub-regulation 3 of Regulation 20 of the InvIT Regulations;

(ii) In case that any person other than the Sponsor, its related parties and its associates, acquires Units of the Trust, which taken together with Units held by such person and by persons acting in concert with such persons in the Trust, exceeds 25% of the value of the outstanding Units of the Trust (value of Units held by parties related to the transaction shall not be considered for this specific purpose);

Provided that if the required approval is not received, the person acquiring the Units shall provide an exit option to the dissenting Unitholders to the extent and in the manner as may be specified by SEBI;

(iii) Prior to any change in Sponsor or inducted sponsor or change in control of Sponsor or inducted sponsor (value of Units held by parties related to the transaction shall not be considered for this specific purpose).

If the required approval is not received:

a. in case of change in Sponsor or inducted sponsor, the proposed inducted sponsor shall provide the dissenting Unitholders an option to exit by buying their units in the manner specified by SEBI; and

b. in case of change in control of the Sponsor or inducted sponsor, the said Sponsor or inducted sponsor shall provide the dissenting Unitholders an option to exit by buying their Units in the manner specified by SEBI.

Information rights

The Investment Manager, on behalf of the Trust, shall also submit such information to the Stock Exchange and Unitholders, on a periodical basis as may be required under the InvIT Regulations and the Listing Agreement entered into with the Stock Exchange. The Investment Manager (on behalf of the Trust) shall disclose to the Stock Exchange, Unitholders and SEBI, all such information and in such manner as specified under the InvIT Regulations and such other requirements as may be specified by SEBI. The Investment Manager, on behalf of the Trust, shall also provide disclosures or reports specific to the sector or sub-sector in which the Trust has invested or proposes to invest, in the manner as may be specified by SEBI.

Dispute Resolution

All claims, differences or disputes between the Unitholders and the Investment Manager arising out of or in relation to the activities of the Investment Manager in the securities market shall be submitted to a resolution mechanism that includes mediation and/or conciliation and/or arbitration, in accordance with the procedure specified by SEBI pursuant to the Master Circular for Online Resolution of Disputes in the Indian Securities Market dated July 31, 2023 issued by the SEBI and bearing reference number SEBI/HO/OIAE/OIAE_IAD-1/P/CIR/2023/145, as amended.

No loss or damage or expenses incurred by the investment manager or officers of the investment manager, including those in relation to resolution of claims or disputes of investors, shall be met out of the trust property.

The Investment Manager shall redress investor grievances within the timelines specified under the InvIT Regulations in the manner as specified by SEBI.

Buy-back, Listing and Delisting of Units

Any buy-back, listing or delisting of Units, shall be in accordance with the Trust Deed and the InvIT Regulations.

ISSUE STRUCTURE

An issue through a private placement of 497,926,000* Units by way of an institutional placement, for cash at price at Issue Price of ₹ 124.14 per Unit aggregating up to approximately ₹ 61,812.53 * million by the Trust. This Issue constitutes at least 37.95% of the total outstanding Units on a post-Offer basis.

** The IM Board by way of its resolution dated February 10, 2024 and the Unitholders of the Trust by way of their resolution dated March 4, 2024, have approved the Issue of upto 497,926,090 Units at or above ₹ 122.86 per Unit ("**Base Price**"). The Trust proposes to undertake the issue of up to 117,159,080 Units to the Sponsor, on a preferential basis ("**Preferential Issue**"), in accordance with the SEBI Institutional Placement Guidelines and the InvIT Regulations. The Unitholders by way of a resolution dated March 4, 2024 have approved the Preferential Issue. The Sponsor, by way of its letter dated March 6, 2024, has confirmed its willingness to subscribe to atleast 87,869,310 Units, at a base offer price of ₹ 122.86 per Unit plus premium payable, if any. Further, the Sponsor, by way of its letter dated March 14, 2024 has agreed to subscribe to 87,869,400 Units at a price of ₹ 124.14 per Unit pursuant to the Preferential Issue.*

Particulars	Details
Number of Units available for Allotment/allocation	497,926,000 Units^
Floor Price	₹ 124* per Unit
Issue Price	₹ 124.14 per Unit
Maximum Bid	Such number of Units not exceeding the size of this Issue, subject to applicable limits(1)
Mode of Allotment	Compulsorily in dematerialised form
Bid Lot/ Minimum Bid Size	A minimum of 21,19,000 Units and in multiples of 10 Units thereafter
Allotment Lot	A minimum of 21,19,000 Units, and in multiples of 10 Units thereafter
Trading Lot(2)	Upon listing, such number of Units, the value of which is, or exceeds, ₹ 20 million
Who can apply	Institutional Investors
Terms of Payment	Entire Bid Amount shall be payable at the time of submission of the Application Form(1)

* *Bids were required to be made for Units at a price that is at or above the floor price. Please note that Bids below the Floor Price were liable to be rejected.*

^ ** The IM Board by way of its resolution dated February 10, 2024 and the Unitholders of the Trust by way of their resolution dated March 4, 2024, have approved the Issue of upto 497,926,090 Units at or above ₹ 122.86 per Unit ("**Base Price**"). The Trust proposes to undertake the issue of up to 117,159,080 Units to the Sponsor, on a preferential basis ("**Preferential Issue**"), in accordance with the SEBI Institutional Placement Guidelines and the InvIT Regulations. The Unitholders by way of a resolution dated March 4, 2024 have approved the Preferential Issue. The Sponsor, by way of its letter dated March 6, 2024, has confirmed its willingness to subscribe to atleast 87,869,310 Units, at a base offer price of ₹ 122.86 per Unit plus premium payable, if any. Further, the Sponsor, by way of its letter dated March 14, 2024 has agreed to subscribe to 87,869,400 Units at a price of ₹ 124.14 per Unit pursuant to the Preferential Issue.*

(1) In case of joint Bids, the Application Form was required to contain only the name of the First Bidder whose name should also appear as the first holder of the beneficiary account held in joint names. The signature of only the First Bidder would be required in the Application Form and such First Bidder would be deemed to have signed on behalf of the joint holders. Bidders were advised to consult their own advisors with respect to any restrictions or limitations that may be applicable to them, including any restrictions or limitations in relation to their ability to invest in the Units. By making a Bid (including any revision thereof), the Bidder will be deemed to have represented to the Investment Manager, the Trustee, the Lead Managers and the Lead Managers that it was eligible to participate in the Issue and be Allotted Units under applicable law.

(2) The trading lot shall be as prescribed under the InvIT Regulations and other applicable law, from time to time.

Indicative Issue Timeline

Event	Indicative Date
Bid/ Issue Opening Date	Tuesday, March 12, 2024
Bidders were required to submit completed Application Forms	Bid/ Issue Period
Bid/ Issue Closing Date	Wednesday, March 13, 2024
Dispatch of CANs to successful Bidders	On or about Friday, March 15, 2024
Closing Date	On or about Friday, March 15, 2024
Designated Date	On or about Friday, March 15, 2024
Initiation of refunds, if any, in excess of the amount which was required to be paid by such Bidder pursuant to the Units Allocated to such Bidder	On or about Friday, March 15, 2024
Listing Date	On or about Tuesday, March 19, 2024

The above timetable is indicative and does not constitute any obligation or liability on the Trust, the Investment Manager, the Trustee or the Lead Managers.

While the Investment Manager shall ensure that all steps for the completion of the necessary formalities for the listing and the commencement of trading of the Units on the Stock Exchanges are completed within 2 Working Days from the date of Allotment, the timetable may change due to various factors, such as, any delay in receiving the final listing and trading approvals from the Stock Exchanges. The commencement of trading of the Units will be entirely at the discretion of the Stock Exchanges and in accordance with applicable law.

ISSUE PROCEDURE

The following is a summary intended to present a general outline of the procedure relating to the application, payment of Application Amount, Allocation and Allotment of the Units. The procedure followed in the Issue may differ from the one mentioned below and investors are assumed to have apprised themselves of the same from the Investment Manager or the Lead Managers. Investors are advised to inform themselves of any restrictions or limitations that may be applicable to them and are required to consult their respective advisors in this regard. Investors that apply in the Issue will be required to confirm, and will be deemed to have represented to us, the Trustee, the Investment Manager, the Lead Managers and their respective directors, officers, agents, advisors, affiliates and representatives, that they are eligible under all applicable law, rules, regulations and guidelines to bid for, acquire and hold the Units in the Issue. For further details please see the section entitled "Selling and Transfer Restrictions" on page 331. The Trust, the Investment Manager, the Trustee, the Lead Managers and their respective directors, officers, agents, advisors, affiliates and representatives accept no responsibility or liability for advising any investor on whether such investor is eligible to bid for, acquire or hold the Units in the Issue. The Trustee or the Investment Manager are acting on behalf of the Trust.

The Trust, the Investment Manager, the Trustee, the Lead Managers and their respective directors, officers, agents, advisors, affiliates and representatives are not liable for any amendment or modification or change to applicable laws or regulations, which may occur after the date of this Placement Document. Investors are advised to make their independent investigations and satisfy themselves that they are Eligible Investors and are eligible to apply in the Issue. Eligible Investors are advised to ensure that any single Bid from them does not exceed the investment limits or maximum number of Units that can be held by them under applicable law or regulation or as specified in this Placement Document. Further, Eligible Investors shall be solely responsible for compliance with applicable securities laws, including the SEBI (Prohibition of Insider Trading) Regulations, 2015 and the UPSI Policy, other applicable law and dealing in securities of the Trust.

Authority for the Issue

THE PRELIMINARY PLACEMENT DOCUMENT AND THIS PLACEMENT DOCUMENT RELATE TO AN ISSUE BEING MADE ONLY TO ELIGIBLE INVESTORS AND NO ISSUE IS BEING MADE TO THE PUBLIC OR TO ANY OTHER CLASS OF INVESTORS.

This Placement Document has not been, and will not be, filed as a prospectus with SEBI and, no Units will be offered in India or overseas to the public or any members of the public or any other class of investors, other than Eligible Investors.

The Issue is being made to Eligible Investors in reliance upon the SEBI Institutional Placement Guidelines and the InvIT Regulations, through the mechanism of institutional placement. The Trust is eligible to undertake the Issue under the SEBI Institutional Placement Guidelines and the InvIT Regulations.

The Preliminary Placement Document and this Placement Document are private documents provided only to select Eligible Investors. Please note that if you did not receive a serially numbered copy of the Preliminary Placement Document addressed to you, you may not rely on the Preliminary Placement Document or this Placement Document uploaded or to be uploaded, as applicable, on the website of the Stock Exchanges or the Trust, with a disclaimer to the effect that it is in connection with an institutional placement and that no offer is being made to the public or to any other category of investors, for making an application to subscribe to Units pursuant to the Issue.

The Issue was authorized and approved by the Board of Directors of the Investment Manager on February 10, 2024 and approved by the Unitholders on March 4, 2024.

Units being Allotted pursuant to the Issue shall not be sold for a period of one year from the date of Allotment, except on a recognized stock exchange.

The Units offered in the Issue have not been, and will not be, registered under the U.S. Securities Act or any other applicable law of the United States and may not be offered or sold within the United States, except pursuant to an exemption from, or in a transaction not subject to, the registration requirements of the U.S. Securities Act and applicable state securities laws. Accordingly, the Units are only being offered and sold outside the United States in an "offshore transaction" as defined in and in compliance with Regulation S under the U.S. Securities Act and the applicable laws of the jurisdiction where those offers and sales occur. For further information, please see the section entitled "*Selling and Transfer Restrictions*" on page 331.

The Units have not been and will not be registered, listed or otherwise qualified in any other jurisdiction outside India and may not be offered or sold, and Bids may not be made by persons in any such jurisdiction, except in compliance with the applicable laws of such jurisdiction.

The Investment Manager has filed a copy of the Preliminary Placement Document and the Placement Document with each of the Stock Exchanges. The Trust has received in-principle approval dated March 11, 2024 from each of the Stock Exchanges under the SEBI Institutional Placement Guidelines.

After the Allotment of Units pursuant to the Issue, the Investment Manager shall make applications to the Stock Exchanges for the listing approvals. Subsequently, after the credit of Units to the beneficiary accounts of the Allottees, the Investment

Manager shall make applications to the Stock Exchanges for the final trading approvals.

Disclaimer of the Stock Exchanges

Stock Exchanges do not in any manner:

1. warrant, certify or endorse the correctness or completeness of the contents of this Placement Document;

2. warrant that the Units issued pursuant to the Issue will be listed or will continue to be listed on the Stock Exchanges; or

3. take any responsibility for the financial or other soundness of National Highways Infra Trust, its management or any scheme or project of National Highways Infra Trust.

It should not for any reason be deemed or construed to mean that this Placement Document has been cleared or approved by the Stock Exchanges. Every person who desires to apply for or otherwise acquire any Units may do so pursuant to an independent inquiry, investigation and analysis and shall not have any claim against the Stock Exchanges whatsoever by reason of any loss which may be suffered by such person consequent to or in connection with such subscription/acquisition whether by reason of anything stated or omitted to be stated herein or for any other reason whatsoever.

Issue Procedure

1. On the Issue Opening Date, the Lead Managers had electronically circulated serially numbered copies of the Preliminary Placement Document and the serially numbered Application Form, to Eligible Investors and the Application Form was specifically addressed to each such Eligible Investor. The Lead Managers maintained a record of the Eligible Investors to whom a serially numbered Preliminary Placement Document and Application Form had been dispatched. The Lead Managers have made and will make the requisite filings with SEBI within the stipulated time periods as required under the SEBI Institutional Placement Guidelines. The list of Eligible Investors to whom the serially numbered copies of the Preliminary Placement Document and the Application Form have been circulated has been determined by the Investment Manager in consultation with the Lead Managers.

2. **Unless a serially numbered Preliminary Placement Document along with the serially numbered Application Form, which included the details of the bank account where the Application Amount is to be deposited, was addressed to a particular Eligible Investor, no invitation to make an offer to subscribe shall be deemed to have been made to such Eligible Investor.** Even if such documentation were to come into the possession of any person other than the intended recipient, no offer or invitation to offer shall be deemed to have been made to such person and any application that does not comply with this requirement shall be treated as invalid.

3. Eligible Investors were required to submit the Application Form, including any revisions thereof along with the Application Amount and a copy of the PAN card or PAN allotment letter, during the Issue Period to the Lead Managers.

4. Bidders were required to indicate the following in the Application Form:

    - full official name of the Bidder to whom Units were to be Allotted, complete address, phone number, PAN, e-mail address and bank account details;

    - number of Units Bid for;

    - category to which they belong to, as indicated in the Application Form;

    - price at which they are agreeable to subscribe for the Units (which shall not be less than the Floor Price) and the aggregate Application Amount for the number of Units Bid for;

    - details of the depository account to which the Units should be credited;

    - it has agreed to certain other representations set forth in the Application Form and the Preliminary Placement Document;

    - Eligible FPIs are required to indicate their SEBI FPI registration number in the Application Form; and

    - a representation that they are outside the United States and acquiring the Units in an "offshore transaction" as defined in and in compliance with Regulation S and the applicable laws of the jurisdiction where those offers and sales occur and they have agreed to certain other representations set forth in the section entitled "*Notice to Investors*" on page 1, and certain other representations made in the Application Form.

5. Each Bidder was required to make the entire payment of the Application Amount for the Units Bid for, along with the Application Form, only through electronic transfer to the Escrow Account within the Issue Period as specified in the Application Form sent to the respective Bidders. Please note that any payment of Application Amount for the

Units was to made from the bank accounts of the relevant Bidders and the Investment Manager had to keep a record of the bank account from where such payment had been received. Application Amount payable on Units to be held by joint holders was to be paid from the bank account of the person whose name appeared first in the Application Form. Pending Allotment, the Trustee and the Investment Manager were to ensure that the Application Amount received for subscription of the Units is kept in a separate bank account in the name of Trust and shall only be utilized for adjustment against allotment of Units or refund of money to the Bidders till the time such Units are listed. Notwithstanding the above, in the event, among others, a Bidder is not Allocated Units in the Issue, or a Bidder withdraws the Bid prior to the Issue Closing Date or the number of Units Allocated to the Bidder is lower than the number of Units applied for through the Application Form and towards which Application Amount has been paid by such Bidder, or the Application Amount is in excess of the amount equivalent to the product of the Units that have been Allocated to the Bidder and the Issue Price, the excess Application Amount were to be and will be refunded to the same bank account from which it was remitted, in the form and manner set out in the section entitled "- *Refunds*" below.

6. Once a duly completed Application Form was submitted by a Bidder and the Application Amount was transferred to the Escrow Account, such Application Form constitutes an irrevocable offer and the Bid cannot be withdrawn or revised downwards after the Issue Closing Date. In case of an upward revision before the Issue Closing Date, an additional amount was to be required to be deposited towards the Application Amount in the Escrow Account along with the submission of such revised Bid. The Issue Closing Date was notified to the Stock Exchanges and the Eligible Investors shall be deemed to have been given notice of such date after receipt of the Application Form.

7. The Bids to be made by asset management companies or custodians of Mutual Funds shall specifically state the names of the concerned schemes for which the Bids were made. In case of a Mutual Fund, a separate Bid were to be made in respect of each scheme of the Mutual Fund registered with SEBI.

8. Each FPI was required to submit a separate Application Form.

9. Upon receipt of the duly completed Application Form and the Application Amount in the Escrow Account, after the Issue Closing Date, the Investment Manager, in consultation with the Lead Managers, determined the final terms, including the Issue Price of the Units to be issued pursuant to the Issue and Allocation and the successful Bidders to whom such Units have been Allocated. Upon such determination, the Lead Managers, on behalf of the Trust, have sent serially numbered CANs to the successful Bidders who have been Allocated Units in the Issue. The dispatch of a CAN, and this Placement Document to a successful Bidder is deemed to be a valid, binding and irrevocable contract for successful Bidders to subscribe to the Units Allocated to such Bidders at an aggregate price equal to the product of the Issue Price and Units Allocated to such Bidders. The CAN contains details such as the number of Units Allocated to the successful Bidders, Issue Price and the aggregate amount received towards the Units Allocated. Please note that the Allocation is at the absolute discretion of the Investment Manager in consultation with the Lead Managers.

10. Upon determination of the Issue Price and the issue of CAN and before Allotment of Units to successful Bidders, the Lead Managers, have, on behalf of the Trust, sent a serially numbered Placement Document to each successful Bidder that has been Allocated Units.

11. Upon dispatch of the serially numbered Placement Document, the Investment Manager shall Allot Units as per the details in the CANs sent to successful Bidders. The Investment Manager will inform the Stock Exchanges of the details of the Allotment.

12. After passing the resolution for Allotment and prior to the credit of Units into the beneficiary account of the successful Bidders maintained by the depository participant, the Investment Manager shall apply to the Stock Exchanges for listing approvals in respect of the Units Allotted pursuant to the Issue.

13. After receipt of the listing approvals from the Stock Exchanges, the Investment Manager shall ensure credit of the Units Allotted pursuant to the Issue into the beneficiary accounts of the respective Allottees.

14. The Investment Manager will then apply for the final trading approvals from the Stock Exchanges.

15. The Units that would have been credited to the beneficiary account with the Depository Participant of the successful Bidders shall be eligible for trading on the Stock Exchanges only upon the receipt of final trading and listing approvals from the Stock Exchanges.

16. As per applicable law, the Stock Exchanges will notify the final listing and trading approvals, which are ordinarily available on their websites, and the Investment Manager may communicate the receipt of the listing and trading approvals to the Allottees. The Investment Manager, the Trust, the Trustee and the Lead Managers shall not be responsible for any delay or non-receipt of the communication of the final trading and listing permissions from the Stock Exchanges or any loss arising from such delay or non-receipt. Investors are advised to apprise themselves of the status of the receipt of the permissions from the Stock Exchanges.

Institutional Investors

Only Eligible Investors are eligible to invest in the Units pursuant to the Issue. Currently, Eligible Investors, being '*institutional investors*', are eligible to participate in the Issue. Regulation 2(1)(ya) of the InvIT Regulations and the SEBI Institutional Placement Guidelines define '*institutional investors*' to mean:

- a qualified institutional buyer; or
- family trust or systematically important NBFCs registered with Reserve Bank of India or intermediaries registered with the SEBI, all with net-worth of more than five hundred crore rupees, as per their last audited financial statements.

Further, Regulation 2(1)(ss) of the SEBI ICDR Regulations define '*qualified institutional buyer*' to mean

- a mutual fund, venture capital fund, alternative investment fund and foreign venture capital investor registered with the SEBI;
- a foreign portfolio investor other than individuals, corporate bodies and family offices;
- a public financial institution;
- a scheduled commercial bank;
- a multilateral and bilateral development financial institution;
- a state industrial development corporation;
- an insurance company registered with the Insurance Regulatory and Development Authority of India;
- a provident fund with minimum corpus of ₹25 crore;
- a pension fund with minimum corpus of ₹25 crore registered with the Pension Fund Regulatory and Development Authority established under sub-section (1) of section 3 of the Pension Fund Regulatory and Development Authority Act, 2013;
- National Investment Fund set up by resolution no. F. No. 2/3/2005-DDII dated November 23, 2005 of the Government of India published in the Gazette of India;
- insurance funds set up and managed by army, navy or air force of the Union of India;
- insurance funds set up and managed by the Department of Posts, India; and
- systemically important non-banking financial companies.

Eligible FPIs are permitted to participate in the Issue in accordance with the FEMA Rules read with applicable provisions of the Foreign Exchange Management (Mode of Payment and Reporting of Non-Debt Instruments) Regulations, 2019 and other applicable foreign exchange laws and such other terms and conditions as may be prescribed by the SEBI from time to time.

Restriction on Allotment

Pursuant to paragraph 7.11.2 of the SEBI Institutional Placement Guidelines, allotment in the Issue shall not be made, either directly or indirectly, to an institutional investor who is our Sponsor or Investment Manager, or is a person related to or a related party or associate (as defined under the InvIT Regulations) of any of the Sponsor or the Investment Manager, provided that allotment of units can be made to the Sponsor for un-subscribed portion in the Issue subject to following conditions:

a. at least ninety percent of the Issue Size has been subscribed;
b. objects of the Issue is acquisition of assets from the Sponsor;
c. units allotted to Sponsor shall be locked in as per paragraph 7.6 of Chapter 7 of the SEBI Institutional Placement Guidelines;
d. unitholders approval shall be taken for unsubscribed portion being allotted to Sponsor.

No Allotment shall be made pursuant to Bids submitted by Eligible Investors such that the Bid or subscription to the Units by the investor would result in acquisition of Units which, taken together with Units already held by such investor and any person acting in concert with such investor in the Trust, would exceed 25% of the value of the post Issue outstanding units of the Trust.

The Trustee, or the Valuer or an employee of the Valuer involved in the valuation of the Project SPVs or the assets proposed to be acquired out of the proceeds of the Issue are not permitted to invest in the Units.

Affiliates or associates of the Lead Managers, who are Eligible Investors, may participate in the Issue in compliance with applicable laws.

Bid Process

Application Form

Eligible Investors were required to only use the serially numbered Application Forms (which were addressed to them) supplied by the Lead Managers electronially for the purpose of making a Bid (including revision of a Bid) in terms of the Preliminary Placement Document.

By making a Bid (including any revision thereof) for Units through Application Forms and pursuant to the terms of this Placement Document, the Eligible Investors were deemed to have made the following representations, warranties, acknowledgements, and undertakings given or made under the sections entitled "*Notice to Investors* and "*Selling and Transfer Restrictions*" on pages 1 and 331, respectively:

- The Eligible Investor confirmed that it is an Institutional Investor and is not prohibited under paragraph 7.11.2 of the SEBI Institutional Placement Guidelines from participating in the Issue, has a valid and existing registration under the applicable law in India (to the extent applicable) and is eligible to participate in the Issue;

- The Eligible Investor acknowledged that it had no right to withdraw or revise its Bid after the Issue Closing Date;

- The Eligible Investor confirmed that if Units are Allotted through the Issue, it shall not, for a period of one year from Allotment, sell such Units otherwise than on the Stock Exchanges;

- The Eligible Investor confirmed that it was eligible to Bid and hold Units so Allotted together with any Units already held by it prior to the Issue. The Eligible Investor further confirms that its holding of the Units, does not and shall not, exceed the level permissible as per any applicable law applicable to the Eligible Investor;

- The Eligible Investor agreed that although the Application Amount is required to be paid by it along with the Application Form within the Issue Period, the Investment Manager (on behalf of the Trust) reserves the right to Allocate and Allot Units pursuant to the Issue on a discretionary basis in consultation with the Lead Managers. The Eligible Investor further acknowledged and agreed that the payment of Application Amount does not guarantee Allocation and/or Allotment of Units Bid for in full or in part;

- The Eligible Investor confirmed that the Bid submitted by it or its subscription to the Units would not result in acquisition of Units which taken together with Units already held by it and any person acting in concert with it in the Trust exceeding 25% of the value of the outstanding units of the Trust;

- The Eligible Investor confirmed that it is outside the United States, and is acquiring the Units in an "offshore transaction" as defined in and in compliance with Regulation S and the applicable laws of the jurisdiction where those offers and sales occur, and is not our affiliate or a person acting on behalf of such an affiliate;

- The Eligible Investor acknowledged that no Allocation shall be made to it if the price at which it has Bid for in the Issue is lower than the Floor Price; and

- The Eligible Investor confirmed that it shall not undertake any trade in the Units credited to its beneficiary account maintained with the Depository Participant until such time that the final listing and trading approvals for the Units are issued by the Stock Exchanges.

Further, in accordance with Press Note No. 3 (2020 Series), dated April 17, 2020, issued by the Department for Promotion of Industry and Internal Trade, Government of India, investments where the beneficial owner of the Units is situated in or is a citizen of a country which shares land border with India, can only be made through the Government approval route, as prescribed in the FDI Policy.

ELIGIBLE INSTITUTIONAL INVESTORS WERE REQUIRED TO PROVIDE THEIR NAME, E-MAIL ID, BENEFICIARY ACCOUNT DETAILS, PAN, NATIONALITY, DEPOSITORY PARTICIPANT'S NAME, COMPLETE ADDRESS, DEPOSITORY PARTICIPANT IDENTIFICATION NUMBER AND BENEFICIARY ACCOUNT NUMBER IN THE APPLICATION FORM. ELIGIBLE INVESTORS ENSURED THAT THE NAME GIVEN IN THE APPLICATION FORM WAS EXACTLY THE SAME AS THE NAME IN WHICH THEIR BENEFICIARY ACCOUNT IS HELD.

IF SO REQUIRED BY THE LEAD MANAGERS, THE ELIGIBLE INVESTORS SUBMITTING A BID, ALONG WITH THE APPLICATION FORM, WILL ALSO HAVE TO SUBMIT REQUISITE DOCUMENT(S) TO THE LEAD MANAGERS TO EVIDENCE THEIR STATUS AS AN "INSTITUTIONAL INVESTOR" AS SET OUT ABOVE.

IF SO REQUIRED BY THE LEAD MANAGERS, ESCROW AGENT OR ANY STATUTORY OR REGULATORY

AUTHORITY IN THIS REGARD, INCLUDING AFTER ISSUE CLOSURE, THE ELIGIBLE INVESTORS WHO HAD SUBMITTED A BID AND/OR WERE ALLOTTED UNITS IN THE ISSUE, WILL ALSO HAVE TO SUBMIT REQUISITE DOCUMENT(S) TO FULFILL THE KNOW YOUR CUSTOMER (KYC) NORMS.

Demographic details such as address and bank account will be obtained from the Depositories as per the Depository Participant account details provided in the Application Form.

The submission of an Application Form and payment of the Application Amount pursuant to the Application Form by a Bidder shall be deemed a valid, binding and irrevocable offer for such Bidder to pay the entire Issue Price for the Units that may be Allotted to such Bidder and shall become a binding contract on a successful Bidder upon issuance of the CAN and this Placement Document (when dispatched) by the Investment Manager in favour of the successful Bidder.

Submission of Application Form

All Application Forms were to be duly completed with information including the number of Units applied for along with payment and a copy of the PAN card or PAN allotment letter. Additionally, the Application Form will include details of the relevant Escrow Account into which the Application Amounts will have to be deposited were included in the Application Form. The Application Amount would be deposited in the Escrow Account as was specified in the Application Form and the Application Form was to be submitted to the Lead Managers either through electronic form or through physical delivery at any of the following addresses:

SBI CAPITAL MARKETS LIMITED
1501, 15th Floor, A & B Wing,
Parinee Crescenzo Building, G Block,
Bandra Kurla Complex, Bandra (East),
Mumbai – 400 051
Tel: +91 22 4196 8300
E-mail: nhaiinvit@sbicaps.com
Investor Grievance E-mail: investor.relations@sbicaps.com
Contact Person: Mandeep Singh
Website: www.sbicaps.com
SEBI Registration Number: INM000003531

AXIS CAPITAL LIMITED
1st Floor, Axis House
Wadia International Centre
Pandurang Budhkar Marg, Worli
Mumbai 400 025
Maharashtra, India
Tel: +91 22 4325 2183
E-mail: nhaiinvit@axiscap.in
Investor Grievance E-mail: compliants@axiscap.com
Contact Person: Harish Patel/ Akash Aggarwal
Website: www.axiscapital.co.in
SEBI Registration Number: INM000012029

ICICI SECURITIES LIMITED
ICICI Venture House,
Appasaheb Marathe Marg,
Prabhadevi, Mumbai – 400 025,
Maharashtra, India
Tel: +91 22 6807 7100
E-mail: nhitinvit@icicisecurities.com
Investor Grievance E-mail: customercare@icicisecurities.com
Contact Person: Sumit Singh/ Rupesh Khant
Website: www.icicisecurities.com
SEBI Registration Number: INM000011179

The Lead Managers, the Trustee and the Investment Manager shall not be required to provide any written acknowledgement of the receipt of the Application Form and the Application Amount.

All Bidders submitting a Bid in the Issue were to pay the entire Application Amount during the Issue Period.

Payment of Application Amount

The Investment Manager had opened the Escrow Account with the Escrow Agent, in terms of the Escrow Agreement. Bidders were required to deposit the entire Application Amount payable for the Units applied for through the Application Form submitted by it in accordance with the applicable laws.

Payments were to be made only through electronic fund transfer.

Payments through cheque, demand draft or cash shall be rejected.

If the payment was not made favouring the Escrow Account within the Issue Period stipulated in the Application Form, the Bid was liable to be rejected.

Permanent Account Number or PAN

Each Bidder had to mention its PAN allotted under the Income Tax Act, 1961 in the Application Form. Applications without this information were considered incomplete and were liable to be rejected, except from Bidders who are not required to hold a PAN under applicable law. The GIR number instead of the PAN was not to be submitted by the Bidders as the Application Form was liable to be rejected.

Bank Account Details

Each Bidder had to mention the details of the bank account from which the payment of Application Amount has been made along with confirmation that such payment has been made from such account.

Pricing and Allocation

Build-up of the Book

The Eligible Investors were to submit their Bids (including any revision thereof) through the Application Forms within the Issue Period to the Lead Managers. Such Bids cannot be withdrawn or revised after the Issue Closing Date. The book shall be maintained by the Lead Managers.

Price Determination and Allocation

The Investment Manager, in consultation with the Lead Managers, has determined the Issue Price, which is at or above the Floor Price.

After finalisation of the Issue Price, the Investment Manager has updated the Preliminary Placement Document with the Issue Price details and has filed this Placement Document with the Stock Exchanges.

Method of Allocation

The Investment Manager has determined the Allocation in consultation with the Lead Managers on a discretionary basis in accordance with the allocation methodology approved by the board of Directors of the Investment Manager ("**Allocation Methodology**") and in compliance with InvIT Regulations and SEBI Institutional Placement Guidelines.

The Allocation Methodology which has been followed by the Investment Manager and the Lead Managers is provided below:

1. Allotment of the number of Units to the existing unitholders of the Trust who have bid in the Issue at or above the Issue Price (the "**Existing Unitholders**"), which is lower of:

    a. the respective number of bids made by each of the Existing Unitholders; and

    b. such number of Units that would result in the post- Issue unitholding (*including the change in unitholding pursuant to the proposed Preferential Issue to the Sponsor*) of the Existing Unitholders not getting diluted below their respective unitholding as of March 7, 2024.

2. If the number of Units offered in the Issue exceeds the number of Units allocated as per Paragraph 1 above, the Allotment of such remaining Units to the successful bidders has been undertaken in accordance with the parameters set out below:

    Step 1 – Tiering the Eligible Investors

    a. Tier 1 – Sovereign wealth funds, pension funds, provident funds and insurance companies/ funds;

    b. Tier 2 – Infrastructure sector focussed funds (including, their respective affiliates holding at least one investment in the infrastructure sector) or AIFs (including, their respective affiliates holding at least one investment in the infrastructure sector), mutual funds and scheduled commercial banks; and

    c. Tier 3 – other Eligible Investors.

    Step 2 – Allocation approach within each Tier as specified above:

    a. Within each tier, allocation has been ascertained basis following:

        - Bid quantum;
        - openness to participate in future rounds; and
        - Eligible Investor repute (AUM, long term capital commitment, early expression of interest etc.)

    b. In case of a tie, discretion has been used by the Investment Manager

    c. The Investment Manager has given priority in Allocation of Units based on tiers i.e. Tier 1 has been given priority first among all three tiers while Tier 3 has been given lower priority in determining the Allocation Methodology. Further, Allocation of Units shall be subject to compliance with InvIT Regulations and applicable laws.

Bids received from the Bidders at or above the Issue Price have been grouped together to determine the total demand. The Allocation to all such Bidders has been made at the Issue Price.

THE DECISION OF THE INVESTMENT MANAGER IN CONSULTATION WITH THE LEAD MANAGERS IN RESPECT OF ALLOCATION IS FINAL AND BINDING ON ALL ELIGIBLE INVESTORS. ELIGIBLE

INVESTORS MAY NOTE THAT ALLOCATION OF UNITS IS AT THE SOLE AND ABSOLUTE DISCRETION OF THE INVESTMENT MANAGER IN CONSULTATION WITH THE LEAD MANAGERS AND ELIGIBLE INVESTORS MAY NOT HAVE RECEIVED ANY ALLOCATION EVEN IF THEY HAVE SUBMITTED VALID APPLICATION FORMS AND PAID THE ENTIRE APPLICATION AMOUNT AT OR ABOVE THE ISSUE PRICE. NEITHER THE INVESTMENT MANAGER NOR THE LEAD MANAGERS WERE OBLIGED TO ASSIGN ANY REASON FOR ANY NON-ALLOCATION.

CAN

Based on receipt of the Application Forms and Application Amount, the Investment Manager, in consultation with the Lead Managers, in its sole and absolute discretion, have decided the successful Bidders to whom the serially numbered CAN has been dispatched, pursuant to which the details of the Units Allocated to them, the Issue Price and the total amount received towards Units Allocated to them has been notified to such successful Bidders.

The successful Bidders have also been sent a serially numbered Placement Document either in electronic form or by physical delivery.

The dispatch of the serially numbered CAN and the Placement Document, to the Eligible Investors shall be deemed to be a valid, binding and irrevocable contract for the Eligible Investors to subscribe to the Units Allocated to such successful Bidders at an aggregate price equivalent to the product of the Issue Price and Units Allocated to such successful Bidders. Subsequently, Board of Directors or the Allotment Committee will approve the Allotment of the Units to the Allottees.

Eligible Investors are advised to instruct their Depository Participant to accept the Units that may be Allotted to them pursuant to the Issue.

By submitting the Application Form, the Eligible Investors would have deemed to have made the representations and warranties as specified in the section entitled "*Notice to Investors*" on page 1 and further that such Eligible Investors shall not undertake any trade on the Units credited to its Depository Participant account pursuant to the Issue until such time as the final listing and trading approval is issued by the Stock Exchanges.

Designated Date and Allotment of Units

The Investment Manager, at its sole discretion, reserves the right to cancel the Issue at any time up to Allotment without assigning any reason whatsoever.

Following the Allotment, the Investment Manager shall apply to the Stock Exchanges for listing approvals and post receipt of the listing approvals from the Stock Exchanges, the Investment Manager shall credit the Units into the beneficiary accounts of the successful Bidders. Following the credit of the Units into the successful Bidders' beneficiary accounts, the Investment Manager will apply for final listing and trading approvals from the Stock Exchanges.

The pre and post- Issue Unitholding pattern of the Trust has been filed by the Investment Manager with the Stock Exchanges and the Investment Manager will also file an allotment report with the SEBI providing details of the Allottees and the Allotment made.

After finalization of the Issue Price, the Investment Manager has updated the Preliminary Placement Document with the Issue details and file the same with the Stock Exchanges as the Placement Document.

Refunds

In the event that the Units are not Allocated to a Bidder for any reason, or the number of Units Allocated to a successful Bidder is lower than the number of Units applied for through the Application Form and towards which Application Amount has been paid by such Bidder, or the Application Amount paid by a successful Bidder is in excess of the amount equivalent to the product of the Units that have been Allocated to such Bidder and the Issue Price, or a Bidder withdraws the Application Form prior to the Issue Closing Date, or the Issue is cancelled prior to Allocation, the excess Application Amount paid by such Bidder will be refunded to the same bank account from which the Application Amount was remitted, in the form and manner set out in the Refund Intimation Letter. The Refund Amount will be transferred to the relevant Bidders within two Working Days from the date of issuance of the CAN.

Post Allotment, the Investment Manager shall make an application for listing of the units to the stock exchange(s) and the Units shall be listed within two working days from the date of Allotment.

If the Units are failed to be listed within the specified time, the monies received shall be refunded through verifiable means within four working days from the date of the allotment, and if any such money is not repaid within such time after the issuer becomes liable to repay it, the Trust and the Investment Manager and its director or partner who is an officer in default shall, on and from the expiry of the fourth working day, be jointly and severally liable to repay that money with interest at the rate of 15% per annum.

Allotment pursuant to the Unitholders' resolution shall be completed within a period of 365 days from the date of passing of the unitholder resolution.

Other Instructions

Right to Reject Applications

The Investment Manager, in consultation with the Lead Managers, may reject Bids, in part or in full, without assigning any reason whatsoever. The decision of the Investment Manager in consultation with the Lead Managers in relation to the rejection of Bids shall be final and binding. In the event the Bid is rejected, the Application Amount paid by the Bidder shall be refunded to the same bank account from which the Application Amount was remitted by such Bidder. For details see – "*Bid Process*" and – "*Refund*" above.

Units in Dematerialized form with NSDL or CDSL

The Allotment of the Units in the Issue shall be only in dematerialized form (i.e., not in physical certificates but be fungible and be represented by the statement issued through the electronic mode).

An Eligible Investor applying for Units to be issued pursuant to the Issue must have at least one beneficiary account with a Depository Participant of either NSDL or CDSL prior to making the Bid. Units Allotted to an Eligible Investor will be credited in electronic form directly to the specified beneficiary account (with the Depository Participant) of the Eligible Investor.

Units in electronic form can be traded only on the stock exchanges having electronic connectivity with NSDL and CDSL. The Stock Exchanges have electronic connectivity with NSDL and CDSL.

The trading of the Units to be issued pursuant to the Issue would be in dematerialized form only for all Eligible Investors in the demat segment of the respective Stock Exchanges.

The Investment Manager and the Lead Managers will not be responsible or liable for the delay in the credit of Units to be issued pursuant to the Issue due to errors in the Application Form or otherwise on the part of the Eligible Investor.

Release of Funds to Trust

The Escrow Agent shall not release the monies lying to the credit of the Escrow Account to Trust until the receipt of final trading and listing approvals of the Stock Exchanges for Units offered in the Issue and the receipt of the relevant instructions.

TAXATION

STATEMENT OF POSSIBLE TAX BENEFITS AVAILABLE TO THE TRUST AND ITS UNITHOLDERS UNDER THE APPLICABLE LAWS IN INDIA

To 07 March 2024

National Highways Infra Trust
G-5 & 6, Sector – 10,
Dwarka,
New Delhi 110 075

National Highways Infra Investment Managers Private Limited
G-5 & 6, Sector – 10
Dwarka
New Delhi 110 075

IDBI Trusteeship Services Limited
1009, 10th Floor,
Ansal Bhawan, KG Marg,
New Delhi – 110 001

Sub: Statement of possible tax benefits available to National Highways Infra Trust and its Unitholders

Dear Sirs,

We refer to the proposed further offering of the units of the National Highways Infra Trust ("**the Trust**"). With reference to the captioned subject, given below is a statement and the Annexure herewith, of the applicable sections of the Income Tax Act, 1961, ("**Income Tax Act**") relating to tax benefits available to the Trust and its Unitholders. These benefits are typically dependent on Trust or its unitholders fulfilling the conditions prescribed under the relevant provisions of the Act.

The benefits discussed in the enclosed Annexure are not exhaustive but illustrative. The information contained in the Annexure is only intended to provide general information to the investors and hence is neither designed nor intended to be a substitute for professional tax advice. In view of the individual tax consequences and the changing tax laws, it is advisable to consult a tax consultant with respect to the specific tax implications arising out of the participation in the issue.

Our confirmation is based on the information, explanations and representations obtained from the Investment Manager and on the basis of our understanding of the business activities and operations of Trust.

We do not express an opinion or provide any assurance as to whether:
- Trust or its unitholders will continue to obtain these benefits in future.
- The conditions prescribed for availing the benefits, where applicable have been/would be met with.
- The revenue authorities/courts will concur with the views expressed herein.

Limitations

Our views expressed in the statement and as enclosed in the Annexure are based on the facts and assumptions indicated above. No assurance is given that the revenue authorities/ courts will concur with the views expressed herein. Our views are based on the existing provisions of law and its interpretation, which are subject to change from time to time. We do not assume responsibility to update the views consequent to such changes.

We hereby give our consent to include this statement and the Annexure attached herewith, regarding possible tax benefits available to the Trust and to its Unitholders in the draft placement memorandum and placement memorandum in connection with the further offering of the units of the Trust which is intended to be filed with Securities and Exchange Board of India, relevant stock exchanges and any regulatory authority, as may be required under applicable law.

This Annexure has been prepared solely in connection with the Institutional private placement under the prescribed regulations.
Reliance on the Annexure is on the express understanding that we do not assume responsibility towards the investors who may or may not invest in the private placement relying on the Annexure.

For A.R. & Co.,
Chartered Accountants
FRN – 002744C

CA. Mohd. Azam Ansari
Partner
MRN – 511623
UDIN:
Date:
Place: New Delhi

ANNEXURE TO STATEMENT OF POSSIBLE TAX BENEFITS AVAILABLE TO THE TRUST AND ITS UNITHOLDERS UNDER THE APPLICABLE LAWS IN INDIA

The information provided below sets out the possible tax benefits available to the unitholders in a summary manner only and is not a complete analysis or listing of all potential tax consequences of purchase, ownership and disposal of equity shares or units, under the Tax Laws presently in force in India. It is not exhaustive or comprehensive analysis and is not intended to be a substitute for professional tax advice.

The Income-tax Act, 1961 ("**Act**") has set-out a special regime for taxation of income arising to the Trust and its unitholders under Chapter XII FA of the Act.

We have summarised below relevant income-tax provisions as applicable to the Trust and its unitholders, under the Act. The income tax provisions listed below are available to the Trust and its unitholders subject to compliance with the applicable provisions and/or the conditions laid out in the Act and the regulations as prescribed under the Securities and Exchange Board of India (Infrastructure Investment Trusts) Regulations, 2014, made under the Securities and Exchange Board of India Act, 1992 (15 of 1992) ('InvIT Regulations').

1. Tax provisions applicable to the Trust

1.1. Definition of business trust under the Act

A 'business trust' is defined under section 2(13A) of the Act to mean a trust registered as an infrastructure investment trust ("InvIT") under the SEBI InvIT Regulations or a Real Estate Investment Trusts (REIT) under the SEBI REIT Regulations.

1.2. Taxability of the Trust

1.2.1. Income received from the Special Purpose Vehicle(s) ('SPVs')

a. Interest and Dividend

Interest received or receivable by the Trust from the Project SPVs (being domestic companies) shall be exempt from tax, subject to satisfaction of conditions given in section 10(23FC) of the Act.

In this regard, please note that as per the explanation to section 10(23FC) of the Act, the expression "special purpose vehicle" means an Indian company in which the business trust holds controlling interest and any specific percentage of shareholding or interest, as may be required by the regulations under which such trust is granted registration.

As per section 194 of the Act, the dividend income distributed to business trust by the SPV is not subject to withholding of taxes. As per section 193(ix) and section 194A(3)(xi) of the Act, any income by way of interest received/receivable by the Trust from SPV is not subject to withholding of taxes.

b. Income from buy-back of share

As per section 115QA of the Act, domestic companies are required to pay additional tax at the rate of 20%[++1] of the distributed income on buy-back of shares ('Buyback Distribution Tax'). Distributed income means the consideration paid by the domestic company on buy back of shares as reduced by the amount received by the company for the issue of such shares, determined as per Rule 40BB of the Income-tax Rules, 1962 ('the Rules').

Further, as per the provisions of section 10(34A) of the Act, any income arising from buy-back of shares on which Buyback Distribution Tax has been paid shall not be taxable in the hands of the Trust.

Further, in view of the provisions of section 14A of the Act, any expenditure incurred in relation to earning the exempt income under 1.2.1(a) and 1.2.1(b) above, whether accrued, arisen or received or not, shall not be tax deductible. In case the tax authorities are not satisfied by the disallowance considered by the Trust, the quantum of disallowance shall be computed in accordance with the provisions of section 14A read with Rule 8D of the Rules.

1.2.2. Income other than the income distributed by the SPVs

a. Income by way of dividend/interest

[1] [++] *excluding applicable surcharge and cess*

Dividend/interest income received by the Trust from listed securities, liquid funds, etc. shall be subject to tax at the maximum marginal rate in force ('MMR') as per section 115UA of the Act. MMR is defined under the provisions of the Act to mean the rate of income-tax (including surcharge on income-tax, if any) applicable in relation to the highest slab of income as per the relevant Finance Act as increased by cess.

As per proviso to section 57 of the Act, no deduction shall be allowable against dividend income other than deduction on account of interest expense and such interest expense shall not exceed 20% of the gross dividend income included in the total income for that year, without deduction under section 57 of the Act.

b. Income by way of capital gains and other income

In terms of section 115UA(2) of the Act, the total taxable income of the Trust shall be chargeable to tax at MMR except for income arising on transfer of short-term capital assets and long-term capital assets[2] under section 111A and section 112 of the Act.

As per the provisions of section 111A of the Act, any income arising from transfer of short-term capital asset being an equity share in a company or a unit of an equity-oriented fund or a unit of a business trust, transacted through a recognized stock exchange and subject to STT, should be taxable at a concessional rate of 15%[++]. However, the condition of subject to STT is not applicable if the transaction is undertaken on a recognized stock exchange located in any International Financial Services Centre ('IFSC') and where the consideration for such transaction is received or receivable in foreign currency.

As per the provisions of section 112 of the Act, gains arising on the transfer of long-term capital assets shall be chargeable to tax in the hands of the Trust at the rate of 20%[++]. However, the tax arising on transfer of long-term capital asset, being listed securities (other than a unit) or zero-coupon bond, shall be lower of the following:

a. 10%[++] without indexation benefit, or
b. 20%[++] with indexation benefit

Section 48 of the Act prescribes the mode of computation of capital gains and provides for deduction of cost of acquisition/ improvement and expenses incurred in connection with the transfer of a capital asset, from the sale consideration to arrive at the amount of capital gains. However, in respect of long-term capital gains, section 48 of the Act provides for substitution of cost of acquisition/improvement with indexed cost of acquisition/improvement, which adjusts the cost of acquisition/improvement by a cost inflation index as prescribed from time to time. Such indexation benefit would not be available on bonds, debentures, and listed equity shares in a company or units of equity-oriented funds or assets of a business trust (as referred to in section 112A of the Act).

As per section 50CA of the Act, where the consideration on transfer of unquoted shares of a company, is less than the fair market value of such share determined in such manner as may be prescribed, the value so determined shall for the purpose of section 48 of the Act, be deemed to the full value of consideration.

Section 70 read with section 74 of the Act allows short-term capital loss arising during a financial year to be set off against income, if any, from capital gains (short-term or long-term), arising in the same financial year. However, long-term capital loss arising during a financial year is allowed to be set-off only against long-term capital gains. Balance loss, if any, is allowed to be carried forward and set-off against income from capital gains, arising during subsequent eight assessment years, as follows: (i) balance short-term capital loss can be carried forward and set-off against capital gains (short-term or long-term); and (ii) balance long-term capital loss can be carried forward and set-off only against long-term capital gains.

Further, as per Section 71 of the Act, short term/ long term capital loss for the year cannot be set-off against income under any other head other than capital gains for the same year.

2. Taxability of unitholders

2.1. Income by way of dividend and interest

a. As per the provisions of section 115UA(1) of the Act, the income distributed by the Trust is taxable in the hands of the unitholders in the same manner and in the same proportion as the underlying income received by or accrued to the Trust.

[2] As per section 2(42A), a short-term capital asset means: (i) for unlisted shares – period of holding is less than or equal to 24 months; (ii) for unlisted securities (other than unlisted shares) - period of holding is less than or equal to 36 months; (iii) Immovable property being land and/or building - period of holding is less than or equal to 24 months; (iv) listed equity shares or units of an equity-oriented fund – period of holding less than or equal to 12 months. As per section 2(29A), a capital asset which is not a short-term capital asset is regarded as a long-term capital asset.

b. As per the provisions of section 10(23FD), any income referred to in section 115UA(1) of the Act and distributed by the Trust shall not be included in the total income of the unitholders, except for the following income:
   (i) Interest income from SPV [referred to in section 10(23FC)(a)];
   (ii) Dividend Income from SPV [referred to in section 10(23FC)(b)], i.e., if the SPV has opted for concessional tax regime under section 115BAA;

   The above income would be taxable in the hands of the unitholders under section 115UA(3) of the Act at the rates applicable to the respective unitholders.

c. As per section 115A(1)(iiac) of the Act read with section 194LBA of the Act, income in the nature of interest referred to in section 10(23FC)(a) shall be taxable at the rate of 5%++ in the hands of a non-resident. Such interest would be taxable in the hands of resident unitholders at the applicable tax rates.

d. Taxability of dividend income distributed by the Trust to unitholders is dependent on the taxation regime adopted by the SPV(s), which distributes the dividend to the Trust. If the SPV(s) has not opted for a concessional corporate tax rate under section 115BAA of the Act ('Qualifying SPV'), dividend distributed by such Qualifying SPV ('Qualified Dividend') and distributed by the Trust is exempt in the hands of the unitholders. Any dividend other than Qualified Dividend distributed by the Trust ('Unqualified Dividend') is taxable in the hands of the unitholders. Such Unqualified Dividend shall be taxable in the hands of non-resident unitholders at the rate of 20%++ as per section 115A of the Act and shall be taxable in the hands of resident unitholders at the applicable tax rates.

e. Further, where the dividend, interest, or any other income received by the Trust is chargeable to tax in the hands of the Trust, such income shall be exempt in the hands of the unitholders on distribution by the Trust under section 10(23FD) of the Act. Further, any expenditure incurred for earning such exempt income shall not be deductible in the hands of the unitholders under the provisions of section 14A of the Act.

f. Deductions from income in the hands of unitholders

   A domestic company is allowed deduction of dividend income received by it from another domestic company or the Trust subject to certain conditions. Therefore, if the unitholder is a domestic company, it should be able to claim the deduction under section 80M where the prescribed conditions mentioned under section 80M have been complied with.

   Further, as per proviso to section 57 of the Act, no deduction shall be allowable against the dividend income other than deduction on account of interest expense and such interest expense shall not exceed 20% of the gross dividend income for that year, without deduction under section 57 of the Act.

2.2. Distribution of specified sum

a. The Finance Act, 2023 has amended section 56(2) of the Act to add a new clause (xii) which provides the taxability of any specified sum received by unitholders from the Trust in respect of units held by him at any time during the year.

b. Computation of "specified sum" shall be the result of 'A-B-C' where:

   'A' = Cumulative distribution made by trust till date excluding the amount distributed in the nature of dividend, interest or rental income or any amount taxed/taxable in the hands of NHIT InvIT
   'B' = Issue price of such units
   'C' = Amount charged to tax under this provision in earlier years

   Specified sum shall be deemed to be zero if 'A-B-C' results in negative value.

2.3. Other income (income other than interest or dividend income or income chargeable to tax under section 56(2)(xii) of the Act) received from Trust

Other income (income other than interest or dividend income or income chargeable to tax under section 56(2)(xii) of the Act) such as treasury income earned by Trust and distributed to unitholder shall be exempt in hands of unitholders as the same shall be taxable in the hands of Trust. Further, there shall be no withholding on distribution of such other income by the Trust to the unitholders.

2.4. Income by way of capital gains

2.4.1. For resident unitholder

a. For the purpose of computation of capital gains on sale of units of Trust, consideration received on sale of units of Trust shall be reduced by cost of acquisition of such units and expenditure incurred wholly and exclusively in connection with such sale.

b. As per the amendments made by FA 2023, the amount of distribution to the extent not chargeable to tax u/s 56(2)(xii) of the Act and not covered u/s 10(23FC), 10(23FCA) or 115UA(2) of the Act, shall be reduced from the cost of units, for the purpose of computation of capital gains.

c. Investors are advised to consult their tax advisor for computation of capital gains including cost of acquisition of units as per Indian tax laws in each case.

d. Where the gains arising on the transfer of units of the Trust by the unitholder are included in the business income of an assessee assessable under the head 'Profits and Gains from Business or Profession' and on which STT has been charged, such STT shall be a deductible expense from business income as per the provisions of section 36(1)(xv) of the Act. The characterization of gains/ losses, arising from sale of units, as capital gains or business income would depend on the nature of holding in the hands of the unitholder and various other factors.

e. Where the gains on transfer of the units of the Trust are characterized as capital gains, and if such units are long-term capital assets[3] and such transaction is chargeable to STT, income arising on transfer of units of the Trust (over and above INR 0.1 million) will be taxable at a concessional tax rate of 10%$^{++}$ subject to conditions as per section 112A. However, the condition of transaction being chargeable to STT is not required if the transaction is undertaken on a recognised stock exchange located in IFSC and where the consideration for such transaction is received or receivable in foreign currency. Further, in case of long-term capital gain on transfer of units of the Trust, which are not subject to STT, shall be taxable in the hands of the unitholders at the tax rate of 20%$^{++}$ under section 112 of the Act.

f. Short-term capital gains arising on transfer of the units of the Trust will be chargeable to tax at the rate of 15%$^{++}$ as per the provisions of section 111A of the Act, provided such transaction is subject to STT. The condition of STT is not required to be followed if the transaction is undertaken on a recognised stock exchange located in IFSC and where the consideration for such transaction is received or receivable in foreign currency.

g. In case of a unitholder being an individual or HUF, where the total taxable income as reduced by short-term capital gains is below the basic exemption limit, the short-term capital gains will be reduced to the extent of the shortfall and only the balance short-term capital gains will be subjected to such tax in accordance with the proviso to sub-section (1) of section 111A of the Act. Short-term capital gains on transfer of units of the business trust, not transacted through a recognized stock exchange and not subject to STT shall be taxable at the applicable rate of tax for respective unitholders.

h. In case of a unitholder being a resident individual or HUF, where the total taxable income as reduced by long-term capital gains taxable is below the basic exemption limit, such long-term capital gains will be reduced to the extent of the shortfall and only the balance long-term capital gains will be subjected to such tax in accordance with the proviso to sub-section (1) of section 112 and proviso to sub-section (2) of section 112A of the Act.

i. In case of determining the period of holding for units allotted pursuant to exchange of shares of special purpose vehicle, as per clause (hc) of explanation 1 to section 2(42A), the period of holding for the units shall include the period for which the shares were held by the promoter in the SPV

j. In case of unitholder, being a domestic company that are liable to pay MAT under provisions of section 115JB of the Act, the gains arising, if any, on sale of units of the Trust are to be included as part of book profits for the purposes of computing MAT lability. MAT paid by such companies should be available as credit for set off against future tax liability, provided such companies do not opt to be governed by the concessional tax rate under section 115BAA of the Act.

k. In case of unitholders, other than companies, that are liable to Alternate Minimum Tax (AMT) under provisions of Section 115JC of the Act, the gains arising, if any, on sale of units of InvIT are to be included as part of adjusted total income for the purpose of computing AMT liability. AMT paid by such unitholders should be available as credit for set-off against future tax liability, provided they do not opt to be governed by the concessional tax rates u/s 115BAC or 115BAD of the Act.

2.4.2. <u>For non-resident unitholder (other than Foreign Portfolio Investors ('FPIs'):</u>

a. For the purpose of computation of capital gains on sale of units of Trust, consideration received on sale of units of Trust shall be reduced by cost of acquisition of such units and expenditure incurred wholly and exclusively in connection with such sale.

[3] *Capital asset being units of a business trust would be classified as long-term capital asset if the period of holding is more than 36 months immediately preceding the date of its transfer*

b. As per the amendments made by FA 2023, the amount of distribution to the extent not chargeable to tax u/s 56(2)(xii) of the Act and not covered u/s 10(23FC), 10(23FCA) or 115UA(2) of the Act, shall be reduced from the cost of units, for the purpose of computation of capital gains.

c. Investors are advised to consult their tax advisor for computation of capital gains including cost of acquisition of units as per Indian tax laws in each case.

d. Where the gains arising on the transfer of shares of the unitholder are included in the business income of an assessee assessable under the head 'Profits and Gains from Business or Profession' and on which STT has been charged, such STT shall be a deductible expense from business income as per the provisions of section 36(1)(xv) of the Act. Such business income should not be taxable in India unless the non-resident has a taxable presence in India.

e. Where the gains on transfer of the units are characterized as capital gains, if such units are long-term capital assets and such transaction is chargeable to STT, income arising on transfer of units of the Trust (over and above INR 0.1 million) will be taxable at a concessional tax rate of 10%++ subject to conditions as per Section 112A. However, the condition of STT is not required to be followed if the transaction is undertaken on a recognised stock exchange located in IFSC and where the consideration for such transaction is received or receivable in foreign currency. Further, in case of long-term capital gain on transfer of units of the Trust, which are not subject to STT, shall be taxable in the hands of the unitholders at the tax rate of 20%++, with any applicable indexation benefit, under section 112 of the Act.

f. Short-term capital gains arising on transfer of the units of the Trust will be chargeable to tax at the rate of 15%++ as per the provisions of section 111A of the Act if such transaction is chargeable to STT. However, the condition of STT is not required to be followed if the transaction is undertaken on a recognised stock exchange located in IFSC and where the consideration for such transaction is received or receivable in foreign currency.

g. Short-term capital gains on transfer of units of the business trust, not transacted through a recognized stock exchange and not subject to STT shall be taxable at the applicable rate of tax for respective unitholders.

h. As per section 47 of the Act read with Notification no. 16/2020, any capital gain arising on transfer of capital asset being unit of a business trust listed on a recognised stock exchange located in any IFSC where the consideration is received or receivable in foreign currency, would not be regarded as a transfer and therefore, would not be subject to any capital gain tax implications.

i. In case of unitholders, other than companies, that are liable to AMT under provisions of Section 115JC of the Act, the gains arising, if any, on sale of units of InvIT are to be included as part of adjusted total income for the purpose of computing AMT liability. AMT paid by such unitholders should be available as credit for set-off against future tax liability, provided they do not opt to be governed by the concessional tax rates u/s 115BAC or 115BAD of the Act.

   As per explanation 4 to section 115JB(2), the provisions of section 115JB shall not be applicable to a foreign company if the foreign company is a resident of a country having DTAA with India and such foreign company does not have a permanent establishment within the definition of the term in the relevant DTAA, or the foreign company is a resident of a country which does not have a DTAA with India and such foreign company is not required to seek registration under the legislation covering companies in India.

2.4.3. <u>For non-resident unitholders who are FPIs:</u>

a. As per section 2(14) of the Act, any securities held by an FPI, which were invested in accordance with the regulations made under the Securities and Exchange Board of India Act, 1992 shall be deemed to be capital assets. Hence the income from the transfer of such securities shall be deemed to be treated as capital gains.

b. If units of the Trust are long-term capital assets and such transaction is chargeable to STT, income arising on their transfer (over and above INR 0.1 million) will be taxable at a concessional tax rate of 10%$^{++}$ subject to conditions as per section 112A read with section 115AD. Further, in case of long-term capital gain on transfer of units of the Trust, which are not subject to STT, shall be taxable in the hands of the unitholders at the tax rate of 10%$^{++}$, without any indexation benefit as per section 115AD.

c. Short-term capital gains arising on transfer of the units of the Trust will be chargeable to tax at the rate of 15%$^{++}$ as per the provisions of section 111A of the Act read with section 115AD, if such transaction is chargeable to STT. Short-term capital gains on transfer of units of the Trust, not transacted through a recognized stock exchange and not subject to STT shall be taxable at 30%$^{++}$ under section 115AD of the Act. The condition of payment of STT is not required to be followed if the transaction is undertaken on a recognised stock exchange located in IFSC and where the consideration for such transaction is received or receivable in foreign currency.

d. Investors are advised to consult their tax advisor for computation of capital gains including cost of acquisition of units as per Indian tax laws in each case.

2.4.4. For unitholders who are notified Sovereign Wealth Fund and notified Pension Funds:

a. As per section 10(23FE) of the Act, any income by way of dividend, interest, any sum referred to in section 56(2)(xii), or long-term capital gain arising from investment made in units of the Trust on or after 1 April 2020 and before 31 March 2024 and held for at least three years shall be exempt for notified Sovereign Wealth Fund, wholly owned subsidiary of Abu Dhabi Investment Authority (ADIA) and notified Pension Funds, subject to satisfaction of stipulated conditions.

Investors are advised to consult their tax advisor for computation of capital gains including cost of acquisition of units as per Indian tax laws in each case.
In this regard, please note that there are no withholding tax provisions under the Act which provide for exemption from withholding taxes on above mentioned income accruing to the specified persons as defined under section 10(23FE) of the Act.

2.4.5. For unitholders who are mutual funds:

Under section 10(23D) of the Act, any income earned by a Mutual Fund registered under the Securities and Exchange Board of India Act, 1992, or a Mutual Fund set up by a public sector bank or a public financial institution, or a Mutual Fund authorised by the Reserve Bank of India would be exempt from income-tax, subject to such conditions as the Central Government may by notification in the Official Gazette specify in this behalf.

In light with the provisions of section 196 of the Act, no deduction of tax shall be made on any sum payable to a Mutual Fund specified under clause (23D) of section 10. Accordingly, the Trust is not required to withhold tax on any sum payable to Mutual Fund set up under section 10(23D) of the Act.

2.4.6. For Venture Capital Companies/Funds:

For VCF/VCC registered prior to 21 May 2012:

Under Section 10(23FB) of the Act, any income of Venture Capital Company to whom the certificate of registration is granted before 21/05/2012 under SEBI (Venture Capital Funds) Regulations, 1996 or as a subcategory I Alternative Investment Fund as is regulated under SEBI (Alternative Investment Funds Regulations) under the SEBI Act, 1992, would be exempt from income tax, subject to conditions specified therein.

As per Section 115U of the Act, any income derived by a person from his investment in Venture Capital Company/Venture Capital Fund would be taxable in the hands of the person making an investment in the same manner as if it were the income accruing or arising to or received by such person had the investments been made directly in the venture capital undertaking.

For VCF/VCC registered post 21 May 2012:

VCF/VCC registered post 21 May 2012 shall be classified as a Category 1 Alternate Investment Fund which shall be governed by the SEBI (AIF) Regulations 2012. For such funds benefit of section 10(23FB) and section 115U shall not be applicable and shall be governed by section 115UB read with section 10(23FBA) and 10(23FBB) which states that business income earned by such fund shall be taxable in the hands of the Fund and exempt in the hands of the unit holders, and other income earned viz. capital gains, income from other sources shall be exempt in the hands of the fund and taxable in the hands of unit holder.

2.4.7. Benefits under Double taxation avoidance agreement (DTAA)

As per section 2(30) of the Act, non-resident is defined to mean a person who is not a "resident".

A non-resident unit holder should be subject to taxation in India only if:

- it is regarded a tax resident of India; or
- being a non-resident in India, it derives: (a) if any income is received / deemed to be received in India; or (b) if any income has accrued or arisen / deemed to have accrued or arisen in India in terms of the provisions of the Act.

Section 6 of the Act provides that a foreign company should be treated as a tax resident in India if its place of effective management (POEM) is in India in that year. POEM has been defined to mean a place where key

managerial and commercial decisions that are necessary for the conduct of the business of an entity as a whole are, in substance made.

Under the provisions of section 90(2) of the Act, a non-resident will be governed by the provisions of the DTAA between India and the country of tax residence of the non-resident and the provisions of the Act apply to the extent they are more beneficial to the assessee.

However, the non-resident investor will have to furnish a certificate of his being a tax resident in a country outside India and a suitable declaration stating that such non-resident does not have a fixed base/ permanent establishment in India, to obtain the benefit of the applicable DTAA and such other document as may be prescribed as per the provision of section 90(4) of Act. Further, as per Notification No. 3/2022 dated 16th July 2022, Form 10F is required to be furnished electronically for submitting information as required under Rule 21AB, where tax residence certificate does not contain all the prescribed requisite information.

As per the provisions of section 90(2) of the Act, the provisions of the Act would prevail over the provisions of the DTAA to the extent they are more beneficial to the non-resident.

2.4.8. Treatment of loss:

Section 70 read with section 74 of the Act allows short-term capital loss arising during a financial year to be set off against income, if any, from capital gains (short-term or long-term), arising in the same financial year. However, long-term capital loss arising during a financial year is allowed to be set-off only against long-term capital gains. Balance loss, if any, is allowed to be carried forward and set-off against income from capital gains, arising during subsequent eight assessment years, as follows: (i) balance short-term capital loss can be carried forward and set-off against capital gains (short-term or long-term); and (ii) balance long-term capital loss can be carried forward and set-off only against long-term capital gains.

Further, as per Section 71 of the Act, short term/ long term capital loss for the year cannot be set-off against income under any other head other than capital gains for the same year.

2.5. Tax deduction at source by the Trust

a. Section 194LBA – Certain income from units of the Trust: As per section 194LBA of the Act, taxes shall be required to be deducted at source at the time of payment/ credit (whichever is earlier) from following income distributions by the Trust to its unitholders:

Class of unitholders	Nature of income	Applicable tax rates
• Resident unitholders*	Interest income - Section 194LBA(1) Unqualified Dividend income - Section 194LBA(1) Qualified Dividend income - Section 194LBA(2A) Specified sum – Section 56(2)(xii)	10% 10% Not subject to withholding tax Not subject to withholding tax
• Non-resident unitholders*#^	Interest income – Section 194LBA(2) Unqualified Dividend income^ - Section 194LBA(2) Qualified Dividend income – Section 194LBA(2A) Specified sum – Section 56(2)(xii)	5%++ 10%++ Not subject to withholding tax Tax rates as may be applicable (inclusive of applicable surcharge and cess)
• Category I & II Alternative Investment Funds • Mutual Funds	Any distribution	Not subject to withholding tax

*The unitholders may provide NIL/Lower withholding certificate issues under section 197 of the Act with respect to income as specified u/s 194LBA of the Act.

^ If the Act provides withholding tax rate for any specific category of non-resident unitholders, then the same needs to be considered.

Non-resident unitholders may seek to avail any beneficial provisions under applicable DTAA that India may have entered into with its country of residence. Rate of TDS for FPI/FII may be governed in accordance with section 196D of the Act.

b. Applicability of other provisions:

No income tax is deductible at source from income in the nature of capital gains arising to a resident unitholder under the provisions of the Act.

However, as per the provisions of Section 195 read with section 90 of the Act, any income on transfer of units of the Trust by non-residents may be subject to withholding of tax at the rate under the domestic tax laws or under the

DTAA, whichever is more beneficial to the Assessee (other than FPIs/ FIIs who are subject to provisions of section 196D(2) of the Act)

Further, section 196D of the Act provide that in case of a payee, being FPIs/ FIIs of country with which India has entered into DTAA, tax shall be deducted at the rate of 20% or the DTAA rates (for the incomes referred in section 115AD(1)(ii) other than capital gains and interest income subject to TDS u/s 196LD of the Act), whichever is lower, subject to the FPI/ FII furnishing a Tax Residency Certificate (referred to in Section 90(4) of the Act) and a suitable declaration for not having a fixed base/ permanent establishment in India, to the payer.

Further, as per sub-section (2) of section 196D of the Act, no tax is to be deducted from any income, in the nature of capital gains arising to a FPI or FII from the transfer of units, subject to the FPI/ FII furnishing a Tax Residency Certificate (referred to in Section 90(4) of the Act) and a suitable declaration for not having a fixed base/ permanent establishment in India, to the payer.

Buyer and seller of unlisted shares/securities also need to check the applicability of TDS u/s 194Q of the Act read with provision of Tax Collection at Source (TCS) u/s 206C(1H) of the Act. As per the clarification issued by CBDT, the transaction in shares not taken place through recognized stock exchange/ recognised clearing corporations may also fall under the ambit of section 194Q/206C(1H) of the Act since CBDT has clarified that the said provisions of section 194Q/206C(1H) of the Act are not applicable to transactions in securities and commodities transacted through recognised stock exchanges/ recognised clearing corporations, including those located in International Financial Service Centre.

c. Provisions of section 206AA of the Act

As per section 206AA of the Act, where a tax payer does not possess a Permanent Account Number ('PAN'), taxes have to be withheld on payment of income to the tax payer (where chargeable to tax) at higher of the following:

- at the rate specified in the Act; or
- at the rate or rates in force; or
- at the rate of twenty per cent

The Finance Act, 2016 amended the aforementioned provision to provide an exemption to non-residents, subject to compliance of such conditions as may be prescribed by the CBDT. In furtherance of the amended provision, the CBDT issued a notification prescribing the rules (Rule 37BC of the Rules) for relaxation from withholding of tax at higher rates in the absence of PAN in the case of non-resident deductee and laid down the information and alternative documents required to claim such relaxation.

d. Provisions of section 206AB of the Act

Finance Act 2021 has inserted section 206AB which *inter alia* stipulates that where tax is required to be withheld by a person on payment or credit to a *specified person*[4], the tax shall be deducted at the higher of the following rates:

- at twice the rate specified in the relevant provision of the Act; or
- at twice the rate or rates in force; or
- at the rate of five per cent.

If the provisions of section 206AA is applicable to a specified person, in addition to the provision of section 206AB, the tax shall be deducted at higher of the two rates provided in section 206AB and in section 206AA.

e. Applicability of other provisions:

Section 94(7) of the Act (commonly known as dividend stripping)

Vide Finance Act, 2022, applicability of section 94(7) of the Act (commonly known as dividend stripping) has been extended to the units of Trust as well (that with effect from Financial Year 2022-23) which provides that where:

a) any person buys or acquires any securities or unit within a period of three months prior to the record date[5];
b) such person sells or transfers such securities within three months after such record date or such units within a period of nine months after such record date;
c) the dividend or income on such securities or unit received or receivable by such person is exempt

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[4] *As per the provisions of section 206AB of the Act, 'Specified person' means a person who:*
(i) has not furnished the return of income for the previous year immediately preceding the previous year in which the tax is required to be deducted, for which time-limit of furnishing the return of income u/s 139(1) has expired; and
(ii) the aggregate of tax deducted at source and tax collected at source is INR 50,000 or more in the said previous year

[5] *Record date means a date fixed to entitles the holder of such securities or units to receive dividend, income, or additional securities or unit without consideration, as the case may be*

then, the loss, if any, arising from the sale and purchase of securities and units, to the extent of dividend or income received or receivable on such securities or unit, shall be ignored for computing income chargeable to tax.

Section 94(8) of the Act (commonly known as bonus stripping)

Vide Finance Act, 2022, applicability of section 94(8) of the Act (commonly known as bonus stripping) has been extended to the units of Trust as well (that with effect from Financial Year 2022-23) which provides that where:

a) any person buys or acquires any units within a period of three months prior to the record date[6];
b) such person is allotted additional units without any payment on the basis of holding of such units on such record date;
c) such person sells or transfers all or any of the units within a period of nine months after the record date, while continuing to hold all or any of the additional units referred in clause (ii) above

then, the loss, if any, arising from the sale and purchase of all or any of the units shall be ignored for computing income chargeable to tax and notwithstanding anything contained in any other provision of the Act, the amount of loss so ignored shall be deemed to be the cost of purchase or acquisition of such additional units referred to in clause (ii) above as are held on the date of such sale or transfer.

Disclaimer

1. The stated benefits will be available only to the sole/ first named holder in case the units are held by joint holders.

2. Please note that the TDS rates mentioned in the given document may be subject to any concessions introduced/ allowed by the Government under any policy, press release, etc. Also, the same may also be subject to lower/ nil withholding tax certificates which may be furnished by the unit holders.

3. In respect of non-residents, the tax rates and the consequent taxation mentioned above shall be further subject to any benefits available under the applicable DTAA, if any, between India and the country in which the non-resident has fiscal domicile. Further, it is pertinent to meet the terms and condition viz. Principal purpose test, beneficial ownership test etc. as enacted in DTAAs entered into by India with various countries based on Multilateral Convention to implement tax treaty related measures to prevent Base Erosion and Profit Shifting ('MLI').

4. The tax implications/ benefits stated in this document are subject to General Anti Avoidance Rules (GAAR) provisions under the Act. GAAR may be invoked by the Indian income-tax authorities in case arrangements are found to be impermissible avoidance arrangements. Further, in case GAAR provisions are invoked, the onus to prove that the main purpose of an arrangement was not to obtain any tax benefit is on the taxpayer. Also, any resident or non-resident may approach the Authority for Advance Rulings to determine whether an arrangement can be regarded as an impermissible avoidance arrangement.
5. This statement is intended only to provide general information to the investors and is neither designed nor intended to be substituted for professional tax advice. In view of the individual nature of tax consequences, each investor is advised to consult his/her own tax advisor with respect to specific tax consequences of his/her participation in the scheme

6. No assurance is given that the revenue authorities/courts will concur with the views expressed herein. Our views are based on the existing provisions of law and its interpretation, which are subject to changes from time to time. We do not assume responsibility to update the views consequent to such changes. We shall not be liable to any claims, liabilities or expenses relating to this assignment, except to the extent of fees relating to this assignment, as finally judicially determined to have resulted primarily from bad faith or intentional misconduct. We will not be liable to any other person in respect of this statement.

7. This statement of possible direct tax benefits enumerated above is as per the Act as amended by the Finance Act, 2023 applicable for financial year ending 31 March 2024 relevant to the assessment year 2024-25. The above statement of possible Direct-tax Benefits sets out the possible tax benefits available to the Trust and its unitholders under the current tax laws presently in force in India. Several of these benefits available are dependent on the Trust or its unitholders fulfilling the conditions prescribed under the relevant tax laws.

8. Please note that the tax rates provided in this statement are excluding applicable surcharge and cess. As per the Finance Act, 2023, rates given in sub-section (1A) of section 115BAC of the Act ('New Tax Regime') are the default rates applicable to all individual/ HUF/ AOP (other than co-operative)/ BOI/ AJP. Accordingly, tax rates and surcharge prevailing as per New Tax Regime will be considered for the purpose of withholding.

[6] *Record date means a date fixed to entitles the holder of such securities or units to receive dividend, income, or additional securities or unit without consideration, as the case may be*

The information provided above sets out the possible tax benefits available to the unit holders in a summary manner only and is not a complete analysis or listing of all potential tax consequences of the purchase, ownership and disposal of equity shares and units, under the current tax laws presently in force in India. It is not exhaustive or comprehensive and is not intended to be a substitute for professional advice. Investors are advised to consult their own tax advisor with respect to the tax implications arising on account of any investment in equity shares or units (including tax implications on account of any distributions by/ receipts from the Trust), particularly in view of the fact that certain recently enacted legislation may not have a direct legal precedent or may have a different interpretation impacting the benefits, which an investor can avail

LEGAL MATTERS

Each of Cyril Amarchand Mangaldas, J. Sagar Associates and Linklaters Singapore Pte. Ltd. do not make, or purport to make, any statement in this Placement Document and is not aware of any statement in this Placement Document which purports to be based on a statement made by any of them, and it makes no representation, express or implied, regarding, and to the extent permitted by law takes no responsibility for, any statement in or omission from this Placement Document.

INDEPENDENT ACCOUNTANTS

The Audited Financial Information have been prepared in accordance with the Ind AS and in accordance with the accounting principles generally accepted in India. The Audited Financial Information included in this Placement Document have been audited by A.R. & Co., the statutory auditors of the Trust, as stated in their audit reports dated August 18, 2021, May 23, 2022, May 22, 2023 and March 4, 2024 included in this Placement Document.

CAPITALIZATION STATEMENT

For the Trust on a consolidated basis:

Particulars	Pre-Issue as at December 31, 2023 (Rs. in million), except ratios^	Post-Issue as Adjusted for the Issue (Rs. in million), except ratios*
Unitholders' Funds		
Initial Contribution to the Trust	0.01	0.01
Unit Capital	74,159.35	1,46,879.99
Other Equity	(1720.59)	(1720.59)
Total Unitholders' Funds (A)	**72,438.77**	1,45,159.41
Long Term Borrowings	29,564.80	29,915.40
Short Term Borrowings	-	-
Other Borrowings (Current Maturity of Long Terms Borrowings)	419.25	419.25
Total Debt (B)	**29,984.05**	30,334.65**
Total Capitalization (A+B)	**1,02,422.82**	1,75,494.06
Long Term Debt/Unitholders' Funds Ratio	0.41	0.21
Total Debt/ Unitholders' Funds Ratio	0.41	0.21

^As derived from Audited Financial Information for the nine month period ended December 31, 2023.

* As adjusted to reflect the number of Units to be issued pursuant to the Issue and the Preferential Issue and proceeds from the Issue and the Preferential Issue.

** Includes additional borrowings of Rs. 350.00 million availed by the Trust post December 31, 2023.

ASSET REVENUE INFORMATION

In accordance with the SEBI Exemption, the revenue data for each asset for the financial years ended March 31, 2023, March 31, 2022 and March 31, 2021 and for the months of April 1, 2023 to February 29, 2024 is disclosed below. For further details, please see "R*isk Factors - We have no operating history or financial information for the R3 Toll Roads. Accordingly, the information disclosed in this Placement Document in relation to the R3 Toll Roads is limited." on page 70.*

R1 Toll Roads

The details in relation to the revenue of the R1 Toll Roads for the financial years ended March 31, 2021 and March 31, 2020 and up to the Appointed Date (in terms of R1 Concession Agreements) as provided by the Sponsor by way of its letter dated August 24, 2021 are disclosed below:

Assured remittance details as per Tolling Contracts				
S. No.	**Project Highway**	**Toll Plaza**	**Period**	**Equivalent Annualized Amount (in ₹ million)**
1.	**Abu Road To Swaroopganj**	**Undavariya**	08.05.2021-15.12.2021	601.5
			04.03.2021-04.06.2021 (terminated on 07.05.2021)	590.6
			19.01.2020-19.01.2021 (extended till 04.03.2021)	440.1
			12.12.2018-22.12.2019 (extended till 19.01.2020)	374.5
2.	**Abu Road To Palanpur**	**Khemana**	16.12.2020-15.12.2021	713.5
			05.09.2020-05.12.2020 (extended till 16.12.2020)	663.6
			16.06.2019-16.06.2020 (extended till 05.09.2020)	623.7
			13.04.2018-13.07.2019 (terminated on 16.06.2019)	555.5
3.	**Chittorgarh – Kota & Chittorgarh Bypass**	**Bassi, Aroli, Dhaneswar**	24.04.2021-15.12.2021	870.8
			23.01.2021-23.04.2021	886.5
			22.09.2020-22.12.2020	775.2
			11.08.2020-22.09.2020	705.0
			04.05.2019-04.08.2020	848.7
4.	**Maharashtra Karnataka Border to Belgaum**	**Kognoli**	17.12.2020-15.12.2021	815.4
			22.09.2020-17.12.2020	116.7
			08.08.2020-22.09.2020	50.7
			22.02.2020-08.08.2020	297.4
			23.01.2020-22.02.2020	50.0
			23.10.2019 to 23.01.2020	150.2

Assured remittance details as per Tolling Contracts				
S. No.	**Project Highway**	**Toll Plaza**	**Period**	**Equivalent Annualized Amount (in ₹ million)**
			16.06.2019-23.10.2019	43.0
			16.06.2019-16.09.2019	129.1
		Hattargi	18.12.2020-15.12.2021	333.3
			22.09.2020-18.12.2020	65.4
			05.08.2020-22.09.2020	25.3
			05.03.2020-05.08.2020	114.3
			05.12.2019-05.03.2020	68.6
			05.11.2019-05.12.2019	25.6
			05.08.2019-05.11.2019	76.9
			05.05.2019-05.08.2019	79.2
5.	**Kothakota Bypass To Kurnool**	**Pullur**	08.03.2021-15.12.2021	1275.3
			07.12.2019-07.12.2020	1203.3
			07.09.2018-07.12.2019	1173.6

The details of the revenue of the R1 Toll Roads (i) from December 16, 2021 (i.e. the Appointed Date) up to the financial year ended March 31, 2022; (ii) financial year ended March 31, 2023; and (iii) nine months period ended December 31, 2023; (iv) for the month January 2024 and February 2024 are as follows:

(in ₹ million)

Period	Aburoad Swaroopganj Project	Palanpur Aburoad Project	Kothakota Kurnool Project	Belgaum Kagal Project	Chittorgarh Kota Project	Total
December 16, 2021 – March 31, 2022*	181.20	221.36	385.76	344.10	261.77	**1,394.19**
1st April 2022-31st March, 2023#	655.60	923.17	1714.66	1286.82	933.46	**5513.72**
1st April 2023-31st December, 2023#	506.53	717.51	1434.17	837.33	730.12	**4225.66**
1st January, 2024 to 31st January, 2024^	59.41	83.96	161.63	89.79	80.93	**475.72**
1st February, 2024 to 29th February, 2024^	61.37	85.16	163.65	85.24	79.13	**474.56**
Total	**1,464.12**	**2031.17**	**3859.88**	**2643.28**	**2085.41**	**12,083.85**

R2 Toll Roads

The details of the revenue of the R2 Toll Roads for the preceding three financial years ended March 31, 2022, March 31, 2021 and March 31, 2020 and for the nine months period ended December 31, 2023 as provided by the Sponsor by way of its letter dated September 21, 2022 are disclosed below:

Assured remittance details as per Tolling Contracts				
S. No.	**Project Highway**	**Toll Plaza**	**Period**	**Equivalent Annualized Amount per annum (in ₹ million)***
1.	**Agra Bypass**	**Raibha**	16.10.2021-16.10.2022	770
			16.10.2020-16.10.2021	641
			11.07.2020-16.10.2020	463
			12.04.2019-11.07.2020	370
2.	**Shivpuri-Jhansi**	**Raksha**	18.03.2022-18.03.2023	608.9
			29.01.2021-18.03.2022	587.8
			15.01.2020-29.01.2021	463.5
			15.10.2018-15.01.2020	466.4
3.	**Borkhedi-Wadner**	**Daroda**	24.12.2021-24.12.2022	657.7
			21.12.2020-24.12.2021	605.1
			23.09.2020-23.12.2020	516.8
			17.09.2019-23.09.2020	383.6
			24.05.2019-17.09.2019	332.5
		Kelapur	20.11.2021-20-12-2022	732.5
			11.09.2021-20.11.2021	684.3
			05.08.2021-11.09.2021	648.9
			12.06.2021-05.08.2021	558.4
			09.02.2021-12.06.2021	634.0
			28.01.2020-09.02.2021	496.8
			31.10.2019-28.01.2020	210.9
			11.09.2018-31.10.2019	197.7

**Note: The above assured remittances are as per the contractually agreed terms with the tolling contractors. However, the remittance amount payable by the tolling contractor gets revised every year from April 1 based on the revision of the toll rate revision for the year. Accordingly, the current remittance amounts (with effect from April 1, 2022) payable by the tolling contractor are as under*:

The details of the revenue of the R2 Toll Roads (i) from October 29, 2022 (i.e. the Appointed Date) up to the financial year ended March 31, 2023; (ii) nine months period ended December 31, 2023; (iii) for the month January 2024 and February 2024 are as follows:

(in ₹ million)

Period	Agra Bypass Project	Shivpuri Jhansi Project	Borkhedi WadnerProject	Total
October 29, 2022 – March 31, 2023	376.94	286.91	693.33	**1357.18**
1st April 2023- 31st December, 2023	764.77	592.40	1,450.57	**2,807.75**
1st January, 2024 to 31st January, 2024	84.32	63.45	155.50	**303.27**
1st February, 2024 to 29th February, 2024	87.83	68.13	162.00	**317.96**
Total	1,313.86	1010.89	2,461.41	**4,786.16**

Target Toll Roads

In terms of the SEBI Exemption, the details of the revenue of the R3 Toll Roads for the preceding three financial years ended March 31, 2021, March 31, 2022 and March 31, 2023 and for the period from April 1, 2023 to February 29, 2024 as provided by the Sponsor by way of its letter dated March 7, 2024 are disclosed below:

Details of Revenue (Contracted Revenue) from the assets which are transferred to NEPPL*

S.No.	Project Stretch	Toll Plaza	Period	Equivalent Annualized Amount (Rs cr/annum)
1	Kaljhar to Patacharkuchi	Galia (Plaza commenced w.e.f. 16.11.2021)	03.08.2023- 03.08.2024	36.6
			03.08.2022 -03.08.2023	30.3
			23.03.2022-03.08.2022	29.26
			16.11.2021-23.03.2022	28.8
2	Hubli-Haveri-Devangere-Chitradurga	Bankapur	18.01.2024 - 18.01.2025	102.1
			12.01.2023- 18.01.2024	53.8
			08.01.2022 – 12.01.2023	47.8
			17.12.2020-08.01.2022	46.2
			24.09.2020- 17.12.2020	39.0
			14.08.2020-24.09.2020	32.23
			02.04.2019-14.08.2020	45.68
2	Hubli-Haveri-Devangere-Chitradurga	Hebbalu	29.03.2023-29.03.2024	125.7
			29.03.2022-29.03.2023	55.1
			02.03.2021-02.03.2022	53.4
			21.03.2020 to 02.03.2021	`52.54
2	Hubli-Haveri-Devangere-Chitradurga	Chalageri	17.02.2024 -17.05.2024	140.10
			05.05.2023-17.02.2024	146.5
			05.05.2022 - 05.05.2023	71.6
			22.03.2022 to 05.05.2022	71.08
			22.01.2022-22.03.2022	67.05
			08.01.2021 -22.01.2022	64.27
			15.10.2020 - 08.01.2021	55.99
			12.09.2020-15.10.2020	45.88
			08.08.2020-12.09.2020	40.65
			21.11.2019-08.08.2020	55.81
3	Lakhnadon- Mahagaon-Khawasa	Madai	26.08.2023-26.08.2024	109.6
			26.08.2022-26.08.2023	90.4
			26.04.2022 -26.08.2022	89.45
			03.03.2022-26.04.2022	77.06
			29.12.2021-03.03.2022	74.04
			25.12.2020-29.12.2021	64.08
			22.09.2020-25.12.2020	41.35
			06.08.2020-22.09.2020	30.55
			18.12.2019-06.08.2020	54.20

3	Lakhnadon- Mahagaon-Khawasa	Khawasa (Plaza started on 19.02.2021)	19.09.2023-19.09.2024	98.0
			19.09.2022 -19.09.2023	81.5
			19.09.2021-19.09.2022	55.6
			30.07.2021-19.09.2021	50.8
			29.05.2021-30.07.2021	42.99
			19.02.2021-29.05.2021	43.29
4	Kachugaon-Rakhaldubi Bus Junction & Rakhaldubi Bus Junction - Kaljhar	Patgaon	29.11.2023 - 29.11.2024	70.3
			18.11.2022- 29.11.2023	58.9
			18.06.2022 - 18.11.2022	58.0
			30.03.2022 - 18.06.2022	52.2
			11.12.2020- 30.03.2022	50.6
			10.09.2020- 11.12.2020	34.7
			08.02.2020 - 10.09.2020	27.1
4	Kachugaon-Rakhaldubi Bus Junction & Rakhaldubi Bus Junction - Kaljhar	Dahalapara	29.11.2023 - 29.11.2024	69.7
			18.11.2022- 29.11.2023	60.3
			29.06.2022 - 18.11.2022	61.5
			29.06.2021 - 29.06.2022	55.5
			06.06.2020 - 29.06.2021	36.9
			30.01.2020 - 06.06.2020	27.9
5	Rewa-Katni-Jabalpur-Lakhnadon	Odhaki	01.05.2023 - 01.05.2024	58.9
			01.05.2022-01.05.2023	50.6
			01.05.2021 - 01.05.2022	48.6
			06.02.2021 - 01.05.2021	47.6
			19.09.2020 - 06.02.2021	44.2
			01.08.2020 - 19.09.2020	41.6
			29.02.2020 - 01.08.2020	41.5
5	Rewa-Katni-Jabalpur-Lakhnadon	Kherwasani	01-01-2024- 01-01-2025	80.12
			05-01-2023- 01-01-2024	66.4
			01.01.2022 - 01.01.2023	55.2
			29.10.2021 - 01.01.2022	52.3
			16.08.2021 - 29.10.2021	56.1
			23.06.2020 - 16.08.2021	46.7
			22.12.2019 - 23.06.2020	42.5
5	Rewa-Katni-Jabalpur-Lakhnadon	Mohtara	25.03.2023 - 25.03.2024	81.7
			25.03.2022 - 25.03.2023	62.2
			01.01.2022 - 25.03.2022	61.6
			25.12.2022 - 01.01.2022	57.5
			17.09.2020 - 25.12.2020	48.6
			20.07.2020 - 17.09.2020	47.0
			05.02.2020 - 20.07.2020	48.9
5	Rewa-Katni-Jabalpur-Lakhnadon	Boharipar	15.03.2023 - 15.03.2024	63.5
			15.03.2022 - 15.03.2023	53.1
			09.03.2021 - 15.03.2022	50.4
			25.12.2020 - 09.03.2021	56.8
			09.10.2020 - 25.12.2020	43.1

			14.07.2020 - 09.10.2020	36.8
			13.02.2020 - 14.07.2020	48.6
6	Orai-Bara	Usaka	05.07.2023 -05.07.2024	123.8
			05.04.2022 -05.07.2023	112.12
			22.02.2022- 05.04.2022	102.6
			16.11.2020 - 22.02.2022	107.0
			24.09.2020 - 16.11.2020	90.4
			20.08.2020 - 24.09.2020	81.1
			10.03.2020 - 20.08.2020	101.4
6	Chichira-Kharagpur	Bhalibhasa	02.07.2023-02.07.2024	92.5
			22.03.2022 - 22.07.2023	82.12
			22.12.2021 - 22.03.2022	81.7
			17.10.2020 - 22.12.2021	69.5
			17.07.2020 - 17.10.2020	60.4

*** The details above are as per work order issued by CO Division and the annualized amount is subject to revision in between of the contract due to annual rate revision.**

The above assured remittances are as per contract values. However, the remittance amount payable by the tolling contractor gets revised every year from 1st April based on the toll rate revision for the year. Accordingly the current remittance amounts as on date for FY 23-24 payable by the tolling contractor are as under:

S.No.	Project Stretch	Toll Plaza	Current Annualized (Rs cr/annum) Equivalent Amount
1	Kaljhar to Patacharkuchi	Galia	36.6
2	Hubli-Haveri-Devangere-Chitradurga	Bankapur	102.1
	Hubli-Haveri-Devangere-Chitradurga	Hebbalu	131.61
	Hubli-Haveri-Devangere-Chitradurga	Chalageri	140.10
3	Lakhnadon- Mahagaon- Khawasa	Madai	109.6
	Lakhnadon- Mahagaon- Khawasa	Khawasa	98.0
4	Kachugaon-Rakhaldubi Bus Junction & Rakhaldubi Bus Junction - Kaljhar	Patgaon	70.3

S.No.	Project Stretch	Toll Plaza	Current Annualized (Rs cr/annum) Equivalent Amount
	Kachugaon-Rakhaldubi Bus Junction & Rakhaldubi Bus Junction - Kaljhar	Dahalapara	69.7
5	Rewa-Katni-Jabalpur-Lakhnadon	Odhaki	58.9
	Rewa-Katni-Jabalpur-Lakhnadon	Kherwasani	80.12
	Rewa-Katni-Jabalpur-Lakhnadon	Mohtara	83.7
	Rewa-Katni-Jabalpur-Lakhnadon	Boharipar	65.1
6	Orai-Bara	Usaka	123.8
7	Chichira-Kharagpur	Bhalibhasa	92.5

DECLARATION

The Investment Manager declares and certifies that all relevant provisions of the InvIT Regulations, the SEBI Institutional Placement Guidelines, SEBI Act and all regulations and guidelines issued by the GoI or SEBI (as the case may be) have been complied with and no statement made in this Placement Document is contrary to the provisions of the InvIT Regulations, the SEBI Institutional Placement Guidelines, the SCRA, SEBI Act and all regulations and guidelines issued by the GoI or SEBI (as the case may be). The Investment Manager further certifies that all the statements and disclosures in this Placement Document are material, true, correct, not misleading and adequate in order to enable the Bidders to make a well informed decision.

For National Highways Infra Investment Managers Private Limited

Suresh Goyal
Managing Director and Chief Executive Officer

Place: Delhi
Date: March 15, 2024

DECLARATION

The Investment Manager declares and certifies that all relevant provisions of the InvIT Regulations, the SEBI Institutional Placement Guidelines, SEBI Act and all regulations and guidelines issued by the GoI or SEBI (as the case may be) have been complied with and no statement made in this Placement Document is contrary to the provisions of the InvIT Regulations, the SEBI Institutional Placement Guidelines, the SCRA, SEBI Act and all regulations and guidelines issued by the GoI or SEBI (as the case may be). The Investment Manager further certifies that all the statements and disclosures in this Placement Document are material, true, correct, not misleading and adequate in order to enable the Bidders to make a well informed decision.

For National Highways Infra Investment Managers Private Limited

N.R.V.V.M.K. Rajendra Kumar
Nominee Director

Place: Mumbai
Date: March 15, 2024

DECLARATION

The Investment Manager declares and certifies that all relevant provisions of the InvIT Regulations, the SEBI Institutional Placement Guidelines, SEBI Act and all regulations and guidelines issued by the GoI or SEBI (as the case may be) have been complied with and no statement made in this Placement Document is contrary to the provisions of the InvIT Regulations, the SEBI Institutional Placement Guidelines, the SCRA, SEBI Act and all regulations and guidelines issued by the GoI or SEBI (as the case may be). The Investment Manager further certifies that all the statements and disclosures in this Placement Document are material, true, correct, not misleading and adequate in order to enable the Bidders to make a well informed decision.

For National Highways Infra Investment Managers Private Limited

Mahavir Parsad Sharma
Independent Director

Place: Delhi
Date: March 15, 2024

DECLARATION

The Investment Manager declares and certifies that all relevant provisions of the InvIT Regulations, the SEBI Institutional Placement Guidelines, SEBI Act and all regulations and guidelines issued by the GoI or SEBI (as the case may be) have been complied with and no statement made in this Placement Document is contrary to the provisions of the InvIT Regulations, the SEBI Institutional Placement Guidelines, the SCRA, SEBI Act and all regulations and guidelines issued by the GoI or SEBI (as the case may be). The Investment Manager further certifies that all the statements and disclosures in this Placement Document are material, true, correct, not misleading and adequate in order to enable the Bidders to make a well informed decision.

For National Highways Infra Investment Managers Private Limited

Shailendra Narain Roy
Independent Director

Place: Delhi
Date: March 15, 2024

DECLARATION

The Investment Manager declares and certifies that all relevant provisions of the InvIT Regulations, the SEBI Institutional Placement Guidelines, SEBI Act and all regulations and guidelines issued by the GoI or SEBI (as the case may be) have been complied with and no statement made in this Placement Document is contrary to the provisions of the InvIT Regulations, the SEBI Institutional Placement Guidelines, the SCRA, SEBI Act and all regulations and guidelines issued by the GoI or SEBI (as the case may be). The Investment Manager further certifies that all the statements and disclosures in this Placement Document are material, true, correct, not misleading and adequate in order to enable the Bidders to make a well informed decision.

For National Highways Infra Investment Managers Private Limited

Pushkar Kulkarni
Unitholder Nominee Director

Place: Mumbai
Date: March 15, 2024

DECLARATION

The Investment Manager declares and certifies that all relevant provisions of the InvIT Regulations, the SEBI Institutional Placement Guidelines, SEBI Act and all regulations and guidelines issued by the GoI or SEBI (as the case may be) have been complied with and no statement made in this Placement Document is contrary to the provisions of the InvIT Regulations, the SEBI Institutional Placement Guidelines, the SCRA, SEBI Act and all regulations and guidelines issued by the GoI or SEBI (as the case may be). The Investment Manager further certifies that all the statements and disclosures in this Placement Document are material, true, correct, not misleading and adequate in order to enable the Bidders to make a well informed decision.

For National Highways Infra Investment Managers Private Limited

Debapratim Hajara
Unitholder Nominee Director

Place: Singapore
Date: March 15, 2024

DECLARATION

The Investment Manager declares and certifies that all relevant provisions of the InvIT Regulations, the SEBI Institutional Placement Guidelines, SEBI Act and all regulations and guidelines issued by the GoI or SEBI (as the case may be) have been complied with and no statement made in this Placement Document is contrary to the provisions of the InvIT Regulations, the SEBI Institutional Placement Guidelines, the SCRA, SEBI Act and all regulations and guidelines issued by the GoI or SEBI (as the case may be). The Investment Manager further certifies that all the statements and disclosures in this Placement Document are material, true, correct, not misleading and adequate in order to enable the Bidders to make a well informed decision.

For National Highways Infra Investment Managers Private Limited

Pradeep Singh Kharola
Independent Director

Place: Delhi
Date: March 15, 2024

DECLARATION

The Investment Manager declares and certifies that all relevant provisions of the InvIT Regulations, the SEBI Institutional Placement Guidelines, SEBI Act and all regulations and guidelines issued by the GoI or SEBI (as the case may be) have been complied with and no statement made in this Placement Document is contrary to the provisions of the InvIT Regulations, the SEBI Institutional Placement Guidelines, the SCRA, SEBI Act and all regulations and guidelines issued by the GoI or SEBI (as the case may be). The Investment Manager further certifies that all the statements and disclosures in this Placement Document are material, true, correct, not misleading and adequate in order to enable the Bidders to make a well informed decision.

For National Highways Infra Investment Managers Private Limited

Sumit Bose
Independent Director

Place: Delhi
Date: March 15, 2024

DECLARATION

The Trustee declares and certifies that all relevant provisions of the InvIT Regulations, the SEBI Institutional Placement Guidelines, SEBI Act and all regulations and guidelines issued by the GoI or SEBI (as the case may be) have been complied with and no statement made in this Placement Document is contrary to the provisions of the InvIT Regulations, the SEBI Institutional Placement Guidelines, the SCRA, SEBI Act and all regulations and guidelines issued by the GoI or SEBI (as the case may be). The Trustee further certifies that all the statements and disclosures in this Placement Document are material, true, correct, not misleading and adequate in order to enable the Bidders to make a well informed decision.

For and on behalf of IDBI Trusteeship Services Limited

Authorised Signatory
Place: New Delhi
Date: March 15, 2024

ANNEXURE A

AUDITED FINANCIAL INFORMATION

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A. R. & Co.
Chartered Accountant

A-403, Gayatri Apartments
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INDEPENDENT AUDITORS' REPORT

To,
The Unit Holders of National Highways Infra Trust

Opinion

We have audited the condensed consolidated interim financial statements of National Highways Infra Trust ("the 'Trust') "), which comprise the condensed consolidated interim balance sheet as at 31 December 2023, the condensed consolidated interim statement of profit and loss (including other comprehensive income) for year to-date period then ended, and the condensed consolidated interim statement of cash flows for the year-to-date period then ended, the condensed Statement of Net Assets at fair value for the year-to-date period then ended, the condensed Statement of Total Returns at fair value and the condensed Statement of Net Distributable Cash Flows ("NDCFs") for the year-to-date period then ended and notes to the condensed consolidated interim financial statements, including a summary of the significant accounting policies ("the condensed consolidated interim financial statements") and other explanatory information, as required by Indian Accounting Standard 34, "Interim Financial Reporting" ("Ind AS 34") and other accounting principles generally accepted in India.

In our opinion and to the best of our information and according to the explanations given to us, the aforesaid condensed consolidated interim financial statements give the information required by the Securities and Exchange Board of India (Infrastructure Investment Trusts) Regulations, 2014 as amended from time to time including any guidelines
and circulars issued thereunder (together referred to as the "SEBI InvIT Regulations") in the manner so required and give a true and fair view in conformity with Ind AS 34 and other accounting principles generally accepted in India, to the extent not inconsistent with SEBI InvIT Regulations, of the state of affairs of the Trust, as at 31 December 2023, Profit and other comprehensive income for the year-to-date period then ended , its cash flows for the year-to-date-period ended on that date, its statement of changes in Unitholder's equity for the year-to-date period then ended, its net assets at fair value as at 31 December 2023, its total returns at fair value and the net distributable cash flows of the Trust for the year-to-date period then ended..

Basis for Opinion

We conducted our audit in accordance with the Standards on Auditing ("SAs") issued by the Institute of Chartered Accountants of India. Our responsibilities under those SAs are further described in the Auditor's Responsibilities for the Audit of the Condensed Consolidated Interim Financial Statements section of our report. We are independent of the Trust in accordance with the Code of Ethics issued by the Institute of Chartered Accountants of India together with the ethical requirements that are relevant to our audit of the condensed consolidated interim financial statements under the provisions of the of the SEBI InvIT Regulations, and we have fulfilled our other ethical responsibilities in accordance with

A.R. & Co. New Delhi Chartered Accountants

A. R. & Co.
Chartered Accountant

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these requirements and the Code of Ethics. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

RESPONSIBILITIES OF THE BOARD OF DIRECTORS OF INVESTMENT MANAGER FOR THE CONDENSED CONSOLIDATED INTERIM FINANCIAL STATEMENTS

The Board of Directors of National Highways Infra Investment Managers Private Limited (Investment Manager) is are responsible for the preparation of these condensed consolidated interim financial statements that give a true and fair view of the state of affairs, profit and other comprehensive income , cash flows and the movement of the Unitholder's equity for the year-to-date period then ended, the net assets at fair value as at 31 December 2023, the total returns at fair value and the net distributable cash flows of the Trust in accordance with the requirements of the SEBI InvIT Regulations, Indian Accounting Standards as defined in Rule 2(1)(a) of Companies (Indian Accounting Standards) Rules, 2015, as amended and other accounting principles generally accepted in India, to the extent not inconsistent with SEBI InvIT Regulations.
This responsibility also includes maintenance of adequate accounting records in accordance with the provisions of the SEBI Invit Regulations for safeguarding of the assets of the Trust and for preventing and detecting frauds and other irregularities; selection and application of appropriate accounting policies; making judgments and estimates that are reasonable and prudent; and design, implementation and maintenance of adequate internal financial controls that were operating effectively for ensuring accuracy and completeness of the accounting records, relevant to the preparation and presentation of the condensed consolidated interim financial statements that give a true and fair view and are free from material misstatement, whether due to fraud or error.

In preparing the condensed consolidated interim financial statements, the Board of Directors of Investment Manager are responsible for assessing the Trust's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless the management either intends to liquidate the Trust or to cease operations, or has no realistic alternative but to do so.

The Board of Directors of Investment Manager are also responsible for overseeing the Trust's financial reporting process.

Auditor's Responsibilities for the Audit of the Condensed Consolidated Interim Financial Statements

Our objectives are to obtain reasonable assurance about whether the condensed consolidated interim financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditors' report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with SAs will always detect a

A.R. & Co. New Delhi Chartered Accountants

A. R. & Co.
Chartered Accountant

A-403, Gayatri Apartments
Plot No-27, Sector-10, Dwarka,
New Delhi-110075
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E-mail: ar_co1981@yahoo.co.in
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material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these condensed consolidated interim financial statements.

As part of an audit in accordance with SAs, we exercise professional judgment and maintain professional skepticism throughout the audit. We also:

- Identify and assess the risks of material misstatement of the condensed consolidated interim financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.

- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Trust's internal control.

- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by management.

- Conclude on the appropriateness of management's use of the going concern basis of accounting and based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Trust's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditors' report to the related disclosures in the condensed consolidated interim financial statements or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditors' report. However, future events or conditions may cause the Trust to cease to continue as a going concern.

- Evaluate the overall presentation, structure and content of the condensed consolidated interim financial statements, including the disclosures, and whether the condensed consolidated interim financial statements represent the underlying transactions and events in a manner that achieves fair presentation.

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We communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.

We also provide those charged with governance with a statement that we have complied with relevant ethical requirements regarding independence, and communicate with them all relationships and other matters that may reasonably be thought to bear on our independence, and where applicable, related safeguards.

Other Matter

Attention is drawn to the fact that the figures for the year-to-date-period ended on 31 December 2022 as reported in these condensed interim consolidated financial statements, were subject to a limited review by us.

Our opinion is not modified in respect of this matter.

For A. R. & Co.
Chartered Accountants
FRN. 002744C

A.R. & Co. New Delhi Chartered Accountants

CA Mohd Azam Ansari
Partner
Membership No: 0511623
UDIN: 24511623BKCSOP7866
Place: New Delhi
Date: 04-03-2024

NATIONAL HIGHWAYS INFRA TRUST
SEBI Registration Number :-IN/InvIT/20-21/0014
CONSOLIDATED INTERIM BALANCE SHEET AS AT DECEMBER 31, 2023

(All amounts in ₹ lakh unless otherwise stated)

Particulars	Note No.	As at December 31, 2023	As at March 31, 2023
ASSETS			
1) Non - Current Assets			
(a) Property, Plant and Equipment	3	184.45	125.17
(b) Goodwill	4	10,144.46	10,144.46
(c) Intangible assets	5	10,95,766.28	10,01,400.09
(d) Financial Assets			
(i) Other Financial Assets	6	10,058.79	9,672.44
(e) Deferred Tax Assets (net)	7	9,305.55	4,685.32
(f) Other Non Current Assets	8	1,519.81	-
(g) Non -Current Tax Assets (Net)	9	16.81	12.06
Total non-current assets		**11,26,996.15**	**10,26,039.54**
2) Current Assets			
(a) Financial Assets			
(i) Trade receivables	10	660.05	350.87
(ii) Cash and Cash Equivalents	11	24,008.63	21,124.08
(iii) Bank Balances Other than Cash & Cash Equivalents	12	512.43	-
(iii) Other financial assets	13	4.74	6.65
(b) Other current assets	14	2,388.08	1,634.06
Total current assets		**27,573.93**	**23,115.66**
TOTAL ASSETS		**11,54,570.08**	**10,49,155.20**
EQUITY AND LIABILITIES			
EQUITY			
1) Unit Capital	15	7,41,593.47	7,41,604.32
2) Initial settlement amount		0.10	0.10
3) Other Equity	16	(17,205.93)	(2,469.86)
Total Equity		**7,24,387.64**	**7,39,134.56**
LIABILITIES			
1) Non-Current liabilities			
(a) Financial liabilities			
(i) Borrowings	17	2,95,648.02	2,92,158.33
(ii) Other Financial liabilities	18	28.98	-
(b) Provisions	19	43,474.19	6,318.81
Total non-current liabilities		**3,39,151.19**	**2,98,477.14**
2) Current liabilities			
(a) Financial liabilities			
(i) Borrowings	20	4,192.50	2,000.00
(ii) Trade Payables	21		
(a) Total Outstanding, dues of micro and small enterprises		660.96	137.23
(b) Total outstanding, dues of creditors other than micro and small enterprises		3,475.72	3,871.17
(iii) Other financial liabilities	22	2,737.40	5,284.95
(b) Other current liabilities	23	71.19	240.61
(c) Provisions	24	79,849.77	0.56
(d) Current Tax Liabilities (Net)	25	43.71	8.98
Total current liabilities		**91,031.25**	**11,543.50**
TOTAL EQUITY & LIABILITIES		**11,54,570.08**	**10,49,155.20**

The accompanying notes form an integral part of these consolidated financial statements. 1 - 56

This is the Consolidated Balance Sheet referred to in our report of even date.

For A.R. & Co.
Chartered Accountants
Firm Registration no. 002744C

A.R. & Co. New Delhi Chartered Accountants

CA Mohd. Azam Ansari
Partner
M.No.511623

Date : 04-03-2024
Place : New Delhi

For and on behalf Board of the National Highways Infra Investment Managers Private Limited (Investment Manager of National Highways Infra Trust)

Suresh Krishan Goyal
Director
DIN: 02721580

Mahavir Parsad Sharma
Director
DIN: 03158413

National Highways Infra Trust New Delhi

Mathew George
Chief Financial Officer

Gunjan Singh
Compliance Officer

NATIONAL HIGHWAYS INFRA TRUST
SEBI Registration Number :-IN/InvIT/20-21/0014
CONSOLIDATED INTERIM STATEMENT OF PROFIT AND LOSS FOR THE YEAR ENDED DECEMBER 31, 2023

(All amounts in ₹ lakh unless otherwise stated)

Particulars	Note No.	For the nine month ended December 31, 2023	For the nine month ended December 31, 2022	For the year ended March 31, 2023
INCOME				
Revenue from Operations	26	70,334.10	46,937.59	68,717.20
Interest Income	27	667.77	130.96	373.43
Profit on sale of investments	28	797.49	540.15	671.17
Other Income	29	26.35	61.16	326.11
TOTAL INCOME		**71,825.71**	**47,669.86**	**70,087.91**
EXPENSES				
Investment Manger Fee		1,356.16	935.51	1,263.70
Trusteeship Fee		8.73	7.23	9.60
Valuation expenses		5.40	4.00	4.00
Annual listing fees		40.53	15.07	20.00
Rating fees		6.35	0.20	0.20
Insurance expenses		573.32	435.52	628.74
Custodian Fees		2.38	0.63	0.84
Project Management Fees		743.40	743.40	991.20
Operating Expenses	30	10,770.38	5,650.22	9,025.05
Employee Benefits Expenses	31	843.96	139.09	296.22
Finance Cost	32	19,565.51	10,693.87	16,621.32
Depreciation & Amortization Expense	33	17,660.65	11,756.98	17,560.63
Other Expenses	34	1,602.61	626.95	1,917.06
Audit Fees	35			
- Statutory audit fees		13.44	5.81	7.73
- Other audit services (including certification)		1.04	0.09	0.93
TOTAL EXPENSES		**53,193.86**	**31,014.57**	**48,347.22**
Profit / (Loss) before Tax		**18,631.85**	**16,655.29**	**21,740.69**
Tax Expenses	36			
Current Tax		408.31	248.13	473.89
Current tax - earlier years		(2.52)	0.01	0.01
Deferred Tax expense/(credit)		(4,620.23)	(2,956.42)	(4,422.79)
Total Tax	-	**(4,214.44)**	**(2,708.28)**	**(3,948.89)**
Profit/ (loss) for the period	-	**22,846.29**	**19,363.57**	**25,689.57**
Other Comprehensive Income				
Items that will not be reclassified to Profit and Loss		(2.24)	-	-
Income tax relating to items that will not be reclassified to profit or loss		0.45	-	-
		(1.79)	-	-
Total Comprehensive Income for the year/ period	-	**22,844.50**	**19,363.57**	**25,689.57**
Earnings per Unit				
Basic	37	3.14	3.05	3.91
Diluted	37	3.14	3.05	3.91

The accompanying notes form an integral part of these consolidated financial statements. 1 - 56

This is the Statement of Profit and Loss referred to in our report of even date.

For A.R. & Co.
Chartered Accountants
Firm Registration no. 002744C

CA Mohd. Azam Ansari
Partner
M.No.511623

Date : 04-03-2024
Place : New Delhi

For and on behalf Board of the National Highways Infra Investment Managers Private Limited (Investment Manager of National Highways Infra Trust)

Suresh Krishan Goyal
Director
DIN: 02721580

Mahavir Parsad Sharma
Director
DIN: 03158413

Mathew George
Chief Financial Officer

Gunjan Singh
Compliance Officer

NATIONAL HIGHWAYS INFRA TRUST
SEBI Registration Number :-IN/InvIT/20-21/0014
CONSOLIDATED INTERIM CASH FLOW STATEMENT FOR THE YEAR ENDED DECEMBER 31, 2023

(All amounts in ₹ lakh unless otherwise stated)

Particulars	For the nine month ended December 31, 2023	For the nine month ended December 31, 2022	For the year ended March 31, 2023
A. OPERATING ACTIVITIES			
Net Profit/(Loss) Before Tax	18,631.85	16,655.29	21,740.68
Adjustments for :			
Depreciation and Amortization	17,660.65	11,756.98	17,560.63
Profit on redemption of mutual funds	(797.49)	(540.15)	(671.17)
Interest income from FDR	(667.77)	(130.96)	(373.43)
Finance Cost (net)	18,394.93	10,678.13	16,590.17
Provision for major maintenance expenses	6,666.36	3,567.86	5,879.20
Unwinding interest on major maintenance provision	1,042.86	15.74	24.95
Provision for Laeave encashment and Gratuity	32.79	-	11.93
Provision for expected credit loss	-	-	59.60
Bad debts written off	-	-	9.90
Operating Profit/(Loss) before Working Capital Changes	**60,964.18**	**42,002.89**	**60,832.46**
Working Capital Adjustments:			
Decrease / (Increase) in Trade & Other Receivables	(309.18)	(117.44)	180.10
Decrease / (Increase) in Other Non Current Financial Assets	(0.68)	35.81	(208.85)
Decrease / (Increase) in Other Non Current/Current Assets	(670.49)	(572.50)	(834.96)
Decrease / (Increase) in Other Current Financial Assets	(4.74)	(547.75)	(293.53)
Increase / (Decrease) in Trade & Other Payables	128.32	1,763.94	3,267.01
Increase / (Decrease) in Other Financial Liabilities	(141.94)	380.59	57.50
Increase / (Decrease) in Provisions	(1.37)	(0.00)	(0.11)
Increase / (Decrease) in Other Current Liabilities	(163.37)	(73.52)	(0.14)
	(1,163.45)	**869.13**	**2,167.02**
Income Tax paid	(375.82)	(486.84)	(626.67)
Net Cash Flows from/(used in) Operating Activities	**59,424.91**	**42,385.16**	**62,372.81**
B. INVESTING ACTIVITIES			
Purchase of Property, Plant & Equipment, including CWIP, capital creditors and capital advances	(3,778.38)	(2,85,018.21)	(2,85,101.04)
Long Term Loans given	-	-	-
Investment in FDR	(755.17)	-	(6,299.19)
Interest received on maturity of FDR	530.45	56.15	189.55
Profit on redemption of mutual funds	797.49	540.15	671.17
Net cash flows from (used in) Investing activities	**(3,205.61)**	**(2,84,421.91)**	**(2,90,539.51)**
C. FINANCING ACTIVITIES			
Proceeds from Issue of Unit Capital	-	1,43,013.67	1,43,013.67
Expense incurred towards initial public debt offering	-	-	(1,689.00)
Expense incurred towards institutional unit allotment	(10.85)	(710.23)	(1,099.13)
Proceeds from issue of shares	-	-	-
Distribution to Unit Holders	(37,580.57)	(24,700.80)	(34,927.86)
Proceeds from Long Term Borrowings (net of processing fees)	7,900.00	1,50,000.00	1,50,000.00
Financing charges paid	-	(197.00)	(197.00)
Repayment of Long Term Borrowings	(2,381.07)	(758.63)	(1,010.98)
Finance Costs Paid	(21,262.26)	(9,071.72)	(11,180.86)
Net cash flows from (used in) Financing activities	**(53,334.75)**	**2,57,575.29**	**2,42,908.84**
Net Increase/Decrease in Cash and Cash equivalents (A+B+C)	**2,884.55**	**15,538.54**	**14,742.14**
Cash and cash equivalents at the beginning of the year	21,124.08	6,381.94	6,381.94
Cash and cash equivalents at the end of the year/period	**24,008.63**	**21,920.48**	**21,124.08**

National Highways Infra Trust New Delhi

A.R. & Co. New Delhi Chartered Accountants

Reconciliation of liabilities arising from Financing Activities pursuant to Ind AS 7- Statement of Cash Flows.
Net Debt Recognition

(All amounts in ₹ lakh unless otherwise stated)

Particulars	For the nine month ended December 31, 2023	For the nine month ended December 31, 2022	For the year ended March 31, 2023
a) Carrying amount of debt at the beginning of the year/period	2,94,158.33	1,46,537.80	1,46,537.80
b) Additional borrowings during the year/period	7,900.00	1,50,000.00	1,50,000.00
c) Repayments during the year/period	(2,381.07)	(758.63)	(1,010.98)
d) Other adjustments/settlements during the year/period	-	-	-
e) Transaction Cost adjustment	163.26	(1,366.31)	(1,368.49)
f) Unwinding of interest	-	-	-
g) Carrying amount of debt at the end of the year/period	**2,99,840.52**	**2,94,412.86**	**2,94,158.33**

This is the Consolidated Cash Flow Statement referred to in our report of even date.

For A.R. & Co.
Chartered Accountants
Firm Registration no. 002744C

CA Mohd. Azam Ansari
Partner
M.No.511623

Date : 04-03-2024
Place : New Delhi

For and on behalf of the National Highways Infra Investment Managers Private Limited (Investment Manager of National Highways Infra Trust)

Suresh Krishan Goyal
Director
DIN: 02721580

Mahavir Parsad Sharma
Director
DIN: 03158413

Mathew George
Chief Financial Officer

Gunjan Singh
Compliance Officer

NATIONAL HIGHWAYS INFRA TRUST
SEBI Registration Number :-IN/InvIT/20-21/0014
CONSOLIDATED INTERIM STATEMENT OF CHANGES IN UNIT HOLDER'S EQUITY FOR THE YEAR ENDED DECEMBER 31, 2023

A. Initial Settlement Amount

(All amounts in ₹ lakh unless otherwise stated)

Particulars	Amount
Balance as at April 1, 2022	0.10
Changes in unit capital	-
Balance as at Dec 31, 2022	0.10
Changes in unit capital	-
Balance as at March 31 2023	0.10
Changes in unit capital	-
Balance as at Dec 31, 2023	0.10

B. Unit Capital *

Particulars	Number of unit	Amount
Balance as at April 1, 2022	**59,52,00,000**	**5,99,442.82**
Changes in unit capital	13,12,05,200	1,43,013.67
One time issue expenses	-	(710.23)
Balance as at December 31, 2022	**72,64,05,200**	**7,41,746.26**
Changes in unit capital	-	-
One time issue expenses	-	(141.94)
Balance as at March 31, 2023	**72,64,05,200**	**7,41,604.32**
Changes in unit capital	-	-
One time issue expenses	-	(10.85)
Balance as at December 31, 2023	**72,64,05,200**	**7,41,593.47**

National Highways Infra Trust New Delhi

A.R. & Co. New Delhi Chartered Accountants

C. OTHER EQUITY **

(All amounts in ₹ lakh unless otherwise stated)

Particulars	Reserves and Surplus	Items of Other Comprehensive Income	Total
		Items that will not be reclassified to profit or loss	
	Retained Earnings	Remeasurement of Defined Benefit Obligation/ Plan	
Balance as at April 1, 2022	6,768.43	-	**6,768.43**
Profit/ (Loss) for the year	19,363.57	-	**19,363.57**
Less:			
Distribution to unit holders			-
Interest	(24,137.46)	-	**(24,137.46)**
Other Income	(563.33)	-	**(563.33)**
Balance as at December 31, 2022	1,431.21	-	**1,431.21**
Profit/ (Loss) for the year	6,326.01	-	**6,326.01**
Less:			
Distribution to unit holders			
Interest	(10,046.20)	-	**(10,046.20)**
Other Income	(180.87)	-	**(180.87)**
Balance as at March 31, 2023	**(2,469.86)**	-	**(2,469.86)**
Profit/ (Loss) for the year	22,846.29	(1.79)	22,844.50
Less:			
Distribution to unit holders^			
Interest	(37,001.63)	-	(37,001.63)
Other Income	(578.94)	-	(578.94)
Balance as at December 31, 2023	**(17,204.14)**	**(1.79)**	**(17,205.93)**

^The distribution relates to the distributions during the financial year along with the distribution related to the last quarter of FY 2022-23 and does not include the distribution relating to the period October 01, 2023 to December 31, 2023 which will be paid after December 31, 2023. The distributions by the Trust to its unit holders are based on the Net Distributable Cash Flows of the Trust under the SEBI InvIT Regulations.

* Refer Note No. 15
** Refer Note No. 16

For A.R. & Co.
Chartered Accountants
Firm Registration no. 002744C

CA Mohd. Azam Ansari
Partner
M.No.511623

Date : 04-03-2024
Place : New Delhi

For and on behalf of the National Highways Infra Investment Managers Private Limited (Investment Manager of National Highways Infra Trust)

Suresh Krishan Goyal
Director
DIN: 02721580

Mahavir Parsad Sharma
Director
DIN: 03158413

Mathew George
Chief Financial Officer

Gunjan Singh
Compliance Officer

NATIONAL HIGHWAYS INFRA TRUST

SEBI Registration Number :-IN/InvIT/20-21/0014

Disclosures pursuant to SEBI circulars (SEBI Master Circular No. CIRSEBI/HO/DDHS_Div3/P/CIR/2021/1673 dated 29 November 2021 issued under the InvIT regulations)

Consolidated Statement of Net Assets at Fair Value

(All amounts are in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023		As at March 31, 2023	
	Book value	Fair value^	Book value	Fair value^
A. Assets	11,54,570.08	13,34,977.84	10,49,155.20	11,68,122.00
B. Liabilities (at book value)	4,30,182.44	4,30,182.44	3,10,020.64	3,10,020.64
C. Net assets (A-B)	**7,24,387.64**	**9,04,795.40**	**7,39,134.56**	**8,58,101.36**
D. No of units	72,64,05,200.00	72,64,05,200.00	72,64,05,200.00	72,64,05,200.00
E. NAV (C/D)	**99.72**	**124.56**	**101.75**	**118.13**

^Fair values of total assets relating to the Trust as at December 31, 2023 & March 31, 2023 as disclosed above are based on the independent valuer report.

Consolidated Statement of Total Return at Fair Value:

(All amounts are in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023	As at March 31, 2023
Total comprehensive income for the year (As per the Consolidated Statement of Profit and Loss)	22,844.50	25,689.57
Add: Other changes in fair value for the year/period *	1,80,407.76	1,18,966.80
Total return	**2,03,252.26**	**1,44,656.38**

* In the above statement, other changes in fair value for the period ended December 31, 2023 & March 31, 2023 have been computed based on best estimates of the management.

The accompanying notes form an integral part of the Consolidated Financial Statements.

This is the Consolidated Statement of Net Assets at Fair Value and Consolidated Statement of Total Return at Fair Value referred to in our report of even date.

National Highways Infra Trust New Delhi

A.R. & Co. New Delhi Chartered Accountants

NATIONAL HIGHWAYS INFRA TRUST
SEBI Registration Number :-IN/InvIT/20-21/0014

Disclosures pursuant to SEBI circulars (SEBI Master Circular No. CIRSEBI/HO/DDHS_Div3/P/CIR/2021/1673 dated 29th November, 2021 issued under the InvIT regulations)

a. Statement of Net Distributable Cash Flows (NDCF) at Trust Level (NHIT)

(All amounts in ₹ lakh unless otherwise stated)

S. No.	Particulars	For the nine month ended December 31, 2023
1	**Profit after tax as per Statement of profit and loss/income and expenditure (Standalone) (A)**	**70,715.37**
2	Add:- Income recognised in previous year and received in this year	46,688.43
3	Less:- Interest expenses recognised in previous year and paid in this period	(5,129.59)
4	**Add:** Depreciation and amortization as per statement of profit and loss account. Incase of Impairment reversal, same needs to be deducted from profit and loss.	-
5	**Add/Less:** Loss/gain on sale of infrastructure assets	-
6	**Add:** Proceeds from sale of infrastructure assests adjusted for the following: related debts settled or due to be settled from sale proceeds; directly attributable transaction costs; proceeds reinvested or planned to be reinvested as per Regulation 18(7)(a) of the InvIT regulations	-
7	**Add:** Proceeds from sale of infrastructure assets not distributed pursuant to an earlier plan to re-invest, if such proceeds are not intended to be invested subsequently, net of any profit/ (loss) recognised in profit and loss account.	-
8	**Add/ Less:** Any other item of non- cash expense/ non cash income (net of actual cash flows for these items), if deemed necessary by the Investment Manager. For example, any decrease/ increase in carrying amount of an asset or a liability recognised in profit and loss /income and expenditure on measurement of the asset or the liability at fair value; Interest cost as per effective interest rate method, deferred tax lease rents recognised on a straight line basis, etc.	(71,361.51)
9	**Less:** Repayment of external debt (principal) / redeemable preference shares / debentures, etc. (excluding refinancing) / net cash set aside to comply with DSRA requirement under loan agreements.	(2,643.74)
10	**Total Adjustment (B)**	**(32,446.41)**
11	**Net Surplus (C) = (A+B)**	**38,268.96**
12	Less: NDCF already distributed to Unitholders in Q1 & Q2 of FY 23-24	25,932.66
13	**Balance Net Distributable Cash Flows for the nine months ended 31 December 2023**	**12,336.30**

National Highways Infra Trust New Delhi

A.R. & Co. New Delhi Chartered Accountants

NATIONAL HIGHWAYS INFRA TRUST
SEBI Registration Number :-IN/InvIT/20-21/0014

Disclosures pursuant to SEBI circulars (SEBI Master Circular No. CIRSEBI/HO/DDHS_Div3/P/CIR/2021/1673 dated 29th November, 2021 issued under the InvIT regulations)

b. Statement of Net Distributable Cash Flows (NDCF) at SPV Level (NHIPPL)

(All amounts in ₹ lakh unless otherwise stated)

S. No.	Particulars	Nine Months ended 31 December, 2023
1	**Loss after tax as per Statement of profit and loss/income and expenditure (Standalone) (A)**	**(47,856.07)**
2	**Add:** Depreciation and amortization as per statement of profit and loss account. Incase of Impairment reversal, same needs to be deducted from profit and loss.	17,660.56
3	**Add/Less:** Loss/gain on sale of infrastructure assets	-
4	**Add:** Proceeds from sale of infrastructure assests adjusted for the following: related debts settled or due to be settled from sale proceeds; directly attributable transaction costs; proceeds reinvested or planned to be reinvested as per Regulation 18(7)(a) of the InvIT regulations	-
5	**Add:** Proceeds from sale of infrastructure assets not distributed pursuant to an earlier plan to re-invest, if such proceeds are not intended to be invested subsequently, net of any profit/ (loss) recognised in profit and loss account. *	(92.63)
6	**Add/ Less:** Any other item of non- cash expense/ non cash income (net of actual cash flows for these items), if deemed necessary by the Investment Manager. For example, any decrease/ increase in carrying amount of an asset or a liability recognised in profit and loss /income and expenditure on measurement of the asset or the liability at fair value; Interest cost as per effective interest rate method, deferred tax lease rents recognised on a straight line basis, etc.	93,309.42
7	**Less:** Repayment of external debt (principal) / redeemable preference shares / debentures, etc. (excluding refinancing) / net cash set aside to comply with DSRA requirement under loan agreements.	(492.50)
8	**Total Adjustments (B)**	1,10,384.85
9	**Opening Surplus from previous FY 22-23 (C)**	3,896.22
10	**Net Distributable Cash Flows (D) = (A+B+C)**	**66,425.00**
11	**Less: Distributions paid to Trust (as Interest Pass through)**	**(63,355.93)**
12	**Balance Distributable Cash Flow upto Dec 2023**	**3,069.07**

* This includes amount utilized for purchase of Property, Plant and Equipment's and Intangible Assets

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NATIONAL HIGHWAYS INFRA TRUST
SEBI Registration Number :-IN/InvIT/20-21/0014
Notes to the Consolidated Interim Financial Statements for the period ended December 31, 2023

1 TRUST INFORMATION AND NATURE OF OPERATIONS

National Highways Infra Trust ("Trust" or "InvIT") is an irrevocable trust registered under the provisions of the Indian Trusts Act, 1882 on 19th October 2020. It is registered under the Securities and Exchange Board of India (Infrastructure Investment Trust) Regulations, 2014 on 28th October 2020 having registration number IN/InvIT/20-21/0014.

The Trust was setup by National Highways Authority of India ("NHAI" or the "Sponsor"). The Trustee to the Trust is IDBI Trusteeship Services Limited (the "Trustee") and Investment Manager for the Trust is National Highways Infra Investment Managers Private Limited ("Investment Manager").

The Trust has been formed to invest in infrastructure assets primarily being in the road sector in India. The Trust's road projects are implemented and held through special purpose vehicles ("Project SPVs"/ "Subsidiaries"). The units of the Trust were listed in Bombay Stock Exchange and National Stock Exchange on 10th November 2021.

During the FY 2021-22, the Trust acquired 100% equity control in National Highway Infra Projects Private Limited (the "Project SPV") from the Sponsor with effect from 3rd November 2021. During the FY 2020-21 the project SPV entered into five Concession Agreements for 30 years with the Sponsor (National Highways Authority of India - NHAI) on Toll, Operate and Transfer ('TOT') basis and in FY 2022-23 NHIPPL further signed 3 new Concession Agreements for 20 years with National Highways Authority of India for Toll, Operate and Transfer ('TOT') basis. Further, during the period ended Dec 31, 2023, the Trust has invested the amount of Rs. 10 Lakh in the equity share capital of the NHIT Eastern Projects Private Limited (the "Project SPV-II") on 16th June 2023.

2 Basis of Preparation

The Consolidated financial statements comprises of the Consolidated Balance Sheet, Consolidated Statement of Profit and Loss, Consolidated Cash Flow Statement, Consolidated Statement of Changes in Equity and Consolidated explanatory notes thereon of National Highways Infra Trust, for the nine months ended 31 December 2023 ("Interim Financial Information"). The Interim financial Information has been prepared in accordance with recognition and measurement principles laid down in Indian Accounting Standard 34- Interim Financial Reporting (Ind AS 34), as presribed in Rule 2(1)(a) of the Companies (Indian Accounting Standards) Rules, 2015 (as amended) and other accounting principles generally accepted in India, to the extent not inconsistent with the Securities and Exchange Board of India (Infrastructure Investment Trusts) Regulations, 2014, as amended, the additional disclosures as required in Chapter 4 of SEBI Master Circular No. SEBI/HO/DDHS-PoD 2/P/CIR/2023/115 dated 06 July 2023 as amended including any guidelines and circulars issued thereunder ("SEBI Circulars/InvIT Regulations")

The Consolidated financial statements were authorised for issue in accordance with resolution passed by the board of directors of the Investment Manager on 04.03.2024.

The audit of these Interim Financials for the Nine months ended December 31, 2023 of NHIT has been carried out by the Statutory Auditors of NHIT.

New amendments adopted during the period

The Ministry of Corporate Affairs has notified Companies (Indian Accounting Standards) Amendment Rules, 2023 dated 31 March 2023 to amend the following Ind AS:

Ind AS 8, Accounting Policies, Changes in Accounting Estimates and Errors
Ind AS 1, Presentation of Financial Statements
Ind AS 12, Income Taxes

The amendments are applicable for annual periods beginning on or after the April 1, 2023, however, these do not have material impact on the financial statements of the Group.

2.1 Material accounting policies and key sources of estimation uncertainities and critical judgements

A Material accounting policies

The accounting policies adopted in preparation of these financial statements are consistent with those followed in preparation of the Group's latest Annual Consolidated Financial Statements.

B Key sources of estimation uncertainities and critical judgements

The preparation of the consolidated financial statements requires use of certain critical accounting estimates and judgements. It also requires the management to exercise judgement in the process of applying the Group's accounting policies. The areas where judgements and estimates are significant to the financial statements or areas involving a higher degree of judgement or complexity are the same as those applied to the Group's latest Annual Consolidated Financial Statements.

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Notes to the Consolidated Interim Financial Statements for the period ended December 31, 2023

3 Property, Plant and Equipment

(All amounts in ₹ lakh unless otherwise stated)

Particulars	Temporary Structure	Computer	Office Equipments	Furniture & Fixtures	Total
Gross Carrying Amount:					
Balance as at April 1, 2022	-	**0.50**	-	-	**0.50**
Additions	25.59	44.94	17.42	44.27	132.22
Less: Disposals	-	-	-	-	-
Balance as at March 31, 2023	**25.59**	**45.44**	**17.42**	**44.27**	**132.72**
Additions	10.99	33.53	35.51	13.10	93.13
Less: Disposals	-	0.59	-	-	0.59
Balance as at December 31, 2023	**36.58**	**78.38**	**52.93**	**57.37**	**225.26**
Accumulated Depreciation:					
Balance as at April 1, 2022	-	0.04	-	-	0.04
Additions	1.49	4.32	0.82	0.88	7.51
Less: Disposals	-	-	-	-	-
Balance as at March 31, 2023	**1.49**	**4.36**	**0.82**	**0.88**	**7.55**
Additions	7.81	15.35	6.50	3.75	33.41
Less: Disposals	-	0.15	-	-	0.15
Balance as at December 31, 2023	**9.30**	**19.56**	**7.32**	**4.63**	**40.81**
Net Carrying Amount:					
Balance as at March 31, 2023	**24.10**	**41.08**	**16.60**	**43.39**	**125.17**
Balance as at December 31, 2023	**27.28**	**58.82**	**45.61**	**52.74**	**184.45**

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4 Goodwill arising on Consolidation

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	As at December 31, 2023	As at March 31, 2023
Gross Carrying Amount		
Balance at the beginning of the year	10,144.46	10,144.46
Additions	-	-
Less: Disposals	-	-
Less: Impairment	-	-
Balance at the closing of the year/period	**10,144.46**	**10,144.46**

The carrying amount relates to goodwill arising on acquisition of Project SPV (NHIPPL) by the Trust and has been tested for impairment against the respective cash generating unit (CGU). The calculation uses cash flow forecast based on financial models which cover remaining future periods of respective concession periods of toll assets.

Based on a review of the future discounted cash flows of the intangible assets (Toll Collection Rights) held by the subsidiary (NHIPPL), the recoverable amount is higher than the carrying amount of the assets, and accordingly no impairment loss has been recognised in the statement of profit and loss for the period ended December 31, 2023.

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5 Intangible Assets

(All amounts in ₹ lakh unless otherwise stated)

Particulars	Software	Toll collection rights	Total
Gross Carrying Amount:			
Balance as at April 1, 2022	-	**7,35,040.00**	**7,35,040.00**
Additions	2.16	2,84,966.66	**2,84,968.82**
Less: Disposals		-	-
Balance as at March 31, 2023	**2.16**	**10,20,006.66**	**10,20,008.82**
Additions	-	1,11,993.43	1,11,993.43
Less: Disposals	-	-	-
Balance as at December 31, 2023.	**2.16**	**11,32,000.09**	**11,32,002.25**
Accumulated Amortization:			
Balance as at April 1, 2022	-	1,055.61	**1,055.61**
Additions	0.25	**17,552.87**	**17,553.12**
Less: Disposals	-	-	-
Balance as at March 31, 2023	**0.25**	**18,608.48**	**18,608.73**
Additions	0.33	17,626.91	17,627.24
Less: Disposals	-	-	-
Balance as at December 31, 2023.	**0.58**	**36,235.39**	**36,235.97**
Net Carrying Amount			
Balance as at March 31, 2023	**1.91**	**10,01,398.18**	**10,01,400.09**
Balance as at December 31, 2023.	**1.58**	**10,95,764.70**	**10,95,766.28**

Note:-

1. In FY 2021-22, the Group has acquired rights for Tolling, Operation, Maintenance and Transfer of five toll road projects for a period of 30 years basis Toll Concession agreements with NHAI, for a consideration of INR 7,350.40 Crore and the same have been recognised as Intangible Assets in financial statements. The Group further acquired rights during the Previous FY 2022-23 for Tolling, Operation, Maintenance and Transfer of three additional toll road projects for a period of 20 years basis Toll Concession Agreements with NHAI, for a consideration of INR 2,849.66 Crore and the same have been addition in the Intangible Assets in financial statements.

2.Toll Collection Rights has been amortized on the basis of Consumption based model (using Passenger Car Unit (PCU) projections) over the tenure of the Concession Agreement i.e. 30 years and 20 years basis respective concession agreements for those toll road projects.

3. During the current period, the Group has capitalised Initial Improvement Works amounting to Rs. 1,119.94 Crores to intangibles (For detailed note on initial improvement works refer note no.47).

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6 Other Financial Assets: Non Current

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023	As at March 31, 2023
Investment in Fixed Deposits		
Fixed Deposits with banks*	9,732.66	9,469.99
Security Deposits	3.48	1.60
Interest receivable on Debenture recovery expense fund	1.10	0.42
Interest receivable on fixed deposits	306.55	185.43
Deposit - Debenture Recovery Expense Fund for NCD's	15.00	15.00
Total	**10,058.79**	**9,672.44**

*The Fixed Deposits are kept in Debt Servicing Reserve Account (DSRA) as per borrowing agreements with lenders and as per terms of the debenture trust deed, to be utilized at the end of tenure of long term borrowings from Senior Lenders and to maintain DSRA balance for Debenture holders, hence classified as Other Financial Assets- Non Current irrespective of date of maturity.

7 Deferred Tax Assets (Net)

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023	As at March 31, 2023
Deferred Tax Assets arising on account of:		
- Expense disallowed as per Income Tax Act, 1961, allowable in future years	-	-
- Unabsorbed depreciation	1,07,152.46	72,562.41
-Provision on Initial improvement	27,674.56	-
Total (A)	**1,34,827.02**	**72,562.41**
Deferred Tax Liabilities arising on account of:		
- Difference between book & tax base related to Intangible assets	1,25,521.46	67,877.09
- Difference between book & tax base related to Investments	-	-
- Expense disallowed earlier as per Income Tax Act, 1961, allowed now	-	-
Total (B)	**1,25,521.46**	**67,877.09**
Net Asset (A) - (B)	**9,305.55**	**4,685.32**

Reconciliation of Deferred Tax Asset/ (Liabilities)

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023	As at March 31, 2023
Opening Balance - Deferred Tax Asset	4,685.32	262.53
Deferred tax income/ (expense) during the period recognised in profit & loss	4,620.23	4,422.79
Deferred tax income/ (expense) during the period recognised in Other Comprehensive Income	-	-
Closing Balance - Deferred Tax Asset	**9,305.55**	**4,685.32**

As at December 31, 2023, based on the expected future profitability of the NHIPPL (SPV), the management has recognised deferred tax assets on the unabsorbed tax depreciation carried forward only and not recognised Deferred Tax Assets on major maintainance obligation and business losses for the period, as carried forward business losses will not be available for utilisation within the time limit allowable as per the Income Tax Act based on the future projections of the profitability of the entity in accordance with provision of Ind AS 12 "Income Taxes".

8 Other non current assets

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At December 31, 2023	As At March 31, 2023
Capital advances	1,496.52	-
Processing fees paid for undrawn loan	23.29	-
	1,519.81	-

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9 Non Current Tax Assets (Net)

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023	As at March 31, 2023
Income tax refundable (net of provision)	16.81	12.06
Total	**16.81**	**12.06**

10 Trade Receivables: Current

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023	As at March 31, 2023
Considered good-unsecured	660.05	350.87
Trade Receivables - Credit Impaired (unsecured)	59.60	59.60
	719.65	410.47
Less:- Allowances for expected credit loss	(59.60)	(59.60)
Total	**660.05**	**350.87**

The receivables are hypothecated by way of first ranking exclusive charge to secure senior lenders and non convertible debenture holders in Trust.

Trade Receivables ageing schedule as on December 31, 2023

Particulars	Outstanding for following period from due date of payment.					
	0-6 Months	6 Month -1 Year	1-2 Years	2-3 Years	More than 3 years	Total
Undisputed trade receivables						
i) Considered good	660.05	-	-	-	-	660.05
ii) Which have significant increase in credit risk	-	-	-	-	-	-
iii) Credit impaired	-	-	59.60	-	-	59.60
Disputed trade receivables						
i) Considered good	-	-	-	-	-	-
ii) Which have significant increase in credit risk	-	-	-	-	-	-
iii) Credit impaired	-	-	-	-	-	-
Total	660.05	-	59.60	-	-	719.65

Trade Receivables ageing schedule as on March 31, 2023

Particulars	Outstanding for following period from due date of payment.					
	0-6 Months	6 Month -1 Year	1-2 Years	2-3 Years	More than 3 years	Total
Undisputed trade receivables						
i) Considered good	350.87	-	-	-	-	350.87
ii) Which have significant increase in credit risk	-	-	-	-	-	-
iii) Credit impaired	-	59.60	-	-	-	59.60
Disputed trade receivables						
i) Considered good	-	-	-	-	-	-
ii) Which have significant increase in credit risk	-	-	-	-	-	-
iii) Credit impaired	-	-	-	-	-	-
Total	350.87	59.60	-	-	-	410.47

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11 Cash and Cash Equivalents

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023	As at March 31, 2023
Balances with Banks*		
In Current Accounts	1,676.41	735.06
In Escrow Accounts	131.68	338.04
Draft in Hand	-	8.14
Cash in Hand	17.20	7.93
Fixed Deposits (having original maturity of less than 3 months)	4,325.50	10,000.00
SBI Overnight mutual fund	17,857.84	10,034.91
	24,008.63	**21,124.08**

* These balances with banks are hypothecated against secured borrowings

12 Bank Balance Other than Cash and Cash Equivalent

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023	As at March 31, 2023
Bank Deposits with original maturity of more than 3 Months	492.50	-
Interest Accrued on bank deposits	19.93	-
	-	
	512.43	**-**

13 Other Financial Assets: Current

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023	As at March 31, 2023
Interest receivable on long term loans	-	-
Security deposits	4.09	2.92
Interest receivable on Fixed Deposits	-	3.73
Other Financial Assets	0.65	-
Total	**4.74**	**6.65**

14 Other Current Assets

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023	As at March 31, 2023
Prepaid expenses*	1,206.37	882.86
GST Input	957.27	642.12
Processing fees paid for undrawn loan	188.87	103.49
Advance to suppliers	35.56	5.59
Others	0.01	-
Total	**2,388.08**	**1,634.06**

* Prepaid includes Round 3 expenses of Rs 582.09 lakh during the current period and Rs. 290.72 Lakh in previous year.

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15 Unit Capital

(All amounts are in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023		As at March 31, 2023	
	No of Units	Amount	No of Units	Amount
Unit Capital*				
Opening balance	72,64,05,200	7,41,604.32	59,52,00,000.00	5,99,442.82
Add: Units issued during the year	-	-	13,12,05,200	1,43,013.67
Less: Issue expenses (refer note below)	-	(10.85)	-	(852.17)
Balance	**72,64,05,200**	**7,41,593.47**	**72,64,05,200**	**7,41,604.32**

* 13,12,05,200 unit issued at Rs 109 per unit in previous financial year.

In previous year the Trust offered an issue of 13,12,05,200 units of National Highways Infra Trust ("NHIT"), for cash at a price of 109.00 per unit (the "issue price"), aggregating to ` Rs 1,43,013.67 lacs through Institutional and preferential placement in accordance with the Securities and Exchange Board of India (Infrastructure Investment Trust) Regulations, 2014 including the rules, circulars and guidelines issued thereunder.

Issue expenses of Rs. 10.85 (March 31, 2023: Rs 852.17) lakhs incurred in connection with issue of units have been reduced from the Unitholders capital in accordance with Ind AS 32 Financial Instruments: Presentation

Rights/ preferences and restrictions attached to Unit Capital

Subject to the provisions of the InvIT Regulations, the indenture of funds, and applicable rules, regulations and guidelines, the rights of the unit holders include:

a) The beneficial interest of each unitholder shall be equal and limited to the proportion of the number of the units held by that unitholder to the total number of units.

b) Right to receive income or distributions with respect to the units held.

c) Right to attend the annual general meeting and other meetings of unit holders of the Trust.

d) Right to vote upon any matters/resolutions proposed in relation to the Trust.

e) Right to receive periodic information having a bearing on the operation or performance of the Trust in accordance with the InvIT Regulations.

f) Right to apply to the Trust to take up certain issues at meetings for unit holders approval.

g) Right to receive additional information, if any, in accordance with InvIT documents filed with Placement Memorandum.

h) The non-sponsor unit holders ("Eligible Persons") of the Trust are entitled to representation on the Board of Directors of the Investment Manager through appointment of up to two (2) directors ("Non-Sponsor Directors"), provided that no Eligible Person shall have the right to nominate more than one Director at a time for appointment on the Board of Directors.

In accordance with the InvIT Regulations, no unit holders shall enjoy superior voting or any other rights over any other unit holders, and there shall not be multiple classes of units. There shall be only one denomination of units. Not withstanding the above, subordinate units may be issued only to the Sponsor and its Associates, where such subordinate units shall carry only inferior voting or any other rights compare to the other units.

Under the provisions of the InvIT Regulations, not less than ninety percent of the net distributable cash flows of the Trust is required to be distributed to the unitholders, and in accordance with such statutory obligation the Trust has formulated a distribution policy to declare and distribute the distributable cash flows to its unitholders atleast once every financial year as approved by the Board of Directors of the Investment Manager. The distributions made by Trust to its unitholders are based on the Net Distributable Cash Flows (NDCF) of the Trust under the InvIT Regulations and represent repayment of proportionate capital and share of profit. The distribution in proportion to the number of units held by the unitholders. The Trust declares and pays in distributions in indian rupees.

Limitation to the Liability of the unit holders

The liability of each unit holders towards the payment of any amount (that may arise in relation to the Trust including any taxes, duties, fines, levies, liabilities, costs or expenses) shall be limited only to the extent of the capital contribution of such unit holders and after such capital contribution shall have been paid in full by the unit holders, the unit holders shall not be obligated to make any further payments.

The unit holders shall not have any personal liability or obligation with respect to the Trust.

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Classification of Unit Holders' Funds

Under the provisions of the InvIT Regulations, NHIT is required to distribute to Unitholders not less than ninety percent of the net distributable cash flows of NHITfor each financial year. Accordingly, a portion of the unitholders' funds contains a contractual obligation of the Trust to pay to its Unitholders cash distributions. The Unitholders' funds could therefore have been classified as compound financial instrument which contain
both equity and liability components in accordance with Ind AS 32 - Financial Instruments: Presentation. However, in accordance with SEBI Circulars (No. CIR/IMD/DF/114/2016 dated 20-Oct-2016 and No. CIR/IMD/DF/127/2016 dated 29-Nov-2016) issued under the InvIT Regulations, the unitholders' funds have been classified as equity in order to comply with the mandatory requirements of Section H of Annexure A to the SEBI Circular dated 20-Oct-2016 dealing with the minimum disclosures for key financial statements. In line with the above, the distribution payable to unit holders is recognised as liability when the same is approved by the Investment Manager.

Details of Unitholders Holding More Than 5% Units In The Trust

Name of Unitholders	As at December 31, 2023		As at March 31, 2023	
	No of Units	%	No of Units	%
Ontario Limited	18,16,01,300	25.00%	18,16,01,300	25.00%
CPP Investment Board Private Holdings Inc.	18,16,01,300	25.00%	18,16,01,300	25.00%
SBI Balanced Advantage Trust	6,31,60,260	8.69%	6,31,60,260	8.69%
National Highways Authority of India (NHAI)	11,52,02,600	15.86%	11,52,02,600	15.86%

As per records of the Trust, including its register of unitholders and other declaration received from unitholders regarding beneficial interest, the above unitholding represent both legal and beneficial ownership of units.
The Trust has not allotted any fully paid-up units by way of bonus units nor has it bought back any class of units from the date of incorporation till the balance sheet date. Further the Trust has not issued any units for consideration other than cash during the year.

Reconciliation of number of units outstanding is set out below*:

Particulars	As at December 31, 2023		As at March 31, 2023	
	No of Units	Amount (amounts in ₹ lakh)*	No of Units	Amount (amounts in ₹ lakh)*
Number of Units at the beginning of the year	72,64,05,200	7,44,165.67	59,52,00,000	6,01,152.00
Units issued during the year	-	-	13,12,05,200	1,43,013.67
Number of Units at the end of the year	72,64,05,200	7,44,165.67	72,64,05,200	7,44,165.67

* Amount related to issue expenses are not deducted in the reconciliation of number of unit capital outstanding.

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16 Other equity

(All amounts in ₹ lakh unless otherwise stated)

Reserves and Surplus	As At December 31, 2023	As At March 31, 2023
Retained Earnings		
Balance at the beginning of the year	**(2,469.86)**	**6,768.43**
Total comprehensive income for the year	22,846.29	25,689.57
Other Comprehensive Income for the period	(1.79)	-
Less:		
Distribution to unit holders^	-	-
Interest	37,001.63	34,183.66
Other Income	578.94	744.20
Balance at the closing of the year/ period	**(17,205.93)**	**(2,469.86)**

^The distribution relates to the distributions during the financial year along with the distribution related to the last quarter of FY 2022-23 and does not include the distribution relating to the period October 01, 2023 to December 31, 2023 which will be paid after December 31, 2023. The distributions by the Trust to its unit holders are based on the Net Distributable Cash Flows of the Trust under the SEBI InvIT Regulations.

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17 Borrowings: Non Current

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023	As at March 31, 2023
Secured		
Non-Convertible Debenture	1,50,000.00	1,50,000.00
Less: Unamortized Borrowing Cost	1,373.95	1,411.80
Total (A)	**1,48,626.05**	**1,48,588.20**

Note:- Other terms and conditions of NCD

i) Interest rate: 7.90% p.a payable semi annually.

ii) Terms of repayment: Redemption of respective STRPP shall be made in equal instalments
i) STRPP A - starting from eigth anniversary of deemed date of allotment till thirteenth anniversary.
ii) STRPP-B- starting from thirteenth anniversary of deemed date of allotment till eighteenth anniversary.
iii) STRPP-C- starting from eighteenth anniversary of deemed date of allotment till twenty fifth anniversary.

Term Loan:		
From Banks	1,51,506.36	1,45,987.43
Term Loan from Related Party	-	-
	1,51,506.36	**1,45,987.43**
Less: Current Maturities of Long Term borrowings (Refer Note 20)	4,192.50	2,000.00
Less: Unamortised Borrowing Cost	291.89	417.30
Total (B)	**1,47,021.97**	**1,43,570.13**
Grand Total C = (A+B)	**2,95,648.02**	**2,92,158.33**

Note:- Other terms and conditions of Term Loans

i) Interest rate: Marginal Cost of fund based lending rate (MCLR) plus spread applicable on each reset date.

ii) Terms of repayment: Repayable in unstructured quarterly instalments with last repayment date upto March 31, 2041.

Security for Term Loans :

The loan is secured by,
- first pari passu charge on all immovable assets (if any), movable assets and receivables of the Trust including but not limited to,
(i) the interest and principal repayments on the loans advanced by the Trust to Project SPV
(ii) dividends to be paid by Project SPV to the Trust
- first pari passu Security Interest on Trust Escrow account and all sub-accounts thereunder, including DSRA.
- pledge of 100% equity shares of Project SPV (NHIPPL) in dematerialized form held by the Trust
- assignment of loans advanced by the Trust to Project SPV (NHIPPL) and securities created by the Trust including the assignment of rights of submission, termination and invocation of provision of Escrow agreement in case of default.
- negative lien on immovable assets (including current assets and cash flows) of the Project SPV (NHIPPL) subject to sale of obsolete items or cars/ ambulances, old toll equipment etc., under normal business practice, subject to maximum cumulative value of INR 5 Crore in any financial year.

The senior lenders of the Trust have also been provided with a corporate guarantee from Project SPV (NHIPPL) to guarantee upto the secured obligations of the Trust. The funds have been raised at Trust level from unitholders and domestic lenders, and the same have been lent to Project SPV (NHIPPL) for payment of concession fee by NHIPPL to NHAI. The cashflows viz., toll collections are lying in NHIPPL. Accordingly, corporate guarantee amounting upto the secured obligations of the Trust via Corporate Guarantee Deed dated 14.03.2022 and 08.01.2024, valid across the tenure of the loan of the Trust i.e. up to 31.03.2041 and 31.03.2042 respectively, has been provided by the Project SPV (NHIPPL) to the senior lenders of the Trust.

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Nature of Security for Non Convertible debentures:
The debenture holders are secured by :

a) a first ranking pari passu Security Interest over the Group's immovable assets (if any), both present and future. The Group does not own any immovable property at the present time. In the event, the Group acquires any immovable property in future, the Group shall mortgage said property within 180 (one hundred eighty) days from the date of acquisition of such immovable assets. The Debenture Trustee shall be authorised to do all acts, deeds, and enter into necessary documents, agreement, amendments and/or modifications, as may be required to give effect the same, including carrying out the due diligence as may be required by Debenture Trustee;
b) a first ranking pari passu Security Interest over the Hypothecated Assets (including Receivables), both present and future; and
c) Negative Lien Undertaking
d) corporate guarantee executed by the Project SPV (NHIPPL) in favour of the Debenture Trustee for guaranteeing the due repayment of the secured obligations in accordance with the terms of the Debenture Trust Deed
The non convertible debenture holders of the Trust acting through debenture trustee have also been provided with a corporate guarantee from Project SPV (NHIPPL) to guarantee the repayment of amount raised from non convertible debenture holders by the Trust. The funds have been raised at Trust level from debentureholders, have been lent to Project SPV (NHIPPL) for payment of concession fee by NHIPPL to NHAI. Accordingly, corporate guarantee amounting upto the secured obligations via Corporate Guarantee Deed dated 21.10.2022 is valid till all outstanding principal and accrued interest payable by the Trust are satisfied to the non convertible debenture holders of the Trust.

There have been no breaches in financial covenants with respect to the borrowings from Senior lenders.

18 Other Financial liabilities: Non Current

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023	As at March 31, 2023
Provision for employees benefits		
Gratuity (unfunded)	28.98	-
Leave Encashment (unfunded)	-	-
	28.98	**-**

19 Provisions: Non Current

(All amounts in ₹ lakh unless otherwise stated)

Particulars		As at December 31, 2023	As at March 31, 2023
Provision for employees benefits			
Gratuity (unfunded)		16.18	4.41
Leave Encashment (unfunded)		28.40	6.96
Provision for major maintenance	(Refer Note 46)	13,319.50	6,307.44
Provision for Infrastructure Upgrade	(Refer Note 47)	30,110.11	-
Total		**43,474.19**	**6,318.81**

Details of movement in Provisions

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023	As at March 31, 2023
Opening Balance	6,307.44	403.29
Add: Accretion during the year	-	-
Provision for Major Maintenance Obligation	6,666.36	5,879.20
Unwinding finance cost on major maintenance provision	345.70	24.95
Less: Utilized during the year	-	-
Closing Balance	**13,319.50**	**6,307.44**

20 Borrowings: Current

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023	As at March 31, 2023
Current Maturities of Long Term borrowings (Refer Note No.17)	4,192.50	2,000.00
Total	**4,192.50**	**2,000.00**

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21 Trade Payables: Current

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023	As at March 31, 2023
Total outstanding, dues of micro and small enterprises	660.96	137.23
Total outstanding, dues of creditors other than micro and small enterprises (Outstanding for less than 12 months from the due date of payment)	3,475.72	3,871.17
Total	**4,136.68**	**4,008.40**

Note:-

Details of dues to micro and small enterprises as per MSMED Act, 2006.

The group has certain dues to suppliers registered under Micro, Small and Medium Enterprises Development Act, 2006 ('MSMED Act'). The disclosures pursuant to the said MSMED Act are as follows:

	As at December 31, 2023	As at March 31, 2023
a) The principal amount remaining unpaid to any supplier at the end of the year	660.96	137.23
b) Interest accrued and due thereon to suppliers under MSMED Act on the above amount remaining unpaid to any supplier at the end of year.	-	-
c) The amount of interest paid by the buyer in terms of section 16 of the MSMED Act, 2006, along with the amount of the payment made to the supplier beyond the appointed day during the year	-	-
d) The amount of interest due and payable for the period of delay in making payment (which have been paid but beyond the appointed day during the year) but without adding the interest specified under the MSMED Act, 2006	-	-
e) The amount of interest accrued and remaining unpaid at the end of each accounting year	-	-
f) The amount of further interest remaining due and payable even in the succeeding years, until such date when the interest dues above are actually paid to the small enterprises, for the purpose of disallowance of a deductible expenditure under section 23 of the MSMED Act, 2006	-	-

Disclosure of payable to vendors as defined under the "Micro, Small and Medium Enterprise Development Act, 2006" is based on the information available with the group regarding the status of registration of such vendors under the said Act, as per the intimation received from them on requests made by the group.

Trade Payable ageing schedule as at December 31, 2023

(All amounts in ₹ lakh unless otherwise stated)

Particulars	Not due*	Outstanding for following period from due date of payment.				
		Less than 1 Year	1-2 Years	2-3 Years	More than 3 Years	Total
i) MSME	-	660.96	-	-	-	660.96
ii) Others	3,360.46	100.27	14.99	-	-	3,475.72
iii) Disputed dues - MSME	-	-	-	-	-	-
iv) Disputed dues - Others	-	-	-	-	-	-

* Trade Payables include unbilled payables amounting to Rs 3,360.46 Lakh

Trade Payable ageing schedule as at March 31, 2023

(All amounts in ₹ lakh unless otherwise stated)

Particulars	Not due*	Outstanding for following period from due date of payment.				
		Less than 1 Year	1-2 Years	2-3 Years	More than 3 Years	Total
i) MSME	-	137.23	-	-	-	137.23
ii) Others	2,468.10	1,403.07	-	-	-	3,871.17
iii) Disputed dues - MSME	-	-	-	-	-	-
iv) Disputed dues - Others	-	-	-	-	-	-

* Trade Payables include unbilled payables amounting to Rs 2,468.10 Lakh

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22 Other Financial Liabilities: Current

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023	As at March 31, 2023
Interest accrued but not due on NCD	2,207.67	5,129.59
Double toll Fee payable to NHAI	10.21	151.17
Security Deposit	4.19	4.19
Employees payable	2.21	-
Creditors for capital supplies and services	513.12	-
Total	**2,737.40**	**5,284.95**

23 Other Current Liabilities

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023	As at March 31, 2023
Statutory dues payable(TDS & GST Payable)	70.12	226.85
Salary & Wages Payable	0.61	-
Unearned Revenue	-	2.12
- Advance received	0.46	5.00
- Employees payable	-	6.64
Total	**71.19**	**240.61**

24 Provisions: Current

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023	As at March 31, 2023
Provision for Employee Benefits		
Leave Encashment (unfunded)	0.55	0.55
Gratuity (unfunded)	0.01	0.01
Provision for Infrastructure Upgrade	79,849.21	
Total	**79,849.77**	**0.56**

25 Current Tax Liabilities (Net)

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023	As at March 31, 2023
Provision for Income Tax	43.71	8.98
Total	**43.71**	**8.98**

Reconciliation of Current Tax Liabilities

Particulars	As at December 31, 2023	As at March 31, 2023
Opening Balance	8.98	161.77
Add: Income Tax Payable for the year	408.31	473.89
Less: Income taxes paid during the year (including earlier year taxes)	373.58	626.68
Closing Balance	**43.71**	**8.98**

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26 Revenue from operations

(All amounts in ₹ lakh unless otherwise stated)

Particulars	For the nine month ended December 31, 2023	For the nine month ended December 31, 2022	For the year ended March 31, 2023
Sale of Services			
Revenue from Toll Collection	70,334.10	46,929.57	68,708.93
Other Operative Revenue			
Interest on delay in Toll Remittance	-	8.02	8.27
Total	**70,334.10**	**46,937.59**	**68,717.20**

27 Interest income

(All amounts in ₹ lakh unless otherwise stated)

Particulars	For the nine month ended December 31, 2023	For the nine month ended December 31, 2022	For the year ended March 31, 2023
On fixed deposits with banks	667.77	130.96	373.43
Total	**667.77**	**130.96**	**373.43**

28 Profit on sale of investments

(All amounts in ₹ lakh unless otherwise stated)

Particulars	For the nine month ended December 31, 2023	For the nine month ended December 31, 2022	For the year ended March 31, 2023
Profit on redemption of Mutual Funds	797.49	540.15	671.17
Total	**797.49**	**540.15**	**671.17**

29 Other Income

(All amounts in ₹ lakh unless otherwise stated)

Particulars	For the nine month ended December 31, 2023	For the nine month ended December 31, 2022	For the year ended March 31, 2023
Other non operating income			
Other Income	26.35	61.16	326.11
Total	**26.35**	**61.16**	**326.11**

30 Operating Expenses

(All amounts in ₹ lakh unless otherwise stated)

Particulars	For the nine month ended December 31, 2023	For the nine month ended December 31, 2022	For the year ended March 31, 2023
Operation and Maintenance Expenses	4,104.02	2,082.36	3,145.85
Major Maintenance Obligation	6,666.36	3,567.86	5,879.20
Total	**10,770.38**	**5,650.22**	**9,025.05**

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31 Employee Benefit Expenses

(All amounts in ₹ lakh unless otherwise stated)

Particulars	For the nine month ended December 31, 2023	For the nine month ended December 31, 2022	For the year ended March 31, 2023
Salaries and wages	662.86	114.08	222.98
Contribution to provident and other funds	45.28	7.81	15.26
Gratuity Expenses	9.98	-	4.42
Leave Encashment Expense	22.81	-	7.51
Staff Welfare Expenses	39.79	16.02	38.84
Training and Seminar Expenses	39.01	1.18	7.21
Employee Insurance Policy	20.26	-	-
Relocation and Transfer Expenses	3.97	-	-
Total	**843.96**	**139.09**	**296.22**

32 Finance Cost

(All amounts in ₹ lakh unless otherwise stated)

Particulars	For the nine month ended December 31, 2023	For the nine month ended December 31, 2022	For the year ended March 31, 2023
Interest on Long term borrowings	9,412.24	8,249.45	11,244.91
Interest on Debentures	8,928.10	2,216.32	5,129.59
Finance Charges	182.31	212.36	221.87
Unwinding finance cost on major maintenance provision	345.70	15.74	24.95
Unwinding interest on infrastructure upgrade	697.16	-	-
Total	**19,565.51**	**10,693.87**	**16,621.32**

33 Depreciation and Amortization Expenses

(All amounts in ₹ lakh unless otherwise stated)

Particulars	For the nine month ended December 31, 2023	For the nine month ended December 31, 2022	For the year ended March 31, 2023
Depreciation on Property, Plant and Equipment	33.42	2.34	7.51
Amortization on Intangible Assets	17,627.23	11,754.64	17,553.12
Total	**17,660.65**	**11,756.98**	**17,560.63**

34 Other Expenses

(All amounts in ₹ lakh unless otherwise stated)

Particulars	For the nine month ended December 31, 2023	For the nine month ended December 31, 2022	For the year ended March 31, 2023
Advertisement expenses	19.81	29.46	35.75
Legal and Professional fees	943.56	395.16	1,542.22
Community Engagement Program	8.41	-	-
Independent consultant fees	-	59.38	-
Director's sitting fees	15.10	13.22	15.10
Travelling and conveyance	56.12	9.55	19.80
Telephone and internet charges	14.89	3.12	6.58
Power and fuel	181.35	32.87	58.78
Environment, health and safety expenses	46.54	0.38	13.06
Fee, subscription & taxes	76.30	23.80	43.42
Printing & Stationery	0.07	-	-
Bank charges	1.34	1.05	1.53
Data Management Expenses	3.40	-	3.00
Provision for expected credit loss	-	-	59.60
Vehicle hire charges	133.35	36.09	63.58
Repair and maintenance expenses	31.93	8.71	14.71
Preliminery Expenses written off	2.55	-	-
Miscellaneous expenses	67.89	14.16	30.03
Bad Debts Written Off	-	-	9.90
Total	**1,602.61**	**626.95**	**1,917.06**

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35 Audit Fees

(All amounts in ₹ lakh unless otherwise stated)

Statutory audit fees	4.78	3.43	4.53
Limited review fees	7.95	1.67	2.26
Tax audit fees	0.71	0.71	0.94
Total	**13.44**	**5.81**	**7.73**
Certification and other charges	1.04	0.09	0.93
Total	**1.04**	**0.09**	**0.93**

Further an amount of Rs.Nil (March 31, 2023: Rs 6 lakh) paid to auditor as certification charges has been booked as part of one time expenses in the Unit Capital. (Refer note no 15)

36 Tax Expense

(All amounts in ₹ lakh unless otherwise stated)

Particulars	For the nine month ended December 31, 2023	For the nine month ended December 31, 2022	For the year ended March 31, 2023
Current Tax	408.31	248.13	473.89
Provision for Taxation–Earlier years	(2.52)	0.01	0.01
	405.79	**248.14**	**473.90**
Deferred tax expense/(credit)	(4,620.23)	(2,956)	(4,422.79)
	(4,214.44)	**(2,708.28)**	**(3,948.89)**

37 Earning per Unit

(All amounts in ₹ lakh unless otherwise stated)

Particulars	For the nine month ended December 31, 2023	For the nine month ended December 31, 2022	For the year ended March 31, 2023
Basic and diluted EPU			
Net Profit/ loss available for unitholders (in ₹ lakh)	22,844.50	19,363.57	25,689.57
Weighted average number of units for EPU computation	72,64,05,200	63,38,45,895	65,66,68,738
EPU- Basic and diluted	**3.14**	**3.05**	**3.91**

Basic EPU amounts are calculated by dividing the profit for the period/ year attributable to Unit holders by the weighted average number of units outstanding during the period/ year. Diluted EPU amounts are calculated by dividing the profit/(loss) attributable to unit holders by the weighted average number of units outstanding during the period/ year plus the weighted average number of units that would be issued on conversion of all the dilutive potential units into unit capital.

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38 Statement of Related Parties

A. List of Related Parties as per requirement of IND AS 24 – "Related Party Disclosures"

Enterprises where Control / significant influence exists	National Highways Infra Projects Private Limited (Subsidiary Company) (NHIPPL)
	NHIT Eastern Projects Private Limited (Subsidiary Company) (NEPPL)

B. List of additional related parties as per Regulation 2(1)(zv) of the SEBI InvIT Regulations

Parties to the Trust

National Highways Infra Investment Managers Private Limited (NHIIMPL) - Investment Manager (IM) of the Trust
IDBI Trusteeship Services Limited (ITSL) - Trustee of the Trust
National Highways Authority of India (NHAI) - Sponsor
National Highways InvIT Project Managers Private Limited (NHIPMPL)- Project Manager

Promoters of the Parties to the Trust specified above

Government of India ((acting through Ministry of Road, Transport & Highways (MORTH)) - Promoter of NHIIMPL
IDBI Bank Limited (IDBI Bank) - Promoter of ITSL
Government of India ((acting through Ministry of Road, Transport & Highways (MORTH)) - Promoter of NHAI
National Highways Authority of India (NHAI)- Promoter of NHIPMPL

Directors of the parties to the Trust specified above

Directors of NHIIMPL
Mr. Suresh Krishan Goyal
Mr. Shailendra Narain Roy
Mr. Mahavir Prasad Sharma
Mr. Pradeep Singh Kharola
Mr. N.R.V.V.M.K. Rajendra Kumar
Mr. Sumit Bose
Mr. Pushkar Vijay Kulkarni (w.e.f. 08.11.2023)
Mr. Debapratim Hajara (w.e.f. 08.11.2023)
Mr. Bruce Cane (Ceased to be director w.e.f. 07.11.2023)
Ms. Kavita Saha (Ceased to be director w.e.f. 08.11.2023)
Mr. Amit Kumar Ghosh (Ceased to be director w.e.f. 15.11.2023)

Directors of NHIPPL
Mr. Suresh Krishan Goyal
Mr.Muralidhara Rao Bugatha
Mr. M. P. Sharma
Mr. Shailendra Narain Roy
Mr. N.R.V.V.M.K. Rajendra Kumar

Directors of NEPPL
Mr. Suresh Krishan Goyal
Mr. Mathew George

Directors of ITSL
Mr. Pradeep Kumar Jain
Ms. Jayashree Ranade
Mr. Pradeep Kumar Malhotra
Ms. Baljinder Kaur Mandal
Ms. Jayakumar Subramoniapillai

Directors of NHIPMPL
Mr. Akhil Khare
Mr. Ashish Kumar Singh

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C. Transactions with Related Parties during the period/year

(All amounts in ₹ lakh unless otherwise stated)

Particulars	Nine Month ended December 31, 2023	Year ended March 31, 2023
National Highways Infra Investment Managers Private Limited (NHIIMPL)		
Investment Manager Fee	1,356.16	1,491.17
Advance Investment Manager Fees	-	86.06
Other Support Services	4.00	3.12
Reimbursement of Expenses to NHIIMPL on behalf of NHIPPL	-	0.07
Amount Paid by NHIPPL for their Expenses	0.65	-
Reimbursement of Expenses to NHIIMPL on behalf of NHIT	15.35	39.79
National Highways Authority of India (NHAI)		
Issue of units of Trust to NHAI	-	21,366.83
Payment related to aquisation of intangible assets	-	2,84,966.66
O & M Expenses	357.61	1,152.32
Double toll fees	407.29	679.17
Independent engineers fees	171.42	345.38
Advance Paid	900.00	-
Interest and other Income distribution	5,960.01	5,589.34
IDBI Trusteeship Services Limited (ITSL)		
Trustee Fees	7.23	12.73
Other fees related to Round 1&2 Assets	1.50	3.54
National Highways InvIT Project Managers Private Limited (NHIPMPL)		
Project Manager Fees	743.40	991.20

D. Summary of transactions with Key Managerial Personnel (KMP)

(All amounts in ₹ lakh unless otherwise stated)

Details of Key Managerial Personnel	Particulars	Nine Month ended December 31, 2023	Year ended March 31, 2023
Mr. Suresh Krishan Goyal	Reimbursement of Expenses	0.76	0.39
Mr. M P Sharma	Director's sitting fees	6.40	6.40
Mr. Shailendra Narain Roy	Director's sitting fees	6.40	6.40
Mrs. Ajanta Sen	Salary	-	1.84
Mr. Arun Kumar Jha	Salary	51.46	-
Mr. Arun Kumar Jha	Reimbursement of Expenses	3.25	-
Mr. Bhanu Sharma (CS)	Salary	6.30	3.91
Mr. Bhanu Sharma (CS)	Reimbursement of Expenses	0.01	-
Ms Aashima Agarwal (CS)	Salary (including Reimbursement of Expenses)	5.03	-

E. Balance outstanding at the end of the period/year

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At December 31, 2023	As at March 31, 2023
National Highways Authority of India (NHAI)		
Balance outstanding at the end of the period/year		
Issue of units of Trust to NHAI	1,17,922.83	1,17,922.83
O&M Fees Payable	979.56	880.35
Double Toll Fees Payable	10.21	148.21
Advance Paid	900.00	-
Independent Engineer Payable	415.63	276.03
National Highways Infra Investment Managers Private Limited (NHIIMPL)		
Expense Payable	15.35	0.48
Payable for Other Support Services	4.00	-
IM Fees Payable	-	1.89
Receivable for the Expenses paid on	0.65	-
IDBI Trusteeship Services Limited (ITSL)		
Trustee Fee Payable	7.23	1.73
Other Fees related to Round 2 Assets	0.27	-
National Highways InvIT Project Managers Private Limited (NHIPMPL)		
Project Manager Fee Payable	177.80	762.50

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F. Closing Balances with Key Managerial Personnel (KMP)

(All amounts in ₹ lakh unless otherwise stated)

Details of Key Managerial Personnel	Particulars	As At December 31, 2023	As at March 31, 2023
Mr. M P Sharma	Director's sitting fees	0.72	-
Mr. Shailendra Narain Roy	Director's sitting fees	0.72	-
Ms. Aashima Agarwal (CS)	Short Term Employee Benefits Payable	0.61	-

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39 Disclosure as per Ind AS 115, "Revenue from contracts with customers"

Disaggregation of revenue

Revenue recognised mainly comprises of revenue from toll collections, claims with NHAI, contract revenue. Set out below is the disaggregation of the Group's revenue from contracts with customers:

(All amounts in ₹ lakh unless otherwise stated)

Description	For the nine month ended December 31, 2023	For the nine month ended December 31, 2022	For the year ended March 31, 2023
Operating revenue			
(a) Toll income (User Fee) from Highways	70,334.10	46,929.57	68,708.93
(b) Interest on delay in Toll Remittance	-	8.02	8.27
Total revenue	**70,334.10**	**46,937.59**	**68,717.20**

The table below presents disaggregated revenues from contracts with customers based on nature, amount and timing:

S.No.	Types of Products by Nature	Types of Services by Timing	For the nine month ended December 31, 2023	For the nine month ended December 31, 2022	For the year ended March 31, 2023
1	Services	At the point in time	70,334.10	46,937.59	68,717.20

40 Financial Instrument by Category

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at 31st December, 2023			As at 31st March, 2023		
	Amortized Cost	At FTVPL	At FVOCI	Amortized Cost	At FTVPL	At FVOCI
Assets:						
Trade Receivables	660.05	-	-	350.87	-	-
Cash and Cash Equivalents	24,008.63	-	-	21,124.08	-	-
Bank Balances Other than Cash & Cash Equivalents	512.43	-	-	-	-	-
Other Financial Assets	10,063.53	-	-	9,679.09	-	-
Total	**35,244.64**	-	-	**31,154.04**	-	-
Liabilities:						
Borrowings	2,99,840.52	-	-	2,94,158.33	-	-
Trade Payables	4,136.68	-	-	4,008.40	-	-
Other Financial Liabilities	2,766.38	-	-	5,284.95	-	-
Total	**3,06,743.58**	-	-	**3,03,451.68**	-	-

Defaults and breaches

There are no defaults during the year with respect to repayment of principal and payment of interest and no breaches of the terms and conditions of the borrowings.

There are no breaches during the year which permitted lender to demand accelerated payment.

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41 Fair Values of Assets and Liabilities

The carrying amount of all financial assets and liabilities appearing in the financial statements is reasonable approximation of fair values. Fair value of the financial assets and liabilities is the amount at which the instrument could be exchanged in a current transaction between willing parties, other than in a forced or liquidation sale.

Fair Value Hierarchy

The Group uses the following hierarchy for fair value measurement of the Group's financial assets and liabilities:

Level 1 - Quoted prices (unadjusted) in active markets for identical assets or liabilities.

Level 2 – Inputs other than quoted prices included within Level 1 that are observable for the asset or liability, either directly (i.e. as prices) or indirectly (i.e. derived from prices).

Level 3 - Inputs for the assets or liabilities that are not based on observable market data (unobservable inputs).

Fair value of financial assets and financial liabilities that are not measured at fair value (but fair value disclosures are required)

(All amounts in ₹ lakh unless otherwise stated)

Particulars	Carrying Value		Fair Value	
	As at 31st December, 2023	As at 31st March, 2023	As at 31st December, 2023	As at 31st March, 2023
Financial Assets at Amortized Cost:				
Trade Receivables	660.05	350.87	660.05	350.87
Cash and Cash Equivalents	24,008.63	21,124.08	24,008.63	21,124.08
Bank Balances Other than Cash & Cash Equivalents	512.43	-	512.43	-
Loans & Advances	-	-	-	-
Other Financial Assets	10,063.53	9,679.09	10,063.53	9,679.09
Total	**35,244.64**	**31,154.04**	**35,244.64**	**31,154.04**
Financial Liabilities at Amortized Cost:				
Borrowings*	2,99,840.52	2,94,158.33	2,99,840.52	2,94,158.33
Trade Payables	4,136.68	4,008.40	4,136.68	4,008.40
Other Financial Liabilities	2,766.38	5,284.95	2,766.38	5,284.95
Total	**3,06,743.58**	**3,03,451.68**	**3,06,743.58**	**3,03,451.69**

The carrying value of current financial assets and other financial liabilities measured at amortised cost are considered to be same as their fair values largely due to their short term nature.

*The carrying value of borrowings approximates the fair value as the instruments are at prevailing market rate

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42 Statement of Contingent Liabilities/Contingent Assets

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at December 31, 2023	As at March 31, 2023
Contingent Liabilities		
Stamp Duty on Concession agreement on Belgaum Kagal Project (refer note (a) below)	6,990	-
Corporate Guarantee issued in favour of Senior Lenders & Debenture Trsutee of the Trust (refer note (c))	4,37,700	3,50,000
Contingent Assets		
Stamp Duty on Concession agreement on Belgaum Kagal Project (refer note (b) below)	6,990	-

a) Stamp Duty on Concession agreement on Belgaum Kagal Project - The Group has received notice from Office of Deputy Registrar of Stamps, Government of Karnataka. As per this notice additional stamp duty of Rs 69.90 crore has been imposed on the Group for the concession agreement entered into for Belgaum-Kagal road.

Stamp legislation in certain states (including Karnataka) also specifies that copy of the main document in respect of any property, or any business within the state also needs to be stamped with original amount of stamp duty, if the original document has not been stamped with full amount of the stamp duty applicable for place of business .

As regards to the applicability of stamp duty on Concession Agreement, it may please be noted that there is no specific entry in respect of the concession agreement. Such agreements are stamped under the residuary category of the agreements and a nominal amount was paid on such agreements. We are given to understand that the Karnataka State Govt. has given instructions to procure copies of licence /Agreement of toll collecting agencies in respect of roads passing through state of Karnataka. We have further been issued a notice for recovery of shortfall in stamp duty.

Various judicial pronouncements by various high courts have divergent views and the issue is debatable and there is no clarity on the same.

The Group is contesting this imposition of deficit stamp duty on concession agreement notice with Government of Karnataka. We are also in receipt of copies of letters sent by NHAI to the Karnataka State Govt clarifying the issue.

b) Contingent Assets

Stamp Duty on Concession agreement on Belgaum Kagal Project- In the event of the stamp duty becoming payable, it shall be reimbursed by NHAI as confirmed by them vide letter No. NHAI/F&A/InVIT/2021-22/CLFN_GST&SD(E-106870) dated 28.09.2021. Since no provision has been recognised in the books with respect to stamp duty, the reimbursement has not been recognised as an asset considering the guidance in Ind AS 37.

c) Corporate Guarantees

31st December 2023	Rs 4,37,700.00 Lakh
31st March 2023	Rs 3,50,000.00 Lakh

The Project SPV company (NHIPPL) has issued Corporate Guarantees amounting to Rs. 2,000 Crore or secured obligations on 14.03.2022 and Rs 877 Crore or secured obligations on 08.01.2024 in favour of Senior Lenders, Rs. 1,500 Crore or secured obligations on 21.10.2022 in favour of Debenture Trustee of the Trust (Long Term Loan of Rs. 2,000 Crore ,Rs. 1,500 Crore for Non Convertible Debentures and long term loan of Rs 877 Crore for Round 2 Assets) availed by the Trust from external lenders. The Corporate Guarantee is valid till the external debt obligations of the Trust are satisfied.

43 Financial Information of Investment Manager

The summary financials of Investment Manager are not disclosed alongwith these financials as its networth is not materially eroded.

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44 Distribution made

(All amounts in ₹ lakh unless otherwise stated)

Particulars	For the period ended December 31, 2023^	For the year ended March 31, 2023
Interest	25,540.41	29,985.38
Return of capital	-	-
Dividend	-	-
Other income of the Trust	392.26	240.39
Total	**25,932.67**	**30,225.77**

^The distribution relates to the distributions during the current period does not include the distribution relating to the period October 01, 2023 to December 31, 2023 which will be paid after December 31, 2023. The distributions by the Trust to its unit holders are based on the Net Distributable Cash Flows of the Trust under the SEBI InvIT Regulations.

45 Details of Project Management Fees and Investment Management Fees

Details of fees paid to project manager and investment manager as required pursuant to SEBI Circular No. CIR/MD/DF/127/2016, dated 29th November 2016 are as under:

Project Management Fees:
The Project Manager fee Payable as per PIMA Agreement dated March 30, 2021 shall be Rs. 70 lakhs per month for a period of 18 months from the date of commencement of this agreement which is 16.12.2021 as per letter dated September 29, 2021. Further, The fee shall be remain the same till 31.10.2023 as per letter No. NHIPMPL/O&M Fees/01/02 dated 26.09.2023.

The project manager's fee for the period thereafter shall be as may be mutually agreed between the parties.

Investment Management Fees:

i) The Investment Manager's fee as per agreement dated 21st October 2020 will initially be Rs. 1,100 Lakh (Rupees Eleven Hundred Lakhs) per annum.
ii) The Investment Management Agreement is revised and the fee with effect from 1st April 2023 has been agreed at Rs 1,800 Lakhs (Rupees Eighteen hundred lakhs) for the Financial Year 2023-24.
iii) The management fee set out in paragraph (ii) above shall be subject to escalation on an annual basis at the rate of 10% of the management fee for the previous year.
iv) Any applicable taxes, cess or charges, as the case may be, shall be in addition to the management fee and shall be payable by National Highways Infra Trust (NHIT) to the Investment Manager (NHIIMPL).
Payment of frequency: Payment of management fee shall be made by National Highways Infra Trust (NHIT) to the Investment Manager (NHIIMPL) in advance on a quarterly basis at the beginning of each quarter of a financial year.

46 Provision for Major Maintenance

The Group has a contractual obligation to maintain the performance standards of the Project Highways in respect of riding quality and allied measures as per the performance parameters stipulated under the respective Concession Agreements. Cost of such obligation is measured at the best estimate of the expenditure required to settle the obligation at the balance sheet date and recognised over the period at the end of which the overlay is estimated to be carried out using Discounted Cash Flows method with the discount rate taken as the risk-free interest rate i.e. GOI 30 yr. Bond Yield. The next major overlay for one of the Project Highways is expected to be carried out in FY 2024-25. The Group has recognised finance cost on major maintenance provision for the period ended December 31, 2023 amounting to Rs 345.70 Lakhs (PY Rs 24.95 lakhs). The provision for Major Maintenance Obligation as at December 31, 2023 has been recognised in the financial statements at Rs 13,319.50 Lakhs (P.Y. 6,207.44 Lakhs).

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47 Initial Improvement Works

As per the concession agreement between NHIPPL and NHAI, the concessionaire is obligated to undertake initial improvement works as specified in Schedule B including certain improvement works required initially and then to extend required repairs maintenance, regular upkeep of the Project Highway. These obligations will require outflow of economic resources and will be fulfilled over the period of time. Therefore, a provision shall be recognised and measured as per Ind AS 37 for contractual obligations toward the Fair Value of future upgrade services and correspondingly the Group shall capitalize the present value of provision for upgrade services to the intangible asset at the time of acquisition.

At the time of acquisition of SPV's there was uncertainty with respect to the cost estimates for the initial improvement work to be done and the Group was in discussion with NHAI for de-scoping of certain work. Further, as per Ind as 38, an intangible asset can be recognised if, and only, if the cost of the asset can be measured reliably.

Since the cost for initial improvement work was not ascertainable until 1st Dec 2023 (under Ind AS 38) because of discussion around de-scoping of various works, no reliable estimates could be made for the Fair Value of the said scope. This was further substantiated with the technical note prepared by the technical department basis their discussion and meetings with NHAI and various vendors. Considering that the management has now ascertained the costs based on contracts awarded and the sign off received from the PMC, (estimated as required under Ind AS 38) has now , based on discussions with its technical consultants, capitalised the initial improvement works amounting to Rs. 1,21,227.32 Lakhs (Undiscounted Value) on 1st Dec 2023.

Further the Group has also recognised provision for initial improvement works as per Ind AS 37 amounting to Rs. 1,11,993.43 Lakhs (Present Value) on 1st December 2023 with corresponding impact in Statement of Profit and Loss amounting to Rs. 282.21 Lakhs and Rs. 697.16 Lakhs on account of amortization of initial improvement work and unwinding of interest on provision of initial improvement respectively.
Actual initial improvement work done up to December 2023 is Rs. 2,731.27 Lakhs.

48 Capital and Other Commitments

(All amounts in ₹ lakh unless otherwise stated)

Nature of Work	Unexecuted Contract Value	
	As at December 31, 2023	As at March 31, 2023
Estimated amount of contracts remaining to be executed on capital account and not provided for	64,073.65	
	64,073.65	-

49 Segment Reporting

The activities of the Group mainly include investing in infrastructure assets primarily in the SPVs operating in the road sector to generate cash flows for distribution to unit holders. Based on the guiding principles given in Ind AS - 108 "Operating Segments", this activity falls within a single operating segment. Further, the entire operations of the Group are only in India and hence, disclosure of secondary/ geographical segment information does not arise. Accordingly, requirement of providing disclosures under Ind AS 108 does not arise.

50 The Board of Directors of the Investment Manager has declared distribution for Quarter 3 of FY 2023-24 of Rs. 1.697 per unit which comprises of Rs. 1.693 per unit as interest and Rs. 0.004 per unit as other income on surplus funds at the Trust level in their meeting held on 2nd February, 2024. Further The Board of Directors of the Investment Manager had declared distribution for Quarter 2 of FY 2023-24 of Rs. 1.816 per unit which comprises of Rs. 1.774 per unit as interest and Rs. 0.042 per unit as other income on surplus funds at the Trust level in their meeting held on 8th November, 2023 and the Board of Directors of the Investment Manager had declared distribution for Quarter 1 of FY 2023-24 of Rs. 1.754 per unit which comprises of Rs. 1.742 per unit as interest and Rs. 0.012 per unit as other income on surplus funds at the Trust level in their meeting held on 11th August, 2023.

51 During the Nine Months ended 31 December 2023, the Trust has taken a further disbursement of amounting to Rs. 63 Crores from the Axis Bank Limited and Rs. 16 Crores from the Bank of Maharashtra in accordance with Facility agreement. The Trust has given the above said amount to Project SPV as Loan at the rate of 12.70% p.a. for initial Improvement works.

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NATIONAL HIGWAYS INFRA TRUST
SEBI Registration Number :-IN/InvIT/20-21/0014
Notes to the Consolidated Interim Financial Statements for the period ended December 31, 2023

52 Subsequent Material Developments

NHIT made an offer to NHAI for 7 additional projects ("Leap Road Projects") at a base concession fee of Rs. 15,624.9 Crore. Acceptance of offer of NHIT by NHAI vide its letter dated 07.02.2024 for the acquisition of "Leap Roads" at an aggregate valuation of INR 15,624.90 Crores ("Leap Offer");

NHIT planning to avail additional credit facilities jointly from Various Banks and Financial Institutions for amounts not exceeding Rs. 9,000 Crores (Rupees Nine Thousand Crores only) to part finance the acquisition of the Concession rights and obligations of the Leap Road, by National Highways Infra trust ("NHIT") through its SPV, NHIT Eastern Projects Private Limited ("NEPPL").

NHIT Planning for raising of fresh funds through issuance of Units under Institutional Placement and/or on Preferential issue basis to part finance acquisition of the Concession rights and obligations of the Leap Roads in the Board Meeting held on 10.02.2024;

Approval for Issuance of units of National Highways Infra Trust through Institutional Placement and/or on Preferential issue basis and Acquisition of Road Assets under Project Leap in 4th EGM of Unit holders of NHIT held on 04.03.2024;

Approval for the Draft Concession Agreements to be entered into between National Highways Authority of India ("NHAI") and NHIT Eastern Projects Private Limited ("NEPPL) in relation with (i) Chichira-Kharagpur (West Bengal) (ii) Orai-Bara (Uttar Pradesh) (iii) Rewa-Katni-Jabalpur-Lakhnadon (Madhya Pradesh) (iv) Kachugaon-Rakhaldubi Bus Junction & Rakhaldubi Bus Junction - Kaljhar (Assam Package) (v) Hubli-Haveri-Devangere-Chitradurga (Karnataka); (vi) Lakhnadon- Mahagaon- Khawasa (Madhya Pradesh) (vii) Kaljhar- Patacharkuchi (Assam) road stretches ("Project Leap/Leap Roads") in the Board Meeting held on 27.01.2024

53 Key sources of estimation

The preparation of Consolidated financial statements in conformity with Ind AS requires the Group to makes estimates and assumptions that affect the reported amounts of income and expenses of the period, the reported balances of assets and liabilities and the disclosures relating to contingent liabilities as of the date of the financial statements. The estimates and underlying assumptions are reviewed on an ongoing basis. Revisions to accounting estimates include allowance for doubtful loans /other receivables, fair value measurement etc. Difference, if any, between the actual results and estimates is recognised in the period in which the results are known.

54 Disclosure pursuant to Ind AS 23 "Borrowing Costs"

Borrowing cost capitalised during the period ended Dec 31, 2023 Rs. Nil [March 31 , 2023 : Rs. Nil]

55 Default and breaches

There are no defaults during the year with respect to repayment of principal and payment of interest and no breaches of the terms and conditions of the borrowings. There are no breaches during the year which permitted lender to demand accelerated payment.

56 Comparatives figures have been reclassified/regrouped wherever necessary to confirm to the current period classification.

For A.R. & Co.
Chartered Accountants
Firm Registration no. 002744C

A.R. & Co. New Delhi Chartered Accountants

CA Mohd. Azam Ansari
Partner
M.No.511623
Date : 04.03.2024
Place : New Delhi

National Highways Infra Trust New Delhi

For and on behalf of Board of Directors of the National Highways Infra Investment Managers Private Limited (Acting as Investment Manager of National Highways Infra Trust)

Suresh Krishan Goyal
Director
DIN: 02721580

Mahavir Parsad Sharma
Director
DIN: 03158413

Mathew George
Chief Financial Officer

Gunjan Singh
Compliance Officer

A.R. & CO.
Chartered Accountants

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Ghaziabad- 201001 Delhi-NCR National
Capital region Of Delhi

INDEPENDENT AUDITOR'S REPORT

To the Unit Holders of National Highways Infra Trust

Report on the Audit of the Consolidated Financial Statements

OPINION

We have audited the accompanying consolidated financial statements of National Highways Infra Trust (hereinafter referred to as "the InvIT" or "the Trust") and its one subsidiary (hereinafter referred to as "National Highways Infra Projects Private Limited" or "NHIPPL") (the Trust and its subsidiary together referred to as "the Group"), which comprising of the consolidated Balance Sheet as at 31 March 2023, the consolidated Statement of Profit and Loss (including Other Comprehensive Income), the consolidated Statement of Changes in Unitholder's Equity and the consolidated Statement of Cash Flows for the year then ended, the consolidated Statement of Net Assets at fair value as at 31 March 2023, the consolidated Statement of Total Returns at fair value, the Statement of Net Distributable Cash Flows of the Trust and its subsidiary for the year then ended and notes to the consolidated financial statements including a summary of significant accounting policies and other explanatory information (hereinafter referred to as "the consolidated financial statements").

In our opinion and to the best of our information and according to the explanations given to us and based on the consideration of our report on financial statements of subsidiary and on the other financial information of the subsidiary, the aforesaid consolidated financial statements give the information required by the Securities and Exchange Board of India (Infrastructure Investment Trusts) Regulations, 2014 as amended from time to time including any guidelines and circulars issued thereunder (together referred to as the "SEBI InvIT Regulations") in the manner so required and give a true and fair view in conformity with the Indian Accounting Standards as defined in Rule 2(1)(a) of the Companies (Indian Accounting Standards) Rules, 2015, as amended ("Ind AS") and other accounting principles generally accepted in India, to the extent not inconsistent with SEBI InvIT Regulations, of the consolidated state of affairs of the Group as at 31 March 2023, its consolidated profit including other comprehensive income, its consolidated cash flows, its consolidated statement of changes in Unitholders' equity for the year ended 31 March 2023, its consolidated net assets at fair value as at 31 March 2023, its consolidated total returns at fair value of the Group and

the net distributable cash flows of the Trust and its subsidiary for the year ended 31 March 2023.

BASIS FOR OPINION

We conducted our audit of the consolidated financial statements in accordance with the Standards on Auditing ("SAs") issued by the Institute of Chartered Accountants of India. Our responsibilities under those Standards are further described in the auditor's responsibilities for the audit of the consolidated financial statements section of our report. We are independent of the Group in accordance with the Code of Ethics issued by the Institute of Chartered Accountants of India together with the ethical requirements that are relevant to our audit of the consolidated financial statements under the provisions of the SEBI InvIT Regulations, and we have fulfilled our other ethical responsibilities in accordance with these requirements and the Code of Ethics. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion on the consolidated financial statements.

KEY AUDIT MATTERS

Key audit matters are those matters that, in our professional judgment, were of most significance in our audit of the consolidated financial statements for the financial year ended 31 March 2023. These matters were addressed in the context of our audit of the consolidated financial statements as a whole, and in forming our opinion thereon, and we do not provide a separate opinion on these matters. We have determined the matters described below to be the key audit matters to be communicated in our report.

Sr. No.	Key Audit Matter	Auditor's Response
1.	**Assessment of Impairment of Intangible Assets in form of Toll Collection Rights** The Group operates toll assets which is constructed on Toll, Operate and Transfer (TOT) basis. The carrying value of the toll collection rights as at March 31, 2023 is Rs. 10,01,398.18 Lakhs. In accordance with its accounting policy and requirements under Ind AS 36 "Impairment of Assets", the Management has performed an impairment assessment by comparing the carrying value of the toll collection rights to their recoverable amount. For impairment testing, value in use has been determined by forecasting and discounting future cash flows. Further, the value in use is highly sensitive to changes in critical variable used for forecasting the	Our Audit Procedures included the following :- • Verified the appropriateness of the Group's accounting policy on impairment of Intangible Assets and Valuation Methodology applied in determining the recoverable amount. • Checked the Impairment Sheet provided by the Management. • Obtained the Management Representation on the assumptions around the key drivers of the revenue

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	future cash flows including traffic projections and discounting rates. The determination of the recoverable amount of the toll collection right involves significant estimates and judgments and accordingly, the evaluation of impairment of toll collection rights has been determined as a key audit matter. (Refer Note No. 2.7 for accounting policy relating to Intangible Assets and Note No. 42 and 49 of Consolidated Financial Statements for the year ended 31.03.2023)	projections, future cash flow, discount rates / weighted average cost of capital that were used by them. • Tested the arithmetical accuracy of the Impairment sheet.
2.	**Assessment of Impairment of Goodwill on Consolidation** Goodwill on consolidation is tested for impairment as per Ind AS 36 on an annual basis by the Group using enterprise value of respective subsidiary company to which the goodwill relates to. Enterprise value calculation involves use of future cashflow projections, discounted to present value, terminal value and other variables. These use of management projections and estimates results in inherent risk of error with respect to the valuation of Goodwill and accuracy of impairment loss, if any. Goodwill amounting to Rs. 10,144.46 Lakhs as on March 31, 2023 (March 31, 2022: 10,144.46 Lakhs) arising out of business combination as per Ind AS 103 has been tested for impairment by the management. (Refer Note No. 2.3 for accounting policy relating to Goodwill on Consolidation, Note No. 42 and 49 of Consolidated Financial Statements for the year ended 31.03.2023) Therefore, Impairment of Goodwill has been considered as a Key Audit Matter.	Our Audit Procedures included the following :- • Verified the appropriateness of the Group's accounting policy on impairment of Goodwill and Valuation Methodology applied in determining the enterprise value. • Checked the Impairment Sheet provided by the Management. • Obtained the Management Representation on the assumptions around the key drivers of the revenue projections, future cash flow, discount rates / weighted average cost of capital that were used by them. • Tested the arithmetical accuracy of the Impairment sheet.
3.	**Provisioning of Major Maintenance/Periodic Maintenance/resurfacing expenses (Refer Note No. 16 and 61 of the Consolidated Financial Statements)** As per Concession Agreement, the Group is obligated to perform regular maintenance	Our Audit Procedures included the following :- • Understood the Group's Process associated with the estimation of resurfacing obligation.

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	along with periodic maintenance of road assets during the entire concession period. The Periodic maintenance includes resurface of pavements, repairs of structures and other equipment and maintenance of service roads. The Group has estimated the provision required towards major maintenance in accordance with Ind AS 37 "Provisions, Contingent Liabilities and Contingent Assets". The Provision made by the Group over the Concession involves detailed Calculation and Judgement and accordingly, the major maintenance expense is considered to be the Key audit Matter.	• Verified the requirement under Concession agreement and Group's accounting policy. • Tested the assumption used in determining the major maintenance provision. • Tested the arithmetical accuracy and also verified the disclosure in the Consolidated Financial Statements.
4.	**Computation and disclosures as prescribed in the SEBI InvIT regulations relating to Consolidated Statement of Net Assets at Fair Value and Consolidated Total Returns at Fair Value** As per SEBI InvIT regulations, the Trust is required to disclose statement of net assets at fair value and statement of total returns at fair value. The fair value is determined by forecasting and discounting future cash flows from the operations of the investee entities which involves management estimates and judgements. These estimates and judgements include discounting rates, Tax rates and inflation rates which are considered for computing the fair value. There is an inherent risk in the computation of fair value due to the use of estimates and judgements mentioned above. Therefore, computation and disclosures of Consolidated statement of net assets at fair value and Consolidated statement of total returns at fair value is considered as a Key Audit Matter. Refer Note-49 Significant Accounting Assumptions – Fair Value and Disclosures and Statement of net assets at fair value and Statement of total returns at fair value in the Consolidated financial statements.	Our Audit Procedures included the following :- • Obtained the understanding of the requirements of SEBI InvIT regulations for disclosures relating to Consolidated Statement of Net Assets at Fair Value and Consolidated Statement of Total Returns at Fair Value. • Assessed the Valuation Report issued by the Independent Valuer engaged by the management. Also assessed the appropriateness of the Trust's valuation methodology applied in determining the fair values. • Obtained Management representation in this respect. • Tested the arithmetical accuracy of computation in the statement of net assets and total returns at fair value.

		• Ensured that disclosures is in compliance with SEBI InvIT regulations relating to the statement of net assets at fair value and the statement of total returns at fair value.

INFORMATION OTHER THAN THE CONSOLIDATED FINANCIAL STATEMENTS AND AUDITOR'S REPORT THEREON

The Board of Directors of the Investment Manager is responsible for the other information. The other information comprises the information included in the Management Discussion and Analysis, Report of Investment Manager including annexures to Investment Manager's Report and other information as required to be given by SEBI InvIT Regulations, but does not include the consolidated financial statements and our report thereon.

Our opinion on the consolidated financial statements does not cover the other information and we do not express any form of assurance conclusion thereon.
In connection with our audit of the consolidated financial statements, our responsibility is to read the other information and, in doing so, consider whether the other information is materially inconsistent with the consolidated financial statements or our knowledge obtained during the course of our audit or otherwise appears to be materially misstated.

If, based on the work we have performed on the other information that we obtained prior to the date of this auditor's report, we conclude that there is a material misstatement of this other information, we are required to report that fact. We have nothing to report in this regard.

RESPONSIBILITIES OF THE BOARD OF DIRECTORS OF INVESTMENT MANAGER FOR THE CONSOLIDATED FINANCIAL STATEMENTS

The Board of Directors of Investment Manager is responsible for the preparation of these consolidated financial statements that give a true and fair view of the consolidated Balance Sheet as at 31 March 2023, consolidated statement of Profit & Loss including other comprehensive income, consolidated cash flows and consolidated statement of changes in Unitholder's equity for the year ended 31 March 2023, the consolidated net assets at fair value as at 31 March 2023, the consolidated total returns at fair value of the Group and the net distributable cash flows of the Trust and its subsidiary for the year ended 31 March 2023 in accordance with the requirements of the SEBI InvIT Regulations, Indian Accounting Standards as defined in Rule 2(1) (a) of Companies (Indian Accounting Standards) Rules, 2015, as amended and other accounting principles generally accepted in India, to the extent not inconsistent with SEBI InvIT Regulations. The respective Board of Directors of the subsidiary company included in the Group are responsible for maintenance of adequate accounting records for safeguarding of the assets of the Group and for preventing and detecting frauds and other irregularities; selection and application of appropriate accounting policies;

making judgements and estimates that are reasonable and prudent; and design, implementation and maintenance of adequate internal financial controls for ensuring the accuracy and completeness of accounting records, relevant to the preparation and presentation of the consolidated financial statements that give a true and fair view and are free from material misstatement, whether due to fraud and error, which have been used for the purpose of preparation of the consolidated financial statements by the Board of Directors of Investment Manager, as aforesaid.

In preparing the consolidated financial statements, the Board of Directors of Investment Manager and respective Board of Directors of the company included in the Group are responsible for assessing the ability of the Group to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless the respective Board of Directors either intends to liquidate the Group or to cease operations, or has no realistic alternative but to do so.

The Board of Directors of the Investment Manager and the respective Board of Directors of the subsidiary company included in the Group are also responsible for overseeing the financial reporting process of the Group.

AUDITOR'S RESPONSIBILITY FOR THE AUDIT OF THE CONSOLIDATED FINANCIAL STATEMENTS

Our objectives are to obtain reasonable assurance whether the consolidated financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with SAs will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

As part of an audit in accordance with SAs, we exercise professional judgment and maintain professional skepticism throughout the audit. We also:

- Identify and assess the risks of material misstatement of the consolidated financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.
- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Group's internal controls.
- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by the Board of Directors of the Investment Manager.

- Conclude on the appropriateness of the Board of Directors of Investment Manager use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Group's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report. However, future events or conditions may cause the Group to cease to continue as a going concern.
- Evaluate the overall presentation, structure and content of the consolidated financial statements, including the disclosures, and whether the consolidated financial statements represent the underlying transactions and events in a manner that achieves fair presentation.
- Obtain sufficient appropriate audit evidence regarding the financial information of the entities or business activities within the Group of which we are the independent auditors, to express an opinion on the consolidated financial statements. We are responsible for the direction, supervision and performance of the audit of financial statements of such entities included in the consolidated financial statements of which we are the independent auditors. We remain solely responsible for our audit opinion.

Materiality is the magnitude of misstatements in the consolidated financial statements that, individually or in aggregate, makes it probable that the economic decisions of a reasonably knowledgeable user of the financial statements may be influenced. We consider quantitative materiality and qualitative factors in (i) planning the scope of our audit work and in evaluating the results of our work; and (ii) to evaluate the effect of any identified misstatements in the financial statements.

We communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.

We also provide those charged with governance with a statement that we have complied with relevant ethical requirements regarding independence, and to communicate with them all relationships and other matters that may reasonably be thought to bear on our independence, and where applicable, related safeguards.

From the matters communicated with those charged with governance, we determine those matters that were of most significance in the audit of the consolidated financial statements of the current period and are therefore the key audit matters. We describe these matters in our auditor's report unless law or regulation precludes public disclosure about the matter or when, in extremely rare circumstances, we determine that a matter should not be communicated in our report because the adverse consequences of doing so would reasonably be expected to outweigh the public interest benefits of such communication.

REPORT ON OTHER LEGAL AND REGULATORY REQUIREMENTS

Based on our audit and as required by SEBI InvIT Regulations, we report that:

a) We have sought and obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purposes of our audit of the aforesaid consolidated financial statements.

b) the consolidated Balance Sheet, the consolidated Statement of Profit and Loss, the consolidated Statement of Cash Flows, the consolidated Statement of Changes in Unitholders' Equity, the consolidated Statement of Net Assets at fair value, the consolidated Statement of Total Returns at fair value and the Statement of Net Distributable Cash Flows of the Trust and its subsidiary dealt with by this Report are in agreement with the books of account.

c) In our opinion, the aforesaid financial statements comply with the Indian Accounting Standards as defined in Rule 2(1)(a) of Companies (Indian Accounting Standards) Rules, 2015, as amended, to the extent not inconsistent with SEBI InvIT regulations.

For A. R. & Co.
Chartered Accountants
FRN. 002744C

CA Kailash Chand Gupta
Partner
Membership No: 085003
UDIN: 23085003BGWVFJ8283

Place: New Delhi
Date: 22.05.2023

NATIONAL HIGHWAYS INFRA TRUST

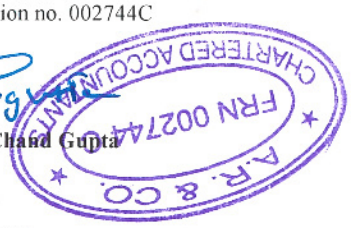
CONSOLIDATED BALANCE SHEET AS AT MARCH 31, 2023

(All amounts in ₹ lakh unless otherwise stated)

Particulars	Note No.	As At March 31, 2023	As At March 31, 2022
ASSETS			
1) Non - Current Assets			
(a) Property, Plant and Equipment	3	125.17	0.46
(b) Goodwill	4	10,144.46	10,144.46
(c) Intangible assets	5	10,01,400.09	7,33,984.39
(d) Financial Assets			
(i) Other Financial Assets	6	9,672.44	3,170.81
(e) Deferred Tax Assets (net)	7	4,685.32	262.53
(f) Non -Current Tax Assets (Net)	8	12.06	-
Total non-current assets		**10,26,039.54**	**7,47,562.64**
2) Current Assets			
(a) Financial Assets			
(i) Trade receivables	9	350.87	600.47
(ii) Cash and Cash Equivalents	10	21,124.08	6,381.94
(iii) Other financial assets	11	297.36	5.38
(b) Other current assets	12	1,343.35	347.29
Total current assets		**23,115.66**	**7,335.07**
TOTAL ASSETS		**10,49,155.20**	**7,54,897.72**
EQUITY AND LIABILITIES			
EQUITY			
1) Unit Capital	13	7,41,604.32	5,99,442.82
2) Initial settlement amount		0.10	0.10
3) Other Equity	14	(2,469.86)	6,768.43
Total Equity		**7,39,134.56**	**6,06,211.35**
LIABILITIES			
1) Non-Current liabilities			
(a) Financial liabilities			
(i) Borrowings	15	2,92,158.33	1,45,556.94
(b) Provisions	16	6,318.81	403.37
Total non-current liabilities		**2,98,477.14**	**1,45,960.32**
2) Current liabilities			
(a) Financial liabilities			
(i) Borrowings	17	2,000.00	980.86
(ii) Trade Payables	18		
(a) Total Outstanding, dues of micro and small enterprises		137.23	-
(b) Total outstanding, dues of creditors other than micro and small enterprises		3,871.17	1,244.79
(iii) Other financial liabilities	19	5,284.95	97.85
(b) Other current liabilities	20	240.61	240.75
(c) Provisions	21	0.56	0.03
(d) Current Tax Liabilities (Net)	22	8.98	161.77
Total current liabilities		**11,543.50**	**2,726.06**
TOTAL EQUITY & LIABILITIES		**10,49,155.20**	**7,54,897.72**
Significant Accounting Policies	1 - 2		
The accompanying notes form an integral part of these consolidated financial statements.	3 - 64		

This is the Consolidated Balance Sheet referred to in our report of even date.

For A.R. & Co.
Chartered Accountants
Firm Registration no. 002744C



CA Kailash Chand Gupta
Partner
M.No.085003

Date : 22.05.2023
Place : New Delhi

For and on behalf Board of the National Highways Infra Investment Managers Private Limited (Investment Manager of National Highways Infra Trust)

Suresh Krishan Goyal
Director
DIN: 02721580

Mahavir Parsad Sharma
Director
DIN: 03158413

Mathew George
Chief Financial Officer

Gunjan Singh
Compliance Officer

NATIONAL HIGHWAYS INFRA TRUST

CONSOLIDATED STATEMENT OF PROFIT AND LOSS FOR THE YEAR ENDED MARCH 31, 2023

(All amounts in ₹ lakh unless otherwise stated)

Particulars	Note No.	For the year ended March 31 2023	For the year ended March 31 2022
INCOME			
Revenue from Operations	23	68,717.20	13,960.55
Interest Income	24	373.43	5.86
Profit on sale of investments	25	671.17	690.00
Other Income	26	326.11	318.67
TOTAL INCOME		**70,087.91**	**14,975.08**
EXPENSES			
Investment Manger Fee		1,263.70	1,931.71
Trusteeship Fee		9.60	3.73
Valuation expenses		4.00	-
Annual listing fees		20.00	-
Rating fees		0.20	0.57
Insurance expenses		628.74	166.04
Custodian Fees		0.84	-
Project Management Fees		991.20	290.43
Operating Expenses	27	9,025.05	849.77
Employee Benefits Expenses	28	311.33	2.12
Finance Cost	29	16,621.32	3,154.43
Depreciation & Amortization Expense	30	17,560.63	1,055.65
Other Expenses	31	1,901.95	504.87
Audit Fees	32		
- Statutory audit fees		7.73	4.86
- Other audit services (including certification)		0.93	0.52
TOTAL EXPENSES		**48,347.23**	**7,964.71**
Profit / (Loss) before Tax		**21,740.68**	**7,010.37**
Tax Expenses	33		
Current Tax		473.89	436.36
Current tax - earlier years		0.01	
Deferred Tax expense/(credit)		(4,422.79)	(262.32)
Total Tax	-	(3,948.89)	174.04
Profit/ (loss) for the year	-	**25,689.57**	**6,836.33**
Other Comprehensive Income			
Items that will not be reclassified to Profit and Loss		-	-
Items that will be reclassified to Profit and Loss		-	-
		-	-
Total Comprehensive Income for the year	-	**25,689.57**	**6,836.33**
Earnings per Unit			
Basic	34	3.91	1.15
Diluted	34	3.91	**1.15**
Significant Accounting Policies	1 - 2		
The accompanying notes form an integral part of these consolidated financial statements.	3 - 64		

This is the Statement of Profit and Loss referred to in our report of even date.

For A.R. & Co.
Chartered Accountants
Firm Registration no. 002744C

A.R. & CO. FRN 002744 C CHARTERED ACCOUNTANTS

CA Kailash Chand Gupta
Partner
M.No.085003
Date : 22.05.2023
Place : New Delhi

For and on behalf Board of the National Highways Infra Investment Managers Private Limited (Investment Manager of National Highways Infra Trust)

Suresh Krishan Goyal
Director
DIN: 02721580

Mahavir Parsad Sharma
Director
DIN: 03158413

Mathew George
Chief Financial Officer

Gunjan Singh
Compliance Officer

NATIONAL HIGHWAYS INFRA TRUST

CONSOLIDATED CASH FLOW STATEMENT FOR THE YEAR ENDED MARCH 31, 2023

(All amounts in ₹ lakh unless otherwise stated)

	Particulars	For the year ended March 31 2023	For the year ended March 31 2022
A.	**OPERATING ACTIVITIES**		
	Net Profit/(Loss) Before Tax	21,740.68	7,010.37
	Adjustments for :		
	Depreciation and Amortization	17,560.63	1,055.65
	Profit on redemption of mutual funds	(671.17)	(682.62)
	Interest income from FDR	(373.43)	(5.86)
	Finance Cost (net)	16,590.17	3,154.43
	Provision for major maintenance expenses	5,879.20	403.29
	Unwinding interest on major maintenance provision	24.95	-
	Provision for Laeave encashment and Gratuity	11.93	0.11
	Provision for expected credit loss	59.60	-
	Bad debts written off	9.90	-
	Operating Profit/(Loss) before Working Capital Changes	**60,832.46**	**10,935.37**
	Working Capital Adjustments:		
	Decrease / (Increase) in Trade & Other Receivables	180.10	(600.47)
	Decrease / (Increase) in Other Non Current Financial Assets	(208.85)	(0.00)
	Decrease / (Increase) in Other Non Current/Current Assets	(834.96)	(347.29)
	Decrease / (Increase) in Other Current Financial Assets	(293.53)	0.59
	Increase / (Decrease) in Trade & Other Payables	3,267.01	651.07
	Increase / (Decrease) in Other Financial Liabilities	57.50	(7,34,867.55)
	Increase / (Decrease) in Provisions	(0.11)	0.00
	Increase / (Decrease) in Other Current Liabilities	(0.14)	238.59
	Increase / (Decrease) in Current Tax Liabilities	-	(0.59)
		2,167.02	**(7,34,925.66)**
	Income Tax paid	(626.67)	(274.00)
	Net Cash Flows from/(used in) Operating Activities	**62,372.81**	**(7,24,264.28)**
B.	**INVESTING ACTIVITIES**		
	Purchase of Property, Plant & Equipment, including CWIP, capital	(2,85,101.04)	(0.50)
	Purchase of Non Current Investments	-	(1.52)
	Investment in FDR	(6,299.19)	(3,170.81)
	Interest received on maturity of FDR	189.55	-
	Profit on redemption of mutual funds	671.17	682.62
	Net cash flows from (used in) Investing activities	**(2,90,539.51)**	**(2,490.21)**
C.	**FINANCING ACTIVITIES**		
	Proceeds from Issue of Unit Capital	1,43,013.67	5,91,000.00
	Expense incurred towards initial public debt offering	(1,689.00)	-
	Expense incurred towards institutional unit allotment	(1,099.13)	(1,364.94)
	Distribution to Unit Holders	(34,927.86)	-
	Proceeds from Long Term Borrowings (net of processing fees)	1,50,000.00	1,47,646.00
	Financing charges paid	(197.00)	-
	Repayment of Long Term Borrowings	(1,010.98)	(1,001.59)
	Finance Costs Paid	(11,180.86)	(3,143.04)
	Net cash flows from (used in) Financing activities	**2,42,908.84**	**7,33,136.43**
	Net Increase/Decrease in Cash and Cash equivalents (A+B+C)	**14,742.14**	**6,381.94**
	Cash and cash equivalents at the beginning of the year	6,381.94	-
	Cash and cash equivalents at the end of the year	**21,124.08**	**6,381.94**

This is the Consolidated Cash Flow Statement referred to in our report of even date.

For A.R. & Co.
Chartered Accountants
Firm Registration no. 002744C

A.R. & CO. FRN 002744 C CHARTERED ACCOUNTANTS

CA Kailash Chand Gupta
Partner
M.No.085003
Date : 22.05.2023
Place : New Delhi

For and on behalf of the National Highways Infra Investment Managers Private Limited (Investment Manager of National Highways Infra Trust)

Suresh Krishan Goyal
Director
DIN: 02721580

Mahavir Parsad Sharma
Director
DIN: 03158413

Mathew George
Chief Financial Officer

Gunjan Singh
Compliance Officer

NATIONAL HIGHWAYS INFRA TRUST

CONSOLIDATED STATEMENT OF CHANGES IN UNIT HOLDER'S EQUITY FOR THE YEAR ENDED MARCH 31, 2023

A. INITIAL SETTLEMENT AMOUNT

(All amounts in ₹ lakh unless otherwise stated)

Particulars	Amount
Balance as at April 1, 2021	0.10
Changes in unit capital	-
Balance as at March 31 2022	0.10
Changes in unit capital	-
Balance as at March 31 2023	0.10

B. UNIT CAPITAL *

Particulars	Number of unit	Amount
Balance as at April 1, 2021	-	-
Changes in unit capital	59,52,00,000	6,01,152.00
One time issue expenses		(1,709.18)
Balance as at 31 March 2022	**59,52,00,000**	**5,99,442.82**
Changes in unit capital	13,12,05,200	1,43,013.67
One time issue expenses		(852.17)
Balance as at March 31 2023	**72,64,05,200**	**7,41,604.32**

C. OTHER EQUITY **

Particulars	Reserves and Surplus	Items of Other Comprehensive Income	Total
		Items that will not be reclassified to profit or loss	
	Retained Earnings	Remeasurement of Defined Benefit Obligation/ Plan	
Balance as at April 1, 2021	**(67.90)**	-	**(67.90)**
Profit/ (Loss) for the year	**6,836.33**	-	**6,836.33**
Balance as at 31 March 2022	**6,768.43**	-	**6,768.43**
Profit/ (Loss) for the year	25,689.57	-	25,689.57
Less:			
Distribution to unit holders^			
Interest	34,183.66	-	34,183.66
Other Income	744.20	-	744.20
Balance as at March 31 2023	**(2,469.86)**	-	**(2,469.86)**

^The distribution relates to the distributions during the financial year along with the distribution related to the last quarter of FY 2021-22 and does not include the distribution relating to the period January 01, 2023 to March 31, 2023 which will be paid after March 31, 2023. The distributions by the Trust to its unit holders are based on the Net Distributable Cash Flows of the Trust under the SEBI InvIT Regulations.

* Refer Note No. 13
** Refer Note No. 14

For A.R. & Co.
Chartered Accountants
Firm Registration no. 002744C

A.R. & CO. FRN 002744 C CHARTERED ACCOUNTANTS

CA Kailash Chand Gupta
Partner
M.No.085003

Date : 22.05.2023
Place : New Delhi

For and on behalf of the National Highways Infra Investment Managers Private Limited (Investment Manager of National Highways Infra Trust)

Suresh Krishan Goyal
Director
DIN: 02721580

Mahavir Parsad Sharma
Director
DIN: 03158413

Mathew George
Chief Financial Officer

Gunjan Singh
Compliance Officer

NATIONAL HIGHWAYS INFRA TRUST

Disclosures pursuant to SEBI circulars (SEBI Master Circular No. CIRSEBI/HO/DDHS_Div3/P/CIR/2021/1673 dated 29 November 2021 issued under the InvIT regulations)

Consolidated Statement of Net Assets at Fair Value (All amounts in ₹ lakh unless otherwise stated)

	March 31, 2023		March 31, 2022	
Particulars	**Book value**	**Fair value^**	**Book value**	**Fair value^**
A. Assets	10,49,155.20	11,68,122.00	7,54,897.72	7,54,897.72
B. Liabilities	3,10,020.64	3,10,020.64	1,48,686.37	1,48,686.37
C. Net assets (A-B)	**7,39,134.56**	**8,58,101.36**	**6,06,211.35**	**6,06,211.35**
D. No of units	72,64,05,200	72,64,05,200	59,52,00,000	59,52,00,000
E. NAV (C/D)	**101.75**	**118.13**	**101.85**	**101.85**

^Fair values of total assets relating to the Trust as at March 31, 2023 as disclosed above are based on the independent valuer report.

Note: The trust has only one SPV i.e. NHIPPL hence SPV wise break up of fair value of assets are not required

Consolidated Statement of Total Return at Fair Value: (All amounts in ₹ lakh unless otherwise stated)

Particulars	**March 31, 2023**	**March 31, 2022**
Total comprehensive income for the year/period (As per the Consolidated Statement of Profit and Loss)	25,689.57	6,836.33
Add: Other changes in fair value for the year *	1,18,966.80	-
Total return	**1,44,656.37**	**6,836.33**

* In the above statement, other changes in fair value for the year ended 31 March, 2023 have been computed based independent valuers report.

The accompanying notes form an integral part of the Consolidated Financial Statements.

This is the Consolidated Statement of Net Assets at Fair Value and Consolidated Statement of Total Return at Fair Value referred to in our report of even date.

For A.R. & Co.
Chartered Accountants
Firm Registration no. 002744C

A.R. & CO. FRN 002744 C CHARTERED ACCOUNTANTS

CA Kailash Chand Gupta
Partner
M.No.085003

Date : 22.05.2023
Place : New Delhi

For and on behalf Board of the National Highways Infra Investment Managers Private Limited (Investment Manager of National Highways Infra Trust)

Suresh Krishan Goyal
Director
DIN: 02721580

Mahavir Parsad Sharma
Director
DIN: 03158413

Mathew George
Chief Financial Officer

Gunjan Singh
Compliance Officer

NATIONAL HIGHWAYS INFRA TRUST

Disclosures pursuant to SEBI circulars (SEBI Master Circular No. CIRSEBI/HO/DDHS_Div3/P/CIR/2021/1673 dated 29 November 2021 issued under the InvIT

Consolidated Statement of Net Distributable Cash Flows (All amounts in ₹ lakh unless otherwise stated)

S. No.	Particulars	March 31, 2023	March 31, 2022
1	**Profit after tax as per Statement of profit and loss/income and expenditure (Standalone) (A)**	77,236.17	18,192.23
2	Add: Income recognised in previous year and received in this year	10,651.13	-
3	**Add:** Depreciation and amortization as per statement of profit and loss account. Incase of Impairment reversal, same needs to be deducted from profit and loss.	-	-
4	**Add/Less:** Loss/gain on sale of infrastructure assets	-	-
5	**Add:** Proceeds from sale of infrastructure assets adjusted for the following: - related debts settled or due to be settled from sale proceeds; - directly attributable transaction costs; - proceeds reinvested or planned to be reinvested as per Regulation 18(7)(a) of the InvIT regulations	-	-
6	**Add:** Proceeds from sale of infrastructure assets not distributed pursuant to an earlier plan to re-invest, if such proceeds are not intended to be invested subsequently, net of any profit/ (loss) recognised in profit and loss account	-	-
7	**Add/ Less:** Any other item of non- cash expense/ non cash income (net of actual cash flows for these items), if deemed necessary by the Investment Manager. For example, any decrease/ increase in carrying amount of an asset or a liability recognised in profit and loss /income and expenditure on measurement of the asset or the liability at fair value; Interest cost as per effective interest rate method, deferred tax lease rents recognised on a straight line basis, etc.	(42,570.15)	(8,233.88)
8	**Less:** Repayment of external debt (principal) / redeemable preference shares / debentures, etc. (excluding refinancing) / net cash set aside to comply with DSRA requirement under loan agreements	(1,010.98)	(5,204.50)
9	**Total Adjustment (B)**	(32,930.01)	(13,438.39)
10	**Net Distributable Cash Flows (C) = (A+B)**	**44,306.16**	**4,753.84**
11	**Less: NDCF already distributed to Unitholders in Q1,Q2 and Q3**	30,225.78	-
12	**Balance Net Distributable Cash Flows**	**14,080.39**	**4,753.84**
13	**Less: Amounts setaside for payment of financial liabilites and other liabilities**	(2,431.84)	-
14	**Balance Net Distributable Cash Flows for Q4**	**11,648.55**	**4,753.84**

A.R. & CO. FRN 002744 C CHARTERED ACCOUNTANTS

NATIONAL HIGHWAYS INFRA TRUST

Disclosures pursuant to SEBI circulars (SEBI Master Circular No. CIRSEBI/HO/DDHS_Div3/P/CIR/2021/1673 dated 29 November 2021 issued under the InvIT

Statement of Net Distributable Cash Flows

National Highways Infra Projects Private Limited (Project SPV)

(All amounts in ₹ lakh unless otherwise stated)

S. No.	Particulars	March 31, 2023	March 31, 2022
1	**Profit after tax as per Statement of profit and loss/income and expenditure (standalone) (A)**	**(51,546.61)**	**(11,355.90)**
2	**Add:** Depreciation and amortization as per statement of profit and loss account. Incase of Impairment reversal, same needs to be deducted from profit and loss.	17,560.63	1,055.65
3	**Add/Less:** Loss/gain on sale of infrastructure assets	-	-
4	**Add:** Proceeds from sale of infrastructure assets adjusted for the following: related debts settled or due to be settled from sale proceeds; directly attributable transaction costs; proceeds reinvested or planned to be reinvested as per Regulation 18(7)(a) of the InvIT regulations	-	-
5	**Add:** Proceeds from sale of infrastructure assets not distributed pursuant to an earlier plan to re-invest, if such proceeds are not intended to be invested subsequently, net of any profit/ (loss) recognised in profit and loss account	(134.38)	-
6	**Add/ Less:** Any other item of non- cash expense/ non cash income (net of actual cash flows for these items), if deemed necessary by the Investment Manager. For example, any decrease/ increase in carrying amount of an asset or a liability recognised in profit and loss /income and expenditure on measurement of the asset or the liability at fair value; Interest cost as per effective interest rate method, deferred tax lease rents recognised on a straight line basis, etc.	40,575.45	10,888.85
7	**Less:** Repayment of external debt (principal) / redeemable preference shares / debentures, etc. (excluding refinancing) / net cash set aside to comply with DSRA requirement under loan agreements	(4,004.00)	-
8	**Total Adjustment (B)**	53,997.70	11,944.50
9	**Net Distributable Cash Flows (C) = (A+B)**	**2,451.09**	**588.61**

A.R. & CO. FRN 002744 C CHARTERED ACCOUNTANTS

NATIONAL HIGHWAYS INFRA TRUST

SIGNIFICANT ACCOUNTING POLICIES FORMING PART OF CONSOLIDATED FINANCIAL STATEMENTS FOR THE YEAR ENDED ON MARCH 31, 2023

1. GROUP INFORMATION AND NATURE OF OPERATIONS

The consolidated financial statements comprise financial statements of National Highways Infra Trust ("the Trust" or "InvIT") and its subsidiary (Project SPV – National Highways Infra Projects Private Limited (NHIPPL)) (collectively, the Group).

The Trust is an irrevocable trust registered under the provisions of the Indian Trusts Act, 1882 on October 19, 2020. It is registered under the Securities and Exchange Board of India (Infrastructure Investment Trust) Regulations, 2014 on October 28, 2020 having registration number IN/InvIT/20-21/0014.

The Trust was setup by National Highways Authority of India ("NHAI" or the "Sponsor"), an Infrastructure Development Trust in India. The Trustee to the Trust is IDBI Trusteeship Services Limited (the "Trustee") and Investment Manager for the Trust is National Highways Infra Investment Managers Private Limited ("Investment Manager").

The Trust has been formed to invest in infrastructure assets primarily being in the road sector in India. The Trust's road projects are implemented and held through special purpose vehicles ("Project SPVs"/ "Subsidiaries"). The units of the Trust were listed in Bombay Stock Exchange and National Stock Exchange on November 10, 2021.

During the year ended March 31, 2022, the Trust acquired 100% equity control in National Highway Infra Projects Private Limited (the "Project SPV") from the Sponsor with effect from November 03, 2021. During the year ended 31.03.2021, the project SPV entered into five Concession Agreements for 30 years with the Sponsor (National Highways Authority of India – NHAI) on Toll, Operate and Transfer ('TOT') basis and in year ended 31.03.23 further signed three new Concession Agreements for 20 years with National Highways Authority of India on Toll, Operate and Transfer ('TOT') basis.

The registered office of the Investment Manager is G-5 & 6, Sector-10, Dwarka, Delhi - 110075.

The consolidated financial statements were authorised for issue in accordance with resolution passed by the board of directors of the Investment Manager on May 22, 2023.

2. SIGNIFICANT ACCOUNTING POLICIES

2.1 Basis of Preparation

The Consolidated financial statements of the Group have been prepared in accordance with Indian Accounting Standards as defined in Rule 2(1)(a) of the Companies (Indian Accounting Standards) Rules, 2015, as amended, prescribed under Section 133 of the Companies Act, 2013 ("Ind AS") read with Securities and Exchange Board of India (Infrastructure Investment Group) Regulations, 2014, as amended and the circulars issued thereunder ("SEBI InvIT Regulations") and other accounting principles generally accepted in India.

Accordingly, the Group has prepared these Consolidated Financial Statements comprising of the Balance Sheet as on March 31, 2023, the Statement of Profit and Loss for the year ended on March 31, 2023, the Statement of Cash Flows for the year ended on March 31, 2023, the Statement of Changes of Equity for the year ended on March 31, 2023 and Notes to Accounts (together hereinafter referred to as "Consolidated Financial Statements").

These Financial Statements have been prepared on accrual basis under the historical cost convention, except certain financial assets and liabilities which have been measured at Fair Value. Accounting policies have been consistently applied, except where a newly issued Accounting Standard is initially adopted or a revision to an existing Accounting Standard requires a change in the accounting policy hitherto in use. Further, these consolidated financial statements have been prepared on a going concern basis.

The financial statements are presented in Indian Rupees (INR) which is the Group's functional and presentation currency and all amounts are rounded to the nearest Lakh (`00,000) and two decimals thereof, except as otherwise stated.

2.2 Basis of Consolidation

The consolidated financial statements incorporate the financial statements of the Trust and it's subsidiary (Project SPV- NHIPPL) from date of acquisition i.e. November 3, 2021.

For the purpose of consolidation, an entity which is, directly or indirectly, controlled by the Group is treated as subsidiary. Control exists when the Group, directly or indirectly, has power over the investee, is exposed to variable returns from its involvement with the investee and has the ability to use its power to affect its returns.

Consolidation of a subsidiary begins when the Group, directly or indirectly, obtains control over the subsidiary and ceases when the Group, directly or indirectly, loses control of the subsidiary. Income and expenses of a subsidiary acquired or disposed of during the period are included in the consolidated statement of profit and loss from the date the Group, directly or indirectly, gains control until the date when the Group, directly or indirectly, ceases to control the subsidiary.

Consolidation procedure:

- Combine like items of assets, liabilities, equity, income, expenses and cash flows of the parent with those of its subsidiary. For this purpose, income and expenses of the Subsidiaries are based on the amounts of the assets and liabilities recognised in the Consolidated financial statements at the acquisition date.

- Offset (eliminate) the carrying amount of the parent's investment in each subsidiary and the parent's portion of equity of each subsidiary. Business combinations policy explains how to account for any related goodwill.

- Eliminate in full intragroup assets and liabilities, equity, income, expenses and cash flows relating to transactions between entities of the group (profits or losses resulting from intragroup transactions that are recognised in assets, such as inventory and fixed assets, are eliminated in full. Intragroup losses may indicate an impairment that requires recognition in the consolidated financial statements.

A.R. & CO. FRN 002744 C CHARTERED ACCOUNTANTS

- The carrying amount of the Group's investment in each subsidiary and the Group's portion of equity of each subsidiary are offset with each other in the consolidated financial statements.

Ind AS 12 - Income Taxes applies to temporary differences that arise from the elimination of profits from intragroup transactions.

The accounting policies of subsidiaries have been harmonised to ensure the consistency with the policies adopted by the Group. The consolidated financial statements have been presented to the extent possible, in the same manner as Group's standalone financial statements.

2.3 Business Combination/ Goodwill on Acquisition

Business combinations are accounted for using the acquisition method. The cost of an acquisition is measured as the aggregate of the consideration transferred, measured at acquisition date fair value and the amount of any non-controlling interests in the acquiree. For each business combination, the Group elects whether to measure the non-controlling interests in the acquiree at fair value or at the proportionate share of the acquiree's identifiable net assets. Acquisition related costs are recognised in the statement of profit and loss as incurred.
The acquiree's identifiable assets, liabilities and contingent liabilities that meet the condition for recognition are recognised at their fair values at the acquisition date.

At the acquisition date, the identifiable assets acquired and the liabilities assumed are recognised at their acquisition date fair values. For this purpose, the liabilities assumed include contingent liabilities representing present obligation and they are measured at their acquisition fair values irrespective of the fact that outflow of resources embodying economic benefits is not probable

Goodwill is initially measured at cost, being the excess of the aggregate of the consideration transferred and the amount recognised for non-controlling interests, and any previous interest held, over the net identifiable assets acquired and liabilities assumed. If the fair value of the net assets acquired is in excess of the aggregate consideration transferred, the Group re-assesses whether it has correctly identified all of the assets acquired and all of the liabilities assumed and reviews the procedures used to measure the amounts to be recognised at the acquisition date. If the reassessment still results in an excess of the fair value of net assets acquired over the aggregate consideration transferred, then the gain is recognised in other comprehensive income and accumulated in equity as capital reserve. However, if there is no clear evidence of gain on bargain purchase, the entity recognises the gain directly in equity as capital reserve, without routing the same through other comprehensive income.

Goodwill arising on consolidation is not amortised, however, it is tested for impairment annually. In the event of cessation of operations of a subsidiary, the unimpaired goodwill is written off fully. For the purpose of impairment testing, goodwill acquired in a business combination is, from the acquisition date, allocated to each of the Group's cash-generating units that are expected to benefit from the combination, irrespective of whether other assets or liabilities of the acquire are assigned to those units. A cash generating unit to which goodwill has been allocated is tested for impairment annually, or more frequently when there is an indication that the unit may be impaired. If the recoverable amount of the cash generating unit is less than it's carrying amount, the impairment loss is allocated first to reduce the carrying amount of any goodwill allocated to the unit and then to the other assets of the unit pro-rata based on the carrying amount of each asset in the unit.

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Any impairment loss for goodwill is recognised in the consolidated statement of profit or loss. An impairment loss recognised for goodwill is not reversed in subsequent periods. Where goodwill has been allocated to a cash generating unit and part of the operation within that unit is disposed of, the goodwill associated with the disposed operation is included in the carrying amount of the operation when determining the gain or loss on disposal.

Goodwill disposed in these circumstances is measured based on the relative values of the disposed operation and the portion of the cash-generating unit retained.

2.4 Use of Judgement and Estimates

The preparation of financial statements is in conformity with the generally accepted accounting principles in India, and requires the Investment Manager to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent liabilities at the date of the financial statements and the results of operations during the reporting period end. Although these estimates are based upon Investment Manager's best knowledge of current events and actions, actual results could differ from these estimates.

Current versus non-current classification

Assets and Liabilities in the Consolidated Balance Sheet have been classified as either Current or Non–Current based upon the requirements of Schedule III notified under the Companies Act, 2013.

An asset has been classified as Current if,

(a) it is expected to be realized in, or is intended for sale or consumption in, the Group's normal operating cycle; or

(b) it is held primarily for the purpose of being traded; or

(c) it is expected to be realized within twelve months after the reporting date; or

(d) it is cash or cash equivalent unless it is restricted from being exchanged or used to settle a liability for at least twelve months after the reporting date.

All other assets have been classified as Non–Current.

A liability has been classified as Current when,

(a) it is expected to be settled in the Group's normal operating cycle; or

(b) it is held primarily for the purpose of being traded; or

(c) it is due to be settled within twelve months after the reporting date; or

(d) the Group does not have an unconditional right to defer settlement of the liability for at least twelve months after the reporting date.

All other liabilities have been classified as Non–Current.

The operating cycle is the time between the acquisition of assets for processing and their realisation in cash and cash equivalents. The group has identified twelve months as its operating cycle.

Deferred tax assets and liabilities are classified as non-current assets and liabilities.

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2.5 Revenue Recognition

Revenue is recognised to the extent that it is probable that the economic benefits will flow to the Group and the revenue can be reliably measured, regardless of when the payment is being made. Revenue is measured at the fair value of the consideration received or receivable, taking into account contractually defined terms of payment and excluding taxes or duties collected on behalf of the government.

The specific recognition criteria described below must also be met before revenue is recognised:

Toll Revenue - Toll Revenue from users of toll roads held by subsidiary company is recognised in respect of toll revenue accrued for respective toll road projects. Revenue from electronic toll collection is recognised on accrual basis.

Interest income - Interest is recognised on time proportion basis taking into account the amount outstanding and the rates applicable. For all Debt instruments measured either at Amortized Cost or Fair Value through Other Comprehensive Income, interest income is recorded using EIR method that is the rate that exactly discounts estimated future cash receipts through the expected life of the financial instrument to the net carrying amount of the financial asset.

Dividends - Dividend income is recognised when the Group's right to receive the payment is established, which is generally when shareholders approve the dividend.

Fair value gains on current investments carried at fair value are included in other income.

Claims with National Highways Authority of India ('NHAI') and other government authorities are accounted as and when the money is received from the respective authorities, in cases of monetary compensations.

Other items - Other items of income are recognised as and when the right to receive the income arises.

2.6 Property, plant and equipment

Property, Plant and Equipment (PPE) is recognised when it is probable that future economic benefits associated with the item will flow to the Group and the cost of the item can be measured reliably.

PPE are stated at acquisition cost less accumulated depreciation and cumulative impairment. Such cost includes the cost of replacing part of the plant and equipment and borrowing costs for long-term construction projects if the recognition criteria are met.

Recognition:

The cost of an item of property, plant and equipment shall be recognised as an asset if, and only if:

(a) it is probable that future economic benefits associated with the item will flow to the entity; and

(b) the cost of the item can be measured reliably.

When significant parts of plant and equipment are required to be replaced at intervals, Group depreciates them separately based on their specific useful lives.

Gains or losses arising from de - recognition of Property, plant and equipment are measured as the difference between the net disposable proceeds and the carrying amount of the asset and are recognized in the Consolidated Statement of Profit and Loss when the asset is derecognized.

The Group has estimated following useful lives for its tangible fixed assets

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Asset Class	Useful Life
Office Equipments	5 Years
Computers	3 Years
Furniture & Fixtures	10 Years

Depreciation on Property, plant and equipment

Depreciation on Property, plant and equipment ("PPE") is provided on straight line method, up to the cost of the asset (net of residual value), in accordance with the useful lives prescribed under Schedule II to the Companies Act, 2013.

Depreciation on additions is being provided on a pro-rata basis from the date of such additions. Similarly, depreciation on assets sold/disposed off during the year is being provided up to the dates on which such assets are sold/disposed off. Modification or extension to an existing asset, which is of capital nature and which becomes an integral part thereof is depreciated prospectively over the remaining useful life of that asset.

The estimated residual value of the PPE has been taken as 5% in line with the provisions of Schedule II to the Companies Act, 2013.

Fixed assets amounting up to INR 5,000 are recognised in Consolidated Statement of Profit and Loss in entirety in the first year of purchase.

The residual values, useful lives and methods of depreciation of property, plant and equipment are reviewed at each financial year end and adjusted prospectively, if appropriate.

Depreciation charge for impaired assets is adjusted in future periods in such a manner that the revised carrying amount of the asset is allocated over its remaining useful life.

2.7 Intangible assets

In accordance with Ind AS 38 "Intangible Assets", Intangible assets are recognised when it is probable that the future economic benefits that are attributable to the asset will flow to the Group and the cost of the asset can be measured reliably.

Pre-operative expenses including administrative and other general overhead expenses that are specifically attributable to the development or acquisition of intangible assets are allocated and capitalised as a part of the cost of the intangible assets.

Intangible assets not ready for the intended use on the date of the Consolidated Balance Sheet are disclosed as "intangible assets under development". Intangible assets are derecognised when no future economic benefits are expected from use or disposal.

The cost of intangible assets acquired in an amalgamation in the nature of purchase is their fair value as at the date of amalgamation. Following initial recognition, intangible assets are carried at cost less accumulated amortization and accumulated impairment losses, if any.

The useful lives of intangible assets are assessed as either finite or indefinite.

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Rights under Service Concession Arrangements – Toll Collection Rights
The Group has acquired rights for Tolling, Operation, Maintenance and Transfer of five toll road projects for a period of 30 years basis Toll Concession agreements with NHAI, group further acquired rights during the current financial year for Tolling, Operation, Maintenance and Transfer of three additional toll road projects for a period of 20 years basis Toll Concession agreements with NHAI, and the same have been recognised as Other Intangible Assets in the financial statements.

Extension of concession period by the Authority in compensation for claims made by the Group are capitalised as part of Toll Collection Rights on acceptance of the claim. Where the Group has a contractual right to an extension in the concession period as per the concession agreement, the same is capitalized when the right to extension in the concession period is established at the estimated amount of eligible claims.

Amortisation of Intangible Assets
Intangible assets with finite lives are amortised over the useful economic life and assessed for impairment whenever there is an indication that the intangible asset may be impaired. The amortisation period and the amortisation method for an intangible asset with a finite useful life are reviewed at least at the end of each reporting period. Changes in the expected useful life or the expected pattern of consumption of future economic benefits embodied in the asset are considered to modify the amortisation period or method, as appropriate, and are treated as changes in accounting estimates. The amortisation expense on intangible assets with finite lives is recognised in the Consolidated Statement of Profit and Loss unless such expenditure forms part of carrying value of another asset.

In accordance with Ind AS 38 "Intangible Assets", Intangible assets should be amortized by a method which reflects the pattern in which the asset's future economic benefits are expected to be consumed by the entity.

Toll Collection Rights shall be amortized basis a Consumption based model (using Passenger Car Unit (PCU) projections) over the tenure of the Concession Agreement.

Other intangible assets - Software purchased is amortized over a period of three to six years on straight line basis from the month in which the addition is made.

Gains or losses arising from derecognition of an intangible asset are measured as the difference between the net disposal proceeds and the carrying amount of the asset and are recognised in the statement of profit or loss when the asset is derecognised.

Amortisation on impaired assets is provided by adjusting the amortisation charge in the remaining periods so as to allocate the assets' revised carrying amount over its remaining useful life.

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2.8 Employee benefits

Employee benefits include provident fund, gratuity, compensated absences, long service awards and medical benefits.

i. **Short term employee benefits**

Employee benefits such as salaries, short term compensated absences, expected cost of bonus, ex-gratia and performance linked rewards falling due wholly within twelve months of rendering the service are classified as short-term employee benefits and are expensed in the period in which the employee renders the related service.

ii. **Post-Employment Benefits**

Defined contribution plan: A defined contribution plan is a post-employment plan under which an entity pays fixed contributions and will have no legal or constructive obligations to pay further amounts. The Group contributes to provident fund and employees deposit linked insurance scheme, and have no further obligations beyond making its contributions. The Group's contribution to the above funds are charged to the Consolidated Statement of Profit and Loss.

Defined benefit plan: The Group has an un-funded benefit plan for post-employment benefits in the form of Gratuity. The value of obligation under the plan is determined by the group based on best estimate of the present value of the estimated future cash flows towards the gratuity obligation. Defined benefit costs comprising current service cost, past service cost and gains or losses on settlements are recognised in the Consolidated Statement of Profit and Loss as employee benefits expense. Gains or losses on the curtailment or settlement of any defined benefit plan are recognised when the curtailment or settlement occurs.

iii. **Termination benefits**

Termination benefits such as compensation under employee separation schemes (wherever applicable) are recognised as expense in the Consolidated Statement of Profit and Loss. Liability for the same is recognised at the earlier of when the group can no longer withdraw the offer of the termination benefit.

iv. **Other long-term employee benefits**

The present value of the obligation under long term employee benefit plans such as compensated absences is determined and is recognised in a similar manner as in the case of defined benefit plans.

Long term employee benefit costs comprising current service cost and gains or losses on curtailments and settlements, re-measurements are recognised in the Consolidated Statement of Profit and Loss as employee benefit expenses. Interest cost implicit in long term employee benefit cost is recognised in the Consolidated Statement of Profit and Loss under finance cost.

2.9 Leases

(i) The determination of whether an arrangement is or contains a lease is based on the substance of the arrangement at the inception of the lease.

i.i) Property, plant, and equipment acquired under leases with lease term more than 12 months is long term lease. The lease liability is recognised for the obligation to make the lease

payments and a right of use of asset for the underlying property, plant and equipment for the lease term. The lease liability is measured at the present value of the lease payments to be made over the lease term. The right of use property, plant and equipment are initially measured at the amount of the lease liability, adjusted for lease prepayments, lease incentives received and the initial direct costs such as commissions and an estimate cost of restoration, removal and dismantling of property, plant and equipment. Lease liabilities are increased to reflect the interest cost and are reduced with lease payments.

i.ii) Property, plant, and equipment having lease term 12 months or less than 12 months are recognised on a straight-line basis.

(ii) Property, plant and equipment leased out under operating leases are continued to be capitalised by the Group. Rental income is recognised on a straight-line basis over the term of the relevant lease.

2.10 Borrowing costs

Borrowing Cost consist of interest and other ancillary costs incurred in connection with the arrangement of borrowings. Borrowing costs directly attributable to the acquisition, construction or production of an asset that necessarily takes a substantial period of time to get ready for its intended use or sale are capitalized as part of the cost of the respective asset.

All other borrowing costs are charged to the Consolidated Statement of Profit and Loss in the period they occur. In case of significant Long term loans, other costs incurred in connection with the borrowing of funds are amortized over the period of respective Loan. Borrowing cost also includes exchange differences to the extent regarded as an adjustment to the borrowing costs.

2.11 Financial Instruments

Financial assets and/or financial liabilities are recognised when the Group becomes party to a contract embodying the related financial instruments. A financial instrument is any contract that gives rise to a financial asset of one entity and a financial liability or equity instrument of another entity. A financial asset and a financial liability are offset and presented on net basis in the Consolidated Balance Sheet when there is a current legally enforceable right to set-off the recognised amounts and it is intended to either settle on net basis or to realise the asset and settle the liability simultaneously.

Financial assets

Initial recognition and measurement

All financial assets are recognised initially at fair value plus, in the case of financial assets not recorded at fair value through profit or loss, transaction costs that are attributable to the acquisition of the financial asset. Purchases or sales of financial assets that require delivery of assets within a time frame established by regulation or convention in the market place (regular way trades) are recognised on the trade date, i.e., the date that the Group commits to purchase or sell the asset. Trade receivables and trade payables that do not contain a significant financing component are initially measured at their transaction price.

Subsequent measurement

For purposes of subsequent measurement, financial assets are classified in following categories;

- at amortised cost
- at fair value through profit or loss (FVTPL)
- at fair value through other comprehensive income (FVOCI)

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Financial Assets at amortised cost

A financial asset is classified and subsequently measured at the amortised cost if both the following conditions are met:

a) The asset is held within a business model whose objective is to hold assets for collecting contractual cash flows, and
b) Contractual terms of the asset give rise on specified dates to cash flows that are solely payments of principal and interest (SPPI) on the principal amount outstanding.

This category is the most relevant to the Group. All the Loans and other receivables under financial assets (except Investments) are non-derivative financial assets with fixed or determinable payments that are not quoted in an active market.

After initial measurement, such financial assets are subsequently measured at amortised cost using the effective interest rate (EIR) method. Amortised cost is calculated by taking into account any discount or premium on acquisition and fees or costs that are an integral part of the EIR. The losses arising from impairment are recognised in the Consolidated Statement of Profit and Loss.

Investments in equity instruments of Subsidiaries are recognised at original cost in accordance with Ind AS 27. Impairment testing of Investment in subsidiary that are accounted for at cost as per Ind AS 27 are within scope of Ind AS 36 Impairment of Assets. Any impairment in value of investment in equity investments in Subsidiaries is recognised in the Consolidated Statement of Profit and Loss.

Financial Assets at Fair Value through Other Comprehensive Income (FVOCI)

A financial asset is classified and subsequently measured at FVTOCI if both of the following criteria are met:

a) The asset is held within a business model whose objective is achieved both by collecting contractual cash flows and selling the financial assets, and
b) Contractual terms of the asset give rise on specified dates to cash flows that are solely payments of principal and interest (SPPI).

Investment in Debt instruments included within the FVTOCI category are measured initially as well as at each reporting date at fair value. Fair value movements are recognized in the other comprehensive income (OCI). However, the Group recognizes interest income, impairment losses & reversals and foreign exchange gain or loss in the Consolidated Statement of Profit and Loss.

Interest earned whilst holding FVTOCI debt instrument is reported as interest income using the EIR method.

Financial Assets at Fair Value through Profit and Loss (FVTPL)

A financial asset which is not classified in any of the above categories are subsequently fair valued through profit or loss. Financial assets included within the FVTPL category are measured at fair value with all changes recognized in the Consolidated statement of profit and loss. The Group measures its investments which are classified as equity instruments (other than investment in shares of Subsidiaries, Joint Ventures and Associates) at fair value through profit and loss account.

Any debt instrument, which does not meet the criteria for categorization as at amortized cost or as FVTOCI, is classified as at FVTPL. In addition, the Group may elect to designate a debt instrument, which otherwise meets amortized cost or FVTOCI criteria, as at FVTPL. However, such election is allowed only if doing so reduces or eliminates a measurement or recognition

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inconsistency (referred to as 'accounting mismatch'). The Group has not designated any debt instrument as at FVTPL.

The Group has investment in debt oriented mutual funds which are held for trading, and the same are classified as at FVTPL. The Group makes such election on an instrument by instrument basis. The classification is made on initial recognition and is irrevocable. The gain/ loss on sale of investments are recognised in the Consolidated Statement of Profit and Loss.

Reclassification of Financial Assets

The Group determines classification of financial assets on initial recognition. After initial recognition, no reclassification is made for financial assets which are equity instruments and financial liabilities. For financial assets which are debt instruments, a reclassification is made only if there is a change in the business model for managing those assets. Changes to the business model are expected to be infrequent. The Investment Manager of the Group determines change in the business model as a result of external or internal changes which are significant to the Group's operations. Such changes are evident to external parties. A change in the business model occurs when the Group either begins or ceases to perform an activity that is significant to its operations. If the Group reclassifies financial assets, it applies the reclassification prospectively from the reclassification date which is the first day of the immediately next reporting period following the change in business model. The Group does not restate any previously recognised gains, losses (including impairment gains or losses) or interest.

The following table shows various reclassification and how they are accounted for:

Original Classification	**Revised Classification**	**Accounting Treatment**
Amortized Cost	FVTPL	Fair value is measured at reclassification date. Difference between previous amortised cost and fair value is recognised in Consolidated statement of profit and loss.
FTVPL	Amortized Cost	Fair value at reclassification date becomes its new gross carrying amount.
Amortized Cost	FVOCI	Fair value is measured at reclassification date. Difference between previous amortised cost and fair value is recognised in other comprehensive income. No Change in EIR due to reclassification.
FVOCI	Amortized Cost	Fair value at reclassification date becomes its new gross carrying amount. However cumulative gain or loss in other comprehensive income is adjusted against Fair value. Consequently, the asset is measured as if it had always been measured at amortised cost.
FTVPL	FVOCI	Fair value at reclassification date becomes its new carrying amount. No other adjustment is required.
FVOCI	FTVPL	Assets continue to be measured fair value. Cumulative gain or loss previously recognized in other comprehensive income is

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		reclassified to Consolidated statement of profit and loss at the reclassification date.

Derecognition

A financial asset (or, where applicable, a part of a financial asset or part of Group's similar financial assets) is primarily derecognised (i.e. removed from the Consolidated Balance Sheet) when:

- The rights to receive cash flows from the asset have expired, or
- The group has transferred its rights to receive cash flows from the asset or has assumed an obligation to pay the received cash flows in full without material delay to a third party under a 'pass-through' arrangement; and either (a) the group has transferred substantially all the risks and rewards of the asset, or (b) the group has neither transferred nor retained substantially all the risks and rewards of the asset, but has transferred control of the asset.

When the Group has transferred its rights to receive cash flows from an asset or has entered into a pass-through arrangement, it evaluates if and to what extent it has retained the risks and rewards of ownership. When it has neither transferred nor retained substantially all of the risks and rewards of the asset, nor transferred control of the asset, the group continues to recognise the transferred asset to the extent of the group's continuing involvement. In that case, the group also recognises an associated liability. The transferred asset and the associated liability are measured on a basis that reflects the rights and obligations that the group has retained.
Continuing involvement that takes the form of a guarantee over the transferred asset is measured at the lower of the original carrying amount of the asset and the maximum amount of consideration that the group could be required to repay.

Financial liabilities

Initial recognition and measurement

Financial liabilities are classified, at initial recognition, as financial liabilities at fair value through profit or loss, loans and borrowings, payables, as appropriate.
All financial liabilities are recognised initially at fair value and, in the case of loans and borrowings and payables, net of directly attributable transaction costs.
The Group's financial liabilities include trade and other payables, loans and borrowings etc.

Subsequent measurement

Financial liabilities designated upon initial recognition at fair value through profit or loss are designated as such at the initial date of recognition, and only if the criteria in Ind AS 109 are satisfied. For liabilities designated as FVTPL, fair value gains/ losses attributable to changes in own credit risk are recognized in OCI. These gains/losses are not subsequently transferred to Consolidated statement of profit and loss. However, the Group may transfer the cumulative gain or loss within equity. All other changes in fair value of such liability are recognised in the Consolidated statement of profit and loss. The Group has not designated any financial liability as at fair value through profit and loss.

Loans and borrowings

This is the category most relevant to the Group. After initial recognition, interest-bearing loans and borrowings are subsequently measured at amortised cost using the EIR method. Gains and

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losses are recognised in Statement of Profit or Loss when the liabilities are derecognised as well as through the EIR amortisation process. Amortised cost is calculated by taking into account any discount or premium on acquisition and fees or costs that are an integral part of the EIR. The EIR amortisation is included as finance costs in the Consolidated Statement of Profit and Loss.
This category generally applies to borrowings and security deposits received.

Derecognition
A financial liability is derecognised when the obligation under the liability is discharged or cancelled or expires. When an existing financial liability is replaced by another from the same lender on substantially different terms, or the terms of an existing liability are substantially modified, such an exchange or modification is treated as the derecognition of the original liability and the recognition of a new liability. The difference in the respective carrying amounts is recognised in the statement of profit or loss.

Offsetting financial instrument

Financial assets and liabilities are offset and the net amount is reported in the Consolidated Balance Sheet where there is a legally enforceable right to offset the recognised amounts and there is an intention to settle financial asset and liability on a net basis or realise the asset and settle the liability simultaneously. The legally enforceable right must not be contingent on future events and must be enforceable in the normal course of business and in the event of default, insolvency or bankruptcy of the Company or the counterparty.

2.12 Fair Value measurement
The Group measures financial instruments at fair value at each financial statement date.
Fair value is the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date. The fair value measurement is based on the presumption that the transaction to sell the asset or transfer the liability takes place either:
i) In the principal market for the asset or liability, or
ii) In the absence of a principal market, in the most advantageous market for the asset or liability

The principal or the most advantageous market must be accessible by the Group.

The fair value of an asset or a liability is measured using the assumptions that market participants would use when pricing the asset or liability, assuming that market participants act in their economic best interest.

A fair value measurement of a non-financial asset takes into account a market participant's ability to generate economic benefits by using the asset in its highest and best use or by selling it to another market participant that would use the asset in its highest and best use.

The Group uses valuation techniques that are appropriate in the circumstances and for which sufficient data are available to measure fair value, maximising the use of relevant observable inputs and minimising the use of unobservable inputs.

All assets and liabilities for which fair value is measured or disclosed in the financial statements are categorised within the fair value hierarchy, described as follows, based on the lowest level input that is significant to the fair value measurement as a whole:
Level 1 — Quoted prices (unadjusted) in active markets for identical assets or liabilities

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Level 2 — Inputs other than quoted prices included within Level 1 that are observable for the asset or liability, either directly (i.e. as prices) or indirectly (i.e. derived from prices)
Level 3 — Inputs for the assets or liabilities that are not based on observable market data (unobservable inputs).

For assets and liabilities that are recognised in the financial statements on a recurring basis, the Group determines whether transfers have occurred between levels in the hierarchy by re-assessing categorisation (based on the lowest level input that is significant to the fair value measurement as a whole) at the end of each reporting period.

The Group determines the policies and procedures for both recurring fair value measurement, such as derivative instruments and unquoted financial assets measured at fair value, and for non-recurring measurement, such as assets held for distribution in discontinued operations.

At each reporting date, the Group analyses the movements in the values of assets and liabilities which are required to be remeasured or re-assessed as per the Group's accounting policies. For this analysis, the Group verifies the major inputs applied in the latest valuation by agreeing the information in the valuation computation to contracts and other relevant documents.

The Group also compares the change in the fair value of each asset and liability with relevant external sources to determine whether the change is reasonable.
On an annual basis, the Board of Directors of the Investment Manager presents the valuation results to the Audit Committee and the Group's independent auditors. This includes a discussion of the major assumptions used in the valuations. For the purpose of fair value disclosures, the Group has determined classes of assets and liabilities on the basis of the nature, characteristics and risks of the asset or liability and the level of the fair value hierarchy as explained above. This note summarises accounting policy for fair value. Other fair value related disclosures are given in the relevant notes.

2.13 Cash and Cash Equivalents

Cash and cash equivalents in the Consolidated Balance Sheet comprise cash at banks and on hand and short-term deposits with an original maturity of three months or less, which are subject to an insignificant risk of changes in value.

For the purpose of the Consolidated statement of cash flows, cash and cash equivalents consist of cash and short-term deposits, as defined above, net of outstanding bank overdrafts as they are considered an integral part of the Group's cash management.

2.14 Impairment of Assets

Impairment of Financial Assets

All financial assets except for those designated at FVTPL are subject to review for impairment at least each reporting date to identify whether there is any objective evidence that a financial asset or group of financial assets is impaired. In accordance with Ind AS 109, the group applies expected credit loss (ECL) model for measurement and recognition of impairment loss for financial assets carried at amortized cost.

For recognition of impairment loss on other financial assets and risk exposure, the group determines that whether there has been a significant increase in the credit risk since initial

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recognition. If credit risk has not increased significantly, 12-month ECL is used to provide for impairment loss. However, if credit risk has increased significantly, lifetime ECL is used. If, in a subsequent period, credit quality of the instrument improves such that there is no longer a significant increase in credit risk since initial recognition, then the entity reverts to recognising impairment loss allowance based on 12-month ECL.

Lifetime ECL are the expected credit losses resulting from all possible default events over the expected life of a financial instrument. The 12-month ECL is a portion of the lifetime ECL which results from default events that are possible within 12 months after the reporting date.
ECL is the difference between all contractual cash flows that are due to the group in accordance with the contract and all the cash flows that the entity expects to receive (i.e., all cash shortfalls), discounted at the original EIR. When estimating the cash flows, an entity is required to consider:

- All contractual terms of the financial instrument (including prepayment, extension, call and similar options) over the expected life of the financial instrument. However, in rare cases when the expected life of the financial instrument cannot be estimated reliably, then the entity is required to use the remaining contractual term of the financial instrument
- Cash flows from the sale of collateral held or other credit enhancements that are integral to the contractual terms

ECL impairment loss allowance (or reversal) recognized during the year is recognized as income/ expense in the Consolidated Statement of Profit and Loss (P&L). This amount is reflected under the head 'other expenses' in the P&L.

Impairment of Non- Financial Assets
The Group assesses, at each reporting date, whether there is an indication that an asset may be impaired. If any indication exists, or when annual impairment testing for an asset is required, the Group estimates the asset's recoverable amount. An asset's recoverable amount is the higher of an asset's or cash-generating unit's (CGU) fair value less costs of disposal and its value in use. Recoverable amount is determined for an individual asset unless the asset does not generate cash inflows that are largely independent of those from other assets or Group's assets. When the carrying amount of an asset or CGU exceeds its recoverable amount, the asset is considered impaired and is written down to its recoverable amount. In assessing value in use, the estimated future cash flows are discounted to their present value using a pre—tax discount rate that reflects current market assessments of the time value of money and the risks specific to the asset. In determining net selling price, recent market transactions are taken into account, if available. If no such transactions can be identified, an appropriate valuation model is used. Impairment losses of continuing operations are recognized in the Consolidated statement of profit and loss, except for previously revalued tangible fixed assets, where the revaluation was taken to revaluation reserve. In this case, the impairment is also recognized in the revaluation reserve up to the amount of any previous revaluation. After impairment, depreciation is provided on the revised carrying amount of the asset over its remaining useful life.

An assessment is made at each reporting date as to whether there is any indication that previously recognized impairment losses may no longer exist or may have decreased. If such indication exists, the group estimates the asset's CGU's recoverable amount. A previously recognized impairment loss is reversed only if there has been a change in the assumptions used to determine the assets recoverable amount since the last impairment loss was recognized. The reversal is limited so that the carrying amount of the asset does not exceed its recoverable amount, nor exceed the carrying amount that would have been determined, net of depreciation, had no impairment loss been

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recognized for the asset in prior years. Such reversal is recognized in the Consolidated statement of profit and Loss unless the asset is carried at a revalued amount, in which case the reversal is treated as a revaluation increase.

2.15 Foreign currency transactions

The Group's financial statements are presented in INR, which is group's functional currency.
Foreign currency transactions are recorded at the exchange rate prevailing on the date of the respective transactions between the functional currency and the foreign currency.

Monetary foreign currency assets and liabilities remaining unsettled at the Financial Statement date are translated at the rates of exchange prevailing on that date.

Gains / losses arising on account of realisation / settlement of foreign currency transactions and on translation of foreign currency assets and liabilities are recognized in the Consolidated Statement of Profit and Loss.

Exchange differences arising on the settlement of monetary items at rates different from those at which they were initially recorded during the year, or reported in previous financial statements, are recognized as income or as expenses in the year in which they arise.

Non - Monetary items which are carried in terms of historical cost denominated in a foreign currency are reported using the exchange rate at the date of the transaction; and Non - Monetary items which are carried at fair value or other similar valuation denominated in a foreign currency, are reported using the exchange rates that existed when the values were determined.

The gain or loss arising on translation of Non-Monetary items measured at fair value is treated in line with the recognition of the gain or loss on the change in Fair value of the item (i.e., translation differences on items whose fair value gain or loss is recognised in OCI or profit or loss are also recognised in OCI or profit or loss, respectively).

2.16 Taxes on income

Tax expense comprises of Current and Deferred tax.
Current income tax is measured at the amount expected to be paid to the tax authorities in accordance with the Income Tax Act, 1961.

Current income tax assets and liabilities are measured at the amount expected to be recovered from or paid to the taxation authorities. The tax rates and tax laws used to compute the amount are those that are enacted or substantively enacted, at the reporting date. The tax rates and tax laws used to compute the amount are those that are enacted or substantively enacted, at the reporting date.
Current income tax relating to items recognised outside profit or loss is recognised outside profit or loss (either in other comprehensive income or in equity).
Current tax items are recognised in correlation to the underlying transaction either in OCI or directly in equity.
Investment Manager periodically evaluates positions taken in the tax returns with respect to situations in which applicable tax regulations are subject to interpretation and establishes provisions where appropriate.

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Deferred tax is provided using the liability method on temporary differences between the tax bases of assets and liabilities and their carrying amounts for financial reporting purposes at the reporting date.

Deferred tax assets and liabilities are measured at the tax rates that are expected to apply in the year when the asset is realised or the liability is settled, based on tax rates (and tax laws) that have been enacted or substantively enacted at the reporting date.

Deferred tax assets are recognised for all deductible temporary differences, the carry forward of unused tax credits and any unused tax losses. Deferred tax assets are recognised to the extent that it is probable that taxable profit will be available against which the deductible temporary differences, and the carry forward of unused tax credits and unused tax losses can be utilised. The carrying amount of deferred tax assets is reviewed at each reporting date and reduced to the extent that it is no longer probable that sufficient taxable profit will be available to allow all or part of the deferred tax asset to be utilised.

Deferred tax relating to items recognised outside profit or loss is recognised outside profit or loss (either in other comprehensive income or in equity).

Deferred tax assets and deferred tax liabilities are offset if a legally enforceable right exists to set off current tax assets against current tax liabilities and the deferred taxes relate to the same taxable entity and the same taxation authority.

2.17 Provisions, Contingent Liabilities, Contingent Assets and Capital Commitments

Contingent Liabilities

A contingent liability is a possible obligation that arises from past events whose existence will be confirmed by the occurrence or non–occurrence of one or more uncertain future events beyond the control of the Group or a present obligation that is not recognized because it is not probable that an outflow of resources will be required to settle the obligation. A contingent liability also arises in extremely rare cases where there is a liability that cannot be recognized because it cannot be measured reliably. Contingent Liabilities are reviewed at each reporting date. The Group does not recognize a contingent liability but discloses its existence in the financial statements, however discloses its existence in the financial statements in the notes to accounts.

Contingent Assets

Contingent assets usually arise from unplanned or other unexpected events that give rise to the possibility of an inflow of economic benefits to the entity.
Contingent assets are recognized when the realisation of income is virtually certain, in which case the related asset is not a contingent asset and its recognition is appropriate.
Contingent assets are reviewed at each reporting date. A contingent asset is disclosed where an inflow of economic benefits is probable.

Provisions

Provisions are recognised when the Group has a present obligation (legal or constructive) as a result of a past event, it is probable that an outflow of resources embodying economic benefits will be required to settle the obligation and a reliable estimate can be made of the amount of the obligation. When the Group expects some or all of a provision to be reimbursed, for example, under an insurance contract, the reimbursement is recognised as a separate asset, but only when

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the reimbursement is virtually certain. The expense relating to a provision is presented in the Consolidated statement of profit and loss net of any reimbursement.
If the effect of the time value of money is material, provisions are discounted using a current pre-tax rate that reflects, when appropriate, the risks specific to the liability. When discounting is used, the increase in the provision due to the passage of time is recognised as a finance cost.

Commitments
Commitments are future liabilities for contractual expenditure, classified and disclosed as follows:

- estimated amount of contracts remaining to be executed on capital account and not provided for;
- funding related commitment to subsidiary companies; and
- other non-cancellable commitments, if any, to the extent they are considered material and relevant in the opinion of management.

Other commitments related to services to be rendered / procurements made in the normal course of business are not disclosed to avoid excessive details.

2.18 Consolidated Statement of Cash Flows

Consolidated Statement of Cash Flows is prepared segregating the cash flows into operating, investing and financing activities.
Cash flow from operating activities is reported using indirect method adjusting the net profit for the effects of:

- changes during the period in operating receivables and payables, transactions of a non-cash nature;
- non-cash items such as depreciation, provisions, deferred taxes, unrealised foreign currency gains and losses;
- all other items for which the cash effects are investing or financing cash flows.

Cash and cash equivalents (including bank balances) shown in the Consolidated Statement of Cash Flows exclude items which are not available for general use as at the date of Consolidated Balance Sheet.

2.19 Assets held for sale

Non-current assets or disposal groups comprising of assets and liabilities are classified as 'held for sale' when all of the following criteria's are met: (i) decision has been made to sell. (ii) the assets are available for immediate sale in its present condition. (iii) the assets are being actively marketed and (iv) sale has been agreed or is expected to be concluded within 12 months of the Consolidated Balance Sheet date.
Subsequently, such non-current assets and disposal groups classified as held for sale are measured at the lower of its carrying value and fair value less costs to sell. Non-current assets held for sale are not depreciated or amortised.

2.20 Unit Capital

Units are classified as equity. Incremental costs attributable to the issue of units are directly reduced from equity as per requirements of Ind AS 32.

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2.21 Distribution to unit holders

The Group recognises a liability to make cash distributions to unit holders when the distribution is authorised and a legal obligation has been created. As per the SEBI InvIT Regulations, a distribution is authorised when it is approved by the Board of Directors of the Investment Manager. A corresponding amount is recognised directly in other equity.

2.22 Earnings per Unit (EPU)

Basic EPU amounts are calculated by dividing the profit for the period attributable to unitholders by the weighted average number of units outstanding during the period.

Diluted EPU amounts are calculated by dividing the profit/(loss) attributable to unitholders by the weighted average number of units outstanding during the period plus the weighted average number of units that would be issued on conversion of all the dilutive potential units into unit capital.

2.23 Recent Pronouncements

Ministry of Corporate Affairs ("MCA") notifies new standards or amendments to the existing standards under Companies (Indian Accounting Standards) Rules as issued from time to time. On March 31, 2023, MCA amended the Companies (Indian Accounting Standards) Amendment Rules, 2023, as below:

Ind AS 1 - Presentation of Financial Statements - This amendment requires the entities to disclose their material accounting policies rather than their significant accounting policies. The effective date for adoption of this amendment is annual periods beginning on or after April I, 2023. The Group has evaluated the amendment and the impact of the amendment is insignificant in the Group's financial statements.

Ind AS 8 - Accounting Policies, Changes in Accounting Estimates and Errors_- This amendment has introduced a definition of 'accounting estimates' and included amendments to Ind AS 8 to help entities distinguish changes in accounting policies from changes in accounting estimates. The effective date for adoption of this amendment is annual periods beginning on or after April I, 2023. The Group has evaluated the amendment and there is no impact on its consolidated financial statements.

Ind AS 12 - Income Taxes - This amendment has narrowed the scope of the initial recognition exemption so that it does not apply to transactions that give rise to differences. The effective date for adoption of this amendment is annual periods beginning on or after April 1, 2023. The Group has evaluated the amendment and there is no impact on its consolidated financial statement.

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Notes to Consolidated Financial Statements for the year ended March 31, 2023

3 Property, Plant and Equipment

(All amounts in ₹ lakh unless otherwise stated)

Particulars	Temporary Structure	Computer	Office Equipments	Furniture & Fixtures	Total
Gross Carrying Amount:					
Balance as at April 1, 2021	-	-	-	-	-
Additions	-	**0.50**	-	-	**0.50**
Less: Disposals	-	-	-		-
Balance as at March 31, 2022	-	**0.50**	-	-	**0.50**
Additions	25.59	44.94	17.42	44.27	**132.22**
Less: Disposals	-	-	-	-	-
Balance as at March 31, 2023	**25.59**	**45.44**	**17.42**	**44.27**	**132.72**
Accumulated Depreciation:					-
Balance as at April 1, 2021	-	-	-	-	-
Additions	-	**0.04**	-	-	0.04
Less: Disposals	-	-	-	-	-
Balance as at March 31, 2022	-	**0.04**	-	-	**0.04**
Additions	1.49	4.32	0.82	0.88	7.51
Less: Disposals	-	-	-	-	-
Balance as at March 31, 2023	**1.49**	**4.36**	**0.82**	**0.88**	**7.55**
Net Carrying Amount:					
Balance as at March 31, 2022	-	**0.46**	-	-	**0.46**
Balance as at March 31, 2023	**24.10**	**41.08**	**16.60**	**43.39**	**125.17**

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Notes to Consolidated Financial Statements for the year ended March 31, 2023

4. Goodwill arising on Consolidation

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	As At March 31, 2023	As At March 31, 2022
Gross Carrying Amount		
Balance at the beginning of the year	10,144.46	-
Additions*	-	10,144.46
Less: Disposals	-	-
Less: Impairment	-	-
Balance at the closing of the year	**10,144.46**	**10,144.46**

The carrying amount relates to goodwill arising on acquisition of Project SPV (NHIPPL) by the Trust and has been tested for impairment against the respective cash generating unit (CGU). The calculation uses cash flow forecast based on financial models which cover remaining future periods of respective concession periods of toll assets.

Based on a review of the future discounted cash flows of the intangible assets (Toll Collection Rights) held by the subsidiary (NHIPPL), the recoverable amount is higher than the carrying amount of the assets, and accordingly no impairment loss has been recognised in the statement of profit and loss for the year ended March 31, 2023.

*Refer Note 37

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5: Intangible Assets

(All amounts in ₹ lakh unless otherwise stated)

Particulars	Software	Toll collection rights	Total
Gross Carrying Amount:			
Balance as at April 1, 2021		**7,35,040.00**	**7,35,040.00**
Additions	-	-	-
Less: Disposals		-	-
Balance as at March 31, 2022	-	**7,35,040.00**	**7,35,040.00**
Additions	2.16	2,84,966.66	2,84,968.82
Less: Disposals	-		-
Balance as at March 31, 2023	**2.16**	**10,20,006.66**	**10,20,008.82**
Accumulated Amortization:			
Balance as at April 1, 2021	-		-
Additions		**1,055.61**	**1,055.61**
Less: Disposals			-
Balance as at March 31, 2022	-	**1,055.61**	**1,055.61**
Additions	0.25	17,552.87	**17,553.12**
Less: Disposals	-	-	-
Balance as at March 31, 2023	**0.25**	**18,608.48**	**18,608.73**
Net Carrying Amount			
Balance as at March 31, 2022	-	**7,33,984.39**	**7,33,984.39**
Balance as at March 31, 2023	**1.91**	**10,01,398.18**	**10,01,400.09**

Note:-

1. The project SPV (NHIPPL) has acquired rights for Tolling, Operation, Maintenance and Transfer of five toll road projects for a period of 30 years basis Toll Concession agreements with NHAI, for a consideration of INR 7,350.40 Crore and the same have been recognised as Other Intangible Assets in financial statements. The project SPV (NHIPPL) further acquired rights during the current financial year for Tolling, Operation, Maintenance and Transfer of three additional toll road projects for a period of 20 years basis Toll Concession agreements with NHAI, for a consideration of INR 2,849.66 Crore and the same have been addition in the Other Intangible Assets in financial statements.

2.Toll Collection Rights shall be amortized on the basis of Consumption based model (using Passenger Car Unit (PCU) projections) over the tenure of the Concession Agreement i.e. 30 years and 20 years basis respective concession agreements for those toll road projects.

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6 Other Financial Assets: Non Current

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Investment in Fixed Deposits		
Fixed Deposits with banks*	9,469.99	3,170.81
Security Deposits	1.60	-
Interest receivable on REF	0.42	
Interest receivable on fixed deposits	185.43	-
Deposit - Debenture Recovery Expense Fund for NCD's	15.00	-
Total	**9,672.44**	**3,170.81**

* The Fixed Deposits are kept in Debt Servicing Reserve Account (DSRA) as per borrowing agreements with lenders and as per terms of the debenture trust deed, to be utilized at the end of tenure of long term borrowings from Senior Lenders and to maintain DSRA balance for Debenture holders, hence classified as Other Financial Assets- Non Current irrespective of date of maturity.

7 Deferred Tax Assets (Net)

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Deferred Tax Assets arising on account of:		
- Expense disallowed as per Income Tax Act, 1961, allowable in future years	0.00	0.03
- Unabsorbed depreciation	72,562.41	23,124.38
Total (A)	72,562.41	**23,124.41**
Deferred Tax Liabilities arising on account of:		
- Difference between book & tax base related to Intangible assets	67,877.09	22,858.70
- Difference between book & tax base related to Investments	-	3.16
- Expense disallowed earlier as per Income Tax Act, 1961, allowed now	-	0.03
Total (B)	67,877.09	**22,861.88**
Net Asset (A) - (B)	**4,685.32**	**262.53**

Reconciliation of Deferred Tax Asset/ (Liabilities)

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Opening Balance - Deferred Tax Asset	262.53	-
Deferred tax income/ (expense) during the period recognised in profit & loss	4,422.79	262.53
Deferred tax income/ (expense) during the period recognised in Other Comprehensive Income	-	-
Closing Balance - Deferred Tax Asset	**4,685.32**	**262.53**

8 Non Current Tax Assets (Net)

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Income tax refundable (net of provision)	12.06	-
Total	**12.06**	-

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9 Trade Receivables: Current

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Considered good-unsecured	350.87	600.47
Trade Receivables - Credit Impaired (unsecured)	59.60	-
	410.47	**600.47**
Less:- Allowances for expected credit loss	(59.60)	-
Total	**350.87**	**600.47**

The receivables are hypothecated by way of first ranking exclusive charge to secure senior lenders and non convertible debenture holders in Trust.

Trade Receivables ageing schedule as on March 31, 2023

Particulars	Outstanding for following period from due date of payment.					
	0-6 Months	6 Month -1 Year	1-2 Years	2-3 Years	More than 3 years	Total
i) Undisputed Trade Receivables - considered good	350.87	-	-	-	-	350.87
ii) Undisputed Trade Receivables - which have significant increase in credit risk	-	-	-	-	-	-
iii) Undisputed Trade Receivables - credit impaired	-	59.60	-	-	-	59.60

Trade Receivables ageing schedule as on March 31, 2022

Particulars	Outstanding for following period from due date of payment.					
	0-6 Months	6 Month - 1 Year	1-2 Years	2-3 Years	More than 3 years	Total
i) Undisputed Trade Receivables - considered good	600.47	-	-	-	-	600.47
ii) Undisputed Trade Receivables - which have significant increase in credit risk	-	-	-	-	-	-
iii) Undisputed Trade Receivables - credit impaired	-	-	-	-	-	-

10 Cash and Cash Equivalents

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Balances with Banks		
In Current Accounts	735.06	1,004.69
In Escrow Accounts	338.04	35.09
Draft in Hand	8.14	-
Cash in Hand	7.93	-
Fixed Deposits (having original maturity of less than 3 months)	10,000.00	4,350.00
SBI Overnight mutual fund	10,034.91	992.16
	21,124.08	**6,381.94**

11 Other Financial Assets: Current

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Security deposits	2.92	-
Interest receivable on Fixed Deposits	3.73	5.28
Others receivables*	290.71	0.10
Total	**297.36**	**5.38**

* These receivables to be recovered from new SPV (NHIT Eastern Projects Private Limited) for expenses incurred on its behalf.

12 Other Current Assets

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Prepaid expenses	592.15	347.29
GST Input	642.12	-
Processing fees paid for undrawn loan	103.49	-
Advance to suppliers	5.59	-
Total	**1,343.35**	**347.29**

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Notes to Consolidated Financial Statements for the year ended March 31, 2023

13 Unit Capital

(All amounts are in ₹ lakh unless otherwise stated)

Particulars	As at March 31, 2023		As at March 31, 2022	
	No of Units	Amount	No of Units	Amount
Unit Capital*				
Opening balance	59,52,00,000	5,99,442.82	-	-
Add: Units issued during the year	13,12,05,200	1,43,013.67	59,52,00,000	6,01,152.00
Less: Issue expenses (refer note below)	-	(852.17)	-	(1,709.18)
Balance	**72,64,05,200**	**7,41,604.32**	**59,52,00,000**	**5,99,442.82**

* 13,12,05,200 unit issued at Rs 109 per unit and 59,52,00,000 unit issued at Rs 101 per unit.

The Trust offered an issue of 13,12,05,200 units of National Highways Infra Trust ("NHIT") during the current financial year and such units, the "units"), for cash at a price of 109.00 per unit (the "issue price"), aggregating to ` Rs 1,43,013.67 lacs through Institutional and preferential placement in accordance with the Securities and Exchange Board of India (Infrastructure Investment Trust) Regulations, 2014 including the rules, circulars and guidelines issued thereunder. The issue opened on September 30, 2022 and closed on October 03, 2022. The Board of Directors of National Highways Infra Investment Managers Private Limited considered and approved allotment of 13,12,05,200 units to the eligible unitholders of Trust on October 12, 2022.

Issue expenses of Rs 852.17 lakhs (previous year Rs 1,709.18) incurred in connection with issue of units have been reduced from the Unit holders capital in accordance with Ind AS 32 Financial Instruments: Presentation

Rights/ preferences and restrictions attached to Unit Capital

Subject to the provisions of the InvIT Regulations, the indenture of funds, and applicable rules, regulations and guidelines, the rights of the unit holders include:

a) The beneficial interest of each unitholder shall be equal and limited to the proportion of the number of the units held by that unitholder to the total number of units.

b) Right to receive income or distributions with respect to the units held.

c) Right to attend the annual general meeting and other meetings of unit holders of the Trust.

d) Right to vote upon any matters/resolutions proposed in relation to the Trust.

e) Right to receive periodic information having a bearing on the operation or performance of the Trust in accordance with the InvIT

f) Right to apply to the Trust to take up certain issues at meetings for unit holders approval.

g) Right to receive additional information, if any, in accordance with InvIT documents filed with Placement Memorandum.

h) The non-sponsor unit holders ("Eligible Persons") of the Trust are entitled to representation on the Board of Directors of the Investment Manager through appointment of up to two (2) directors ("Non-Sponsor Directors"), provided that no Eligible Person shall have the right to nominate more than one Director at a time for appointment on the Board of Directors.

In accordance with the InvIT Regulations, no unit holders shall enjoy superior voting or any other rights over any other unit holders, and there shall not be multiple classes of units. There shall be only one denomination of units. Not withstanding the above, subordinate units may be issued only to the Sponsor and its Associates, where such subordinate units shall carry only inferior voting or any other rights compare to the other units.

Under the provisions of the InvIT Regulations, not less than ninety percent of the net distributable cash flows of the Trust is required to be distributed to the unitholders, and in accordance with such statutory obligation the Trust has formulated a distribution policy to declare and distribute the distributable cash flows to its unitholders atleast once every financial year as approved by the Board of Directors of the Investment Manager. The distributions made by Trust to its unitholders are based on the Net Distributable Cash Flows (NDCF) of the Trust under the InvIT Regulations and represent repayment of proportionate capital and share of profit. The distribution in proportion to the number of units held by the unitholders. The Trust declares and pays distributions in INR.

Limitation to the Liability of the unit holders

The liability of each unit holders towards the payment of any amount (that may arise in relation to the Trust including any taxes, duties, fines, levies, liabilities, costs or expenses) shall be limited only to the extent of the capital contribution of such unit holders and after such capital contribution shall have been paid in full by the unit holders, the unit holders shall not be obligated to make any further payments.

The unit holders shall not have any personal liability or obligation with respect to the Trust.

Details of Unitholders Holding More Than 5% Units In The Trust

Name of Unitholders	As at March 31, 2023		As at March 31, 2022	
	No of Units	%	No of Units	%
Ontario Limited	18,16,01,300	25.00%	14,88,00,000	25.00%
CPP Investment Board Private Holdings Inc.	18,16,01,300	25.00%	14,88,00,000	25.00%
SBI Balanced Advantage Trust	6,31,60,260	8.69%	5,68,00,000	9.54%
National Highways Authority of India (NHAI)	11,52,02,600	15.86%	9,56,00,000	16.06%

As per records of the Trust, including its register of unitholders and other declaration received from unitholders regarding beneficial interest, the above unitholding represent both legal and beneficial ownership of units.

The Trust has not allotted any fully paid-up units by way of bonus units nor has it bought back any class of units from the date of incorporation till the balance sheet date. Further the Trust has not issued any units for consideration other than cash during the year.

Reconciliation of number of units outstanding is set out below:

Particulars	As at March 31, 2023		As at March 31, 2022	
	No of Units	Amount (amounts in ₹ lakh)*	No of Units	Amount (amounts in ₹ lakh)*
Number of Units at the beginning of the year	59,52,00,000	6,01,152.00	-	-
Units issued during the year	13,12,05,200	1,43,013.67	59,52,00,000	6,01,152.00
Number of Units at the end of the year	72,64,05,200	7,44,165.67	59,52,00,000	6,01,152.00

* Amount related to issue expenses are not deducted in the reconciliation of number of unit capital outstanding.

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Notes to Consolidated Financial Statements for the year ended March 31, 2023

14 Other equity (All amounts in ₹ lakh unless otherwise stated)

Reserves and Surplus	As At March 31, 2023	As At March 31, 2022
Retained Earnings		
Balance at the beginning of the year	**6,768.43**	**(67.90)**
Total comprehensive income for the year	25,689.57	6,836.33
Less:		
Distribution to unit holders^		
Interest	34,183.66	-
Other Income	744.20	-
Balance at the closing of the year	**(2,469.86)**	**6,768.43**

^The distribution relates to the distributions during the financial year along with the distribution related to the last quarter of FY 2021-22 and does not include the distribution relating to the period January 01, 2023 to March 31, 2023 which will be paid after March 31, 2023. The distributions by the Trust to its unit holders are based on the Net Distributable Cash Flows of the Trust under the SEBI InvIT Regulations.

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Notes to Consolidated Financial Statements for the year ended March 31, 2023

15 Borrowings: Non Current

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Secured		
Non-Convertible Debenture	1,50,000.00	-
Less: Unamortized Borrowing Cost	1,411.80	-
Total (A)	**1,48,588.20**	

Note:- Other terms and conditions of NCD

i) Interest rate	7.90% p.a payable semi annually.
ii) Terms of repayment	Redemption of respective STRPP shall be made in equal instalments i) STRPP A - starting from eigth anniversary of deemed date of allotment till thirteenth anniversary. ii) STRPP-B- starting from thirteenth anniversary of deemed date of allotment till eighteenth anniversary. iii) STRPP-C- starting from eighteenth anniversary of deemed date of allotment till twentyfifth anniversary.

Term Loan:

From Banks	1,45,987.43	1,46,998.41
	1,45,987.43	1,46,998.41
Less: Current	2,000.00	980.86
Less: Unamortised Borrowing Cost	417.30	460.61
Total (B)	**1,43,570.13**	**1,45,556.94**
Grand Total C = (A+B)	**2,92,158.33**	**1,45,556.94**

Note:- Other terms and conditions of Term Loans

i) Interest rate	Marginal Cost of fund based lending rate (MCLR) plus spread applicable on each reset date.
ii) Terms of repayment	Repayable in unstructured quarterly instalments with last repayment date upto March 31, 2041.

Security for Term Loans :
The loan is secured by,
- first pari passu charge on all immovable assets (if any), movable assets and receivables of the Trust including but not limited to,
(i) the interest and principal repayments on the loans advanced by the Trust to Project SPV
(ii) dividends to be paid by Project SPV to the Trust
- first pari passu Security Interest on Trust Escrow account and all sub-accounts thereunder, including DSRA.
- pledge of 100% equity shares of Project SPV (NHIPPL) in dematerialized form held by the Trust
- assignment of loans advanced by the Trust to Project SPV (NHIPPL) and securities created by the Trust including the assignment of rights of submission, termination and invocation of provision of Escrow agreement in case of default.
- negative lien on immovable assets (including current assets and cash flows) of the Project SPV (NHIPPL) subject to sale of obsolete items or cars/ ambulances, old toll equipment etc., under normal business practice, subject to maximum cumulative value of INR 5 Crore in any financial year.

The senior lenders of the Trust have also been provided with a corporate guarantee from Project SPV (NHIPPL) to guarantee upto the secured obligations of the Trust. The funds have been raised at Trust level from unitholders and domestic lenders, and the same have been lent to Project SPV (NHIPPL) for payment of concession fee by NHIPPL to NHAI. The cashflows viz., toll collections are lying in NHIPPL. Accordingly, corporate guarantee amounting upto the secured obligations of the Trust via Corporate Guarantee Deed dated 14.03.2022, valid across the tenure of the loan of the Trust i.e. up to 31.03.2041, has been provided by the Project SPV (NHIPPL) to the senior lenders of the Trust.

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Nature of Security for Non Convertible debentures:

The debenture holders are secured by :

a) a first ranking pari passu Security Interest over the immovable assets (if any) both present and future. There are no immovable properties at the present time. In the event, the group acquires any immovable property in future, the group shall mortgage said property within 180 (one hundred eighty) days from the date of acquisition of such immovable assets. The Debenture Trustee shall be authorised to do all acts, deeds, and enter into necessary documents, agreement, amendments and/or modifications, as may be required to give effect the same, including carrying out the due diligence as may be required by Debenture Trustee;

b) a first ranking pari passu Security Interest over the Hypothecated Assets (including Receivables), both present and future; and

c) Negative Lien Undertaking;

d) corporate guarantee executed by the Project SPV in favour of the Debenture Trustee for guaranteeing the due repayment of the secured obligations in accordance with the terms in the Debenture Trust Deed.

The non convertible debenture holders of the Trust acting through debenture trustee have also been provided with a corporate guarantee from Project SPV (NHIPPL) to guarantee the repayment of amount raised from non convertible debenture holders by the Trust. The funds have been raised at Trust level from debentureholders, have been lent to Project SPV (NHIPPL) for payment of concession fee by NHIPPL to NHAI. Accordingly, corporate guarantee amounting upto the secured obligations via Corporate Guarantee Deed dated 21.10.2022 is valid till all outstanding principal and accrued interest payable by the Trust are satisfied to the non convertible debenture holders of the Trust.

There have been no breaches in financial covenants with respect to the borrowings from Senior lenders.

16 Provisions: Non Current

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Provision for employees benefits		
Gratuity (unfunded)	4.41	0.05
Leave Encashment (unfunded)	6.96	0.03
Provision for major maintenance*	6,307.44	403.29
Total	**6,318.81**	**403.37**

Provision for Major Maintenance*

The group is required to operate and maintain the project tollway during the entire concession period and hand over the project back to NHAI as per the maintenance standards prescribed in concession agreements. For this purpose, a regular maintenance along with periodic maintenance is required to be performed. Normally, periodic maintenance includes resurface of pavements, repairs of structures and other equipment and maintenance of service roads. As per industry practice, the periodic maintenance is expected to occur once in five to seven years. The provisions for MMR has been made based on the first cycle of of overlay expected to occur in five to seven years and not based on the total MMR cost over entire concession period as per industry practice. The discounting rate used for arriving at the present value for MMR provisions is government bond rate of 30 years for projects acquired in first phase and 20 years for projects acquired in second phase. The maintenance cost / bituminous overlay may vary based on the actual usage during maintenance period. Accordingly, on the grounds of matching cost concept and based on technical estimates, a provision for major maintenance expense is reviewed and is provided for in the financial statements in each reporting period. Considering that the expense to be incurred is depended on various factors including the usage, wear and tear of the toll road, bituminous overlay, etc., it is not possible to estimate the exact timing and the quantum of the cashflow.

Details of movement in Provisions

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Opening Balance	403.29	-
Add: Accretion during the year	-	403.29
Provision for Major Maintenance Obligation	5,879.20	-
Unwinding finance cost on major maintenance provision	24.95	-
Less: Utilized during the year	-	-
Closing Balance	**6,307.44**	**403.29**

17 Borrowings: Current

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Current Maturities of Long Term borrowings (Refer Note No. 15)	2,000.00	980.86
Total	**2,000.00**	**980.86**

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18 Trade Payables: Current

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Total outstanding, dues of micro and small enterprises	137.23	-
Total outstanding, dues of creditors other than micro and small enterprises (Outstanding for less than 12 months from the due date of payment)	3,871.18	1,244.79
Total	**4,008.41**	**1,244.79**

Note:-

Details of dues to micro and small enterprises as per MSMED Act, 2006.

The group has certain dues to suppliers registered under Micro, Small and Medium Enterprises Development Act, 2006 ('MSMED Act'). The disclosures pursuant to the said MSMED Act are as follows:

	As At March 31, 2023	As At March 31, 2022
a) The principal amount remaining unpaid to any supplier at the end of the year	137.23	-
b) Interest accrued and due thereon to suppliers under MSMED Act on the above amount remaining unpaid to any supplier at the end of year.	-	-
c) The amount of interest paid by the buyer in terms of section 16 of the MSMED Act, 2006, along with the amount of the payment made to the supplier beyond the appointed day during the year	-	-
d) The amount of interest due and payable for the period of delay in making payment (which have been paid but beyond the appointed day during the year) but without adding the interest specified under the MSMED Act, 2006	-	-
e) The amount of interest accrued and remaining unpaid at the end of each accounting year	-	-
f) The amount of further interest remaining due and payable even in the succeeding years, until such date when the interest dues above are actually paid to the small enterprises, for the purpose of disallowance of a deductible expenditure under section 23 of the MSMED Act, 2006	-	-
Disclosure of payable to vendors as defined under the "Micro, Small and Medium Enterprise Development Act, 2006" is based on the information available with the group regarding the status of registration of such vendors under the said Act, as per the intimation received from them on requests made by the group.	-	-

Trade Payable ageing schedule as at March 31, 2023

(All amounts in ₹ lakh unless otherwise stated)

Particulars	Not due*	Outstanding for following period from due date of payment.				
		Less than 1 Year	1-2 Years	2-3 Years	More than 3 Years	Total
i) MSME	-	137.24	-	-	-	137.24
ii) Others	2,468.10	1,403.08	-	-	-	3,871.18
iii) Disputed dues - MSME	-	-	-	-	-	-
iv) Disputed dues - Others	-	-	-	-	-	-

* Trade Payables include unbilled payables amounting to Rs 2,468.10 Lakh (Previous year: Rs.920.00 Lakh)

Trade Payable ageing schedule as at March 31, 2022

Particulars	Not due*	Outstanding for following period from due date of payment.				
		Less than 1 Year	1-2 Years	2-3 Years	More than 3 Years	Total
i) MSME	-	-	-	-	-	-
ii) Others	920.00	324.79	-	-	-	1,244.79
iii) Disputed dues - MSME	-	-	-	-	-	-
iv) Disputed dues - Others	-	-	-	-	-	-

* Trade Payables include unbilled payables amounting to Rs 920.00 Lakh (Previous year: Rs.Nil Lakh)

** The total outstanding of MSME vendors include Rs 24.72 lacs outstandings which are due for more than 45 days and payments have not been released against these due to queries raised to vendors in respect of these have not been resolved by these vendors.

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19 Other Financial Liabilities: Current

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Interest accrued but not due on NCD	5,129.59	-
Double toll Fee payable to NHAI	151.17	97.85
Security Deposit	4.19	-
Total	**5,284.95**	**97.85**

20 Other Current Liabilities

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Statutory dues payable	226.85	240.75
Unearned Revenue	2.12	-
- Advance received	5.00	-
- Employees payable	6.64	-
Total	**240.61**	**240.75**

21 Provisions: Current

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Provision for Employee Benefits (refer note no 39A)		
Leave Encashment (unfunded)	0.55	0.03
Gratuity (unfunded)	0.01	
Total	**0.56**	**0.03**

22 Current Tax Liabilities (Net)

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Provision for Income Tax	8.98	161.77
Total	**8.98**	**161.77**

Reconciliation of Current Tax Liabilities

Particulars	As At March 31, 2023	As At March 31, 2022
Opening Balance	161.77	-
Add: Income Tax Payable for the year	473.89	436.36
Less: Taxes Paid	626.68	274.59
Closing Balance	**8.98**	**161.77**

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23 Revenue from operations

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Sale of Services		
Revenue from Toll Collection	68,708.93	13,941.94
Other Operative Revenue		
Interest on delay in Toll Remittance	8.27	18.61
Total	**68,717.20**	**13,960.55**

24 Interest income

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
On fixed deposits with banks	373.43	5.86
Total	**373.43**	**5.86**

25 Profit on sale of investments

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Profit on redemption of Mutual Funds	671.17	682.62
Net Gain on fair valuation of investments designated at FVTPL	-	7.38
Total	**671.17**	**690.00**

26 Other Income

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Other non operating income		
Other Income	326.11	318.67
Total	**326.11**	**318.67**

27 Operating Expenses

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Operation and Maintenance Expenses	3,145.85	446.48
Major Maintenance Obligation	5,879.20	403.29
Total	**9,025.05**	**849.77**

28 Employee Benefit Expenses

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Salaries and wages	222.98	1.75
Contribution to provident and other funds (Refer Note 39 (i))	15.27	0.13
Gratuity Expenses (Refer Note 39A)	4.42	0.05
Leave Encashment Expense (Refer Note 39B)	7.51	0.06
Staff Welfare Expenses	46.05	0.13
Director's sitting fees	15.10	
Total	**311.33**	**2.12**

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29 Finance Cost

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Interest on Long term borrowings	11,244.91	3,149.19
Interest on Debentures	5,129.59	-
Finance Charges	221.87	5.24
Unwinding finance cost on major maintenance provision	24.95	-
	-	
Total	**16,621.32**	**3,154.43**

30 Depreciation and Amortization Expenses

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Depreciation on Property, Plant and Equipment	7.51	0.04
Amortization on Intangible Assets	17,553.12	1,055.61
Total	**17,560.63**	**1,055.65**

31 Other Expenses

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Advertisement expenses	35.75	8.47
Legal and Professional fees	1,542.22	202.56
Travelling and conveyance	19.80	-
Telephone and internet charges	6.58	-
Power and fuel	58.78	-
Environment, health and safety expenses	13.06	-
Fee, subscription & taxes	43.42	291.63
Bank charges	1.53	0.04
Data Management Expenses	3.00	1.31
Provision for expected credit loss	59.60	-
Vehicle hire charges	63.58	-
Repair and maintenance expenses	14.71	-
Miscellaneous expenses	30.03	0.87
Bad Debts Written Off	9.90	
Total	**1,901.95**	**504.87**

32 Audit Fees

		-
Statutory audit fees	4.53	4.57
Limited review fees	2.26	-
Tax audit fees	0.94	0.30
Total	**7.73**	**4.86**
Certification and other charges	0.93	0.52
Total	**0.93**	**0.52**

Further an amount of Rs 6 lakh paid to auditor as certification charges has been booked as part of one time expenses in the Unit Capital. (Refer note no 13)

33 Tax Expense

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Current Tax	473.89	436.36
Provision for Taxation–Earlier years	0.01	-
	473.90	**436.36**
Deferred tax expense/(credit)	(4,422.79)	(262.32)
	(3,948.89)	**174.04**

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Effective tax Reconciliation:

Numerical reconciliation of tax expense applicable to (profit)/ loss before tax at the latest statutory enacted tax rate in India to income tax expense reported is as follows:

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	As At March 31, 2023	As At March 31, 2022
Accounting Profit before Income Taxes	21,740.68	7,015.74
Tax at India's statutory income tax rate for Companies (25.17%)	(14,086.70)	(2,925.10)
Tax at India's statutory income tax rate for Business Trusts - Maximum Marginal Rate (42.744%)	33,215.05	7,963.95
Increase/ (reduction) in taxes on account of:		
Impact of deferred tax on reversible allowance/ disallowance of business expense and income, as per Indian Income Tax Act, 1961	9,663.91	2,662.78
Impact of exemption u/s 10(23FC) of the Indian Income Tax Act, 1961 available to the Trust	(32,741.15)	(7,542.34)
Provision for interest on delayed deposit of income tax	-	14.75
Income tax expense reported in the statement of profit and loss	**(3,948.89)**	**174.04**

34 Earning per Unit

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Basic and diluted EPU		
Net Profit/ loss available for unitholders (in ₹ lakh)	25,689.57	6,836.33
Weighted average number of units for EPU computation	65,66,68,737.53	59,52,00,000
EPU- Basic and diluted	**3.91**	**1.15**

35 Contingent Liabilities

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Contingent Liabilities:		
Corporate Guarantee issued by the Project SPV (NHIPPL) to the lenders of NHIT	2,00,000.00	2,00,000.00
Corporate Guarantee issued by the Project SPV (NHIPPL) to debenture trustee for debenture holders of NHIT	1,50,000.00	
Total	**3,50,000.00**	**2,00,000.00**

The SPV (NHIPPL) has issued a Corporate Guarantee amounting to INR 2,000 Crore on 14.03.2022 in favour of Security Trustee for the lenders of NHIT as part of debt covenants of the loan received from NHIT, to secure the term loan of INR 2,000 Crore availed by NHIT from external lenders. The Corporate Guarantee is valid across the tenure of the loan till March 31, 2041 till the external loans to the Trust are satisfied

'The SPV(NHIPPL) has issued a Corporate Guarantee amounting to INR 1,500 Crore on October 21, 2022 in favour of debenture trustee for the benefit of debenture holders of NHIT , to secure the Non Convertible debenture borrowings of INR 1,500 Crore availed by NHIT from debenture holders. The Corporate Guarantee is valid across the tenure of the loan till all outstanding principal and accrued interest thereon by the Trust are satisfied.

In previous year, the SPV (NHIPPL) had provided a corporate guarantee for an amount not exceeding INR 2000 crore, to Security Trustee for the lenders of NHIT in respect of the long-term borrowing obtained by the Holding entity. During the year, the Project SPV (NHIPPL) had carried out a fair valuation of said corporate guarantee from an independent external valuer. Basis such valuation report, fair value of corporate guarantee is estimated to Nil.

During the year, the SPV (NHIPPL) have provided a corporate guarantee for an amount not exceeding INR 1500 crores, to Debenture Trustee (for the benefit of the lenders to National Highways Infra Trust ('NHIT'), the Holding entity) in respect of non-convertible debentures obtained by the Holding entity. The Project SPV (NHIPPL) have carried out a fair valuation of said corporate guarantee from an independent external valuer. Basis such valuation report, fair value of corporate guarantee was estimated to Nil.

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36 Disclosure as per Ind AS 115, "Revenue from contracts with customers"

(All amounts in ₹ lakh unless otherwise stated)

1 Disaggregation of revenue

Revenue recognised mainly comprises of revenue from toll collections, claims with NHAI, contract revenue etc. Set out below is the disaggregation of the Trust's revenue from contracts with customers:

Description	As At March 31, 2023	As At March 31, 2022
Operating revenue		
(a) Toll income from Expressway	68,708.93	13,941.94
(b) Interest on delay in Toll Remittance	8.27	18.61
Total revenue	**68,717.20**	**13,960.55**

The table below presents disaggregated revenues from contracts with customers based on nature, amount and timing for the year ended 31 March 2023 and 31 March 2022:

S.No.	Types of Products by Nature	Types of Services by timing	As At March 31, 2023	As At March 31, 2022
1	Toll Income	Over the period of time	68,717.20	13,960.55

2 Assets and liabilities related to contracts with customers

The following table provides information about receivables, contract assets and contract liabilities from contract with customers:

Description	As At March 31, 2023	As At March 31, 2022
	Current	Current
Contract assets		
Trade receivables:		
Receivables under service concession arrangements	350.87	600.47
Total	**350.87**	600.47
Contract liabilities		
Trade Payables	4,008.41	1,244.79
Other Payables	5,284.95	97.85
Total	**9,293.36**	1,342.64

3 Performance obligation

Income from toll collection

The performance obligation in service of toll collection is recorded as per rates notified by NHAI and approved by management and payment is generally due at the time of providing service.

Contract revenue

The performance obligation under service concession agreements ('SCA') is due on completion of work as per terms of SCA.

4 Disclosure under Appendix - C & D to Ind AS 115 - " Service Concession Arrangements"

All the below service concession arrangement have been accounted under intangible asset model

Name of Concessionaire	Start of Concession period under concession agreement (Appointed Date)	End of Concession period under concession agreement	Period of Concession since the appointed date till March 31, 2023 (in days)
National Highways Infra Projects Private Limited	16.12.2021 (Five Projects)	15.12.2051	471
National Highways Infra Projects Private Limited	29.10.2022 (Three Projects)	28.10.2042	154

i) The above TOT projects shall have following rights / obligations in accordance with the Concession Agreement entered into with the respective Government Authorities

a. Right to use the Specified Assets

b. Obligations to provide or rights to except provision of services

c. Obligations to deliver or rights to receive at the end of concession

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37 DISCLOSURES PURSUANT TO IND AS 103 "BUSINESS COMBINATIONS"

(All amounts in ₹ lakh unless otherwise stated)

a) Acquisition of subsidiaries

i) Pursuant to the Share Purchase Agreement dated September 30, 2021, the Trust acquired the entire equity share capital of the the Project SPV (NHIPPL) on December 14, 2021 for an equity consideration of Rs. 1,39,553.52 Lakhs. Accordingly, the financial statements of the subsidiary NHIPPL for the period from December 14, 2021 to March 31,2022 have been considered in the consolidated financial statements of the Trust. Funding for the said acquisition was raised through preferential issue of units of the Trust. The Group has carried out a fair valuation of the net assets of the Project SPV at the time of acquisition and accordingly the goodwill has been recorded in the consolidated financial statements.

ii) **Details of the purchase consideration:**

Particulars	Amount
Cash Consideration	1,29,400.00
Unit capital issued	10,153.52
Total purchase consideration	**1,39,553.52**

The fair value of Rs 139,553.52 lakhs paid for acquisition of the above mentioned project SPVs includes consideration in cash amounting to Rs. 1,294 Crore and consideration in form of issuance of 10.05 Lakh units of Trust at the rate of Rs. 101 per unit. Issue costs of Rs 1.52 Lakh directly attributable to the issue of the units have been added to the purchase consideration.

ii) **Assets acquired and liabilities recognised on the date of acquisition are as follows:**

Particulars	Amount
Non - Current Assets:	
Intangible assets	7,35,040.00
Deferred Tax Assets (net)	0.21
Current Assets:	
Financial Assets	
Cash and Cash Equivalents	10.00
Total Assets	**7,35,050.20**
Current Liabilities:	
Financial liabilities	
Other financial liabilities	7,35,041.12
Other current liabilities	0.02
Total Liabilities	**7,35,041.14**
Net assets acquired	**9.06**

iii) **Calculation of Goodwill / (Capital Reserve)**

Particulars	Amount
Purchase Consideration	1,39,553.52
Less: Fair Value of Net Assets acquired	9.06
Less: Acquisition of fresh issue of shares of NHIPPL by the Trust	1,29,400.00
Goodwill	**10,144.46**

iv) Goodwill on acquisiion has been accounted for under Non Current Assets in the Balance Sheet.

v) **Entity wise Revenue and Profit after tax from the date of acquisition till March 31, 2022:**

Particulars	Amount
Revenue	13,960.55
Profit after Tax	**6,836.33**

vi) **Entity wise Revenue and Profit after tax for the financial year 2020-21**

Particulars	Amount
Revenue	-
Profit after Tax	**(67.90)**

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NATIONAL HIGHWAYS INFRA TRUST

Additional disclosure as required by paragraph 6 of Annexure A to the SEBI Circular No. CIR/IMD/DF/127/2016

38 Statement of Related Parties

A. List of Related Parties as per requirement of IND AS 24 – "Related Party Disclosures"

Enterprises where Control / significant influence exists	**National Highways Infra Projects Private Limited (Subsidiary Company)**

B. List of additional related parties as per Regulation 2(1)(zv) of the SEBI InvIT Regulations

Parties to the Trust

National Highways Infra Investment Managers Private Limited (NHIIMPL) - Investment Manager (IM) of the Trust
IDBI Trusteeship Services Limited (ITSL) - Trustee of the Trust
National Highways Authority of India (NHAI)- Sponsor
National Highways InvIT Project Managers Private Limited (NHIPMPL)- Project Manager

Promoters of the Parties to the Trust specified above

Government of India ((acting through Ministry of Road, Transport & Highways (MORTH)) - Promoter of NHIIMPL
IDBI Bank Limited (IDBI Bank) - Promoter of ITSL
Government of India ((acting through Ministry of Road, Transport & Highways (MORTH)) - Promoter of NHAI
National Highways Authority of India (NHAI)- Promoter of NHIPMPL

Directors of the parties to the Trust specified above

Directors of NHIIMPL

Mr. Suresh Krishan Goyal
Mr. Shailendra Narain Roy
Mr. Balasubramanyam Sriram (Ceased to be Director w.e.f. 31.03.2023)
Mr. Mahavir Prasad Sharma
Mr. Pradeep Singh Kharola
Mr. Amit Kumar Ghosh
Mrs. Kavita Saha (Ceased to be Director w.e.f. 29.11.2022, however reappointed on 06.01.2023)
Mr. Bruce Ross Crane (Ceased to be Director w.e.f. 29.11.2022, however reappointed on 06.01.2023)
Mr. N.R.V.V.M.K. Rajendra Kumar
Mr. Vivek Rae (Ceased to be Director w.e.f 12.07.2022)
Mr. Sumit Bose (Appointed w.e.f. 11.01.2023)

Directors of ITSL

Mr. J. Samuel Joseph
Mr. Pradeep Kumar Jain
Ms. Jayashree Ranade
Ms. Madhuri Jayant Kulkarni (Ceased to be Director w.e.f. 06.12.2022)
Ms. Padma Vinod Betai (Ceased to be Director w.e.f. 31.12.2022)
Mr. Pradeep Kumar Malhotra (Appointed w.e.f. 14.12.22)
Ms. Baljinder Kaur Mandal (Appointed w.e.f. 17.01.2023)

Directors of NHIPMPL

Mr. Ashish Asati (Ceased to be Director w.e.f. 28.10.2022)
Mr. Akhil Khare (Appointed w.e.f. 28.10.2022)
Mr. Muralidhara Rao Bugatha (Ceased to be Director w.e.f 17.01.2023)
Mr. Ashish Kumar Singh (Appointed w.e.f. 17.01.2023)

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NATIONAL HIGHWAYS INFRA TRUST

Additional disclosure as required by paragraph 6 of Annexure A to the SEBI Circular No. CIR/IMD/DF/127/2016

C. Transactions with Related Parties during the year

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
National Highways Infra Investment Managers Private Limited (NIIIMPL)		
Transaction during the year		
Investment Manager Fees	1,491.17	1,931.71
Advance Investment Manager Fees	86.06	-
Reimbursement of Expenses to NHIIMPL	39.79	214.80
National Highways Authority of India (NHAI)		
Transaction during the year		
Reimbursement of Pre-Issue expenses of NHIT by NHAI	-	578.02
Purchase of equity shares of Project SPV (NHIPPL) by the Trust from NHAI	-	10,153.52
Issue of units of Trust to NHAI	21,366.83	96,556.00
Interest and other income distribution	5,589.34	-
O & M Expenses	1,152.32	-
Payment for acquiring intangible assets (Toll)	2,84,966.66	7,35,040.00
Double toll fees	679.17	-
Independent engineers fees	345.38	-
National Highways InvIT Project Managers Private Limited (NHIPMPL)		
Transaction during the year		
Project Manager fees	991.20	290.43
IDBI Trusteeship Services Limited (ITSL)		
Transaction during the year		
Trusteeship Fee	12.73	12.15
Other fees	3.54	-

D. Closing Balance with Related Parties

Particulars	As At March 31, 2023	As At March 31, 2022
National Highways Authority of India (NHAI)		
Balance outstanding at the end of the year		
Issue of units of Trust to NHAI	1,17,922.83	96,556.00
O & M Expenses payable	880.35	-
Double toll fees payable	148.21	-
Independent Engineers Fees payable	276.03	-
National Highways Infra Investment Managers Private Limited (NHIIMPL)		
Balance outstanding at the end of the year		
IM Fees Payable	1.89	-
GST Amount payable	0.48	
National Highways InvIT Project Managers Private Limited (NHIPMPL)		
Balance outstanding at the end of the year		
Project Manager fees Payable	762.50	290.43
IDBI Trusteeship Services Limited		
Balance outstanding at the end of the year		
Initial Settlement Amount	-	0.10
Trusteeship Fee Payable	1.73	2.77

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NATIONAL HIGHWAYS INFRA TRUST

Additional disclosure as required by paragraph 6 of Annexure A to the SEBI Circular No. CIR/IMD/DF/127/2016

E. Summary of transactions with Key Managerial Personnel (KMP)

For the year ended March 31, 2023

(All amounts in ₹ lakh unless otherwise stated)

	Remuneration					
Details of Key Managerial Personnel	**Sitting Fees**	**Short term employment benefits**	**Post employement benefits**	**Other long term employment benefits**	**Termination benefits**	**Outstanding Loans/Advances /Receivables**
Mr. Suresh Krishan Goyal*	-	0.39	-	-	-	-
Mr. M P Sharma	6.40	-	-	-	-	-
Mr. Shailendra Narain Roy	6.40	-	-	-	-	-
Mr. N.R.V.V.M.K. Rajendra Kumar	-	-	-	-	-	-
Mrs. Ajanta Sen	-	1.84	-	-	-	-
Mrs. Bhanu Sharma (CS)	-	3.83	-	0.08	-	-

* This is reimbursement of expenses.

For the year ended March 31, 2022

	Remuneration					
Details of Key Managerial Personnel	**Sitting Fees**	**Short term employment benefits**	**Post employement benefits**	**Other long term employment benefits**	**Termination benefits**	**Outstanding Loans/Advances /Receivables**
Mr. Suresh Krishan Goyal	-	-	-	-	-	-
Mr. B.M. Rao	-	-	-	-		-
Mrs. Ajanta Sen	-	1.52	-	0.24	-	-

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40 Capital Management

For the purpose of the Group's capital management, capital includes issued unit capital and all other reserves attributable to the unit holders of the Group.

The primary objective of the Group's capital management is to ensure that it maintains a strong credit rating and healthy capital ratios in order to support its business and maximise unit holder value.

The Group manages its capital structure and makes adjustments to it in light of changes in economic conditions and the requirements of the financial covenants. To maintain or adjust the capital structure, the Group may adjust the dividend payment / income distribution to unit holders (subject to the provisions of SEBI InvIT Regulations which require distribution of at least 90%of the net distributable cash flows of the Group to unit holders), return capital to unit holders or issue new units. The Group monitors capital using a gearing ratio, which is net debt divided by total capital plus net debt. The Group's policy is to keep the gearing ratio optimum.

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at March 31, 2023	As at March 31, 2022
Net Debt Components:		
Long Term Borrowings (Non-Current portion)	2,92,158.33	1,45,556.94
Current Maturities of Long-Term Borrowings	2,000.00	980.86
Trade Payables	4,008.41	1,244.79
Other financial liabilities	5,284.95	97.85
Less: Cash and Cash Equivalents	(21,124.08)	(6,381.94)
Less: Bank Balances other than cash and cash equivalents	(4,685.32)	(3,170.81)
Net Debt (i)	**2,77,642.28**	**1,38,327.70**
Capital Components:		
Unit Capital	7,41,604.32	5,99,442.82
Initial Settlement Amount	0.10	0.10
Other Equity	(2,469.86)	6,768.43
Total Capital (ii)	**7,39,134.56**	**6,06,211.35**
Capital and Debt [(iii) = (i) + (ii)]	**10,16,776.84**	**7,44,539.04**
Gearing Ratio (i)/(iii)	**27.31%**	**18.58%**

In order to achieve this overall objective, the Board of Directors of Investment Manager, amongst other things, aims to ensure that it meets financial covenants attached to the interest-bearing loans and borrowings that define capital structure requirements. Breaches in meeting the financial covenants would permit the lenders to call loans and borrowings. There have been no breaches in the financial covenants of any interest-bearing loans and borrowing in the current year. No changes were made in the objectives, policies or processes for managing capital during the years ended March 31, 2023 and March 31, 2022.

41 Financial Risk Management Objectives and Policies

The Group is in the process of formulation of its risk management policies with an objective of identification and analysis of risks faced by the Group, to set appropriate risk limits and controls, and to monitor risks and adherence to limits. Risk management policies shall be reviewed regularly to reflect changes in market conditions and the Group's activities.

The Board of Directors of Investment Manager has overall responsibility for the establishment and oversight of the Group's risk management framework.

In performing its operating, investing and financing activities, the Group is exposed to the Credit risk, Liquidity risk and Market risk.

Market Risk

Market risk is the risk that the fair value of future cash flows of a financial instrument will fluctuate because of changes in market prices. Market risk comprises three types of risk: interest rate risk, currency risk and other price risk. Financial instruments affected by market risk include loans and borrowings, Receivable and Payables and Investments measured at FVTPL.

The sensitivity analyses in the following sections relate to the position as at March 31, 2023 and March 31, 2022.

The sensitivity analyses have been prepared on the basis that the amount of net debt, the ratio of fixed to floating interest rates of the debt are all constant.

The following assumptions have been made in calculating the sensitivity analyses:

The sensitivity of the relevant profit or loss item is the effect of the assumed changes in respective market risks. This is based on the financial assets and financial liabilities held at March 31, 2023 & March 31, 2022.

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Foreign Currency Risk

Foreign currency risk is the risk that the fair value or future cash flows of an exposure will fluctuate because of changes in foreign exchange rates. The Group transacts business primarily in Indian Rupees only, and hence, the sensitivity of profit and loss of the Group to a possible change in foreign exchange rates is non-existent as on 31st March, 2023 and 31st March, 2022.

Interest Rate Risk

Interest rate risk is the risk that the fair value or future cash flows of a financial instrument will fluctuate because of changes in market interest rates. Exposure to risk of changes in market interest rates generally relates primarily to long-term debt obligations with floating interest rates.

The following table provides a break-up of the group fixed and floating rate borrowings:

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at March 31, 2023	As at March 31, 2022
Floating Rate Borrowings	1,43,570.13	1,46,537.80

The Group's exposure to interest rate risk due to variable interest rate borrowings is as follows:

Sensitivity analysis based on average outstanding Debt: (All amounts in ₹ lakh unless otherwise stated)

Particulars	As at March 31, 2023	As at March 31, 2022
Increase or decrease in interest rate by 25 basis points	358.93	388.94

Price Risk

Price risk is the risk that the fair value or future cash flows of a financial instrument will fluctuate because of changes in market prices (other than those arising from interest rate risk or currency risk).

Credit risk

Credit risk is the risk that counterparty will not meet its obligations under a financial instrument or customer contract, leading to a financial loss. With respect to credit risk arising from other financial assets of the Group, which comprise Balances with banks, Trade Receivables, Loans and Advances and Investments. The Group's exposure to credit risk arises from default of the counterparty, with maximum exposure equal to the carrying amount of these instrument.

The carrying value of financial assets represents the maximum credit risk. The maximum exposure to credit risk was Rs. 31,444.75 Lakh and Rs. 10,158.59 Lakh as at March 31, 2022 respectively, being the total carrying value of Loans and Advances, Trade receivables, Investments, Balances with bank, bank deposits and other financial assets.

Liquidity Risk

Liquidity risk is the risk that an entity will encounter difficulty in meeting obligations associated with financial liabilities that are settled by delivering cash or another financial assets.

The Group is exposed to liquidity risk due to bank borrowings and trade and other payables.

The Group measures risk by forecasting cash flows.

The Group's approach to managing liquidity is to ensure, as far as possible, that it will always have sufficient liquidity to meet its liabilities when due without incurring unacceptable losses or risking damage to the Group's reputation. The Group ensures that it has sufficient funds to meet expected operational expenses, servicing of financial obligations.

In addition, processes and policies related to such risk are overseen by senior management. Management monitors the Group's net liquidity position through rolling forecast on the basis of expected cash flows.

The table below summarises the maturity profile of the group's financial liabilities based on contractual undiscounted payments.

(All amounts in ₹ lakh unless otherwise stated)

As at 31-03-2023	Carrying Amo	<1 Yr.	1-3 Yrs.	>3 Yrs.
Borrowings	2,94,158.33	2,000.00	6,000.00	2,86,158.33
Trade Payables	4,008.41	4,008.41	-	-
Other Financial Liabilities	5,284.95	5,284.95	-	-
Total	**3,03,451.68**	**11,293.36**	**6,000.00**	**2,86,158.33**

As at 31-03-2022	Carrying	<1 Yr.	1-3 Yrs.	>3 Yrs.
Borrowings	1,46,537.80	1,000.00	8,000.00	1,37,537.80
Trade Payables	1,244.79	1,244.79	-	-
Other Financial Liabilities	97.85	97.85	-	-
Total	**1,47,880.44**	**2,342.64**	**8,000.00**	**1,37,537.80**

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Notes to the Consolidated Financial Statements for the year ended March 31, 2023

42 Disclosure pursuant to IND AS 36 "Impairment of Assets"

Based on impairment testing done which involves review of the future discounted cash flows of the subsidiary, the recoverable amount is higher than the carrying amount of the investment made in the subsidiary and accordingly, no provision for impairment is required to be recognised in the books as on the reporting date. In case of goodwill based on impairment testing recoverable amount is higher then the carrying value as on the reporting date, hence no provision for impairment is required to be recognised in the books as on reporting date.

43 Disclosure of Financial Instruments by Category

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at March 31, 2023			As at March 31, 2022		
	Amortized Cost	FTVPL		Amortized Cost	FTVPL	
		At Cost	At Fair Value		At Cost	At Fair Value
Assets:						
Cash and Cash Equivalents	21,124.08	-	-	6,381.94	-	-
Trade Receivables	350.87	-	-	600.47	-	-
Other Financial Assets	9,969.80	-	-	3,176.18	-	-
Total	**31,444.75**	-	-	**10,158.59**	-	-
Liabilities:						
Borrowings	2,94,158.33	-	-	1,46,537.80	-	-
Trade Payables	4,008.41	-	-	1,244.79	-	-
Other Financial Liabilities	5,284.95	-	-	97.85	-	-
Total	**3,03,451.68**	-	-	**1,47,880.44**	-	-

Defaults and Breaches

There are no defaults during the year with respect to repayment of principal and payment of interest and no breaches of the terms and conditions of the borrowings.

There are no breaches during the year which permitted lender to demand accelerated payment

44 Fair Values of Assets and Liabilities

The carrying amount of all financial assets and liabilities appearing in the financial statements is reasonable approximation of fair values. Fair value of the financial assets and liabilities is the amount at which the instrument could be exchanged in a current transaction between willing parties, other than in a forced or liquidation sale.

The Group is required to present the Statement of total assets at fair value and Statement of total returns at fair value as per SEBI Circular No. CIR/IMD/DF/114/2016 dated October 20, 2016 as a part of these financial statements - Refer Statement of Net assets at fair value and Statement of Total Returns at fair value.

45 Fair Value Hierarchy

All financial instruments for which fair value is recognised or disclosed are categorised within the fair value hierarchy described as follows, based on the lowest level input that is significant to the fair value measurement as a whole.

Level 1 - Quoted prices (unadjusted) in active markets for identical assets or liabilities.

Level 2 – Inputs other than quoted prices included within Level 1 that are observable for the asset or liability, either directly (i.e. as prices) or indirectly (i.e. derived from prices).

Level 3 - Inputs for the assets or liabilities that are not based on observable market data (unobservable inputs).

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Class wise composition and comparison of carrying amounts and fair values of financial assets and liabilities that are recognised in the financial statements along with Fair Value Hierarchy details are given below:

(All amounts in ₹ lakh unless otherwise stated)

Particulars	Fair Value Hierarchy Level	Carrying Value		Fair Value	
		As at March 31, 2023	As at March 31, 2022	As at March 31, 2023	As at March 31, 2022
Financial Assets at Amortized Cost:					
Cash and Cash Equivalents	Level 3	21,124.08	6,381.94	21,124.08	6,381.94
Trade Receivables	Level 3	350.87	600.47	350.87	600.47
Other Financial Assets	Level 3	9,969.80	3,176.18	9,969.80	3,176.18
Total		**31,444.75**	**10,158.59**	**31,444.75**	**10,158.59**
Financial Liabilities at Amortized Cost:					
Borrowings	Level 3	2,94,158.33	1,46,537.80	2,94,158.33	1,46,537.80
Trade Payables	Level 3	4,008.41	1,244.79	4,008.41	1,244.79
Other Financial Liabilities	Level 3	5,284.95	97.85	5,284.95	97.85
Total		**3,03,451.68**	**1,47,880.44**	**3,03,451.68**	**1,47,880.44**

There is one transfer during the year from Level 1 to Level 3 for Investment in Mutual Funds as these have been been grouped into cash and cash equivalents

The policy of the Group is to recognise transfers into and transfer out of fair values hierarchy levels as at the end of the reporting period.

Valuation technique and inputs used to determine fair value

Financial assets and liabilities	Valuation method	Inputs
Financial assets		
Investments in equity shares of subsidiaries	Income	Cash Flow
Loans	Income	Effective Rate of Interest
Financial liabilities		
Term loans from Bank	Income	Effective Rate of Borrowings
Non-Convertible Debentures	Income	Effective Rate of Borrowings

46 Disclosure of segment information pursuant to IND AS 108 "Operating Segments"

The activities of the Group mainly include investing in infrastructure assets primarily in the SPVs operating in the road sector to generate cash flows for distribution to unit holders. Based on the guiding principles given in Ind AS - 108 "Operating Segments", this activity falls within a single operating segment. Further, the entire operations of the Group are only in India and hence, disclosure of secondary / geographical segment information does not arise. Accordingly, requirement of providing disclosures under Ind AS 108 does not arise.

47 Disclosure pursuant to IND AS 23 "Borrowing Costs"

Borrowing cost capitalised during the year Rs. Nil [March 31, 2022: Rs. Nil]

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48 Details of Project Management Fees and Investment Management Fees

Details of fees paid to project manager and investment manager as required pursuant to SEBI Circular No. CIR/MD/DF/127/2016, dated November 29, 2016 are as under:

Project Management Fees

The project manager National Highways InVIT Project Managers Private Limited ('NHIPMPL') for initial portolio of assets and assets acquired in current financial year is entitled to fixed fees of Rs 991.20 lakh per annum (Previous year Rs 290.43 lakh) inclusive of taxes.The same is based on the Project Implementation and Management Agreement (PIMA) signed by both the parties dated 30th March, 2021.

Investment Management Fees

i) The investment manager's fee will initially be Rs. 1,100 Lakh (Rupees Eleven Hundred Lakh) per annum, exclusive of applicable taxes as per agreement dated 21st October, 2020.

ii) The investment manager's fee set out in above shall be subject to escalation on an annual basis at the rate of 10% of the management fee for the previous year.

iii) Any applicable taxes, cess or charges shall be in addition to the investment manager's fee and shall be payable by National Highways Infra Trust (NHIT) to the Investment Manager (NHIIMPL).

iv) The payment of investment manager's fee shall be made by National Highways Infra Trust (NHIT) to the investment manager (NHIIMPL) in advance on a quarterly basis.

49 Significant accounting judgements, estimates and assumptions

The preparation of the Group's financial statements requires management to make judgements, estimates and assumptions that affect the reported amounts of revenues, expenses, assets and liabilities, and the accompanying disclosures, and the disclosure of contingent liabilities. Uncertainty about these assumptions and estimates could result in outcomes that require a material adjustment to the carrying amount of assets or liabilities affected in future periods.

Judgements

In the process of applying the Group's accounting policies, management has made the following judgments, apart from those involving estimations, which have the most significant effect on the amounts recognised in the financial statements:

Classification of unit holders Funds

Under the provisions of the SEBI InvIT Regulations, the Trust is required to distribute to its Unit holders not less than ninety percent of the net distributable cash flows of the Trust for each financial year. Accordingly, a portion of the unit holders' funds contain a contractual obligation of the Trust to pay to its Unit holders cash distributions.
The Unit holder's funds could therefore have been classified as compound financial instrument which contain both equity and debt components in accordance with Ind AS 32 'Financial Instruments: Presentation'. However, in accordance with SEBI Circulars (Circular no. CIR/IMD/DF/114/2016 dated October 20, 2016 and No. CIR/IMD/ DF/127/2016 dated November 29, 2016) issued under the SEBI InvIT Regulations, the unit holders' funds have been classified as equity in order to comply with the mandatory requirements of Section H of Annexure A to the SEBI Circular dated October 20, 2016 dealing with the minimum disclosures for key financial statements. In line with the above, the income distribution payable to unit holders is recognized as liability when the same is approved by Board of Directors of the Investment Manager.

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Fair valuation and disclosures

SEBI Circulars issued under the SEBI InvIT Regulations requires disclosures relating to net assets at fair value and total returns at fair value. In estimating the fair value of investments in subsidiaries (which constitute substantial portion of the net assets), the Group engages independent qualified external valuers to perform the valuation. The Investment Manager works closely with the valuers to establish the appropriate valuation techniques and inputs to the model. The valuation report and findings are discussed at the meeting of the Board of Directors on yearly basis to understand the changes in the fair value of the subsidiaries. The inputs to the valuation models are taken from observable markets, where possible, but where this is not feasible, a degree of judgement is required in establishing fair values. Judgements include considerations of inputs such as weighted average cost of capital, tax rates, inflation rates etc. Changes in assumptions about these factors could affect the fair value.

Taxes

In accordance with section 10 (23FC) of the Income Tax Act, 1961, the income of business groups in the form of interest received or receivable from subsidiaries is exempt from tax. Accordingly, the Group is not required to provide any current tax liability. Further, deferred tax asset on carry forward losses is not created since there is no reasonable certainty of reversal of the same in the near future.

Defined benefit plans (gratuity benefits)

A liability in respect of defined benefit plans is recognised in the balance sheet and is measured as the present value of the defined benefit obligation at the reporting date. The present value of the defined benefit obligation is based on expected future payments at the reporting date, calculated annually by independent actuaries. Consideration is given to expected future salary levels, experience of employee departures and periods of service.

Impairment of intangible assets

Impairment exists when the carrying value of an asset or cash generating unit exceeds its recoverable amount, which is the higher of its fair value less costs of disposal and its value in use. The recoverable amounts for the intangible assets are based on value in use of the underlying projects. The value in use calculation is based on a DCF model. The cash flows are derived from budgets/ forecasts over the life of the projects.

Major Maintenance Expenses / Resurfacing Expenses

As per industry practice, the Project SPV (NHIPPL) is required to carry out resurfacing of the roads under the Concession. For this purpose, a regular maintenance along with periodic maintenances is required to be performed. Normally, periodic maintenance includes resurface of pavements, repairs of structures and other equipment and maintenance of service roads. The maintenance cost / bituminous overlay may vary based on the actual usage during maintenance period. Accordingly, on the grounds of matching cost concept and based on technical estimates, a provision for major maintenance expenses is reviewed and is provided for in the accounts annually.

The provisions for MMR as per industry practice has been made based on the first cycle of of overlay expected to occur in five to seven years and not based on the total MMR cost over entire concession period. The discounting rate used for arriving at the present value for MMR provisions is government bond rate of 30 years for projects acquired in first phase and 20 years for projects acquired in second phase.

Expected Credit Loss on financial assets

As per Ind AS 109, Financial Assets that are measured at amortised cost are required to compute the Expected Credit Loss (ECL). As at the reporting period, Investment manager of the Group assessed the credit risk of the financial assets and concluded that no provision for ECL is required.

50 Other Statutory information

i) The Group have not traded or invested in Crypto currency or Virtual Currency during the financial year.

ii) The Group does not hold benami property and no proceedings under benami transaction (Prohibition) Act 1988 have been initiated against the Group.

iii) The Group do not have any transactions with companies struck off.

iv) The Group have not any such transaction which is not recorded in the books of accounts that has been surrendered or disclosed as income during the year in the tax assessments under the Income Tax Act, 1961 (such as search or surveyor any other relevant provisions of the Income Tax Act, 1961).

v) The Group have not received any fund from any person(s) or entity(ies), including foreign entities (Funding Party) with the understanding (whether recorded in writing or otherwise) that the Group shall:

(a) directly or indirectly lend or invest in other persons or entities identified in any manner whatsoever by or on behalf of the Funding Party (Ultimate Beneficiaries) or

(b) provide any guarantee, security or the like on behalf of the Ultimate Beneficiaries.

vi) The Group have not advance or loaned or invested (either from borrowed fund or share premium or any other source or kind of fund) by the company to or in any person(s) or entity(ies), including foreign entities (Funding Party) with the understanding (whether recorded in writing or otherwise) that the Group shall:

(a) directly or indirectly lend or invest in other persons or entities identified in any manner whatsoever by or on behalf of the Group (Ultimate Beneficiaries) or

(b) provide any guarantee, security or the like on behalf of the Ultimate Beneficiaries.

vii) The Group did not have any long-term contracts including derivative contract for which there were any material foreseeable losses.

viii) The Group has not declared a wilful defaulter by any bank financial institution or any other lender during the year.

51 Subsequent Events

The Board of Directors of the Investment Manager has declared distribution for Quarter 4 FY 22-23 of Rs. 1.6035 per unit was made which comprised of Rs. 1.5778 per unit as interest and Rs 0.0257 per unit as other income on surplus funds at Trust level in their meeting held on 22nd May 2023 to be paid on or before 15 days from the date of declaration.

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52 Capital and Other Commitments

There are no capital and other commitments as at March 31, 2023 (March 31, 2022: Rs. Nil)

53 Distributions Made

(All amounts in ₹ lakh unless otherwise stated)

Particulars	FY 2022-23	FY 2021-22
Interest (Return on capital)	29,985.39	4,198.27
Return of capital	-	-
Dividend	-	-
Other income on surplus fund at Group	240.39	503.81
Total	**30,225.78**	**4,702.08**

54 Reconciliation of Financing Activities in Cash Flow Statement

Net Debt Recognition

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at March 31, 2023 (Long Term Borrowing)	As at March 31, 2022 (Long Term Borrowing)
a) Carrying amount of debt at the beginning of the year/period	1,46,537.80	-
b) Additional borrowings during the year/period	1,50,000.00	1,48,000.00
c) Repayments during the year/period	(1,010.98)	(1,001.59)
d) Other adjustments/settlements during the year/period	-	-
- Impact in equity	-	
- Transaction Costs	(1,432.55)	(472.00)
- Unwinding of interest	64.06	11.39
Carrying amount of debt at the end of the year/period	**2,94,158.33**	**1,46,537.80**

55 Additional Regulatory Information

Financial Ratios as on March 31, 2023 and March 31, 2022

S. No.	Particulars	As at March 31, 2023	As at March 31, 2022
1	Current Asset ratio (Current Assets /Current Liability)	2.00	2.69
2	Debt- Equity ratio (Debt/ Equity)	0.40	0.24
3	Debt service coverage ratio (Net Operating Cash flow/ Debt Service Obligation)	4.60	2.58
4	Interest service coverage ratio (EBIT/Finance Cost)	2.31	3.22
5	Networth (Unit Capital + Other Equity)	7,39,134.56	6,06,211.35
6	Asset Cover Ratio	3.21	-
7	Return on Equity (ROE ratio) (Net Profit/ Equity)	3.48%	1.13%
8	Total Debt to total assets	0.28	0.19
9	Net profit after tax	25,689.57	6,836.33
10	Outstanding redeemable preference shares (quantity and value) :	-	-
11	Capital redemption reserve/debenture redemption reserve :	-	-
12	Long term debt to working capital	25.25	31.58
13	Earning per unit	3.91	1.15
14	Inventory turnover ratio	-	-
15	Trade receivable turnover ratio	36.12	46.50
16	Trade payable turnover ratio	0.86	1.37
17	Bed debt to account receivable ratio	-	-
18	Net Capital turnover ratio (Total Income / Net Working Capital)	6.06	3.25
19	Operating margin %	79.39%	73.11%
20	Net profit after tax ratio (Net profit / Total Income)	36.65%	45.65%
21	Return on capital employed ratio ((Net Profit plus Finance Cost)/ (Equity + Debt))	4.09%	1.35%
22	Return on investment (Income on Investment / Average Cost of Investment)	6.07%	15.69%

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56 Disclosure pursuant to IND AS 33 "Earnings per Unit"

Basic and Diluted Earnings per Unit (EPU) computed in accordance with Ind AS 33 "Earnings per Share":

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As at March 31, 2023	As at March 31, 2022
Basic and Diluted		
Profit attributable to unit holders of the Fund (A)	25,689.57	6,836.33
Weighted average number of units (B)	6,566.69	5,952.00
Earnings Per Unit (In Rs.) (A/B)	**3.91**	**1.15**

1312.052 lakh units issued at Rs 109 per unit and 5952 lakh unit capital issued at Rs 101

57 The Code on Social Security. 2020 ('Code') relating to employee benefits during employment and post-employment benefits received Presidential assent in September 2020. The Code has been published in the Gazette of India. However, the date on which the Code will come into effect has not been notified The Group will assess the impact of the Code when it comes into effect and will record any related impact in the period the Code becomes effective.

58 Financial Information of Investment Manager

The summary financials of Investment Manager are not disclosed alongwith these financials as its networth is not materially eroded.

59 Withholding Tax liability for interest accrued but not due on non convertible debentures

The Trust has issued publicly listed non convertible debentures ("NCDs") with interest payable on semi-annual basis. Interest on these NCDs was due for payment on 25 April 2023 and for the purpose of payment of interest, record date was 10 April 2023 and debenture-holders existing as on 10 April 2023 are entitled to the coupon interest. Trust has recorded liability of interest accrued till 31st March 2023 and there is no credit in favour of any payee at the time of creating such provision as entitled payee will be identifiable as on record date i.e., on 10 April 2023.

As on the year end March 2023, there is uncertainty with respect to the ultimate recipient of interest income, and such uncertainty would only become clear on the record date i.e., 10 April 2023 when the obligation of payment of interest by NHIT arises and therefore Trust has not withheld any taxes at the time of creating these provisions.

60 Salient aspects of the Tolling Concession Arrangement

The Project SPV (NHIPPL) has entered into five concession agreements with National Highway Authority of India ("NHAI") on March 30, 2021 for Tolling, Management, Maintenance and Transfer of five toll road projects for a period of 30 years from the Appointed Date. The Appointed Date has commenced on 16.12.2021. The toll roads covered under the concession agreement as follows:

- Palanpur/ Khemana – Abu Road Project on NH-27 with total length of 45 kms, connecting the states of Gujrat and Rajasthan
- Abu Road- Swaroopganj Project on NH-27 with total length of 31 kms, in the state of Rajasthan
- Maharashtra Karnataka Border (Kagal) – Belgaum Project on NH-48 with a length of 77.7 Kms, connecting the states of Karnataka and Maharashtra
- Chitorgarh- Kota & Chittorgarh Project on NH-27 with total length of 160.5 Kms, in the state of Rajasthan
- Kothakota Bypass- Kurnool Highway Project on NH-44 with total length of 74.6 Kms, connecting the states of Telangana and Andhra Pradesh

The project SPV (NHIPPL) acquired rights for Tolling, Management and Maintenance of the five toll roads under the concession agreement for consideration of INR 7,350.40 Crore, and the rights have been recognized in the financial statements as Intangible Assets.

In current financial year, the project SPV (NHIPPL) entered into three new concession agreements with National Highway Authority of India ("NHAI") on September 26, 2022 for Tolling, Management, Maintenance and Transfer of three toll road projects for a period of 20 years from the Appointed Date. The Appointed Date has commenced on 29.10.2022. The toll roads covered under the concession agreement as follows:

- Agra bypass Section (from km 0.000 to km 32.800) of NH-19 in the state of Uttar Pradesh
- Borkhedi-Wadner-Deodhari-Kelapur Section (from km 36.600 to km 175.000) of NH-44 in the state of Maharashtra
- Shivpuri – Jhansi Section (from km 1305.087 to km 1380.387) of NH-27 in the states of Madhya Pradesh and Uttar Pradesh.

The project SPV (NHIPPL) has acquired rights for Tolling, Management and Maintenance of these three toll roads at a consideration of INR 2,849.66 Crore, and the rights have been recognized in the financial statements as Intangible Assets.

The project SPV (NHIPPL) is required to operate and maintain the Project/ Project Facilities in accordance with the provision of the Agreement, Applicable Laws and Applicable permits.

A.R. & CO. FRN 002744 C CHARTERED ACCOUNTANTS

61 Disclosures as per Ind AS 37 "Provisions, Contingent Liabilities and Contingent assets"

a) Nature of provisions

The project SPV (NHIPPL)is required to operate and maintain the project tollway during the entire concession period and hand over the project back to NHAI as per the maintenance standards prescribed in concession agreements. For this purpose, a regular maintenance along with periodic maintenance is required to be performed. Normally, periodic maintenance includes resurface of pavements, repairs of structures and other equipment and maintenance of service roads. As per industry practice, the periodic maintenance is expected to occur once in five to seven years. The provisions for MMR as per industry practice has been made based on the first cycle of of overlay expected to occur in five to seven years and not based on the total MMR cost over entire concession period. The discounting rate used for arriving at the present value for MMR provisions is government bond rate of 30 years for projects acquired in first phase and 20 years for projects acquired in second phase. The maintenance cost / bituminous overlay may vary based on the actual usage during maintenance period. Accordingly, on the grounds of matching cost concept and based on technical estimates, a provision for major maintenance expense is reviewed and is provided for in the financial statements in each reporting period. Considering that the expense to be incurred is depended on various factors including the usage, wear and tear of the toll road, bituminous overlay, etc., it is not possible to estimate the exact timing and the quantum of the cashflow.

62 Assets pledged as security

Under security provisions for external lenders, the shares of project SPV i.e. NHIPPL held by NHIT (Trust) are pledged to external lenders to Trust. Whereas the loans provided by Trust to NHIPPL is assigned to the external lenders. Also it may be noted that the shares are not pledged to debenture holders. The carrying amounts of assets pledged as security for current and non current borrowings are :

(All amounts in ₹ lakh unless otherwise stated)

Particulars	As At March 31, 2023	As At March 31, 2022
Current		
Financial assets		
First Charge		
Trade receivables	350.87	600.47
Cash and cash equivalents	21,124.08	6,381.94
Other financial assets	297.36	5.38
Non Financial assets	-	-
First Charge	-	-
Other current assets	1,343.35	347.29
Total current assets pledged as	**23,115.65**	**7,335.07**
Non Current		
Other financial assets	9,672.44	3,170.81
Non -current tax assets (Net)	12.06	-
Total non current assets	9,684.50	3,170.81
Total assets pledged as security	**32,800.16**	**10,505.88**

63 Key sources of estimation

The preparation of financial statements in conformity with Ind AS requires the Group makes estimates and assumptions that affect the reported amounts of income and expenses of the period, the reported balances of assets and liabilities and the disclosures relating to contingent liabilities as of the date of the financial statements. The estimates and underlying assumptions are reviewed on an ongoing basis. Revisions to accounting estimates include allowance for doubtful loans /other receivables, fair value measurement etc. Difference, if any, between the actual results and estimates is recognised in the period in which the results are known.

64 Previous Year Figures

Previous year's numbers have been regrouped / reclassified, wherever necessary to conform to current year's classification.

For A.R. & Co.
Chartered Accountants

Firm Registration no. 002744C

A.R. & Co. FRN 002744 C CHARTERED ACCOUNTANTS

CA Kailash Chand Gupta
Partner
M.No.085003
Date : 22.05.2023
Place: New Delhi

For and on behalf Board of the National Highways Infra Investment Managers Private Limited (Investment Manager of National Highways Infra Trust)

Suresh Krishan Goyal
Director
DIN: 02721580

Mahavir Parsad Sharma
Director
DIN: 03158413

Mathew George
Chief Financial Officer

Gunjan Singh
Compliance Officer

A.R. & CO.
Chartered Accountants

Delhi Office:
A-403, Gayatri Apartment
Airlines Group Housing
SocietyPlot No 27, Sector 10,
Dwarka, New Delhi -110075
Cell No.9810195084, 9810444051
E-mail: ar_co1981@yahoo.co.in
pawankgoel1@gmail.com

Corporate and Correspondence Office:C-1, II Floor, RDC, Raj Nagar
Ghaziabad- 201001 Delhi-NCR National
Capital region Of Delhi

INDEPENDENT AUDITOR'S REPORT

To the Unit Holders of National Highways Infra Trust

Report on the Audit of the Consolidated Financial Statements

OPINION

We have audited the accompanying consolidated financial statements of National Highways Infra Trust ("the InvIT" or "the Trust") and its one subsidiary (hereinafter referred to as "National Highways Infra Projects Private Limited" or "NHIPPL") (the Trust and its subsidiary together referred to as "the Group"), which comprising of the consolidated Balance Sheet as at 31 March 2022, the consolidated Statement of Profit and Loss (including Other Comprehensive Income), the consolidated Statement of Changes in Unitholder's Equity and the consolidated Statement of Cash Flows for the year then ended, the consolidated Statement of Net Assets at fair value as at 31 March 2022, the consolidated Statement of Total Returns at fair value, the Statement of Net Distributable Cash Flows of the Trust and its subsidiary for the year then ended and notes to the consolidated financial statements including a summary of significant accounting policies and other explanatory information (hereinafter referred to as "the consolidated financial statements").

In our opinion and to the best of our information and according to the explanations given to us and based on the consideration of report of other auditor on separate financial statements and on the other financial information of the subsidiary, the aforesaid consolidated financial statements give the information required by the Securities and Exchange Board of India (Infrastructure Investment Trusts) Regulations, 2014 as amended from time to time including any guidelines and circulars issued thereunder (together referred to as the "SEBI InvIT Regulations") in the manner so required and give a true and fair view in conformity with the Indian Accounting Standards as defined in Rule 2(1)(a) of the Companies (Indian Accounting Standards) Rules, 2015, as amended ("Ind AS") and other accounting principles generally accepted in India, to the extent not inconsistent with SEBI InvIT Regulations, of the consolidated state of affairs of the Group as at 31 March 2022, its consolidated profit including other comprehensive income, its consolidated cash flows, its consolidated statement of changes in Unitholders' equity for the year ended 31 March 2022, its consolidated net assets

at fair value as at 31 March 2022, its consolidated total returns at fair value of the Group and the net distributable cash flows of the Trust and its subsidiary for the year ended 31 March 2022.

BASIS FOR OPINION

We conducted our audit of the consolidated financial statements in accordance with the Standards on Auditing ("SAs") issued by the Institute of Chartered Accountants of India. Our responsibilities under those Standards are further described in the auditor's responsibilities for the audit of the consolidated financial statements section of our report. We are independent of the Group in accordance with the Code of Ethics issued by the Institute of Chartered Accountants of India together with the ethical requirements that are relevant to our audit of the consolidated financial statements under the provisions of the SEBI InvIT Regulations, and we have fulfilled our other ethical responsibilities in accordance with these requirements and the Code of Ethics. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion on the consolidated financial statements.

KEY AUDIT MATTERS

Key audit matters are those matters that, in our professional judgment, were of most significance in our audit of the consolidated financial statements for the financial year ended 31 March 2022. These matters were addressed in the context of our audit of the consolidated financial statements as a whole, and in forming our opinion thereon, and we do not provide a separate opinion on these matters. We have determined the matters described below to be the key audit matters to be communicated in our report.

Sr. No.	Key Audit Matter	Auditor's Response
1.	**Assessment of Impairment of Intangible Assets** The Group operates toll assets which is constructed on Toll, Operate and Transfer (TOT) basis. In accordance with its accounting policy and requirements under Ind AS 36 "Impairment of Assets", the Management is required to perform an impairment assessment by comparing the carrying value of the toll collection rights to their recoverable amount. For impairment testing, value in use has to be determined by forecasting and discounting future cash flows. Further, the value in use is highly sensitive to changes in critical variable used for forecasting the future cash flows including traffic	Our Audit Procedures included the following :- • Verifying the appropriateness of the Group's accounting policy on impairment of Intangible Assets. • Study of latest DCF Valuation • Assessing the assumptions around the key drivers of the revenue projections, future cash

	projections and discounting rates. The determination of the recoverable amount of the toll collection right involves significant estimates and judgments and accordingly, the evaluation of impairment of toll collection rights has been determined as a key audit matter.	flow, discount rates / weighted average cost of capital that were used by the management
2.	**Computation and disclosures as prescribed in the SEBI InvIT regulations relating to Consolidated Statement of Net Assets at Fair Value and Consolidated Total Returns at Fair Value** As per SEBI InvIT regulations, the Trust is required to disclose statement of net assets at fair value and statement of total returns at fair value. The fair value is determined by forecasting and discounting future cash flows from the operations of the investee entities which involves management estimates and judgements. These estimates and judgements include discounting rates, Tax rates and inflation rates which are considered for computing the fair value. There is an inherent risk in the computation of fair value due to the use of estimates and judgements mentioned above. Therefore, computation and disclosures of Consolidated statement of net assets at fair value and Consolidated statement of total returns at fair value is considered as a Key Audit Matter. Refer statement of net assets at fair value and Statement of total returns at fair value in the Consolidated financial statements.	Our Audit Procedures included the following :- • Obtained the understanding of the requirements of SEBI InvIT regulations for disclosures relating to Consolidated Statement of Net Assets at Fair Value and Consolidated Statement of Total Returns at Fair Value. • Obtained Management representation in this respect as Management has considered fair value equal to the book value of Net Assets • Tested the arithmetical accuracy of computation in the statement of net assets and total returns at fair value. • Ensured that disclosures is in compliance with SEBI InvIT regulations relating to the statement of net assets at fair value and the statement of total returns at fair value.

INFORMATION OTHER THAN THE CONSOLIDATED FINANCIAL STATEMENTS AND AUDITOR'S REPORT THEREON

The Board of Directors of the Investment Manager is responsible for the other information. The other information comprises the information included in the Management Discussion and Analysis, Report of Investment Manager including annexures to Investment Manager's Report and other information as required to be given by SEBI InvIT Regulations, but does not include the consolidated financial statements and our report thereon.

Our opinion on the consolidated financial statements does not cover the other information and we do not express any form of assurance conclusion thereon.
In connection with our audit of the consolidated financial statements, our responsibility is to read the other information and, in doing so, consider whether the other information is materially inconsistent with the consolidated financial statements or our knowledge obtained during the course of our audit or otherwise appears to be materially misstated.

If, based on the work we have performed on the other information that we obtained prior to the date of this auditor's report, we conclude that there is a material misstatement of this other information, we are required to report that fact. We have nothing to report in this regard.

RESPONSIBILITIES OF THE BOARD OF DIRECTORS OF INVESTMENT MANAGER FOR THE CONSOLIDATED FINANCIAL STATEMENTS

The Board of Directors of Investment Manager is responsible for the preparation of these consolidated financial statements that give a true and fair view of the consolidated Balance Sheet as at 31 March 2022, consolidated statement of Profit & Loss including other comprehensive income, consolidated cash flows and consolidated statement of changes in Unitholder's equity for the year ended 31 March 2022, the consolidated net assets at fair value as at 31 March 2022, the consolidated total returns at fair value of the Group and the net distributable cash flows of the Trust and its subsidiary for the year ended 31 March 2022 in accordance with the requirements of the SEBI InvIT Regulations, Indian Accounting Standards as defined in Rule 2(1) (a) of Companies (Indian Accounting Standards) Rules, 2015, as amended and other accounting principles generally accepted in India, to the extent not inconsistent with SEBI InvIT Regulations. The respective Board of Directors of the subsidiary company included in the Group are responsible for maintenance of adequate accounting records for safeguarding of the assets of the Group and for preventing and detecting frauds and other irregularities; selection and application of appropriate accounting policies; making judgements and estimates that are reasonable and prudent; and design, implementation and maintenance of adequate internal financial controls for ensuring the accuracy and completeness of accounting records, relevant to the preparation and presentation of the consolidated financial statements that give a true and fair view and are free from material misstatement, whether due to fraud and error, which have been used for the purpose of preparation of the consolidated financial statements by the Board of Directors of Investment

Manager, as aforesaid.

In preparing the consolidated financial statements, the Board of Directors of Investment Manager and respective Board of Directors of the company included in the Group are responsible for assessing the ability of the Group to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless the respective Board of Directors either intends to liquidate the Group or to cease operations, or has no realistic alternative but to do so.

The Board of Directors of the Investment Manager and the respective Board of Directors of the subsidiary company included in the Group are also responsible for overseeing the financial reporting process of the Group.

AUDITOR'S RESPONSIBILITY FOR THE AUDIT OF THE CONSOLIDATED FINANCIAL STATEMENTS

Our objectives are to obtain reasonable assurance whether the consolidated financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with SAs will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

As part of an audit in accordance with SAs, we exercise professional judgment and maintain professional skepticism throughout the audit. We also:

- Identify and assess the risks of material misstatement of the consolidated financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.
- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Group's internal controls.
- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by the Board of Directors of the Investment Manager.
- Conclude on the appropriateness of the Board of Directors of Investment Manager use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Group's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the financial statements or, if such disclosures are

inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report. However, future events or conditions may cause the Group to cease to continue as a going concern.

- Evaluate the overall presentation, structure and content of the consolidated financial statements, including the disclosures, and whether the consolidated financial statements represent the underlying transactions and events in a manner that achieves fair presentation.
- Obtain sufficient appropriate audit evidence regarding the financial information of the entities or business activities within the Group of which we are the independent auditors, to express an opinion on the consolidated financial statements. We are responsible for the direction, supervision and performance of the audit of financial statements of such entities included in the consolidated financial statements of which we are the independent auditors. For the other entities included in the consolidated financial statements, which have been audited by other auditor, such other auditor remain responsible for the direction, supervision and performance of the audits carried out by them. We remain solely responsible for our audit opinion.

Materiality is the magnitude of misstatements in the consolidated financial statements that, individually or in aggregate, makes it probable that the economic decisions of a reasonably knowledgeable user of the financial statements may be influenced. We consider quantitative materiality and qualitative factors in (i) planning the scope of our audit work and in evaluating the results of our work; and (ii) to evaluate the effect of any identified misstatements in the financial statements.

We communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.

We also provide those charged with governance with a statement that we have complied with relevant ethical requirements regarding independence, and to communicate with them all relationships and other matters that may reasonably be thought to bear on our independence, and where applicable, related safeguards.

From the matters communicated with those charged with governance, we determine those matters that were of most significance in the audit of the consolidated financial statements of the current period and are therefore the key audit matters. We describe these matters in our auditor's report unless law or regulation precludes public disclosure about the matter or when, in extremely rare circumstances, we determine that a matter should not be communicated in our report because the adverse consequences of doing so would reasonably be expected to outweigh the public interest benefits of such communication.

OTHER MATTERS

We did not audit the financial statements of the subsidiary, whose financial statements reflect total assets of Rs. 7,35,774.44 Lakhs as at 31 March 2022, total revenues of Rs. 13,981.33 Lakhs, losses after taxes including other comprehensive income (net) of Rs. 11,355.90 Lakhs and net cash outflows amounting to Rs. 12,802.25 Lakhs for the period from 01 April 2021 to 31 March 2022, as considered in the consolidated financial statements. These financial statements and other financial information have been audited by other auditor, which financial statements, other financial information and auditor's reports have been furnished to us by the Management of Investment Manager and our opinion on the consolidated financial statements, in so far as it relates to the amounts and disclosures included in respect of that subsidiary is based solely on the report of the other auditor.

Our opinion on the consolidated financial statements, and our report on other legal and regulatory requirements below, are not modified in respect of the above matters with respect to our reliance on the work done by and the report of the other auditor.

REPORT ON OTHER LEGAL AND REGULATORY REQUIREMENTS

Based on our audit and as required by SEBI InvIT Regulations, we report that:

a) We have sought and obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purposes of our audit of the aforesaid consolidated financial statements.

b) the consolidated Balance Sheet, the consolidated Statement of Profit and Loss, the consolidated Statement of Cash Flows, the consolidated Statement of Changes in Unitholders' Equity, the consolidated Statement of Net Assets at fair value, the consolidated Statement of Total Returns at fair value and the Statement of Net Distributable Cash Flows of the Trust and its subsidiary dealt with by this Report are in agreement with the books of account.

c) In our opinion, the aforesaid financial statements comply with the Indian Accounting Standards as defined in Rule 2(1)(a) of Companies (Indian Accounting Standards) Rules, 2015, as amended, to the extent not inconsistent with SEBI InvIT regulations.

For A. R. & Co.
Chartered Accountants
FRN. 002744C

CA Naresh Kumar Karn
Partner
Membership No: 077887
UDIN:

Place: New Delhi
Date: 23.05.2022

NATIONAL HIGHWAYS INFRA TRUST

CONSOLIDATED BALANCE SHEET AS AT 31st MARCH, 2022

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	NOTE NO.	AS AT 31st March, 2022	AS AT 31st March, 2021
ASSETS			
1) Non - Current Assets			
(a) Property, Plant and Equipment	3	0.46	-
(b) Goodwill	4	10,144.46	-
(c) Intangible assets	5	7,33,984.39	-
(d) Financial Assets			
(i) Other Financial Assets	6	3,170.81	-
(e) Deferred Tax Assets	7	262.53	-
2) Current Assets			
(a) Financial Assets			
(i) Investments	8	992.16	-
(ii) Trade receivables	9	600.47	-
(iii) Cash and Cash Equivalents	10	5,389.78	-
(iv) Other financial assets	11	5.38	0.10
(b) Other current assets	12	347.29	-
TOTAL ASSETS		**7,54,897.72**	**0.10**
EQUITY AND LIABILITIES			
EQUITY			
1) Unit Capital	13	6,01,152.00	-
2) Initial settlement amount		0.10	0.10
3) Other Equity	14	5,059.25	(67.90)
LIABILITIES			
1) Non-Current liabilities			
(a) Financial liabilities			
(i) Borrowings	15	1,45,556.94	-
(b) Provisions	16	403.37	-
2) Current Liabilities			
(a) Financial liabilities			
(i) Borrowings	17	980.86	-
(ii) Trade Payables	18		
(a) Total Outstanding, dues of micro and small enterprises		-	-
(b) Total outstanding, dues of creditors other than micro and small enterprises		1,101.23	-
(iii) Other financial liabilities	19	241.41	67.81
(b) Other current liabilities	20	240.75	0.09
(c) Provisions	21	0.03	-
(d) Current Tax Liabilities (Net)	22	161.77	
TOTAL EQUITY & LIABILITIES		**7,54,897.72**	**0.10**

Significant Accounting Policies 1 - 2

The accompanying notes form an integral part of these consolidated financial statements. 3 - 56

This is the Consolidated Balance Sheet referred to in our report of even date.

For A.R. & Co.
Chartered Accountants
Firm Registration no. 002744C

Sd/-
CA Naresh Kumar Karn
Partner
M.No.077887

Date : 23.05.2022
Place : New Delhi

For and on behalf of the National Highways Infra Investment Managers Private Limited (Investment Manager of National Highways Infra Trust)

Sd/-
Suresh Krishan Goyal
Director
DIN: 02721580

Sd/-
Mahavir Parsad Sharma
Director
DIN: 03158413

Sd/-
Mathew George
Chief Financial Officer

Sd/-
Gunjan Singh
Compliance Officer

NATIONAL HIGHWAYS INFRA TRUST

CONSOLIDATED STATEMENT OF PROFIT AND LOSS FOR THE YEAR ENDED 31ST MARCH, 2022

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	NOTE NO.	YEAR ENDED 31st March, 2022	YEAR ENDED 31st March, 2021
INCOME			
Revenue from Operations	23	13,960.55	-
Other Income	24	1,014.53	-
TOTAL INCOME		**14,975.08**	-
EXPENSES			
Investment Manger Fee		1,931.71	-
Trusteeship Fee		3.73	4.21
Operating Expenses	25	1,140.21	-
Employee Benefits Expenses	26	2.12	-
Finance Charges	27	3,154.43	-
Depreciation & Amortization Expense	28	1,055.65	-
Other Expenses	29	676.86	63.69
TOTAL EXPENSES		**7,964.71**	**67.90**
Profit/(Loss) before Exceptional Items and Tax		**7,010.37**	**(67.90)**
Exceptional Items (net)		-	
Profit / (Loss) before Tax		**7,010.37**	**(67.90)**
Tax Expenses	30		
Current Tax		436.36	-
MAT Credit Utilized / (Entitlement)		-	-
Provision for Tax for Earlier Years		-	-
Deferred Tax expense/(credit)		(262.32)	-
Total Tax		174.04	-
Profit/ (loss) for the period		**6,836.33**	**(67.90)**
Other Comprehensive Income			
Items that will not be reclassified to Profit and Loss		-	-
Items that will be reclassified to Profit and Loss		-	-
		-	-
Total Comprehensive Income for the period		**6,836.33**	**(67.90)**
Earnings per Unit			
Basic	31	1.15	-
Diluted	31	**1.15**	-

Significant Accounting Policies 1 - 2
The accompanying notes form an integral part of these financial statements. 3 - 56

This is the Statement of Profit and Loss referred to in our report of even date.

For A.R. & Co.
Chartered Accountants
Firm Registration no. 002744C

For and on behalf of the National Highways Infra Investment Managers Private Limited (Investment Manager of National Highways Infra Trust)

Sd/-
CA Naresh Kumar Karn
Partner
M.No.077887

Sd/-
Suresh Krishan Goyal
Director
DIN: 02721580

Sd/-
Mahavir Parsad Sharma
Director
DIN: 03158413

Date : 23.05.2022
Place : New Delhi

Sd/-
Mathew George
Chief Financial Officer

Sd/-
Gunjan Singh
Compliance Officer

NATIONAL HIGHWAYS INFRA TRUST

CONSOLIDATED CASH FLOW STATEMENT FOR THE YEAR ENDED 31ST MARCH, 2022

(All amounts in ₹ lakh unless otherwise stated)

	YEAR ENDED 31st March, 2022	YEAR ENDED 31st March, 2021
A. OPERATING ACTIVITIES		
Net Profit/(Loss) Before Tax	7,010.37	
Adjustments to reconcile profit before tax to net cash flows:		
Depreciation and Amortization	1,055.65	
Loss/ (Gain) on sale of Investments (net)	(682.62)	
Loss / (Gain) on Fair Valuation of Investments	(7.38)	
Interest Accrued on Bank FD	(5.86)	
Finance Cost (net)	3,154.43	
Operating Profit/(Loss) before Working Capital Changes	**10,524.59**	
Working Capital Adjustments:		
Decrease / (Increase) in Trade & Other Receivables	(600.47)	
Decrease / (Increase) in Other Non Current Financial Assets	(3,170.81)	
Decrease / (Increase) in Other Current Financial Assets	0.59	
Decrease / (Increase) in Other Current Assets	(347.29)	
Increase / (Decrease) in Trade & Other Payables	651.07	
Increase / (Decrease) in Other Financial Liabilities	(7,34,867.55)	
Increase / (Decrease) in Provisions	403.40	
Increase / (Decrease) in Other Current Liabilities	238.59	
Increase / (Decrease) in Current Tax Liabilities	(0.59)	
	(7,37,693.06)	
Income Tax paid	(274.00)	
Net Cash Flows from/(used in) Operating Activities	**(7,27,442.47)**	
B. INVESTING ACTIVITIES		
Purchase of Property, Plant & Equipment, including CWIP, capital	(0.50)	
Purchase of Non Current Investments	(1.52)	
Purchase of Current Investments	(5,96,271.00)	
Sale of Current Investments	5,95,968.84	
Net cash flows from (used in) Investing activities	**(304.19)**	
C. FINANCING ACTIVITIES		
Proceeds from Issue of Unit Capital	5,91,000.00	
One Time Expense paid	(1,364.94)	
Proceeds from Long Term Borrowings (net of processing fees)	1,47,646.00	
Repayment of Long Term Borrowings	(1,001.59)	
Finance Costs Paid	(3,143.04)	
Net cash flows from (used in) Financing activities	**7,33,136.43**	
Net Increase/Decrease in Cash and Cash equivalents (A+B+C)	5,389.78	
Cash and cash equivalents at the beginning of the year	-	
Cash and cash equivalents at the end of the year	**5,389.78**	

This is the Cash Flow Statement referred to in our report of even date.

For A.R. & Co.
Chartered Accountants
Firm Registration no. 002744C

For and on behalf of the National Highways Infra Investment Managers Private Limited (Investment Manager of National Highways Infra Trust)

Sd/-
CA Naresh Kumar Karn
Partner
M.No.077887

Date : 23.05.2022

Sd/-
Suresh Krishan Goyal
Director
DIN: 02721580

Sd/-
Mahavir Parsad Sharma
Director
DIN: 03158413

Sd/-
Mathew George
Chief Financial Officer

Sd/-
Gunjan Singh
Compliance Officer

NATIONAL HIGHWAYS INFRA TRUST

CONSOLIDATED STATEMENT OF CHANGES IN EQUITY FOR THE YEAR ENDED 31ST MARCH, 2022

A. INITIAL SETTLEMENT AMOUNT *

(All amounts in ₹ lakh unless otherwise stated)

Balance as at 1st April 2020	Changes in Unit Capital During the year	Changes in Unit Capital due to prior period errors	Balance as at 31st March, 2021	Changes in Unit Capital During the year	Changes in Unit Capital due to prior period errors	Balance as at 31st March, 2022
-	0.10	-	0.10	-	-	0.10
-	**0.10**	-	**0.10**	-	-	**0.10**

B. UNIT CAPITAL *

Balance as at 1st April 2020	Changes in Unit Capital During the year	Changes in Unit Capital due to prior period errors	Balance as at 31st March, 2021	Changes in Unit Capital During the year	Changes in Unit Capital due to prior period errors	Balance as at 31st March, 2022
-	-	-	-	6,01,152.00	-	6,01,152.00
-	-	-	-	**6,01,152.00**	-	**6,01,152.00**

C. OTHER EQUITY **

(All amounts in ₹ lakh unless otherwise stated)

Particulars	Reserves and Surplus	Items of Other Comprehensive Income		Total
		Items that will not be reclassified to profit or loss	Items that will be reclassified to profit or	
	Retained Earnings	Remeasurement of Defined Benefit Obligation/ Plan	Fair Value Gain on Preference Shares	
Balance as at 1st April 2020	-	-	-	-
Profit/ (Loss) for the year	**(67.90)**	-	-	**(67.90)**
Balance as at 31st March, 2021	**(67.90)**	-	-	**(67.90)**
Profit/ (Loss) for the year	**6,836.33**	-	-	**6,836.33**
One time unit issue expenses	1,709.18	-	-	**1,709.18**
	-	-	-	-
Balance as at 31st March, 2022	**5,059.25**	-	-	**5,059.25**

* Refer Note No. 13
** Refer Note No. 14

For A.R. & Co.
Chartered Accountants
Firm Registration no. 002744C

Sd/-
CA Naresh Kumar Karn
Partner
M.No.077887

Date : 23.05.2022

For and on behalf of the National Highways Infra Investment Managers Private Limited
(Investment Manager of National Highways Infra Trust)

Sd/-
Suresh Krishan Goyal
Director
DIN: 02721580

Sd/-
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Director
DIN: 03158413

Sd/-
Mathew George
Chief Financial Officer

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Compliance Officer

NATIONAL HIGHWAYS INFRA TRUST

Disclosures pursuant to SEBI circulars (SEBI Master Circular No. CIRSEBI/HO/DDHS_Div3/P/CIR/2021/1673 dated 29 November 2021 issued under the InvIT

Consolidated Statement of Net Distributable Cash Flows (All amounts in ₹ lakh unless otherwise stated)

S. No.	PARTICULARS	YEAR ENDED 31st March, 2022	YEAR ENDED 31st March, 2021
1	**Profit after tax as per Statement of profit and loss/income and expenditure (Consolidated) (A)**	**18,185.92**	**-**
2	**Add:** Depreciation and amortization as per statement of profit and loss account. Incase of Impairment reversal, same needs to be deducted from profit and loss.	-	
3	**Add/Less:** Loss/gain on sale of infrastructure assets	-	-
4	**Add:** Proceeds from sale of infrastructure assets adjusted for the following: - related debts settled or due to be settled from sale proceeds; - directly attributable transaction costs; - proceeds reinvested or planned to be reinvested as per Regulation 18(7)(a) of the InvIT regulations	-	-
5	**Add:** Proceeds from sale of infrastructure assets not distributed pursuant to an earlier plan to re-invest, if such proceeds are not intended to be invested subsequently, net of any profit/ (loss) recognised in profit and loss account	-	-
6	**Add/ Less:** Any other item of non- cash expense/ non cash income (net of actual cash flows for these items), if deemed necessary by the Investment Manager. For example, any decrease/ increase in carrying amount of an asset or a liability recognised in profit and loss /income and expenditure on measurement of the asset or the liability at fair value; Interest cost as per effective interest rate method, deferred tax lease rents recognised on a straight line basis, etc.	(8,227.84)	
7	**Less:** Repayment of external debt (principal) / redeemable preference shares / debentures, etc. (excluding refinancing) / net cash set aside to comply with DSRA requirement under loan agreements	(5,204.50)	-
8	**Total Adjustment (B)**	(13,432.34)	-
9	**Net Distributable Cash Flows (C) = (A+B)**	**4,753.58**	**-**

The accompanying notes form an integral part of the Consolidated Financial Statements.

This is the Statement of Net Distributable Cash Flows referred to in our report of even date.

NATIONAL HIGHWAYS INFRA TRUST

Disclosures pursuant to SEBI circulars (SEBI Master Circular No. CIRSEBI/HO/DDHS_Div3/P/CIR/2021/1673 dated 29 November 2021 issued under the InvIT

Statement of Net Distributable Cash Flows

National Highways Infra Projects Private Limited (Project SPV company)

(All amounts in ₹ lakh unless otherwise stated)

S. No.	PARTICULARS	YEAR ENDED 31-03-2022
1	**Profit after tax as per Statement of profit and loss/income and expenditure (standalone) (A)**	**(11,355.90)**
2	**Add:** Depreciation and amortization as per statement of profit and loss account. Incase of Impairment reversal, same needs to be deducted from profit and loss.	1,055.65
3	**Add/Less:** Loss/gain on sale of infrastructure assets	-
4	**Add:** Proceeds from sale of infrastructure assets adjusted for the following: related debts settled or due to be settled from sale proceeds; directly attributable transaction costs; proceeds reinvested or planned to be reinvested as per Regulation 18(7)(a) of the InvIT regulations	**-**
5	**Add:** Proceeds from sale of infrastructure assets not distributed pursuant to an earlier plan to re-invest, if such proceeds are not intended to be invested subsequently, net of any profit/ (loss) recognised in profit and loss account	**-**
6	**Add/ Less:** Any other item of non- cash expense/ non cash income (net of actual cash flows for these items), if deemed necessary by the Investment Manager. For example, any decrease/ increase in carrying amount of an asset or a liability recognised in profit and loss /income and expenditure on measurement of the asset or the liability at fair value; Interest cost as per effective interest rate method, deferred tax lease rents recognised on a straight line basis, etc.	23,080.85
7	**Less:** Repayment of external debt (principal) / redeemable preference shares / debentures, etc. (excluding refinancing) / net cash set aside to comply with DSRA requirement under loan agreements	**-**
8	**Total Adjustment (B)**	24,136.50
9	**Net Distributable Cash Flows (C) = (A+B)**	**12,780.61**

Statement of Reconciliation of NDCF with distributions for FY 2021-22

(All amounts in ₹ lakh unless otherwise stated)

S. No.	PARTICULARS	YEAR ENDED 31-03-2022
1	**Net Distributable Cash Flows for the year ended on 31st March, 2022**	12,780.61
2	Amount distributed as Interest on borrowing from NHIT	12,192.00
3	**Cash and Cash Equivalents at the end of the reporting period**	**588.61**

NATIONAL HIGHWAYS INFRA TRUST

Disclosures pursuant to SEBI circulars (SEBI Master Circular No. CIRSEBI/HO/DDHS_Div3/P/CIR/2021/1673 dated 29 November 2021 issued under the InvIT regulations)

Consolidated Statement of Net Assets at Fair Value (All amounts in ₹ lakh unless otherwise stated)

	As at 31st March, 2022		As at 31st March, 2021	
Particulars	**Book value**	**Fair value^**	**Book value**	**Fair value^**
A. Assets	7,54,898	7,54,898	-	-
B. Liabilities (at book value)	1,48,686	1,48,686	-	-
C. Net assets (A-B)	**6,06,211**	**6,06,211**	-	-
D. No of units	59,52,00,000	59,52,00,000	-	-
E. NAV (C/D)	**101.85**	**101.85**	-	-

^Fair values of total assets relating to the Trust as at 31 March, 2022 as disclosed above are based on the best estimates of the management.

Consolidated Statement of Total Return at Fair Value: (All amounts in ₹ lakh unless otherwise stated)

Particulars	**For the period ended 31st March, 2022**	**For the year ended 31st March 2021**
Total comprehensive income for the year/period (As per the Consolidated Statement of Profit and Loss)	6,836.33	(67.90)
Add: Other changes in fair value for the year *	-	-
Total return	**6,836.33**	**(67.90)**

* In the above statement, other changes in fair value for the year ended 31 March, 2022 have been computed based on best estimates of the management.

The accompanying notes form an integral part of the Consolidated Financial Statements.

This is the Consolidated Statement of Net Assets at Fair Value and Consolidated Statement of Total Return at Fair Value referred to in our report of even date.

NATIONAL HIGHWAYS INFRA TRUST

NOTES FORMING PART OF CONSOLIDATED FINANCIAL STATEMENTS FOR THE YEAR ENDED ON MARCH 31, 2022

1. GROUP INFORMATION AND NATURE OF OPERATIONS

The consolidated financial statements comprise financial statements of NHAI Infra Trust ("the Trust" or "InvIT") and its subsidiary (collectively, the Group).

The Trust is an irrevocable trust registered under the provisions of the Indian Trusts Act, 1882 on October 19, 2020. It is registered under the Securities and Exchange Board of India (Infrastructure Investment Trust) Regulations, 2014 on October 28, 2020 having registration number IN/InvIT/20-21/0014.

The Trust was setup by National Highways Authority of India ("NHAI" or the "Sponsor"), an infrastructure development Trust in India. The Trustee to the Trust is IDBI Trusteeship Services Limited (the "Trustee") and Investment Manager for the Trust is National Highways Infra Investment Managers Private Limited ("Investment Manager").

The Trust has been formed to invest in infrastructure assets primarily being in the road sector in India. The Trust's road projects are implemented and held through special purpose vehicles ("Project SPVs"/ "Subsidiaries"). The units of the Trust were listed in Bombay Stock Exchange and National Stock Exchange on November 10, 2021.

During the year ended March 31, 2022, the Trust acquired 100% equity control in National Highway Infra Projects Private Limited (the "Project SPV") from the Sponsor with effect from November 03, 2021. During the year ended 31.03.2021, the project SPV entered into five Concession Agreements for 30 years with the Sponsor (National Highways Authority of India – NHAI) on Toll, Operate and Transfer ('TOT') basis.

The registered office of the Investment Manager is G-5 & 6, Setor-10, Dwarka, Delhi - 110075.

The consolidated financial statements were authorised for issue in accordance with resolution passed by the board of directors of the Investment Manager on May 23, 2022.

2. SIGNIFICANT ACCOUNTING POLICIES

2.1 Basis of Preparation

The Consolidated financial statements of the Group have been prepared in accordance with Indian Accounting Standards as defined in Rule 2(1)(a) of the Companies (Indian Accounting Standards) Rules, 2015, as amended, prescribed under Section 133 of the Companies Act, 2013 ("Ind AS") read with Securities and Exchange Board of India (Infrastructure Investment Group) Regulations, 2014, as amended and the circulars issued thereunder ("SEBI InvIT Regulations") and other accounting principles generally accepted in India.

Accordingly, the Group has prepared these Consolidated Financial Statements comprising of the Balance Sheet as on March 31, 2022, the Statement of Profit and Loss for the year ended on March 31, 2022, the Statement of Cash Flows for the year ended on March 31, 2022, the Statement of Changes of Equity for the year ended on March 31, 2022 and Notes to Accounts (together hereinafter referred to as "Consolidated Financial Statements").

These Financial Statements have been prepared on accrual basis under the historical cost convention, except certain financial assets and liabilities which have been measured at Fair Value. Accounting policies have been consistently applied, except where a newly issued Accounting Standard is initially adopted or a revision to an existing Accounting Standard requires a change in the accounting policy hitherto in use. Further, these standalone financial statements have been prepared on a going concern basis.

The financial statements are presented in Indian Rupees (INR) which is the Group's functional and presentation currency and all amounts are rounded to the nearest Lakh (` 00,000) and two decimals thereof, except as otherwise stated.

2.2 Basis of Consolidation

The consolidated financial statements incorporate the financial statements of the Trust and it's subsidiary (Project SPV- NHIPPL) from date of acquisition i.e. November 3, 2021.

For the purpose of consolidation, an entity which is, directly or indirectly, controlled by the Group is treated as subsidiary. Control exists when the Group, directly or indirectly, has power over the investee, is exposed to variable returns from its involvement with the investee and has the ability to use its power to affect its returns.

Consolidation of a subsidiary begins when the Group, directly or indirectly, obtains control over the subsidiary and ceases when the Group, directly or indirectly, loses control of the subsidiary. Income and expenses of a subsidiary acquired or disposed of during the period are included in the consolidated statement of profit and loss from the date the Group, directly or indirectly, gains control until the date when the Group, directly or indirectly, ceases to control the subsidiary.

The consolidated financial statements of the Group combine financial statements of the Trust and its subsidiaries on line-by-line basis by adding together the like items of assets, liabilities, income and expenses. All intra-group assets, liabilities, income, expenses and unrealised profits/losses on intra-group transactions are eliminated on consolidation unless the transaction provides evidence of an impairment of transferred asset. The carrying amount of the Group's investment in each subsidiary and the Group's portion of equity of each subsidiary are offset with each other in the consolidated financial statements.

Ind AS 12 'Income Taxes' applies to temporary differences that arise from the elimination of profits and losses resulting from intragroup transactions.

The accounting policies of subsidiaries have been harmonised to ensure the consistency with the policies adopted by the Group. The consolidated financial statements have been presented to the extent possible, in the same manner as Group's standalone financial statements. Profit or loss and each component of other comprehensive income are attributed to the unit holders of the Group and to the non-controlling interests, even if this results in the non-controlling interests having a deficit balance.

Non-controlling interest (if any) represents that part of the total comprehensive income and net assets of subsidiaries attributable to interests which are not owned, directly or indirectly, by the Group and are excluded in the consolidated financial statements from the total comprehensive income and net assets.

2.3 Business Combination/ Goodwill on Acquisition

Business combinations are accounted for using the acquisition method. The cost of an acquisition is measured as the aggregate of the consideration transferred, measured at acquisition date fair value and the amount of any non-controlling interests in the acquiree. For each business combination, the Group elects whether to measure the non-controlling interests in the acquiree at fair value or at the proportionate share of the acquiree's identifiable net assets. Acquisition related costs are recognised in the statement of profit and loss as incurred.
The acquiree's identifiable assets, liabilities and contingent liabilities that meet the condition for recognition are recognised at their fair values at the acquisition date.

Goodwill is initially measured at cost, being the excess of the aggregate of the consideration transferred and the amount recognised for non-controlling interests, and any previous interest held, over the net identifiable assets acquired and liabilities assumed. If the fair value of the net assets acquired is in excess of the aggregate consideration transferred, the Group re-assesses whether it has correctly identified all of the assets acquired and all of the liabilities assumed and reviews the procedures used to measure the amounts to be recognised at the acquisition date. If the reassessment still results in an excess of the fair value of net assets acquired over the aggregate consideration transferred, then the gain is recognised in other comprehensive income and accumulated in equity as capital reserve. However, if there is no clear evidence of gain on bargain purchase, the entity recognises the gain directly in equity as capital reserve, without routing the same through other comprehensive income.

Goodwill arising on consolidation is not amortised, however, it is tested for impairment annually. In the event of cessation of operations of a subsidiary, the unimpaired goodwill is written off fully. For the purpose of impairment testing, goodwill acquired in a business combination is, from the acquisition date, allocated to each of the Group's cash-generating units that are expected to benefit from the combination, irrespective of whether other assets or liabilities of the acquire are assigned to those units. A cash generating unit to which goodwill has been allocated is tested for impairment annually, or more frequently when there is an indication that the unit may be impaired. If the recoverable amount of the cash generating unit is less than it's carrying amount, the impairment loss is allocated first to reduce the carrying amount of any goodwill allocated to the unit and then to the other assets of the unit pro-rata based on the carrying amount of each asset in the unit.

Any impairment loss for goodwill is recognised in the consolidated statement of profit or loss. An impairment loss recognised for goodwill is not reversed in subsequent periods. Where goodwill has been allocated to a cash generating unit and part of the operation within that unit is disposed of, the goodwill associated with the disposed operation is included in the carrying amount of the operation when determining the gain or loss on disposal.
Goodwill disposed in these circumstances is measured based on the relative values of the disposed operation and the portion of the cash-generating unit retained.

2.4 Use of Judgement and Estimates

The preparation of financial statements is in conformity with the generally accepted accounting principles in India, and requires the Investment Manager to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent liabilities at the date of the financial statements and the results of operations during the reporting period end. Although these estimates are based upon Investment Manager's best knowledge of current events and actions, actual results could differ from these estimates.

Current versus non-current classification

Assets and Liabilities in the Consolidated Balance Sheet have been classified as either Current or Non–Current based upon the requirements of Schedule III notified under the Companies Act, 2013.
An asset has been classified as Current if,
(a) it is expected to be realized in, or is intended for sale or consumption in, the Group's normal operating cycle; or
(b) it is held primarily for the purpose of being traded; or
(c) it is expected to be realized within twelve months after the reporting date; or
(d) it is cash or cash equivalent unless it is restricted from being exchanged or used to settle a liability for at least twelve months after the reporting date.
All other assets have been classified as Non–Current.

A liability has been classified as Current when,
(a) it is expected to be settled in the Group's normal operating cycle; or
(b) it is held primarily for the purpose of being traded; or
(c) it is due to be settled within twelve months after the reporting date; or

(d) the Group does not have an unconditional right to defer settlement of the liability for at least twelve months after the reporting date.
All other liabilities have been classified as Non–Current.

The operating cycle is the time between the acquisition of assets for processing and their realisation in cash and cash equivalents. The group has identified twelve months as its operating cycle.

Deferred tax assets and liabilities are classified as non-current assets and liabilities.

2.5 Revenue Recognition

Revenue is recognised to the extent that it is probable that the economic benefits will flow to the Group and the revenue can be reliably measured, regardless of when the payment is being made. Revenue is measured at the fair value of the consideration received or receivable, taking into account contractually defined terms of payment and excluding taxes or duties collected on behalf of the government.
The specific recognition criteria described below must also be met before revenue is recognised:

Toll Revenue - Toll Revenue from users of toll roads held by subsidiary company is recognised in respect of toll revenue accrued for respective toll road projects.
Interest income - Interest is recognised on time proportion basis taking into account the amount outstanding and the rates applicable. For all Debt instruments measured either at Amortized Cost or Fair Value through Other Comprehensive Income, interest income is recorded using EIR method that is the rate that exactly discounts estimated future cash receipts through the expected life of the financial instrument to the net carrying amount of the financial asset.
Dividends - Dividend income is recognised when the Group's right to receive the payment is established, which is generally when shareholders approve the dividend.
Fair value gains on current investments carried at fair value are included in other income.
Claims with National Highways Authority of India ('NHAI') and other government authorities are accounted as and when the money is received from the respective authorities, in cases of monetary compensations.
Other items - Other items of income are recognised as and when the right to receive the income arises.

2.6 Property, plant and equipment

Property, Plant and Equipment (PPE) is recognised when it is probable that future economic benefits associated with the item will flow to the Group and the cost of the item can be measured reliably.

PPE are stated at acquisition cost less accumulated depreciation and cumulative impairment. Such cost includes the cost of replacing part of the plant and equipment and borrowing costs for long-term construction projects if the recognition criteria are met.

Recognition:
The cost of an item of property, plant and equipment shall be recognised as an asset if, and only if:
(a) it is probable that future economic benefits associated with the item will flow to the entity; and
(b) the cost of the item can be measured reliably.

When significant parts of plant and equipment are required to be replaced at intervals, Group depreciates them separately based on their specific useful lives.

Gains or losses arising from de - recognition of Property, plant and equipment are measured as the difference between the net disposable proceeds and the carrying amount of the asset and are recognized in the Consolidated Statement of Profit and Loss when the asset is derecognized.

Depreciation on Property, plant and equipment

Depreciation on Property, plant and equipment ("PPE") is provided on straight line method, up to the cost of the asset (net of residual value), in accordance with the useful lives prescribed under Schedule II to the Companies Act, 2013.

Depreciation on additions is being provided on a pro-rata basis from the date of such additions. Similarly, depreciation on assets sold/disposed off during the year is being provided up to the dates on which such assets are sold/disposed off. Modification or extension to an existing asset, which is of capital nature and which becomes an integral part thereof is depreciated prospectively over the remaining useful life of that asset.

The estimated residual value of the PPE has been taken as 5% in line with the provisions of Schedule II to the Companies Act, 2013.

Fixed assets amounting up to INR 5,000 are recognised in Consolidated Statement of Profit and Loss in entirety in the first year of purchase.

The residual values, useful lives and methods of depreciation of property, plant and equipment are reviewed at each financial year end and adjusted prospectively, if appropriate.

Depreciation charge for impaired assets is adjusted in future periods in such a manner that the revised carrying amount of the asset is allocated over its remaining useful life.

2.7 Intangible assets

In accordance with Ind AS 38 "Intangible Assets", Intangible assets are recognised when it is probable that the future economic benefits that are attributable to the asset will flow to the Group and the cost of the asset can be measured reliably.

Pre-operative expenses including administrative and other general overhead expenses that are specifically attributable to the development or acquisition of intangible assets are allocated and capitalised as a part of the cost of the intangible assets.

Intangible assets not ready for the intended use on the date of the Consolidated Balance Sheet are disclosed as "intangible assets under development". Intangible assets are derecognised when no future economic benefits are expected from use or disposal.

The cost of intangible assets acquired in an amalgamation in the nature of purchase is their fair value as at the date of amalgamation. Following initial recognition, intangible assets are carried at cost less accumulated amortization and accumulated impairment losses, if any.

The useful lives of intangible assets are assessed as either finite or indefinite.

Rights under Service Concession Arrangements – Toll Collection Rights

The Group has acquired rights for Tolling, Operation, Maintenance and Transfer of five toll road projects for a period of 30 years basis Toll Concession agreements with NHAI, and the same have been recognised as Other Intangible Assets in the financial statements.

Extension of concession period by the Authority in compensation for claims made by the Group are capitalised as part of Toll Collection Rights on acceptance of the claim. Where the Group has a contractual right to an extension in the concession period as per the concession agreement, the same is capitalized when the right to extension in the concession period is established at the estimated amount of eligible claims.

Amortisation of Intangible Assets

Intangible assets with finite lives are amortised over the useful economic life and assessed for impairment whenever there is an indication that the intangible asset may be impaired. The amortisation period and the amortisation method for an intangible asset with a finite useful life are reviewed at least at the end of each reporting period. Changes in the expected useful life or the expected pattern of consumption of future economic benefits embodied in the asset are considered to modify the amortisation period or method, as appropriate, and are treated as changes in accounting estimates. The amortisation expense on intangible assets with finite lives is recognised in the Consolidated Statement of Profit and Loss unless such expenditure forms part of carrying value of another asset.

In accordance with Ind AS 38 "Intangible Assets", Intangible assets should be amortized by a method which reflects the pattern in which the asset's future economic benefits are expected to be consumed by the entity.

Toll Collection Rights shall be amortized basis a Consumption based model (using Passenger Car Unit (PCU) projections) over the tenure of the Concession Agreement i.e. 30 years.

Other intangible assets - Software purchased is amortized over a period of three to six years on straight line basis from the month in which the addition is made.

Gains or losses arising from derecognition of an intangible asset are measured as the difference between the net disposal proceeds and the carrying amount of the asset and are recognised in the statement of profit or loss when the asset is derecognised.

Amortisation on impaired assets is provided by adjusting the amortisation charge in the remaining periods so as to allocate the assets' revised carrying amount over its remaining useful life.

2.8 Employee benefits

Employee benefits include provident fund, gratuity, compensated absences, long service awards and medical benefits.

i. Short term employee benefits

Employee benefits such as salaries, short term compensated absences, expected cost of bonus, ex-gratia and performance linked rewards falling due wholly within twelve months of rendering the service are classified as short-term employee benefits and are expensed in the period in which the employee renders the related service.

ii. Post-Employment Benefits

Defined contribution plan: A defined contribution plan is a post-employment plan under which an entity pays fixed contributions and will have no legal or constructive obligations to pay further amounts. The Group contributes to provident fund and employees deposit linked insurance scheme, and have no further obligations beyond making its contributions. The Group's contribution to the above funds are charged to the Consolidated Statement of Profit and Loss.

Defined benefit plan: The Group has an un-funded benefit plan for post-employment benefits in the form of Gratuity. The value of obligation under the plan is determined by the group based on best estimate of the present value of the estimated future cash flows towards the gratuity obligation. Defined benefit costs comprising current service cost, past service cost and gains or losses on settlements are recognised in the Consolidated Statement of Profit and Loss as employee benefits expense. Gains or losses on the curtailment or settlement of any defined benefit plan are recognised when the curtailment or settlement occurs.

iii. Termination benefits

Termination benefits such as compensation under employee separation schemes (wherever applicable) are recognised as expense in the Consolidated Statement of Profit and Loss. Liability for the same is recognised at the earlier of when the group can no longer withdraw the offer of the termination benefit.

iv. Other long-term employee benefits

The present value of the obligation under long term employee benefit plans such as compensated absences is determined and is recognised in a similar manner as in the case of defined benefit plans.

Long term employee benefit costs comprising current service cost and gains or losses on curtailments and settlements, re-measurements are recognised in the Consolidated Statement of Profit and Loss as employee benefit expenses. Interest cost implicit in long term employee benefit cost is recognised in the Consolidated Statement of Profit and Loss under finance cost.

2.9 Leases

(i) The determination of whether an arrangement is or contains a lease is based on the substance of the arrangement at the inception of the lease.

i.i) Property, plant, and equipment acquired under leases with lease term more than 12 months is long term lease. The lease liability is recognised for the obligation to make the lease payments and a right of use of asset for the underlying property, plant and equipment for the lease term. The lease liability is measured at the present value of the lease payments to be made over the lease term. The right of use property, plant and equipment are initially measured at the amount of the lease liability, adjusted for lease prepayments, lease incentives received and the initial direct costs such as commissions and an estimate cost of restoration, removal and dismantling of property, plant and equipment. Lease liabilities are increased to reflect the interest cost and are reduced with lease payments.

i.ii) Property, plant, and equipment having lease term 12 months or less than 12 months are recognised on a straight-line basis.

(ii) Property, plant and equipment leased out under operating leases are continued to be capitalised by the Group. Rental income is recognised on a straight-line basis over the term of the relevant lease.

2.10 Borrowing costs

Borrowing Cost consist of interest and other ancillary costs incurred in connection with the arrangement of borrowings. Borrowing costs directly attributable to the acquisition, construction or production of an asset that necessarily takes a substantial period of time to get ready for its intended use or sale are capitalized as part of the cost of the respective asset.

All other borrowing costs are charged to the Consolidated Statement of Profit and Loss in the period they occur. In case of significant Long term loans, other costs incurred in connection with the borrowing of funds are amortized over the period of respective Loan. Borrowing cost also includes exchange differences to the extent regarded as an adjustment to the borrowing costs.

2.11 Financial Instruments

Financial assets and/or financial liabilities are recognised when the Group becomes party to a contract embodying the related financial instruments. A financial instrument is any contract that gives rise to a financial asset of one entity and a financial liability or equity instrument of another entity. A financial asset and a financial liability are offset and presented on net basis in the Consolidated Balance Sheet when there is a current legally enforceable right to set-off the recognised amounts and it is intended to either settle on net basis or to realise the asset and settle the liability simultaneously.

Financial assets

Initial recognition and measurement

All financial assets are recognised initially at fair value plus, in the case of financial assets not recorded at fair value through profit or loss, transaction costs that are attributable to the acquisition of the financial asset. Purchases or sales of financial assets that require delivery of assets within a time frame established by regulation or convention in the market place (regular way trades) are recognised on the trade date, i.e., the date that the Group commits to purchase or sell the asset. Trade receivables and trade payables that do not contain a significant financing component are initially measured at their transaction price.

Subsequent measurement

For purposes of subsequent measurement, financial assets are classified in following categories;

- at amortised cost
- at fair value through profit or loss (FVTPL)
- at fair value through other comprehensive income (FVOCI)

Financial Assets at amortised cost

A financial asset is classified and subsequently measured at the amortised cost if both the following conditions are met:
a) The asset is held within a business model whose objective is to hold assets for collecting contractual cash flows, and
b) Contractual terms of the asset give rise on specified dates to cash flows that are solely payments of principal and interest (SPPI) on the principal amount outstanding.

This category is the most relevant to the Group. All the Loans and other receivables under financial assets (except Investments) are non-derivative financial assets with fixed or determinable payments that are not quoted in an active market.

After initial measurement, such financial assets are subsequently measured at amortised cost using the effective interest rate (EIR) method. Amortised cost is calculated by taking into account any discount or premium on acquisition and fees or costs that are an integral part of the EIR. The losses arising from impairment are recognised in the Consolidated Statement of Profit and Loss.

Investments in equity instruments of Subsidiaries are recognised at original cost in accordance with Ind AS 27. Impairment testing of Investment in subsidiary that are accounted for at cost as per Ind AS 27 are within scope of Ind AS 36 Impairment of Assets. Any impairment in value of investment in equity investments in Subsidiaries is recognised in the Consolidated Statement of Profit and Loss.

Financial Assets at Fair Value through Other Comprehensive Income (FVOCI)

A financial asset is classified and subsequently measured at FVTOCI if both of the following criteria are met:
a) The asset is held within a business model whose objective is achieved both by collecting contractual cash flows and selling the financial assets, and
b) Contractual terms of the asset give rise on specified dates to cash flows that are solely payments of principal and interest (SPPI).

Investment in Debt instruments included within the FVTOCI category are measured initially as well as at each reporting date at fair value. Fair value movements are recognized in the other comprehensive income (OCI). However, the Group recognizes interest income, impairment losses & reversals and foreign exchange gain or loss in the Consolidated Statement of Profit and Loss.

Interest earned whilst holding FVTOCI debt instrument is reported as interest income using the EIR method.

Financial Assets at Fair Value through Profit and Loss (FVTPL)

A financial asset which is not classified in any of the above categories are subsequently fair valued through profit or loss. Financial assets included within the FVTPL category are measured at fair value with all changes recognized in the Consolidated statement of profit and loss. The Group measures its investments which are classified as equity instruments (other than investment in shares of Subsidiaries, Joint Ventures and Associates) at fair value through profit and loss account.

Any debt instrument, which does not meet the criteria for categorization as at amortized cost or as FVTOCI, is classified as at FVTPL. In addition, the Group may elect to designate a debt instrument, which otherwise meets amortized cost or FVTOCI criteria, as at FVTPL. However, such election is allowed only if doing so reduces or eliminates a measurement or recognition inconsistency (referred to as 'accounting mismatch'). The Group has not designated any debt instrument as at FVTPL.

The Group has investment in debt oriented mutual funds which are held for trading, and the same are classified as at FVTPL. The Group makes such election on an instrument by instrument basis. The classification is made on initial recognition and is irrevocable. The gain/ loss on sale of investments are recognised in the Consolidated Statement of Profit and Loss.

Reclassification of Financial Assets

The Group determines classification of financial assets on initial recognition. After initial recognition, no reclassification is made for financial assets which are equity instruments and financial liabilities. For financial assets which are debt instruments, a reclassification is made only if there is a change in the business model for managing those assets. Changes to the business model are expected to be infrequent. The Investment Manager of the Group determines change in the business model as a result of external or internal changes which are significant to the Group's operations. Such changes are evident to external parties. A change in the business model occurs when the Group either begins or ceases to perform an activity that is significant to its operations.
If the Group reclassifies financial assets, it applies the reclassification prospectively from the reclassification date which is the first day of the immediately next reporting period following the change in business model. The Group does not restate any previously recognised gains, losses (including impairment gains or losses) or interest.

The following table shows various reclassification and how they are accounted for:

Original Classification	Revised Classification	Accounting Treatment
Amortized Cost	FVTPL	Fair value is measured at reclassification date. Difference between previous amortised cost and fair value is recognised in Consolidated statement of profit and loss.
FTVPL	Amortized Cost	Fair value at reclassification date becomes its new gross carrying amount.
Amortized Cost	FVOCI	Fair value is measured at reclassification date. Difference between previous amortised cost and fair value is recognised in other comprehensive income. No Change in EIR due to reclassification.

FVOCI	Amortized Cost	Fair value at reclassification date becomes its new gross carrying amount. However cumulative gain or loss in other comprehensive income is adjusted against Fair value. Consequently, the asset is measured as if it had always been measured at amortised cost.
FTVPL	FVOCI	Fair value at reclassification date becomes its new carrying amount. No other adjustment is required.
FVOCI	FTVPL	Assets continue to be measured fair value. Cumulative gain or loss previously recognized in other comprehensive income is reclassified to Consolidated statement of profit and loss at the reclassification date.

Derecognition
A financial asset (or, where applicable, a part of a financial asset or part of Group's similar financial assets) is primarily derecognised (i.e. removed from the Consolidated Balance Sheet) when:

- The rights to receive cash flows from the asset have expired, or
- The group has transferred its rights to receive cash flows from the asset or has assumed an obligation to pay the received cash flows in full without material delay to a third party under a 'pass-through' arrangement; and either (a) the group has transferred substantially all the risks and rewards of the asset, or (b) the group has neither transferred nor retained substantially all the risks and rewards of the asset, but has transferred control of the asset.

When the Group has transferred its rights to receive cash flows from an asset or has entered into a pass-through arrangement, it evaluates if and to what extent it has retained the risks and rewards of ownership. When it has neither transferred nor retained substantially all of the risks and rewards of the asset, nor transferred control of the asset, the group continues to recognise the transferred asset to the extent of the group's continuing involvement. In that case, the group also recognises an associated liability. The transferred asset and the associated liability are measured on a basis that reflects the rights and obligations that the group has retained.
Continuing involvement that takes the form of a guarantee over the transferred asset is measured at the lower of the original carrying amount of the asset and the maximum amount of consideration that the group could be required to repay.

Financial liabilities

Initial recognition and measurement

Financial liabilities are classified, at initial recognition, as financial liabilities at fair value through profit or loss, loans and borrowings, payables, as appropriate.
All financial liabilities are recognised initially at fair value and, in the case of loans and borrowings and payables, net of directly attributable transaction costs.
The Group's financial liabilities include trade and other payables, loans and borrowings etc.

Subsequent measurement
Financial liabilities designated upon initial recognition at fair value through profit or loss are designated as such at the initial date of recognition, and only if the criteria in Ind AS 109 are satisfied. For liabilities designated as FVTPL, fair value gains/ losses attributable to changes in own credit risk are recognized in OCI. These gains/losses are not subsequently transferred to Consolidated statement of profit and loss. However, the Group may transfer the cumulative gain or loss within equity. All other changes in fair value of such liability are recognised in the Consolidated statement of profit and loss. The Group has not designated any financial liability as at fair value through profit and loss.

Loans and borrowings
This is the category most relevant to the Group. After initial recognition, interest-bearing loans and borrowings are subsequently measured at amortised cost using the EIR method. Gains and losses are recognised in Statement of Profit or Loss when the liabilities are derecognised as well as through the EIR amortisation process. Amortised cost is calculated by taking into account any discount or premium on acquisition and fees or costs that are an integral part of the EIR. The EIR amortisation is included as finance costs in the Consolidated Statement of Profit and Loss.
This category generally applies to borrowings and security deposits received.

Derecognition
A financial liability is derecognised when the obligation under the liability is discharged or cancelled or expires. When an existing financial liability is replaced by another from the same lender on substantially different terms, or the terms of an existing liability are substantially modified, such an exchange or modification is treated as the derecognition of the original liability and the recognition of a new liability. The difference in the respective carrying amounts is recognised in the statement of profit or loss.

Offsetting financial instrument

Financial assets and liabilities are offset and the net amount is reported in the Consolidated Balance Sheet where there is a legally enforceable right to offset the recognised amounts and there is an intention to settle financial asset and liability on a net basis or realise the asset and settle the liability simultaneously. The legally enforceable right must not be contingent on future events and must be enforceable in the normal course of business and in the event of default, insolvency or bankruptcy of the Company or the counterparty.

2.12 Fair Value measurement

The Group measures financial instruments at fair value at each financial statement date.
Fair value is the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date. The fair value measurement is based on the presumption that the transaction to sell the asset or transfer the liability takes place either:
i) In the principal market for the asset or liability, or
ii) In the absence of a principal market, in the most advantageous market for the asset or liability

The principal or the most advantageous market must be accessible by the Group.

The fair value of an asset or a liability is measured using the assumptions that market participants would use when pricing the asset or liability, assuming that market participants act in their economic best interest.

A fair value measurement of a non-financial asset takes into account a market participant's ability to generate economic benefits by using the asset in its highest and best use or by selling it to another market participant that would use the asset in its highest and best use.

The Group uses valuation techniques that are appropriate in the circumstances and for which sufficient data are available to measure fair value, maximising the use of relevant observable inputs and minimising the use of unobservable inputs.

All assets and liabilities for which fair value is measured or disclosed in the financial statements are categorised within the fair value hierarchy, described as follows, based on the lowest level input that is significant to the fair value measurement as a whole:
Level 1 — Quoted prices (unadjusted) in active markets for identical assets or liabilities
Level 2 — Inputs other than quoted prices included within Level 1 that are observable for the asset or liability, either directly (i.e. as prices) or indirectly (i.e. derived from prices)
Level 3 — Inputs for the assets or liabilities that are not based on observable market data (unobservable inputs).

For assets and liabilities that are recognised in the financial statements on a recurring basis, the Group determines whether transfers have occurred between levels in the hierarchy by re-assessing categorisation (based on the lowest level input that is significant to the fair value measurement as a whole) at the end of each reporting period.

The Group determines the policies and procedures for both recurring fair value measurement, such as derivative instruments and unquoted financial assets measured at fair value, and for non-recurring measurement, such as assets held for distribution in discontinued operations.

At each reporting date, the Group analyses the movements in the values of assets and liabilities which are required to be remeasured or re-assessed as per the Group's accounting policies. For this analysis, the Group verifies the major inputs applied in the latest valuation by agreeing the information in the valuation computation to contracts and other relevant documents.

The Group also compares the change in the fair value of each asset and liability with relevant external sources to determine whether the change is reasonable.
On an annual basis, the Board of Directors of the Investment Manager presents the valuation results to the Audit Committee and the Group's independent auditors. This includes a discussion of the major assumptions used in the valuations. For the purpose of fair value disclosures, the Group has determined classes of assets and liabilities on the basis of the nature, characteristics and risks of the asset or liability and the level of the fair value hierarchy as explained above. This note summarises accounting policy for fair value. Other fair value related disclosures are given in the relevant notes.

2.13 Cash and Cash Equivalents

Cash and cash equivalents in the Consolidated Balance Sheet comprise cash at banks and on hand and short-term deposits with an original maturity of three months or less, which are subject to an insignificant risk of changes in value.
For the purpose of the Consolidated statement of cash flows, cash and cash equivalents consist of cash and short-term deposits, as defined above, net of outstanding bank overdrafts as they are considered an integral part of the Group's cash management.

2.14 Impairment of Assets

Impairment of Financial Assets

All financial assets except for those designated at FVTPL are subject to review for impairment at least each reporting date to identify whether there is any objective evidence that a financial asset or group of financial assets is impaired. In accordance with Ind AS 109, the group applies expected credit loss (ECL) model for measurement and recognition of impairment loss for financial assets carried at amortized cost.

For recognition of impairment loss on other financial assets and risk exposure, the group determines that whether there has been a significant increase in the credit risk since initial recognition. If credit risk has not increased significantly, 12-month ECL is used to provide for impairment loss. However, if credit risk has increased significantly, lifetime ECL is used. If, in a subsequent period, credit quality of the instrument improves such that there is no longer a significant increase in credit risk since initial recognition, then the entity reverts to recognising impairment loss allowance based on 12-month ECL.

Lifetime ECL are the expected credit losses resulting from all possible default events over the expected life of a financial instrument. The 12-month ECL is a portion of the lifetime ECL which results from default events that are possible within 12 months after the reporting date.

ECL is the difference between all contractual cash flows that are due to the group in accordance with the contract and all the cash flows that the entity expects to receive (i.e., all cash shortfalls), discounted at the original EIR. When estimating the cash flows, an entity is required to consider:

- All contractual terms of the financial instrument (including prepayment, extension, call and similar options) over the expected life of the financial instrument. However, in rare cases when the expected life of the financial instrument cannot be estimated reliably, then the entity is required to use the remaining contractual term of the financial instrument
- Cash flows from the sale of collateral held or other credit enhancements that are integral to the contractual terms

ECL impairment loss allowance (or reversal) recognized during the year is recognized as income/ expense in the Consolidated Statement of Profit and Loss (P&L). This amount is reflected under the head 'other expenses' in the P&L.

Impairment of Non- Financial Assets

The Group assesses, at each reporting date, whether there is an indication that an asset may be impaired. If any indication exists, or when annual impairment testing for an asset is required, the Group estimates the asset's recoverable amount. An asset's recoverable amount is the higher of an asset's or cash-generating unit's (CGU) fair value less costs of disposal and its value in use. Recoverable amount is determined for an individual asset unless the asset does not generate cash inflows that are largely independent of those from other assets or Group's assets. When the carrying amount of an asset or CGU exceeds its recoverable amount, the asset is considered impaired and is written down to its recoverable amount. In assessing value in use, the estimated future cash flows are discounted to their present value using a pre—tax discount rate that reflects current market assessments of the time value of money and the risks specific to the asset. In determining net selling price, recent market transactions are taken into account, if available. If no such transactions can be identified, an appropriate valuation model is used. Impairment losses of continuing operations are recognized in the Consolidated statement of profit and loss, except for previously revalued tangible fixed assets, where the revaluation was taken to revaluation reserve. In this case, the impairment is also recognized in the revaluation reserve up to the amount of any previous revaluation. After impairment, depreciation is provided on the revised carrying amount of the asset over its remaining useful life.

An assessment is made at each reporting date as to whether there is any indication that previously recognized impairment losses may no longer exist or may have decreased. If such indication exists, the group estimates the asset's CGU's recoverable amount. A previously recognized impairment loss is reversed only if there has been a change in the assumptions used to determine the assets recoverable amount since the last impairment loss was recognized. The reversal is limited so that the carrying amount of the asset does not exceed its recoverable amount, nor exceed the carrying amount that would have been determined, net of depreciation, had no impairment loss been recognized for the asset in prior years. Such reversal is recognized in the Consolidated statement of profit and Loss unless the asset is carried at a revalued amount, in which case the reversal is treated as a revaluation increase.

2.15 Foreign currency transactions

The Group's financial statements are presented in INR, which is group's functional currency.

Foreign currency transactions are recorded at the exchange rate prevailing on the date of the respective transactions between the functional currency and the foreign currency.

Monetary foreign currency assets and liabilities remaining unsettled at the Financial Statement date are translated at the rates of exchange prevailing on that date.

Gains / losses arising on account of realisation / settlement of foreign currency transactions and on translation of foreign currency assets and liabilities are recognized in the Consolidated Statement of Profit and Loss.

Exchange differences arising on the settlement of monetary items at rates different from those at which they were initially recorded during the year, or reported in previous financial statements, are recognized as income or as expenses in the year in which they arise.

Non - Monetary items which are carried in terms of historical cost denominated in a foreign currency are reported using the exchange rate at the date of the transaction; and Non - Monetary items which are carried at fair value or other similar valuation denominated in a foreign currency, are reported using the exchange rates that existed when the values were determined.

The gain or loss arising on translation of Non-Monetary items measured at fair value is treated in line with the recognition of the gain or loss on the change in Fair value of the item (i.e., translation differences on items whose fair value gain or loss is recognised in OCI or profit or loss are also recognised in OCI or profit or loss, respectively).

2.16 Taxes on income

Tax expense comprises of Current and Deferred tax.
Current income tax is measured at the amount expected to be paid to the tax authorities in accordance with the Income Tax Act, 1961.

Current income tax assets and liabilities are measured at the amount expected to be recovered from or paid to the taxation authorities. The tax rates and tax laws used to compute the amount are those that are enacted or substantively enacted, at the reporting date. The tax rates and tax laws used to compute the amount are those that are enacted or substantively enacted, at the reporting date.
Current income tax relating to items recognised outside profit or loss is recognised outside profit or loss (either in other comprehensive income or in equity).
Current tax items are recognised in correlation to the underlying transaction either in OCI or directly in equity.
Investment Manager periodically evaluates positions taken in the tax returns with respect to situations in which applicable tax regulations are subject to interpretation and establishes provisions where appropriate.

Deferred tax is provided using the liability method on temporary differences between the tax bases of assets and liabilities and their carrying amounts for financial reporting purposes at the reporting date.

Deferred tax assets and liabilities are measured at the tax rates that are expected to apply in the year when the asset is realised or the liability is settled, based on tax rates (and tax laws) that have been enacted or substantively enacted at the reporting date.

Deferred tax assets are recognised for all deductible temporary differences, the carry forward of unused tax credits and any unused tax losses. Deferred tax assets are recognised to the extent that it is probable that taxable profit will be available against which the deductible temporary differences, and the carry forward of unused tax credits and unused tax losses can be utilised. The carrying amount of deferred tax assets is reviewed at each reporting date and reduced to the extent that it is no longer probable that sufficient taxable profit will be available to allow all or part of the deferred tax asset to be utilised.

Deferred tax relating to items recognised outside profit or loss is recognised outside profit or loss (either in other comprehensive income or in equity).

Deferred tax assets and deferred tax liabilities are offset if a legally enforceable right exists to set off current tax assets against current tax liabilities and the deferred taxes relate to the same taxable entity and the same taxation authority.

2.17 Provisions, Contingent Liabilities, Contingent Assets and Capital Commitments

Contingent Liabilities
A contingent liability is a possible obligation that arises from past events whose existence will be confirmed by the occurrence or non–occurrence of one or more uncertain future events beyond the control of the Group or a present obligation that is not recognized because it is not probable that an outflow of resources will be required to settle the obligation. A contingent liability also arises in extremely rare cases where there is a liability that cannot be recognized because it cannot be measured reliably. Contingent Liabilities are reviewed at each reporting date. The Group does not recognize a contingent liability but discloses its existence in the financial statements, however discloses its existence in the financial statements in the notes to accounts.

Contingent Assets
Contingent assets usually arise from unplanned or other unexpected events that give rise to the possibility of an inflow of economic benefits to the entity.
Contingent assets are recognized when the realisation of income is virtually certain, in which case the related asset is not a contingent asset and its recognition is appropriate.
Contingent assets are reviewed at each reporting date. A contingent asset is disclosed where an inflow of economic benefits is probable.

Provisions
Provisions are recognised when the Group has a present obligation (legal or constructive) as a result of a past event, it is probable that an outflow of resources embodying economic benefits will be required to settle the obligation and a reliable estimate can be made of the amount of the obligation. When the Group expects some or all of a provision to be reimbursed, for example, under an insurance contract, the reimbursement is recognised as a separate asset, but only when the reimbursement is virtually certain. The expense relating to a provision is presented in the Consolidated statement of profit and loss net of any reimbursement.

If the effect of the time value of money is material, provisions are discounted using a current pre-tax rate that reflects, when appropriate, the risks specific to the liability. When discounting is used, the increase in the provision due to the passage of time is recognised as a finance cost.

Commitments
Commitments are future liabilities for contractual expenditure, classified and disclosed as follows:

- estimated amount of contracts remaining to be executed on capital account and not provided for;
- funding related commitment to subsidiary companies; and
- other non-cancellable commitments, if any, to the extent they are considered material and relevant in the opinion of management.

Other commitments related to services to be rendered / procurements made in the normal course of business are not disclosed to avoid excessive details.

2.18 Consolidated Statement of Cash Flows

Consolidated Statement of Cash Flows is prepared segregating the cash flows into operating, investing and financing activities. Cash flow from operating activities is reported using indirect method adjusting the net profit for the effects of:

- changes during the period in operating receivables and payables, transactions of a non-cash nature;
- non-cash items such as depreciation, provisions, deferred taxes, unrealised foreign currency gains and losses;
- all other items for which the cash effects are investing or financing cash flows.

Cash and cash equivalents (including bank balances) shown in the Consolidated Statement of Cash Flows exclude items which are not available for general use as at the date of Consolidated Balance Sheet.

2.19 Assets held for sale

Non-current assets or disposal groups comprising of assets and liabilities are classified as 'held for sale' when all of the following criteria's are met: (i) decision has been made to sell. (ii) the assets are available for immediate sale in its present condition. (iii) the assets are being actively marketed and (iv) sale has been agreed or is expected to be concluded within 12 months of the Consolidated Balance Sheet date.
Subsequently, such non-current assets and disposal groups classified as held for sale are measured at the lower of its carrying value and fair value less costs to sell. Non-current assets held for sale are not depreciated or amortised.

2.20 Unit Capital

Units are classified as equity. Incremental costs attributable to the issue of units are directly recorded in Other Equity, net of tax.

2.21 Distribution to unit holders

The Group recognises a liability to make cash distributions to unit holders when the distribution is authorised and a legal obligation has been created. As per the SEBI InvIT Regulations, a distribution is authorised when it is approved by the Board of Directors of the Investment Manager. A corresponding amount is recognised directly in equity.

2.22 Earnings per Unit (EPU)

Basic EPU amounts are calculated by dividing the profit for the period attributable to unitholders by the weighted average number of units outstanding during the period.

Diluted EPU amounts are calculated by dividing the profit/(loss) attributable to unitholders by the weighted average number of units outstanding during the period plus the weighted average number of units that would be issued on conversion of all the dilutive potential units into unit capital.

3. Property, Plant and Equipment

(All amounts in ₹ lakh unless otherwise stated)

Particulars	Computer	Total
Gross Carrying Amount		
Balance as at March 31, 2020	-	-
Additions	-	-
Less: Disposals	-	-
Balance as at March 31, 2021	-	-
Additions	0.50	0.50
Less: Disposals	-	-
Balance as at March 31, 2022	**0.50**	**0.50**
Accumulated Depreciation		
Balance as at March 31, 2020	-	-
Additions	-	-
Less: Disposals	-	-
Balance as at March 31, 2021	-	-
Additions	0.04	0.04
Less: Disposals	-	-
Balance as at March 31, 2022	**0.04**	**0.04**
Net Carrying Amount		
As at March 31, 2020	-	-
As at March 31, 2021	-	-
As at March 31, 2022	**0.46**	**0.46**

4. Goodwill arising on Consolidation

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Gross Carrying Amount		
Balance as at March 31, 2020	-	-
Additions	-	-
Less: Disposals	-	-
Less: Impairment	-	-
Balance as at March 31, 2021	-	-
Additions*	10,144.46	-
Less: Disposals	-	-
Less: Impairment	-	-
Balance as at March 31, 2022	**10,144.46**	-

The carrying amount relates to goodwill arising on acquisition of Project SPV company (NHIPPL) by the Trust and has been tested for impairment against the respective cash generating unit (CGU). The calculation uses cash flow forecast based on approved financial budgets/strategic forecast which cover future periods of 30 years.

Based on a review of the future discounted cash flows of the intangible assets (Toll Collection Rights) held by the subsidiary (NHIPPL), the recoverable amount is higher than the carrying amount of the assets, and accordingly no impairment loss has been recognised in the statement of profit and loss for the year ended March 31, 2022.

*Refer Note 34

NATIONAL HIGHWAYS INFRA TRUST

Consolidated Summary of significant accounting policies and other explanatory information

5. Intangible Assets

(All amounts in ₹ lakh unless otherwise stated)

Particulars	License to charge users of Toll Road					
	Abu Road-Swaroopganj	Abu Road-Palanpur	Belgaum- Kagal	Chittorgarh- Kota	Kolthakota-Kurnool	Total
Gross Carrying Amount:						
Balance as at March 31, 2021	-	-	-	-	-	-
Additions	74,170.00	1,14,650.00	2,32,870.00	1,19,340.00	1,94,010.00	7,35,040.00
Less: Disposals	-	-	-	-	-	-
Balance as at March 31, 2022	**74,170.00**	**1,14,650.00**	**2,32,870.00**	**1,19,340.00**	**1,94,010.00**	**7,35,040.00**
Accumulated Amortization:		-				
Balance as at March 31, 2021	-	-	-	-	-	-
Additions	102.06	156.78	366.53	156.35	273.89	1,055.61
Less: Disposals	-	-				
Balance as at March 31, 2022	**102.06**	**156.78**	**366.53**	**156.35**	**273.89**	**1,055.61**
Net Carrying Amount						
Balance as at March 31, 2021	-	-	-	-	-	-
Balance as at March 31, 2022	**74,067.94**	**1,14,493.22**	**2,32,503.47**	**1,19,183.65**	**1,93,736.11**	**7,33,984.39**

Note:-

The Project SPV (NHIPPL) has acquired rights for Tolling, Operation, Maintenance and Transfer of five toll road projects for a period of 30 years from the appointed date of 16.12.2021 basis Toll Concession agreements with the NHAI, for a consideration of INR 7,350.40 Crore and the same have been recognised as Other Intangible Assets in financial statements.

Toll Collection Rights shall be amortized basis a Consumption based model (using Passenger Car Unit (PCU) projections) over the tenure of the Concession Agreement i.e. 30 years.

6. Other Financial Assets: Non Current

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Investment in Fixed Deposits		
Fixed Deposits with banks*	3,170.81	-
	3,170.81	**-**

* The Fixed Deposits are earmarked for Debt Servicing Reserve Account (DSRA), to be utilized at the end of tenure of long term borrowings from Senior Lenders, hence classified as Other Financial Assets- Non Current irrespective of date of maturity.

7. Deferred Tax Assets (Net)

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Deferred Tax Assets arising on account of:		
- Expense disallowed as per Income Tax Act, 1961, allowable in future years	0.03	-
- Unabsorbed depreciation & Carried forward tax losses	23,124.38	-
Total (A)	**23,124.41**	**-**
Deferred Tax Liabilities arising on account of:		
- Difference between book & tax base related to Intangible assets	22,858.70	-
- Difference between book & tax base related to Investments	3.16	
- Expense disallowed earlier as per Income Tax Act, 1961, allowed now	0.03	-
Total (B)	**22,861.88**	**-**
Net Asset (A) - (B)	**262.53**	**-**

Reconciliation of Deferred Tax Asset/ (Liabilities)

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Opening Balance - Deferred Tax Asset	-	-
Deferred tax income/ (expense) during the period recognised in profit & loss	262.53	-
Deferred tax income/ (expense) during the period recognised in Other Comprehensive Income	-	-
Closing Balance - Deferred Tax Asset	**262.53**	**-**

8. Investments: Current

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
In Mutual Funds - Quoted at FVTPL		
Overnight Mutual Funds (28,664.02 units @ NAV of Rs. 3,461.3538 per unit)	992.16	-
Total	**992.16**	-

NATIONAL HIGHWAYS INFRA TRUST

Consolidated Summary of significant accounting policies and other explanatory information

9. Trade Receivables: Current

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Outstanding for the following period from the due date of payment:		
Undisputed trade receivables- considered good*	600.47	-
(Outstanding for less than 6 months from the due date of payment)		
Disputed trade receivables- considered good	-	-
	600.47	-

* Undisputed Trade Receivables include unbilled receivables amounting to Rs. 401.12 Lakh

10. Cash and Cash Equivalents

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Cash & Cash Equivalents		
Balances with Banks		
In Current Accounts	1,004.69	-
In Escrow Accounts	35.09	-
Fixed Deposits (having original maturity of less than 3 months)	4,350.00	-
	5,389.78	-

11. Other Financial Assets: Current

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Interest receivable on investment in Fixed Deposits	5.28	-
Other Financial Assets	0.10	-
Total	**5.38**	-

12. Other Current Assets

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Prepaid expenses	347.29	-
Total	**347.29**	-

NATIONAL HIGHWAYS INFRA TRUST

Consolidated Summary of significant accounting policies and other explanatory information

13. Unit Capital*

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022		AS AT 31st March, 2021	
	NO. OF UNITS	AMOUNT	NO. OF UNITS	AMOUNT
Unit Capital	59,52,00,000	6,01,152.00	-	-

Rights/ preferences and restrictions attached to Unit Capital

Subject to the provisions of the InvIT Regulations, the indenture of funds, and applicable rules, regulations and guidelines, the rights of the unit holders include:

a) The beneficial interest of each unitholder shall be equal and limited to the proportion of the numbers of the units held by that unitholder to the total number of the units.
b) Right to receive income or distributions with respect to the units held.
c) Right to attend the annual general meeting and other meetings of the unit holders of the Trust.
d) Right to vote upon any matters/resolutions proposed in relation to the Trust.
e) Right to receive periodic information having a bearing on the operation or performance of the Trust in accordance with the InvIT Regulations; and
f) Right to apply to the Trust to take up certain issues at meetings for unit holders approval.
g) Right to receive additional information, if any, in accordance with InvIT documents filed with Placement Memorandum.
h) The non-sponsor unit holders ("Eligible Persons") of the Trust are entitled to representation on the Board of Directors of the Investment Manager through appointment of up to two (2) directors ("Non-Sponsor Directors"), provided that no Eligible Person shall have the right to nominate more than one Director at a time for appointment on the Board of Directors.

In accordance with the InvIT Regulations, no unit holders shall enjoy superior voting or any other rights over any other unit holders, and there shall not be multiple classes of units. There shall be only one denomination of units. Not withstanding the above, subordinate units may be issued only to the Sponsor and its Associates, where such subordinate units shall carry only inferior voting or any other rights compare to the other units.

Under the provisions of the InvIT Regulations, not less than ninety percent of the net distributable cash flows of the Trust is required to be distributed to the unitholders, and in accordance with such statutory obligation the Trust has formulated a distribution policy to declare and distribute the distributable cash flows to its unitholders once every quarter of a financial year as approved by the Board of Directors of the Investment Manager. The distributions made by Trust to its unitholders are based on the Net Distributable Cash Flows (NDCF) of the Trust under the InvIT Regulations and represent repayment of proportionate capital and share of profit.

Limitation to the Liability of the unit holders

The liability of each unit holders towards the payment of any amount (that may arise in relation to the Trust including any taxes, duties, fines, levies, liabilities, costs or expenses) shall be limited only to the extent of the capital contribution of such unit holders and after such capital contribution shall have been paid in full by the unit holders, the unit holders shall not be obligated to make any further payments.
The unit holders shall not have any personal liability or obligation with respect to the Trust.

DETAILS OF UNITHOLDERS HOLDING MORE THAN 5% SHARES IN THE COMPANY

NAME OF SHAREHOLDER	AS AT 31st March, 2022		AS AT 31st March, 2021	
	NO. OF UNITS	%	NO. OF UNITS	%
Ontario Limited	14,88,00,000	25.00%	-	-
CPP Investment Board Private Holdings Inc.	14,88,00,000	25.00%	-	-
SBI Balanced Advantage Fund	5,68,00,000	9.54%	-	-
National Highways Authority of India (NHAI)	9,56,00,000	16.06%	-	-

As per records of the Trust, including its register of unitholders and other declaration received from unitholders regarding beneficial interest, the above unitholding represent both legal and beneficial ownership of units.
The Trust has issued 1,00,51,485 nos. of units at the rate of Rs. 101 per unit for consideration other than cash to the Sponsor (National Highways Authority of India), as consideration for purchase of 1,00,000 equity shares of Project SPV - NHIPPL.
No units were bought back since inception of the Trust.

THE RECONCILIATION OF THE NUMBER OF SHARES OUTSTANDING IS SET OUT BELOW:

PARTICULARS	AS AT 31st March, 2022		AS AT 31st March, 2021	
	NO. OF SHARES	AMOUNT	NO. OF SHARES	AMOUNT
Number of Units at the Beginning	-	-	-	-
Units issued during the year	59,52,00,000	6,01,152.00	-	-
Number of Units at the End	59,52,00,000	6,01,152.00	-	-

NATIONAL HIGHWAYS INFRA TRUST

Consolidated Summary of significant accounting policies and other explanatory information

14. Other Equity **

(All amounts in ₹ lakh unless otherwise stated)

Particulars	Reserves and Surplus	Items of Other Comprehensive Income		Total
		Items that will not be reclassified to profit or loss	Items that will be reclassified to profit or loss	
	Retained Earnings	Remeasurement of Defined Benefit Obligation/ Plan	Fair Value Gain on Preference Shares	
Balance as at 1st April 2020	**-**	**-**	**-**	**-**
Profit/ (Loss) for the year	(67.90)	-	-	(67.90)
Balance as at 31st March, 2021	**(67.90)**	**-**	**-**	(67.90)
Profit/ (Loss) for the year	6,836.33	-	-	6,836.33
One time units issue expense	1,709.18	-	-	1,709.18
Balance as at 31st March, 2022	**5,059.25**	**-**	**-**	**5,059.25**

15. Borrowings: Non Current

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Secured		
Term Loan:		
From Banks	1,46,998.41	-
From other parties	-	-
	1,46,998.41	-
Less: Current Maturities of Long Term borrowings (Refer Note 17)	980.86	-
Less: Unamortized Borrowing Cost	460.61	-
	1,45,556.94	-
Total	**1,45,556.94**	-

*Transaction Cost amounting to Rs. 1.18 Crore was not yet paid as at the end of reporting period to the Senior Lenders, however the same has been considered for the purpose of EIR in the forthcoming periods.

The Trust had availed loan cumulating to INR 1,480 Crore (sanctioned amount Rs. 2,000 Crore) from three banks at the rate of 7.20% p.a. via Facility Agreement dated 29.09.2021 for the purpose of investment of Trusts in Project SPV (NHIPPL).

The loan was disbursed on 14.12.2021 and is repayable on quarterly basis over 78 quarterly instalments of Principal and Interest up to 31st March 2041, and the next instalment due on 30th June 2022.

Security:

The loan is secured by,

- first pari passu charge on all immovable assets (if any), movable assets and receivables of the Trust including but not limited to,

(i) the interest and principal repayments on the loans advanced by the Trust to Project SPV

(ii) dividends to be paid by Project SPV to the Trust

- first pari passu Security Interest on Trust Escrow account and all sub-accounts thereunder, including DSRA.
- first pari Passu charge on the Senior Debt Service Account, Sub-Debt Servicing Account and Surplus/ Dividend Account or any other account of the Project SPV where free cash flows of the Project SPV are credited.
- pledge of 100% equity shares of Project SPV (NHIPPL) held by the Trust.
- assignment of loans advanced by the Trust to Project SPV (NHIPPL) and securities created by the Trust including the assignment of rights of submission, termination and invocation of provision of Escrow agreement in case of default.
- negative lien on immovable assets (including current assets and cash flows) of the Project SPV (NHIPPL) subject to sale of obsolete items or cars/ ambulances, old toll equipment etc., under normal business practice, subject to maximum cumulative value of INR 5 Crore in any financial year.

The senior lenders of the Trust have also been provided with a corporate guarantee from Project SPV (NHIPPL) to guarantee the repayment of senior debt by the Trust. The funds have been raised at Trust level by unitholders and domestic lenders, and the same have been lent to Project SPV (NHIPPL) for payment of concession fee by NHIPPL to NHAI. The cashflows viz., toll collections are lying in NHIPPL. Accordingly, corporate guarantee amounting to INR 2,000 Crore via Corporate Guarantee Deed dated 14.03.2022, valid across the tenure of the loan of the Trust i.e. up to 31.03.2041, has been provided by the Project SPV (NHIPPL) to the senior lenders of the Trust.

There have been no breaches in financial covenants with respect to the borrowings from Senior lenders.

16. Provisions: Non Current

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Provision for employees benefits		
Gratuity	0.05	-
Compensated Absences	0.03	-
Provision for Major Maintenance*		
Abu Road- Swaroopganj	7.45	-
Abu Road- Palanpur	28.39	-
Belgaum- Kagal	30.36	-
Chittorgarh- Kota	264.32	-
Kolthakota- Kurnool	72.78	-
Total	**403.37**	**-**

Provision for Major Maintenance*

The Company has a contractual obligation to maintain the performance standards of the Project Highways in respect of riding quality and allied measures as per the performance parameters stipulated under the respective Concession Agreements. Cost of such obligation is measured at the best estimate of the expenditure required to settle the obligation at the balance sheet date and recognised over the period at the end of which the overlay is estimated to be carried out using Discounted Cash Flows method with the discount rate taken as the risk free interest rate i.e. GOI 30 yr. Bond Yield. The next major overlay for one of the Project Highways is expected to be carried out in FY 2024-25.

Details of movement in Provisions

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Opening Balance	-	-
Add: Accretion during the year	403.29	-
Less: Utilized during the year	-	-
Closing Balance	**403.29**	**-**

17. Borrowings: Current

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Current Maturities of Long Term borrowings (Refer Note No. 15)	980.86	-
	-	
	980.86	**-**

18. Trade Payables: Current

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Total outstanding, dues of micro and small enterprises	-	-
Total outstanding, dues of creditors other than micro and small enterprises	1,101.23	-
(Outstanding for less than 12 months from the due date of payment)		
Total	**1,101.23**	**-**

19. Other Financial Liabilities: Current

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Others		
Cash Toll Collection payable to NHAI	97.85	-
Payables towards other expenses	143.56	67.81
Total	**241.41**	**67.81**

20. Other Current Liabilities

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Statutory Liabilities (GST, TDS, TCS and PF)	240.75	0.09
Total	**240.75**	**0.09**

21. Provisions: Current

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Provision for Employee Benefits		
Compensated Absences	0.03	-
Total	**0.03**	**-**

22. Current Tax Liabilities (Net)

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Provision for Income Tax	161.77	-
Total	**161.77**	**-**

Reconciliation of Current Tax Liabilities

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Opening Balance	-	-
Add: Income Tax Payable for the year	436.36	-
Less: Taxes Paid	274.59	-
Closing Balance	**161.77**	**-**

Consolidated Summary of significant accounting policies and other explanatory information

23. Revenue from operations

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Sale of Services		
Revenue from Toll Collection	13,941.94	-
Other Operative Revenue		
Interest on delay in Toll Remittance	18.61	-
Total	**13,960.55**	**-**

24. Other Income

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Interest Income		
On fixed deposits with banks	5.86	-
Other non operating income		
Net Gain on fair valuation of investments designated at FVTPL	7.38	-
Gain on sale of investments	682.62	-
Other Income	318.67	-
Total	**1,014.53**	**-**

25. Operating Expenses

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Project Management Fees	290.43	-
Operation and Maintenance Expenses	446.48	-
Provision for Major Maintenance Obligation	403.29	
Total	**1,140.21**	**-**

26. Employee Benefit Expenses

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Salaries and wages	1.75	-
Contribution to provident and other funds	0.13	-
Gratuity	0.05	-
Compensated absences	0.06	-
Staff welfare expenses	0.13	-
Total	**2.12**	**-**

27. Finance Charges

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Interest on Long Term Borrowings	3,149.19	-
Other Financial Charges	5.24	-
Total	**3,154.43**	**-**

28. Depreciation and Amortization Expenses

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Depreciation on Property, Plant and Equipment	0.04	-
Amortization on Intangible Assets	1,055.61	-
Total	**1,055.65**	**-**

29. Other Expenses

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Advertisement expenses	8.47	-
Professional fees	203.13	47.55
Fee, subscription & taxes	291.63	15.27
Insurance expenses	166.04	-
Bank charges	0.04	-
Auditors' remuneration:		
Statutory Audit fees	4.57	0.87
Tax Audit fees	0.30	-
Certification and other charges	0.52	-
Data Management Expenses	1.31	-
Miscellaneous expenses	0.87	-
Total	**676.86**	**63.69**

30. Tax Expense

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Current Tax	436.36	-
Provision for Taxation–Earlier years	-	-
	436.36	**-**
Deferred tax expense/(credit)	(262.32)	-
	174.04	**-**

Effective tax Reconciliation:

Numerical reconciliation of tax expense applicable to (profit)/ loss before tax at the latest statutory enacted tax rate in India to income tax expense reported is as follows:

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Accounting Profit before Income Taxes	7,010.37	
Tax at India's statutory income tax rate for Companies (25.17%)	(2,925.10)	
Tax at India's statutory income tax rate for Business Trusts - Maximum Marginal Rate (42.744%)	7,963.95	
Increase/ (reduction) in taxes on account of:		
Impact of deferred tax on reversible allowance/ disallowance of business expense and income, as per Indian Income Tax Act, 1961	2,662.78	
Impact of exemption u/s 10(23FC) of the Indian Income Tax Act, 1961 available to the Trust	(7,542.34)	
Provision for interest on delayed deposit of income tax	14.75	
Income tax expense reported in the statement of profit and loss	**174.04**	

31. Earning per Unit

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Basic and diluted EPU		
Net Profit/ loss available for unitholders (in ₹ lakh)	6,836.33	-
Weighted average number of units for EPU computation	59,52,00,000	-
EPU- Basic and diluted	**1.15**	**-**

32. Contingent Liabilities

(All amounts in ₹ lakh unless otherwise stated)

PARTICULARS	AS AT 31st March, 2022	AS AT 31st March, 2021
Contingent Liabilities:		
Corporate Guarantee issued by the Project SPV company (NHIPPL) to the lenders of NHIT	2,00,000.00	-
Total	**2,00,000.00**	**-**

The Project SPV company (NHIPPL) has issued a Corporate Guarantee amounting to INR 2,000 Crore on 14.03.2022 in favour of lenders of NHIT as part of debt covenants of the loan received from NHIT, to secure the term loan of INR 2,000 Crore availed by NHIT from external lenders. The Corporate Guarantee is valid across the tenure of the loan till March 31, 2047, till the external loans of the Trust are satisfied.

33. Revenue from contracts with customers

(All amounts in ₹ lakh unless otherwise stated)

1 Disaggregation of revenue

Revenue recognised mainly comprises of revenue from toll collections, claims with NHAI, contract revenue. Set out below is the disaggregation of the Trust's revenue from contracts with customers:

Description	For the year ended 31st March, 2022	For the year ended 31st March, 2021
Operating revenue		
(a) Toll income from Expressway	13,941.94	-
(b) Interest on delay in Toll Remittance	18.61	-
Total revenue	**13,960.55**	**-**

The table below presents disaggregated revenues from contracts with customers based on nature, amount and timing for the year ended 31 March 2022 and 31 March 2021:

S.No.	Types of Products by Nature	Types of Services by timing	For the year ended 31st March, 2022	For the year ended 31st March, 2021
1	Toll Income	Over the period of time	13,960.55	-

2 Assets and liabilities related to contracts with customers

The following table provides information about receivables, contract assets and contract liabilities from contract with customers:

Description	As at 31st March, 2022	As at 31st March, 2021
	Current	Current
Contract assets		
Trade receivables:		
Receivables under service concession arrangements	600.47	-
Total	**600.47**	**-**
Contract liabilities		
Trade Payables	1,101.23	-
Other Payables	241.41	-
Total	**1,342.64**	**-**

3 Performance obligation

Income from toll collection

The performance obligation in service of toll collection is recorded as per rates notified by NHAI and approved by management and payment is generally due at the time of providing service.

Contract revenue

The performance obligation under service concession agreements ('SCA') is due on completion of work as per terms of SCA.

4 Disclosure under Appendix - C & D to Ind AS 115 - " Service Concession Arrangements"

All the below service concession arrangement have been accounted under intangible asset model

Name of Concessionaire	Start of Concession period under concession agreement (Appointed Date)	End of Concession period under concession agreement	Period of Concession since the appointed date (in days)
National Highways Infra Projects Private Limited	16.12.2021	15.12.2051	106

i) The above TOT projects shall have following rights / obligations in accordance with the Concession Agreement entered into with the respective Government Authorities

a. Right to use the Specified Assets

b. Obligations to provide or rights to except provision of services

c. Obligations to deliver or rights to receive at the end of concession

34. DISCLOSURES PURSUANT TO IND AS 103 "BUSINESS COMBINATIONS"

(All amounts in ₹ lakh unless otherwise stated)

a) Acquisition of subsidiaries

i) Pursuant to the Share Purchase Agreement dated September 30, 2021, the Trust acquired the entire equity share capital of the the Project SPV company (NHIPPL) on December 14, 2021 for an equity consideration of Rs. 1,39,553.52 Lakhs. Accordingly, the financial statements of the subsidiary NHIPPL for the period from December 14, 2021 to March 31,2022 have been considered in the consolidated financial statements of the Trust. Funding for the said acquisition was raised through preferential issue of units of the Trust. The Group has carried out a fair valuation of the net assets of the Project SPV at the time of acquisition and accordingly the goodwill has been recorded in the consolidated financial statements.

ii) **Details of the purchase consideration:**

Particulars	Total
Cash Consideration	1,29,400.00
Unit capital issued	10,153.52
Total purchase consideration	**1,39,553.52**

The fair value of Rs 139,553.52 lakhs paid for acquisition of the above mentioned project SPVs includes consideration in cash amounting to Rs. 1,294 Crore and consideration in form of issuance of 10.05 Lakh units of Trust at the rate of Rs. 101 per unit. Issue costs of Rs 1.52 Lakh directly attributable to the issue of the units have been added to the purchase consideration.

ii) **Assets acquired and liabilities recognised on the date of acquisition are as follows:**

Particulars	Amount
Non - Current Assets:	
Intangible assets	7,35,040.00
Deferred Tax Assets (net)	0.21
Current Assets:	
Financial Assets	
Cash and Cash Equivalents	10.00
Total Assets	**7,35,050.21**
Current Liabilities:	
Financial liabilities	
Other financial liabilities	7,35,041.12
Other current liabilities	0.02
Total Liabilities	**7,35,041.14**
Net assets acquired	**9.07**

iii) **Calculation of Goodwill / (Capital Reserve)**

Particulars	Amount
Purchase Consideration	1,39,553.52
Less: Fair Value of Net Assets acquired	9.07
Less: Acquisition of fresh issue of shares of NHIPPL by the Trust	1,29,400.00
Goodwill	**10,144.46**

iv) Goodwill on acquisiion has been accounted for under Non Current Assets in the Balance Sheet.

v) **Entity wise Revenue and Profit after tax from the date of acquisition till March 31, 2022:**

Particulars	Amount
Revenue	13,960.55
Profit after Tax	**6,836.33**

vi) **Entity wise Revenue and Profit after tax for the financial year 2020-21**

Particulars	Amount
Revenue	**-**
Profit after Tax	**(67.90)**

35 Related Party Disclosures

A. List of additional related parties as per Regulation 2(1)(zv) of the SEBI InvIT Regulations

Parties to the Trust

- National Highways Infra Investment Managers Private Limited (NHIIMPL) - Investment Manager (IM) of the Trust
- IDBI Trusteeship Services Limited (ITSL) - Trustee of the Trust
- National Highways Authority of India (NHAI)- Sponsor
- National Highways InvIT Project Managers Private Limited (NHIPMPL)- Project Manager

Promoters of the Parties to the Trust specified above

- President of India - Promoter of NHIIMPL
- IDBI Bank Limited (IDBI Bank) - Promoter of ITSL
- President of India - Promoter of NHAI
- National Highways Authority of India (NHAI)- Promoter of NHIPMPL

Directors of the parties to the Trust specified above

- **Directors of NHIIMPL**

  Mr. Suresh Krishan Goyal
  Mr. Vivek Rae
  Mr. Shailendra Narain Roy
  Mr. Balasubramanyam Sriram
  Mr. Mahavir Parsad Sharma
  Mr. Pradeep Singh Kharola
  Mr. Amit Kumar Ghosh
  Mrs. Kavita Saha
  Mr. Bruce Ross Crane
  Mr. N.R.V.V.M.K. Rajendra Kumar

- **Directors of ITSL**

  Mr. Padma Vinod Betai
  Mr. Samuel Joseph Jebaraj
  Ms. Madhuri Jayant Kulkarni
  Mr. Pradeep Kumar Jain
  Ms. Jayashree Ranade

- **Directors of NHIPMPL**

  Mr. Ashish Asati
  Mr. Muralidhara Rao Bugatha

B. Transactions with Related Parties during the period

(Amounts in ₹ lakh)

Name of Entity	Particulars	For the period ended March 31, 2022	For the period ended March 31, 2021
Parties to the Trust as per Regulation 2(1)(zv) of the SEBI InvIT Regulations			
National Highways Infra Investment Managers Private Limited (NHIIMPL)	Payment of Investment Manager Fee	1,931.71	-
	Reimbursement of Pre-Issue expenses of NHIT by NHIIMPL	214.80	-
National Highways Authority of India (NHAI)	Reimbursement of Pre-Issue expenses of NHIT by NHAI	578.02	67.03

	Purchase of equity shares of Project SPV (NHIPPL) by the Trust from NHAI	10,153.52	-
	Issue of units of Trust to NHAI	96,556.00	-
IDBI Trusteeship Services Limited (ITSL)	Payment of Trustee Fee	12.15	-
	Initial Settlement Amount	-	0.10

C. Closing Balance with Related Parties

(Amounts in ₹ lakh)

Name of Entity	Particulars	As on March 31, 2022	As on March 31, 2021
Parties to the Trust as per Regulation 2(1)(zv) of the SEBI InvIT Regulations			
National Highways Authority of India (NHAI)	Issue of units of Trust to NHAI (9,56,00,000 units)	96,556.00	-
IDBI Trusteeship Services Limited	Initial Settlement Amount	0.10	0.10
	Other Payables	2.77	-

36 Capital Management

For the purpose of the Group's capital management, capital includes issued unit capital and all other reserves attributable to the unit holders of the Group.

The primary objective of the Group's capital management is to ensure that it maintains a strong credit rating and healthy capital ratios in order to support its business and maximise unit holder value.

The Group manages its capital structure and makes adjustments to it in light of changes in economic conditions and the requirements of the financial covenants. To maintain or adjust the capital structure, the Group may adjust the dividend payment / income distribution to unit holders (subject to the provisions of SEBI InvIT Regulations which require distribution of at least 90%of the net distributable cash flows of the Group to unit holders), return capital to unit holders or issue new units. The Group monitors capital using a gearing ratio, which is net debt divided by total capital plus net debt. The Group's policy is to keep the gearing ratio optimum.

(Amounts in ₹ lakh)

Particulars	As at March 31, 2022	As at March 31, 2021
Net Debt Components:		
Long Term Borrowings (Non-Current portion)	145,556.94	-
Current Maturities of Long-Term Borrowings	980.86	-
Less: Cash and Cash Equivalents	(5,389.79)	-
Less: Bank Balances other than cash and cash equivalents	(3,170.81)	-
Less: Current Investments	(992.16)	-
Net Debt (i)	**1,36,985.04**	-
Capital Components:		
Unit Capital	6,01,152.00	-
Initial Settlement Amount	0.10	-
Other Equity	5,059.25	-
Total Capital (ii)	**6,06,211.35**	-
Capital and Debt [(iii) = (i) + (ii)]	**7,46,363.55**	-
Gearing Ratio (i)/(iii)	**18.35%**	-

In order to achieve this overall objective, the Board of Directors of Investment Manager, amongst other things, aims to ensure that it meets financial covenants attached to the interest-bearing loans and borrowings that define capital structure requirements. Breaches in meeting the financial covenants would permit the lenders to call loans and borrowings. There have been no breaches in the financial covenants of any interest-bearing loans and borrowing in the current period.

No changes were made in the objectives, policies or processes for managing capital during the years ended March 31, 2022 and March 31, 2021.

37 Financial Risk Management Objectives and Policies

The Group is in the process of formulation of its risk management policies with an objective of identification and analysis of risks faced by the Group, to set appropriate risk limits and controls, and to monitor risks and adherence to limits. Risk management policies shall be reviewed regularly to reflect changes in market conditions and the Group's activities.

The Board of Directors of Investment Manager has overall responsibility for the establishment and oversight of the Group's risk management framework.
In performing its operating, investing and financing activities, the Group is exposed to the Credit risk, Liquidity risk and Market risk.

Market Risk
Market risk is the risk that the fair value of future cash flows of a financial instrument will fluctuate because of changes in market prices. Market risk comprises three types of risk: interest rate risk, currency risk and other price risk. Financial instruments affected by market risk include loans and borrowings, Receivable and Payables and Investments measured at FVTPL.
The sensitivity analyses in the following sections relate to the position as at March 31, 2022 and March 31, 2021.
The sensitivity analyses have been prepared on the basis that the amount of net debt, the ratio of fixed to floating interest rates of the debt are all constant.

The following assumptions have been made in calculating the sensitivity analyses:
The sensitivity of the relevant profit or loss item is the effect of the assumed changes in respective market risks. This is based on the financial assets and financial liabilities held at March 31, 2022 & March 31, 2021.

Foreign Currency Risk
Foreign currency risk is the risk that the fair value or future cash flows of an exposure will fluctuate because of changes in foreign exchange rates. The Group transacts business primarily in Indian Rupees only, and hence, the sensitivity of profit and loss of the Group to a possible change in foreign exchange rates is non-existent as on 31st March, 2022.

Interest Rate Risk
Interest rate risk is the risk that the fair value or future cash flows of a financial instrument will fluctuate because of changes in market interest rates. Exposure to risk of changes in market interest rates generally relates primarily to long-term debt obligations with floating interest rates.

The following table provides a break-up of the Company's fixed and floating rate borrowings:

(Amounts in ₹ lakh)

Particulars	As at March 31, 2022	As at March 31, 2021
Floating Rate Borrowings	1,46,537.80	-

The Group's exposure to interest rate risk due to variable interest rate borrowings is as follows:

(Amounts in ₹ lakh)

Particulars	As at March 31, 2022	As at March 31, 2021
Term Loan from Bank	11,201.41	-

Sensitivity analysis based on average outstanding Debt:

(Amounts in ₹ lakh)

Particulars	As at March 31, 2022	As at March 31, 2021
Increase or decrease in interest rate by 25 basis points	388.94	-

Price Risk

Price risk is the risk that the fair value or future cash flows of a financial instrument will fluctuate because of changes in market prices (other than those arising from interest rate risk or currency risk).
The Group is exposed to price risk due to investments in mutual funds and classified as fair value through profit and loss. The Group measures risk through sensitivity analysis.
The Group's risk management policy is to mitigate the risk by investments in mutual funds. The Group has investment in mutual funds amounting Rs 992.16 Lakh as at March 31, 2022 (March 31, 2021: Rs. Nil) and accordingly is expose to price risk.

Sensitivity analysis:

(Amounts in ₹ lakh)

Particulars	Impact on profit / (loss) before tax	
	As at March 31, 2022	As at March 31, 2021
Increase or decrease in NAV by 2%	19.84	-

Credit risk

Credit risk is the risk that counterparty will not meet its obligations under a financial instrument or customer contract, leading to a financial loss. With respect to credit risk arising from other financial assets of the Group, which comprise Balances with banks, Trade Receivables, Loans and Advances and Investments. The Group's exposure to credit risk arises from default of the counterparty, with maximum exposure equal to the carrying amount of these instrument.

The carrying value of financial assets represents the maximum credit risk. The maximum exposure to credit risk was Rs. 10,158.59 Lakh and Rs. 0.10 Lakh as at March 31, 2022 and March 31, 2021 respectively, being the total carrying value of Loans and Advances, Trade receivables, Investments, Balances with bank, bank deposits and other financial assets.

Liquidity Risk

Liquidity risk is the risk that an entity will encounter difficulty in meeting obligations associated with financial liabilities that are settled by delivering cash or another financial assets.

The Group is exposed to liquidity risk due to bank borrowings and trade and other payables.

The Group measures risk by forecasting cash flows.

The Group's approach to managing liquidity is to ensure, as far as possible, that it will always have sufficient liquidity to meet its liabilities when due without incurring unacceptable losses or risking damage to the Group's reputation. The Group ensures that it has sufficient funds to meet expected operational expenses, servicing of financial obligations.

In addition, processes and policies related to such risk are overseen by senior management. Management monitors the Group's net liquidity position through rolling forecast on the basis of expected cash flows.

The table below summarises the maturity profile of the group's financial liabilities based on contractual undiscounted payments.

(Amounts in ₹ lakh)

As at 31-03-2022	**Carrying Amount**	**<1 Yr.**	**1-3 Yrs.**	**>3 Yrs.**
Borrowings	1,46,537.80	1000.00	8,000.00	1,37,537.80
Trade Payables	1,101.23	1,101.23	-	-
Other Financial Liabilities	241.41	241.41	-	-
Total	**1,47,880.44**	**2,342.64**	**8000.00**	**1,37,537.80**

As at 31-03-2021	**Carrying Amount**	**<1 Yr.**	**1-3 Yrs.**	**>3 Yrs.**
Borrowings	-	-	-	-
Trade Payables	-	-	-	-
Other Financial Liabilities	67.81	67.81	-	-
Total	**67.81**	**67.81**	**-**	**-**

38 Disclosure pursuant to IND AS 36 "Impairment of Assets"

Based on management review on expected future cash flows and economic conditions of the assets of the Group, no indicators of impairment of assets exist as on the reporting date. In case of Goodwill, the recoverable amount is higher than the carrying amount as on reporting date. Hence no provision for impairment has been recognised in the books as on the reporting date.

39 Disclosure of Financial Instruments by Category

(Amounts in ₹ lakh)

Particulars	As at March 31, 2022			As at March 31, 2021		
	Amortized Cost	FTVPL		Amortized Cost	FTVPL	
		At Cost	At Fair Value		At Cost	At Fair Value
Assets:						
Cash and Cash Equivalents	5,389.78	-	-	-	-	-
Trade Receivables	600.47					
Other Financial Assets	3,176.18	-	-	-	-	-
Investments in Mutual Funds	-	-	992.16	-	-	-
Total	**9,166.43**	**-**	**992.16**	**-**	**-**	**-**
Liabilities:						
Borrowings	1,46,537.80	-	-	-	-	-
Trade Payables	1,101.23	-	-	-	-	-
Other Financial Liabilities	241.41	-	-	67.81	-	-
Total	**1,47,880.44**	**-**	**-**	**67.81**	**-**	**-**

Defaults and Breaches

There are no defaults during the year with respect to repayment of principal and payment of interest and no breaches of the terms and conditions of the borrowings.

There are no breaches during the year which permitted lender to demand accelerated payment.

40 Fair Values of Assets and Liabilities

The carrying amount of all financial assets and liabilities appearing in the financial statements is reasonable approximation of fair values. Fair value of the financial assets and liabilities is the amount at which the instrument could be exchanged in a current transaction between willing parties, other than in a forced or liquidation sale.

The Group is required to present the Statement of total assets at fair value and Statement of total returns at fair value as per SEBI Circular No. CIR/IMD/DF/114/2016 dated October 20, 2016 as a part of these financial statements - Refer Statement of Net assets at fair value and Statement of Total Returns at fair value.

41 Fair Value Hierarchy

All financial instruments for which fair value is recognised or disclosed are categorised within the fair value hierarchy described as follows, based on the lowest level input that is significant to the fair value measurement as a whole.

Level 1 - Quoted prices (unadjusted) in active markets for identical assets or liabilities.

Level 2 – Inputs other than quoted prices included within Level 1 that are observable for the asset or liability, either directly (i.e. as prices) or indirectly (i.e. derived from prices).

Level 3 - Inputs for the assets or liabilities that are not based on observable market data (unobservable inputs).

Class wise composition and comparison of carrying amounts and fair values of financial assets and liabilities that are recognised in the financial statements along with Fair Value Hierarchy details are given below:

(Amounts in ₹ lakh)

Particulars	Fair Value Hierarchy Level	Carrying Value		Fair Value	
		As at March 31, 2022	As at March 31, 2021	As at March 31, 2022	As at March 31, 2021
Financial Assets at Amortized Cost:					
Cash and Cash Equivalents	Level 3	5,389.78	-	5,389.78	-
Trade Receivables	Level 3	600.47	-	600.47	-
Other Financial Assets	Level 3	3,176.18	-	3,176.18	-
Financial Assets at FVTPL:					-
Investments in Mutual Funds	Level 1	992.16	-	992.16	-

Total		**10,158.59**	**-**	**10,158.59**	**-**
Financial Liabilities at Amortized Cost:					
Borrowings	Level 3	1,46,537.80	-	1,46,537.80	-
Trade Payables	Level 3	1,101.23	-	1,101.23	-
Other Financial Liabilities	Level 3	241.41	67.81	241.41	67.81
Total		**1,47,880.44**	**67.81**	**1,47,880.44**	**67.81**

There are no transfers between level 1 and level 2 during the year.
The policy of the Group is to recognise transfers into and transfer out of fair values hierarchy levels as at the end of the reporting period.

Valuation technique and inputs used to determine fair value

Financial assets and liabilities	Valuation method	Inputs
Financial assets		
Investment in Mutual Funds	Market Approach	NAV
Investments in equity shares of subsidiaries	Income	Cash Flow
Loans	Income	Effective Rate of Interest
Financial liabilities		
Term loans from Bank	Income	Effective Rate of Borrowings
Non-Convertible Debentures	Income	Effective Rate of Borrowings

42 Disclosure of segment information pursuant to IND AS 108 "Operating Segments"

The activities of the Group mainly include investing in infrastructure assets primarily in the SPVs operating in the road sector to generate cash flows for distribution to unit holders. Based on the guiding principles given in Ind AS - 108 "Operating Segments", this activity falls within a single operating segment. Further, the entire operations of the Group are only in India and hence, disclosure of secondary / geographical segment information does not arise. Accordingly, requirement of providing disclosures under Ind AS 108 does not arise.

43 Details of dues To Micro and Small Enterprises as per MSMED Act, 2006

There are no Micro and Small Enterprises as defined in the Micro and Small Enterprises Development Act, 2006 to whom the Group owes dues on account of principal amount together with interest and accordingly no additional disclosures have been made. The above information regarding Micro and Small Enterprises has been determined to the extent such parties has been identified on the basis of information available with the Group.

44 Disclosure pursuant to IND AS 19 "Employee Benefits"

Defined contribution plan:
Contributions to Provident Fund scheme and the Employee Deposit Linked Insurance scheme of the government of India, as a specified percentage of monthly payroll costs comprise the only obligations of the Group with respect to defined contribution plans for the employees.
An amount of Rs. 0.13 Lakh for the reporting period (March 31, 2021: Rs. Nil), being contribution made to these funds is recognised as expense under Employee Benefit expense (Note 26) in the Consolidated Statement of Profit and Loss.

Defined Benefit Plan:

Gratuity:
The benefit is governed by Payment of Gratuity Act, 1972, and is calculated as follows:

Components	Particulars
Benefits offered	15/ 26 × Salary × Duration of Service
Salary Definition	Basic Salary including Dearness Allowance (if any)
Vesting Conditions	5 years of continuous service (Not applicable in case of death/disability)
Benefit Eligibility	Upon Death or Resignation / Withdrawal or Retirement
Retirement Age	58 years

45 Disclosure pursuant to IND AS 23 "Borrowing Costs"

Borrowing cost capitalised during the year Rs. Nil [March 31, 2021: Rs. Nil]

46 Details of Project Management Fees and Investment Management Fees

Details of fees paid to project manager and investment manager as required pursuant to SEBI Circular No. CIR/MD/DF/127/2016, dated November 29, 2016 are as under:

Project Management Fees

The Project Manager (NHIPMPL) for managing the initial portfolio of assets is entitled to a Project Management fee which is a percentage of the gross revenue earned by the project SPV (NHIPPL). The same is based on the Project Implementation and Management Agreement (PIMA) signed by both the parties dated 30th March, 2021.

The project SPV (NHIPPL) proposed a fees of Rs. 70.00 Lakh (Rupees Seventy Lakh Only) per month, as project manager's fees against the services offered by the project manager, for a period of 18 months starting from the date of the Concession agreement. The Project Manager's fees for the period after the expiry of 18 months shall be a percentage of gross revenue earned by the project SPV (NHIPPL), which is mutually agreed between the parties in the PIMA.

Investment Management Fees

i) The investment manager's fee will initially be Rs. 1,100 Lakh (Rupees Eleven Hundred Lakh) per annum, exclusive of applicable taxes as per agreement dated 21st October, 2020.

ii) The investment manager's fee set out in above shall be subject to escalation on an annual basis at the rate of 10% of the management fee for the previous year.

iii) Any applicable taxes, cess or charges shall be in addition to the investment manager's fee and shall be payable by National Highways Infra Trust (NHIT) to the Investment Manager (NHIIMPL).

iv) The payment of investment manager's fee shall be made by National Highways Infra Trust (NHIT) to the investment manager (NHIIMPL) in advance on a quarterly basis.

47 Significant accounting judgements, estimates and assumptions

The preparation of the Group's financial statements requires management to make judgements, estimates and assumptions that affect the reported amounts of revenues, expenses, assets and liabilities, and the accompanying disclosures, and the disclosure of contingent liabilities. Uncertainty about these assumptions and estimates could result in outcomes that require a material adjustment to the carrying amount of assets or liabilities affected in future periods.

Judgements

In the process of applying the Group's accounting policies, management has made the following judgments, apart from those involving estimations, which have the most significant effect on the amounts recognised in the financial statements:

Classification of unit holders Funds

Under the provisions of the SEBI InvIT Regulations, the Group is required to distribute to its Unit holders not less than ninety percent of the net distributable cash flows of the Group for each financial year. Accordingly, a portion of the unit holders' funds contain a contractual obligation of the Group to pay to its Unit holders cash distributions.
The Unit holder's funds could therefore have been classified as compound financial instrument which contain both equity and debt components in accordance with Ind AS 32 'Financial Instruments: Presentation'. However, in accordance with SEBI Circulars (Circular no. CIR/IMD/DF/114/2016 dated October 20, 2016 and No. CIR/IMD/ DF/127/2016 dated November 29, 2016) issued under the SEBI InvIT Regulations, the unit holders' funds have been classified as equity in order to comply with the mandatory requirements of Section H of Annexure A to
the SEBI Circular dated October 20, 2016 dealing with the minimum disclosures for key financial statements. In line with the above, the income distribution payable to unit holders is recognized as liability when the same is approved by Board of Directors of the Investment Manager.

Fair valuation and disclosures

SEBI Circulars issued under the SEBI InvIT Regulations requires disclosures relating to net assets at fair value and total returns at fair value. In estimating the fair value of investments in subsidiaries (which constitute substantial portion of the net assets), the Group engages independent qualified external valuers to perform the valuation. The Investment Manager works closely with the valuers to establish the appropriate valuation techniques and inputs to the model. The valuation report and findings are discussed at the meeting of the Board of Directors on yearly basis to understand the changes in the fair value of the subsidiaries. The inputs to the valuation models are taken from observable markets, where possible, but where this is not feasible, a degree of judgement is required in establishing fair values. Judgements include considerations of inputs such as weighted average cost of capital, tax rates, inflation rates, etc. Changes in assumptions about these factors could affect the fair value.

Taxes

In accordance with section 10 (23FC) of the Income Tax Act, 1961, the income of business groups in the form of interest received or receivable from subsidiaries is exempt from tax. Accordingly, the Group is not required to provide any current tax liability. Further, deferred tax asset on carry forward losses is not created since there is no reasonable certainty of reversal of the same in the near future.

Major Maintenance Expenses / Resurfacing Expenses

As per industry practice, the company is required to carry out resurfacing of the roads under the Concession. For this purpose, a regular maintenance along with periodic maintenances is required to be performed. Normally, periodic maintenance includes resurface of pavements, repairs of structures and other equipment and maintenance of service roads. The maintenance cost / bituminous overlay may vary based on the actual usage during maintenance period. Accordingly, on the grounds of matching cost concept and based on technical estimates, a provision for major maintenance expenses is reviewed and is provided for in the accounts annually.

Expected Credit Loss on financial assets

As per Ind AS 109, Financial Assets that are measured at amortised cost are required to compute the Expected Credit Loss (ECL). As at the reporting period, Investment manager of the Group assessed the credit risk of the financial assets and concluded that no provision for ECL is required.

48 Contingent Liabilities

The Project SPV company (NHIPPL) has issued a Corporate Guarantee amounting to Rs. 2,000 Crore on 14.03.2022 in favour of lenders of the Trust as part of debt covenants of the loan received from the Trust, to secure the term loan of Rs. 2,000 Crore availed by the Trust from external lenders. The Corporate Guarantee is valid till the external loans to the Trust are satisfied.

49 Subsequent Events

On May 23, 2022, the Board of Directors of the Investment Manager approved distribution of Rs. 0.79 per unit (Return on capital of Rs. 0.71 per unit, return of capital of Rs. Nil per unit, Dividend of Rs. Nil per unit and other income on surplus funds at Group of Rs. 0.08 per unit) for the period October 01, 2021 to March 31, 2022 to be paid on or before 15 days from the date of declaration.

50 Capital and Other Commitments

There are no capital and other commitments as at March 31, 2022 (March 31, 2021: Rs. Nil)

51 Distributions Made

(Amounts in ₹ lakh)

Particulars	FY 2021-22	FY 2020-21
Interest (Return on capital)	4,198.27	-
Return of capital	-	-
Dividend	-	-
Other income on surplus fund at Group	503.81	-
Total	**4,702.08**	**-**

52 Reconciliation of Financing Activities in Cash Flow Statement

Net Debt Recognition

(Amounts in ₹ lakh)

Particulars	31st March, 2022 (Long Term Borrowing)	31st March, 2021 (Long Term Borrowing)
Carrying amount of debt at the beginning of the year/period	-	-
Additional borrowings during the year/period	1,48,000.00	-
Repayments during the year/period	(1,001.59)	-
Other adjustments/settlements during the year/period	-	-
- Impact in equity	-	-
- Transaction Costs	(472.00)	-
- Unwinding of interest	11.39	
Carrying amount of debt at the end of the year/period	**1,46,537.80**	**-**

53 Additional Regulatory Information

Financial Ratios as on March 21, 2022

S. No.	Particulars	As on March 31, 2022	As on March 31, 2021
1	Current Asset ratio (Current Assets /Current Liability)	2.69	-
2	Debt- Equity ratio (Debt/ Equity)	0.24	-
3	Debt service coverage ratio (Net Operating Cash flow/ Debt Service Obligation)	2.58	-
4	ROE ratio (Net Profit/ Equity)	1.13%	-
5	Inventory turnover ratio	-	-
6	Trade receivable turnover ratio	-	-
7	Trade payable turnover ratio	-	-
8	Net Capital turnover ratio (Total Income / Net Working Capital)	3.25	-
9	Net profit ratio (Net profit / Total Income)	45.65%	-
10	Return on capital employed ratio ((Net Profit plus Finance Cost)/ (Equity + Debt))	1.35%	-
11	Return on investment (Income on Investment / Average Cost of Investment)	15.69%	-

54 Disclosure pursuant to IND AS 33 "Earnings per Unit"

Basic and Diluted Earnings per Unit (EPU) computed in accordance with Ind AS 33 “Earnings per Share”:

(Amounts in ₹ lakh)

Particulars	FY 2021-22	FY 2020-21
Basic and Diluted		
Profit attributable to unit holders of the Fund (A)	6,836.33	-
Weighted average number of units (B)	5,952.00	-
Earnings Per Unit (In Rs.) (A/B)	**1.15**	-
Face value per Unit (In Rs.)	**101**	-

55 Key sources of estimation

The preparation of financial statements in conformity with Ind AS requires the Group makes estimates and assumptions that affect the reported amounts of income and expenses of the period, the reported balances of assets and liabilities and the disclosures relating to contingent liabilities as of the date of the financial statements. The estimates and underlying assumptions are reviewed on an ongoing basis. Revisions to accounting estimates include allowance for doubtful loans /other receivables, fair value measurement etc. Difference, if any, between the actual results and estimates is recognised in the period in which the results are known.

56 Previous Year Figures

Previous year's numbers have been regrouped / reclassified, wherever necessary to conform to current year's classification.

For A.R. & Co.
Chartered Accountants
Firm Registration no. 002744C

Sd/-
CA Naresh Kumar Karn
Partner
M.No.077887
Date: 23.05.2022
Place: New Delhi

For and on behalf of the National Highways Infra Investment Managers Private Limited (Investment Manager of National Highways Infra Trust)

Sd/-
Suresh Krishan Goyal
Director
DIN: 02721580

Sd/-
Mahavir Parsad Sharma
Director
DIN: 03158413

Sd/-
Mathew George
Chief Financial Officer

Sd/-
Gunjan Singh
Compliance Officer

A.R. & CO.
Chartered Accountants

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A-403, Gayatri Apartment
Airlines Group Housing Society
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pawankgoel1@gmail.com

Corporate and Correspondence Office:
C-1, II Floor, RDC, Raj Nagar
Ghaziabad- 201001 Delhi-NCR
National Capital region Of Delhi

Independent Auditor's Report

To,
The Trustees
NATIONAL HIGHWAYS INFRA TRUST
G - 5 & 6, Sector - 10, Dwarka,
New Delhi - 110 075.

Report on the Standalone Financial Statements

We have audited the accompanying standalone financial statements of **NATIONAL HIGHWAYS INFRA TRUST ("the Trust")** which comprises the Balance Sheet as at March 31, 2021, the Statement of Profit and Loss for the period from 19.10.2020 to 31.03.2021, the Statement of cash flows for the period from 19.10.2020 to 31.03.2021 and a summary of significant accounting policies and other explanatory information.

Opinion

In our opinion and to the best of our information and according to the explanations given to us, the aforesaid standalone financial statements give the information required by the Act in the manner so required and give a true and fair view in conformity with the accounting principles generally accepted in India,

(i) In the case of Balance Sheet, of the state of affairs of the Company as at March 31, 2021,
(ii) In case of Statement of Profit & Loss, of the loss for the period from 19.10.2020 to 31.03.2021,
(iii) the Statement of cash flows for the period from 19.10.2020 to 31.03.2021.
(iv) the statement of changes in equity from 19.10.2020 to 31.03.2021

Basis for Opinion

We conducted our audit in accordance with the Standards on Auditing (SAs). Our responsibilities under those Standards are further described in the Auditor's Responsibilities for the Audit of the Financial Statements section of our report. We are independent of the Trust in accordance with the Code of Ethics issued by the Institute of Chartered Accountants of India together with the ethical requirements that are relevant to our audit of the financial statements and we have fulfilled our other ethical responsibilities in accordance with these requirements and the Code of Ethics. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Management's Responsibility for the Standalone Financial Statements

The Trustees of the Trust/ (Management of the Trust) are/is responsible for the matters with respect to the preparation and presentation of these standalone interim financial statements that give a true and fair view of the financial position and financial performance of the Trust in accordance with the accounting principles generally accepted in India, including the Indian Accounting Standards and other accounting principles generally accepted in India. This responsibility also includes maintenance of adequate accounting records for safeguarding the assets of the Company and for preventing and detecting frauds and other irregularities; selection and application of appropriate accounting policies; making judgments and estimates that are reasonable and prudent in the circumstances; and design, implementation and maintenance of adequate internal financial controls, that were operating effectively for ensuring the accuracy and completeness of the accounting records, relevant to the preparation and presentation of the interim financial statements that give a true and fair view and are free from material misstatement, whether due to fraud or error.

Auditor's Responsibility

Our responsibility is to express an opinion on these standalone financial statements based on our audit.

We have taken into account the provisions of the Act, the accounting and auditing standards and matters which are required to be included in the audit report under the provisions of the Act and the Rules made there under.

We conducted our audit in accordance with the Standards on Auditing. Those Standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and the disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal financial control relevant to the Trust's preparation of the financial statements that give a true and fair view in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on whether the Trust has in place an adequate internal financial controls system over financial reporting and the operating effectiveness of such controls. An audit also includes evaluating the appropriateness of the accounting policies used and the reasonableness of the accounting estimates made by the Trust's Management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion on the standalone financial statements.

Report on Other Legal and Regulatory Requirements

As required by SEBI Circular number CIR/IMD/DF/114/2016 dated October 20, 2016 ("SEBI Circular"), we report that:

(a) We have sought and obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purpose of our audit;

(b) The Balance Sheets, Statements of Profit and Loss (including Other Comprehensive Income), Cash Flow Statements and Statements of Changes in Equity dealt with by this Report are in agreement with the books of account maintained

(c) In our opinion, the aforesaid Financial Statements comply with the accounting principles generally accepted in India, including Indian Accounting Standards (hereinafter referred to as the 'Ind AS') and other accounting principles generally accepted in India.

For A. R. & Co.
Chartered Accountants
Firm Registration No. 002744C

(CA Aakansha Nigam)
Partner
Membership No: 416425
UDIN: 21416425AAAABE3018
Place: Ghaziabad
Date: 18.08.2021

NATIONAL HIGHWAYS INFRA TRUST
Regd. Off.: - G-5 & 6, Sector -10, Dwarka, Delhi - 110075
Standalone Balance Sheet as at March 31, 2021

Particulars	Note No.	As at March 31, 2021
ASSETS		
Non-current assets		
a) Property, Plant and Equipment		-
b) Capital work-in-progress		-
c) Intangible assets		-
d) Intangible assets under development		-
e) Financial Assets - Other financial assets		-
f) Other non-current assets		-
	A	-
Current assets		
a) Financial Assets		-
i) Investments		-
ii) Cash and cash equivalents		-
iii) Loans		-
iv) Other financial assets	3	10,000.00
b) Current tax assets (net)		-
c) Other current assets		-
	B	**10,000.00**
TOTAL ASSETS	**A+B**	**10,000.00**
EQUITY AND LIABILITIES		
EQUITY		
a) Initial Settlement Amount	4	10,000.00
b) Equity Unit capital		-
c) Other Equity	5	(67,90,202.00)
	C	**(67,80,202.00)**
LIABILITIES		
Non-current liabilities		
a) Financial liabilities		
i) Borrowings		-
ii) Other financial liabilities		-
b) Provisions		-
c) Other non-current liabilities		-
	D	-
Current liabilities		
a) Financial liabilities		-
i) Borrowings		-
ii) Trade payables		-
iii) Other financial liabilities	6	67,83,699.00
b) Other current liabilities	7	6,503.00
c) Provisions		-
d) Current tax liabilities (net)		-
	E	**67,90,202.00**
TOTAL EQUITY AND LIABILITIES	**(C+D+E)**	**10,000.00**
Notes forming Part of Financial Statements	1 to 8	

For A. R. & Co.
Chartered Accountants
FRN :- 002744C

For and on behalf of NATIONAL HIGHWAYS INFRA TRUST
By its Investment Manager,
National Highways Infra Investment Managers Private Limited

CA Aakansha Nigam
Partner
M. No. 416425

Suresh Krishan Goyal
Director
DIN:- 02721580

Alok
Director
DIN:- 02600247

Mathew George
Chief Financial Officer

Gunjan Singh
Company Secretary

Place: New Delhi
Date: Aug 18, 2021

NATIONAL HIGHWAYS INFRA TRUST
Regd. Off.: - G-5 & 6, Sector -10, Dwarka, Delhi - 110075
Standalone Statement of Profit and Loss Account for the period ended on March 31, 2021

Particulars	Note No.	For the period ended on March 31, 2021
INCOME		
Revenue from operations		-
Other income		-
TOTAL REVENUE (I)		**-**
EXPENSES		
Finance costs		-
Investment Manager Fees		-
Annual Listing Fees		-
Trustee Fees		4,21,260.00
Other Expenses	8	63,68,942.00
TOTAL EXPENSES (II)		**67,90,202.00**
Profit/ (Loss) before tax (I - II)		**(67,90,202.00)**
Tax expense		
Current tax expense		-
Adjustment of tax relating to earlier periods		-
		-
Profit/(Loss) after tax for the period	A	**(67,90,202.00)**
Other Comprehensive Income		**-**
Items which will not be reclassified to profit & loss (net of tax)		-
Items which will be reclassified to profit & loss (net of tax)		-
Total Comprehensive Income (loss) for the period	B	**-**
Total	(A+B)	**(67,90,202.00)**

For A. R. & Co.
Chartered Accountants
FRN :- 002744C

For and on behalf of NATIONAL HIGHWAYS INFRA TRUST
By its Investment Manager,
National Highways Infra Investment Managers Private Limited

CA Aakansha Nigam
Partner
M. No. 416425

Suresh Krishan Goyal
Director
DIN:- 02721580

Alok
Director
DIN:- 02600247

Mathew George
Chief Financial Officer

Gunjan Singh
Company Secretary

Place: New Delhi
Date: Aug 18, 2021

NATIONAL HIGHWAYS INFRA TRUST
Regd. Off.: - G-5 & 6, Sector -10, Dwarka, Delhi - 110075
Standalone Statement of Cash flow for the period ended on March 31, 2021

Particulars	For the period ended on March 31, 2021
A. Cash flows from operating activities	
Net Profit/ (loss) before tax	(67,90,202.00)
Adjustments for:	
Depreciation expense	-
Interest expense	-
Interest income	-
Profit on sale of assets	-
Provision for Gratuity and Leave encashment	-
Capital work in progress written off	-
Provision for doubtful debts and advances	-
Liability no longer required written back	-
Operating profit/(loss) before working capital changes	**(67,90,202.00)**
Movements in working capital:	
(Increase) / Decrease in inventories	-
(Increase) / Decrease in trade receivables	-
(Increase) /Decrease in loans and advances and other financial assets	(10,000.00)
Receipts from/ (Repayments to) related party liabilities	-
Increase / (Decrease) in trade payables and liabilities	67,90,202.00
Cash generated from operations	**(10,000.00)**
Direct taxes paid (TDS receivable)	-
Net cash (used in)/generated from operating activities (A)	**(10,000.00)**
B. Cash flows from investing activities	
Sale /(Purchase) of tangible assets	-
Margin money (deposited) /matured	-
Interest received	-
Net cash (used in)/generated investing activities (B)	**-**
C. Cash flows from financing activities	
Receipt from Initial Settlement Amount	10,000.00
Net Proceeds from /(repayment) of long/short term borrowings	-
Interest paid	-
Net cash (used in)/generated from financing activities (C)	**10,000.00**
Net increase/(decrease) in cash and cash equivalents (A + B + C)	-
Cash and cash equivalents at the beginning of the period	-
Cash and cash equivalents at the end of the period	**-**

For A. R. & Co.
Chartered Accountants
FRN :- 002744C

For and on behalf of NATIONAL HIGHWAYS INFRA TRUST
By its Investment Manager,
National Highways Infra Investment Managers Private Limited

CA Aakansha Nigam
Partner
M. No. 416425

Suresh Krishan Goyal
Director
DIN:- 02721580

Alok
Director
DIN:- 02600247

Mathew George
Chief Financial Officer

Gunjan Singh
Company Secretary

Place: New Delhi
Date: Aug 18, 2021

NATIONAL HIGHWAYS INFRA TRUST

Notes forming part of the Financial Statements

1. Introduction

The Trust was settled by the Sponsor, National Highways Authority of India ("NHAI" or the "Sponsor"), an infrastructure development authority in India on 19.10.2020 as an irrevocable trust, pursuant to the Trust Deed, under the provisions of the Indian Trusts Act, 1882. The Trust was registered with SEBI on 28.10.2020 as an infrastructure investment trust under InvIT Regulations having registration number IN/InvIT/20-21/0014. The principal place of business of the Trust is situated at G - 5 & 6, Sector 10, Dwarka, New Delhi – 110 075.

The Trustee to the Fund is IDBI Trusteeship Services Limited (the "Trustee"). The Investment manager for the Trust is National Highways Infra Investment Managers Private Limited (the "Investment Manager"). The objectives of the Trust are to carry on the activity of and to make investments as an infrastructure investment trust as permissible in terms of the SEBI InvIT Regulations.

2. Significant Accounting Policies

2.1 Statement of Compliance

These Standalone financial statements of the Trust have been prepared in accordance with the accounting principles generally accepted in india, including Indian Accounting Standards (hereinafter referred to as the 'Ind AS') and other accounting principles generally accepted in india.

These Standalone Financial Statements comprise the Balance Sheet as on 31.03.2021, the statement of Profit & Loss for the year ended 31.03.2021, the Statement of Cash Flows for the year ended 31.03.2021, the statement of changes in equity for the year ended 31.03.2021 and notes to Accounts and other explanatory information.

2.2 Basis of Preparation

These financial Statements have been prepared on accrual basis and under the historical cost basis. The trust has determined its operating cycle as 12 months for the purpose of classification of its assets and liabilities as current and non-current.

2.3 Summary of Significant Accounting Policies

The financial statements have been prepared using the significant accounting policies and measurement basis summarized below:-

a) Current and Non-Current Classification

All assets and liabilities have been classified as current or non-current as per the normal operating cycle and other criteria set-out in Ind AS. Deferred tax assets and liabilities are classified as non-current assets and non-current liabilities, as the case may be.

b) Property, Plant and Equipment (PPE)

Property, Plant and Equipment is recognized when it is probable that future economic benefits associated with the item will flow to the trust and the cost can measured reliably. PPE is stated at original cost net of tax /duty credits availed, if any, less accumulated depreciation and cumulative impairment.

Property, Plant and Equipment not ready for the intended use on the date of the Balance Sheet are disclosed as "Capital work-in- progress". Depreciation on Property, Plant and Equipment have been provided on straight-line basis as per useful lives specified in the Schedule II of the Companies Act, 2013. Depreciation on additions / deductions is calculated pro-rata from / to the month of additions / deductions. The estimated residual value /scrap value of the project is estimated as 5% of the value of project. The Trust does not have any PPE as on 31.03.21.

c) Revenue Recognition

Revenue is recognised based on nature of activity when consideration can be reasonably measured and there exists reasonable certainty of its recovery. Revenue is measured at the fair value of the consideration received or receivable. The Trust has not started any activity yet and as on 31.03.21, the trust has nil income.

d) Taxes on Income

Current tax is determined on the basis of taxable income as per the provisions of Income Tax Act, 1961.

Deferred tax is recognised on temporary differences, being the differences between the tax bases of assets and liabilities and their carrying amount in the financial statements. As the Trust has nil income as on 31.03.21, there is no tax liability as on that date.

e) Financial Instruments

Financial assets and financial liabilities are recognized when the trust becomes a party to the contractual provisions of the instruments. Financial assets and financial liabilities are initially measured at fair value. Transaction costs that are directly attributable to the acquisition or issue of financial assets and financial

liabilities (other than financial assets and financial liabilities at fair value through profit or loss) are added to or deducted from the fair value of the financial assets or financial liabilities, as appropriate, on initial recognition.

f) Cash and Cash Equivalents

Cash and Cash Equivalents in the balance sheet comprise cash in hand and at banks and short term deposits with an original maturity of three months or less. For the purpose of the statement of cash flows, cash and cash equivalents consist of cash and short term deposits.

g) Related Party Disclosures as per Ind AS 23:-

i) List of Related Parties:-

1. **Parties to the Trust:-**
    - NHAI (Sponsor)
    - IDBI Trusteeship services Limited (Trustee)
        - **Directors** are :- (1) Padma Vinod Betai (2) Samuel Joseph Jebaraj (3) Ravishankar Gangadhar Shinde (4) Madhuri Jayant Kulkarni and (4) Satyajit Tripathy
    - National Highways Infra Investment Managers Private Limited (Investment Manager of Trust)
        - **Directors** are :- (1) Alok (2) Suresh Krishan Goyal (3) Balasubramanyam Sriram and (4) Mahavir Parsad Sharma (5) Amit Kumar Ghosh (6) Shailendra Roy
    - National Highways Infra Projects Private Limited (Project SPV)
        - **Directors** are :- (1) Akhilesh Kumar Srivastva (2) Muralidhara Rao Bugatha
    - National Highways Invit Project Managers Private Limited (Project Manager)
        - **Directors** are :- (1) Ashish Asati (2) Muralidhara Rao Bugatha
2. **Promoters of Parties to the the Trust**
        - **NHAI -** Government of India

- **National Highways Infra Investment Managers Private Limited –** NHAI
- **National Highways Invit Project Managers Private Limited –** NHAI
- **National Highways Infra Projects Private Limited –** NHAI
- **IDBI Trusteeship services Limited –** IDBI Bank Ltd.

ii) Transaction with Related Parties

Particulars	(Amount)
i) Trustee Fee paid by NHAI to Trustee	Rs. 4,21,260/-
ii) Set up Expenses including Initial Settlement amount introduced by NHAI	Rs. 62,92,242/-

iii) Outstanding Balance Payable to Related Party

Particulars	(Amount)
i) Set Up Expenses including Trustee fee and initial Settlement Amount paid by NHAI on behalf of Trust	Rs. 67,13,502/-

For A. R. & Co.
Chartered Accountants
FRN:- 002744C

For and on behalf of National Highways Infra Trust
By its Investment Manager
National Highways Infra Investment Managers Pvt. Ltd.

CA Aakansha Nigam
Partner
M. No.416425

Suresh Krishan Goyal
Director
DIN:- 02721580

Alok
Director
DIN:- 02600247

Mathew George
Chief Financial Officer

Gunjan Singh
Company Secretary

Place:- New Delhi
Date :- 18.08.2021

NATIONAL HIGHWAYS INFRA TRUST
Regd. Off.: - G-5 & 6, Sector -10, Dwarka, Delhi - 110075
Notes Forming Part of Financial Statements

Statement of Changes in Unitholders Equity for the period ended March 31, 2021

Particulars	As at March 31, 2021
a) Initial Settlement Amount	
At the beginning of the period	-
Add:- Received during the period	10,000.00
At the end of the period	**10,000.00**
b) Unit Capital	
At the beginning of the period	-
Add:- Issued during the period	-
Less:- Capital Reduction during the period	-
At the end of the period	-
c) Other Equity	
Retained Earnings	
Profit/(Loss) for the period	**(67,90,202.00)**
At the end of the period	**(67,90,202.00)**

For A. R. & Co.
Chartered Accountants
FRN :- 002744C

For and on behalf of NATIONAL HIGHWAYS INFRA TRUST
By its Investment Manager,
National Highways Infra Investment Managers Private Limited

CA Aakansha Nigam
Partner
M. No. 416425

Suresh Krishan Goyal
Director
DIN:- 02721580

Alok
Director
DIN:- 02600247

Mathew George
Chief Financial Officer

Gunjan Singh
Company Secretary

Place: New Delhi
Date: Aug 18, 2021

NATIONAL HIGHWAYS INFRA TRUST
Regd. Off.: - G-5 & 6, Sector -10, Dwarka, Delhi - 110075
Notes Forming Part of Financial Statements

Note - 3 Other Financial Assets

Particulars	As at March 31, 2021
IDBI Trusteeship Services Limited	10,000.00
Total	**10,000.00**

Note - 4 Equity - Initial Settlement Amount

Particulars	As at March 31, 2021
Initial Settlement Amount	10,000.00
Total	**10,000.00**

Note - 5 Equity - Other Equity

Particulars	As at March 31, 2021
Retained Earnings	
Profit/Loss for the Period	(67,90,202.00)
Total	**(67,90,202.00)**

Note - 6 Other financial Liabilities

Particulars	As at March 31, 2021
Current	
Audit Fee Payable	80,197.00
NHAI (Sponsor)	67,03,502.00
Total	**67,83,699.00**

Note - 7 Other Current Liabilities

Particulars	As at March 31, 2021
Current	
TDS Payable	6,503.00
Total	**6,503.00**

Note - 8 Other Expenses

Particulars	For the Period Ended March 31, 2021
Application Fees	1,06,030.00
Auditor Fees	86,700.00
Professional Fee	51,76,200.00
SEBI Registration Fee	10,00,012.00
Total	**63,68,942.00**

ANNEXURE B

VALUATION REPORTS

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RBSA Valuation Advisors LLP
VALUATION | INVESTMENT BANKING | RESTRUCTURING | TRANSACTION SERVICES
TRANSACTION TAX | ADVISORY SERVICES

Report on Enterprise Valuation of Seven Road Projects proposed to be acquired by NHIT Eastern Projects Private Limited ("NEPPL") as of 31st December 2023

Head Office: 912, Venus Atlantis Corporate Park, Anandnagar Main Road, Prahaladnagar, Ahmedabad – 380015 Tel: +91 79 4050 6000
Corporate Office: 1121, Solitaire Corp. Park, Chakala, Andheri Kurla Road, Andheri (E), Mumbai - 400 093 Tel: +91 22 6130 6000

Private and Confidential

Report Ref No: RVA2324AMDREP081 09/02/2024

NHIT Eastern Projects Private Limited
G-5 & 6, Sector-10, Dwarka
Delhi 110075

Sub: Enterprise Valuation of Seven new Toll Road projects, pursuant to SEBI (Infrastructure Investment Trusts) Regulations, 2014, as amended.

Dear Sir,

We refer to our appointment letter dated 17th May 2023 wherein RBSA Valuation Advisors LLP ("RBSA" or "We" or "us") has been appointed by National Highways Infra Investment Managers Private Limited ("NHIIMPL"/ the "Investment Manager"), as an independent valuer, as per Regulation 2(zzf) of the SEBI (Infrastructure Investment Trust) Regulations, 2014 ("SEBI InvIT Regulations") and our subsequent discussions, for carrying out the Enterprise Valuation of Seven Toll Road projects (together referred to as the "Specified Projects") proposed to be acquired by NHIT Eastern Projects Private Limited ("NEPPL" or the "SPV").

NEPPL is a wholly owned subsidiary of National Highways Infra Trust ("NHIT" or the "Trust" or "InvIT") and is incorporated as a special purpose vehicle to operate and maintain the road projects. NHIT is registered with the Securities and Exchange Board of India ("SEBI") as an infrastructure investment trust under the SEBI InvIT Regulations. NHIIMPL is acting as the Investment Manager to the Trust, NHAI is acting as the Sponsor to the Trust, and IDBI Trusteeship Services Limited ("Trustee") is acting as Trustee to the Trust, within the meaning of the SEBI InvIT Regulations.

NHIPPL has entered into concession agreements with the NHAI to operate, maintain and transfer the eight projects under the Toll, Operate and Transfer ("TOT") model.

NHAI aims to monetize the Specified Projects through the InvIT (Infrastructure Investment Trust) route. In this context, NHIIMPL is evaluating a proposal for acquisition of the Specified Projects for which NEPPL shall enter into concession agreements with NHAI ("Proposed Transaction"). The Specified Projects proposed to be acquired by NEPPL on a TOT basis are as follows:

1. Assam Package ("AS- Patgaon & Dahalapara")
2. Orai-Bara ("OB")
3. Assam ("Galia")
4. Chichra-Kharagpur ("ChK")
5. Rewa-Katni-Jabalpur-Lakhnadon ("RKJL")
6. Lakhnadon- Khawasa ("LK")
7. Hubbali- Haveri-Chitradurga ("HHC")

In connection with the Proposed Transaction, the Trust intends to undertake the Enterprise Valuation of the Specified Projects, as on 31st December 2023 ("Valuation Date") as per the SEBI InvIT Regulations. RBSA Valuation Advisors LLP has been appointed by the Investment Manager, as an independent valuer, as per Regulation 2(zzf) of the SEBI InvIT Regulations, for the purpose of carrying out the Valuation of the Specified Projects.

We have analyzed the information provided by/ on behalf of the Investment Manager through broad inquiry, analysis and review but have not carried out a due diligence or audit of such information. We have relied on the explanations and information provided by/ on behalf of the Investment Manager. We have no present or planned future interest in the Sponsor, NEPPL or the Investment Manager except to the extent of our appointment as an independent valuer. Our professional fees for the valuation are not contingent upon the values reported herein. Our valuation analysis should not be construed as an investment advice specifically, we do not express any opinion on the suitability or otherwise of entering into any financial or other transaction with the Trust.

We enclose our valuation report (the "Report") providing our opinion on the fair enterprise valuation of the Specified Projects as of 31st December 2023 ("Valuation Date"), on a 'going concern value' premise. The attached Report details the valuation approach and methodologies, calculations, and conclusions with respect to this valuation.

Our valuation analysis must be considered as a whole. Selecting portions of our analysis or the factors we considered, without considering all factors and analysis together could create a misleading view of the process underlying the valuation conclusions. Valuation is a complex process and is not necessarily susceptible to partial analysis or summary description. Any attempt to do so could lead to undue emphasis on any particular factor or analysis.

Our valuation conclusion included herein, and Report complies with the SEBI InvIT Regulations and guidelines, circular or notification issued by SEBI there under.

Please note that the Report must be read in conjunction with the Assumptions and Limiting Conditions, which are contained in Section 3 of this Report. This letter, the Report and the summary of valuation included herein may be provided to the Trust's advisors, the Securities and Exchange Board of India and other regulatory and supervisory authority, as may be required under the applicable regulations in connection with the Transaction and can be reproduced and included in the draft placement memorandum and final placement memorandum proposed to be filed in connection with offering of the units of the Trust.

This letter should be read in conjunction with the attached Report.

For **RBSA Valuation Advisors LLP,**
(RVE No.: IBBI/RV-E/05/2019/110)

Name: Ravishu Vinod Shah
Designation: Partner
Asset Class: Securities or Financial Assets (RV No.: IBBI/RV/06/2020/12728)
Date:09/02/2024
Place: Mumbai

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Appendix 11 – Hubli- Haveri Chitradurga (HHC) (Karnataka): Latest Pictures of the project along with date of physical inspection 61

1. Executive Summary

National Highway Authority of India ("NHAI") was set up by an act of the Indian Parliament, NHAI Act, 1988. NHAI was set up with the primary objective of facilitating development, maintenance and Management of national highways in India. NHAI has been entrusted with National Highways Development Project, along with other minor projects.

National Highways Infra Trust ("NHIT" or the "Trust" or "InvIT") is registered with the Securities and Exchange Board of India ("SEBI") as an infrastructure investment trust under the SEBI InvIT Regulations. National Highways Infra Investment Managers Private Limited ("NHIIMPL" or the "Investment Manager") is acting as Investment Manager to the Trust, National Highway Authority of India ("NHAI" or "Sponsor") is acting as Sponsor to the Trust and IDBI Trusteeship Services Limited ("Trustee") is acting as the Trustee to the Trust, within the meaning of the SEBI InvIT Regulations.

NHIT Eastern Projects Private Limited ("NEPPL" or the "SPV") is a wholly owned subsidiary of NHIT and is incorporated as a special purpose vehicle to operate and maintain the road projects. NHIPPL has entered into concession agreements with NHAI to operate, maintain and transfer the eight projects under the Toll, Operate and Transfer ("TOT") model. NHAI aims to monetize the additional Seven Toll road projects (together referred to as the "Specified Projects") through the InvIT (Infrastructure Investment Trust) route. In this context, NHIIMPL is evaluating a proposal for acquisition of the Specified Projects for which NEPPL shall enter into concession agreements with NHAI ("Proposed Transaction").

In this context, the Trust intends to undertake the Enterprise Valuation of the Specified Projects, as on 31st December 2023 as per the SEBI InvIT Regulations.

In connection with the Proposed Transaction, RBSA Valuation Advisors LLP has been appointed by the Investment Manager, as an independent valuer, as per Regulation 2(zzf) of the SEBI InvIT Regulations, for the purpose of carrying out the Valuation of the Specified Projects.

The Specified Projects proposed to be acquired by NEPPL on a TOT basis are as follows:

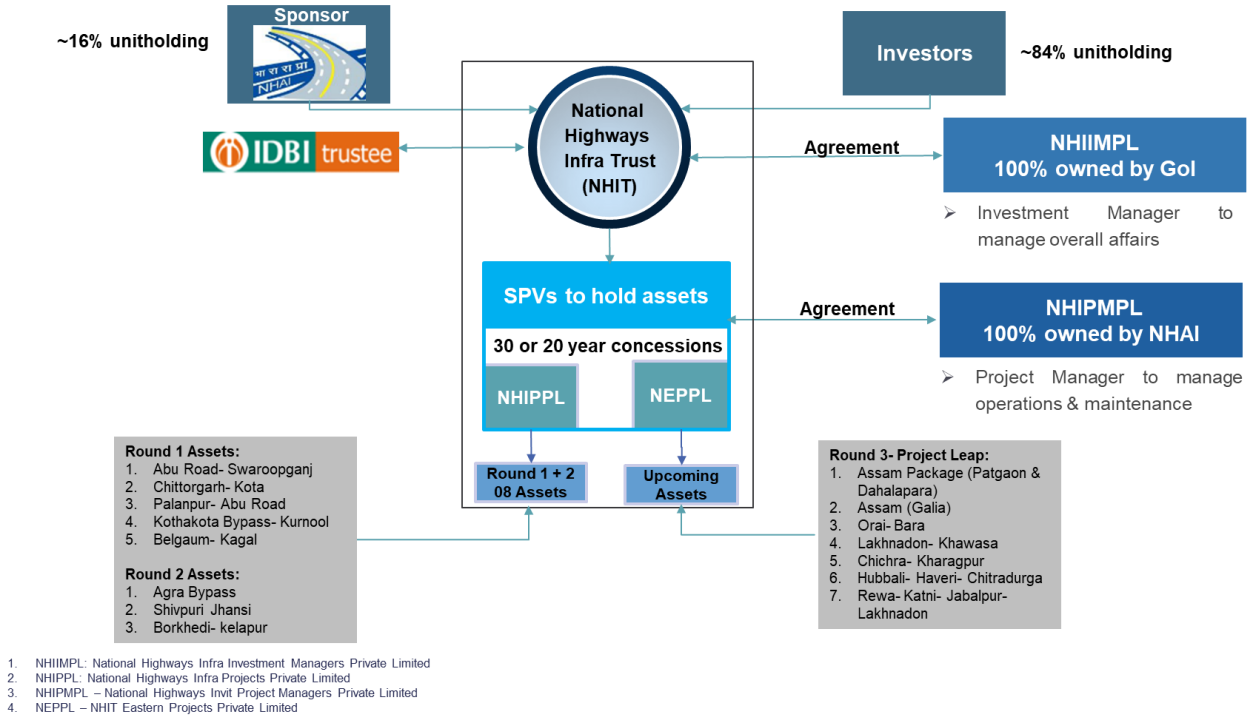
Sr. No.	Name of Section	NH	Total Length (Kms)	Toll Plaza	Start Kms	End Kms
1	Assam Package (AS- Patgaon & Dahalapara)	NH-27	114	Dahalapara	961.500 KM of NH-27	1013.000 KM of NH-27
				Patgaon	30.000 KM of NH-27	92.671 KM of NH-27

Sr. No.	Name of Section	NH	Total Length (Kms)	Toll Plaza	Start Kms	End Kms
2	Orai-Bara (OB)	NH-27	63	Usaka	1515.713 KM of NH-27 (LHS) and 1578.360 KM of NH-27 (RHS)	1578.872 KM of NH-27 (LHS) and 1515.713 KM of NH-27 (RHS)
3	Assam (Galia)	NH-27	27	Galia	1013+000 KM of NH-27	1040+000 KM of NH-27
4	Chichra-Kharagpur (ChK)	NH-49	56	Balibhasha	185.150 KM of NH-49	129.000 KM of NH-49
5	Rewa-Katni-Jabalpur-Lakhnadon (RKJL)	NH-30 & NH-34	287*	Odhaki Paipkhar	656.000 KM of NH-30	725.185 KM of NH-30
				Kherwasani	725.185 KM of NH-30	813.257 KM of NH-30
				Mohtara	813.257 KM of NH-30	880.600 KM of NH-30
				Boharipar	880.600 KM of NH-30	1427.557 KM of NH-34
6	Lakhnadon-Khawasa (LK)	NH-44	107	Madai	546+420 KM of NH-44	610.400 KM of NH-44
				Khawasa	610.400 KM of NH-44	610.400 KM of NH-44
7	Hubbali- Haveri-Chitradurga (HHC)	NH-48	214	Bankapur	403.400 KM of NH- 48	340.00 KM of NH- 48
				Chalageri	340.00 KM of NH- 48	260.00 KM of NH- 48
				Hebbalu	260.00 KM of NH- 48	189.00 KM of NH- 48

**Excluding Katni Bypass Length of ~20 km*

Source: Information provided by the Management

National Highways Infra Trust Structure



1. NHIIMPL: National Highways Infra Investment Managers Private Limited
2. NHIPPL: National Highways Infra Projects Private Limited
3. NHIPMPL – National Highways Invit Project Managers Private Limited
4. NEPPL – NHIT Eastern Projects Private Limited

NHIPPL - National Highways Infra Projects Private Limited, NHIIMPL - National Highways Infra Investment Managers Private Limited, NHIPMPL - National Highways InvIT Project Managers Private Limited, NEPPL - NHIT Eastern Projects Private Limited

Valuation Analysis

The Discounted Cash Flow ("DCF") method under the Income Approach has been adopted for the Enterprise Valuation of the Specified Projects. Free Cash Flow to Firm method under DCF has been applied based on the projected financials of the Specified Projects provided by the management of NHIIMPL (the "Management"). The Enterprise Value of the Specified Projects is estimated on a 'going concern value' premise and is based on an appropriate WACC as at 31 December 2023.

We understand from the Management that the consideration for the acquisition of concession rights for the Specified Projects is expected to be paid simultaneously with the commencement of their concession agreement (expected to begin from 1st April 2024). Accordingly, the Enterprise Value of the Specified Projects have been computed by discounting the free cash flows to the firm as of 1st April 2024.

The Investment Manager has appointed independent consultants to carry out Traffic study and estimation of toll revenue and Technical study for estimation of operating and maintenance expenses and major maintenance expenses, for each of the Specified Projects over the proposed concession period. We have relied upon the Traffic Study Reports and Technical Due Diligence Reports provided by independent consultants on the Specified Projects for the Enterprise Valuation.

Valuation of a company/ business is not a precise science and the conclusions arrived at in many cases will be subjective and dependent on the exercise of individual judgment. There is, therefore, no indisputable single value and we normally express our opinion on the value as falling within a likely range. However, considering the nature of the engagement, we have provided a single point value estimate. While we have provided our opinion on the enterprise value of the Specified Projects based on the information made available to us and within the scope and constraints of our engagement, others may have a different opinion. Accordingly, we expressly disclaim all liability for any loss or damage of whatever kind which may arise from any person acting on any information and estimates contained in this Report which are contrary to the stated purpose.

While our work has involved an analysis of financial and other information provided by/ on behalf of the Management, our engagement does not include an audit in accordance with generally accepted auditing standards of the Specified Projects' existing business records. We have not carried out any independent technical evaluation or appraisal or due diligence of the assets or liabilities of the Specified Projects. Accordingly, we assume no responsibility and make no representations with respect to the accuracy or completeness of any information provided by/ on behalf of the Management. Our Report is subject to the scope, assumptions and limitations detailed hereinafter. As such the Report is to be read in totality, and not in parts, in conjunction with the relevant documents referred to herein and in the context of the purpose for which it is made.

Enterprise Valuation of the Specified Projects as of 31st December 2023 ("Valuation Date"), has been carried out considering inter-alia Traffic Study Reports and Technical Due Diligence Reports of independent consultants, Business plan/ Projected financial statements of the Specified Projects and other information provided by/ on behalf of the Management, industry analysis and other relevant factors.

The Valuation summary of the Specified Projects as of 31st December 2023, is as follows:

Particulars	WACC	Enterprise Value* (INR Cr)
Assam Package (AS- Patgaon & Dahalapara)	10.40%	1,397.9
Orai-Bara (OB)		1,706.0
Assam (Galia)		234.5
Chichra-Kharagpur (ChK)		1,276.1
Rewa-Katni-Jabalpur-Lakhnadon (RKJL)		3,516.1
Lakhnadon- Khawasa (LK)		2,552.6
Hubbali- Haveri-Chitradurga (HHC)		4,941.8
Total	**10.40%**	**15,624.9***

Note: The Enterprise Value of respective Specified Projects has been estimated considering *inter-alia* apportionment of common expenses to the Specified Projects and may not be representative of the Enterprise Value of each Specified Project on a 'standalone' basis.

** Represents value of Concession Rights, without deducting IM expenses. For details, refer Section 8.1*

2. Engagement Overview

- National Highway Authority of India was set up by an act of the Indian Parliament, NHAI Act, 1988. NHAI was set up with the primary objective of facilitating development, maintenance and Management of national highways in India. NHAI has been entrusted with National Highways Development Project, along with other minor projects.

- National Highways Infra Trust ("NHIT" or the "Trust" or "InvIT") is registered with the Securities and Exchange Board of India ("SEBI") as an infrastructure investment trust under the SEBI InvIT Regulations. National Highways Infra Investment Managers Private Limited ("NHIIMPL" or the "Investment Manager") is acting as Investment Manager to the Trust, National Highway Authority of India ("NHAI" or "Sponsor") is acting as Sponsor to the Trust and IDBI Trusteeship Services Limited ("Trustee") is acting as the Trustee to the Trust, within the meaning of the SEBI InvIT Regulations.

- NHIT Eastern Projects Private Limited ("NEPPL" or "SPV") is a wholly owned subsidiary of NHIT to operate and maintain the road projects. NHIPPL has entered into concession agreements with NHAI to operate, maintain and transfer the eight projects under the Toll, Operate and Transfer ("TOT") model. NHAI aims to monetize the additional Seven Toll road projects (together referred to as the "Specified Projects") through the InvIT (Infrastructure Investment Trust) route. In this context, NHIIMPL is evaluating a proposal for acquisition of the Specified Projects for which NEPPL shall enter into concession agreements with NHAI ("Proposed Transaction").

- The Trust intends to undertake the Enterprise Valuation of the Specified Projects, as on 31st December 2023 as per the SEBI InvIT Regulations.

- In connection with the Proposed Transaction, RBSA Valuation Advisors LLP has been appointed by the Investment Manager, as an independent valuer, as per Regulation 2(zzf) of the SEBI InvIT Regulations, for the purpose of carrying out the Valuation of the Specified Projects.

- The Specified Projects proposed to be acquired by NEPPL on a TOT basis are as follows:

Sr. No.	Name of Section	NH	Total Length (Kms)	Toll Plaza	Start Kms	End Kms
1	Assam Package (AS- Patgaon & Dahalapara)	NH-27	114	Dahalapara	961.500 KM of NH-27	1013.000 KM of NH-27
				Patgaon	30.000 KM of NH-27	92.671 KM of NH-27

Sr. No.	Name of Section	NH	Total Length (Kms)	Toll Plaza	Start Kms	End Kms
2	Orai-Bara (OB)	NH-27	63	Usaka	1515.713 KM of NH-27 (LHS) and 1578.360 KM of NH-27 (RHS)	1578.872 KM of NH-27 (LHS) and 1515.713 KM of NH-27 (RHS)
3	Assam (Galia)	NH-27	27	Galia	1013+000 KM of NH-27	1040+000 KM of NH-27
4	Chichra-Kharagpur (ChK)	NH-49	56	Balibhasha	185.150 KM of NH-49	129.000 KM of NH-49
5	Rewa-Katni-Jabalpur-Lakhnadon (RKJL)	NH-30 & NH-34	287*	Odhaki Paipkhar	656.000 KM of NH-30	725.185 KM of NH-30
				Kherwasani	725.185 KM of NH-30	813.257 KM of NH-30
				Mohtara	813.257 KM of NH-30	880.600 KM of NH-30
				Boharipar	880.600 KM of NH-30	1427.557 KM of NH-34
6	Lakhnadon-Khawasa (LK)	NH-44	107	Madai	546+420 KM of NH-44	610.400 KM of NH-44
				Khawasa	610.400 KM of NH-44	610.400 KM of NH-44
7	Hubbali- Haveri-Chitradurga (HHC)	NH-48	214	Bankapur	403.400 KM of NH- 48	340.00 KM of NH- 48
				Chalageri	340.00 KM of NH- 48	260.00 KM of NH- 48
				Hebbalu	260.00 KM of NH- 48	189.00 KM of NH- 48

Source: Information provided by the Management

- RBSA Valuation Advisors LLP is a registered valuer entity under the Section 247 of the Companies Act, 2013 registered with the Insolvency and Bankruptcy Board of India having Registered Valuer Entity No. IBBI/RV-E/05/2019/110.

- We declare that:
  - We are competent to undertake the financial valuation in terms of the SEBI InvIT Regulations;
  - We are an independent registered valuer entity and have prepared the Report on a fair and unbiased basis; and
  - We have at least two partners/ directors having experience of 5 years each in the valuation of infrastructure assets.

- The Valuation Date considered for the Enterprise Valuation of the Specified Projects is 31st December 2023. Valuation analysis and results are specific to the Valuation date. A valuation of this nature involves consideration of various factors including the operational and financial performance and position of the Specified Projects as at the Valuation Date, trends in the equity stock market and fixed income security market, macro-economic and industry trends, etc.

- We have carried out additional scope of work as per schedule V of SEBI InvIT Regulations (Refer para 8.2 for further details).

- This Report covers all the disclosures required as per the SEBI InvIT Regulations and the Valuation of the Specified Projects is impartial, true and fair and in compliance with the SEBI InvIT Regulations.

3. Assumptions and Limiting Conditions

3.1. This Report, its contents and the results herein are specific to (i) the purpose of valuation agreed as per the terms of our engagement; (ii) the date of this Report; (iii) Traffic Study Reports and Technical Due Diligence Reports for the Specified Projects by independent consultants, and (iv) Business plan/ Projected financial statements of the Specified Projects and other information provided by/ on behalf of the Management and information obtained from public domain/ subscribed databases till 1st February 2024.

3.2. While our work has involved an analysis of financial and other information provided by/ on behalf of the Management, our engagement does not include an audit in accordance with generally accepted auditing standards of the Specified Projects' existing business records. We have not carried out any independent technical evaluation or appraisal or due diligence of the assets or liabilities of the Specified Projects. Accordingly, we assume no responsibility and make no representations with respect to the accuracy or completeness of any information provided by/ on behalf of the Management. Our Report is subject to the Scope, Assumptions and Limitations detailed hereinafter. As such the Report is to be read in totality, and not in parts, in conjunction with the relevant documents referred to herein and in the context of the purpose for which it is made.

3.3. The valuation of companies and businesses is not a precise science and the conclusions arrived at in many cases will be subjective and dependent on the exercise of individual judgment. There is, therefore, no indisputable single value and we normally express our opinion on the value as falling within a likely range, considering the purpose and requirement of this engagement, we have provided a single value. While we have provided our opinion on the fair value of the Specified Projects based on the information made available to us and within the scope and constraints of our engagement, others may have a different opinion.

3.4. A valuation of this nature is necessarily based on stock market, financial, economic and other conditions in general and industry trends in particular prevailing as on the Valuation Date and the information made available to us as of the date hereof. Events occurring after the Valuation date may affect this Report and the assumptions used in preparing it, and we do not assume any obligation to update, revise or reaffirm this Report.

3.5. In the course of valuation, we were provided with both written and verbal information as mentioned in the Section 4. We have analysed the information provided to us by/ on behalf of the Management through broad inquiry, analysis and review but have not carried out a due diligence or audit of the information provided for the purpose of this engagement. We have assumed that no information has been withheld that could have influenced the purpose of our Report.

3.6. Valuation may be based on estimates of future financial performance or opinions that represent reasonable expectations at a particular point in time. However, we do not provide assurance on the achievability of the results projected by the Management as events and circumstances do not occur

as expected and differences between actual and expected results may be material. We express no opinion as to how closely the actual results will correspond to those projected as the achievement of the projected results is inter-alia dependent on actions, plans and assumptions of the Management and macro-economic and other external factors which are beyond the control of the Management.

3.7. Our valuation is primarily from a business perspective and does not take into account various legal and other corporate structures beyond the limited information provided to us by the Investment Manager. The value conclusion is not intended to represent the value at any time other than the Valuation Date that is specifically stated in the Report.

3.8. We have also relied on the data from external sources to conclude the valuation. These sources are believed to be reliable and therefore, we assume no liability for the truth or accuracy of any data, opinions or estimates furnished by others that have been used in this analysis. Where we have relied on data, opinions or estimates from external sources, reasonable care has been taken to ensure that such data has been correctly extracted from those sources and/ or reproduced in its proper form and context.

3.9. The actual price achieved in case of a transaction may be higher or lower than our estimate of value depending upon the circumstances and timing of the transaction, the nature of the business and other relevant factors. The knowledge, negotiating ability and motivation of the buyers and sellers and the applicability of a discount or premium for control will also affect actual market price achieved. Accordingly, our valuation conclusion will not necessarily be the price at which any agreement proceeds. The final transaction price is something on which the parties themselves have to agree considering *inter-alia* their own assessment of the Transaction and inputs from other advisors.

3.10. This Report has been prepared for the sole use by the Investment Manager / Trust / Sponsor/ SPV in connection with the purpose stated herein. It is inappropriate to use this Report for any purpose other than the purpose mentioned herein. This restriction does not preclude the Investment Manager from providing a copy of the Report to its third-party advisors whose review would be consistent with the intended use. Our Report may be disclosed in connection with any statutory and regulatory filing in connection with the Transaction and in accordance with the provision of SEBI InvIT Regulations. Further, the Report and summary of valuation included herein can be reproduced and included in the Draft placement memorandum and final placement memorandum, which may be filed with the SEBI. We shall not assume any responsibility to any third party to whom the Report is disclosed or otherwise made available.

3.11. The Report assumes that the Specified Projects comply fully with relevant laws and regulations applicable in its area of operations and usage unless otherwise stated, and that they will be managed in a competent and responsible manner. Further, unless specifically stated to the contrary, this Report has given no consideration to matters of a legal nature, including issues of legal title and compliance with local laws, and litigations and other contingent liabilities that are not recorded/ reflected in the financial statements provided to us.

3.12. It is clarified that this Report is not a fairness opinion under any of the stock exchange/ listing regulations. In case of any third-party having access to this Report, it should be noted that the Report is not a substitute for the third party's own due diligence/ appraisal/ enquiries/ independent advice that the third party should undertake for his purpose.

3.13. In the particular circumstances of this case, our liability (in contract or under statute or otherwise) for any economic loss or damage arising out of or in connection with this engagement, irrespective of the quantum of loss or damage caused, shall be limited to the amount of fees actually received by us from the Investment Manager, as laid out in the engagement letter, for such valuation work.

3.14. In rendering this Report, we have not provided any legal, regulatory, tax, accounting or actuarial advice and accordingly we do not assume any responsibility or liability in respect thereof.

3.15. This Report does not look into the business/ commercial reasons behind the Proposed Transaction nor the likely benefits arising out of the same. Similarly, it does not address the relative merits of investing in an infrastructure trust as compared with any other alternative business transaction, or other alternatives, or whether or not such alternatives could be achieved or are available.

3.16. We are not advisors with respect to legal tax and regulatory matters for the Proposed Transaction. No investigation of the Specified Projects' claim to title of assets has been made for the purpose of this Report and the Specified Projects' claim to such rights have been assumed to be valid. No consideration has been given to liens or encumbrances against the assets, beyond the loans is closed in the accounts. Therefore, no responsibility is assumed for matters of a legal nature.

3.17. The scope of work has been limited both in terms of the areas of the business and operations which have been reviewed. There may be matters, other than those noted in this report, which might be relevant in the context of the transaction and which a wider scope might uncover.

3.18. The outbreak of the Novel Coronavirus ("COVID-19"), declared by the World Health Organization as a "Global Pandemic" on 11th March 2020 and second wave of the same in April 2021, has adversely affected the Global and Indian economy. The third wave on account of Omicron hit India in January 2022. Travel restrictions implemented by many countries has affected the economic activities. Governments have announced various measures to combat COVID 19 pandemic and to support the economic and business activities. Though economic recovery is being witnessed in India coupled with the Government's vaccination efforts and fall in covid cases, with many countries declaring the same as common flu. There are still higher uncertainties in the near to medium term. Considering the unprecedented set of circumstances, Value analysis is reported on the basis of 'material valuation uncertainty' and accordingly less certainty and a higher degree of caution should be attached to the Value Analysis than would normally be the case. It may be noted that the estimated value may change significantly and unexpectedly over a relatively short period of time based on the evolving conditions/ uncertainties on account of COVID 19 pandemic.

3.19. RBSA is not aware of any contingent, commitment or material issue, besides the information disclosed and additionally provided by the Investment Manager / Management which has been presented in this Report, which could materially affect the Specified Projects' economic environment and future performance and therefore, their fair value.

3.20. We have no present or planned future interest in the Trustee, Investment Manager, the Sponsor or the SPV and the fee for this Report is not contingent upon the values reported herein. Our valuation analysis should not be construed as investment advice; specifically, we do not express any opinion on the suitability or otherwise of entering into any financial or other transaction.

3.21. We have relied upon the representations of the Management in respect of the information provided by them. We shall not be liable for any loss, damages, cost or expenses arising from fraudulent acts, misrepresentations, or willful default on part of the Investment Manager, the SPV, their directors, employee or agents.

- **Limitation of Liabilities**
  - It is agreed that, having regard to RBSA's interest in limiting the personal liability and exposure to litigation of its personnel, the Investment Manager, the Sponsor, the Trust or the Trustee will not bring any claim in respect of any damage against any of RBSA's personnel.
  - In no circumstances, RBSA shall be responsible for any consequential, special, direct, indirect, punitive or incidental loss, damages or expenses (including loss of profits, data, business, opportunity cost, goodwill or indemnification) in connection with the performance of the Services whether such damages are based on breach of contract, tort, strict liability, breach of warranty, negligence, or otherwise) even if the Investment Manager had contemplated and communicated to RBSA the likelihood of such damages. Any decision to act upon the Report is to be made by the Investment Manager and no communication by RBSA should be treated as an invitation or inducement to engage the Investment Manager to act upon the Report.
  - In the particular circumstances of this case, our liability (in contract or under statute or otherwise) for any loss or damage caused, shall be limited to the amount of fees actually received by us, as laid out in the engagement letter, for such valuation work.
  - It is clarified that the Sponsor and the Trust will be solely responsible for any delays, additional costs, or other liabilities caused by or associated with any deficiencies in their responsibilities, misrepresentations, incorrect and incomplete information including information provided to determine the assumptions.
  - RBSA will not be liable if any loss arises due to the provision of false, misleading or incomplete information or documentation by the Investment Manager, the Sponsor, the Trust or the Trustee.

4. Sources of Information

For the purpose of undertaking this valuation exercise, we have relied on the following sources of information provided by/ on behalf of the Management:

- Draft Concession Agreements for the Seven projects between the SPV and NHAI for the Specified Projects;
- Reports of independent consultants appointed by the Investment Manager for Traffic study and estimation of toll revenue for the duration of the concession period for each of the Specified Projects (together referred to as the "Traffic Study Reports");
- Reports of independent consultants appointed by the Investment Manager for Technical Due Diligence study for estimation of operating and maintenance expenses and major maintenance expenses for the duration of the concession period for each of the Specified Projects (together referred to as the "Technical Reports");
- Projected financial statements of the Specified Projects for the concession period from 1st April 2024 to the end of the proposed concession period of the Specified Projects which the Management expects to be their best estimate of the expected performance of the Specified Projects ("Management Projections");
- Discussions with the Management to inter-alia understand expected future performance of the Specified Projects, key value drivers and other factors affecting the business of the Specified Projects;
- Management representation letter with respect to mandatory disclosures required by SEBI; and
- Capital IQ's database of publicly traded companies.

We have also obtained the explanations, information and representations, which we believed were reasonably necessary and relevant for our exercise from the Management.

5. Procedures

We have carried out the Enterprise Valuation of the Specified Projects, to the extent applicable, in accordance with ICAI Valuation Standards, 2018 ("ICAI VS") issued by the Institute of Chartered Accountants of India.

We have adopted the following procedures for carrying out the valuation analysis:

- Considered the key terms of Draft Concession Agreements;
- Analysis of the Management Projections;
- Considered the Traffic Study Reports and Technical Reports;
- Analysis of the key economic and industry factors which may affect the valuation of the Specified Projects;
- Analysis of the information available in public domain/ subscribed databases in respect of the comparable companies/ comparable transactions, as considered relevant by us;
- Selection of valuation approach and valuation methodology/(ies), in accordance with ICAI VS, as considered appropriate and relevant by us;
- Analysis of other publicly available information, as considered relevant by us; and
- Determination of Enterprise Value of the Specified Projects.

6. Industry Overview

Road Infrastructure in India

- India has the second largest road network in the world, spanning a total of ~ 6.23 million kilometers ("kms"). This comprises National Highways, Expressways, State Highways, Major District Roads, Other District Roads and Village Roads as under:

Particulars	In kms	% share
National Highways	144,634	2%
State Highways	186,908	3%
Other Roads	5,902,539	95%
Total	6,234,081	

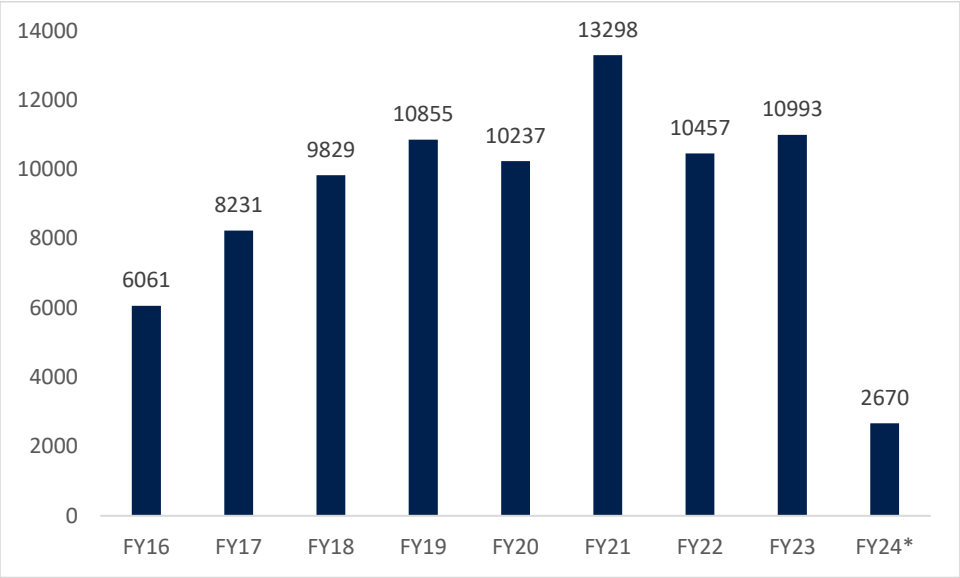
Source: IBEF August 2023 Report

- This road network transports ~64.5 per cent of all goods in the country and ~90 per cent of India's total passenger traffic uses road network to commute. Road transportation has gradually increased over the years with improvement in connectivity between cities, towns, and villages in the country.

Strong momentum in expansion of roadways

- In FY24 (until July), cumulatively, 2,670 km of National Highways have been constructed and has been 1,125 km awarded.
- In FY23, the Ministry of Road Transport and Highways constructed national highways extending ~10,993 kms. In FY 22 the same was ~10,457 kms.
- To transform road infrastructure in Punjab, Haryana and Rajasthan, the Indian government has planned to construct roads for INR 11,000 crore (US$ 1.48 billion).
- The Ministry of Road Transport & Highways extended certain relief measures provided earlier in view of the second COVID-19 wave. The central government sanctioned >INR 600 crore (US$ 81 million), of the Central Road and Infrastructure Fund ("CRIF"), for construction of 42 roads and bridges in Uttarakhand.
- Odisha has completed 62,192 kms of roads under the Pradhan Mantri Gram Sadak Yojana ("PMGSY") programme, making it one of the highest performing states in construction of rural roads.
- GOI aims to construct ~25,000 km of National Highways in FY2022-23 at record speed of ~50km per day.

Highway Construction in India (Kms)



Source: IBEF August 2023 Report

Growth Drivers

Growing Demand
- Rise in two and four wheeler population
- Increasing freight traffic
- Strong trade and tourist flows between states

Policy Support
- Greater Government focus on infrastructure
- Standardised processes for bidding and tolling and clear policy framework
- Tax SOPS, FDI,FII Encouragement

Increasing Investment
- In the Union Budget 2023-24, INR 2.7 Lakh Crore was allocated to MorTH.
- 100% rebate on income tax for 10 consecutive years, out of the first 20 years of a project Under Section 80 IA.
- Private Sector invested US$ 1.98 billion in FY 22
- NHAI is permitted to participate with up to 30% of the equity component in BOT projects.
- NHAI bonds have been exempted from Capital gains tax.

Source: IBEF August 2023 Report & Union Budget 2023-24

Future Growth prospects

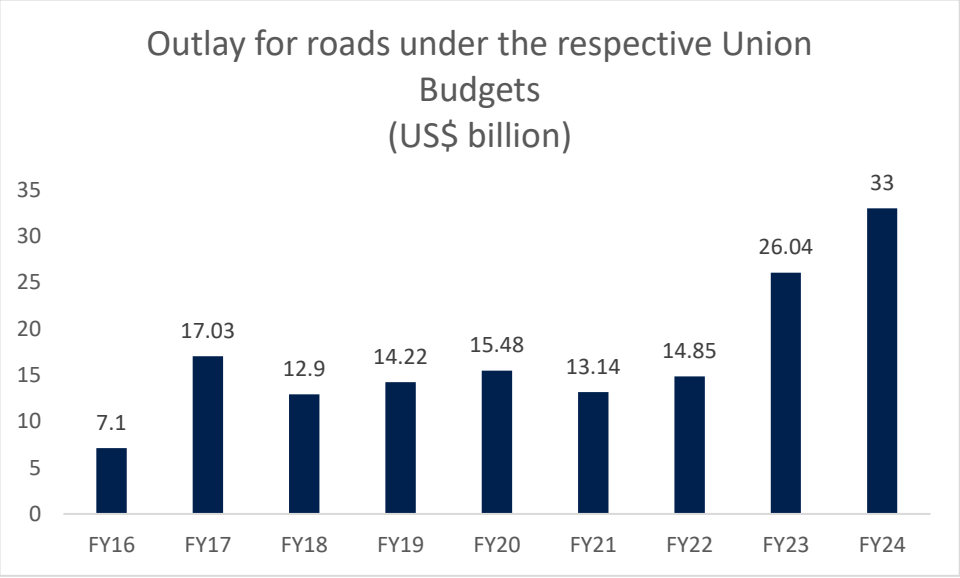
- Mr. Nitin Gadkari, the Union Minister for Road Transport and Highways, informed that under "Parvatmala Pariyojana", the Government of India plans to develop 250+ projects with a Ropeway length of 1,200+ km over five years.
- A total of 600+ sites are planned to be awarded by 2024-25 of which 144 Wayside Amenities (WSAs) have already been awarded.
- In December 2021, the government set a highway monetization target of INR 2 trillion (US$ 26.20 billion) for the next 3 years.

- In October 2021, the Indian government announced five road projects in Ladakh, measuring 255 kms in length, to boost connectivity in the region.
- In August 2021, Union Minister of Road Transport and Highways, Mr. Nitin Gadkari, announced to launch 1,080-km (road construction) projects worth INR 25,370 crore (US$ 3.4 billion) under the Bharatmala Pariyojana—the ambitious road and highways project that aims to build highways from Maharashtra, Gujarat, Rajasthan, Punjab, Haryana and then cover the entire string of Himalayan territories.

- In 2018, the Indian government announced its plan to construct the Delhi-Mumbai Express Highway (extending 1,380 kms), to improve connectivity from Delhi to Mumbai, covering states such as Haryana, Rajasthan, Gujarat and Madhya Pradesh. As of September 2021, contracts for >1,200 kms have been awarded. The estimated cost to construct the Delhi-Mumbai Express Highway is INR 98,000 crore (US$ 13.08 billion).
- NHAI is planning to raise Rs 40,000 crore (US$ 5.72 billion) to monetize its highway assets through Infrastructure Investment Trust.

Highlights of Union Budget 2023-24

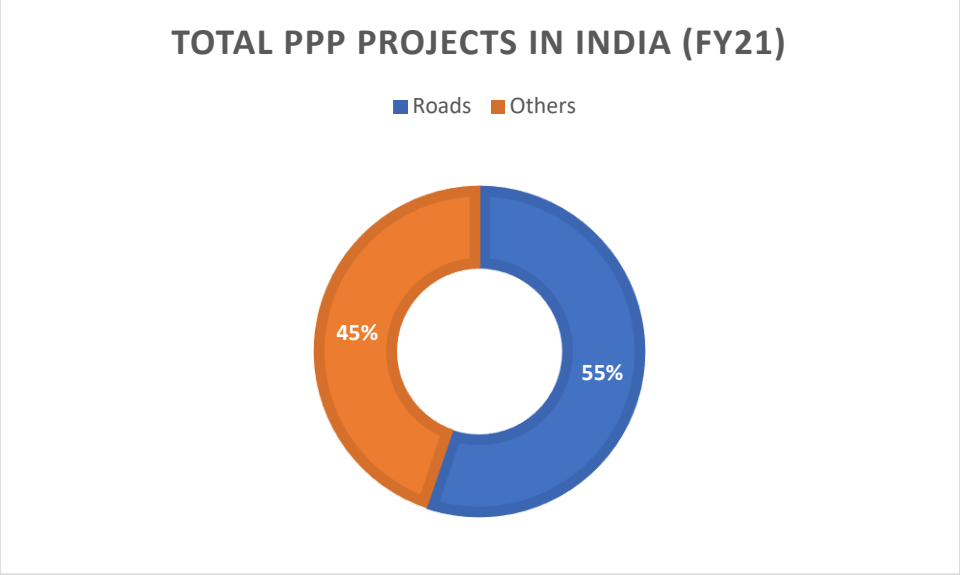
- The Government has allocated INR 2.7 lakh crore for Ministry of Road Transport and Highways – which is ~36.0% higher than last year's budget allocation.
- The Government plans to complete 25,000 Kilometers of National Highways.
- In July 2021, the Union Minister for Road Transport and Highways, Mr. Nitin Gadkari, laid the foundation stone for 16 National Highway projects in Manipur. These projects will cost US$ 556.67 million to build and will cover a total distance of 298 kms.
- To transform road infrastructure in Punjab, Haryana and Rajasthan, the Indian government has planned to construct roads extending 313 kms for INR 11,000 crore (US$ 1.48 billion).



Source: IBEF Road Report August 2023

Private Sector Participation: -

- NHAI is planning to award 1,000-1,500 km of projects under the BOT model in 2023-24.
- During the year 2020–21, 125 PPP projects (Including 69 road projects) with a total cost of Rs 1,72,314 crore were appraised.NHAI targeted 450 kilometers of the Build–operate–transfer (BOT) projects in FY22 and was looking forward to bidding out 600-1000 kilometers of highway stretch under the Build–operate–transfer (BOT) model as of November 2021.
- In August 2020, the Government of India revised the Model Concession Agreement for BOT projects to plug delays by imposing a deadline on the NHAI and incentivizing timely work by concessionaires. According to revised norms, the NHAI will have to hand over 90% of the project land (vacant and ready to build) to private developers, thus creating a more market-friendly sector and attracting more private players.
- In November 2020, L&T Construction bagged a contract to build India's longest river bridge, across Brahmaputra River connecting Dhubri in Assam to Phulbari in Meghalaya.
- KKR, a global investment firm, announced to acquire the entire stake of Global Infrastructure Partners in Highway Concessions One (HC1) and seven other highway assets totaling 487 kms.



(Source: IBEF Road Report August 2023 & Niti Aayog)

Government initiatives: -

1. **National Infrastructure Pipeline (NIP)**

   The government's ambitious National Infrastructure Pipeline which is to be implemented untill FY25 is an attempt undertaken by the centre to facilitate economic revival by relying on infrastructure creation. The NIP covers a gamut of sectors, rural and urban infrastructure as well and entails investments to the tune of INR 111 Lakh Crores to be undertaken by the central government, state governments and the private sector. The Roads sector is expected to account for 18% capital expenditure over FY2019-25.

2. Bharatmala Pariyojana (BMP) – Phase I

- Bharatmala Pariyojana is a program for the highways sector that focuses on optimizing efficiency of freight and passenger movement across the country by bridging critical infrastructure gaps through effective interventions like development of Economic Corridors, Inter Corridors and Feeder Routes, National Corridor Efficiency Improvement, Border and International connectivity roads, Coastal and Port connectivity roads and Green-field expressways.
- A total of around 24,800 kms are being considered in Phase I. In addition, Phase I also includes 10,000 kms of balance road works under NHDP. Estimated outlay for Phase I is ~ INR 5.35 lakh Crores spread over 5 years.
- Summary of Phase 1 Components and approved outlay of for the same are as follows: -

Sr. No.	Components	Length (Km)	Outlay (INR crore)
1	Economic corridors development	9,000	120,000
2	Inter- corridors & feeder roads	6,000	80,000
3	National Corridors Efficiency Improvement	5,000	100,000
4	Border and International Connectivity	2,000	25,000
5	Coastal and port connectivity roads	2,000	20,000
6	Expressways	800	40,000
Total		24,800	385,000
7	Balance Road works under NHDP	10,000	1,50,000
Total		34,800	5,35,000

Source: MorTH Website

NHAI will consider only those projects that require minimal land acquisition worth INR 3 trillion under Bharatmala Pariyojana Scheme. A total of 65,000 kms of roads and highways are to be constructed under Bharatmala Pariyojana.

3. Gati Shakti – National Master Plan

India's Gati Shakti program has consolidated a list of 81 high impact projects, out of which road infrastructure projects were the top priority. The major highway projects include the Delhi-Mumbai expressway (1,350 kilometres), Amritsar-Jamnagar expressway (1,257 kilometres) and Saharanpur-Dehradun expressway (210 kilometres). The main aim of this program is a faster approval process which can be done through the Gati Shakti portal and digitized the approval process completely.

4. Taxes and Other Sops

Companies enjoy 100% tax exemption in road projects for 5 years and 30% relief over the next 5 years.

5. Rural Development

Under the Interim Union Budget 2024-25, the Government of India has allocated INR 19,000 crores for Pradhan Mantri Gram Sadak Yojana (PMGSY). Over 7 lakh kilometers of roads have been constructed under the first and second phases of the scheme, which is currently in its third phase.

7. Valuation Approach and Methodology

VALUATION APPROACHES		
INCOME APPROACH	**MARKET APPROACH**	**ASSET APPROACH**
Estimates value based on the present value of future earnings of cash	Estimates value based on the multiples of comparable companies and precedent comparable transactions	Estimates value based on the fair value of the business' assets less the fair value of its liabilities
Applied	Not applied	Not Applied

Basis and Methodology of Valuation

- **Basis of Valuation**

  It means the indication of the type of value being used in an engagement. Fair Value as per ICAI VS defined as under:

  "Fair value is the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the valuation date."

  Fair value basis has been adopted for enterprise valuation of the Specified Assets.

- **Valuation Date**

  Valuation Date is the specific date at which the value of the assets to be valued gets estimated or measured. Valuation is time specific and can change with the passage of time *inter-alia* due to changes in the condition of the asset to be valued and market parameters. Accordingly, valuation of an asset as at a particular date can be different from other date(s).

  The Valuation Date considered for the fair enterprise valuation of the Specified Projects is 31st December 2023 ("Valuation Date"). The attached Report is drawn up by reference to accounting and financial information as on 31st December 2023.

- **Premise of Value**

  Premise of Value refers to the conditions and circumstances how an asset is deployed. In the present case, we have determined the fair enterprise value of the Specified Assets on a Going Concern Value defined as under:

  "Going concern value is the value of a business enterprise that is expected to continue to operate in the future. The intangible elements of going concern value result from factors such as having a trained work force, an operational plant, the necessary licenses, systems, and procedures in place, etc."

Approach & Method	Applied/Not Applied	Description	Rationale
Income Approach Discounted Cash Flow Method (DCF)	Applied	▪ In the DCF method under the Income approach, forecast cash flows are discounted back to the relevant date for estimating a net present value of the cash flow stream of the business. A terminal value at the end of the explicit forecast period is then determined and that value is also discounted back to the relevant date to give an overall value for the business. ▪ A discounted cash flow methodology typically requires the forecast period to be of such a length to enable the business to achieve a stabilized level of earnings, or to be reflective of an entire operation cycle for more cyclical industries ▪ The rate at which the future cash flows are discounted (the "discount rate") should reflect not only the time value of money, but also the risk associated with the business' future operations. The discount rate most generally employed is Weighted Average Cost of Capital ("WACC") or Cost of Equity (Ke), reflecting an optimal as opposed to actual financing structure	• The Management has provided financial projections of the Specified Projects, which represent their best estimate of the expected performance of the Specified Projects for the tenor of their respective Concession period. Considering the aforementioned, the DCF method has been adopted to estimate the enterprise value of the Specified Projects.
Market Approach • Market Price Method	Not Applied	▪ Under this method, the value of a company is arrived at considering its market price over an appropriate period.	▪ As the Specified Projects are not listed, this method is not applied
Market Approach • Comparable Companies Multiples ("CCM") Method	Not Applied	▪ Under Comparable Companies Method, the value of shares / business of a company is determined based on market multiples of publicly traded comparable companies. Although no two companies are entirely alike, the companies selected as comparable companies should be engaged in the same or a similar line of business as	▪ The Specified Projects are operational and do not have project implementation risk. Further, the projected income and cash flows of the Specified Projects primarily depends on the key terms of the respective concession agreements, residual tenor, project-specific

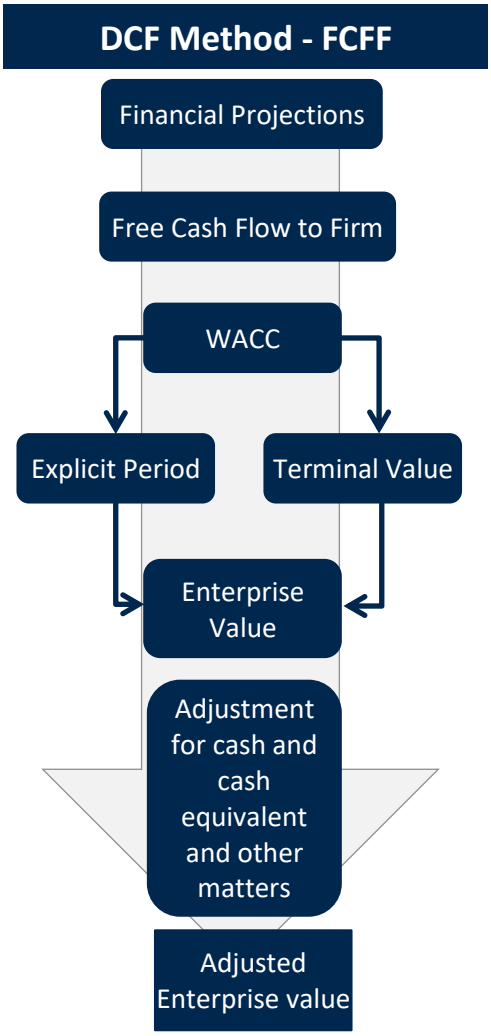
Approach & Method	Applied/Not Applied	Description	Rationale
		the subject company. ▪ The appropriate multiple is generally based on the performance of listed companies with similar business models and size.	characteristics/ factors, etc. which may differ from the other projects. Accordingly, this method is not adopted.
Market Approach • Comparable Transaction Multiples ("CTM") Method	Not Applied	▪ Under Comparable Transaction Multiples Method, the value of shares /business of a company is determined based on market multiples of publicly disclosed transactions in the similar space as that of the subject company ▪ Multiples are generally based on data from recent transactions in a comparable sector, but with appropriate adjustment after consideration is given to the specific characteristics of the business being valued	▪ The projected income and cash flows of the Specified Projects primarily depend on the key terms of the respective concession agreements, residual tenor, project-specific characteristics/ factors, etc. which may differ from the other projects. We have not adopted this methodology due to unavailability of information in public domain involving recent transactions in similar projects.
Asset based Approach • Adjusted Net Asset Value Method	Not Applied	▪ Under the Adjusted Net Asset Value Method, a Valuation of a 'going concern' business is computed by adjusting the assets and liabilities to the fair market value as of the date of the Valuation. ▪ A net asset value methodology is typically most appropriate when: ▪ Valuing a holding company or a capital-intensive company. ▪ Losses are continually generated by the business; or ▪ Valuation methodologies based on a company's net income or cash flow levels indicate a value lower than its adjusted net asset value.	▪ The revenues and cashflows of the Specified Projects are largely predetermined for the concession period and are expected to make operating profits. In such a scenario, the true worth of the business is reflected in its future earning capacity rather than the historical cost of the project. The valuation of the Specified Projects is carried out on a 'going concern value' premise. Since the Net Asset Value does not capture the future earning potential of the businesses, we have not adopted the Asset approach for the valuation of the Specified Projects.

Income Approach

The Income Approach is widely used for valuation under "Going Concern" basis. It focuses on the income generated by a company in the past as well as its future earning capability.

Discounted Cash Flow ("DCF") Method

- Under the DCF method, the business is valued by discounting its free cash flows for the explicit forecast period and the perpetuity value thereafter.
- Free Cash Flows to Firm ("FCFF") under the DCF method has been applied for estimating the enterprise value of the Specified Projects.
- FCFF represent the cash available for distribution to both, the owners and creditors of the business. FCFF for the explicit period and perpetuity value is discounted by the Weighted Average Cost of Capital ("WACC") to derive the net present value. The WACC is an appropriate rate of discount to calculate the present value of the future cash flows as it considers equity–debt risk by incorporating debt–equity ratio of the firm.
- Enterprise Value ("EV") is derived by aggregating the present value of FCFF for the balance tenor of the Concession Agreement ("Explicit period") and Terminal value at the end of the Explicit period.
- Terminal value is estimated based on the business' potential for further growth beyond the Explicit period. Considering *inter-alia* the estimated economic life of the projects, Terminal value has been estimated considering release of net working capital, at the end of the Explicit period.
- The Enterprise Value of the Specified Assets have been determined as an aggregate of the present value of FCFF for the Explicit period and Terminal value.
- We understand from the Management that the consideration for the acquisition of concession rights for the Specified Projects is expected to be paid simultaneously with the commencement of their concession agreement (expected to begin from 1st April 2024). Accordingly, the Enterprise Value of the Specified Projects have been computed by discounting the FCFF as of 1st April 2024.



Weighted Average Cost of Capital (WACC)

WACC has been estimated as under:

Particulars	Definition/Formula
WACC	Ke * (E/ (D + E)) + Kd * (1-T) * (D/(D + E))
Where:	
Ke	cost of equity
E	market value of equity
Kd	cost of debt
D	market value of debt
T	effective tax rate

The cost of equity is derived using the Capital Asset Pricing Model ("CAPM") as follows:

Particulars	Definition/Formula
Ke	Rf + ß * (Rm – Rf) + α
Where:	
Rf	the return on risk-free assets
Rm	the expected average return of the market
(Rm – Rf)	the average risk premium above the risk – free rate that a "market" portfolio of assets is earning
ß	the beta factor, being the measure of the systematic risk of a particular asset relative to the risk of a portfolio of all risky assets
α	Company specific risk factor (alpha), if any

A summary of WACC for the Specified Projects is appended as per **Appendix 1**.

8. Valuation of Specified Projects

8.1. Key underlying assumptions as provided by the Management:

- We have carried out the Enterprise Valuation of the Specified Projects as of 31st December 2023, considering inter-alia the latest Traffic Study Reports and Technical Reports of independent consultants, Business plan/ Projected financial statements of the Specified Projects and other information provided by/ on behalf of the Management, industry analysis and other relevant factors.

- **Operating Revenue:** Operating revenue for the Specified Projects for their respective proposed concession period (the "Projected Period") have been estimated by the Management considering the traffic projections from Traffic Study Reports of independent traffic consultants appointed by NHIIMPL and toll rates basis NHAI regulations.

- **Operational and Maintenance Expenses (Routine maintenance)**: O&M expenses for the Specified Assets for the Projected Period have been estimated by the Management basis the technical study conducted by independent consultants.

- **Major Maintenance & Repair Expenses (MMR / Periodic maintenance)**: Periodic maintenance expenses are incurred to bring the road asset back to an earlier condition or to keep the road asset operating at its present condition. Like O&M expenses, MMR expenses have been estimated by the Management for the Projected Period basis the Technical Reports of independent consultants.

- **Project Management (PM) Expenses**: PM expenses shall be paid by NHIT to the Project Manager for the Operations and Management of all the toll road projects. These expenses have been considered as per the PM agreement between NHIT and the Project Manager.

- **Insurance and Other Office Expenses**: These expenses for the Projected Period have been estimated by the Management basis the technical study conducted by independent consultants.

- **Administrative/SPV Costs:** The Management has estimated the base year Admin costs for each project and annual escalation as follows:

Project	Annualized Base Year Admin Cost (INR Crore)	Annual Escalation (%)
Assam Package (AS- Patgaon & Dahalapara)	6.76	7.5%
Orai-Bara (OB)	3.45	7.5%
Assam (Galia)	3.18	7.5%

Project	Annualized Base Year Admin Cost (INR Crore)	Annual Escalation (%)
Chichra-Kharagpur (ChK)	3.40	7.5%
Rewa-Katni-Jabalpur-Lakhnadon	14.21	7.5%
Lakhnadon- Khawasa (LK)	6.73	7.5%
Hubbali- Haveri-Chitradurga (HHC)	10.47	7.5%

- **Depreciation and Amortization**: One-time lumpsum consideration for Service Concession to be paid to NHAI and future capital expenditure have been amortized over the period of concession on the basis of projected traffic.

- **Taxes:** Income taxes have been estimated considering, as appropriate, tax depreciation/ amortisation policy proposed to be followed by the SPV and corporate income tax rate of 25.17%.

- **Capital Expenditure:** The Management has projected that capital expenditure aggregating ~INR 342 crore shall be incurred by the SPV during FY2026 and FY2027 for the Specified Projects considering the Technical Due Diligence Reports of independent technical consultants appointed by NHIIMPL. There will be no further capital expenditure in the Projected Period.

- **Working Capital:** Considering the nature of the business of operating toll road projects, the working capital requirement is estimated to be ~0.01% of the projected toll revenues for the Projected Period.

- **Investment Management ("IM") Expenses:** The Trust and Investment Manager has entered into Investment Management Agreement in terms of SEBI InvIT Regulations. The value of Concession Rights for the Specified Projects has been estimated without deducting IM expenses. PV of IM expenses (net of tax) for the Specified Projects is estimated at ~INR 167 Cr.

8.2. Specified Projects to be acquired by NEPPL

8.2.1. Assam Package (Dahalapara and Patgaon)

8.2.1.1. Project Overview

Parameters	Details
Project Name	NH-27 Assam Package
Length of the project	114.17 kms
Toll Plaza Location	Dahalapara and Patgaon

Source: Management information

8.2.1.2. Additional Procedures to be complied with in accordance with InvIT regulations

A. List of one-time sanctions/approvals which are obtained or pending:

As represented by the Management, the list of sanctions/ approvals obtained untill 31st December 2023 is provided in **Appendix 3.**

B. List of up to date/ overdue periodic clearances:

As represented by the Management, all other material permits, registrations, licenses, approvals, consents and other authorizations (collectively, "Governmental Licenses") shall be obtained by NEPPL as per individual project requirements once the rights and obligations are assumed by the SPV. The Project SPV (NEPPL) would in due course and as required under applicable law procure all the Governmental Licenses issued by, and shall make all material declarations and filings with, the applicable Governmental Authority to own, lease, license, operate and use its properties and assets and to conduct the business by the Project SPV, as will be described in the placement documents. No notice of proceedings has been received relating to the revocation or modification of any Governmental Licenses, except as would not result in a Material Adverse Change. The general list of Governmental Licenses is enclosed in **Appendix 4**.

C. Estimates of already carried out as well as proposed major repairs and improvements along with estimated time of completion:

Historical Major Maintenance Expenses (INR Cr):

The Specified Projects are a part of NHAI's road network. Management represented that considering the aforementioned, details of historical major maintenance expenses incurred for the Specified Projects are not available.

Forecasted Major Maintenance Expenses (INR Cr):

Particulars for the year/ period ended	31-Mar-25	31-Mar-26	31-Mar-27	31-Mar-28	31-Mar-29	31-Mar-30	31 Mar-31
No of Months	12	12	12	12	12	12	12
Major Maintenance Expenses	0.00	0.00	0.00	0.00	0.00	218.95	3.32

Particulars for the year/ period ended	31 Mar-32	31 Mar-33	31 Mar-34	31 Mar-35	31-Mar-36	31 Mar-37	31 Mar-38
No of Months	12	12	12	12	12	12	12
Major Maintenance Expenses	0.00	0.00	0.00	0.00	163.69	0.00	8.45

Particulars for the year/ period ended	31 Mar-39	31 Mar-40	31 Mar-41	31 Mar-42	31-Mar-43	31 Mar-44
No of Months	12	12	12	12	12	12
Major Maintenance Expenses	0.00	0.00	0.00	211.59	0.00	0.00

Source: Management information

D. <u>On-going material litigations including tax disputes and claims in relation to the assets, if any;</u>
As represented by the Management, there are no litigations pending against the project as at 31st December 2023.

E. <u>Revenue pendencies including local authority taxes associated with InvIT asset and compounding charges, if any</u>
As represented by the Management, there are no revenue pendencies including local authority taxes associated or compounding charges associated with the project as at 31st December 2023.

F. <u>Vulnerability to natural or induced hazards that may not have been covered in town planning building control.</u>
As represented by the Management, any natural or induced hazards would be adequately covered by insurance.

G. <u>Latest Pictures of the project along with date of physical inspection</u>
Please refer **Appendix 5.**

8.2.2. Orai-Bara (Uttar Pradesh)

8.2.2.1. Project Overview

Parameters	Details
Project Name	NH-27 Orai-Bara (Uttar Pradesh)
Length of the project	62.9 kms
Toll Plaza Location	Usaka

Source: Management information

8.2.2.2. Additional Procedures to be complied with in accordance with InvIT regulations

A. List of one-time sanctions/approvals which are obtained or pending:

As represented by the Management, the list of sanctions/ approvals obtained until 31st December 2023 is provided in **Appendix 3.**

B. List of up to date/ overdue periodic clearances:

As represented by the Management, all other material permits, registrations, licenses, approvals, consents and other authorizations (collectively, "Governmental Licenses") shall be obtained by NEPPL as per individual project requirements once the rights and obligations are assumed by the SPV. The Project SPV (NEPPL) would in due course and as required under applicable law procure all the Governmental Licenses issued by, and shall make all material declarations and filings with, the applicable Governmental Authority to own, lease, license, operate and use its properties and assets and to conduct the business by the Project SPV, as will be described in the placement documents. No notice of proceedings has been received relating to the revocation or modification of any Governmental Licenses, except as would not result in a Material Adverse Change. The general list of Governmental Licenses is enclosed in **Appendix 4**.

C. Estimates of already carried out as well as proposed major repairs and improvements along with estimated time of completion:

Historical Major Maintenance Expenses (INR Cr):

The Specified Projects are a part of NHAI's road network. Management represented that considering the aforementioned, details of historical major maintenance expenses incurred for the Specified Projects are not available.

Forecasted Major Maintenance Expenses (INR Cr):

Particulars for the year/ period ended	31-Mar-25	31-Mar-26	31-Mar-27	31-Mar-28	31-Mar-29	31-Mar-30	31 Mar-31
No of Months	12	12	12	12	12	12	12
Major Maintenance Expenses	0.00	0.00	0.00	100.13	0.00	0.00	2.08

Particulars for the year/ period ended	31 Mar-32	31 Mar-33	31 Mar-34	31 Mar-35	31-Mar-36	31 Mar-37	31 Mar-38
No of Months	12	12	12	12	12	12	12
Major Maintenance Expenses	0.00	101.19	0.00	0.00	0.00	0.00	5.28

Particulars for the year/ period ended	31 Mar-39	31 Mar-40	31 Mar-41	31 Mar-42	31-Mar-43	31-Mar-44
No of Months	12	12	12	12	12	12
Major Maintenance Expenses	0.00	144.30	0.00	0.00	0.00	0.00

Source: Management information

D. <u>On-going material litigations including tax disputes and claims in relation to the assets, if any;</u>
As represented by the Management, there are no litigations pending against the project as at 31st December 2023.

E. <u>Revenue pendencies including local authority taxes associated with InvIT asset and compounding charges, if any</u>
As represented by the Management, there are no revenue pendencies including local authority taxes associated or compounding charges associated with the project as at 31st December 2023.

F. <u>Vulnerability to natural or induced hazards that may not have been covered in town planning building control.</u>
As represented by the Management, any natural or induced hazards would be adequately covered by insurance.

G. <u>Latest Pictures of the project along with date of physical inspection</u>
Please refer **Appendix 6.**

8.2.3. Assam (Galia)

8.2.3.1. Project Overview

Parameters	Details
Project Name	NH-27 Galia (Assam)
Length of the project	27.0 kms
Toll Plaza Location	Galia

Source: Management information

8.2.3.2. Additional Procedures to be complied with in accordance with InvIT regulations

A. List of one-time sanctions/approvals which are obtained or pending:

As represented by the Management, the list of sanctions/ approvals obtained until 31st December 2023 is provided in **Appendix 3.**

B. List of up to date/ overdue periodic clearances:

As represented by the Management, all other material permits, registrations, licenses, approvals, consents and other authorizations (collectively, "Governmental Licenses") shall be obtained by NEPPL as per individual project requirements once the rights and obligations are assumed by the SPV. The Project SPV (NEPPL) would in due course and as required under applicable law procure all the Governmental Licenses issued by, and shall make all material declarations and filings with, the applicable Governmental Authority to own, lease, license, operate and use its properties and assets and to conduct the business by the Project SPV, as will be described in the placement documents. No notice of proceedings has been received relating to the revocation or modification of any Governmental Licenses, except as would not result in a Material Adverse Change. The general list of Governmental Licenses is enclosed in **Appendix 4**.

C. Estimates of already carried out as well as proposed major repairs and improvements along with estimated time of completion:

Historical Major Maintenance Expenses (INR Cr):

The Specified Projects are part of NHAI's road network. Management represented that considering the aforementioned, details of historical major maintenance expenses incurred for the Specified Projects are not available.

Forecasted Major Maintenance Expenses (INR Cr):

Particulars for the year/ period ended	31-Mar-25	31-Mar-26	31-Mar-27	31-Mar-28	31-Mar-29	31-Mar-30	31 Mar-31
No of Months	12	12	12	12	12	12	12
Major Maintenance Expenses	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Particulars for the year/ period ended	31 Mar-32	31 Mar-33	31 Mar-34	31 Mar-35	31-Mar-36	31 Mar-37	31 Mar-38
No of Months	12	12	12	12	12	12	12
Major Maintenance Expenses	69.52	0.00	0.00	0.00	0.00	0.00	64.80

Particulars for the year/ period ended	31 Mar-39	31 Mar-40	31 Mar-41	31 Mar-42	31-Mar-43	31 Mar-44
No of Months	12	12	12	12	12	12
Major Maintenance Expenses	14.24	0.00	0.00	0.00	0.00	67.64

Source: Management information

D. <u>On-going material litigations including tax disputes and claims in relation to the assets, if any;</u>
As represented by the Management, there are no litigations pending against the project as at 31st December 2023.

E. <u>Revenue pendencies including local authority taxes associated with InvIT asset and compounding charges, if any</u>
As represented by the Management, there are no revenue pendencies including local authority taxes associated or compounding charges associated with the project as at 31st December 2023.

F. <u>Vulnerability to natural or induced hazards that may not have been covered in town planning building control.</u>
As represented by the Management, any natural or induced hazards would be adequately covered by insurance.

G. <u>Latest Pictures of the project along with date of physical inspection</u>
Please refer **Appendix 7.**

8.2.4. Chichra-Kharagpur (West Bengal)

8.2.4.1. Project Overview

Parameters	Details
Project Name	NH-49 Chichra-Kharagpur (West Bengal)
Length of the project	56.120 kms
Toll Plaza Location	Balibhasha

Source: Management information

8.2.4.2. Additional Procedures to be complied with in accordance with InvIT regulations

A. List of one-time sanctions/approvals which are obtained or pending:

As represented by the Management, the list of sanctions/ approvals obtained until 31st December 2023 is provided in **Appendix 3.**

B. List of up to date/ overdue periodic clearances:

As represented by the Management, all other material permits, registrations, licenses, approvals, consents and other authorizations (collectively, "Governmental Licenses") shall be obtained by NEPPL as per individual project requirements once the rights and obligations are assumed by the SPV. The Project SPV (NEPPL) would in due course and as required under applicable law procure all the Governmental Licenses issued by, and shall make all material declarations and filings with, the applicable Governmental Authority to own, lease, license, operate and use its properties and assets and to conduct the business by the Project SPV, as will be described in the placement documents. No notice of proceedings has been received relating to the revocation or modification of any Governmental Licenses, except as would not result in a Material Adverse Change. The general list of Governmental Licenses is enclosed in **Appendix 4**.

C. Estimates of already carried out as well as proposed major repairs and improvements along with estimated time of completion:

Historical Major Maintenance Expenses (INR Cr):

The Specified Projects are a part of NHAI's road network. Management represented that considering the aforementioned, details of historical major maintenance expenses incurred for the Specified Projects are not available.

Forecasted Major Maintenance Expenses (INR Cr):

Particulars for the year/ period ended	31-Mar-25	31-Mar-26	31-Mar-27	31-Mar-28	31-Mar-29	31-Mar-30	31 Mar-31
No of Months	12	12	12	12	12	12	12
Major Maintenance Expenses	0.00	0.00	2.22	0.82	0.00	54.16	1.65

Particulars for the year/ period ended	31 Mar-32	31 Mar-33	31 Mar-34	31 Mar-35	31-Mar-36	31 Mar-37	31 Mar-38
No of Months	12	12	12	12	12	12	12
Major Maintenance Expenses	0.00	4.16	0.00	0.00	0.00	0.00	4.21

Particulars for the year/ period ended	31 Mar-39	31 Mar-40	31 Mar-41	31 Mar-42	31-Mar-43	31 Mar-44
No of Months	12	12	12	12	12	12
Major Maintenance Expenses	0.00	0.00	0.00	93.95	0.00	1.81

Source: Management information

D. <u>On-going material litigations including tax disputes and claims in relation to the assets, if any;</u>
As represented by the Management, there are no litigations pending against the project as at 31st December 2023.

E. <u>Revenue pendencies including local authority taxes associated with InvIT asset and compounding charges, if any</u>
As represented by the Management, there are no revenue pendencies including local authority taxes associated or compounding charges associated with the project as at 31st December 2023.

F. <u>Vulnerability to natural or induced hazards that may not have been covered in town planning building control.</u>
As represented by the Management, any natural or induced hazards would be adequately covered by insurance.

G. <u>Latest Pictures of the project along with date of physical inspection</u>
Please refer **Appendix 8.**

8.2.5. Rewa-Katni-Jabalpur-Lakhnadon (Madhya Pradesh)

8.2.5.1. Project Overview

Parameters	Details
Project Name	NH-30 and NH-34 Rewa-Katni-Jabalpur-Lakhnadon (Madhya Pradesh)
Length of the project	287 kms (*Excluding Katni Bypass Length of ~20 km)*
Toll Plaza Location	Odhaki Paipkhar, Kherwasani, Mohtara and Boharipar

Source: Management information

8.2.5.2. Additional Procedures to be complied with in accordance with InvIT regulations

A. List of one-time sanctions/approvals which are obtained or pending:

As represented by the Management, the list of sanctions/ approvals obtained until 31st December 2023 is provided in **Appendix 3.**

B. List of up to date/ overdue periodic clearances:

As represented by the Management, all other material permits, registrations, licenses, approvals, consents and other authorizations (collectively, "Governmental Licenses") shall be obtained by NEPPL as per individual project requirements once the rights and obligations are assumed by the SPV. The Project SPV (NEPPL) would in due course and as required under applicable law procure all the Governmental Licenses issued by, and shall make all material declarations and filings with, the applicable Governmental Authority to own, lease, license, operate and use its properties and assets and to conduct the business by the Project SPV, as will be described in the placement documents. No notice of proceedings has been received relating to the revocation or modification of any Governmental Licenses, except as would not result in a Material Adverse Change. The general list of Governmental Licenses is enclosed in **Appendix 4**.

C. Estimates of already carried out as well as proposed major repairs and improvements along with estimated time of completion:

Historical Major Maintenance Expenses (INR Cr):

The Specified Projects are part of NHAI's road network. Management represented that considering the aforementioned, details of historical major maintenance expenses incurred for the Specified Projects are not available.

Forecasted Major Maintenance Expenses (INR Cr):

Particulars for the year/ period ended	31-Mar-25	31-Mar-26	31-Mar-27	31-Mar-28	31-Mar-29	31-Mar-30	31 Mar-31
No of Months	12	12	12	12	12	12	12
Major Maintenance Expenses	0.00	0.00	12.84	4.46	0.00	265.60	6.64

Particulars for the year/ period ended	31 Mar-32	31 Mar-33	31 Mar-34	31 Mar-35	31-Mar-36	31 Mar-37	31 Mar-38
No of Months	12	12	12	12	12	12	12
Major Maintenance Expenses	0.00	22.70	0.00	0.00	515.22	0.00	23.19

Particulars for the year/ period ended	31 Mar-39	31 Mar-40	31 Mar-41	31 Mar-42	31-Mar-43	31-Mar-44
No of Months	12	12	12	12	12	12
Major Maintenance Expenses	23.18	0.00	0.00	407.04	9.76	0.00

Source: Management information

D. <u>On-going material litigations including tax disputes and claims in relation to the assets, if any;</u>
As represented by the Management, there are no litigations pending against the project as at 31st December 2023.

E. <u>Revenue pendencies including local authority taxes associated with InvIT asset and compounding charges, if any</u>
As represented by the Management, there are no revenue pendencies including local authority taxes associated or compounding charges associated with the project as at 31st December 2023.

F. <u>Vulnerability to natural or induced hazards that may not have been covered in town planning building control.</u>
As represented by the Management, any natural or induced hazards would be adequately covered by insurance.

G. <u>Latest Pictures of the project along with date of physical inspection</u>
Please refer **Appendix 9.**

8.2.6. Lakhandon Khwasa (Madhya Pradesh)

8.2.6.1. Project Overview

Parameters	Details
Project Name	NH-44 Lakhnadon- Khawasa (Madhya Pradesh)
Length of the project	107.0 kms
Toll Plaza Location	Madai and Khawasa

Source: Management information

8.2.6.2. Additional Procedures to be complied with in accordance with InvIT regulations

H. List of one-time sanctions/approvals which are obtained or pending:

As represented by the Management, the list of sanctions/ approvals obtained until 31st December 2023 is provided in **Appendix 3.**

I. List of up to date/ overdue periodic clearances:

As represented by the Management, all other material permits, registrations, licenses, approvals, consents and other authorizations (collectively, "Governmental Licenses") shall be obtained by NEPPL as per individual project requirements once the rights and obligations are assumed by the SPV. The Project SPV (NEPPL) would in due course and as required under applicable law procure all the Governmental Licenses issued by, and shall make all material declarations and filings with, the applicable Governmental Authority to own, lease, license, operate and use its properties and assets and to conduct the business by the Project SPV, as will be described in the placement documents. No notice of proceedings has been received relating to the revocation or modification of any Governmental Licenses, except as would not result in a Material Adverse Change. The general list of Governmental Licenses is enclosed in **Appendix 4**.

J. Estimates of already carried out as well as proposed major repairs and improvements along with estimated time of completion:

Historical Major Maintenance Expenses (INR Cr):

The Specified Projects are part of NHAI's road network. Management represented that considering the aforementioned, details of historical major maintenance expenses incurred for the Specified Projects are not available.

Forecasted Major Maintenance Expenses (INR Cr):

Particulars for the year/ period ended	31-Mar-25	31-Mar-26	31-Mar-27	31-Mar-28	31-Mar-29	31-Mar-30	31 Mar-31
No of Months	12	12	12	12	12	12	12
Major Maintenance Expenses	0.00	36.71	0.00	137.38	0.00	19.43	26.66

Particulars for the year/ period ended	31 Mar-32	31 Mar-33	31 Mar-34	31 Mar-35	31-Mar-36	31 Mar-37	31 Mar-38

No of Months	12	12	12	12	12	12	12
Major Maintenance Expenses	0.00	26.37	144.50	0.00	45.76	29.75	42.76

Particulars for the year/ period ended	31 Mar-39	31 Mar-40	31 Mar-41	31 Mar-42	31-Mar-43	31-Mar-44
No of Months	12	12	12	12	12	12
Major Maintenance Expenses	0.00	0.00	0.00	0.00	5.35	13.68

Source: Management information

K. <u>On-going material litigations including tax disputes and claims in relation to the assets, if any;</u>
As represented by the Management, there are no litigations pending against the project as at 31st December 2023.

L. <u>Revenue pendencies including local authority taxes associated with InvIT asset and compounding charges, if any</u>
As represented by the Management, there are no revenue pendencies including local authority taxes associated or compounding charges associated with the project as at 31st December 2023.

M. <u>Vulnerability to natural or induced hazards that may not have been covered in town planning building control.</u>
As represented by the Management, any natural or induced hazards would be adequately covered by insurance.

N. <u>Latest Pictures of the project along with date of physical inspection</u>
Please refer **Appendix 10.**

8.2.8. Hubli- Haveri Chitradurga (HHC) (Karnataka)

8.2.7.1. Project Overview

Parameters	Details
Project Name	NH-48 Hubbali- Haveri-Chitradurga (HHC) (Karnataka)
Length of the project	214 kms
Toll Plaza Location	Bankapur, Chalageri and Hebbalu

Source: Management information

8.2.7.2. Additional Procedures to be complied with in accordance with InvIT regulations

O. List of one-time sanctions/approvals which are obtained or pending:

As represented by the Management, the list of sanctions/ approvals obtained until 31st December 2023 is provided in **Appendix 3.**

P. List of up to date/ overdue periodic clearances:

As represented by the Management, all other material permits, registrations, licenses, approvals, consents and other authorizations (collectively, "Governmental Licenses") shall be obtained by NEPPL as per individual project requirements once the rights and obligations are assumed by the SPV. The Project SPV (NEPPL) would in due course and as required under applicable law procure all the Governmental Licenses issued by, and shall make all material declarations and filings with, the applicable Governmental Authority to own, lease, license, operate and use its properties and assets and to conduct the business by the Project SPV, as will be described in the placement documents. No notice of proceedings has been received relating to the revocation or modification of any Governmental Licenses, except as would not result in a Material Adverse Change. The general list of Governmental Licenses is enclosed in **Appendix 4**.

Q. Estimates of already carried out as well as proposed major repairs and improvements along with estimated time of completion:

Historical Major Maintenance Expenses (INR Cr):

The Specified Projects are part of NHAI's road network. Management represented that considering the aforementioned, details of historical major maintenance expenses incurred for the Specified Projects are not available.

Forecasted Major Maintenance Expenses (INR Cr):

Particulars for the year/ period ended	31-Mar-25	31-Mar-26	31-Mar-27	31-Mar-28	31-Mar-29	31-Mar-30	31 Mar-31
No of Months	12	12	12	12	12	12	12
Major Maintenance Expenses	0.00	0.00	0.00	7.87	0.00	0.00	0.00

Particulars for the year/ period ended	31 Mar-32	31 Mar-33	31 Mar-34	31 Mar-35	31-Mar-36	31 Mar-37	31 Mar-38
No of Months	12	12	12	12	12	12	12
Major Maintenance Expenses	0.00	0.00	0.00	20.02	155.81	379.47	24.75

Particulars for the year/ period ended	31 Mar-39	31 Mar-40	31 Mar-41	31 Mar-42	31-Mar-43	31-Mar-44
No of Months	12	12	12	12	12	12
Major Maintenance Expenses	100.12	0.00	0.00	12.73	252.43	628.98

Source: Management information

R. <u>On-going material litigations including tax disputes and claims in relation to the assets, if any;</u>

As represented by the Management, there are no litigations pending against the project as at 31st December 2023.

S. <u>Revenue pendencies including local authority taxes associated with InvIT asset and compounding charges, if any</u>

As represented by the Management, there are no revenue pendencies including local authority taxes associated or compounding charges associated with the project as at 31st December 2023.

T. <u>Vulnerability to natural or induced hazards that may not have been covered in town planning building control.</u>

As represented by the Management, any natural or induced hazards would be adequately covered by insurance.

U. <u>Latest Pictures of the project along with date of physical inspection</u>

Please refer **Appendix 11.**

9. Valuation Conclusion

We have carried out the Enterprise Valuation of the Specified Projects as of 31st December 2023, considering *inter-alia* Traffic Study Reports and Technical Reports of independent consultants, Business plan/ Projected financial statements of the Specified Projects and other information provided by/ on behalf of the Management, industry analysis and other relevant factors.

The Valuation summary of the Specified Projects as of 31st December 2023 is as follows:

Particulars	WACC	Enterprise Value* (INR Cr)
Assam Package (AS- Patgaon & Dahalapara)	10.40%	1,397.9
Orai-Bara (OB)		1,706.0
Assam (Galia)		234.5
Chichra-Kharagpur (ChK)		1,276.1
Rewa-Katni-Jabalpur-Lakhnadon (RKJL)		3,516.1
Lakhnadon- Khawasa (LK)		2,552.6
Hubbali- Haveri-Chitradurga (HHC)		4,941.8
Total	**10.40%**	**15,624.9***

Note: The Enterprise Value of respective Specified Projects has been estimated considering *inter-alia* apportionment of common expenses to the Specified Projects and may not be representative of the Enterprise Value of each Specified Project on a 'standalone' basis.

** Represents value of Concession Rights, without deducting IM expenses. For details, refer Section 8.1*

Sensitivity Analysis

WACC	10.20%	10.30%	10.40%	10.50%	10.60%
Enterprise Value (INR Cr)	15,873	15,748	15,625	15,503	15,383
Percentage Change (%)	1.6%	0.8%	0.0%	-0.8%	-1.5%

Appendices

Appendix 1 - WACC

Particulars		Remarks
Debt-to-equity Ratio	1.00	Considering *inter-alia* typical funding pattern for road infrastructure projects and long-term debt-equity ratio and permissible leverage under the SEBI InvIT Regulations
Unlevered Beta – Industry	0.44	Beta is a measure of the risk of the shares of a company. ß is the co-variance between the return on sample stock and the return on the market. In order to determine the appropriate beta factor for the Company, consideration must be given either to the market beta of the Company or betas of comparable quoted companies. Unlevered beta has been estimated based on the 5-year monthly beta of select comparable companies.
Cost of Equity (Ke)		
Risk Free Rate (Rfr)	~ 7.13%	Based on 10-year zero coupon yield curve for GoI securities as at 31st December2023
Equity Market Risk Premium	~ 7.00%	Equity Market equity risk premium is estimated considering inter-alia historical equity market returns over a risk-free rate and forward-looking equity market risk premium estimates. Data sources reviewed generated a range of equity risk premium indications. However, a 7% equity market risk premium was considered reasonable representative of the equity risk premium for India.
Relevered Beta	~ 0.88	Considering *inter-alia* 5-year monthly beta of comparable companies and debt-to-equity ratio
Additional Risk Premium	1.00%	Considering *inter-alia* nature of revenue of the Specified Projects (toll collection), projected performance of the Specified Projects, traffic risk, macro-economic additional uncertainties due to certain global events, partially offset by the operational nature of the Specified Projects.
Cost of Equity (Ke)	~ **14.27%**	
Cost of Debt (Kd)		
Pre-Tax Cost of Debt (Kd)	~ 8.00%	The Management estimate considering *inter-alia* prevailing interest rate at which the Trust has borrowed money from the consortium of three banks, impact of measures taken/ expected to be taken by the Reserve Bank of India to curtail inflationary pressures, etc.
Effective tax rate	~ 18.5%	Estimated considering *inter-alia* tax depreciation/ amortization policy proposed to be followed and corporate income tax rate
Post-Tax Cost of Debt (Kd)	~ **6.52%**	
WACC	~ **10.40%**	
Rounded off WACC	~ **10.40%**	

Appendix 2A – Discounted Cash Flow (DCF)

Enterprise Valuation of the Specified Projects

Amount in INR Cr.

Financial Year		FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	FY2032	FY2033	FY2034
Months		12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
Revenue		1,341.2	1,586.4	1,732.3	1,871.5	2,022.9	2,198.3	2,310.2	2,474.8	2,638.3	2,863.9
EBITDA before MMR Provisions		1,193.3	1,348.8	1,461.7	1,573.2	1,738.0	1,895.7	1,988.9	2,143.1	2,286.1	2,499.9
Less: IM Expenses	-	-	-	-	-	-	-	-	-	-	-
Less: Income Tax		-	-	-	-	-	-	-	-	-	(454.5)
Less: MM Expenses		-	(36.7)	(15.1)	(250.6)	-	(558.1)	(40.4)	(69.5)	(154.4)	(144.5)
Less: Capital Expenditure		-	(125.0)	(217.2)	-	-	-	-	-	-	-
Add/Less: Working Capital		(0.2)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Free Cashflows		**1,193.2**	**1,187.1**	**1,229.4**	**1,322.5**	**1,738.0**	**1,337.6**	**1,948.6**	**2,073.6**	**2,131.6**	**1,900.8**
Time to Midpoint		0.50	1.50	2.50	3.50	4.50	5.50	6.50	7.50	8.51	9.51
Discount Rate	10.40%	0.95	0.86	0.78	0.71	0.64	0.58	0.53	0.48	0.43	0.39
Discounted Cash Flow		**1,135.6**	**1,023.4**	**960.0**	**935.3**	**1,113.2**	**776.0**	**1,024.0**	**986.9**	**918.8**	**742.2**

Mid Point Working	31-Mar-24	31-Mar-25	31-Mar-26	31-Mar-27	31-Mar-28	31-Mar-29	31-Mar-30	31-Mar-31	31-Mar-32	31-Mar-33	31-Mar-34
Days		182.50	547.50	912.50	1,278.00	1,643.50	2,008.50	2,373.50	2,739.00	3,104.50	3,469.50
Time to Midpoint		**0.50**	**1.50**	**2.50**	**3.50**	**4.50**	**5.50**	**6.50**	**7.50**	**8.51**	**9.51**

Financial Year		FY2035	FY2036	FY2037	FY2038	FY2039	FY2040	FY2041	FY2042	FY2043	FY2044
Months		12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.0
Revenue		3,112.0	3,381.0	3,656.2	3,962.4	4,287.3	4,646.8	5,008.6	5,410.0	5,841.8	6,313.1
EBITDA before MMR Provisions		2,725.1	2,955.8	3,143.3	3,405.1	3,711.3	4,028.0	4,340.7	4,690.3	5,065.0	5,474.6
Less: IM Expenses	-	-	-	-	-	-	-	-	-	-	-
Less: Income Tax		(623.3)	(479.2)	(655.9)	(790.6)	(884.6)	(969.4)	(1,090.6)	(1,002.0)	(1,217.2)	(1,194.3)
Less: MM Expenses		(20.0)	(880.5)	(409.2)	(173.4)	(137.6)	(144.3)	-	(725.3)	(267.5)	(712.1)
Less: Capital Expenditure		-	-	-	-	-	-	-	-	-	-
Add/Less: Working Capital		(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.1)	(0.1)
Free Cashflows		**2,081.7**	**1,596.1**	**2,078.2**	**2,441.0**	**2,689.2**	**2,914.3**	**3,250.1**	**2,963.0**	**3,580.2**	**3,568.1**
Time to Midpoint		10.51	11.51	12.51	13.51	14.51	15.51	16.51	17.51	18.51	19.51
Discount Rate	10.40%	0.35	0.32	0.29	0.26	0.24	0.22	0.20	0.18	0.16	0.15
Discounted Cash Flow		**736.2**	**511.2**	**602.9**	**641.4**	**640.1**	**628.2**	**634.5**	**524.0**	**573.5**	**517.6**

Mid Point Working	31-Mar-24	31-Mar-35	31-Mar-36	31-Mar-37	31-Mar-38	31-Mar-39	31-Mar-40	31-Mar-41	31-Mar-42	31-Mar-43	31-Mar-44
Days		3,834.50	4,200.00	4,565.50	4,930.50	5,295.50	5,661.00	6,026.50	6,391.50	6,756.50	7,122.00
Time to Midpoint		**10.51**	**11.51**	**12.51**	**13.51**	**14.51**	**15.51**	**16.51**	**17.51**	**18.51**	**19.51**

Enterprise Value as on 31/12/2023	**15,624.9***

** Represents value of Concession Rights, without deducting IM expenses. For details, refer Section 8.1*

Appendix 2B – Additional Disclosure for the Specified Projects

Particulars	Acquired from	NEPPL Interest in the Concession agreement	Acquisition Cost	Enterprise Valuation for Previous 3 Financial year ended		
				31 March 2023	31 March 2022	31 March 2021
Assam Package (AS- Patgaon & Dahalapara)	**Not Applicable #**					
Orai-Bara (OB)						
Assam (Galia)						
Chichra-Kharagpur (ChK)						
Rewa-Katni-Jabalpur-Lakhnadon (RKJL)						
Lakhnadon- Khawasa (LK)						
Hubbali- Haveri-Chitradurga (HHC)						
Total						

 # The Specified Projects are part of NHAI's road network and NEPPL is yet to enter into concession agreement with NHAI (the Sponsor) for acquiring 100% interest in the Specified Projects

Statement of Assets of Specified Projects as at 31st December 2023:

Not Applicable ##

The Specified Projects are part of NHAI's road network. Management represented that considering the aforementioned, statement of assets of the Specified Projects as at 31 December 2023 is not available.

Appendix 3 – List of one-time sanctions/approvals

- Specified Projects are part of NHAI road network. Considering inter-alia the aforementioned, the Management represented that the information regarding applicable one-time sanctions obtained by the respective Specified Projects is not available with the Trust.

Appendix 4 – List of Governmental Licenses

S. No.	Statutory Permission
1	Environmental Clearance
2	Forest Clearance
3	Tree Cutting permission
4	Borrow Area permission from state & local panchayat office
5	Boulder Extraction permission from state & local panchayat office
6	Quarry permission
7	Drilling & Blasting -Explosive License & permissing
8	Permission from State to draw Ground Water from river / reservoir
9	Factory License for Camp Set up
10	Shop & Establishment License for Setting up of Office other than Camp
11	Labour License
12	Inspector of Factories- For Setting up of Crusher, Batching Plant and HMP (CTE)
13	Inspector of Factories & Local Panchayat- For Consent to Operate- Crusher, Batching Plant and HMP (CTO)
14	PCB permission for Batching plant, HMP and Crusher Set up
15	PCB Permission/ State permission for using DG sets in camp and Construction projects
16	Approval /permission from Utility Shifting Agency- Electricity, Gas, Water pipelines for Excavations & elevated structure erection
17	Approval of Railways for ROB / RUB Construction
18	RTO permission to Operate and Run Construction equipments (movable) which does not have registration
19	Other any, as per local/ state Judicial body

Source: Information provided by the Management

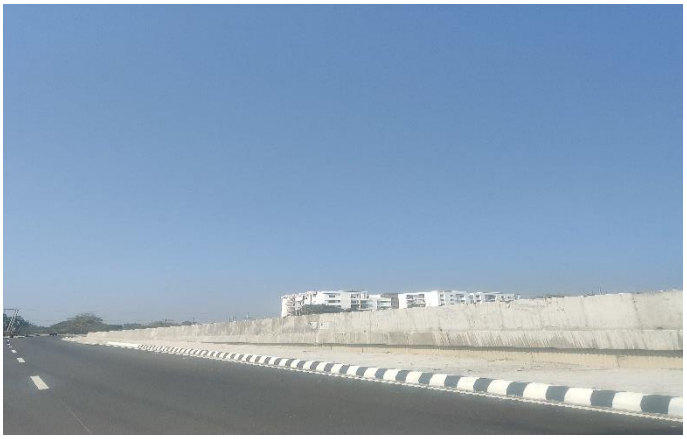
Appendix 5 – Assam Package (Dahalapara and Patgaon): Latest Pictures of the project along with date of physical inspection

- Date of physical inspection: January 4, 2024 and January 5, 2024

Dahalapara Toll Plaza

Patgaon Toll Plaza

Assam Package Road Stretch



Appendix 6 – Orai-Bara (Uttar Pradesh): Latest Pictures of the project along with date of physical inspection

- Date of physical inspection: January 04, 2024

Usaka Toll Plaza

Orai-Bara (Uttar Pradesh) Road Stretch

Appendix 7 – Assam (Galia): Latest Pictures of the project along with date of physical inspection

- Date of physical inspection: January 5, 2023

Galia Toll Plaza

Appendix 8 – Chichra-Kharagpur (West Bengal): Latest Pictures of the project along with date of physical inspection

- Date of physical inspection: January 05, 2024

Balibhasha Toll Plaza

Chichra-Kharagpur (West Bengal) Road Stretch

Appendix 9 – Rewa-Katni-Jabalpur-Lakhnadon (Madhya Pradesh): Latest Pictures of the project along with date of physical inspection

- Date of physical inspection: January 04, 2024

Odhaki Paipkhar Toll Plaza

Kherwasani Toll Plaza

Mohtara Toll Plaza

Boharipar Toll Plaza

Rewa-Katni-Jabalpur-Lakhnadon (Madhya Pradesh) Road Stretch

Appendix 10 – Lakhnadon Khawasa (Madhya Pradesh): Latest Pictures of the project along with date of physical inspection

- Date of physical inspection: January 03, 2024

Khawasa Toll Plaza

Madai Toll Plaza

Lakhnadon Khawasa Road Stretch

Appendix 11 – Hubli- Haveri Chitradurga (HHC) (Karnataka): Latest Pictures of the project along with date of physical inspection

- Date of physical inspection: January 04, 2024

Hebbalu Toll Plaza

Chalageri Toll Plaza

Bankapur Toll Plaza

Hubli- Haveri Chitradurga Road Stretch

ANNEXURE C

TRAFFIC REPORTS

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Assessment and projection of traffic and revenue for Kharagpur-Chichra section of NH-49

Feb 2024

Final Report

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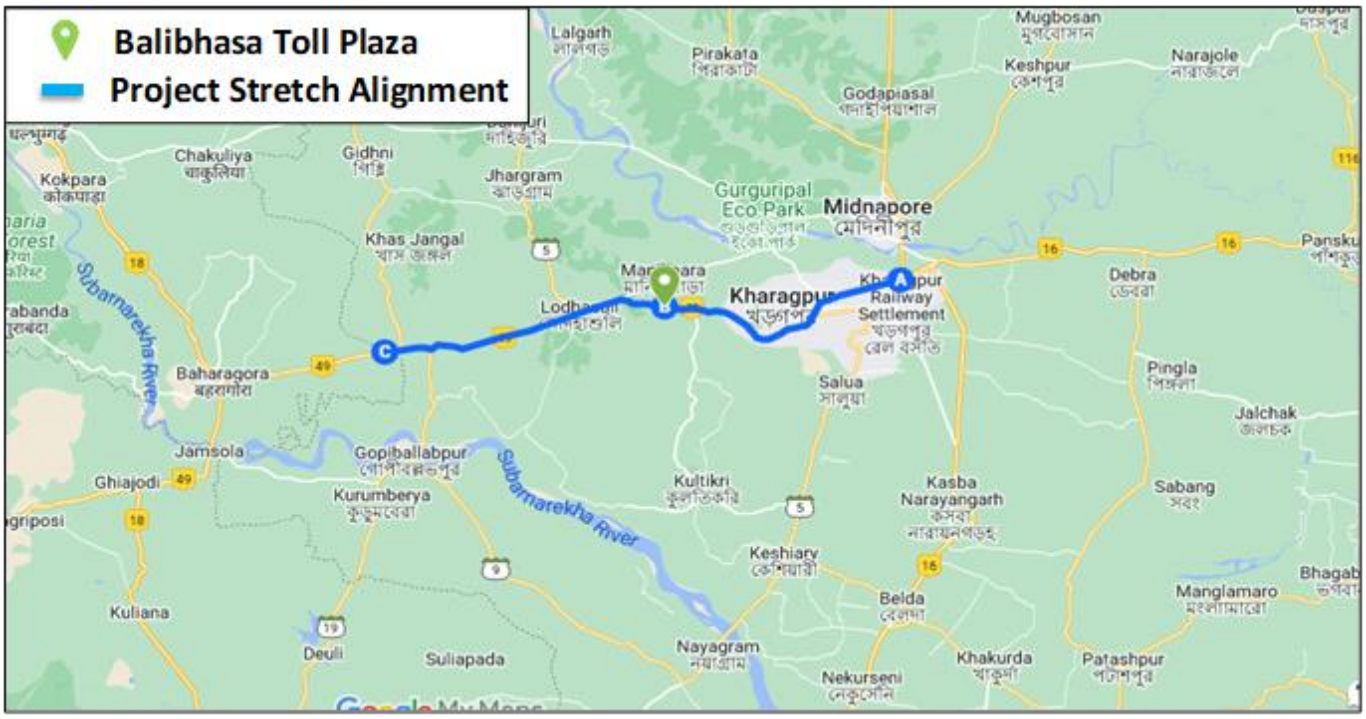
1 Executive Summary

Project overview

According to the Traffic Consultant, Chichra-Kharagpur is a 4-lane, 56.120 kms long stretch, on national highways (NH) 49 which connects Chichra and Kharagpur to Jharkhand and Odisha states in the vicinity. The two states Jharkhand and Odisha form the two key project stretch influence states. The project stretch has one toll plaza by the name of Balibhasa Toll Plaza which lies at the chainage of km 157+915 near Guptamoni. In the larger road network, the project stretch is a part of East-West connectivity which connects Mumbai and Kolkata. Due to presence of sand mining blocks near Gopiballapur, which is in the vicinity of project stretch, the traffic is mostly West Bengal state bound, with construction materials like sand being the top commodity plying on the project stretch.



Source: CRISIL MI&A

Salient growth features and traffic generators

According to the Traffic Consultant, the project stretch is used by the traffic originating and destined in regions such as Gopiballapur (sand mining), Kolkata, Jhargram in West Bengal. For the traffic travelling in Chichra to Kharagpur direction, though West Bengal dominates as the origin state (~59% share), Jharkhand and Odisha are amongst the other states responsible for the originating traffic with almost combined share of ~29%. Sand mining is prevalent in the vicinity of stretch, due to which, sand is the topmost commodity plying on the project stretch which originates majorly from Gopiballapur belt and destined at Kolkata and nearby areas.

There exists an alternate route between Lodhasuli and Kharagpur which could have been a potential route to bypass the Toll Plaza, however the route is majorly under construction in patches, also it passes through multiple small villages, and moreover it is a 2L road which increases the travel time by almost 2x, in comparison to the equivalent road stretch that passes through the Project Stretch. Thus, for commercial vehicles, this route is

unfavourable over the project stretch route, which shall continue to be the preferred route owing to better condition of roads, which will result in saving time too.

Further, there is a greenfield expressway coming up in vicinity of project stretch. Varanasi-Kolkata Expressway connects West Bengal and Uttar Pradesh states which is anticipated to improve the connectivity between these two states. The expressway passes through Jharkhand, which is one of the neighbouring states of West Bengal. Tatanagar, Chaibasa, Ranchi are amongst the originating points for the traffic on the project stretch. Commodities like Iron and Steel products is plying on the vehicles originating from these cities and destinated at West Bengal. However, the overall impact shall be marginal as the Traffic plying on the project stretch is mostly West Bengal bound. The impact of Varanasi-Kolkata Expressway is assumed partially from FY27 and fully from FY28 onwards.

Construction Materials forms the key commodity travelling on the project stretch, followed by Agri Produce, Iron and Steel, and courier and parcel. Gopiballapur, Mahapal, Jhargram are the major contributors to the goods traffic on the project stretch. Project stretch and its vicinity regions such as Jhargram, Midnapore, Kolkata etc. are the key origin-destination places for the passenger traffic. Sand is the topmost commodity plying on the project stretch. There are sand blocks located near Subarnarekha River, which is in the vicinity of Chichra-Kharagpur stretch. Gopiballapur, Sankrail and Mahapal are amongst the key areas where sand mining blocks are located. However, Gopiballapur belt dominates amongst the three regions with more than ~70% mining leases in the region. West Bengal government have been taking vital decisions to regulate the sand mining processes and put a cap on illegal sand mining, the impact of which could be seen in the years to come.

Rashmi Metallics plant is situated near Kharagpur district, which is one of the important industries on the project stretch responsible for the traffic movement on the project stretch. Odisha and Kolkata are amongst the key OD pairs for the traffic due to Rashmi Metallics plant.

Traffic volume and composite of vehicles

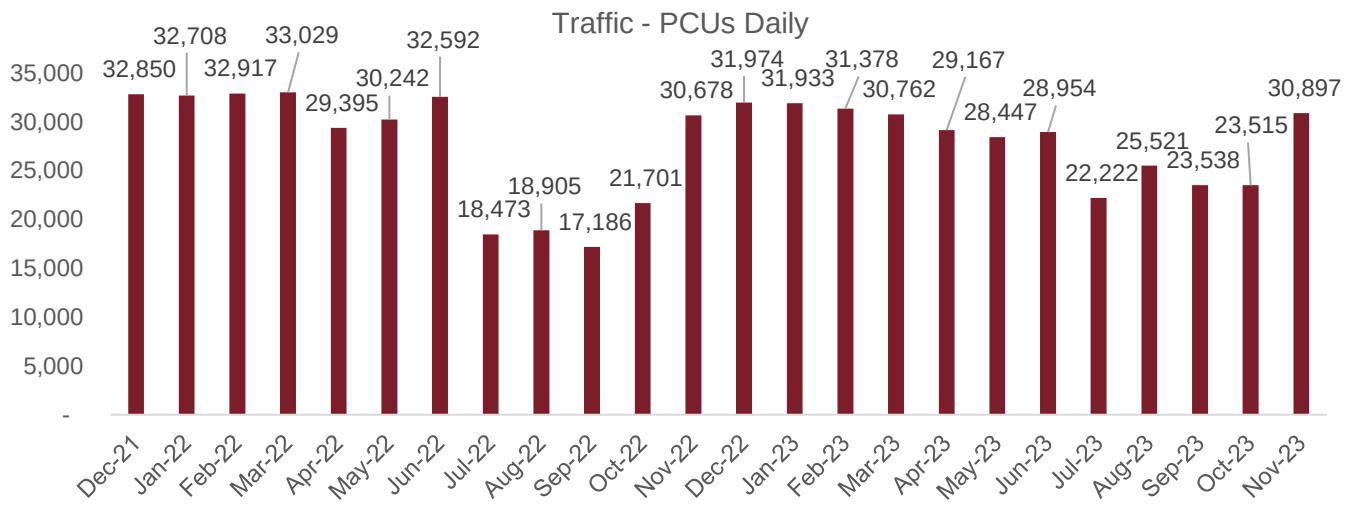
Historical traffic data

The following table shows the TVC seven-day traffic count of Chichra-Kharagpur stretch according to the Traffic Consultant:

Date	Days	Car	LCV + 2 Axle	3-axle	MAV	Total	Total (PCUs)
11/23/2022	Wednesday	2,381	3,298	1,094	3529	10,302	30,268
11/24/2022	Thursday	2,367	3,000	1,161	3865	10,393	31,197
11/25/2022	Friday	2,783	2,938	1,208	3725	10,654	30,937
11/26/2022	Saturday	2,828	2,810	1,181	3961	10,780	31,607
11/27/2022	Sunday	2,887	2,921	1,206	3767	10,781	31,237
11/28/2022	Monday	2,675	2,810	949	2968	9,402	26,453
11/29/2022	Tuesday	2,651	3,077	1,059	3607	10,394	30,164
ADT		**2,653**	**2,979**	**1,123**	**3,632**	**10,387**	**30,266**

Source: CRISIL MI&A

The chart below shows the average daily traffic on Chichra-Kharagpur stretch over December 2021 to November 2023.



Source: CRISIL MI&A

Overloading scenario on the project stretch

To ascertain the quantum of overloading, a seven day axle load survey was done by the technical consultants of the client. The results of axle load survey provided by the client, reveal that overloaded vehicles form a sizeable share of vehicles across categories. As per the survey, 49% of the MAVs, 33% of 3 axle and 11% of the 2 Axle vehicles are overloaded *(considering more than 5% overload than permissible limits).*

Sand, iron, steel, and coal are key commodities which are overloaded. Overloading is also prevalent in Chichra to Kharagpur direction primarily.

As per discussions with the client, it is proposed that overloading will be levied on 25% of MAV and 3 Axle vehicles which are overloaded for more than 20% of the threshold. The quantum of vehicles for charging overloading penalty is decided after considering the practical numbers which can be charged per lane per hour. The revenue potential is arrived at, by considering an overloading levy equivalent to 1x of single journey toll rates.

Following table shows the overloading scenario for commercial vehicles on the stretch.

Direction	Vehicle Category	Sample	>5% overload	>20% overload	>5% overload	>20% overload
Overall	MAV	571	281	171	49%	30%
Overall	2A	403	46	5	11%	1%
Overall	3A	286	95	44	33%	15%
Chichra-Kharagpur	MAV	286	216	147	76%	52%
Chichra-Kharagpur	2A	212	42	4	20%	2%
Chichra-Kharagpur	3A	136	79	42	58%	31%
Kharagpur-Chichra	MAV	285	65	24	23%	8%
Kharagpur-Chichra	2A	191	4	0	2%	0%

Direction	Vehicle Category	Sample	>5% overload	>20% overload	>5% overload	>20% overload
Kharagpur-Chichra	3A	150	16	3	10%	2%

Source: CRISIL MI&A

Toll Segmentation

The table below presents a segmentation of total traffic assessed from the toll data from January 2023 to November 2023 *(based on available data)* for the Balibhasa toll plaza of Chichra-Kharagpur stretch. The trip segmentation has been assumed to remain constant throughout the projection period i.e., over fiscals 2024 to 2044 as follows:

Vehicle category	Single journey	Return journey	Local monthly pass	Local commercial vehicles	Exemption
Car, jeep, van or LMV	34.59%	62.72%	1.63% (local non-commercial)	-	1.07%
LCV, light goods vehicle, or minibus	37.05%	61.55%	-	-	1.40%
Bus or truck (2-axle)	34.34%	65.14%	-	0.15%	0.37%
3-axle CV	64.99	34.85	-	-	0.16%
HCM, EME or MAV (4-6 axle)	53.60%	46.18%	-	-	0.22%

Source: CRISIL MI&A

The table below provides the traffic growth rates considering diversions to expressway and other alternative routes and other impact factors, as provided by the Traffic Consultant:

CAGR	FY24-25	FY25-30	FY30-40	FY24-44
Car	4.9%	4.1%	4.0%	3.9%
Bus	2.5%	2.4%	2.0%	2.1%
Minibus	2.0%	1.8%	1.6%	1.6%
LCV	4.2%	3.2%	3.0%	3.1%
2-axle	6.8%	5.0%	3.9%	4.2%
3-axle	6.5%	4.8%	4.0%	4.2%
MAV	6.0%	4.6%	3.9%	4.1%
Total PCU	**6.0%**	**4.6%**	**3.9%**	**4.1%**
Revenue growth	**8.1%**	**9.3%**	**8.1%**	**8.3%**

Note: Revenue growth includes overloading levies
Source: CRISIL MI&A

Vehicle Type	FY24	FY25	FY30	FY40	FY43
Car	2,949	3,094	3,782	5,583	6,185
Bus	120	123	138	168	177
Minibus	106	109	119	139	145

Vehicle Type	FY24	FY25	FY30	FY40	FY43
LCV	233	242	284	382	415
2-axle	1,679	1,793	2,287	3,360	3,730
3-axle	1,050	1,118	1,416	2,088	2,322
MAV	3,777	4,005	5,007	7,312	8,111
Total	9,915	10,484	13,033	19,031	21,086
Total PCU	29,003	30,744	38,440	56,115	62,214

Tollable Length and Toll Rates

In terms of tollable length, the Chichra - Kharagpur Project comprises 56.667 kms of 4-Lane equivalent length and 6.094 kms of 2-Lane equivalent length, which sums up to 62.761 kms of total tollable length. In India, toll rates are as per notification by the Ministry of Road Transport and Highways in the National Gazette. The present toll rates are determined with reference to the published base toll rates and are adjusted annually at the beginning of each fiscal year equal to 40% of the movement in the wholesale price index in December of the preceding year plus a fixed 3%.

Single toll rates in INR at the Balibhasa toll plaza, calculated as per schedule-M data, applicable until March 2024 are as provided below:

Type of Vehicle	SJ: Balibhasa
CJV	90
LCV	145
Bus/Truck	305
3A	330
MAV/ HCM/EME	475
OSV	580

Source: CRISIL MI&A

2 Objective and background

The client appointed CRISIL Market Intelligence and Analytics (MI&A) to undertake a study to analyse investment attractiveness of Chichra-Kharagpur Road stretch (km 185+150 (Design Ch. 16+130) of NH-49 at Chichra and ends at km 129+000 (Design Ch. 72+250). CRISIL MI&A conducted a detailed traffic study and provided traffic & revenue projections for the road stretch under consideration for the period FY24-44 (including the traffic survey required to undertake the study).

CRISIL MI&A's report intends to facilitate investment decisions based on a detailed assessment of the road stretch, using derived yearly toll revenue and revenue risk for the road stretch.

Table 1 Details of the road stretch

Project stretch	State	Toll plaza	Length (km)
Four Lane Chichra-Kharagpur stretch (km 185+150 of NH49 at Chichra and ends at km 129+000)	West Bengal	Balibhasa Toll Plaza	56.120

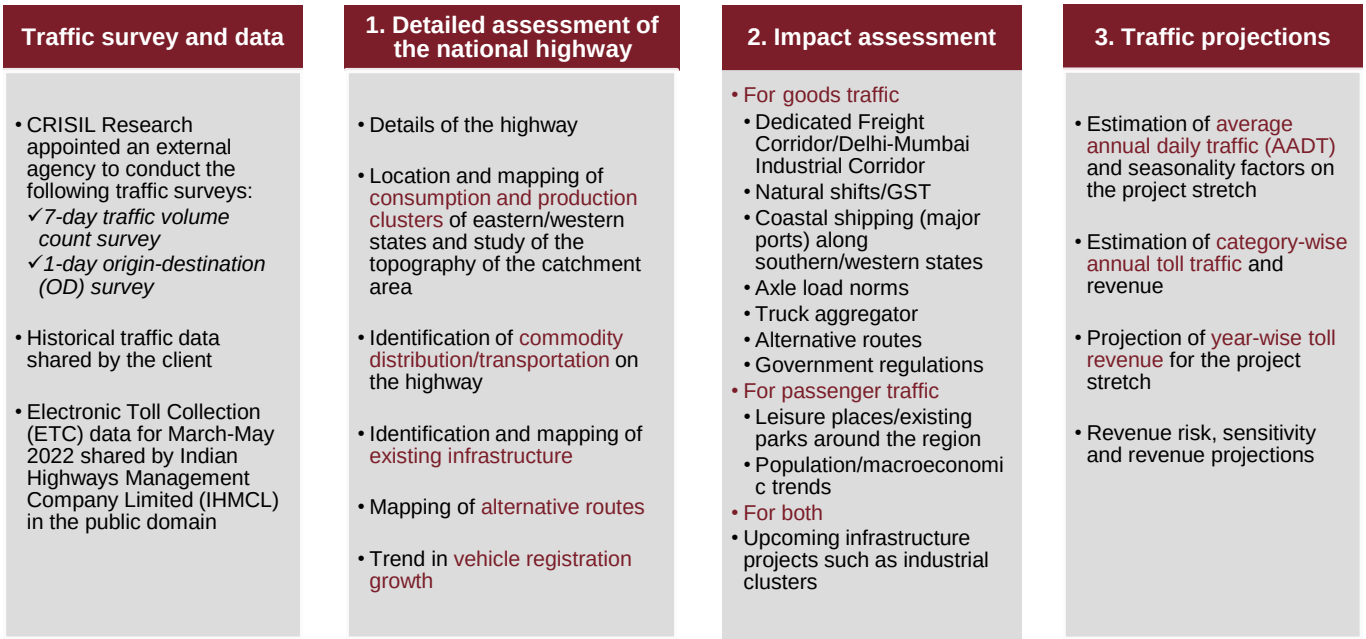
The report is divided into the following sections:

- Section I: Detailed assessment of the project stretch
- Section II: Growth and impact factor assessment
- Section III: Traffic and revenue projections for the project stretch

3 Approach and methodology

CRISIL Research conducted a detailed traffic assessment to understand the composition of current traffic for the stretch and various growth drivers and impact factors for this traffic and arrive at traffic projections. Traffic for the stretch has been projected by factoring in traffic composition (vehicle category share, commodity carried by freight traffic vehicle categories, and origin-destination locations), outlook on production and consumption centres, alternative routes, and other factors impacting road traffic. This study helped us assess the project's traffic growth against key macro- and socio-economic parameters, and thus comment on the future prospects of the stretch.

Figure 1: Overview of approach and methodology for the study



Source: CRISIL Research

CRISIL has used its proprietary traffic projection methodology to project traffic using regional industry growth assumptions, macroeconomic developments, infra development and consumption centre growth factors of the catchment area and adjacent regions.

CRISIL, based on its coverage of 80+ sectors and the MSME industry, has developed a knowledge base to understand the growth of industries and demand across various regions and clusters. The growth expectations for various industries are applied to each vehicle category based on the commodity composition of the vehicle category. For example, the share of light commercial vehicles (LCVs) carrying agricultural commodities is expected to grow as per agricultural output growth; the share of LCVs carrying consumer products is expected to grow as per the volume growth of durables; and the share of Multi axle vehicles (MAVs) carrying steel commodities is expected to grow as per demand/supply volume of steel products based on regional dynamics. This approach helps CRISIL provide a more accurate growth rate of commercial traffic in the region.

For passenger traffic, CRISIL assesses the sale of passenger cars in the region, growth of vehicular population, purpose and frequency of passenger travel, population growth, expansion of the city, and infrastructure development in the catchment area.

Further, CRISIL also examines the various factors that will impact traffic over the concession period, such as upcoming alternative road routes, truck aggregation by logistics players, dedicated freight corridors and other transportation options. Thus, the analysis considers the impact of central and state policies, growth in production and consumption centres along the stretch, and infrastructure in the adjoining regions. The report covers both growth drivers and restraints for the traffic along the stretch. CRISIL has enumerated and detailed the parameters that will positively/negatively impact the traffic on the stretch in the future.

CRISIL's methodology is appropriate for the traffic study of Chichra-Kharagpur stretch

Construction Materials is the topmost commodity on the stretch, sand tops as the sub-commodity

Construction Materials is the largest commodity on the project stretch and it is majorly dominated by Sand (~67% of the entire construction materials sample). Sand mining is prevalent in the vicinity of stretch, as Subarnarekha River is close to the stretch. The traffic on the project stretch is majorly due to the movement of vehicles carrying construction materials like sand, cement. Sand mining is considered to be an irregulated activity, where tracking of its growth becomes little tricky. Despite state government's efforts, there exists some percentage of Sand Mining activities that still falls under the scanner of unlawful measures.

CRISIL's methodology considers in-depth analysis of the District Survey Reports of the districts in the vicinity of project stretch and gives an outlook on the future of sand mining in the state based on the past trends. The mapping of sand mining leases and how are they placed in the coming years becomes important in this case, as there are multiple sand mining blocks near one river that could be responsible for the traffic movement in and around those blocks. CRISIL has mapped all the existing and upcoming leases to analyse the impact of sand mining on the traffic growth. For this reason, CRISIL's method is more appropriate for the road stretch.

Agri produce commodity accounts for nearly 10-12% of the total traffic on the project stretch

Agri produce is the second largest commodity observed on the project stretch. The commodity is composed of food grains, fruits and vegetables. As per the survey conducted during the course of this traffic study, in terms of vehicle wise composition, the category is made up of 43% LCVs, 33% of MAV, 16% of 2-axle and 8% of 3-axle. In total, the Agri produce accounts for 10.5% of the traffic on the stretch

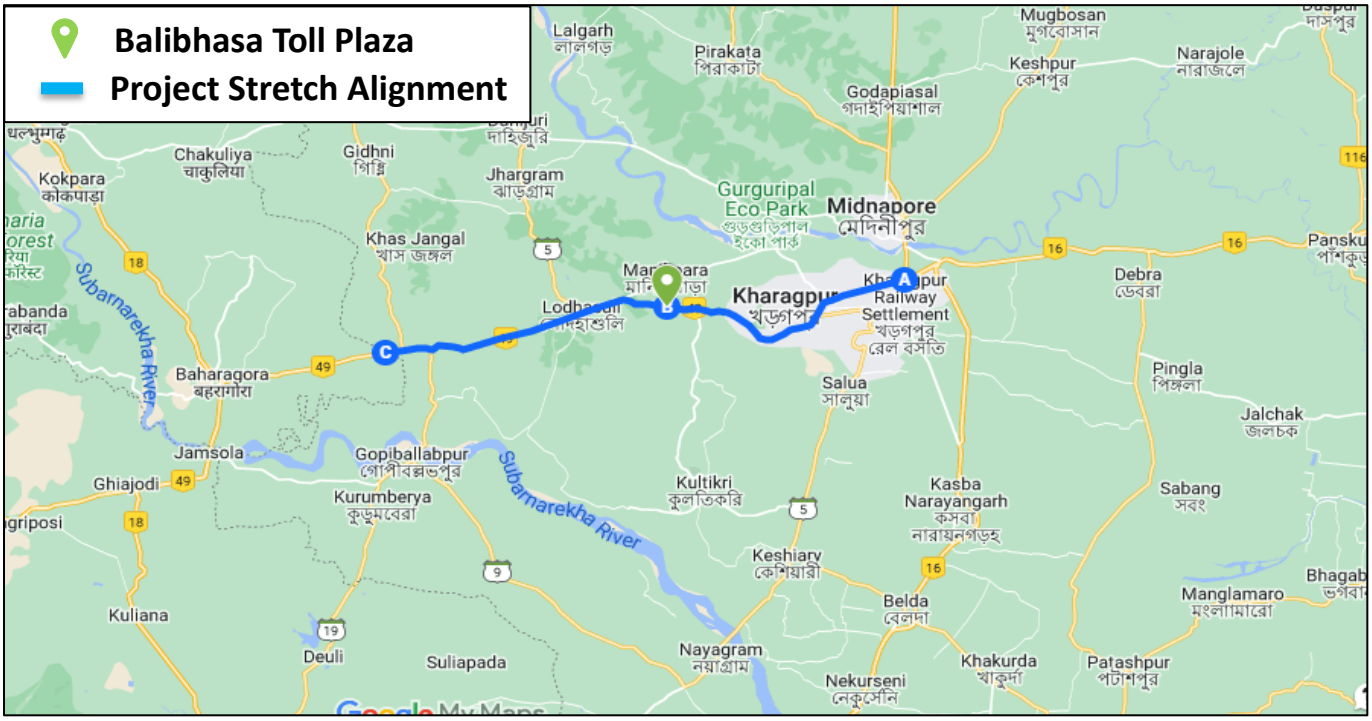
CRISIL's methodology considers the growth of the Agri produce commodity at the regional level to derive the traffic growth of each vehicle category. Growth in Agri produce is highly volatile as it depends on the positive outcome of the monsoon season. Hence on a long-term period, it grows at low rate compared to the aggregate GDP. Given the high proportion of the Agri produce on the stretch, it's imperative to assess it at a regional and commodity level, compared to a macroeconomic level. This is evident, considering only the macro level growth. The India GVA (constant prices) from agriculture, forestry & fishing has grown at a CAGR of 3.5% over FY12-22 while the GDP growth of India during the same period has been 5.4% CAGR. For this reason, CRISIL's method is more appropriate for the road stretch.

4 Overview of project stretch

Project stretch delineation

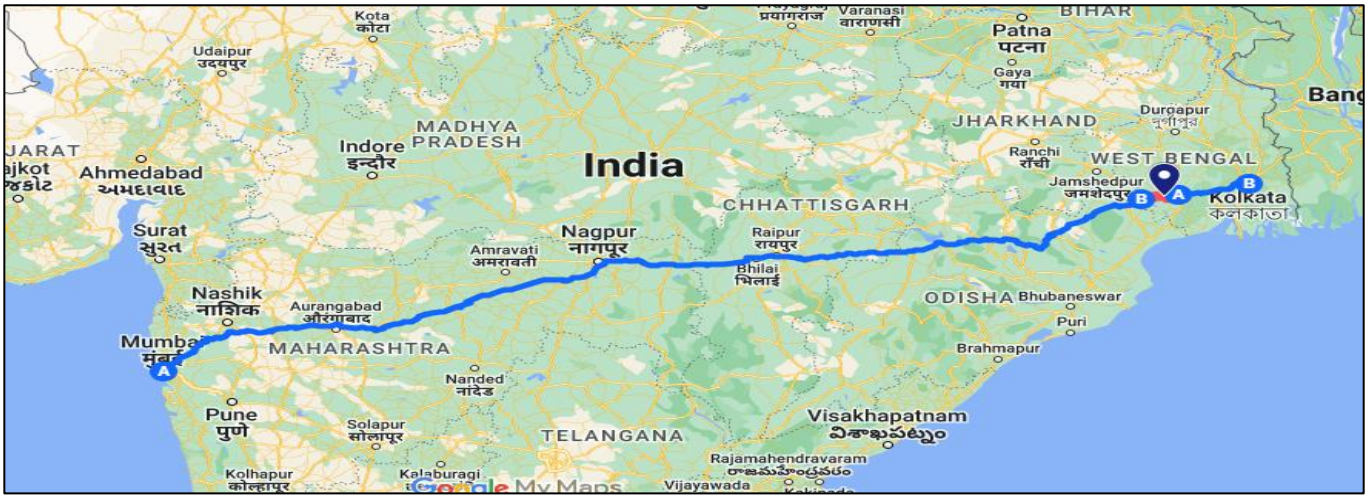
The Chichra-Kharagpur section of NH-49 connects the districts of Chichra and Kharagpur in West Bengal. The project stretch has one toll plaza – Balibhasa Toll Plaza – that lies at the chainage of km 157+915. The project stretch is a part of East-West connectivity between Mumbai and Kolkata.

Figure 2: Project stretch alignment



Source: Google Maps, CRISIL MI&A

Figure 3: Project stretch alignment with regard to East-West connectivity



Source: Google Maps, CRISIL MI&A

Table 2: Key details of project stretch

Project Stretch	NH-49 (km 185+150 to km 129+000)
Authority	National Highway Authority of India
No. of lanes	4-lane configuration
Project type	Tolling, Operations, Maintenance & Transfer
Length of Project Stretch	56.120 km
No. of Toll Plaza(s)	01
Name of Toll Plaza(s)	Balibhasa toll plaza (Ch. - km 157+915)

Source: NHAI, CRISIL MI&A

Secondary Data available for the assessment

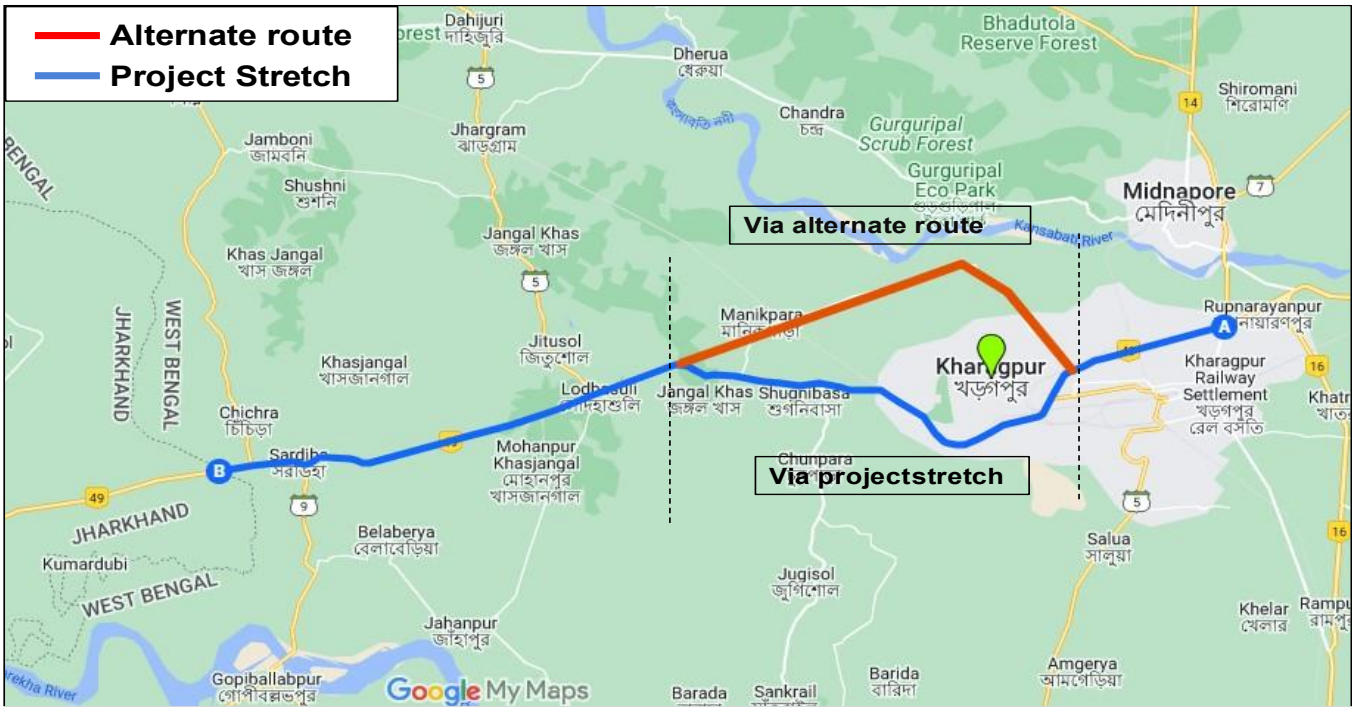
Balibhasa TP	
ETC segmented data	Data is available from May 22 to November 23 **June 22 data unavailable**
TMS data – includes tollable traffic (Cash + FASTag)	Data available from April-22 to November-22 (Overall level) November-22 to July-23 (Vehicle level)
ETC data at a vehicle category level	Data is available from April 2020 to Oct 2022

ETC Segmented data (which has details of Single Journey, Return Journey, Monthly traffic) was available from May 2022 to November 2023, with unavailability of data for June month in that period. TMS Data was available from April 2022 to November 2022, on an overall level, while for November 2022 to July 2023 data has details on vehicle category level. The November 2022 to July 2023 data is used in the assessment for calculation of Exempted and violated traffic, along with cash paying traffic. Besides these, ETC data for all categories of vehicles was available from April 2020 to October 2022. All these data points are used for the overall assessment of traffic and revenue for the project stretch.

Current alternative routes to project stretch

The project stretch is used by the traffic originating and destined in regions such as Kharagpur, Gopiballapur, Midnapore, Kolkata from West Bengal and some portion from Jharkhand and Odisha too. The present alternate route allows the traffic to bypass the Toll Plaza but takes almost double the time than that via equivalent project stretch route. The alternate route is a 2-Lane Road, and it passes through multiple small villages. The road has some construction work going on, on patches, which makes it a non-likely option for the commercial traffic to take this route.

Figure 4: Alignment of current alternative routes and project stretch

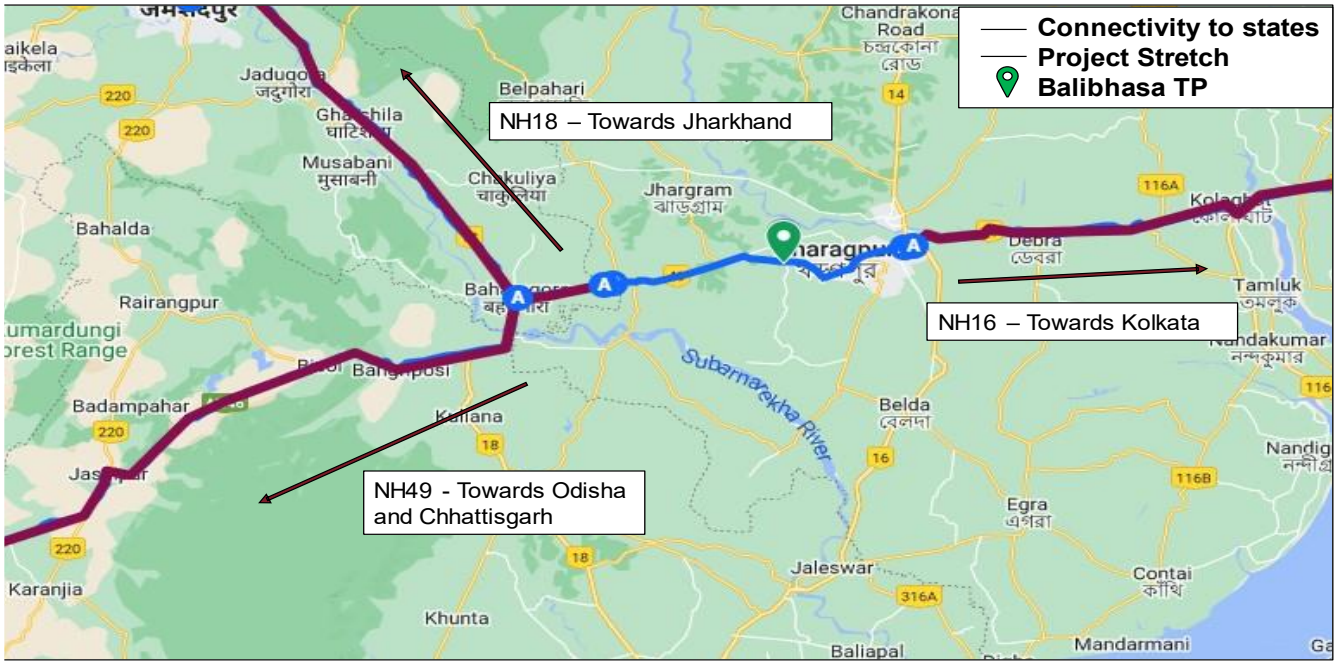


Source: Google Maps, CRISIL MI&A

Network in the vicinity of project stretch

The project stretch provides connectivity to Jharkhand via NH18, and Odisha and further, Chhattisgarh via NH49. NH16 connects Kolkata to Kharagpur, which is the starting point of the project stretch. Due to connectivity to major cities in the vicinity, the project stretch serves as the important route for traffic traversing in East-West direction.

Figure 5: Road network in the vicinity of project stretch



Source: Google Maps, CRISIL MI&A

4. Traffic assessment of project stretch

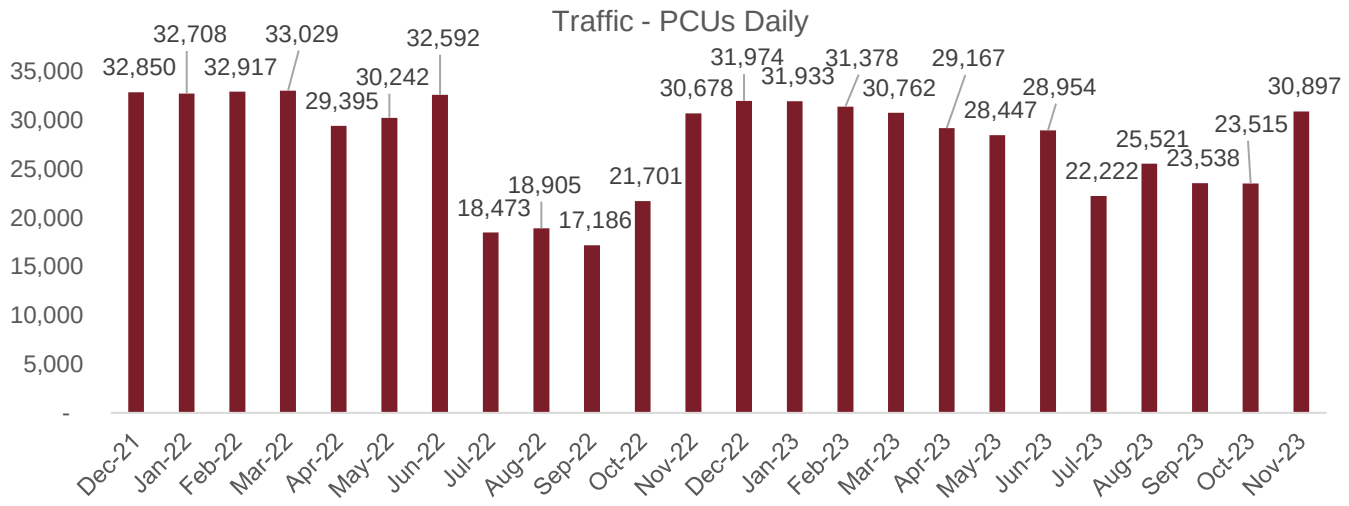
Review of traffic at Balibhasa toll plaza

MAVs contribute 59% to Balibhasa plaza's traffic in PCUs; ETC is the dominant payment method across vehicle categories.

The project stretch saw steady traffic growth during the period Dec-21 to Aug-23; however, there was a dip in traffic during July-October-22 months due to the ban on Sand Mining near the banks of Subarnarekha River, which is close to the project stretch and contributes for the significant traffic movement on the stretch, thus carrying sand to the nearby locations. There was an official order issued by the District Magistrate of Jhargram District, which states that there shall be a ban on sand mining activities near Subarnarekha River (Gopiballapur Region) owing to monsoon period and its implications on environmental commitments. Traffic in July to October-22 period is subdued due to sand mining ban, vis-à-vis other months.

In first quarter of fiscal of 2024, traffic was subdued due to labour shortage and slump in construction activity due to Panchayat elections. The traffic in July, August and September 23 – the monsoon months, was relatively better due to lower rainfall and pent-up activity resumption.

Table 3: ETC Traffic from Dec 21 – Nov 23 in PCUs



Apr-2023 ADT is based on 25 days, as plaza was non-operational for 5 days
Source: NHAI, CRISIL MI&A

Table 4: ADT volume recorded on project stretch in April 2023-November 2023 (ETC Traffic)

Vehicle category	Traffic volume (vehicles)	Traffic volume (PCUs)	Share (%) - PCUs
Cars/Jeep/Van	2,732	2,732	10%
LCV	308	462	2%
2-Axle	1,539	4,616	17%

Vehicle category	Traffic volume (vehicles)	Traffic volume (PCUs)	Share (%) - PCUs
3-Axle	958	2,873	11%
MAV	3,516	15,823	60%
Total	**9,053**	**26,506**	**100%**

Source: Toll plaza data, CRISIL MI&A

Based on November 2022 to July 2023 data received from client, the cash component (as % of ETC traffic) is lower for categories such as cars (~1.8% vehicles use cash), 2-axles (~0.1%), 3-axles (~0.1%) and MAVs (0.1%). It is largely prevalent in the LCV category, where nearly 3.9% of LCVs use cash and pay the non-ETC penalty.

Table 5: Vehicles using various payment methods (As % of ETC traffic)

Vehicle category	Cash	Exemption
Car/jeep/van	1.8%	1.1%
LCV	3.9%	1.5%
2-axle	0.1%	0.4%
3-axle	0.1%	0.2%
MAV	0.1%	0.2%

Note: The percentages are based on cash and exempted traffic over November 2022-July 2023, across vehicle categories

Source: Toll Plaza data, CRISIL MI&A

Analysis of ETC data shows that traffic in PCU terms grew by 3% on-year for Jun-Mar period of fiscal 2023. Traffic grew by 8% during April-September period of 2023. Traffic for 2 Axle and 3 Axle vehicles has declined, while growth for MAVs remained strong. Traffic growth for Apr-Sep period is high due to activity resumption post Panchayat elections in July 2023 and deficit rainfall observed in fiscal 2024 around the project stretch.

Table 6: Traffic growth

Period	CJV	LCV	2 Axle	3 Axle	MAV	Total	PCU	On Year growth
Jun-Mar FY22	2,624	302	2,261	1,251	2,718	9,157	25,846	
Jun-Mar FY23	2,579	310	1,972	1,018	3,221	9,100	26,508	3%
April-Nov FY23	2,453	323	2,142	1,027	2,758	8,702	24,854	
April-Nov FY24	2,732	308	1,539	958	3,516	9,053	26,506	6.6%

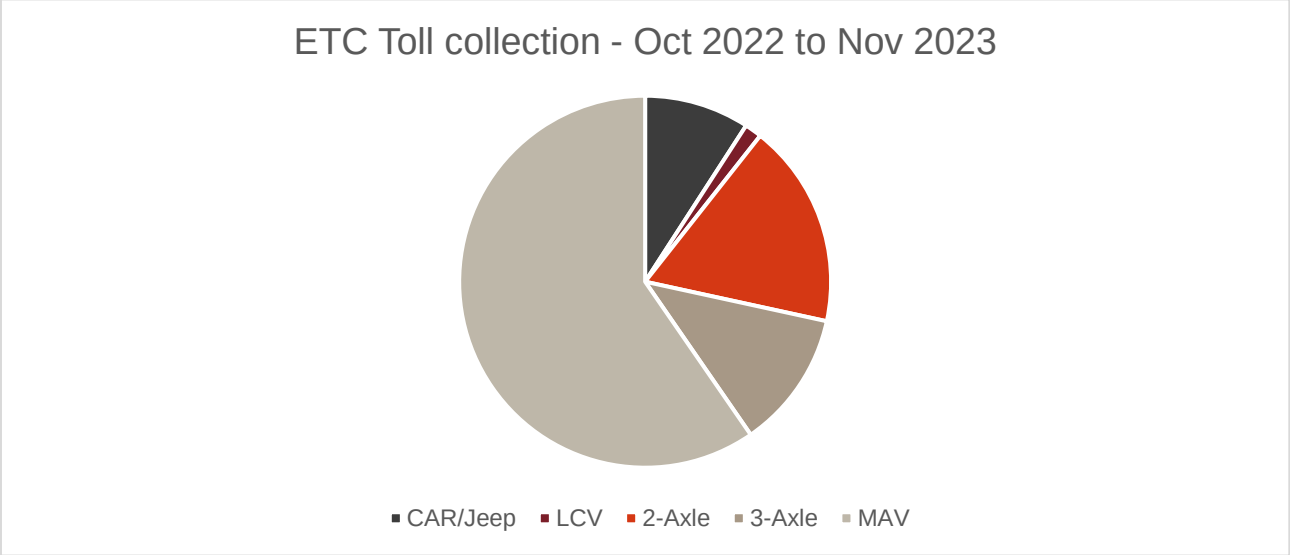
Source: Toll Plaza data, CRISIL MI&A

Table 7: Per day ETC collection of the project stretch from December 2021 to November 2023

Month-Year	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sept-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23
Per day ETC collection (Rs million)	2.14	2.26	2.29	2.27	2.26	2.41	2.64	1.61	1.62	1.54	1.68	2.54	2.64	2.63	2.61	2.57	2.13	2.49	2.52	2.01	2.28	2.11	2.11	2.70

Source: Toll plaza data, CRISIL MI&A

Figure 6: Share (%) of vehicle categories in the ETC toll collection of the project stretch



Note: The percentages are the average of ETC collection share of vehicles over Oct 2022 to Nov 2023
Source: Toll Plaza data, CRISIL MI&A

Review of traffic survey results

CRISIL appointed a traffic consultant who conducted traffic surveys on the following dates. Additionally, a site visit was also done in August 2023 (21st and 22nd) and December (22nd) to understand trends and tonnage shifts in commercial vehicle movement, particularly for sand carrying vehicles. Transporter interactions were conducted to identify the vehicular preferences for the nature of load carried. Views of other stakeholders, such as sand miners, plaza manager etc. were also taken regarding traffic patterns.

Table 8: Details of traffic surveys conducted for the assessment

Survey details			
Survey name	**Survey location**	**Duration**	**Date**
Traffic volume count survey	Balibhasa Toll Plaza	7 days	November 23-29, 2022
Origin-destination survey	Balibhasa Toll Plaza	1 day	November 24, 2022

Origin-destination survey	Balibhasa Toll Plaza	1 day	December 29, 2023

Two TMC surveys were also conducted around toll plaza. Details given in Assessment of Impact factors section.
Source: CRISIL MI&A

CRISIL conducted TMC and OD survey in December 2023 as well to understand the traffic characteristics, state influence and commodity profile for the asset.

Traffic volume count (TVC) survey recorded 10,387 vehicles on an average; recorded survey traffic volume is close to the actual traffic numbers

The ADT numbers were obtained by taking the average of the volume count numbers of seven days of the traffic survey. For the period, the actual traffic has been compared. There is a noticeable difference in numbers for one day i.e., 28th November 2022, which could be possibly due to classification mismatch. For the rest of the days, survey numbers are close to the actual numbers.

Table 9: Details of traffic recorded in the TVC survey conducted for the assessment

Date	Days	Car	LCV + 2 Axle	3-axle	MAV	Total	Total (PCUs)
11/23/2022	Wednesday	2,381	3,298	1,094	3529	10,302	30,268
11/24/2022	Thursday	2,367	3,000	1,161	3865	10,393	31,197
11/25/2022	Friday	2,783	2,938	1,208	3725	10,654	30,937
11/26/2022	Saturday	2,828	2,810	1,181	3961	10,780	31,607
11/27/2022	Sunday	2,887	2,921	1,206	3767	10,781	31,237
11/28/2022	Monday	2,675	2,810	949	2968	9,402	26,453
11/29/2022	Tuesday	2,651	3,077	1,059	3607	10,394	30,164
ADT		**2,653**	**2,979**	**1,123**	**3,632**	**10,387**	**30,266**

Source: CRISIL MI&A

The TVC survey data and the actual traffic are similar, except for the MAV category. The LCV and 2-axles are to be looked at together since the survey data has a classification error between the two vehicle categories. The ADT of the MAV category in the survey is 2,968 compared with the actuals recorded of 3,302 vehicles.

Table 10: ETC Traffic Data for the survey period

Date	Days	Car	LCV + 2-axle	3-axle	MAV	Total	Total PCUs
11/23/2022	Wednesday	2,298	3,176	1,144	3,502	10,120	30,435
11/24/2022	Thursday	2,296	2,905	1,134	3,827	10,162	31,123
11/25/2022	Friday	2,716	2,880	1,167	3,764	10,527	31,305
11/26/2022	Saturday	2,710	2,917	1,119	3,884	10,630	31,759
11/27/2022	Sunday	2,800	2,969	1,196	3,727	10,692	31,552

11/28/2022	Monday	2,397	2,758	1,012	3,302	9,469	28,035
11/29/2022	Tuesday	2,604	2,918	1,078	3,572	10,172	30,132
ADT		**2,546**	**2,932**	**1,121**	**3,654**	**10,253**	**30,620**

Source: CRISIL MI&A

Table 11: ETC vs TVC data comparison

ETC and TVC traffic volume comparison						
Average daily traffic	***Car***	***LCV + 2-Axle***	***3 axle***	***MAV***	***Total***	***Total PCUs***
ETC	*2,571*	*2,961*	*1,140*	*3,713*	*10,384*	*31,051*
Cash (Nov 2022 TMS)	*47*	*17*	*1*	*4*	*70*	
Exemption (Nov 2022 TMS)	*64*	*23*	*2*	*5*	*94*	
ETC + Cash + Exemption	*2,682*	*3,001*	*1,142*	*3,722*	*10,548*	
TVC Survey	*2,650*	*3,007*	*1,152*	*3,742*	*10,551*	*30,902*

Average considered for 23 Nov to 27 Nov and 29 Nov
Exemption vehicles are available on overall level. Mix considered same as cash vehicles.
Source: CRISIL MI&A

Annual average daily traffic for fiscal 2024 estimated based on actual traffic volume for eight months

In order to derive the annual average daily traffic (AADT) for fiscal 2024, we have considered actual ETC data for eight months (Apr-Nov) of fiscal 2024, while other four months (Dec-Mar) of the fiscal are projected. Projected ETC AADT for the fiscal is expanded based on share of cash and exemption traffic, estimated from TMS data, to arrive at total AADT for the fiscal.

Annual aggregate freight for fiscal 2024 is estimated by considering a growth rate (9.5% over fiscal 2023 tonnage), based on commodity profile of toll plaza. The annual aggregate freight is segmented into freight carried by respective vehicle categories, based on trends in tonnage carried by respective vehicle categories during post monsoon period of fiscal 2023 and pre-monsoon period of fiscal 2024. This tonnage is subsequently converted to number of vehicles.

To assess the annual average daily traffic (AADT) for fiscal 2024, the vehicular trends for the asset are assessed and presented in the below table. From the fiscal 2023 traffic data, it is observed that traffic of 2 Axle vehicles has declined in post-monsoon (Q3 and Q4) period of the fiscal vis-à-vis pre-monsoon (Q1) period. Traffic of MAVs increased during corresponding period, indicating a tonnage shift from 2 Axle Vehicles to MAVs.

Table 12: Vehicular trends – FY23 and FY24 H1

Fiscal Year	Quarter	CJV	LCV	2A	3A	MAV	Total	PCU
FY23	Q1	2,559	368	3,447	1,279	2,989	10,641	30,737

Fiscal Year	Quarter	CJV	LCV	2A	3A	MAV	Total	PCU
	Q2	2,312	291	995	840	2,211	6,647	18,199
	Q3	2,633	309	2,127	1,024	3,454	9,546	28,090
	Q4	2,790	319	2,198	1,128	4,025	10,460	31,357
FY24	Q1	2,707	322	2,116	1,069	3,579	9,793	28,851
	Q2	2,630	293	1,039	890	3,313	8,165	23,763
	Oct-Nov	2,925	308	1,431	894	3,729	9,288	27,146

Source: Toll data, CRISIL MI&A

Estimated fiscal 2024 AADT is provided below. This incorporates the impact of the tonnage shift as well as deficit rainfall observed in fiscal 2024 monsoons. This is juxtaposed with freight growth expectations for fiscal 2024 vis-à-vis fiscal 2023 and vehicular mix for LCV, 2A, 3A and Multi Axle vehicles. The fiscal 2024 AADT translates to 6.4% growth in terms of PCU vis-à-vis fiscal 2023.

Estimated AADT[1] for fiscal 2024 takes into consideration the ETC traffic, daily cash paying and the exempted traffic. The daily cash paying and exempted & violating traffic was derived based on Nov-22 to July-23 traffic from TMS traffic data.

Table 13: Projected FY24 AADT for the project stretch

Year	CJV	LCV	2A	3A	MAV	Total	PCU
FY24P	**2,949**	**339**	**1,799**	**1,050**	**3,777**	**9,915**	**29,003**

Source: Toll Plaza data, CRISIL MI&A

Origin-destination survey

CRISIL appointed a traffic consultant to conduct a 24-hour (O-D) survey at Balibhasa toll plaza. The survey was undertaken on November 24, 2022. The total size of the sample collected is a minimum of ~60% across each vehicles category.

Table 14: Details of sample collected in the O-D survey conducted for the assessment

O-D survey sample (%)	
Vehicle category	**Balibhasa TP**
Cars/Jeep/Van	57%
Bus	64%
Minibus	46%
LCV	76%
2-Axle	71%
3-Axle	77%
MAV	75%

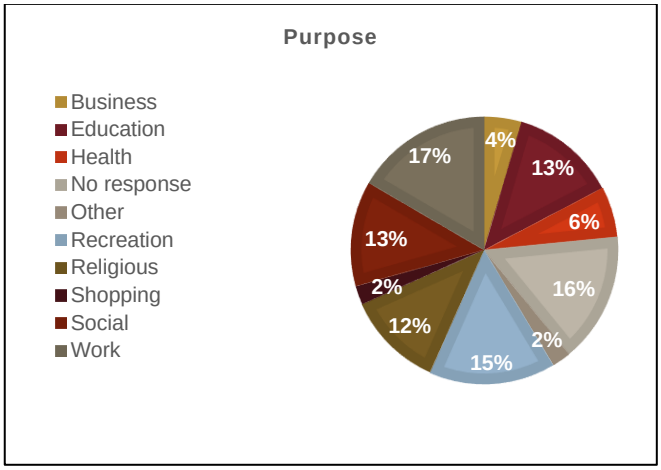
[1] *Methodology for AADT calculation is provided in Annexure-1*

Source: CRISIL MI&A

Passengers Traffic is largely West Bengal bound, with Jhargram, Gopiballapur, Kolkata and Midnapore districts as the key origin-destination pairs

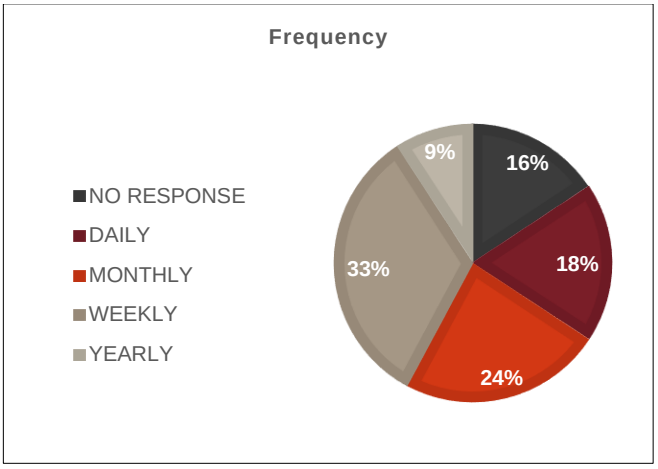
The O-D survey noted responses of the passengers on the traffic plying on the project stretch. These queries included purpose of the visit, frequency of travelling, origin point, and destination point. In terms of the purpose of travelling, passengers of 15% of the vehicles cited recreation, followed by social reasons and education (13% each). In terms of frequency, 33% cited weekly travel, 24% monthly travel, 18% daily travel, and the rest cited yearly travel.

Figure 7: Trip purpose of the passenger traffic at toll plaza as per O-D survey



Source: CRISIL MI&A

Figure 8: Trip frequency of the passenger traffic at toll plaza as per O-D survey



Source: CRISIL MI&A

The O-D survey revealed the key origin point and destination points for the passenger traffic are Jhargram, Kolkata, Gopiballapur, Midnapore; which lies in the vicinity of project stretch. The same pattern is noted in both directions, i.e., towards Chichra and towards Kharagpur.

Table 15: Key O-D regions for passenger traffic at toll plaza in Chichra to Kharagpur direction

Origin	%	Destination	%
West Bengal	**56%**	**West Bengal**	**100%**
Jhargram	*47%*	*Kolkata*	*31%*
Gopiballapur	*14%*	*Midnapore*	*27%*
Manikpara	*13%*	*Kharagpur*	*16%*
Lodhasuli	*7%*	*Guptamoni*	*6%*
Jharkhand	**25%**	**West Bengal**	**100%**
Orrisa	**19%**	**West Bengal**	**100%**

Source: CRISIL MI&A

Table 16: Key O-D regions for passenger traffic at toll plaza in Kharagpur to Chichra direction

Origin	%	Destination	%
West Bengal	**100%**	**West Bengal**	**63%**
Midnapore	*20%*	*Jhargram*	*38%*
Kharagpur	*16%*	*Gopiballapur*	*9%*
Kolkata	*13%*	*Lodhasuli*	*7%*
Guptamoni	*4%*	*Manikpara*	*7%*
West Bengal	**100%**	**Jharkhand**	**24%**
West Bengal	**100%**	**Orrisa**	**11%**

Source: CRISIL MI&A

West Bengal, Jharkhand, Orrisa form key O-D states for the stretch, contributes to ~87% of the entire origin points

The Chichra-Kharagpur section is an important stretch for Sand Mining traffic originated from Gopiballapur, near Subarnarekha River and traversing towards Kolkata. There is Rashmi Metallics Plant located in Kharagpur, which is another important source of traffic, carrying commodities like Iron & Steel and Construction Materials. The project stretch also serves as an important link for East-West connectivity which connects West Bengal with Maharashtra.

Table 17: Key O-D regions for goods traffic at toll plaza in Chichra to Kharagpur direction

Origin	%	Destination	%
West Bengal	**59%**	**West Bengal**	**98%**
Gopiballapur	*37%*	*Kolkata*	*14%*
Mahapal	*13%*	*Kharagpur*	*12%*
Jhargram	*11%*	*Midnapore*	*9%*
Lodhasuli	*10%*	*Haldia*	*7%*
Balibhasa	*3%*	*Rashmi Metallics Ltd*	*5%*
Jharkhand	**17%**	**Bangladesh**	**1%**
Orrisa	**11%**	**Assam**	**0.5%**
Maharashtra	**7%**		
Uttar Pradesh	**1%**		
Chhattisgarh	**1%**		
Bihar	**1%**		
Madhya Pradesh	**1%**		
Gujarat	**2%**		
Other states	**2%**		

Source: CRISIL MI&A

Table 18: Key O-D regions for goods traffic at toll plaza in Kharagpur to Chichra direction

Origin	%	Destination	%
West Bengal	**98%**	**West Bengal**	**56%**
Kolkata	*10%*	*Gopiballapur*	*23%*
Kharagpur	*9%*	*Mahapal*	*16%*
Midnapore	*6%*	*Jhargram*	*12%*
Haldia	*6%*	*Lodhasuli*	*7%*
Rashmi Metallics Ltd	*5%*	*Balibhasa*	*4%*
Panskura	*5%*	*Jitusol*	*3%*
Debra	*4%*	*Chichra*	*3%*
Belda	*2%*	**Jharkhand**	**21%**
Assam	**1%**	**Orrisa**	**9%**
Bangladesh	**1%**	**Maharashtra**	**5%**
		Chhattisgarh	**2%**
		Uttar Pradesh	**2%**

Source: CRISIL MI&A

Construction materials forms the key commodity travelling on the project stretch, followed by Agri produce and Iron & Steel Products

The O-D survey recorded the key commodities travelling the road stretch. The survey provides the share of vehicles for each commodity. The largest commodity is construction materials as per the survey, accounting for ~27% of the goods vehicles (LCV, 2-axle, 3-axle, and MAV) travelling the project stretch. This comprises sand, cement, stones. This is followed by Agri produce, which comprises 10.5% goods vehicles. Other key commodities are iron & steel products at 10% and courier & parcel at 5.1%. Empty vehicles are ~20% of the total goods vehicles as per the O-D survey.

Table 19: Commodity share (%) based on O-D survey

Commodity	LCV	2-axle	3-axle	MAV	Total
Construction materials	43.9%	30.4%	8.9%	21.4%	26.3%
Empty	29.4%	23.6%	10.8%	16.4%	19.8%
Agri Produce	6.5%	6.1%	28.6%	7.7%	10.5%
Iron & Steel Products	3.5%	12.2%	5.5%	14.5%	10.0%
Courier & parcel	2.7%	4.2%	7.3%	6.0%	5.1%
Consumer Products	1.0%	2.3%	11.0%	4.5%	4.4%
Plastic products	2.7%	2.7%	4.0%	3.6%	3.3%
Chemical products	1.6%	2.2%	0.7%	4.6%	2.9%
Petroleum Products	1.0%	3.8%	0.0%	3.7%	2.4%
Others	1.2%	1.0%	3.1%	3.3%	2.4%
Machinery	1.1%	1.3%	0.5%	3.6%	2.2%
Coal	0.5%	3.0%	0.5%	3.0%	2.0%
Textile & Footwear	1.1%	1.5%	5.1%	1.2%	1.8%
Consumer Foods	1.1%	0.1%	5.4%	0.4%	1.3%
Automobiles	0.2%	2.2%	0.6%	1.9%	1.3%
Tiles & Ceramic products	0.9%	0.7%	1.5%	1.4%	1.2%
Paper products	0.5%	1.1%	2.3%	0.5%	0.9%
Plywood & Timber products	0.3%	0.5%	1.1%	1.1%	0.8%
Pharmaceuticals	0.4%	0.8%	0.9%	0.5%	0.6%
Rubber products	0.3%	0.1%	0.7%	0.4%	0.4%
Milk & Animal Food	0.2%	0.1%	1.2%	0.0%	0.3%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

As per the OD Survey conducted in December 2023, there is no major change in the state influence and commodity profile vis-a-vis the OD survey conducted in November 2022.

Note: Green highlighted cells represent the top 5 commodity in each vehicle category.

Review of commodity growth rate assumptions

CRISIL Research's traffic projections are based on volume growth of commodities being transported on the road stretch. The below listed growth rates are assumed for the traffic study. These growth rates are applied to the traffic volume of vehicle categories based on the share of each vehicle category across various commodity categories (mentioned earlier in the report).

Construction Materials is the largest commodity on the project stretch. Due to sand mining activities near the project stretch, there is traffic movement carrying sand as the major commodity followed by cement and other construction materials like stones, fly ash, bitumen. West Bengal is the dominant origin state followed by Jharkhand. Within West Bengal, Gopiballapur is the top origin point which is situated near the banks of Subarnarekha River. Similarly, the dominant destination state is again West Bengal followed by Jharkhand. The topmost destination districts are Haldia, Kharagpur, Midnapore.

Agri Produce is the second largest commodity on the stretch. Largely, it is the combination of seasonal crops and horticulture in the proportion of ~60-40% respectively. Here, the major origin state is West Bengal which is approximately ~74% of the entire Agri Produce sample, followed by Maharashtra, Jharkhand, and Odisha which combinedly comprises of ~22% share. Similarly, West Bengal is the dominant destination state, followed by Jharkhand and Odisha.

The iron and steel produce is the third largest commodity, which largely originates from West Bengal, Jharkhand, and Odisha. Among the top origin areas in West Bengal are Lodhasuli, Kolkata, Kharagpur. Similarly, West Bengal followed by Jharkhand and Odisha are the key destination states. In that, Kharagpur, Rashmi Metallics, Kolkata is amongst the top destination places. Rashmi Metallics plant is located near Kharagpur which is a manufacturing unit responsible for manufacturing finished iron products. The plant has traffic carrying raw materials from the nearby locations and also from Odisha, which is then delivered to the nearby locations as finished goods. Thus, this entire process is contributing to iron and steel as the commodity.

Table 20: Growth rates of key commodities (volume terms) – excluding diversion impacts

Commodity	Share (%)	FY25-30	FY30-35	FY35-44
Empties	19.8%	4.7%	4.0%	3.6%
Courier & parcel	5.1%	6.9%	5.9%	5.2%
Agri Produce	10.5%	1.7%	1.4%	1.2%
Iron & Steel Products	10.0%	6.3%	5.0%	4.4%
Construction materials	26.3%	6.3%	4.5%	4.0%
Tiles & Ceramic products	1.2%	4.1%	3.5%	3.1%
Consumer Foods	1.3%	2.4%	2.2%	2.0%
Coal	2.0%	2.0%	1.8%	1.6%
Automobiles	1.3%	6.3%	5.9%	5.2%
Plastic products	3.3%	5.4%	4.5%	4.0%
Petroleum Products	2.4%	1.8%	1.6%	1.4%
Machinery	2.2%	2.1%	1.8%	1.6%
Textile & Footwear	1.8%	3.1%	2.6%	2.3%
Consumer Products	4.4%	2.6%	2.2%	2.0%
Plywood & Timber products	0.8%	4.4%	4.0%	3.5%
Pharmaceuticals	0.6%	3.6%	3.1%	2.7%

Commodity	Share (%)	FY25-30	FY30-35	FY35-44
Chemical products	2.9%	4.0%	3.5%	3.1%
Others	2.4%	3.1%	2.6%	2.3%
Paper products	0.9%	3.2%	2.6%	2.3%
Milk & Animal Food	0.3%	2.7%	2.2%	2.0%
Rubber products	0.4%	4.2%	3.8%	3.3%

As per the OD Survey conducted in December 2023, there is no major change in the state influence and commodity profile vis-a-vis the OD survey conducted in November 2022. Accordingly, the commodity growth rates considered are based on November 2022 OD survey commodity shares.

Source: CRISIL MI&A

Construction materials – the category's growth is driven by strong growth in housing and infrastructure

Construction materials dominates the project stretch with ~27% share as per the OD survey conducted during the course of this study. The key sub-category is sand, majorly originating from West Bengal. The stretch also has some proportion of cement, stones, fly ash, bitumen originating from West Bengal, Odisha, and Jharkhand.

The largest commodity in construction materials, sand, majorly originates from Gopiballapur (Jhargram district) and Mahapal (Midnapore district) and goes towards Haldia, Midnapore, Kharagpur, Debra as the key destination points. Gopiballapur is located at the banks of Subarnarekha River, which is an important sand mining block, responsible for sand mining activities in the state.

There are greenfield expressways coming in, in the vicinity of project stretch, which may add to the construction materials demand going up the coming time. Some of the key expressways that may do so, are, Raxaul-Haldia Expressway, Varanasi-Kolkata Expressway and Kharagpur-Morgram Expressway.

In the last five years, the eastern (Odisha, Bihar, and West Bengal) regions exhibited strong demand led by a surge in infrastructure. construction and rural housing. Madhya Pradesh, Uttar Pradesh, West Bengal, Bihar, and Odisha form almost 65% of under construction houses in PMAY Rural.

As seen in the past decade, the Eastern and Central regions are expected to continue to drive construction material demand in India in the medium term on the back of continued government thrust on infra and housing in the region. Healthy rural housing demand in West Bengal as well as a plethora of infrastructure projects and pickup in urban housing will aid the construction material traffic. Key infrastructure projects in the region such as East Coast Corridor Project and other road and highway projects, Economic Corridor (Kharagpur-Bardhaman-Morgram) Project will keep the demand elevated.

During fiscals 2023-27, the upcoming cement capacity additions in the eastern region amount to ~47-49 million tonnes, 1/3rd of all India capacity addition. Rising income levels and growing preference of rural consumer for ceramic tiles will drive the long-term growth of the construction material traffic on the stretch. Government initiatives such as 100 smart cities, Housing for all by 2022, increase in deduction limit for housing loan, relaxed norms for issuing long term bonds by banks for financing affordable housing will aid growth.

The DSR (District Survey Report) of Jhargram district suggests that the number of mining leases have increased significantly from Jan 2021 to Sep 2022, as mentioned in the table below

Table 21: Mining leases in the Jhargram district (Subarnarekha and Kangsbati river)

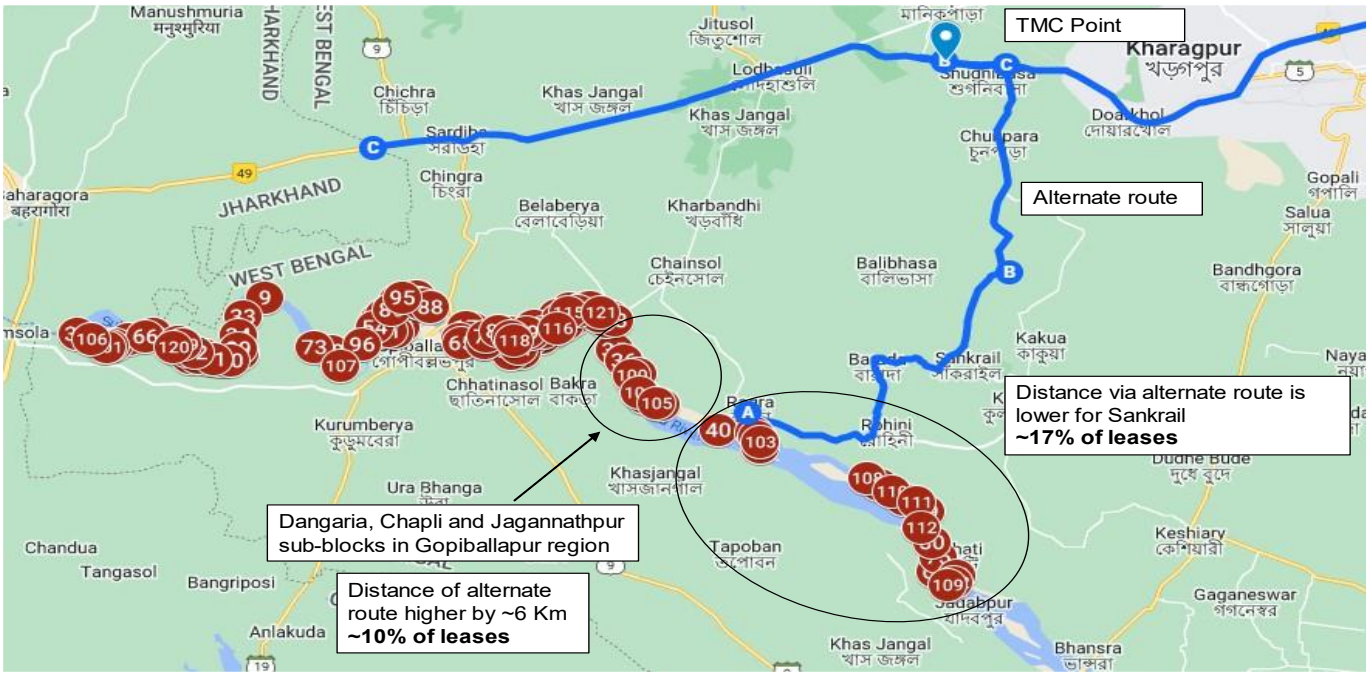
Mining leases	Mining leases
Jan 2021	**73**
Sep 2022	**145** ***-Subarnarekha river (125)*** ***-Kangsbati river (20)***

Source: DSR Jhargram Report 2021 and 2022, CRISIL MI&A

The new sand mining policy has been declared by West Bengal State, which has following features that will aid the leasing of new sand mining blocks, thus leading to continued sand mining activities in the Gopiballapur block –

- New mining policy will bid out lease tenures of 5-20 years
- Centralized body will manage the mining leases instead of specific district administration
- Encourages for identification of new mining blocks

Figure 9: Mining leases in Gopiballapur block (Subarnarekha River)



Source: Google Maps, CRISIL MI&A

Around ~83% of the mining leases are in Gopiballapur, which is the key origin, responsible for the sand mining traffic on the project stretch.

Cement, second largest commodity in construction materials, after sand, is anticipated to grow at 7.5-8.5% (East Region). There are cement plants in the vicinity of project stretch which may continue to add to the traffic carrying cement as the commodity. Following is the list if cement plants in the vicinity of project stretch.

Table 22: List of prominent cement players in the vicinity of project stretch

Cement players in WB	Districts	No of plants
Ultratech Cement Ltd	Dankuni	3
Birla Corporation Ltd	Durgapur	2
Ambuja Cement Ltd	Sankrail (Howrah) and Farakka (Murshidabad)	2
Shristi Cement Ltd	Kolkata	1
Ocl India Ltd	Paschim Medinipur	1
Jagdamba Industries Limited	Bidhannagar, Kolkata	1
JSW Cement Ltd	Salboni (Paschim Medinipur)	1
Shakti Udyog	Siliguri, West Bengal	1
The Ramco Cements Limited	Kolaghat (Paschim Medinipur)	1
Acc Limited	Kolkata division	1
Nu Vista Limited	Kolkata	1

Source: CRISIL MI&A

Thus, such strong infrastructure pipeline, combined with consistent sand mining activities near the project stretch, may contribute to construction materials anticipating to grow at ~9% in FY24, and ~3-4% in the longer term.

Agri Produce is a mixture of seasonal crops and horticulture

Agri Produce is the second largest commodity on the project stretch. Some of the key crops are Paddy and Wheat, which are the major producing crops in the state. The state also has a fair production of horticulture crops/vegetables like onion, apple, potato as the key one's.

West Bengal state is known for its varied agro-climatic conditions which, in a way supports the cultivation of wide range of crops across the year. The state has net cropped area as 52.05 lakh ha. which comprises 68% of the geographical area and 92% of arable land. In terms of vegetables production, the top five states as of fiscal 2020 are West Bengal (28.3 MMT), Uttar Pradesh (27.5 MMT), Madhya Pradesh (18.8 MMT), Bihar (16.9 MMT), and Gujarat (12.6 MMT). West Bengal has time and again topped the vegetable production, nationwide, thus proving to be one of the important states as far as Agriculture sector is concerned.

Also, on the other hand, as Bay of Bengal is close by, the state has faced many calamities like cyclones, hailstorms, thus leading to considerable damage to the Agri output. The Indian agriculture sector is highly volatile as it is still

dependent on the outcome of the monsoon season. In order to account for such volatility, agri-produce traffic is expected to growth at 3% in fiscal 2024. In the long term, ~2-2.5% growth is expected.

Midnapore being one of the key emerging warehousing clusters and the connectivity of the project stretch towards Kolkata is driving the courier & parcel traffic

Warehouses are situated in and around Kolkata, followed by few warehouses in Midnapore districts. The key origin points for this commodity are West Bengal, Jharkhand, and Maharashtra. Within West Bengal - Kolkata, Midnapore and Kharagpur are the key origin points. Similarly, key destination state is also West Bengal, followed by Jharkhand, where Kolkata and Jhargram are the key destination districts. Kolkata and Jhargram are amongst the top populated districts in the state thus, evidently responsible for the major traffic movement carrying courier and parcel across the project stretch.

The connectivity of warehousing clusters to the major cities in the state is anticipated to drive the growth for courier and parcel commodity. Thus, the commodity is anticipated to grow at 9% in FY24, whereas in the long term it is anticipated to grow at ~4-4.5%.

Figure 10: Key hubs of warehousing in India

Source: CRISIL MI&A

Figure 11: Emerging small warehousing hubs in India

Source: CRISIL MI&A

Rashmi Metallics plant plays a vital role to aid Iron and Steel growth

Iron and Steel is amongst the top five commodities in the state, thus driving the traffic growth on the stretch. One of the most important aspects, for driving this growth (specific to project stretch) is Rashmi Metallics Plant located in Kharagpur. The Rashmi Groups, who is the owner of the plant, has developed core competence in minerals, steel, cement. The following are the products and services that the plant offers –

1. Manufacturing of Cement
2. Making of Sponge Iron and pig iron
3. Iron Ore mining and exports
4. Railway Logistics

The key OD pairs in the OD survey also shows traffic movement across the project stretch destined at Rashmi Metallics Plant. The raw materials required for the manufacturing process are brought to the plant from nearby locations. The growth of Iron and Steel commodity on the stretch will be strongly backed by the production capacity growth of Rashmi Metallics plant. Thus, it is anticipated to grow at 9% in FY24, whereas in long term, the growth is anticipated to be in the range of ~3-4%.

Strong pipeline of infrastructure projects to boost growth in the region

Top 100 projects across the Midnapore, Jhargram, Kharagpur, Haldia have been considered. Total project cost is Rs 1,336 billion. Railways, roadways, finished steel, LNG storage & distribution and coal-based power plants form nearly 75% of the total project costs.

Table 23: Key upcoming infrastructure projects in the influence area of the project stretch

Key upcoming projects in Midnapore, Jhargram, Kharagpur, Haldia	Implementation stage	Project cost (Rs billion)
East Coast Corridor Project	Nascent	567.5

Key upcoming projects in Midnapore, Jhargram, Kharagpur, Haldia	Implementation stage	Project cost (Rs billion)
Economic Corridor (Kharagpur-Bardhaman-Morgram) Project	Planning	120.0
Coastal Road (Gopalpur-Digha) Project	Planning	80.0
Floating Storage & Regasification Terminal (Kukrahati) Project	Under Execution	51.0
Ethylene (Haldia) Project - Expansion to 770 KTA	Under Execution	43.1
Purified Terephthalic Acid (Bhuniaraichak) Project	Planning	37.0
Steel Plant (Gopinathpur) Project	Planning	35.0
Coal Based Power (Haldia) Project	Under Execution	33.1
Petroleum Refinery (Haldia) Project-Expansion	Under Execution	32.2
Coastal Economic Zone (Goura) Project	Nascent	30.0
Narayangarh-Bhadrak Third Railway Line Project	Under Execution	20.4
Liquid Handling Cargo (Shalukkhali - Haldia Dock-II) Project	Under Execution	17.1
Solar Photovoltaic Power (Salboni) Project	Nascent	16.0
Solar Park (Dadanpatrabar, Mania & Dakshin Purushottampur)	Planning	16.0
Kharagpur-Adityapur 3rd Railway Line Project	Under Execution	14.8
Steel Plant (Kharagpur)	Planning	13.0
LNG Terminal (Haldia) Project	Under Execution	11.3
Steel Plant (Gokulpur) - Expansion	Planning	10.0
Sports Complex (Haldia) [Arena Haldia International Sports City]	Partially Completed	10.0
Decorative Paints (Kharagpur) Project	Planning	10.0

Source: Projects Today, CRISIL MI&A

Table 24: Sectors in the influence area of the project stretch

Sectors of upcoming projects in Indore, Shivpuri, Jhansi, Kanpur, and Lucknow	Project cost (Rs billion)
Railways	607.3
Roadways	222.0
Finished Steel	68.5
LNG Storage & Distribution	62.3
Coal/Lignite Based Power	46.7

Source: Projects Today, CRISIL MI&A

Regional growth in infra projects and better connectivity positive for the project stretch

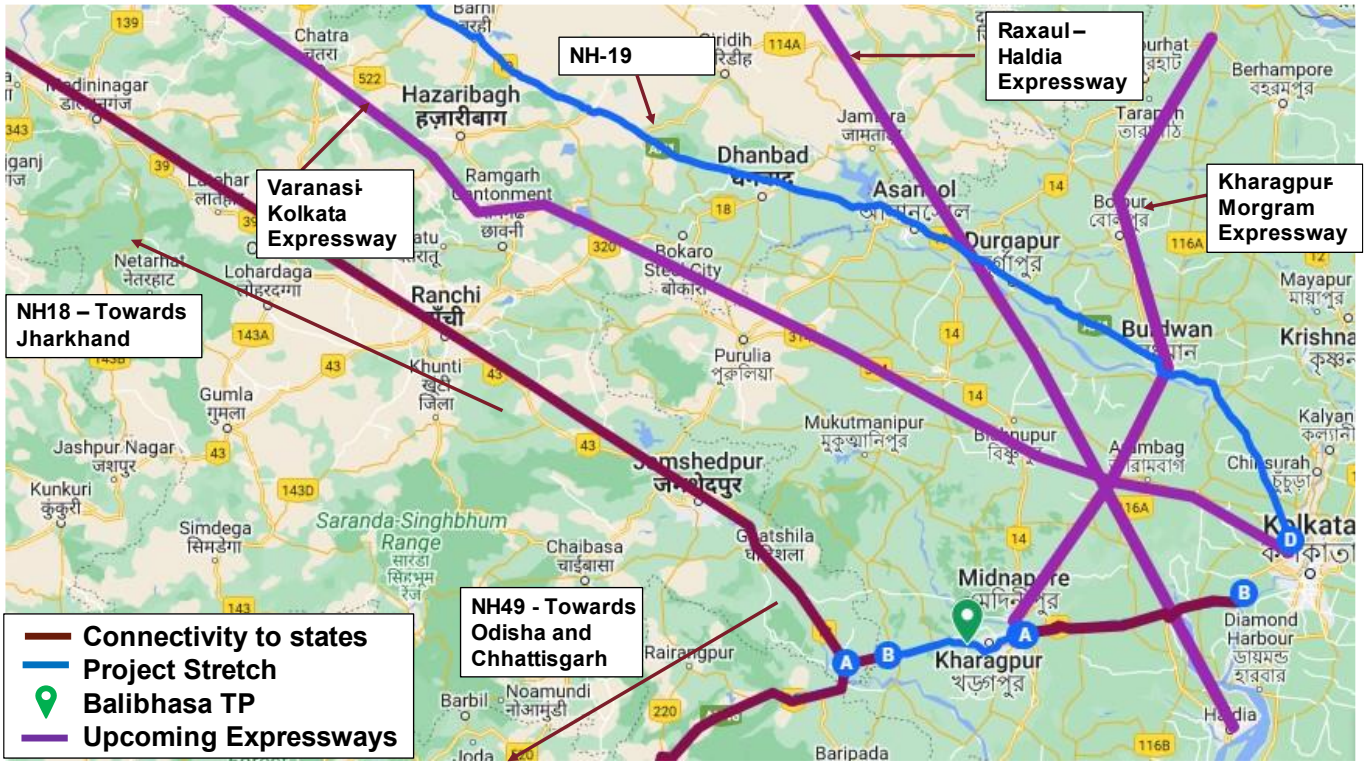
The region's connectivity is expected to improve with the upcoming expressways in the coming time. Following map has the anticipated alignment of the Expressways. Raxaul-Haldia, Kharagpur-Morgram, Varanasi-Kolkata; are the expressways that can improve the connectivity of the project stretch and West Bengal in particular with the other states.

Raxaul-Haldia Expressway passes near Kharagpur and goes towards Haldia thus, connecting improving the traffic originating from Haldia port and traversing in the direction of Bihar state. This expressway's alignment will see it diagonally cut through Bihar, Jharkhand, and West Bengal. Along the way, it will pass by Muzaffarpur in Bihar and Asansol – Durgapur in West Bengal.

Kharagpur-Morgram Expressway is a part of Kharagpur-Siliguri economic Corridor being developed in West Bengal under Bharatmala Pariyojana. The 230-km-long greenfield expressway starts from NH-16, near Kharagpur and ends at Morgram (NH-34 & NH-60 Junction) in the state of West Bengal. Currently, traffic originating from Tamil Nadu and Odisha and destined for north Bengal has to cross Kolkata. This leads to huge traffic snarls in the city as well as increases the travel time by almost five hours. The proposed expressway will provide direct connectivity to Siliguri in north Bengal and decongest the 'city of joy' i.e. Kolkata.

Varanasi-Kolkata Expressway connects West Bengal to Uttar Pradesh thus, improving the connectivity between the two states. This expressway passes through Jharkhand, thus proving to be one of the preferred routes, in future, for the traffic originating from Jharkhand and destined at West Bengal. There are few O-D pairs in the OD survey from Jharkhand state, thus making this expressway vital from connectivity perspective.

Figure 12: Map of upcoming expressways' alignment in the influence region of project stretch



Source: Google Maps, CRISIL MI&A

5. Assessment of impact factors

7-days Axle load Survey was conducted to examine overloading potential on the stretch

Axle load norms and NHAI strictness have reduced the incentives for overloading

Overloading was significantly prevalent for the bulk commodities like building materials, food grains, iron and steel etc., prior to axle load implementation. Some of the reasons which contributed to the same are non-stricter compliance, high incentives for the transporters for carrying extra load over permissible limits, lenient checking on toll Plazas, and usage of alternate routes to bypass the toll plazas for short haul traffic.

Overloading, in general, has seen a considerable decline post the implementation of new axle load norms, which increased the permissible loads across vehicle categories. Few of the factors, which can be attributed to this are reduced incentive to carry beyond permissible limits, stricter checking at toll plazas, and shift in preference of transporters for prioritising the efficiency of vehicles and safety of drivers.

NHAI, also, over the years has issued multiple circulars, restricting the overloading across plazas on national highways. It is expected that the incidence of overloading observed across plazas located on national highways will also reduce over next few years.

High overloading is still seen on project stretch

In order to ascertain the quantum of overloading, an axle load survey ranging from 19th March 2023 to 25th March 2023 (7-days) was done by the technical consultants of the client. The results of axle load survey provided by the client, reveal that overloaded vehicles form a sizeable share of vehicles across categories.

As per the survey, 49% of the MAVs, 33% of 3 axle and 11% of the 2 axle vehicles are overloaded *(considering more than 5% overload than permissible limits)*. Direction wise, 76% of the MAVs, 58% of 3 axle and 20% of the 2 Axle vehicles are overloaded *(considering more than 5% overload than permissible limits)* in the Chichra to Kharagpur direction. Vehicles traversing from Chichra to Kharagpur direction are majorly sand carrying vehicles. Whereas, from Kharagpur to Chichra direction, the overloading is relatively lower, 23% for MAVs, 10% for 3 Axle and 2% for 2 Axle *(considering more than 5% overload than permissible limits).*

Table 25: Overloaded vehicles as per Axle load survey

Direction	Vehicle Category	Sample	>5% overload	>20% overload	>5% overload	>20% overload
Overall	MAV	571	281	171	49%	30%
Overall	2A	403	46	5	11%	1%
Overall	3A	286	95	44	33%	15%
Chichra-Kharagpur	MAV	286	216	147	76%	52%
Chichra-Kharagpur	2A	212	42	4	20%	2%
Chichra-Kharagpur	3A	136	79	42	58%	31%
Kharagpur-Chichra	MAV	285	65	24	23%	8%
Kharagpur-Chichra	2A	191	4	0	2%	0%
Kharagpur-Chichra	3A	150	16	3	10%	2%

Source: Client data, CRISIL MI&A

Sand, Iron and Steel aggregates, Parcel, Coal are major commodities, which account for majority of the overloading (more than 20% of permissible tonnage). Sand, as a commodity has overloading of ~66%, Iron ore has overloading of ~49%, Coal at 44%. However, Sand emerges as the top commodity to be overloaded by MAVs and 3A vehicles, considering the sand mining belt near project stretch, responsible for carrying sand along the road.

Table 26: Overloading across vehicle categories (more than 20% vis-à-vis permissible limit)

Commodity	MAV (7 Day Sample)	Overloaded vehicles (>20%) (7 Days)	Overloaded %
SAND	832	551	66%
EMPTY	644	0	0%
PARCEL	151	23	15%
PIPE	287	27	9%
IRON/STEEL	355	124	35%
COAL	263	115	44%
PETROLEUM	125	20	16%
POWDER	150	23	15%
PARCHUN	60	14	23%
IRON ORE	137	67	49%
MACHINE/TOOLS	87	24	28%
BUILDING MATERIAL	62	24	39%
OTHERS	845	186	22%
Total	**3998**	**1198**	**30%**

Source: Client data, CRISIL MI&A

In fact, the current assured revenue is around Rs 925 million (July 2023 to July 2024), while the estimated revenue for fiscal 2024 is Rs 936 million.

Overloading revenue is considered through levies of select overloaded vehicles

As per discussions with the client, it is proposed that overloading will be levied on 25% of MAV and 3 Axle vehicles which are overloaded for more than 20% of the threshold. The revenue potential is arrived at, by considering an overloading levy equivalent to 1x of single journey toll rates, against the allowed levy of up to 10x of toll rates. It is also assumed that the share of overloaded vehicles will keep declining steadily over the projection period.

The overloading revenue is projected as Rs 65.4 million by fiscal 2026, against Rs 1,126 million of steady state revenue.

Table 27: Overloading revenue assumptions

Particulars	Vehicles	FY24	FY26	FY30	FY35	FY43
AADT	MAV	3,777	4,227	5,007	6,091	8,111
	2A	1,679	1,909	2,287	2,792	3,730
	3A	1,050	1,186	1,416	1,731	2,321

Particulars	Vehicles	FY24	FY26	FY30	FY35	FY43
Overloading % *(More than 20%)*	MAV	30%	30%	25%	20%	12%
	2A	1%	1%	1%	0%	0%
	3A	15%	15%	10%	5%	0%
Steady State overloaded traffic	MAV	1,133	1,268	1,252	1,218	973
	2A	17	17	11	0	0
	3A	158	178	142	87	0
Overloaded vehicles, for revenue (%)	MAV	25%	25%	25%	25%	25%
	2A					
	3A	25%	25%	25%	25%	25%
Overloaded vehicles, for revenue	MAV	283	317	313	305	243
	2A	-	-	-	-	-
	3A	39	44	35	22	-
Penalty considered (1x toll rate) *As per Schedule M*	MAV	475	515	610	745	1,025
	2A					
	3A	330	360	425	515	710
Overloading revenue (Rs Mn)	MAV	49	60	70	83	49
	2A	0.0	0.0	0.0	0.0	0.0
	3A	5	6	5	4	5
	Total	**54**	**65**	**75**	**87**	**54**

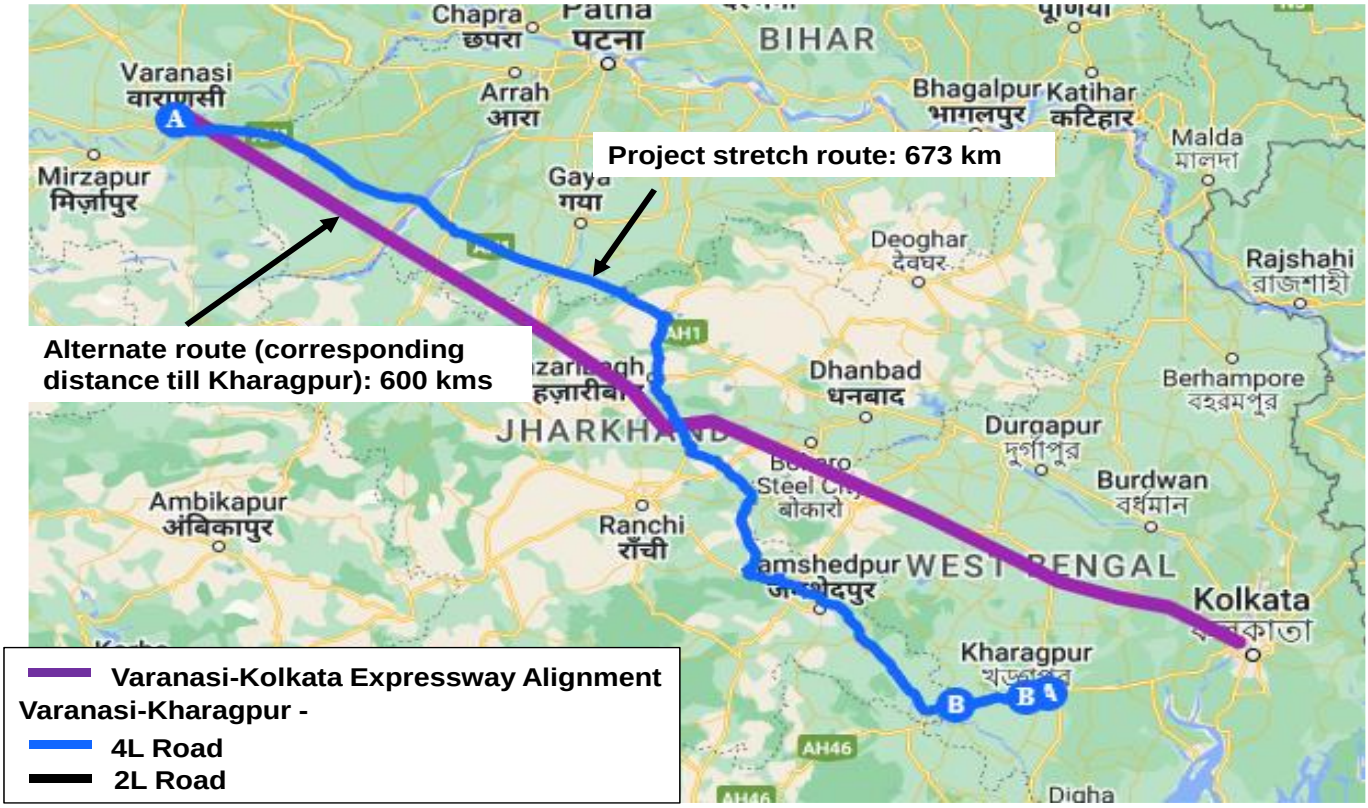
Source: Client data, CRISIL MI&A

Few O-D pairs indicate traffic from Jharkhand and UP, impact of Varanasi-Kolkata Expressway is assessed, which may pass through Jharkhand state, once operational

Varanasi-Kolkata Expressway connects West Bengal with Uttar Pradesh. The expressway passes through Jharkhand state, which is one of the important states as far as project stretch is concerned. As per O-D survey, Tatanagar, Ranchi, Chaibasa, Baharagora are the key origin points from the Jharkhand, which are anticipated to be carrying commodities like Iron & Steel and Construction Materials. Around ~8% of the traffic is originated from Jharkhand which is majorly destined at West Bengal.

Currently, the preferred route passes via project stretch which approximately takes ~14 hours, which, after Expressway is operational, shall take ~11 hours, thus cutting the travel time by 3 hrs, with an improved connectivity and better amenities.

Figure 13: Alignment of Varanasi-Kolkata vis-à-vis current preferred route



Source: Google Maps, CRISIL MI&A

The generalised cost ratio has been defined by calculating the vehicle operating time cost, vehicle operating cost and toll rates. The toll rates considered for cost analysis are for fiscal 2023. Toll rates for the upcoming augmented expressway are based on per Km rates of Delhi-Mumbai Expressway. Based on the cost assessment, diversion percentages are derived as per IRC norms. A generalised cost ratio (GCR) greater than one indicates that the cost of travelling on the project stretch is cheaper than the alternative. A GCR of one denotes ~50% diversion to the alternative stretch.

To assess the at-risk traffic for Varanasi-Kolkata Expressway, traffic between Uttar Pradesh, Jharkhand, West Bengal is considered. Few OD pairs had suggested some traffic movement from Tatanagar, Ranchi, Chaibasa in the Jharkhand state towards West Bengal. And the upcoming Varanasi-Kolkata Expressway is anticipated to pass through Jharkhand, thus making it as one of the preferred routes, once it is operational. The at-risk traffic is then multiplied with the diversion percentage, which is defined based on IRC-defined formulae. This process yields the percentage of diverted traffic. We have considered a lower diversion percentage than calculated, as the project stretch will continue to remain the preferred route for passenger traffic, whereas for goods traffic, the OD sample shows minimal traffic from the at-risk locations vis-à-vis entire OD sample. Thus, the impact assessment is done in order to cover that minimal share of traffic, and to see if the new expressway can be a potential threat for the project route.

Table 28: GCR for the project stretch

Generalised cost ratio* of travelling Varanasi-Kharagpur	
Vehicle category	**Alternative stretch/Project stretch**
Cars/Jeep/Van	0.74
Bus	0.84
LCV	0.85
2-Axle	0.84
3-Axle	0.81
MAV	0.84

Source: CRISIL MI&A

Note: GCR > 1 indicates cost of travelling on project stretch is cheaper than the alternative and the GCR = 1 denotes ~50% diversion to the alternative stretch

Chichra-Kharagpur section traffic to remain unaffected by the DFCs

Dedicated freight corridors (DFCs) are constructed exclusively for movement of goods. The first phase of the project includes construction of the Western DFC from Mumbai to Dadri, near Delhi, and the Eastern DFC from Dankuni in West Bengal to Ludhiana in Punjab. The former will mainly cater to containers as 60% of container traffic originates from this region. The later will cater to dry bulk cargo. The DFCs aim to regain railway's lost share in handling of key commodities such as coal, steel, iron ore, cement, food grains, fertilisers, petroleum products, and containers.

The project stretch has negligible proportion of O-D pairs likely to be impacted due to Eastern DFC, as majorly the project stretch is dominated by West Bengal bound traffic. And the long-haul traffic is from Maharashtra and Madhya Pradesh which may not be impacted by both the DFCs.

Hence, in the assessment, it is considered that there will no impact of DFCs on the traffic plying on project stretch.

Figure 14: Alignment of DFCs with regard to the project stretch

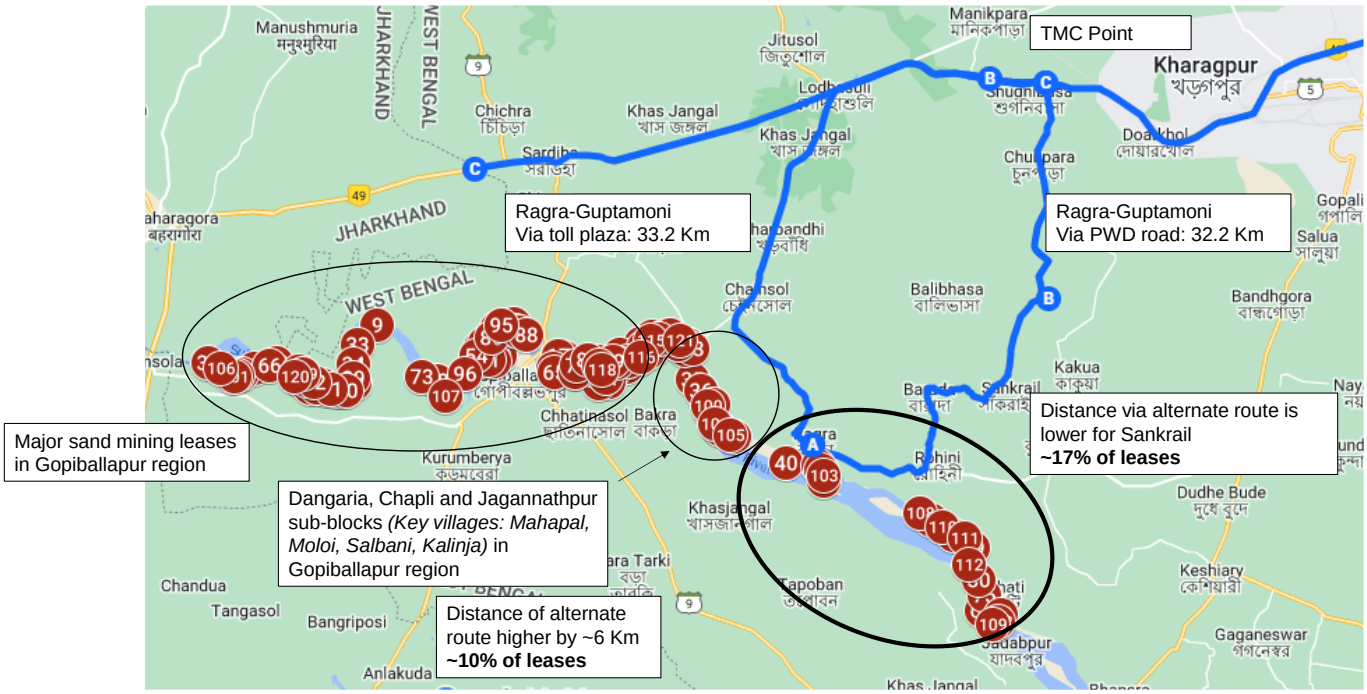
Source: Google Maps, CRISIL MI&A

Local alternate routes

Guptamoni-Rohini route is marginally shorter for Sankrail block…

A turning movement count survey was conducted at Guptamoni to assess the quantum of sand mining traffic passing through Guptamoni-Rohini route. The alternate route is a 2L PWD road, road upgradation is planned, however, it expected to have no sizeable impact for the traffic on plaza.

Figure 15: Alignment of local alternate route, Guptamoni-Rohini

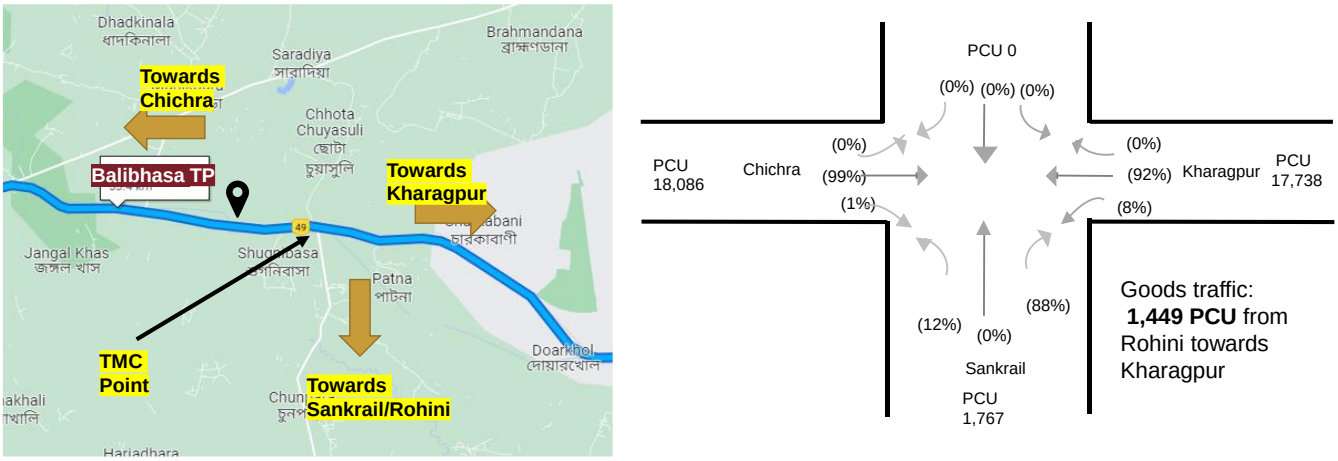


Source: Google Maps, CRISIL MI&A

The Guptamoni-Rohini route is a natural route for mining locations in Sankrail region (17% on mining leases), while mining locations in Mahapal, Salbani, Moloi, Kalinja villages (10% of mining leases), have an option to use the project stretch or the Guptamoni-Rohini route. The TMC survey suggests that ~1,500 goods PCU move towards Kharagpur from Guptamoni-Rohini route.

Comparison of TMC results and the sand mining traffic observed at Balibhasa plaza indicates that Kharagpur bound goods traffic (primary assumed to be sand mining traffic) accounts for ~25% of sand mining traffic.

Figure 16: Location of TMC survey



The comparison of TMC done in December 2023 is provided in the annexures.

Source: Google Maps, CRISIL MI&A

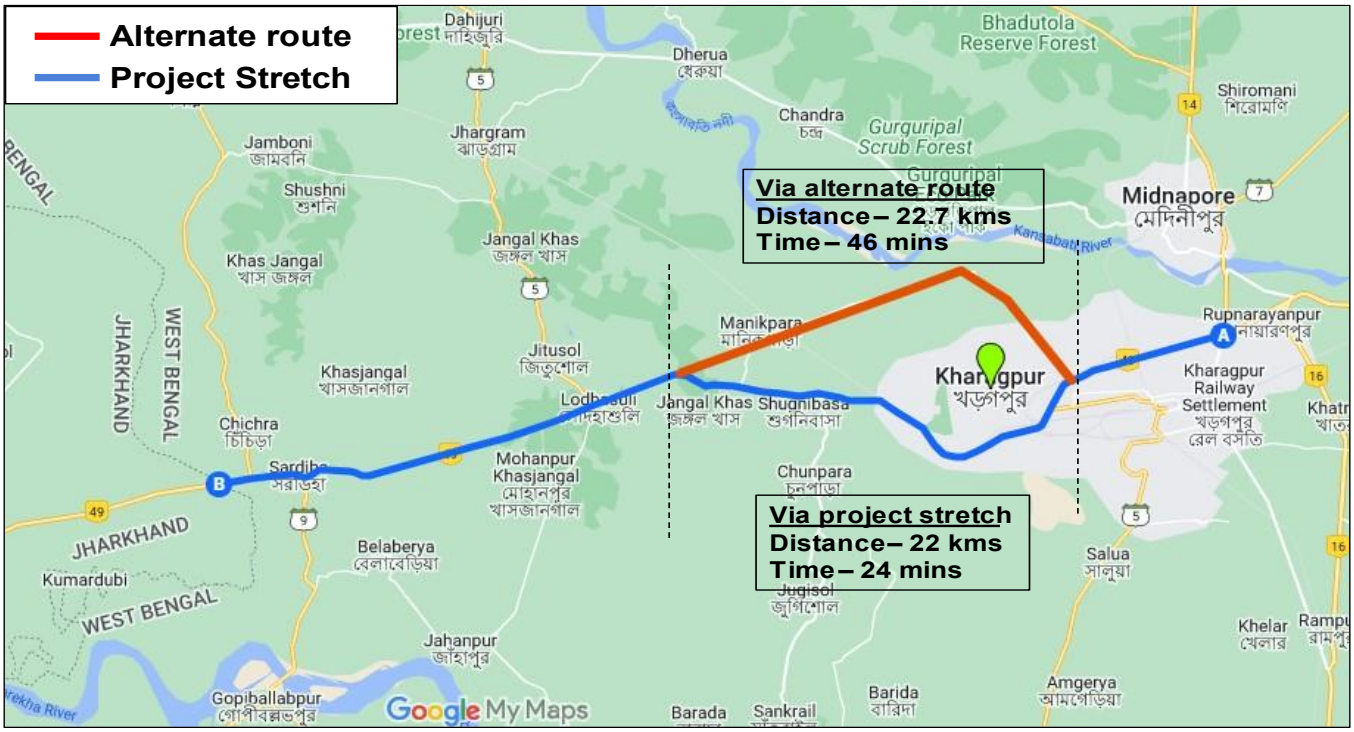
Table 29: Impact of various factors on the project stretch traffic

Particulars	OD survey@Toll plaza	TMC@Guptamoni	Overall sand mining PCU^
Date	23 Nov 2022	09 Jan 2023	
Towards Kharagpur	~4,000 PCU*	~1,449 PCU	~5,600 PCU**
Major origin points	Sand mining from Gopiballapur	Sand mining blocks from Sankrail	
% share in PCU		~25%	
% share in mining leases	n.m.	~17% (21 blocks)	~125 blocks

Source: Google Maps, District Survey Report Sep-2022, CRISIL MI&A

Alternate route bypassing the Toll Plaza

Figure 17: Alignment and update on the alternative routes considered in the traffic assessment



Source: Google Maps, CRISIL MI&A

An alternate route exists, which allows to bypass the Balibhasa Toll Plaza. The road is a 2L road and the length of the bypass road is almost same as the project route equivalent. But, the time taken to traverse via alternate route is almost double than that via project stretch due to weak road conditions. There is construction work going on, on patches of the road thus, making it a less preferred option for a commercial vehicle to take that road in order to bypass the Toll Plaza.

The road also passes through multiple villages, which makes it crowded which in turn results in additional time to complete that patch of the road. The last leg of the alternate route, approximately 5 kms long, is under construction and completely undeveloped which again, makes this route as an unpreferred option for the commercial traffic trying to bypass the Toll Plaza.

Hence, in the assessment, it is considered that there will be no impact of this alternate route.

Diversion to alternative routes could lead to ~0.5% loss in traffic

The impact of Varanasi-Kolkata Expressway will be minimal i.e. ~0.5%, as, the traffic from the locations close to the alignment of the expressway is minimal and barring goods traffic from Jharkhand, rest of the traffic may continue to use the project stretch as the preferred route. There will be impact on the passenger traffic too, which may shift to the Expressway, to travel in the West Bengal direction.

Commercial vehicles traffic originating from Tatanagar, Ranchi and few other nearby locations of Jharkhand are considered as at-risk traffic, and hence assessed to see if they are likely to shift to the Expressway, once it is operational.

CJVs are anticipated to have close to ~2.4% impact on the traffic, which indicates that 2.4% of the traffic is likely to be shifted to the Varanasi-Kolkata Expressway and may skip the project stretch as the preferred route to travel. Similarly, LCVs are anticipated to have ~1% impact, 2-Axle may have 0.1%, 3-Axle 0.2%, MAVs 0.4%, which in total results in ~0.5% overall impact of Varanasi-Kolkata Expressway.

Table 30: Impact of various factors on the project stretch traffic

Factors	AADT		Varanasi-Kolkata Expressway	AADT
Vehicle Type/Year	FY24	FY44 (Without diversions)	FY44	FY44 (With diversions)
Car	2,949	6,550	-2.4%	6,392
Bus	120	180	0.0%	180
Mini Bus	106	147	0.0%	147
LCV	233	430	-1.0%	426
2-Axle	1,679	3,860	-0.1%	3,857
3- Axle	1,050	2,404	-0.2%	2,402
MAV	3,777	8,416	-0.4%	8,384
Overall PCU	29,003	64,623	**-0.5%**	64,298

Source: CRISIL MI&A

Table 31: Impact of Varanasi-Kolkata Expressway on the project stretch

Balibhasa Toll Plaza														
Year	Cars	y-o-y growth (%)	LCV	y-o-y growth (%)	2-Axle	y-o-y growth (%)	3-Axle	y-o-y growth (%)	MAV	y-o-y growth (%)	Total	y-o-y growth (%)	Total PCUs	y-o-y growth (%)
FY27	3,354	3.4%	373	2.8%	2,148	5.6%	1,251	5.5%	4,442	5.1%	11,568	4.7%	34,101	5.0%
FY28	3,465	3.3%	382	2.4%	2,240	4.2%	1,305	4.3%	4,624	4.1%	12,016	3.9%	35,482	4.1%
FY29	3,622	4.5%	392	2.7%	2,330	4.0%	1,359	4.2%	4,811	4.0%	12,515	4.2%	36,930	4.1%
FY30	3,782	4.4%	403	2.7%	2,424	4.0%	1,416	4.2%	5,007	4.1%	13,033	4.1%	38,440	4.1%

Source: CRISIL MI&A

**Note: The impact is based on traffic volume in vehicle terms*

6. Traffic and revenue projection for the remaining concession

Traffic projections

The traffic is anticipated to grow at CAGR 4.1% for fiscal 2024-44 period. With the considered diversion impacts, the project road traffic is likely to cross 40,000 PCUs in FY32. DPR may be prepared during FY31 and FY32 and the construction period for six laning is likely to be in FY33 and FY34.

Table 32: Projected AADT – FY24-44

Year	Cars	Bus	Minibus	LCV	2-Axle	3-Axle	MAV	Total Traffic per day	PCU	On-year PCU Growth (%)
FY24P	2,949	120	106	233	1,679	1,050	3,777	9,915	29,003	6.4%
FY25P	3,094	123	109	242	1,793	1,118	4,005	10,484	30,744	6.0%
FY26P	3,242	126	111	252	1,909	1,186	4,227	11,053	32,471	5.6%
FY27P	3,354	129	113	260	2,020	1,251	4,442	11,568	34,101	5.0%
FY28P	3,465	132	115	267	2,108	1,305	4,624	12,016	35,482	4.0%
FY29P	3,622	135	117	276	2,195	1,359	4,811	12,515	36,930	4.1%
FY30P	3,782	138	119	284	2,287	1,416	5,007	13,033	38,440	4.1%
FY31P	3,947	141	121	293	2,382	1,475	5,212	13,571	40,015	4.1%
FY32P	4,115	144	123	302	2,481	1,537	5,422	14,123	41,636	4.1%
FY33P	4,286	147	125	311	2,582	1,600	5,640	14,691	43,306	4.0%
FY34P	4,461	150	127	321	2,686	1,665	5,863	15,273	45,018	4.0%
FY35P	4,640	153	129	330	2,792	1,732	6,091	15,867	46,768	3.9%
FY36P	4,822	156	131	340	2,901	1,800	6,324	16,474	48,556	3.8%
FY37P	5,007	159	133	350	3,012	1,869	6,563	17,094	50,387	3.8%
FY38P	5,196	162	135	361	3,125	1,941	6,807	17,726	52,253	3.7%
FY39P	5,388	165	137	371	3,242	2,014	7,058	18,375	54,172	3.7%
FY40P	5,583	168	139	382	3,360	2,088	7,312	19,031	56,115	3.6%
FY41P	5,781	171	141	393	3,481	2,165	7,573	19,705	58,112	3.6%
FY42P	5,982	174	143	404	3,606	2,243	7,842	20,394	60,163	3.5%
FY43P	6,185	177	145	415	3,730	2,322	8,111	21,086	62,214	3.4%
FY44P	6,392	180	147	426	3,857	2,402	8,384	21,788	64,298	3.3%
CAGR (FY24-44) %	**3.9%**	**2.1%**	**1.6%**	**3.1%**	**4.2%**	**4.2%**	**4.1%**	**4.0%**	**4.1%**	

Source: CRISIL MI&A

Traffic volume CAGR (FY24-44) excluding diversions would have been higher by ~0.03%

Table 33: Traffic growth rates without considering diversions to expressway and other alternative routes

CAGR	FY24-25	FY25-30	FY30-40	FY24-44
Car	4.9%	4.6%	4.0%	4.1%
Bus	2.5%	2.4%	2.0%	2.1%
Minibus	2.0%	1.8%	1.6%	1.6%
LCV	4.2%	3.4%	3.0%	3.1%
2-axle	6.8%	5.0%	3.9%	4.3%
3-axle	6.4%	4.9%	4.0%	4.2%
MAV	6.0%	4.6%	3.9%	4.1%
Total PCU	6.0%	4.7%	3.9%	4.1%

Source: CRISIL MI&A

Table 34: Traffic growth rates considering diversions to expressway and other alternative routes

CAGR	FY24-25	FY25-30	FY30-40	FY24-44
Car	4.9%	4.1%	4.0%	3.9%
Bus	2.5%	2.4%	2.0%	2.1%
Minibus	2.0%	1.8%	1.6%	1.6%
LCV	4.2%	3.2%	3.0%	3.1%
2-axle	6.8%	5.0%	3.9%	4.2%
3-axle	6.5%	4.8%	4.0%	4.2%
MAV	6.0%	4.6%	3.9%	4.1%
Total PCU	6.0%	4.6%	3.9%	4.1%

Source: CRISIL MI&A

Trip segmentation

Trip segmentation and exemptions have been derived based on the ETC segmentation data from January 2023 to November 2023 (for available months) and cash and exemptions data from November 2022 to July 2023. For revenue calculation, the trip factor used for a return journey is two, and for a monthly pass it is 45. The trip segmentation has been assumed to remain constant throughout the projection period i.e., over fiscals 2024 to 2044.

Table 35: Details of trip segmentation across vehicle categories

Vehicle category	Single journey	Return journey	Local monthly pass	Local commercial vehicles	Exemption
Car, jeep, van or LMV	34.59%	62.72%	1.63% (local non-commercial)	-	1.07%
LCV, light goods vehicle, or minibus	37.05%	61.55%	-	-	1.40%
Bus or truck (2-axle)	34.34%	65.14%	-	0.15%	0.37%
3-axle CV	64.99	34.85	-	-	0.16%
HCM, EME or MAV (4-6 axle)	53.60%	46.18%	-	-	0.22%

Source: Toll plaza data, CRISIL MI&A

Wholesale Price Index projections

The projected toll rates are dependent on Wholesale Price Index (WPI) assumptions for fiscals 2023 to 2053. For WPI projection, CRISIL MI&A has relied on inputs from CRISIL's economic research team.

Table 36: WPI projections till December 2041

Month-Year	WPI	Expected on-year growth
Dec-20 (actual)	385.4	
Dec-21 (actual)	440.4	14.3%
Dec-22 (actual)	462.6	5.02%
Dec-23 (actual)	466.0	0.73%
Dec-24	490.4	5.25%
Dec-25	512.5	4.5%
Dec-26	530.4	3.5%
Dec-27	549.0	3.5%
Dec-28	568.2	3.5%
Dec-29	588.1	3.5%
Dec-30	608.7	3.5%
Dec-31 to Dec-50	↓	3.5%
Dec-51	1,253.5	3.5%

Other details for revenue calculations

The following details have been used for the toll rate calculations which have been sourced from the technical schedules,

Table 37: Base rates for toll calculation

Vehicle category	Base rate of fee per km (base year = FY08), in Rs
Car, jeep, van or LMV	0.65
LCV, light goods vehicle, or minibus	1.05
Bus or truck (2-axle)	2.20
3-axle CV	2.40
HCM, EME or MAV (4-6 axles)	3.45
Oversized vehicles (seven or more axles)	4.20

Source: Technical schedules, CRISIL MI&A

Table 38: Details of toll rate calculation for multiple journeys

Amount payable	Maximum number of one-way journeys allowed	Period of validity
One-and-a-half times of the fee	Two	Twenty-four hours from

for one-way journey		the time of payment
Two-thirds of amount of the fee payable for 50 single journeys or more	50 or more	One month from date of payment
Fee for CVs (excluding vehicles plying under national permit) registered in the district where the fee plaza falls will be 50% of the prescribed rate for that category of vehicle		

Source: Technical schedules, CRISIL MI&A

Table 39: Details of road length, structures, and bypass on the project stretch

SN	Location of Toll Plaza (Existing Kilometer [Km])	Length (in km) for which Fee is Payable		Rate at which Fee is payable
		Before construction of Flyover at km 63.254 and EUP at km 47.360	After construction of Flyover at km 63.254 and EUP at km 47.360	
1	Balibhasa Toll plaza at Design Km 43+350	55.295 (Excluding the 0.270 km Length of 4 Lane Structures and 0.554 km length of 2 L Structure	55.128 (Excluding the 0.438 km Length of 4 Lane Structures and 0.554 km length of 2 L Structure	100% of the base rates
2	Balibhasa Toll plaza at Design Km 43+350	0.5542	0.5542	60% of the base rates

As per latest discussions with the client, after construction is not included in client's scope and accordingly the toll rates are considered as per before construction scenario of the entire projection period.

In addition to above, the following fee shall also be due and payable for the use of the following structures having length more than 60 m at the following toll plaza, by converting the length of structures into an equivalent length of highway by multiplying the length of such structures by an equalization factor of 10.

Table 40: Details of road length, structures, and bypass on the project stretch

SN	Location of Toll Plaza (Existing Kilometer[Km])	Length (in km) for which Fee is Payable		Rate at which Fee is payable
		Before construction of Flyover at km 63.254 and EUP at km 47.360		
		Length of structures (in km) to be converted into equivalent road	Equivalent road length (in km)	
1	Balibhasa Toll plaza at Design Km 43+350	0.2704	2.704	100% of the base rates mentioned in Table-29 above
2		0.5542	5.542	60% of the base rates mentioned in Table-29 above

Source: Technical schedules, CRISIL MI&A

Revenue projections

Base Revenue (excluding revenue from overloading penalty) is projected to grow at 8.3% CAGR for FY24-44 period.

Table 41: Projected revenue (Rs million) for FY24-44 (excluding overloading revenue)

Year	Car	LCV + minibus	Bus + 2-axle	3-axle	MAV	Total	On-year growth (%)
Mar-24	78	15	162	114	568	936	12.2%
Mar-25	83	16	177	123	613	1,012	8.1%
Mar-26	91	17	198	138	683	1,126	11.3%
Mar-27	100	18	219	152	752	1,242	10.2%
Mar-28	108	19	239	165	815	1,346	8.4%
Mar-29	115	21	258	179	883	1,455	8.1%
Mar-30	126	22	279	195	958	1,581	8.6%
Mar-31	137	24	302	211	1,038	1,712	8.3%
Mar-32	148	25	328	228	1,128	1,858	8.5%
Mar-33	161	27	353	248	1,217	2,006	8.0%
Mar-34	173	29	383	268	1,313	2,166	8.0%
Mar-35	188	31	414	291	1,423	2,346	8.3%
Mar-36	205	33	447	315	1,541	2,541	8.3%
Mar-37	221	35	482	339	1,661	2,738	7.8%
Mar-38	239	38	520	368	1,795	2,959	8.0%
Mar-39	257	40	563	396	1,932	3,189	7.8%
Mar-40	277	43	606	429	2,091	3,446	8.1%
Mar-41	300	45	653	461	2,247	3,706	7.5%
Mar-42	321	48	703	499	2,425	3,997	7.8%
Mar-43	347	52	755	536	2,612	4,303	7.7%
Mar-44	375	55	817	580	2,816	4,643	7.9%
CAGR (FY24-44) %	**8.2%**	**6.8%**	**8.4%**	**8.5%**	**8.3%**	**8.3%**	

Source: CRISIL MI&A

Table 42: Projected revenue (Rs million) for FY24-44 (including overloading revenue)

Year	Base Revenue	Overloading Revenue	Overall Revenue
FY24	936	0	936
FY25	1,012	0	1,012
FY26	1,126	65	1,192
FY27	1,242	69	1,311
FY28	1,346	72	1,419
FY29	1,455	75	1,530
FY30	1,581	79	1,659
FY31	1,712	81	1,793
FY32	1,858	84	1,942
FY33	2,006	87	2,093
FY34	2,166	89	2,256
FY35	2,346	92	2,438
FY36	2,541	94	2,635
FY37	2,738	95	2,834
FY38	2,959	97	3,056
FY39	3,189	95	3,284
FY40	3,446	97	3,544
FY41	3,706	98	3,804
FY42	3,997	99	4,095
FY43	4,303	99	4,401
FY44	4,643	98	4,741
CAGR (FY24-44)	**8.3%**	**2.3%**	**8.4%**

8. Annexures

1-Tonnage analysis for fiscal 2024 AADT

- Aggregate freight carried (for fiscal 2023) through the toll plaza is calculated through the estimated payload (in tonnes) of respective freight vehicle categories. Payload for vehicle categories is estimated through Axle load survey data provided by the client *(A 7-Day Axle load survey was done in March 2023)* and interactions with select commercial vehicle OEMs. Payloads considered are MAV (28.5 tonne), 3A (17.1 tonne), 2A (11.1 tonne) and LCV (5 tonne).

- Annual aggregate freight for fiscal 2024 is estimated by considering a growth rate (9.5% over fiscal 2023 tonnage), based on commodity profile of toll plaza.

- The annual aggregate freight is segmented into freight carried by respective vehicle categories, based on trends in tonnage carried by respective vehicle categories during post monsoon period of fiscal 2023 and pre-monsoon period of fiscal 2024. This estimated share freight carried by respective vehicles categories is based on trends *(primarily for sand carrying vehicles, in terms of distance to be travelled, vehicle segment wise transporter profitability, miscellaneous operating expenses applicable for vehicle categories etc.)* observed at the asset. This may remain a monitorable for future traffic assessment for the asset.

- Finally, freight carried by respective vehicle categories is converted into number of vehicles *(vehicle wise ETC AADT),* based on respective payloads.

- ETC AADT is expanded based on cash and exemption levels for respective vehicle categories.

- Validation of the AADT was done based on preceding twelve-month data (December 2022 to November 2023) as well. To project December 2023 to March 2024 traffic, a growth rate of 4%, 4% and 6% was applied on 2A, 3A and MAV traffic of December 2022 to March 2023 traffic. FY24 AADT was also calculated based on this approach. The PCU traffic as per two approaches is similar and accordingly, we can validate the traffic as estimated through tonnage based approach.

2-Traffic projections scenario based on econometric model

We have projected the traffic based on an econometric model where the traffic growth is linked to GDP growth of India and the respective states. For the current assessment, we have used a traffic growth to GDP growth multiple methodology based on an internal study. The multiple used is 1.0 for car, 0.6 for bus, 0.66 for minibus/LCV, 0.7 for 2-axle, 0.7 for 3-axle and 0.7 for MAV. We have used this multiple along with India and state GDP forecasts to derive the traffic growth rate.

The traffic CAGR (fiscal 2024-44) as per the econometric method (without diversion impact) is 4.1%, while traffic CAGR (fiscal 2024-44), as per CRISIL's projections is 4.1%.

Table 43: AADT projections as per econometric method (no diversions) for FY24-44

Year	Car	Bus	Minibus	LCV	2-axle	3-axle	MAV	Total PCU	On-year growth (%)	CRISIL - Total PCUs	Econometric model's PCU – CRISIL's projected PCU
FY24P	2,949	120	106	233	1,679	1,050	3,777	29,003	6.4%	29,003	0
FY25P	3,132	124	111	243	1,754	1,097	3,947	30,353	4.7%	30,744	(391)
FY26P	3,330	129	115	254	1,834	1,148	4,127	31,790	4.7%	32,470	(681)
FY27P	3,540	134	120	266	1,918	1,200	4,316	33,296	4.7%	34,188	(892)
FY28P	3,758	139	125	278	2,003	1,253	4,507	34,826	4.6%	35,663	(837)
FY29P	3,981	144	130	290	2,089	1,307	4,700	36,377	4.5%	37,119	(742)
FY30P	4,203	148	135	301	2,172	1,359	4,888	37,890	4.2%	38,637	(747)
FY31P	4,437	153	140	313	2,259	1,413	5,083	39,468	4.2%	40,219	(752)
FY32P	4,685	158	145	326	2,350	1,470	5,286	41,113	4.2%	41,849	(736)
FY33P	4,947	164	150	339	2,444	1,529	5,498	42,828	4.2%	43,527	(699)
FY34P	5,224	169	156	352	2,541	1,590	5,718	44,617	4.2%	45,248	(631)
FY35P	5,512	175	162	366	2,642	1,653	5,943	46,456	4.1%	47,006	(550)
FY36P	5,813	181	167	380	2,744	1,717	6,174	48,345	4.1%	48,803	(458)
FY37P	6,126	186	173	395	2,850	1,783	6,411	50,284	4.0%	50,644	(360)
FY38P	6,452	192	179	410	2,957	1,850	6,653	52,273	4.0%	52,518	(246)
FY39P	6,789	198	186	425	3,067	1,919	6,900	54,307	3.9%	54,447	(140)
FY40P	7,139	204	192	441	3,179	1,989	7,152	56,390	3.8%	56,400	(10)
FY41P	7,501	211	198	457	3,293	2,060	7,410	58,521	3.8%	58,406	115
FY42P	7,877	217	205	473	3,410	2,133	7,672	60,700	3.7%	60,467	232
FY43P	8,265	223	212	489	3,529	2,208	7,940	62,925	3.7%	62,529	396
FY44P	8,667	230	218	506	3,650	2,283	8,212	65,197	3.6%	64,623	574
CAGR (FY24-44)	**5.5%**	**3.3%**	**3.7%**	**4.0%**	**4.0%**	**4.0%**	**4.0%**	**4.1%**		**4.1%**	

Note: *The CAGR given is based on a scenario where there are no diversions.

Source: CRISIL MI&A

Table 44: Historical WPI data (December 2001 to December 2021)

Month-year	All commodities - WPI series (base: FY12)	On-year growth
Dec-2001	55.3	
Dec-2002	57.2	3.3%
Dec-2003	60.5	5.7%
Dec-2004	64.6	6.8%
Dec-2005	67.2	4.1%
Dec-2006	71.9	7.0%
Dec-2007	74.8	4.0%
Dec-2008	79.8	6.7%
Dec-2009	85.5	7.1%
Dec-2010	93.5	9.4%
Dec-2011	100.8	7.7%
Dec-2012	107.1	6.3%
Dec-2013	113.4	5.9%
Dec-2014	112.1	-1.1%
Dec-2015	109.4	-2.4%
Dec-2016	111.7	2.1%
Dec-2017	115.7	3.6%
Dec-2018	119.7	3.5%
Dec-2019	123.0	2.8%
Dec-2020	125.4	2.0%
Dec-2021	143.3	14.3%

Linking factor for WPI (base FY05 to FY12) is 1.561; linking factor for WPI (base FY94 to FY05) is 1.873

Source: Office of the Economic Adviser, CRISIL MI&A

3-Comparison of survey results

TMC survey comparison

The TMC survey suggests that ~1,500 goods PCU move towards Kharagpur from Guptamoni-Rohini route during the January 2023 survey against 955 goods PCU during December 2023 survey.

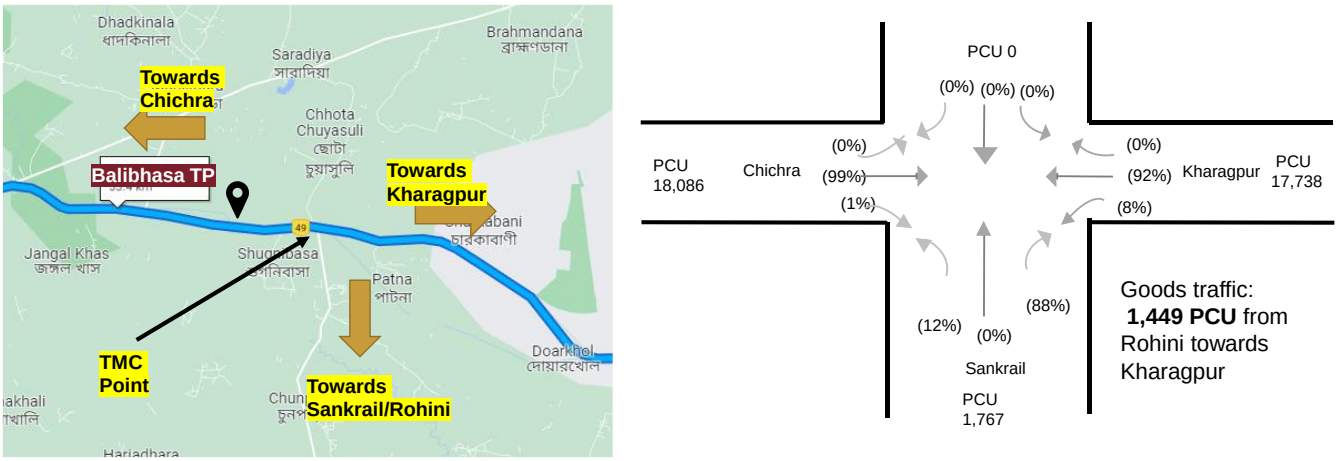


Figure 18: TMC Survey during January 2023

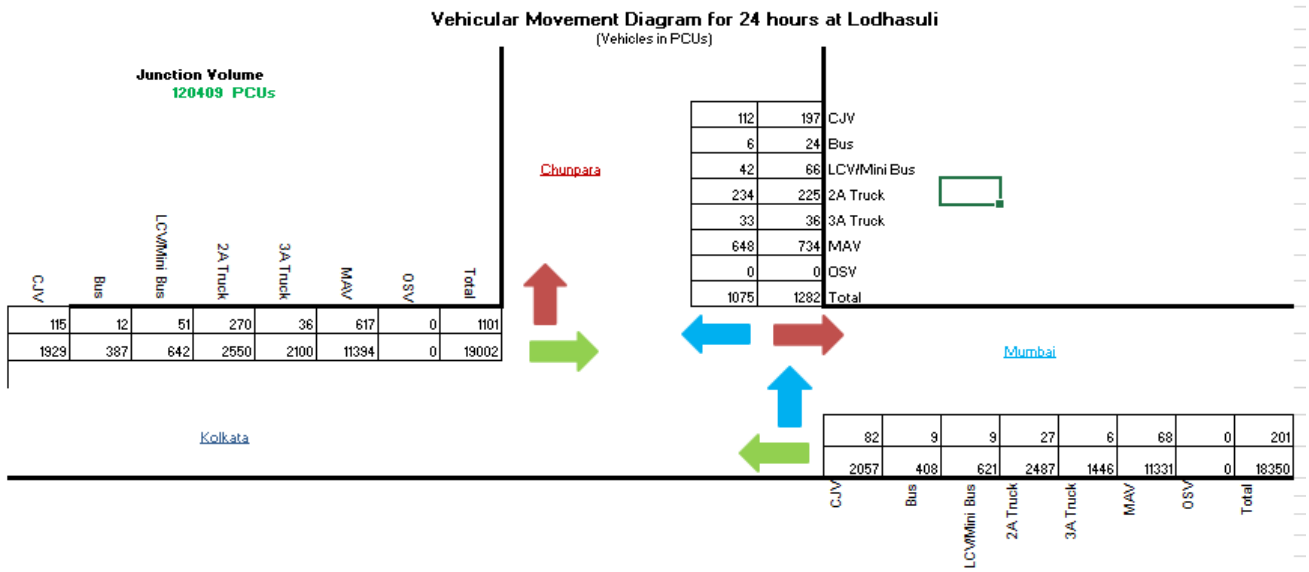


Figure 19: TMC Survey during December 2023

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Assessment and projection of traffic and revenue for Rewa-Katni-Jabalpur-Lakhnadon section of NH-30 & NH-34

Feb 2024

Final Report

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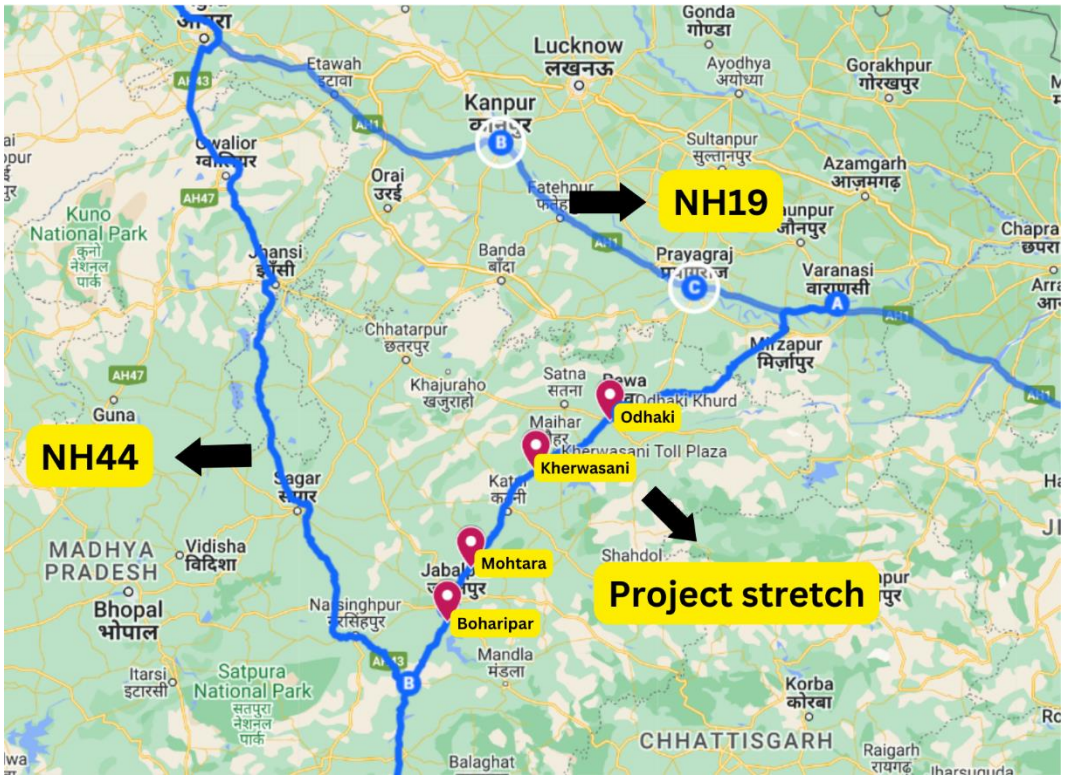
1 Executive Summary

Rewa-Katni-Jabalpur-Lakhnadon Project

Project overview

According to the Traffic Consultant, Rewa-Katni-Jabalpur-Lakhnadon project is a 4-lane, 265 km long stretch, on national highways (NH) 30 & (NH) 34 which connects Rewa, Katni, Jabalpur and Lakhnadon districts of Madhya Pradesh. The project stretch has four toll plazas – Odhaki Paipkhar, Kherwasani, Mohtara, and Boharipar. In the larger road network, the project stretch connects East-West Corridor (NH-19), which connects Kolkata in West Bengal to Delhi and North-South corridor (NH44) towards south. The project stretch largely caters to the vehicle traffic within state only. Other prominent states with residual traffic are Uttar Pradesh, Gujarat, and Maharashtra.

Figure 1: Project and adjoining NH network map



Source: CRISIL MI&A CONSULTING

Salient growth features and traffic generators

According to the Traffic Consultant, the project stretch is used by the traffic originating and destined in regions such as the Prayagraj-Varanasi cluster, & Pune-Nashik cluster. Prayagraj-Varanasi & Pune-Nashik are the key regions where the north-south traffic converges. The traffic travelling between these two clusters uses the project stretch which takes them 23-24 hours and travels ~1321 km. There exists an alternative route between Pune and Varanasi that passes through Indore and uses Jhansi Shivpuri stretch and Bundelkhand expressway. This route takes 28 hours, and the distance is ~1506 km. However, due to both longer distance and time, the route is not a threat to a long haul through traffic.

There exists an alternative route between Lucknow and Indore which passes through Chhatarpur and Sagar. This route takes 16-17 hours, and the distance is 955 km. The key reason for this higher time is that the alternative route is a mix of two and four lanes. Banda to Bhopal section of the alternative route, of nearly 430 km, is 2-lane. The Maharashtra and Gujarat traffic can also use this road, as they converge at Indore, where they will have the option to go towards the project stretch or towards Sagar and use the alternative road. Under the Bharatmala programme, the sections from Kandla to Sagar and Sagar to Lucknow are proposed for augmentation. Hence, in the future, when the augmentation gets completed, the alternative route will be a feasible route in competition to the project stretch. We have assumed the impact of this augmented road to begin in fiscal 2028. To assess the at-risk traffic for Kandla-Sagar corridor and Sagar-Lucknow corridor, traffic between Indore (Traffic originating from Gujarat and Northern Maharashtra could choose to come via Indore) and Eastern UP have been considered.

Agri produce is the largest category on the stretch, comprising mostly wheat, rice and vegetables (including onions) from MP and UP. MP state's Rabi crop production is growing at 4%+ over the last decade, while Kharif has grown at sub 1%, and horticulture has grown at 8.2% (Food grains & Horticulture have 50-50% share in total Agri production). Hence overall agriculture growth is expected to be in the range of ~3.0%. For Mohtara, the growth rate is 5% in the short term and 2.0-3.0% in the long term on account of higher horticulture share in the OD mix.

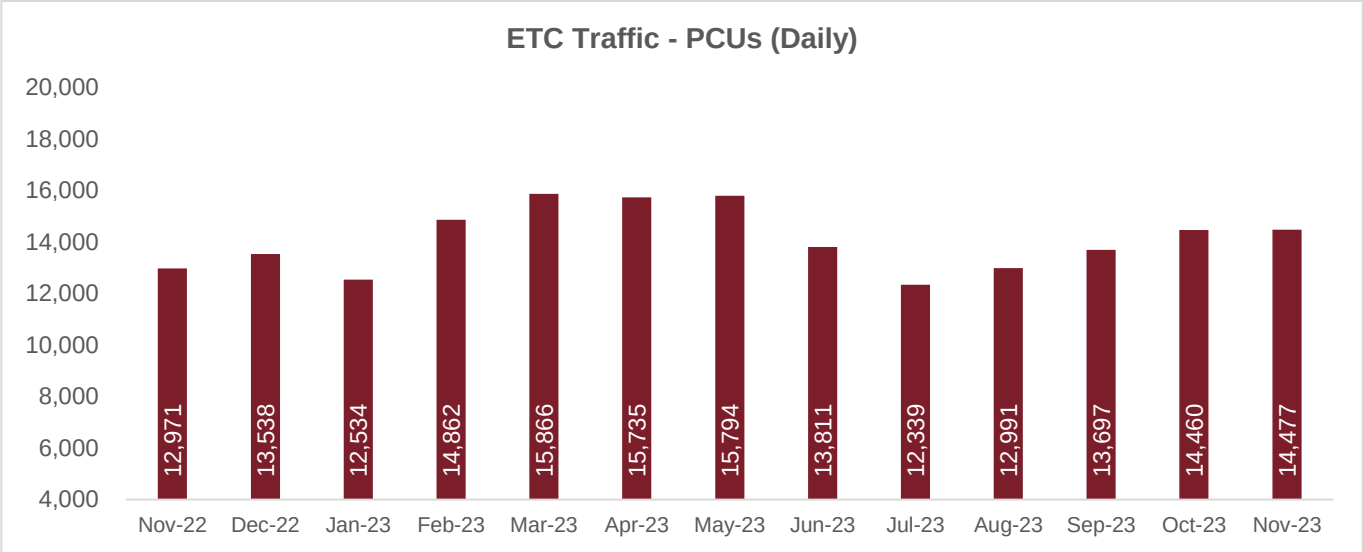
Cement (~40%) & Stone/limestones (~35-40%) form majority of construction materials, largely originated from MP with clusters of cement manufacturing in Maihar (Satna) aka Cement capital of India, Katni, Jabalpur, and Rewa districts and the availability of limestones in the districts across the stretch. MP cement growth to be higher than national average owing to election next year and large-scale irrigation projects underway. Cement to grow at 5-6% (Central region), historical limestones production is at 3-4%

The key destination states are MP & UP owing to strong growth in housing development across schemes such as PMAY Urban and Rural. In the last five years, the central (MP and UP) and eastern (Odisha, Bihar, and West Bengal) regions exhibited strong demand led by a surge in infrastructure. construction and rural housing.

MP and UP are the key origination and destination states for the courier and parcel traffic of the project stretch. The stretch connects warehouse centres like Nagpur, Jabalpur at one end and Prayagraj & Patna at the other end. Proximity of these clusters and connectivity of consumption centres such as Jabalpur, Rewa, Satna, Prayagraj, and Varanasi is expected to lead strong growth for this category. The origination regions are key warehousing clusters such as Jabalpur, Indore, and Prayagraj. Smaller warehousing regions which have fair amount of origination on the stretch include Rewa, Katni and Varanasi.

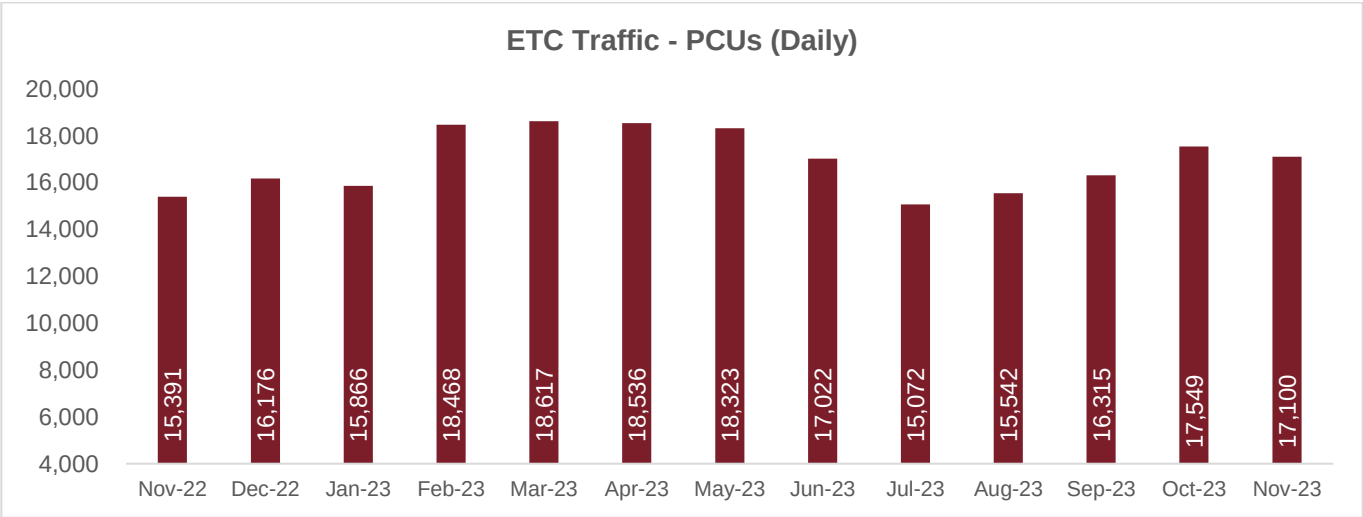
The chart below shows the average daily traffic over Nov 2022 to Nov 2023:

Table 1: Odhaki Toll Plaza



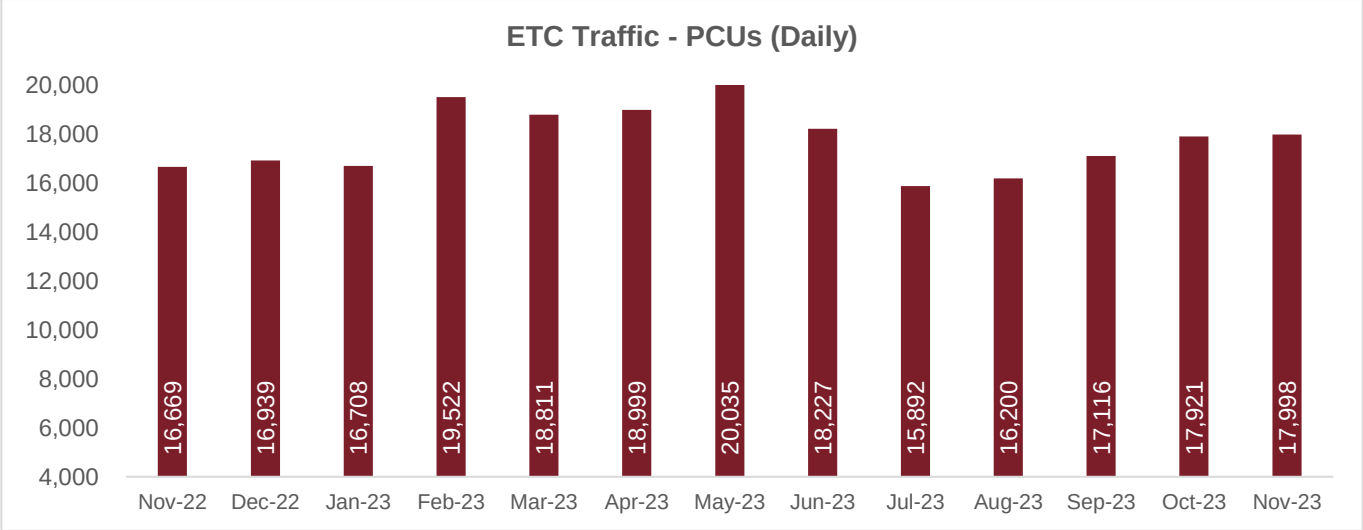
Source: CRISIL MI&A CONSULTING

Table 2: Kherwasani Toll Plaza



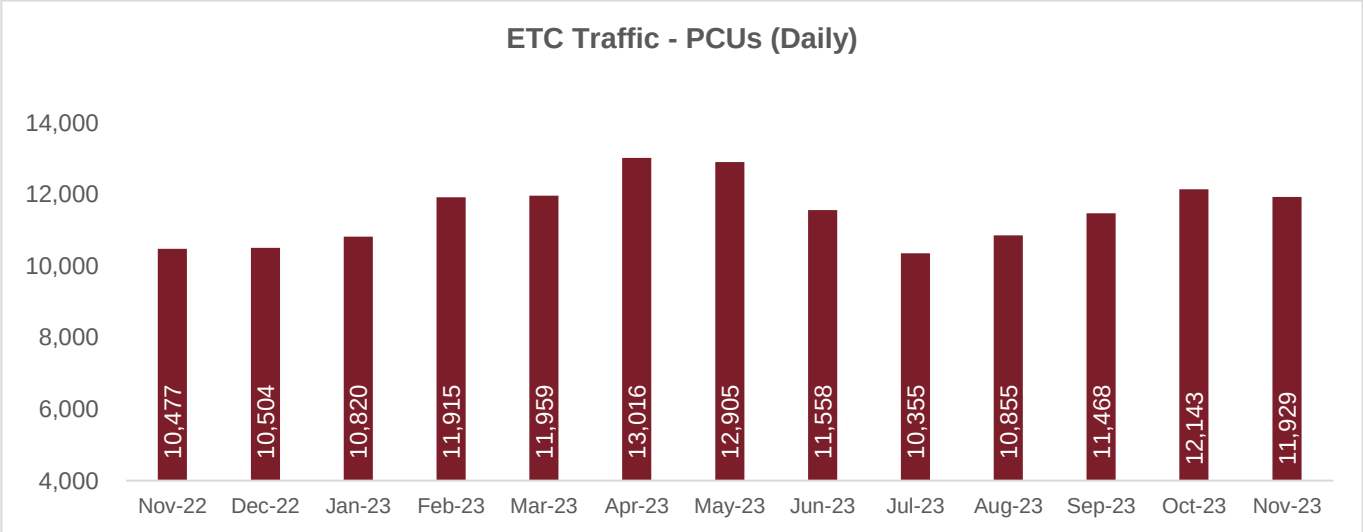
Source: CRISIL MI&A CONSULTING

Table 3: Mohtara Toll Plaza



Source: CRISIL MI&A CONSULTING

Table 4: Boharipar Toll Plaza



Source: CRISIL MI&A CONSULTING

Toll Segmentation

Trip segmentation has been derived from the average share of a single journey, return journey and other categories, based on ETC, cash and exemption data. April 2023 – Nov 2023 period is considered for trip segmentation.

For revenue calculation, the trip factor used for a return journey is two, and for a monthly pass it is 45. Exemptions have been estimated based on the TMS dataset of the toll plazas data from Apr-22 to July-23. The trip segmentation has been assumed to remain constant throughout the projection period i.e., over fiscals 2024 to 2053.

Table 5: Odhaki - Details of trip segmentation across vehicle categories

Vehicle category	Single journey	Return journey	Local Monthly pass	Local Commercial Vehicles	Exemption
Car, jeep, van or LMV	43.76%	45.60%	2.21%	0.00%	8.43%
LCV, light goods vehicle, or minibus	40.86%	44.69%	0.00%	3.80%	10.65%
Bus or truck (2-axle)	73.61%	24.95%	0.00%	0.00%	1.44%
3-axle CV	80.61%	18.24%	0.00%	0.00%	1.15%
HCM, EME or MAV (4-6 axle)	76.42%	23.40%	0.00%	0.00%	0.18%

Source: Toll Plaza data, CRISIL MI&A CONSULTING

Table 6: Kherwasani - Details of trip segmentation across vehicle categories

Vehicle category	Single journey	Return journey	Local Monthly pass	Local Commercial Vehicles	Exemption
Car, jeep, van or LMV	46.25%	42.75%	0.33%	0.01%	10.66%
LCV, light goods vehicle, or minibus	46.23%	41.56%	0.00%	2.75%	9.46%
Bus or truck (2-axle)	72.20%	26.84%	0.00%	0.09%	0.87%
3-axle CV	78.27%	20.17%	0.00%	0.00%	1.56%
HCM, EME or MAV (4-6 axle)	78.62%	21.00%	0.00%	0.06%	0.33%

Source: Toll Plaza data, CRISIL MI&A CONSULTING

Table 7: Mohtara - Details of trip segmentation across vehicle categories

Vehicle category	Single journey	Return journey	Local Monthly pass	Local Commercial Vehicles	Exemption
Car, jeep, van or LMV	33.44%	47.07%	8.46%	1.93%	9.10%
LCV, light goods vehicle, or minibus	36.94%	31.93%	0.00%	17.32%	13.82%
Bus or truck (2-axle)	63.44%	28.97%	0.00%	6.14%	1.45%
3-axle CV	51.95%	26.33%	0.00%	21.51%	0.21%

Vehicle category	Single journey	Return journey	Local Monthly pass	Local Commercial Vehicles	Exemption
HCM, EME or MAV (4-6 axle)	87.13%	11.62%	0.00%	1.08%	0.17%

Source: Toll Plaza data, CRISIL MI&A CONSULTING

Table 8: Boharipar - Details of trip segmentation across vehicle categories

Vehicle category	Single journey	Return journey	Local Monthly pass	Local Commercial Vehicles	Exemption
Car, jeep, van or LMV	37.74%	40.70%	7.70%	0.05%	13.80%
LCV, light goods vehicle, or minibus	44.59%	38.94%	1.84%	0.91%	15.57%
Bus or truck (2-axle)	59.15%	37.23%	0.59%	0.73%	2.89%
3-axle CV	72.22%	20.97%	0.43%	4.25%	2.56%
HCM, EME or MAV (4-6 axle)	92.76%	6.71%	0.00%	0.07%	0.47%

Source: Toll Plaza data, CRISIL MI&A CONSULTING

The table below provides the traffic growth rates considering diversions to expressway and other alternative routes, as provided by the Traffic Consultant:

Table 9: Odhaki Toll Plaza

CAGR	FY24-26	FY26-31	FY31-41	FY24-44
Car	7.4%	5.9%	4.3%	4.8%
Bus	3.7%	3.1%	2.1%	2.4%
Minibus	3.7%	3.1%	2.1%	2.4%
LCV	3.7%	2.8%	3.0%	3.0%
2 axles	4.0%	2.9%	3.4%	3.3%
3 axles	4.0%	1.9%	3.2%	2.9%
MAV	4.5%	3.2%	3.7%	3.6%
Total PCU	5.0%	3.7%	3.7%	3.8%
Revenue growth	9.1%	7.9%	7.9%	8.0%

Source: CRISIL MI&A CONSULTING

Table 10: Kherwasani Toll Plaza

CAGR	FY24-26	FY26-31	FY31-41	FY24-44
Car	7.4%	5.9%	4.3%	4.8%
Bus	3.7%	3.1%	2.1%	2.4%
Minibus	3.7%	3.1%	2.1%	2.4%
LCV	3.5%	2.9%	2.9%	2.9%

CAGR	FY24-26	FY26-31	FY31-41	FY24-44
2 axles	4.2%	3.3%	3.5%	3.4%
3 axles	3.7%	2.3%	2.9%	2.8%
MAV	4.4%	3.2%	3.6%	3.6%
Total PCU	4.9%	3.7%	3.7%	3.7%
Revenue growth	27.2%	8.0%	7.9%	9.6%

Note: FY24-26 revenue CAGR includes the increased toll collection due to addition of Katni bypass in the tollable length. The commencement of Katni Bypass is considered from 1st Jan 2025.
Source: CRISIL MI&A CONSULTING

Table 11: Mohtara Toll Plaza

CAGR	FY24-26	FY26-31	FY31-41	FY24-44
Car	7.4%	5.7%	4.3%	4.7%
Bus	3.7%	3.1%	2.1%	2.4%
Minibus	3.7%	3.1%	2.1%	2.4%
LCV	3.5%	3.0%	3.0%	3.0%
2 axles	3.8%	2.9%	3.1%	3.1%
3 axles	3.4%	2.2%	2.7%	2.6%
MAV	4.4%	3.1%	3.7%	3.6%
Total PCU	5.1%	3.9%	3.7%	3.8%
Revenue growth	8.7%	8.1%	7.9%	7.9%

Source: CRISIL MI&A CONSULTING

Table 12: Boharipar Toll Plaza

CAGR	FY24-26	FY26-31	FY31-41	FY24-44
Car	7.4%	6.2%	4.3%	4.9%
Bus	3.7%	3.1%	2.1%	2.4%
Minibus	3.7%	3.1%	2.1%	2.4%
LCV	3.5%	3.2%	2.9%	3.0%
2 axles	3.9%	3.5%	3.3%	3.4%
3 axles	3.7%	3.3%	3.0%	3.1%
MAV	4.7%	4.3%	4.0%	4.1%
Total PCU	5.2%	4.6%	3.8%	4.1%
Revenue growth	8.8%	8.9%	8.1%	8.2%

Source: CRISIL MI&A CONSULTING

Projected Traffic Data: Growth in Passenger Car Unit (PCU)

Table 13: Odhaki Toll Plaza

Vehicle Type	FY24	FY26	FY31	FY36	FY41	FY44
Car	3,324	3,835	5,107	6,457	7,749	8,473
Bus	130	140	163	184	201	211
Minibus	121	130	151	170	186	195
LCV	199	214	245	286	330	357
2-axle	557	603	694	823	967	1,058
3-axle	272	294	323	379	440	478
MAV	1,948	2,128	2,491	3,004	3,586	3,962

Vehicle Type	FY24	FY26	FY31	FY36	FY41	FY44
Total	**6,550**	**7,343**	**9,175**	**11,303**	**13,460**	**14,734**
Total PCU	**15,447**	**17,038**	**20,451**	**24,817**	**29,486**	**32,370**

Source: CRISIL MI&A CONSULTING

Table 14: Kherwasani Toll Plaza

Vehicle Type	FY24	FY26	FY31	FY36	FY41	FY44
Car	3,693	4,261	5,674	7,174	8,610	9,414
Bus	180	194	226	254	278	291
Minibus	60	65	75	85	93	97
LCV	317	339	392	455	523	565
2-axle	771	837	985	1,173	1,383	1,516
3-axle	363	390	438	509	584	631
MAV	2,284	2,489	2,910	3,496	4,159	4,587
Total	**7,669**	**8,575**	**10,699**	**13,146**	**15,631**	**17,102**
Total PCU	**18,482**	**20,330**	**24,412**	**29,523**	**34,989**	**38,364**

Source: CRISIL MI&A CONSULTING

Table 15: Mohtara Toll Plaza

Vehicle Type	FY24	FY26	FY31	FY36	FY41	FY44
Car	6,193	7,145	9,421	11,910	14,294	15,629
Bus	186	200	234	263	288	302
Minibus	96	103	120	135	148	155
LCV	391	419	486	565	650	703
2-axle	930	1,001	1,157	1,357	1,576	1,713
3-axle	587	627	701	805	916	983
MAV	1,664	1,812	2,114	2,545	3,033	3,349
Total	**10,047**	**11,308**	**14,233**	**17,580**	**20,906**	**22,834**
Total PCU	**19,520**	**21,570**	**26,119**	**31,686**	**37,480**	**40,982**

Source: CRISIL MI&A CONSULTING

Table 16: Boharipar Toll Plaza

Vehicle Type	FY24	FY26	FY31	FY36	FY41	FY44
Car	3,626	4,184	5,653	7,147	8,578	9,379
Bus	173	186	216	243	267	279
Minibus	34	36	42	48	52	55
LCV	247	265	309	359	413	445
2-axle	739	798	949	1,120	1,310	1,429
3-axle	256	275	323	377	435	471
MAV	1,191	1,305	1,608	1,966	2,380	2,651
Total	**6,265**	**7,048**	**9,100**	**11,261**	**13,434**	**14,710**
Total PCU	**12,908**	**14,283**	**17,878**	**21,826**	**26,020**	**28,598**

Source: CRISIL MI&A CONSULTING

Tollable Length and Toll Rates

As per NHTIS, the Rewa-Katni-Jabalpur-Lakhnadon project comprises 315.368 kms of tollable length. In India, toll rates are as per notification by the Ministry of Road Transport and Highways in the National Gazette. The present toll rates are determined with reference to the published base toll rates and are adjusted annually at the beginning of each fiscal year equal to 40% of the movement in the wholesale price index in December of the preceding year plus a fixed 3%.

Single toll rates in INR at four toll plazas, applicable from April 2023 until March 2024 are as provided below:

Table 17: Single toll rates across toll plazas

Type of Vehicle	Odhaki	Kherwasani	Mohtara	Boharipar
CJV	110	115	120	150
LCV	180	185	195	245
Bus/Truck	375	390	415	515
3A	410	430	450	560
MAV/ HCM/EME	590	615	650	805
OSV	720	750	790	980

Source: NHTIS, CRISIL MI&A CONSULTING

2 Objective and background

The client appointed CRISIL Market Intelligence and Analytics (MI&A) Consulting to undertake a study to analyse investment attractiveness of Rewa-Katni-Jabalpur-Lakhnadon Road stretch (part of NH-30 (old NH-7) & NH-34). CRISIL MI&A Consulting conducted a detailed traffic study and provided traffic & revenue projections for the road stretch under consideration for the period FY23-44 (including the traffic survey required to undertake the study). CRISIL MI&A Consulting also conducted a 7-day total volume count and 1-day origin-destination (O-D) traffic survey to understand traffic movement on the national highway road stretch.

CRISIL MI&A Consulting's report intends to facilitate investment decisions based on a detailed assessment of the road stretch, using derived yearly toll revenue and revenue risk for the road stretch.

Table 18: Details of the road stretch

Project stretch	State	Toll plaza	Tollable Length (km)
Four lane of section Rewa to Katni Pkg 1 Km 656+000 to Km 725+185 of NH-30 (old NH-7)	Madhya Pradesh	Odhaki Paipkhar Toll Plaza	71.246
Four lane of section Rewa - Katni - Jabalpur Km 725+185 to km. 813+257 excluding Katni Bypass of NH-30 (old NH-7)	Madhya Pradesh	Kherwasani Toll Plaza	70.868
Four lane of section Rewa to Katni Pkg 4 Km 813+257 to Km 880+600 of NH-30 (old NH-7)	Madhya Pradesh	Mohtara Toll Plaza	71.717
Four lane of section Rewa to Katni Km 880+600 of NH-30 (old NH-7) to Km 1428+557 of NH-34	Madhya Pradesh	Boharipar Toll Plaza	103.337

The report is divided into the following sections:

Section I: Detailed assessment of the project stretch

Section II: Growth and impact factor assessment

Section III: Traffic and revenue projections for the project stretch

3 Approach and methodology

CRISIL MI&A Consulting conducted a detailed traffic assessment to understand the composition of current traffic for the stretch and various growth drivers and impact factors for this traffic and arrive at traffic projections. Traffic for the stretch has been projected by factoring in traffic composition (vehicle category share, commodity carried by freight traffic vehicle categories, and origin-destination locations), outlook on production and consumption centres, alternative routes, and other factors impacting road traffic. This study helped us assess the project's traffic growth against key macro- and socio-economic parameters, and thus comment on the prospects of the stretch.

Figure 2: Overview of approach and methodology for the study

Traffic survey and data

- CRISIL MI&A appointed an external agency to conduct the following traffic surveys:
  - ✓*7-day traffic volume count survey*
  - ✓*3-day traffic volume count survey*
  - ✓*1-day origin-destination (OD) survey*
- Historical traffic data shared by the client
- Electronic Toll Collection (ETC) data for March-May 2022 shared by Indian Highways Management Company Limited (IHMCL) in the public domain

1. Detailed assessment of the national highway

- Details of the highway
- Location and mapping of consumption and production clusters of eastern/western states and study of the topography of the catchment area
- Identification of commodity distribution/transportation on the highway
- Identification and mapping of existing infrastructure
- Mapping of alternative routes
- Trend in vehicle registration growth

2. Impact assessment

- For goods traffic
  - Dedicated Freight Corridor/Delhi-Mumbai Industrial Corridor
  - Natural shifts/GST
  - Coastal shipping (major ports) along southern/western states
  - Axle load norms
  - Truck aggregator
  - Alternative routes
  - Government regulations
- For passenger traffic
  - Leisure places/existing parks around the region
  - Population/macroeconomic trends
- For both
- Upcoming infrastructure projects such as industrial clusters

3. Traffic projections

- Estimation of average annual daily traffic (AADT) and seasonality factors on the project stretch
- Estimation of category-wise annual toll traffic and revenue
- Projection of year-wise toll revenue for the project stretch
- Revenue risk, sensitivity and revenue projections

Source: CRISIL MI&A CONSULTING

CRISIL has used its proprietary traffic projection methodology to project traffic using regional industry growth assumptions, macroeconomic developments, infra development and consumption centre growth factors of the catchment area and adjacent regions.

CRISIL, based on its coverage of 80+ sectors and the MSME industry, has developed a knowledge base to understand the growth of industries and demand across various regions and clusters. The growth expectations for various industries are applied to each vehicle category based on the commodity composition of the vehicle category. For example, the share of light commercial vehicles (LCVs) carrying agricultural commodities is expected to grow as per agricultural output growth; the share of LCVs carrying consumer products is expected to grow as per the volume growth of durables; and the share of Multi axle vehicles (MAVs) carrying steel commodities is expected to grow as per demand/supply volume of steel products based on regional dynamics. This approach helps CRISIL provide a more accurate growth rate of commercial traffic in the region.

For passenger traffic, CRISIL assesses the sale of passenger cars in the region, growth of vehicular population, purpose and frequency of passenger travel, population growth, expansion of the city, and infrastructure development in the catchment area.

Further, CRISIL also examines the various factors that will impact traffic over the concession period, such as upcoming alternative road routes, truck aggregation by logistics players, dedicated freight corridors and other transportation options. Thus, the analysis considers the impact of central and state policies, growth in production and consumption centres along the stretch, and infrastructure in the adjoining regions. The report covers both growth drivers and restraints for the traffic along the stretch. CRISIL has enumerated and detailed the parameters that will positively/negatively impact the traffic on the stretch in the future.

CRISIL's methodology is appropriate for the traffic study of Rewa-Katni-Jabalpur-Lakhnadon stretch.

Agri produce commodity accounts for nearly 25-30% of the total traffic on the project stretch.

Agri produce is the largest commodity on the project stretch with ~25-30% of the share. The stretch has strong proportion of food grains such as wheat and paddy from MP and UP. The stretch passes through a major wheat producing region of Madhya Pradesh and hence wheat is the dominant category in Agri produce throughout the year. MP and UP are major wheat producers in the country. Wheat production increased 4% and 10% CAGR during fiscals 2014-19 MP and UP, respectively.

The stretch also observes vegetables as the key sub-category originating from MP and UP. The key sub-commodity includes peas, onion & potato among vegetables. The major kharif horticulture crops of MP are tomato, chilli, onion, okra, and brinjal. Vegetable production (volume) increased at 6% CAGR over fiscals 2015-20. While Rewa, Sagar and Satna form the cluster for onion production, Chhindwara, Sidhi, Katni, Rewa, and Satna comes in the top 15 potato producing district. Chhindwara, and Seoni, districts near the stretch are also one of the key peas producing regions. Further, in terms of vegetables production, the top five states as of fiscal 2020 are West Bengal (28.3 MMT), Uttar Pradesh (27.5 MMT), Madhya Pradesh (18.8 MMT), Bihar (16.9 MMT), and Gujarat (12.6 MMT).

MP state's Rabi crop production is growing at 4%+ over the last decade, while Kharif has grown at sub 1%, and horticulture has grown at 8.2% (Food grains & Horticulture have 50-50% share in total Agri production). Hence overall agriculture growth is expected to be in the range of ~3.0%. For Mohtara, the growth rate is 5% in the short term and 2.0-3.0% in the long term on account of higher horticulture share in the OD mix.

As per the survey conducted during this traffic study, in terms of vehicle wise composition, the category is made up of 13.7% LCVs, 19.5% of 2-axle, 10.3% of 3-axle and 56.6% of MAVs across the stretch. The commodity share - vehicle category wise have been applied on FY23 estimated AADT, to arrive at the weighted average mix.

CRISIL's methodology considers the growth of the Agri produce commodity at the regional level to derive the traffic growth of each vehicle category. Growth in Agri produce is highly volatile as it depends on the positive outcome of the monsoon season. Hence on a long-term period, it grows at low rate compared to the aggregate GDP. Given the high proportion of the Agri produce on the stretch, it's imperative to assess it at a regional and commodity level, compared to a macroeconomic level. This is evident, considering only the macro level growth. The India GVA (constant prices) from agriculture, forestry & fishing has grown at a CAGR of 3.5% over FY12-22 while the GDP growth of India during the same period has been 5.4% CAGR. For this reason, CRISIL's method is more appropriate for the road stretch.

Origin-destination of the freight traffic of the stretch is limited to few specific states.

The freight traffic is largely concentrated across Madhya Pradesh, Uttar Pradesh, and Maharashtra.

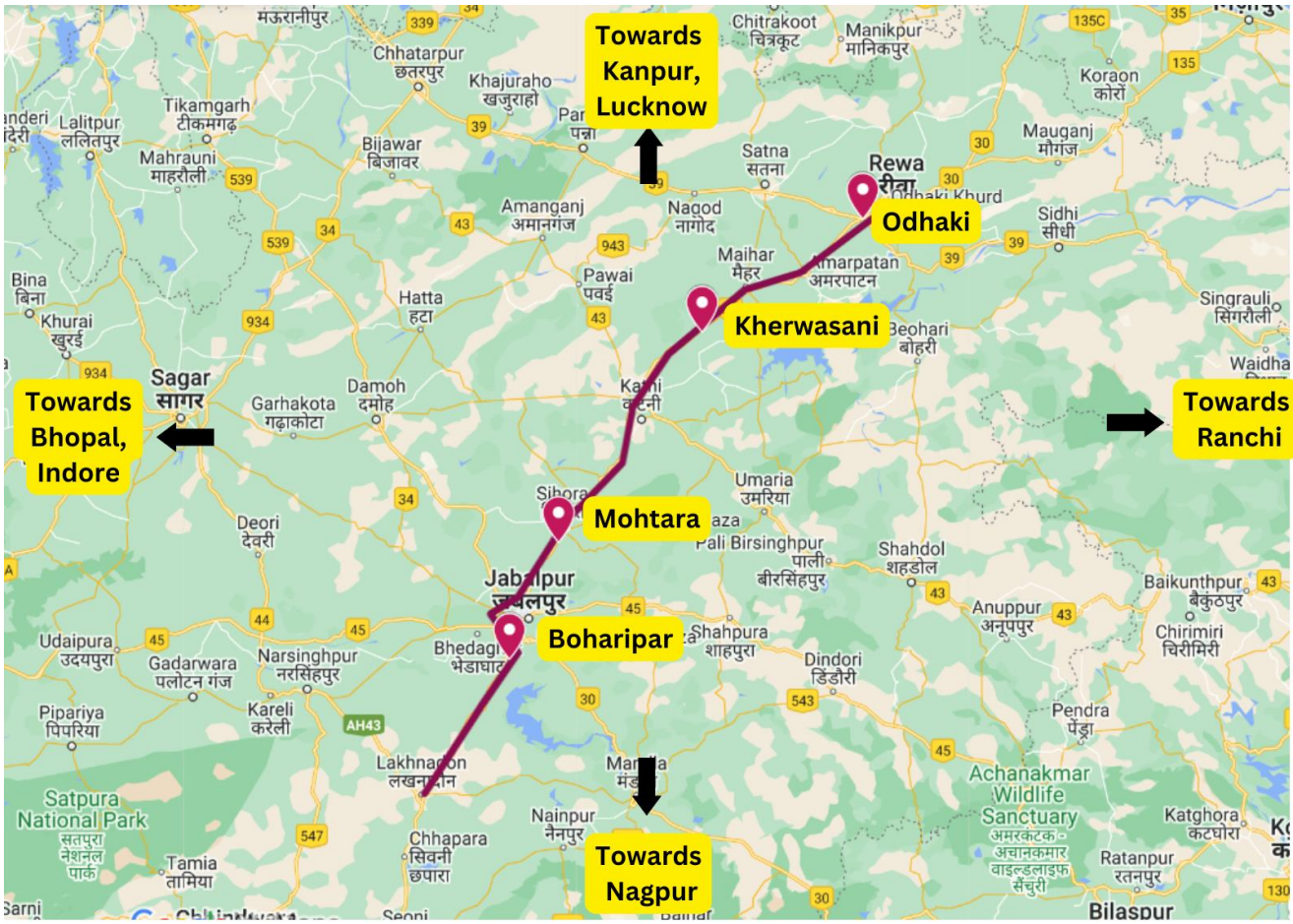
It is evident for the project stretch that the growth of the freight traffic is highly influenced by the regional and state-level growth drivers as against national level factors. As mentioned earlier, CRISIL's traffic forecasting method incorporates its coverage of 80+ sectors and the MSME industry. This knowledge base is used to understand the growth of industries and demand across various regions and clusters which influences the traffic growth. Hence, CRISIL's method is appropriate for this stretch as the growth drivers are concentrated in terms of region and commodities.

4 Overview of project stretch

4.1 Project stretch delineation

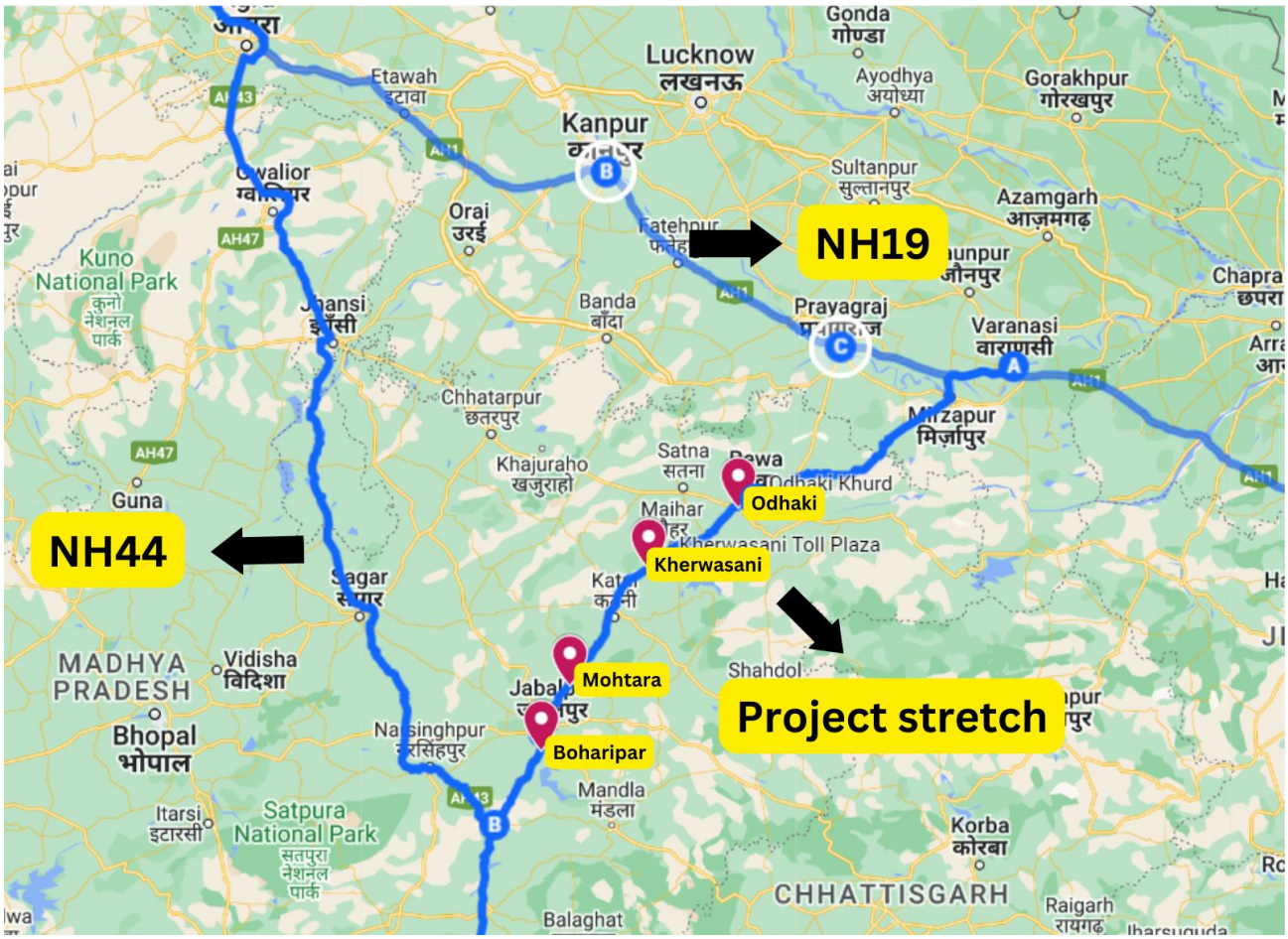
The Rewa-Katni-Jabalpur-Lakhnadon section of NH-30 and NH-34 connects the key districts of MP, UP, and Maharashtra. These are the three key project stretch's influence states. The project stretch has four toll plazas — Odhaki, Kherwasani, Mohtara and Boharipar. In the larger road network, the project stretch connects East-West Corridor (NH-19), which connects Kolkata in West Bengal to Delhi and North-South corridor (NH44) towards south. Hence, the project stretches witnesses moderate long-route traffic.

Figure 3: Project stretch alignment



Source: NHAI, Google Maps, CRISIL MI&A CONSULTING

Figure 4: Project stretch alignment with regard to key freight corridors



Source: NHAI, Google Maps, CRISIL MI&A CONSULTING

Table 19: Key details of project stretch

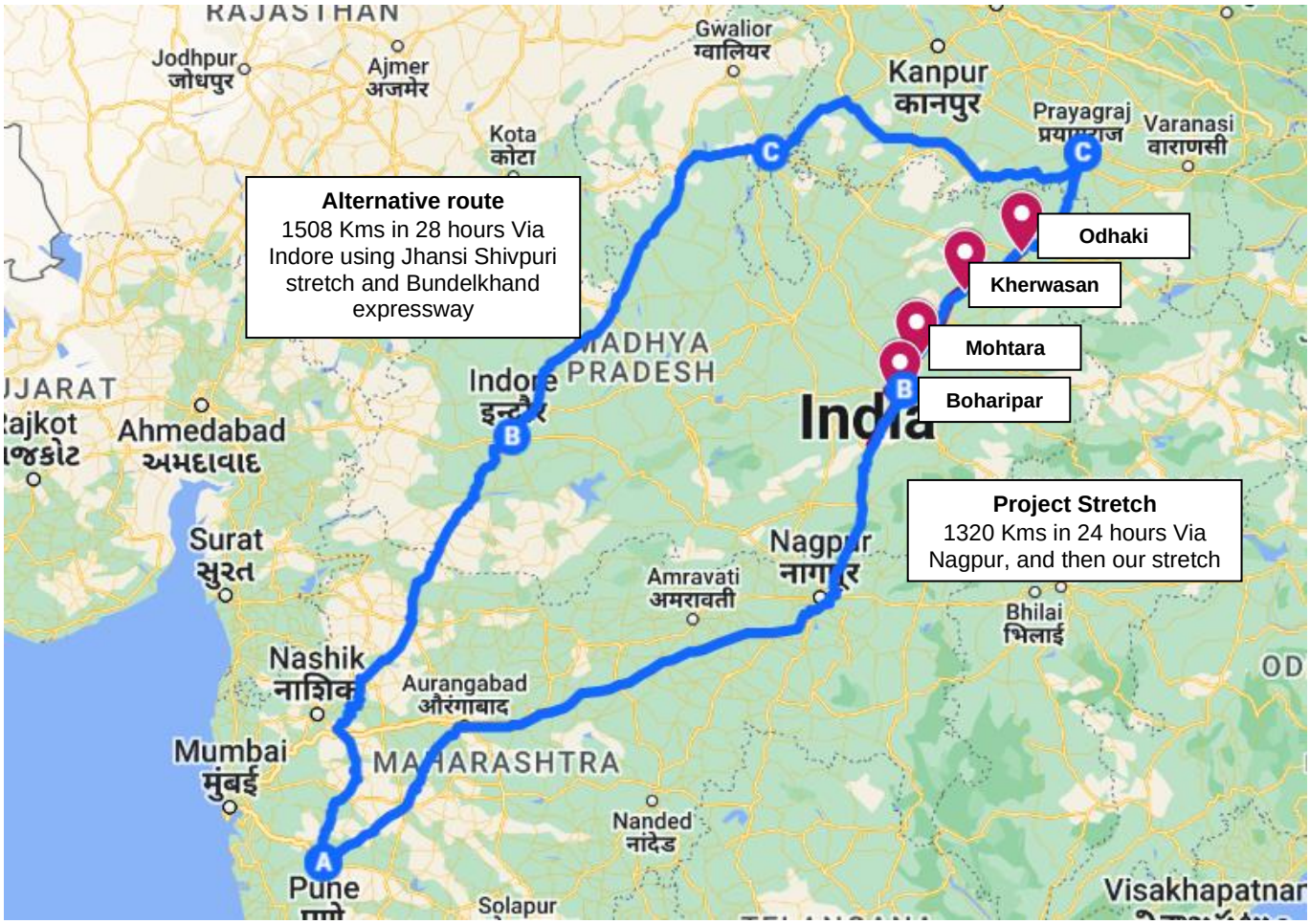
Project stretch	State	Toll plaza	Tollable Length (km)
Four lane of section Rewa to Katni Pkg 1 Km 656+000 to Km 725+185 of NH-30 (old NH-7)	Madhya Pradesh	Odhaki Paipkhar Toll Plaza	71.246
Four lane of section Rewa - Katni - Jabalpur Km 725+185 to km. 813+257 excluding Katni Bypass of NH-30 (old NH-7)	Madhya Pradesh	Kherwasani Toll Plaza	70.868
Four lane of section Rewa to Katni Pkg 4 Km 813+257 to Km 880+600 of NH-30 (old NH-7)	Madhya Pradesh	Mohtara Toll Plaza	71.717
Four lane of section Rewa to Katni Km 880+600 of NH-30 (old NH-7) to Km 1428+557 of NH-34	Madhya Pradesh	Boharipar Toll Plaza	103.337

Source: NHAI, CRISIL MI&A CONSULTING

4.2 Current alternative routes to project stretch

The project stretch is used by the traffic originating and destined in regions such as the Prayagraj-Varanasi cluster, Bihar cluster & Pune-Nashik cluster. Prayagraj-Varanasi, Bihar & Pune-Nashik are the key regions where the north-south traffic converges. The traffic travelling between these two clusters uses the project stretch which takes them 23-24 hours and travels ~1321 km. There exists an alternative route between Pune and Varanasi that passes through Indore and uses Jhansi Shivpuri stretch and Bundelkhand expressway. This route takes 28 hours, and the distance is ~1506 km. However, due to both longer distance and time, the route is not a threat to a long haul through traffic.

Figure 5: Alignment of current alternative routes and project stretch



Source: NHAI, Google Maps, CRISIL MI&A CONSULTING

5 Secondary data available for the assessment

Table 20: Snapshot of availability of secondary data

	Odhaki TP	Kherwasani TP	Mohtara TP	Boharipar TP
ETC data at a vehicle category level	Data is available from Nov-19 to Oct-22 Data gaps in the month of Nov-19, Dec-19, Jan-20	Data is available from Nov-19 to Oct-22 Data gaps in the month of Nov-19, Dec-19, Jan-20, Jan 21 & Feb 21	Data is available from Nov-19 to Oct-22 Data gaps in the month of Nov-19, Dec-19, Jan-20	Data is available from Feb-20 to Oct-22 Data gaps in the month of Nov-19, Dec-19, Jan-20, Jan 21 & Feb 21
ETC segmented data	Data is available from May-22 to Nov-23 Data is unavailable from Mar-21 to Apr-22	Data is available from Mar-21 to Nov-23	Data is available from Dec-21 to Nov-23 Data is unavailable from Mar-21 to Nov-21	Data is available from Mar-21 to Nov-23
Schedule M data	Data is available from Nov-19 to Mar-22 Data is unavailable from Apr-22. The difference between ETC and schedule M data for FY22 is significant for Cars, 2-Axle and LCV category (as high as 47% for LCV and 19% for 2-Axle). This traffic may constitute of cash paying, exempt and violations.	Data is available from Nov-19 to Mar-22 Data is unavailable from Apr-22. The difference between ETC and schedule M data for FY22 is significant for Cars, 2-Axle and LCV category (as high as 47% for LCV and 19% for 2-Axle). This traffic may constitute of cash paying, exempt and violations. Oct-20 data for LCV is unavailable	Data is available from Nov-19 to Mar-22. Data gaps in the month of Feb-21 to Dec-21. Data is unavailable from Apr-22. For majority of the months, we have noticed the ETC traffic is higher than the traffic reported in Schedule M. This is concerning as this cannot be the case. Also, the exemption data is not available for the plaza.	Data is available from Feb-20 to Jan-21. Data gaps in the month of Feb-21 to Mar-22. Data is unavailable from Apr-22. For majority of the months, we have noticed. the ETC traffic is higher than the traffic. reported in Schedule M. This is concerning. as this cannot be the case. Also, the exemption data is not available for the plaza.
Tollable traffic (Cash + FASTag)	Data available from Oct-22 to Dec-22	Data available from Jan-22 to Dec-22	Data available from Jan-22 to Dec-22	Data available from Sep-22 to Dec-22
Cash collection data	Data available from Jan-22 to Mid-Dec-22 Traffic and cash revenue available.	Data available from Jan-22 to Mid-Dec-22 Traffic and cash revenue available.	Data available from Jan-22 to Mid-Dec-22 The reports do not mention traffic volume (cash paying)	Data available from Jan-22 to Mid-Dec-22 The reports do not mention traffic volume. (Cash paying)
TMS Data	Data available from Jan-21 to Aug-23	Data available from Jan-21 to Aug-23	Data available from Jan-21 to Aug-23	Data available from Jan-21 to Aug-23

Source: CRISIL MI&A CONSULTING

To project the AADT for FY24, we have used ETC data from ETC segmented data, and Cash traffic and exemption data from TMS data. We have estimated the share of Minibus and Bus from within the traffic of LCV and 2-Axle basis FY23 ETC traffic (vehicle category wise).

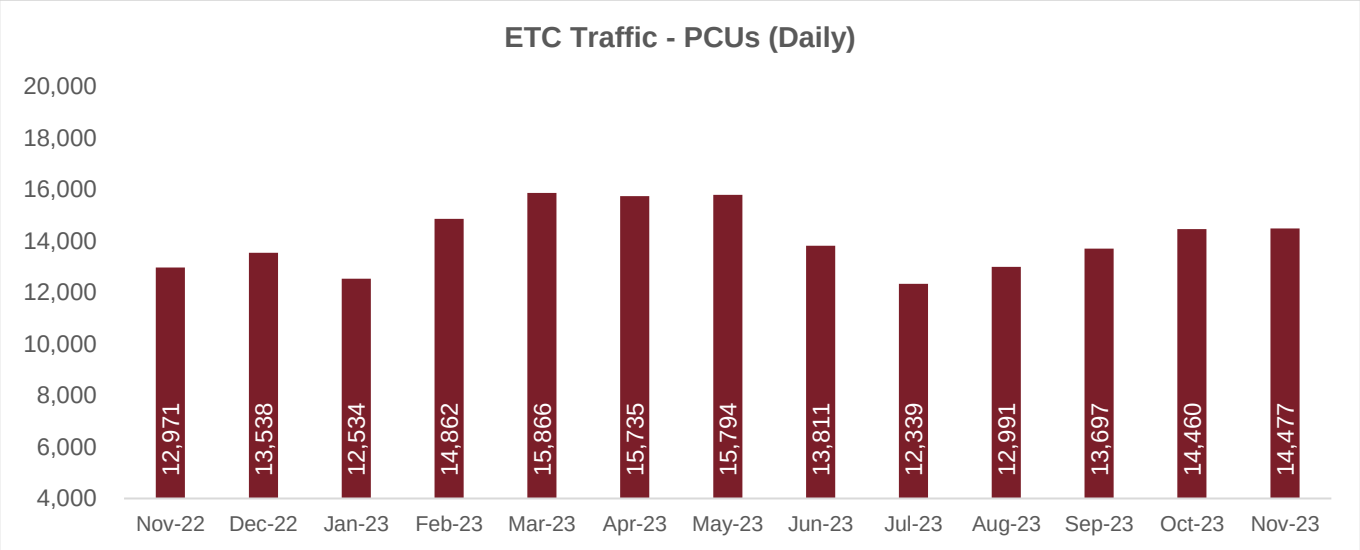
6 Traffic assessment of project stretch

6.1 Review of traffic at toll plazas

Odhaki - MAVs contribute 56% to the stretch's traffic in PCUs; ETC is the dominant payment method across vehicle categories.

The toll plaza recorded 14,477 PCUs in Nov 2023. In terms of PCUs, the traffic mainly comprised MAVs (56%), followed by 2- and 3-axle vehicles (15% and 5%, respectively). Cars accounted for 21% of the traffic.

Figure 6: Total ADT (PCUs) on project stretch over Nov 2022-Nov 2023



Source: Toll Plaza data, CRISIL MI&A CONSULTING

Table 21: ADT volume recorded on project stretch in Nov 2023

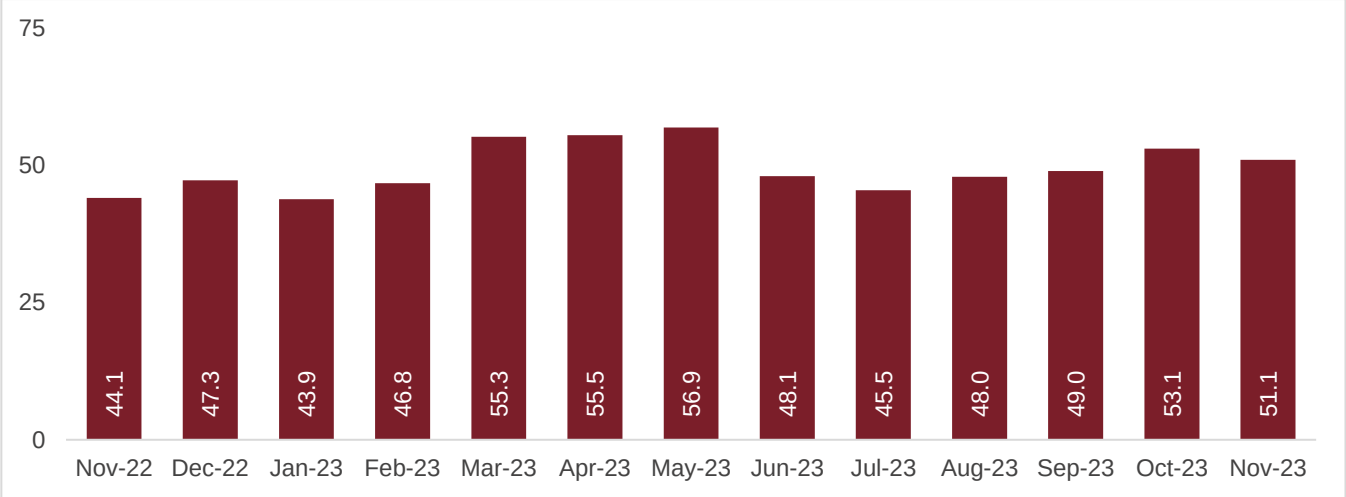
Vehicle category	Traffic volume (vehicles)	Traffic volume (PCUs)	Share (%) - PCUs
Car/jeep/van	3,057	3,057	21%
LCV	280	420	3%
2-axle	725	2,176	15%
3-axle	261	782	5%
MAV	1,787	8,042	56%
Total	**6,110**	**14,477**	**100%**

Source: Toll Plaza data, CRISIL MI&A CONSULTING

Toll plaza collected Rs 1.70 million on average per day in Nov 2023 (ETC Collection)

The project stretch collected an average Rs 1.47 million per day in Nov 2022, which increased by ~16% to Rs 1.70 million per day in Nov 2023. This was primarily driven by the rise in PCU count and secondly, by the increase in the WPI led toll rates.

Figure 7: Total ETC toll collection of the project stretch over Nov 2022 to Nov 2023 (Rs million)



Source: Toll Plaza data, CRISIL MI&A CONSULTING

Table 22: Per day total toll collection of the project stretch from Nov 2022 to Nov 2023

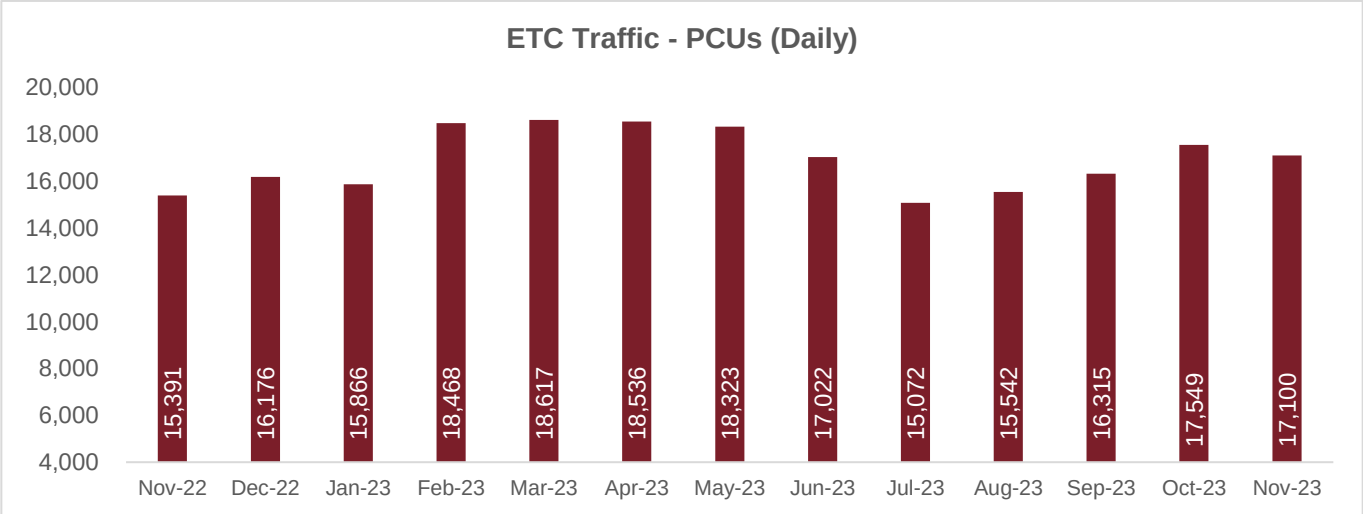
Month-Year	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23
Per day toll collection (Rs million)	1.47	1.53	2.09	1.67	1.78	1.85	1.84	1.6	1.47	1.55	1.63	1.71	1.70

Source: Toll Plaza data, CRISIL MI&A CONSULTING

Kherwasani - MAVs contribute 55% to the stretch's traffic in PCUs; ETC is the dominant payment method across vehicle categories.

The toll plaza recorded 17,100 PCUs in Nov 2023. In terms of PCUs, the traffic mainly comprised MAVs (55%), followed by 2- and 3-axle vehicles (16% and 6%, respectively). Cars accounted for 20% of the traffic.

Figure 8: Total ADT (PCUs) on project stretch over Nov 2022 - Nov 2023



Source: Toll Plaza data, CRISIL MI&A CONSULTING

Table 23: ADT volume recorded on project stretch in Nov 2023

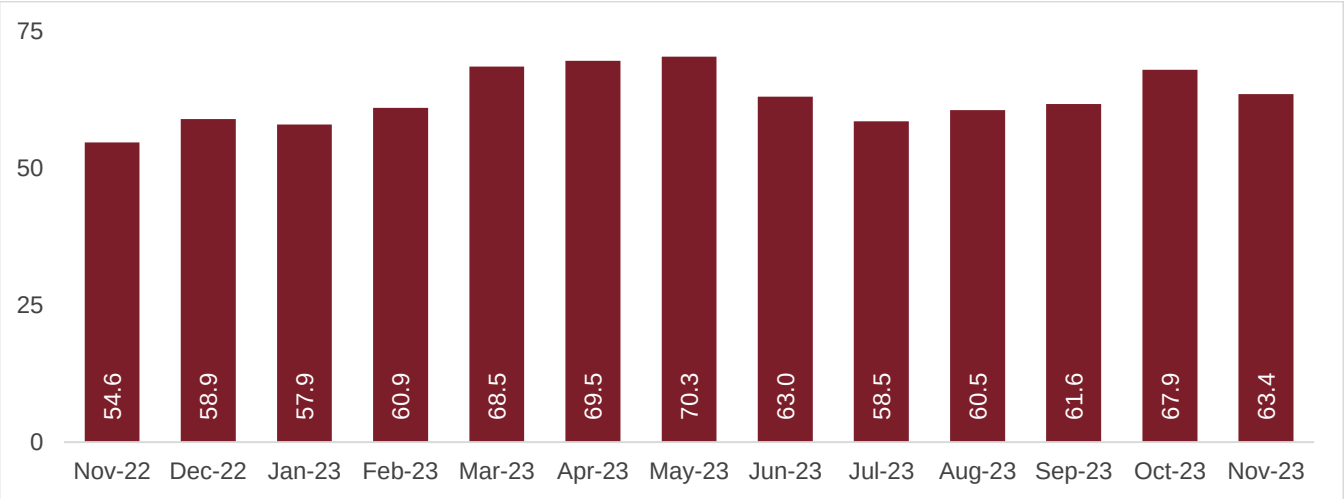
Vehicle category	Traffic volume (vehicles)	Traffic volume (PCUs)	Share (%) - PCUs
Cars/Jeep/Van	3,393	3,393	20%
LCV	322	483	3%
2-Axle	938	2,814	16%
3-Axle	344	1,032	6%
MAV	2,084	9,378	55%
Total	**7,081**	**17,100**	**100%**

Source: Toll Plaza data, CRISIL MI&A CONSULTING

Toll plaza collected Rs 2.11 million on average per day in Nov 2023 (ETC Collection)

The project stretch collected an average Rs 1.82 million per day in Nov 2022, which increased by ~16% to Rs 2.11 million per day in Nov 2023. This was primarily driven by the rise in PCU count and secondly, by the increase in the WPI led toll rates.

Figure 9: Total ETC toll collection of the project stretch over Nov 2022 to Nov 2023 (Rs million)



Source: Toll Plaza data, CRISIL MI&A CONSULTING

Table 24: Per day total toll collection of the project stretch from Nov 2022 to Nov 2023

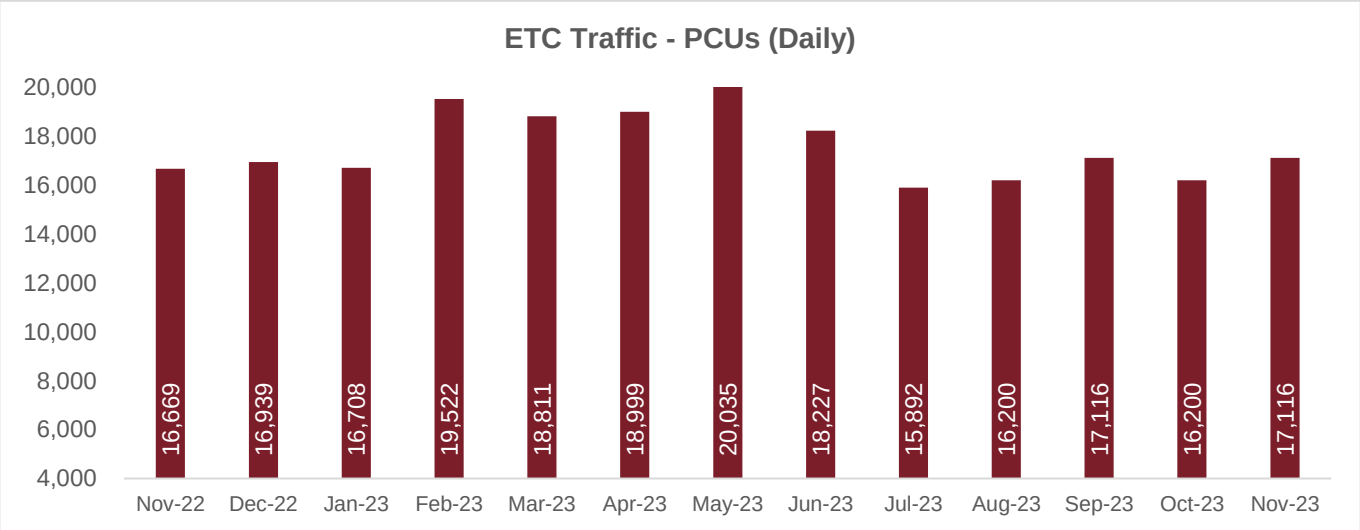
Month-Year	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23
Per day toll collection (Rs million)	1.82	1.90	1.87	2.18	2.21	2.32	2.27	2.10	1.89	1.95	2.05	2.19	2.11

Source: Toll Plaza data, CRISIL MI&A CONSULTING

Mohtara - MAVs contribute 39% to the stretch's traffic in PCUs; ETC is the dominant payment method across vehicle categories.

The toll plaza recorded 17,116 PCUs in Nov 2023. In terms of PCUs, the traffic mainly comprised MAVs (39%), followed by 2- and 3-axle vehicles (18% and 10%, respectively). Cars accounted for 30% of the traffic.

Figure 10: Total ADT (PCUs) on project stretch over Nov 2022 to Nov 2023



Source: Toll Plaza data, CRISIL MI&A CONSULTING

Table 25: ADT volume recorded on project stretch in Nov 2023

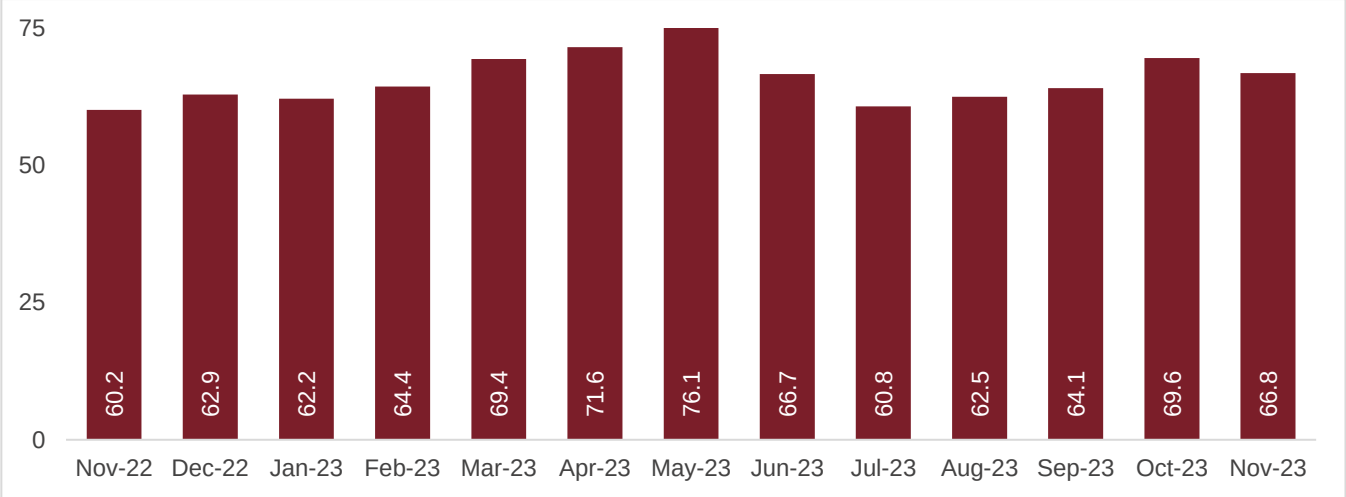
Vehicle category	Traffic volume (vehicles)	Traffic volume (PCUs)	Share (%) - PCUs
Cars/Jeep/Van	5,439	5,439	30%
LCV	361	541	3%
2-Axle	1,070	3,209	18%
3-Axle	600	1,800	10%
MAV	1,558	7,009	39%
Total	**9,027**	**17,998**	**100%**

Source: Toll Plaza data, CRISIL MI&A CONSULTING

Toll plaza collected Rs 2.23 million on average per day in Nov 2023 (ETC Collection)

The project stretch collected an average Rs 2.01 million per day in Nov 2022, which increased by ~11% to Rs 2.23 million per day in Nov 2023. This was primarily driven by the rise in PCU count and secondly, by the increase in the WPI led toll rates.

Figure 11: Total ETC toll collection of the project stretch over Nov 2022 to Nov 2023 (Rs million)



Source: Toll Plaza data, CRISIL MI&A CONSULTING

Table 26: Per day total toll collection of the project stretch from Nov 2022 to Nov 2023

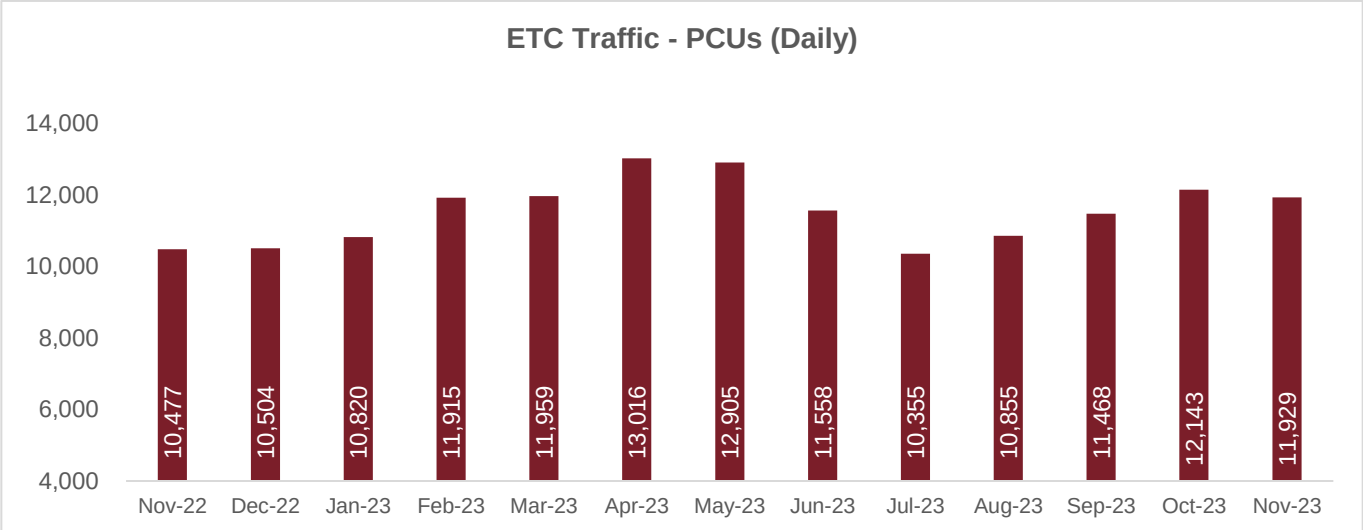
Month-Year	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23
Per day toll collection (Rs million)	2.01	2.03	2.01	2.30	2.24	2.39	2.46	2.22	1.96	2.02	2.14	2.25	2.23

Source: Toll Plaza data, CRISIL MI&A CONSULTING

Boharipar - MAVs contribute 43% to the stretch's traffic in PCUs; ETC is the dominant payment method across vehicle categories.

The toll plaza recorded 11,929 PCUs in Nov 2023. In terms of PCUs, the traffic mainly comprised MAVs (43%), followed by 2- and 3-axle vehicles (21% and 7%, respectively). Cars accounted for 27% of the traffic.

Figure 12: Total ADT (PCUs) on project stretch over Nov 2022 to Nov 2023



Source: Toll Plaza data, CRISIL MI&A CONSULTING

Table 27: ADT volume recorded on project stretch in Nov 2023

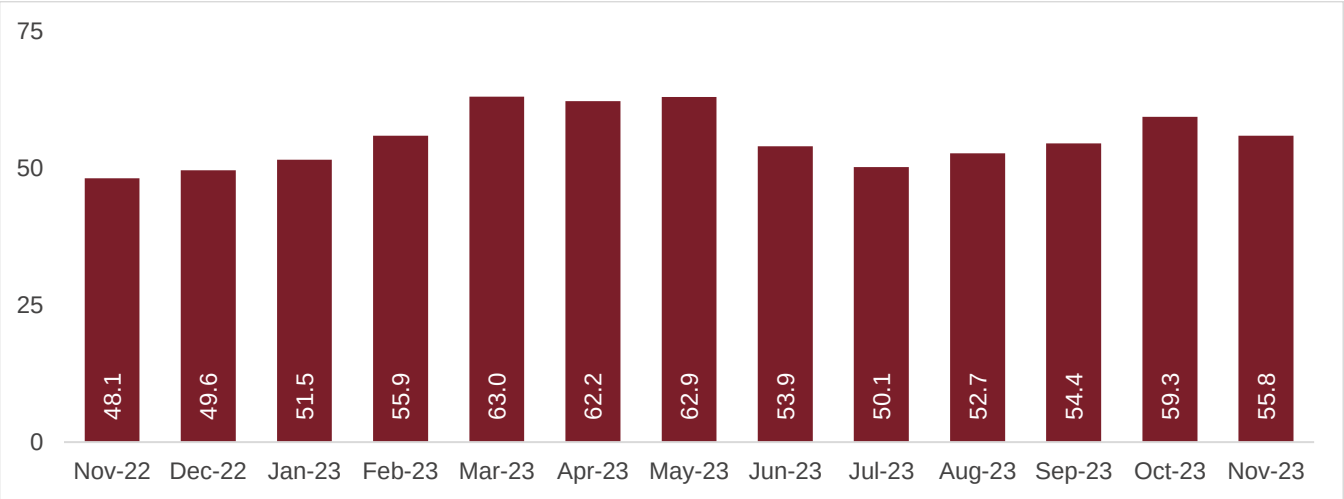
Vehicle category	Traffic volume (vehicles)	Traffic volume (PCUs)	Share (%) - PCUs
Cars/Jeep/Van	3,166	3,166	27%
LCV	226	339	3%
2-Axle	828	2,484	21%
3-Axle	267	802	7%
MAV	1,142	5,138	43%
Total	**5,629**	**11,929**	**100%**

Source: Toll Plaza data, CRISIL MI&A CONSULTING

Toll plaza collected Rs 1.86 million on average per day in Nov 2023 (ETC Collection)

The project stretch collected an average Rs 1.60 million per day in Nov 2022, which increased by ~16% to Rs 1.86 million per day in Nov 2023. This was primarily driven by the rise in PCU count and secondly, by the increase in the WPI led toll rates.

Figure 13: Total ETC toll collection of the project stretch over Nov 2022 to Nov 2023 (Rs million)



Source: Toll Plaza data, CRISIL MI&A CONSULTING

Table 28: Per day total toll collection of the project stretch from Nov 2022 to Nov 2023

Month-Year	Sept-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
Per day toll collection (Rs million)	1.60	1.60	1.66	2.00	2.03	2.07	2.03	1.80	1.62	1.70	1.81	1.91	1.86

Source: Toll Plaza data, CRISIL MI&A CONSULTING

6.2 Review of traffic volume count survey results

CRISIL MI&A Consulting appointed a traffic consultant who conducted traffic surveys on the following dates,

Table 29: Details of traffic surveys conducted for the assessment

Survey details			
Survey name	**Survey location**	**Duration**	**Date**
Traffic Volume Count survey	Odhaki TP Kherwasani TP Mohtara TP* Boharipar TP*	7 days	22nd to 28th November 2022
		3 days	22nd to 24th August 2023 *23rd to 25th August 2023
Origin-Destination survey		1 day	23rd November 2022
		1 day	05th January 2024
Traffic Movement Count	8 locations along the project stretch	1-day	22nd November to 9th December 2022
Registration Plate	Locations in vicinity of Boharipar TP	1-day	9th December 2022

Note: The O-D survey was conducted in Jan 2024 to review the state influence, major O-D pairs, and commodity profile of the stretch.

Source: CRISIL MI&A CONSULTING

Traffic data (3 days TVC) – August 2023

The following table shows the three-day traffic count according to the Traffic Consultant:

Table 30: Odhaki toll plaza

Date	Car	LCV	2-axle	3-axle	MAV	Total	Total (PCUs)
08/22/2023	2,417	255	649	318	1,495	5,134	12,428
08/23/2023	2,621	369	554	317	1,880	5,741	14,248
08/24/2023	2,464	394	605	318	1,770	5,551	13,789
ADT	**2,501**	**339**	**603**	**318**	**1,715**	**5,475**	**13,488**

Source: CRISIL MI&A CONSULTING

Table 31: Kherwasani toll plaza

Date	Car	LCV	2-axle	3-axle	MAV	Total	Total (PCUs)
08/22/2023	2,670	561	791	366	1,928	6,316	15,659
08/23/2023	2,731	516	825	422	2,217	6,711	17,223
08/24/2023	2,665	568	679	480	2,259	6,651	17,160

ADT	**2,689**	**548**	**765**	**423**	**2,135**	**6,559**	**16,680**

Source: CRISIL MI&A CONSULTING

Table 32: Mohtara toll plaza

Date	Car	LCV	2-axle	3-axle	MAV	Total	Total (PCUs)
08/23/2023	4,876	1,113	627	459	1,525	8,600	16,666
08/24/2023	4,921	1,166	726	690	1,656	9,159	18,370
08/25/2023	4,778	1,039	803	586	1,629	8,835	17,834
ADT	**4,858**	**1,106**	**719**	**578**	**1,603**	**8,865**	**17,623**

Source: CRISIL MI&A CONSULTING

Table 33: Boharipar toll plaza

Date	Car	LCV	2-axle	3-axle	MAV	Total	Total (PCUs)
08/23/2023	3,021	666	559	260	1,062	5,568	11,256
08/24/2023	3,063	646	571	340	1,134	5,754	11,868
08/25/2023	3,212	596	821	339	1,052	6,020	12,320
ADT	**3,099**	**636**	**650**	**313**	**1,083**	**5,781**	**11,815**

Source: CRISIL MI&A CONSULTING

Traffic data (7 days TVC) – November 2022

Table 34: Odhaki - Details of traffic recorded in the TVC survey conducted for the assessment

Date	Car	Bus	Minibus	LCV	2-axle	3-axle	MAV	Total	Total
11/22/2022	2,492	234	21	483	226	281	1,626	5,363	12,788
11/23/2022	2,712	279	15	524	230	278	1,712	5,750	13,586
11/24/2022	2,525	272	9	556	206	297	1,687	5,552	13,289
11/25/2022	3,445	306	20	525	201	258	1,566	6,321	13,605
11/26/2022	3,566	328	16	570	197	273	1,718	6,668	14,570
11/27/2022	3,295	322	11	541	185	301	1,720	6,375	14,287
11/28/2022	3,721	273	30	488	210	285	1,632	6,639	14,146
ADT	**3,108**	**288**	**17**	**527**	**208**	**282**	**1,666**	**6,095**	**13,753**

Source: CRISIL MI&A CONSULTING

Table 35: Kherwasani - Details of traffic recorded in the TVC survey conducted for the assessment.

Date	Car	Bus	Minibus	LCV	2-axle	3-axle	MAV	Total	Total
11/22/2022	2,793	214	14	711	324	382	1,937	6,375	15,357
11/23/2022	2,989	197	10	768	344	555	1,936	6,799	16,156
11/24/2022	3,064	181	7	814	328	481	1,937	6,812	15,982
11/25/2022	3,529	267	16	739	270	432	1,923	7,176	16,222

11/26/2022	3,890	250	26	726	250	486	1,864	7,492	16,364
11/27/2022	4,344	198	26	692	350	477	2,037	8,124	17,663
11/28/2022	3,616	232	38	646	337	480	1,941	7,290	16,524
ADT	**3,461**	**220**	**20**	**728**	**315**	**470**	**1,939**	**7,153**	**16,324**

Source: CRISIL MI&A CONSULTING

Table 36: Mohtara - Details of traffic recorded in the TVC survey conducted for the assessment.

Date	Car	Bus	Minibus	LCV	2-axle	3-axle	MAV	Total	Total (PCUs)
11/22/2022	5,220	376	23	790	480	554	1,506	8,949	17,447
11/23/2022	5,359	367	33	962	372	593	1,632	9,318	18,192
11/24/2022	5,280	399	25	1,024	282	520	1,546	9,076	17,414
11/25/2022	6,528	408	39	1,015	232	592	1,739	10,553	19,631
11/26/2022	6,560	452	33	900	478	648	1,549	10,620	19,664
11/27/2022	6,707	395	65	728	348	559	1,712	10,514	19,507
11/28/2022	6,276	416	48	808	407	643	1,519	10,117	18,794
ADT	5,990	402	38	890	371	587	1,600	9,878	18,664

Source: CRISIL MI&A CONSULTING

Table 37: Boharipar - Details of traffic recorded in the TVC survey conducted for the assessment.

Date	Car	Bus	Minibus	LCV	2-axle	3-axle	MAV	Total	Total (PCUs)
11/22/2022	3,375	329	24	488	229	311	977	5,733	11,147
11/23/2022	3,112	333	35	520	277	339	1,109	5,725	11,782
11/24/2022	3,532	342	34	485	346	398	1,043	6,180	12,262
11/25/2022	3,446	319	52	497	271	334	1,001	5,920	11,546
11/26/2022	3,624	329	21	577	208	340	1,115	6,214	12,170
11/27/2022	3,877	382	34	369	261	333	1,105	6,361	12,382
11/28/2022	3,429	330	33	482	254	352	1,134	6,014	12,113
ADT	3,485	338	33	488	264	344	1,069	6,021	11,914

Source: CRISIL MI&A CONSULTING

Comparison of TVC surveys done in November 2022 and August 2023

Reduced TVC vs TMS gap reflects improved compliance primarily at Mohtara and Boharipar toll plazas. Provided below is the comparison in TVC surveys done in November 2022 (7 Day) and August 2023 (3 Day). While in Nov 2022, the TVC count over TMS count was 819 for Mohtara, it significantly reduced to negative in Aug 2023,

reflecting improved compliance. Similar trend is observed for Boharipar toll plaza, where TVC count over TMS count reduced to 350 in Aug 2023 TVs survey from 898 in Nov 2022.

Table 38: Odhaki - Comparison of TVC surveys done in November 2022 and August 2023

Nov-22					
	Car	**LCV + 2-Axle**	**3-axle**	**MAV**	**Total**
TVC	3,108	1,040	282	1,666	6,095
ETC + Cash	2,891	934	275	1,684	5,783
TVC over ETC + Cash	217	106	7	-18	312
Aug-23					
	Car	**LCV + 2-Axle**	**3-axle**	**MAV**	**Total**
TVC	2,501	942	318	1,715	5,475
ETC + Cash	2,354	930	242	1,694	5,221
TVC over ETC + Cash	146	12	76	21	255

Source: CRISIL MI&A CONSULTING

Table 39: Kherwasani - Comparison of TVC surveys done in November 2022 and August 2023

Nov-22					
	Car	**LCV + 2-Axle**	**3-axle**	**MAV**	**Total**
TVC	3,461	1,282	470	1,939	7,153
ETC + Cash	3,272	1,168	389	1,975	6,805
TVC over ETC + Cash	189	114	81	-36	348
Aug-23					
	Car	**LCV + 2-Axle**	**3-axle**	**MAV**	**Total**
TVC	2,689	1,313	423	2,135	6,559
ETC + Cash	2,605	1,266	334	2,019	6,225
TVC over ETC + Cash	83	47	88	115	334

Source: CRISIL MI&A CONSULTING

Table 40: Mohtara - Comparison of TVC surveys done in November 2022 and August 2023

Nov-22					
	Car	**LCV + 2-Axle**	**3-axle**	**MAV**	**Total**
TVC	5,990	1,701	587	1,600	9,878
ETC + Cash	5,171	1,415	567	1,595	8,748
TVC over ETC + Cash	819	286	20	5	1,130
Aug-23					
	Car	**LCV + 2-Axle**	**3-axle**	**MAV**	**Total**
TVC	4,858	1,825	578	1,603	8,865
ETC + Cash	4,877	1,506	556	1,601	8,541
TVC over ETC + Cash	-19	319	22	2	324

Source: CRISIL MI&A CONSULTING

Table 41: Kherwasani - Comparison of TVC surveys done in November 2022 and August 2023

Nov-22 - Boharipar					
	Car	**LCV + 2-Axle**	**3-axle**	**MAV**	**Total**
TVC	3,485	1,123	344	1,069	6,021
ETC + Cash	2,587	954	262	984	4,788
TVC over ETC + Cash	898	169	82	85	1,233
Aug-23					
	Car	**LCV + 2-Axle**	**3-axle**	**MAV**	**Total**
TVC	3,099	1,286	313	1,083	5,781
ETC + Cash	2,749	1,191	252	1,102	5,294
TVC over ETC + Cash	350	95	61	-19	486

Source: CRISIL MI&A CONSULTING

6.3 Annual average daily traffic (AADT) estimation for fiscal 2024

The traffic for fiscal 2023 and eight months (Apr-Nov) of fiscal 2024 was evaluated for estimation of AADT for fiscal 2024. The evaluation of data for fiscal 2024 indicates a considerable difference in traffic base *(based on a year-on-year comparison)* across categories vis-à-vis fiscal 2023. To understand the vehicular dynamics leading to the variance in traffic base, a 3-Day TVC survey was done at all plazas in August 2023 *(Results shown in previous section).*

It was observed that better compliance levels, in addition to network developments and temporary diversions have led to this variance in fiscal 2024 traffic. Thus, to incorporate the relevant factors resulting in traffic changes across plazas, fiscal 2024 traffic (for available months) is considered in conjunction with fiscal 2023 traffic to project fiscal 2024 AADT. Notably, for Odhaki, MAV traffic of Jun and Jul month of 2023 is excluded for AADT estimation, as the category was impacted at the plaza owing to repair work at Naini bridge near Prayagraj, which connects Prayagraj in UP to Rewa in MP. (Refer Annexure-9.1 for details)

We have considered actual ETC traffic volumes, which are further expanded based on TMS cash traffic and exemption data. On these actual traffic volumes, FY23 SCF is applied, to derive AADT for fiscal 2024.

Table 42: FY24 Estimated AADT based on ETC data, SCF and cash & exemption data:

Odhaki	CJV	LCV	2A	3A	MAV	Total PCU
ETC AADT	2,945	277	676	268	1,944	14,941
Cash & Exemption (As % of ETC)	***12.9%***	***15.1%***	***1.7%***	***1.3%***	***0.2%***	
AADT	3,324	319	687	272	1,948	15,447
Kherwasani	**CJV**	**LCV**	**2A**	**3A**	**MAV**	**Total PCU**
ETC AADT	3,239	333	942	357	2,276	17,876
Cash & Exemption (As % of ETC)	***14.0%***	***13.1%***	***1.0%***	***1.7%***	***0.4%***	
AADT	3,693	377	951	363	2,284	18,482
Mohtara	**CJV**	**LCV**	**2A**	**3A**	**MAV**	**Total PCU**
ETC AADT	5,537	410	1,098	585	1,660	18,671
Cash & Exemption (As % of ETC)	***11.8%***	***18.8%***	***1.6%***	***0.3%***	***0.3%***	
AADT	6,193	487	1,116	587	1,664	19,520
Boharipar	**CJV**	**LCV**	**2A**	**3A**	**MAV**	**Total PCU**
ETC AADT	3,118	242	891	250	1,185	12,238
Cash & Exemption (As % of ETC)	***16.3%***	***16.0%***	***2.4%***	***2.2%***	***0.5%***	
AADT	3,626	281	912	256	1,191	12,908

Note: For Cash and exemption (As % of ETC) calculation, data is considered from Apr-22 to Jul-23
A comparison of ETC AADT for fiscal 2024 vis-à-vis fiscal 2023 is also provided in Annexures, indicating traffic variance
Source: CRISIL MI&A Consulting

6.4 Origin-destination survey

CRISIL MI&A Consulting appointed a traffic consultant to conduct a 24-hour (O-D) survey at all the four toll plazas of the project stretch. The survey was undertaken on Nov 23, 2022. The total size of the sample collected is a minimum of ~50% across each vehicle category.

Table 43: Details of sample collected in the O-D survey conducted for the assessment.

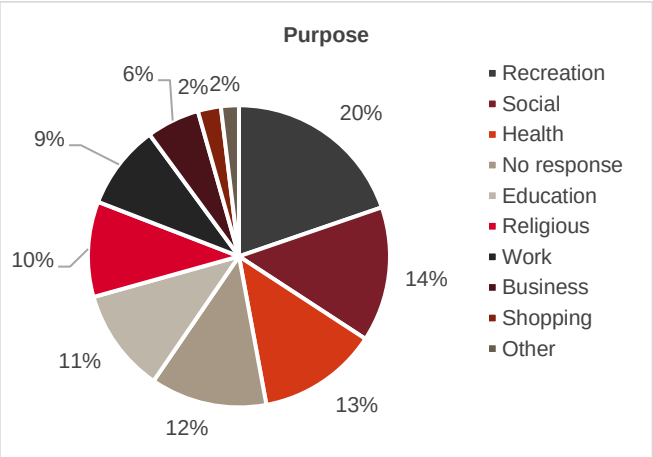
Survey details				
Vehicle category	**Odhaki TP**	**Kherwasani TP**	**Mohtara TP**	**Boharipar TP**
Cars/Jeep/Van	52%	51%	51%	48%
Bus	60%	70%	62%	66%
Minibus	46%	35%	58%	81%
LCV	75%	82%	83%	77%
2-Axle	71%	81%	71%	78%
3-Axle	75%	79%	73%	80%
MAV	75%	74%	80%	73%

Source: CRISIL MI&A CONSULTING

Odhaki - Project stretch and its vicinity regions such as Rewa, Maihar, Jabalpur, Katni are the key origin-destination for the passenger traffic

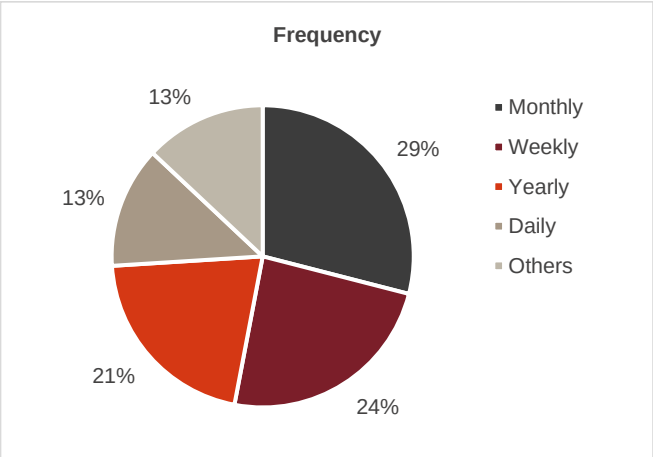
The O-D survey noted responses of the passengers on the traffic plying on the project stretch. These queries included purpose of the visit, frequency of travelling, origin point, and destination point. In terms of the purpose of travelling, passengers of 20% of the vehicles cited recreation reason, followed by social (14%) and health (13%). In terms of frequency, 29% monthly travel, 24% cited weekly travel, 13% daily travel, and 13% cited yearly travel.

Figure 14: Odhaki -Trip purpose of the passenger traffic at toll plaza as per O-D survey



Source: CRISIL MI&A

Figure 15: Odhaki -Trip frequency of the passenger traffic at toll plaza as per O-D survey



Source: CRISIL MI&A

The O-D survey revealed the key origin point and destination points for the passenger traffic are Rewa, Maihar, Jabalpur, Katni. The same pattern is noted in both directions, i.e., towards Rewa and towards Jabalpur.

Table 44: Odhaki -Key O-D regions for passenger traffic at toll plaza towards Rewa direction

Origin	%	Destination	%
Madhya Pradesh	**94%**	**Madhya Pradesh**	**98%**
Maihar	*35%*	*Maihar*	*26%*
Jabalpur	*16%*	*Katni*	*20%*
Katni	*11%*	*Jabalpur*	*17%*
Amarpatan	*9%*	*Amarpatan*	*11%*
Bhopal	*9%*	*Bhopal*	*7%*
Chhindwara	*6%*	*Chhindwara*	*5%*
Indore	*4%*	*Indore*	*3%*
Mantolwa	*2%*	*Mantolwa*	*2%*
Sagar	*1%*	*Umaria*	*1%*
Others	*6%*	*Others*	*8%*

Source: CRISIL MI&A

Table 45: Odhaki -Key O-D regions for passenger traffic at toll plaza towards Jabalpur direction

Origin	%	Destination	%
Madhya Pradesh	**68%**	**Madhya Pradesh**	**63%**
Rewa	*69%*	*Rewa*	*76%*
Bela	*9%*	*Bela*	*8%*
Sidhi	*6%*	*Sidhi*	*7%*
Nai Garhi	*3%*	*Satna*	*2%*
Satna	*3%*	*Hanumana*	*2%*
Hanumana	*3%*	*Nai Garhi*	*1%*
Mauganj	*2%*	*Semariya*	*1%*
Rani Talab	*1%*	*Chakghat*	*1%*
Others	*5%*	*Others*	*3%*
Uttar Pradesh	**30%**	**Uttar Pradesh**	**35%**

Source: CRISIL MI&A

Odhaki - Katni, Jabalpur, Prayagraj & Varanasi are the major contributors to the goods traffic on the project stretch

The Rewa-Katni-Jabalpur-Lakhnadon section is a part of the NH-27, which is the East-West Corridor. Hence, the traffic here largely plies between the eastern and western regions of the country. The key O-D region is Uttar Pradesh. Within the state, Kanpur, Lucknow and Jhansi are the key locations. Other key regions include Madhya Pradesh, Gujarat and Maharashtra. Within these states, the key cities noted in the survey are Indore, Mumbai, and Rajkot, among others.

Table 46: Odhaki -Key O-D regions for goods traffic at toll plaza towards Rewa direction

Origin	%	Destination	%
Madhya Pradesh	**82%**	**Uttar Pradesh**	**46%**
Katni	*25%*	*Prayagraj*	*29%*
Jabalpur	*25%*	*Varanasi*	*22%*
Maihar	*13%*	*Gorakhpur*	*10%*
Indore	*8%*	*Amethi*	*9%*
Bhopal	*8%*	*Mirzapur*	*8%*
Chhindwara	*3%*	*Sultanpur*	*5%*
Maharashtra	**9%**	**Madhya Pradesh**	**42%**
Karnataka	**2%**	*Rewa*	*66%*
Telangana	**2%**	**Bihar**	**12%**
Other States	**5%**	*Patna*	*58%*

Source: CRISIL MI&A

Table 47: Odhaki -Key O-D regions for goods traffic at toll plaza towards Jabalpur direction

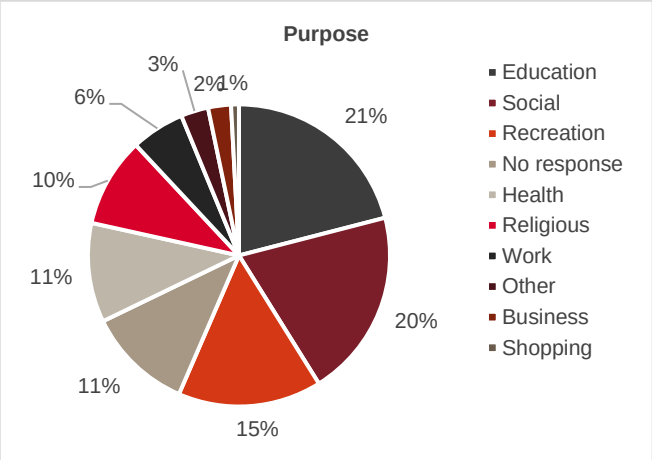
Origin	%	Destination	%
Madhya Pradesh	**47%**	**Madhya Pradesh**	**88%**
Rewa	*66%*	*Katni*	*25%*
Satna	*10%*	*Jabalpur*	*23%*
Sidhi	*5%*	*Maihar*	*19%*
Bela	*5%*	*Bhopal*	*8%*
Uttar Pradesh	**46%**	**Maharashtra**	**9%**
Prayagraj	37%	**Telangana**	**1%**
Varanasi	18%	**Karnataka**	**1%**
Mirzapur	13%	**Goa**	**1%**
Bihar	**6%**		
Other States	**1%**		

Source: CRISIL MI&A

Kherwasani - Project stretch and its vicinity regions such as Jabalpur, Rewa, Satna, Katni etc. are the key origin-destination for the passenger traffic.

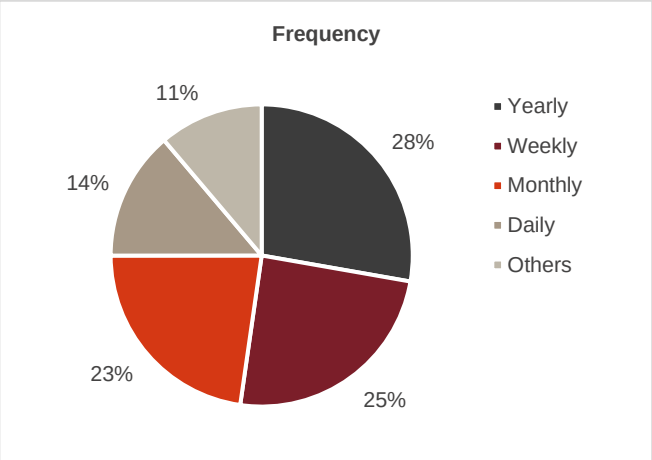
The O-D survey noted responses of the passengers on the traffic plying on the project stretch. These queries included purpose of the visit, frequency of travelling, origin point, and destination point. In terms of the purpose of travelling, passengers of 20% of the vehicles cited recreation reason, followed by social (14%) and health (13%). In terms of frequency, 13% daily travel, 24% cited weekly travel, 29% monthly travel, and 13% cited yearly travel.

Figure 16: Kherwasani -Trip purpose of the passenger traffic at toll plaza as per O-D survey



Source: CRISIL MI&A CONSULTING

Figure 17: Kherwasani -Trip frequency of the passenger traffic at toll plaza as per O-D survey



Source: CRISIL MI&A CONSULTING

The O-D survey revealed the key origin point and destination points for the passenger traffic are Jabalpur, Rewa, Satna, Katni. The same pattern is noted in both directions, i.e., towards Rewa and towards Jabalpur.

Table 48: Kherwasani - Key O-D regions for passenger traffic at toll plaza towards Rewa direction

Origin	%	Destination	%
Madhya Pradesh	**95%**	**Madhya Pradesh**	**79%**
Katni	*36%*	*Rewa*	*31%*
Jabalpur	*28%*	*Satna*	*27%*
Bhopal	*6%*	*Maihar*	*25%*
Sihora	*4%*	*Amarpatan*	*2%*
Indore	*3%*	*Chitrakoot*	*2%*
Sagar	*3%*	*Manikpur*	*2%*
Shahnagar	*2%*	*Nagor*	*2%*
Sleemanabad	*2%*	**Uttar Pradesh**	**15%**
Shahdol	*1%*	**Bihar**	**5%**

Source: CRISIL MI&A CONSULTING

Table 49: Kherwasani - Key O-D regions for passenger traffic at toll plaza towards Katni direction

Origin	%	Destination	%
Madhya Pradesh	**67%**	**Madhya Pradesh**	**95%**
Rewa	*30%*	*Katni*	30%
Satna	*18%*	*Jabalpur*	22%
Maihar	*14%*	*Bhopal*	6%
Sidhi	*4%*	*Sagar*	3%
Amarpatan	*3%*	*Shahnagar*	2%
Bharauli	*2%*	*Lakhnadon*	2%
Manikpur	*2%*	*Sihora*	2%
Uttar Pradesh	**27%**	*Damoh*	*2%*
Varanasi	*16%*	*Sleemanabad*	*2%*
Prayagraj	*13%*	*Indore*	*1%*
Renukoot	*6%*		
Shankargarh	*5%*		

Source: CRISIL MI&A CONSULTING

Kherwasani - Jabalpur, Rewa, Satna, Katni are the major contributors to the goods traffic on the project stretch.

The Rewa-Katni-Jabalpur-Lakhnadon section is a part of the NH-27, which is the East-West Corridor. Hence, the traffic here largely plies between the eastern and western regions of the country. The key O-D region is Uttar Pradesh. Within the state, Kanpur, Lucknow, and Jhansi are the key locations. Other key regions include Madhya Pradesh, Gujarat, and Maharashtra. Within these states, the key cities noted in the survey are Indore, Mumbai, and Rajkot, among others.

Table 50: Kherwasani - Key O-D regions for goods traffic at toll plaza towards Rewa direction

Origin	%	Destination	%
Madhya Pradesh	**84%**	**Madhya Pradesh**	**58%**
Jabalpur	*31%*	*Rewa*	*37%*
Katni	*25%*	*Satna*	*26%*
Indore	*6%*	*Maihar*	*16%*
Bhopal	*6%*	*Singrauli*	*3%*
Jukehi	*3%*	*Sidhi*	*2%*
Maharashtra	**7%**	**Uttar Pradesh**	**28%**
Telangana	**2%**	*Varanasi*	*26%*
Karnataka	**2%**	*Prayagraj*	*25%*
Chhattisgarh	**1%**	*Gorakhpur*	*6%*
Gujarat	**1%**	*Jaunpur*	*6%*
Andhra Pradesh	**1%**	*Akbarpur*	*5%*
Tamil Nadu	**1%**	**Bihar**	**10%**
		West Bengal	**1%**

Source: CRISIL MI&A CONSULTING

Table 51: Kherwasani - Key O-D regions for goods traffic at toll plaza towards Katni direction

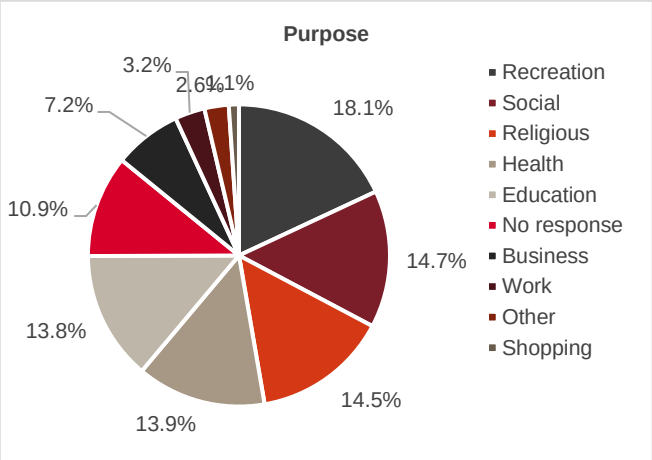
Origin	%	Destination	%
Madhya Pradesh	**59%**	**Madhya Pradesh**	**89%**
Rewa	*34%*	*Jabalpur*	*33%*
Satna	*28%*	*Katni*	*32%*
Maihar	*15%*	*Bhopal*	*4%*
Singrauli	*3%*	*Sagar*	*4%*
Unchehara	*2%*	*Indore*	*3%*
Uttar Pradesh	**32%**	**Maharashtra**	**6%**
Prayagraj	42%	**Telangana**	**2%**
Varanasi	17%	**Chhattisgarh**	**1%**
Mirzapur	6%	**Karnataka**	**1%**
Jaunpur	5%	**Gujarat**	**1%**
Gorakhpur	3%		
Bihar	**6%**		
Jharkhand	**1%**		

Source: CRISIL MI&A CONSULTING

Mohtara - Project stretch and its vicinity regions such as Jabalpur, Katni, Sihora, and Gosalpur etc. are the key origin-destination for the passenger traffic.

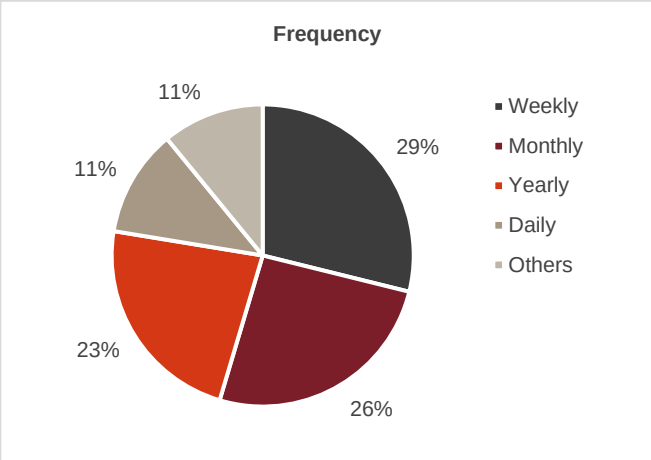
The O-D survey noted responses of the passengers on the traffic plying on the project stretch. These queries included purpose of the visit, frequency of travelling, origin point, and destination point. In terms of the purpose of travelling, passengers of 18% of the vehicles cited recreation reason, followed by social (15%) and religious (15%). In terms of frequency, 11% daily travel, 29% cited weekly travel, 26% monthly travel, and 23% cited yearly travel.

Figure 18: Mohtara - Trip purpose of the passenger traffic at toll plaza as per O-D survey



Source: CRISIL MI&A CONSULTING

Figure 19: Mohtara - Trip frequency of the passenger traffic at toll plaza as per O-D survey



Source: CRISIL MI&A CONSULTING

The O-D survey revealed the key origin point and destination points for the passenger traffic are Jabalpur, Katni, Sihora, and Gosalpur. The same pattern is noted in both directions, i.e., towards Katni and towards Jabalpur.

Table 52: Mohtara - Key O-D regions for passenger traffic at toll plaza towards Katni direction

Origin	%	Destination	%
Madhya Pradesh	**95%**	**Madhya Pradesh**	**84%**
Jabalpur	*40%*	*Katni*	*26%*
Gosalpur	*6%*	*Sihora*	*13%*
Panagar	*6%*	*Rewa*	*9%*
Katangi	*4%*	*Satna*	*9%*
Lakhnadon	*4%*	*Maihar*	*4%*
Seoni	*3%*	*Sleemanabad*	*4%*
Bhopal	*3%*	*Panna*	*2%*
Dhuma	*2%*	*Nagod*	*1%*
Narsinghpur	*1%*	*Amarpatan*	*1%*
Manegaon	*1%*	*Mauhari*	*1%*
Shahpura	*1%*	*Bichhiya*	*1%*
Kareli	*1%*	*Dhangawan*	*1%*
Mandla	*1%*	*Majholi*	*1%*

Source: CRISIL MI&A CONSULTING

Table 53: Mohtara - Key O-D regions for passenger traffic at toll plaza towards Jabalpur direction

Origin	%	Destination	%
Madhya Pradesh	**88%**	**Madhya Pradesh**	**96%**
Katni	*26%*	*Jabalpur*	*41%*
Sihora	*15%*	*Gosalpur*	*8%*
Rewa	*9%*	*Lakhnadon*	*5%*
Satna	*7%*	*Panagar*	*4%*
Maihar	*6%*	*Bhopal*	*4%*
Sleemanabad	*3%*	*Seoni*	*3%*
Majholi	*2%*	*Sewaniya*	*3%*
Shahdol	*2%*	*Indore*	*2%*
Amarpatan	*2%*	*Mandla*	*2%*
Darshani	*2%*	*Katangi*	*2%*
Panna	*1%*	*Dhuma*	*2%*
Raipura	*1%*	*Narsinghpur*	*1%*
Teori	*1%*	*Kareli*	*1%*

Source: CRISIL MI&A CONSULTING

Mohtara - Jabalpur, Rewa, Katni & Chhindwara are the major contributors to the goods traffic on the project stretch.

The Rewa-Katni-Jabalpur-Lakhnadon section is a part of the NH-27, which is the East-West Corridor. Hence, the traffic here largely plies between the eastern and western regions of the country. The key O-D region is Uttar Pradesh. Within the state, Kanpur, Lucknow, and Jhansi are the key locations. Other key regions include Madhya Pradesh, Gujarat, and Maharashtra. Within these states, the key cities noted in the survey are Indore, Mumbai, and Rajkot, among others.

Table 54: Mohtara - Key O-D regions for goods traffic at toll plaza towards Katni direction

Origin	%	Destination	%
Madhya Pradesh	**78%**	**Madhya Pradesh**	**73%**
Jabalpur	*57%*	*Katni*	*36%*
Chhindwara	*8%*	*Rewa*	*17%*
Indore	*6%*	*Satna*	*16%*
Sewaniya	*4%*	*Sihora*	*9%*
Bhopal	*4%*	*Maihar*	*6%*
Maharashtra	**12%**	**Bihar**	**12%**
Mumbai	*31%*	*Patna*	*42%*
Pune	*16%*	*Buxar*	*36%*
Nagpur	*11%*	*Muzaffarpur*	*14%*
Telangana	**3%**	**Uttar Pradesh**	**10%**
Others	**6%**	**Others**	**4%**

Source: CRISIL MI&A CONSULTING

Table 55: Mohtara - Key O-D regions for goods traffic at toll plaza towards Jabalpur direction

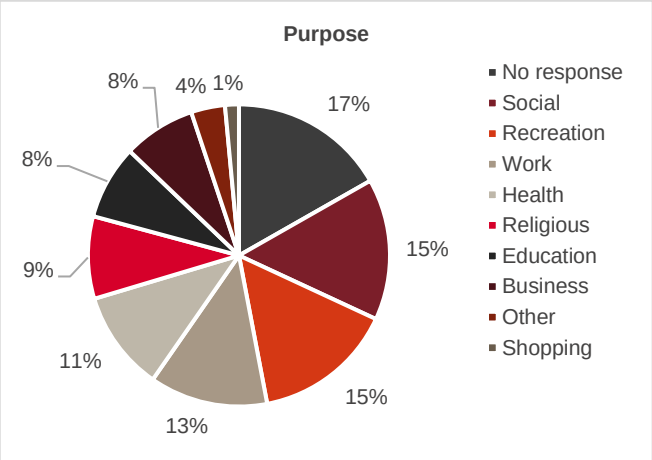
Origin	%	Destination	%
Madhya Pradesh	**80%**	**Madhya Pradesh**	**81%**
Katni	*33%*	*Jabalpur*	*59%*
Rewa	*18%*	*Bhopal*	*7%*
Sihora	*16%*	*Indore*	*6%*
Satna	*13%*	*Gosalpur*	*5%*
Maihar	*8%*	*Sewaniya*	*4%*
Uttar Pradesh	**11%**	**Maharashtra**	**13%**
Prayagraj	*46%*	*Mumbai*	*30%*
Hargarh	*16%*	*Nagpur*	*17%*
Varanasi	*14%*	*Jalgaon*	*9%*
Bihar	**7%**	**Karnataka**	**2%**
Others	**3%**	**Others**	**4%**

Source: CRISIL MI&A CONSULTING

Boharipar - Project stretch and its vicinity regions such as Jabalpur, Chhindwara, Seoni, Bargi are the key origin-destination for the passenger traffic.

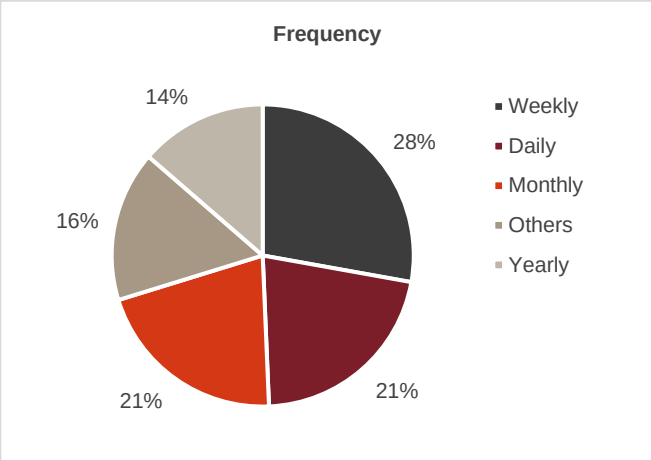
The O-D survey noted responses of the passengers on the traffic plying on the project stretch. These queries included purpose of the visit, frequency of travelling, origin point, and destination point. In terms of the purpose of travelling, passengers of 15% of the vehicles cited recreation reason, followed by social (15%) and work (13%). In terms of frequency, 21% daily travel, 28% cited weekly travel, 21% monthly travel, and 14% cited yearly travel.

Figure 20: Boharipar - Trip purpose of the passenger traffic at toll plaza as per O-D survey



Source: CRISIL MI&A CONSULTING

Figure 21: Boharipar - Trip frequency of the passenger traffic at toll plaza as per O-D survey



Source: CRISIL MI&A CONSULTING

The O-D survey revealed the key origin point and destination points for the passenger traffic are Jabalpur, Chhindwara, Seoni, Bargi. The same pattern is noted in both directions, i.e., towards Seoni and towards Jabalpur.

Table 56: Boharipar - Key O-D regions for passenger traffic at toll plaza towards Seoni direction

Origin	%	Destination	%
Madhya Pradesh	**96%**	**Madhya Pradesh**	**91%**
Jabalpur	*47%*	*Bargi*	*27%*
Katni	*6%*	*Seoni*	*24%*
Satna	*5%*	*Chhindwara*	*24%*
Gour	*5%*	*Dhuma*	*6%*
Bhitoni	*5%*	*Lakhnadon*	*4%*
Rewa	*4%*	*Balaghat*	*4%*
Katangi	*3%*	*Ghansor*	*3%*
Ujjain	*3%*	*Nigri*	*2%*
Maihar	*2%*	*Kaladehi*	*2%*
Bhopal	*2%*	*Sukari*	*1%*
Sagar	*2%*	*Nainpur*	*1%*
Others	*4%*	*Others*	*9%*

Source: CRISIL MI&A CONSULTING

Table 57: Boharipar - Key O-D regions for passenger traffic at toll plaza towards Jabalpur direction

Origin	%	Destination	%
Madhya Pradesh	**86%**	**Madhya Pradesh**	**86%**
Seoni	*34%*	*Jabalpur*	*43%*
Chhindwara	*32%*	*Katni*	*11%*
Bargi	*14%*	*Satna*	*8%*
Lakhnadon	*6%*	*Panagar*	*5%*
Dhuma	*6%*	*Patan*	*5%*
Balaghat	*4%*	*Rewa*	*4%*
Ghansor	*1%*	*Sihora*	*3%*
Nainpur	*0%*	*Maihar*	*3%*
Chhapara	*0%*	*Tilwara*	*2%*
Kanhiwada	*0%*	*Bhandra*	*2%*
Nigri	*0%*	*Katangi*	*2%*
Others	*14%*	*Others*	*14%*

Source: CRISIL MI&A CONSULTING

Boharipar - Jabalpur, Rewa, Seoni, & Dhuma are the major contributors to the goods traffic on the project stretch.

The Rewa-Katni-Jabalpur-Lakhnadon section is a part of the NH-27, which is the East-West Corridor. Hence, the traffic here largely plies between the eastern and western regions of the country. The key O-D region is Uttar Pradesh. Within the state, Kanpur, Lucknow, and Jhansi are the key locations. Other key regions include Madhya Pradesh, Gujarat, and Maharashtra. Within these states, the key cities noted in the survey are Indore, Mumbai, and Rajkot, among others.

Table 58: Boharipar - Key O-D regions for goods traffic at toll plaza towards Seoni direction

Origin	%	Destination	%
Madhya Pradesh	**87%**	**Madhya Pradesh**	**63%**
Jabalpur	*35%*	*Seoni*	*27%*
Rewa	*10%*	*Dhuma*	*15%*
Satna	*7%*	*Lakhnadon*	*15%*
Katni	*6%*	*Bargi*	*10%*
Sihora	*4%*	*Chhindwara*	*10%*
Uttar Pradesh	**10%**	**Maharashtra**	**29%**
Bihar	**1%**	*Nagpur*	*46%*
Rajasthan	**1%**	*Mumbai*	*21%*
Others	**<1%**	*Pune*	*14%*
		Amravati	*5%*
		Gondia	*4%*
		Telangana	**3%**
		Tamil Nadu	**2%**
		Others	**3%**

Source: CRISIL MI&A CONSULTING

Table 59: Boharipar - Key O-D regions for goods traffic at toll plaza towards Jabalpur direction

Origin	%	Destination	%
Madhya Pradesh	**60%**	**Madhya Pradesh**	**77%**
Seoni	*28%*	*Jabalpur*	*36%*
Dhuma	*21%*	*Rewa*	*10%*
Lakhnadon	*14%*	*Katni*	*9%*
Chhindwara	*10%*	*Satna*	*7%*
Balaghat	*7%*	*Sleemanabad*	*4%*
Maharashtra	**23%**	**Uttar Pradesh**	**16%**
Nagpur	*51%*	*Prayagraj*	*26%*
Mumbai	*29%*	*Aligarh*	*15%*
Pune	*4%*	*Kanpur*	*13%*
Amravati	*3%*	*Varanasi*	*11%*
Nashik	*2%*	*Lucknow*	*9%*
Telangana	**6%**	**Bihar**	**5%**
Karnataka	**5%**	**Haryana**	**1%**
Tamil Nadu	**3%**	**Delhi**	**1%**

Source: CRISIL MI&A CONSULTING

Agri produce forms the key commodity travelling on the project stretch, followed by construction material, courier and parcels, iron and steel, and consumer items.

Agri produce commodity accounts for nearly 25-30% of the total traffic on the project stretch.

Table 60: Odhaki - Commodity share (%) based on O-D survey.

Commodity	LCV	2-axle	3-axle	MAV	Total
Empty	*34.5%*	*28.4%*	*32.9%*	*30.4%*	*31.7%*
Agri Produce	31.8%	21.6%	6.8%	21.5%	23.4%
Construction materials	3.1%	5.4%	7.7%	16.4%	10.8%
Courier & parcel	9.1%	8.8%	16.9%	4.0%	7.0%
Iron & Steel Products	3.2%	1.4%	9.7%	7.3%	5.9%
Consumer Products	5.2%	5.4%	2.9%	3.6%	4.1%
Plastic products	2.5%	4.1%	2.9%	2.1%	2.4%
Petroleum Products	0.7%	10.8%	8.2%	1.0%	2.1%
Others	1.4%	0.0%	1.9%	2.6%	2.0%
Consumer Foods	3.6%	3.4%	1.9%	0.9%	2.0%
Tiles & Ceramic products	0.7%	2.7%	3.9%	1.4%	1.5%
Automobiles	0.0%	0.0%	0.5%	2.1%	1.2%
Coal	0.0%	0.0%	0.0%	2.0%	1.1%
Chemical products	0.3%	2.0%	1.4%	1.3%	1.0%
Textile & Footwear	1.1%	1.4%	0.0%	0.9%	0.9%
Plywood & Timber products	1.3%	2.0%	1.4%	0.4%	0.9%
Machinery	0.4%	1.4%	0.0%	1.0%	0.7%
Paper products	0.3%	0.0%	1.0%	0.4%	0.4%
Pharmaceuticals	0.6%	0.0%	0.0%	0.4%	0.4%
Milk & Animal Food	0.3%	1.4%	0.0%	0.3%	0.3%
Rubber products	0.0%	0.0%	0.0%	0.1%	0.0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

Note: Green highlighted cells represent the top 5 commodities in each vehicle category.

Source: CRISIL MI&A CONSULTING

Table 61: Kherwasani - Commodity share (%) based on O-D survey.

Commodity	LCV	2-axle	3-axle	MAV	Total
Agri Produce	29.1%	21.8%	17.9%	27.5%	26.5%
Empty	*24.4%*	*32.1%*	*30.9%*	*22.0%*	*24.8%*
Construction materials	3.4%	4.6%	6.0%	15.7%	9.2%
Courier & parcel	6.1%	11.5%	16.8%	7.8%	8.5%
Iron & Steel Products	5.3%	8.0%	11.1%	5.8%	6.4%
Consumer Products	6.7%	0.4%	1.1%	3.4%	4.1%
Plastic products	3.0%	1.5%	1.4%	1.5%	2.1%
Petroleum Products	1.4%	8.8%	5.4%	1.6%	2.6%
Others	0.5%	2.7%	0.5%	0.7%	0.8%
Consumer Foods	8.1%	1.1%	0.5%	0.7%	3.3%
Tiles & Ceramic products	0.8%	0.8%	0.5%	1.5%	1.1%
Automobiles	0.4%	0.0%	0.0%	1.3%	0.7%
Coal	0.9%	0.4%	2.2%	3.0%	1.9%
Chemical products	1.3%	0.0%	1.4%	2.0%	1.5%
Textile & Footwear	3.4%	0.8%	0.5%	2.0%	2.2%
Plywood & Timber products	0.8%	3.1%	1.1%	0.5%	0.9%
Machinery	0.3%	0.8%	1.6%	1.8%	1.2%
Paper products	2.3%	0.0%	0.0%	0.4%	1.0%
Pharmaceuticals	0.3%	0.0%	0.3%	0.1%	0.2%
Milk & Animal Food	0.8%	1.9%	0.5%	0.7%	0.8%
Rubber products	0.6%	0.0%	0.3%	0.0%	0.3%
Total	100%	100%	100%	100%	100%

Note: Green highlighted cells represent the top 5 commodities in each vehicle category.

Source: CRISIL MI&A CONSULTING

Table 62: Mohtara - Commodity share (%) based on O-D survey.

Commodity	LCV	2-axle	3-axle	MAV	Total
Agri Produce	46.7%	23.0%	31.1%	34.6%	38.7%
Empty	*18.5%*	*15.1%*	*15.6%*	*16.7%*	*17.3%*
Construction materials	4.5%	12.1%	12.4%	19.0%	11.2%
Consumer Foods	10.8%	4.2%	5.0%	3.9%	7.1%
Courier & parcel	6.6%	8.7%	8.2%	4.9%	6.4%
Petroleum Products	0.3%	23.4%	11.0%	1.5%	3.8%
Iron & Steel Products	2.2%	2.3%	2.3%	4.5%	3.0%
Plastic products	3.8%	1.5%	2.1%	1.4%	2.5%
Tiles & Ceramic products	1.1%	0.0%	1.4%	4.5%	2.3%
Others	0.6%	2.6%	1.8%	1.3%	1.2%
Chemical products	0.8%	1.9%	2.3%	1.1%	1.2%
Textile & Footwear	1.5%	0.4%	1.1%	0.8%	1.1%
Coal	0.0%	0.8%	2.1%	1.7%	0.9%
Machinery	0.2%	1.1%	0.5%	1.2%	0.7%
Paper products	0.4%	1.5%	0.7%	0.9%	0.7%
Rubber products	1.0%	0.8%	0.2%	0.2%	0.6%
Consumer Products	0.6%	0.0%	0.0%	0.0%	0.3%
Automobiles	0.0%	0.0%	0.9%	0.6%	0.3%
Plywood & Timber products	0.1%	0.4%	0.5%	0.6%	0.3%
Pharmaceuticals	0.1%	0.4%	0.9%	0.4%	0.3%
Milk & Animal Food	0.4%	0.0%	0.0%	0.0%	0.2%
Total	100%	100%	100%	100%	100%

Note: Green highlighted cells represent the top 5 commodities in each vehicle category.

Source: CRISIL MI&A CONSULTING

Table 63: Boharipar - Commodity share (%) based on O-D survey.

Commodity	LCV	2-axle	3-axle	MAV	Total
Agri Produce	38.4%	27.1%	19.6%	20.7%	28.2%
Empty	*25.4%*	*26.6%*	*23.4%*	*25.0%*	*25.1%*
Courier & parcel	2.8%	13.0%	23.8%	21.6%	13.6%
Consumer Products	8.2%	1.9%	1.7%	1.5%	4.2%
Iron & Steel Products	3.2%	4.3%	5.6%	4.6%	4.1%
Construction materials	3.9%	2.9%	2.8%	3.3%	3.5%
Consumer Foods	3.9%	1.9%	2.4%	3.9%	3.5%
Petroleum Products	0.1%	5.8%	7.3%	3.5%	2.9%
Plastic products	3.3%	1.0%	1.7%	1.7%	2.3%
Others	1.0%	1.9%	2.1%	3.5%	2.1%
Textile & Footwear	1.3%	2.9%	1.7%	2.0%	1.8%
Coal	1.0%	1.4%	0.7%	2.4%	1.5%
Chemical products	1.1%	2.9%	1.7%	0.9%	1.3%
Rubber products	1.6%	1.4%	1.0%	0.8%	1.2%
Pharmaceuticals	0.9%	0.0%	2.1%	1.2%	1.1%
Tiles & Ceramic products	1.6%	0.5%	0.3%	0.4%	0.9%
Machinery	0.1%	0.5%	0.7%	1.9%	0.9%
Milk & Animal Food	1.1%	2.9%	0.0%	0.4%	0.9%
Plywood & Timber products	0.6%	1.0%	0.0%	0.5%	0.5%
Paper products	0.5%	0.0%	1.0%	0.0%	0.3%
Automobiles	0.0%	0.0%	0.0%	0.1%	0.0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

As per the OD Survey conducted in January 2024, there is no major change in the state influence and commodity profile vis-a-vis the OD survey conducted in November 2022.

Note: Green highlighted cells represent the top 5 commodities in each vehicle category.

Source: CRISIL MI&A CONSULTING

6.5 Review of commodity growth rate assumptions

CRISIL MI&A Consulting's traffic projections are based on volume growth of commodities being transported on the road stretch. The below listed growth rates are assumed for the traffic study. These growth rates are applied to the traffic volume of vehicle categories based on the share of each vehicle category across various commodity categories (mentioned earlier in the report).

CRISIL's methodology considers the growth of the Agri produce commodity at the regional level to derive the traffic growth of each vehicle category. Growth in Agri produce is highly volatile as it depends on the positive outcome of the monsoon season. Hence on a long-term period, it grows at low rate compared to the aggregate GDP. Given the high proportion of the Agri produce on the stretch, it's imperative to assess it at a regional and commodity level, compared to a macroeconomic level. This is evident, considering only the macro level growth. The India GVA (constant prices) from agriculture, forestry & fishing has grown at a CAGR of 3.5% over FY12-22 while the GDP growth of India during the same period has been 5.4% CAGR. For this reason, CRISIL's method is more appropriate for the road stretch.

Agri produce is the largest category on the stretch, comprising mostly wheat, rice and vegetables (including onions) from MP and UP. MP state's Rabi crop production is growing at 4%+ over the last decade, while Kharif has grown at sub 1%, and horticulture has grown at 8.2% (Food grains & Horticulture have 50-50% share in total agri production). Hence overall agriculture growth is expected to be in the range of ~3.0%. For Mohtara, the growth rate is 5% in the short term and 2.0-3.0% in the long term on account of higher horticulture share in the OD mix.

Cement (~40%) & Stone/limestones (~35-40%) form majority of construction materials, largely originated from MP with clusters of cement manufacturing in Maihar (Satna) aka Cement capital of India, Katni, Jabalpur, and Rewa districts and the availability of limestones in the districts across the stretch. MP cement growth to be higher than national average owing to election next year and large-scale irrigation projects underway. Cement to grow at 5-6% (Central region), historical limestones production is at 3-4%

The key destination states are MP & UP owing to strong growth in housing development across schemes such as PMAY Urban and Rural. In the last five years, the central (MP and UP) and eastern (Odisha, Bihar and West Bengal) regions exhibited strong demand led by a surge in infrastructure. construction and rural housing.

MP and UP are the key origination and destination states for the courier and parcel traffic of the project stretch. The stretch connects warehouse centres like Nagpur, Jabalpur at one end and Prayagraj & Patna at the other end. Proximity of these clusters and connectivity of consumption centres such as Jabalpur, Rewa, Satna, Prayagraj, and Varanasi is expected to lead strong growth for this category. The origination regions are key warehousing clusters such as Jabalpur, Indore, and Prayagraj. Smaller warehousing regions which have fair amount of origination on the stretch include Rewa, Katni and Varanasi.

Table 64: Growth rates of key commodities (volume terms) – excluding diversion impacts.

Commodity	Weighted average share across toll plazas (%)	FY24	FY25-28	FY28-35	FY35-44
Agri Produce	30.2%	3.0%	3.0%	2.8%	2.3%
*Empty**	*23.9%*	*5.5%*	*4.2%*	*3.8%*	*3.3%*
Construction materials	9.1%	9.0%	4.5%	4.2%	3.5%
Courier & parcel	8.5%	7.0%	6.0%	5.6%	4.6%
Iron & Steel Products	4.7%	9.0%	4.5%	4.2%	3.5%
Consumer Products	2.9%	4.0%	4.0%	3.7%	3.1%
Plastic products	2.3%	8.0%	5.7%	5.1%	4.2%
Petroleum Products	2.9%	3.0%	2.8%	2.2%	1.1%
Others	1.4%	5.0%	5.0%	4.6%	3.8%
Consumer Foods	4.3%	4.0%	4.0%	3.7%	3.1%
Tiles & Ceramic products	1.5%	5.0%	4.5%	4.2%	3.5%
Automobiles	0.5%	10.0%	7.3%	5.2%	3.4%
Coal	1.3%	3.0%	2.7%	1.0%	0.7%
Chemical products	1.3%	6.0%	5.7%	5.1%	4.2%
Textile & Footwear	1.5%	4.0%	4.0%	3.7%	3.1%
Plywood & Timber products	0.6%	5.0%	4.5%	4.2%	3.5%
Machinery	0.9%	3.0%	2.0%	1.9%	1.5%
Paper products	0.6%	6.0%	5.3%	4.6%	3.8%
Pharmaceuticals	0.4%	8.0%	7.3%	6.5%	5.4%
Milk & Animal Food	0.5%	6.0%	5.3%	4.6%	3.8%
Rubber products	0.5%	7.0%	6.0%	5.6%	4.6%

There is no major change in the state influence and commodity profile as per the OD surveys conducted in January 2024 and November 2022. Accordingly, the commodity growth rates considered are based on November 2022 OD survey commodity shares.

Note: *The commodity share used for traffic projections is based on weighted average of commodity shares across toll plazas

Source: Survey data, CRISIL MI&A CONSULTING

Agri produce largely constitutes vegetables and food grains.

Agri produce is the largest commodity on the project stretch with ~25-30% of the share. The stretch has strong proportion of food grains such as wheat and paddy from MP and UP. The stretch passes through a major wheat producing region of Madhya Pradesh and hence wheat is the dominant category in agri produce throughout the year. MP and UP are major wheat producers in the country. Wheat production increased 4% and 10% CAGR during fiscals 2014-19 MP and UP, respectively. Madhya Pradesh accounts for ~20-25% of total wheat production in India. In MY22 (Marketing year; January to December), it produced 22% of India's total wheat production. In the same year, Uttar Pradesh produced 29%, while Gujarat and Rajasthan produced 4% and 8%, respectively.

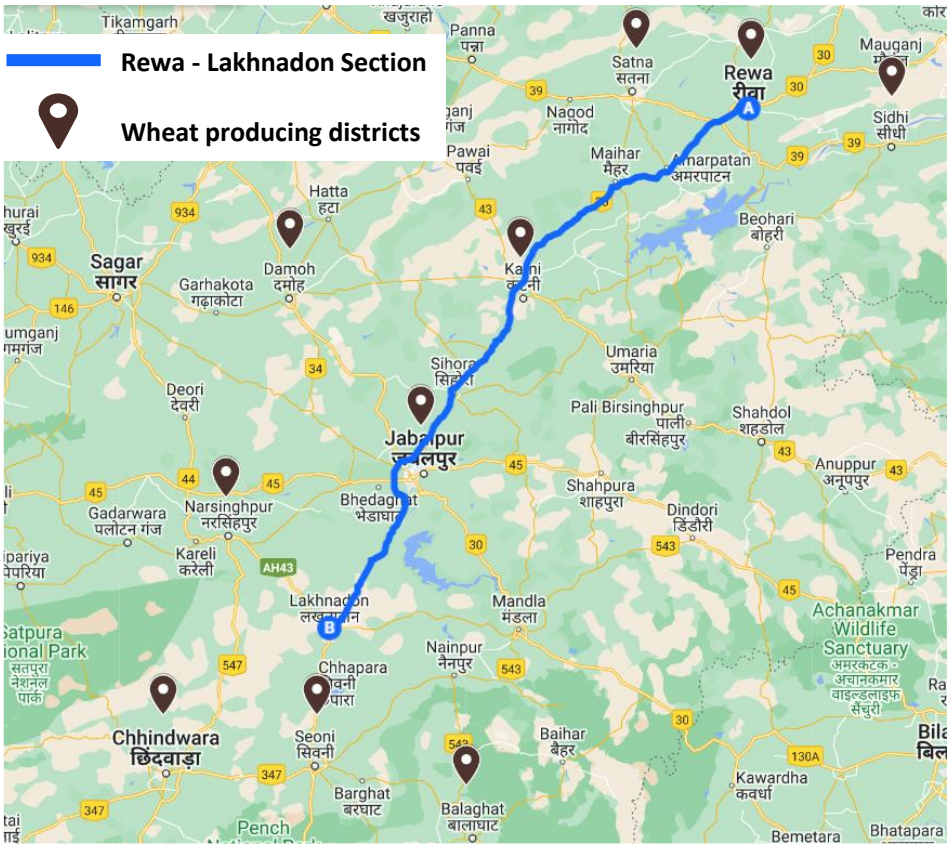
The stretch also observes vegetables as the key sub-category originating from MP and UP. The key sub-commodity includes peas, onion & potato among vegetables. The major kharif horticulture crops of MP are tomato, chilli, onion, okra, and brinjal. Vegetable production (volume) increased at 6% CAGR over fiscals 2015-20. While Rewa, Sagar and Satna form the cluster for onion production, Chhindwara, Sidhi, Katni, Rewa, and Satna comes in the top 15 potato producing district. Chhindwara, and Seoni, districts near the stretch are also one of the key peas producing regions. Further, in terms of vegetables production, the top five states as of fiscal 2020 are West Bengal (28.3 MMT), Uttar Pradesh (27.5 MMT), Madhya Pradesh (18.8 MMT), Bihar (16.9 MMT), and Gujarat (12.6 MMT).

MP state's Rabi crop production is growing at 4%+ over the last decade, while Kharif has grown at sub 1%, and horticulture has grown at 8.2% (Food grains & Horticulture have 50-50% share in total Agri production). Hence overall agriculture growth is expected to be in the range of ~3.0%. For Mohtara, the growth rate is 5% in the short term and 2.0-3.0% in the long term on account of higher horticulture share in the OD mix.

The wheat producing regions marked in the map account for ~33% of total wheat production in Madhya Pradesh. Each region produces 2-4% of total wheat production in Madhya Pradesh. Chhindwara was ranked second in wheat production across the state in fiscal 2020.

Rice is also a prominent crop in Madhya Pradesh and Uttar Pradesh. In MY21, these states produced 5% and 15% of India's total paddy(kharif) production, respectively.

Figure 22:Key wheat producing regions in Madhya Pradesh close to the project stretch

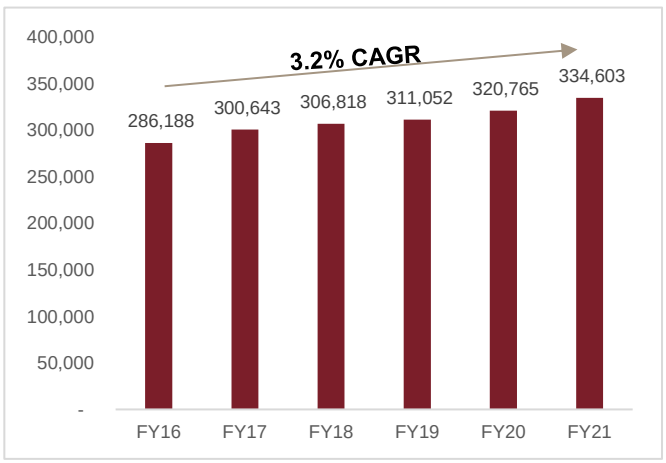


Source: Google Maps, CRISIL MI&A CONSULTING

The Indian agriculture sector is highly volatile as it is still dependent on the monsoon. Historical trends across key states close to the project stretch (Uttar Pradesh and Madhya Pradesh) have shown volatile production of Agri commodities. In order to account for such volatility, Agri produce traffic is expected to grow 3% in fiscal 2024. In the long term, 2-3% growth is expected.

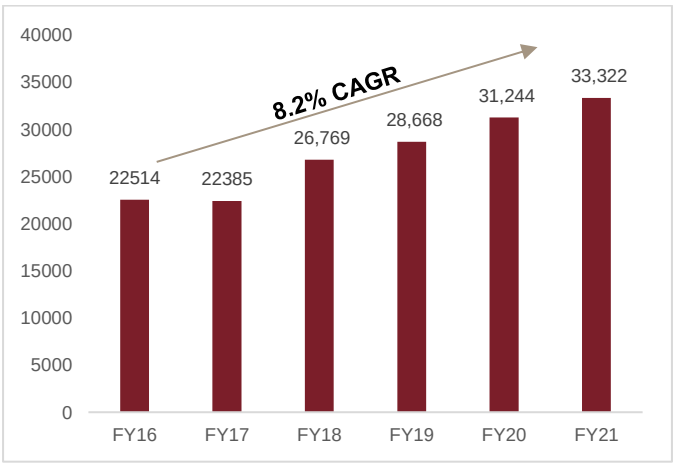
Madhya Pradesh's horticulture production has grown faster than the nation's average.

Figure 23: India Horticulture Production (in '000 MT)



Source: CRISIL MI&A CONSULTING

Figure 24: MP Horticulture Production (in '000 MT)



Source: CRISIL MI&A CONSULTING

Healthy rural housing demand in MP, infrastructure projects and urban housing in UP to aid in the construction material traffic.

Cement (~40%) & Stone/limestones (~35-40%) form majority of construction materials, largely originated from MP with clusters of cement manufacturing in Maihar (Satna) aka Cement capital of India, Katni, Jabalpur, and Rewa districts and the availability of limestones in the districts across the stretch. MP cement growth to be higher than national average owing to election next year and large-scale irrigation projects underway. Cement to grow at 5-6% (Central region), historical limestones production is at 3-4%

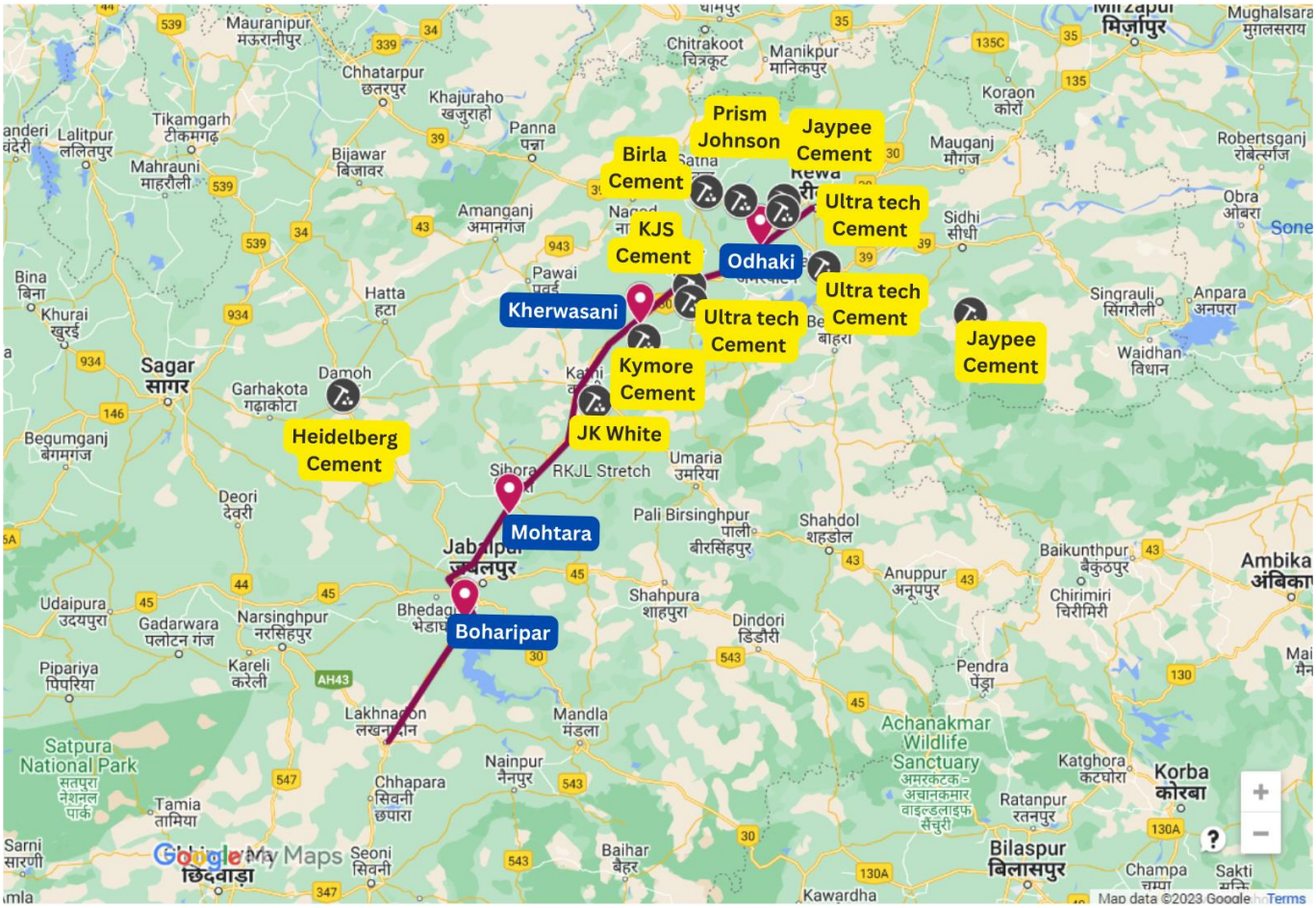
The key destination states are MP & UP owing to strong growth in housing development across schemes such as PMAY Urban and Rural. In the last five years, the central (MP and UP) and eastern (Odisha, Bihar and West Bengal) regions exhibited strong demand led by a surge in infrastructure. construction and rural housing. These two regions were less impacted by Covid-19-induced demand disruptions in fiscal 2021 due to higher rural penetration. MP, UP, West Bengal, Bihar, and Odisha form almost 65% of under construction houses in PMAY Rural. We expect traffic to grow at a bullish pace in the short term.

As seen in the past decade, the Eastern and Central regions are expected to continue to drive construction material demand in India in the medium term on the back of continued government thrust on infra and housing in the region. Healthy rural housing demand in Madhya Pradesh as well as a plethora of infrastructure projects and pickup in urban housing in Uttar Pradesh will aid the construction material traffic. Key infrastructure projects in the region such as Ken-Betwa River Link Project, Lalitpur-Khajuraho-Satna-Rewa-Singrauli SL Railway Line, irrigation projects in Bansagar and Bargi; smart city-related development in Madhya Pradesh (Jabalpur) and Uttar Pradesh (Lucknow); several road and highway projects will keep the demand elevated.

During fiscals 2023-27, the upcoming cement capacity additions in the central region (MP and UP) amount to ~31-33 million tonne. Rising income levels and growing preference of rural consumer for ceramic tiles will drive the long-term growth of the construction material traffic on the stretch. Government initiatives such as 100 smart cities, Housing for all by 2022, increase in deduction limit for housing loan, relaxed norms for issuing long term bonds by banks for financing affordable housing will aid growth. We expect construction material traffic to grow at 3-5% in the long term.

RKJL section falls in one of the major cement clusters of India; Satna is also known as Cement capital of India.

Figure 25: Cement plants in and around the project stretch

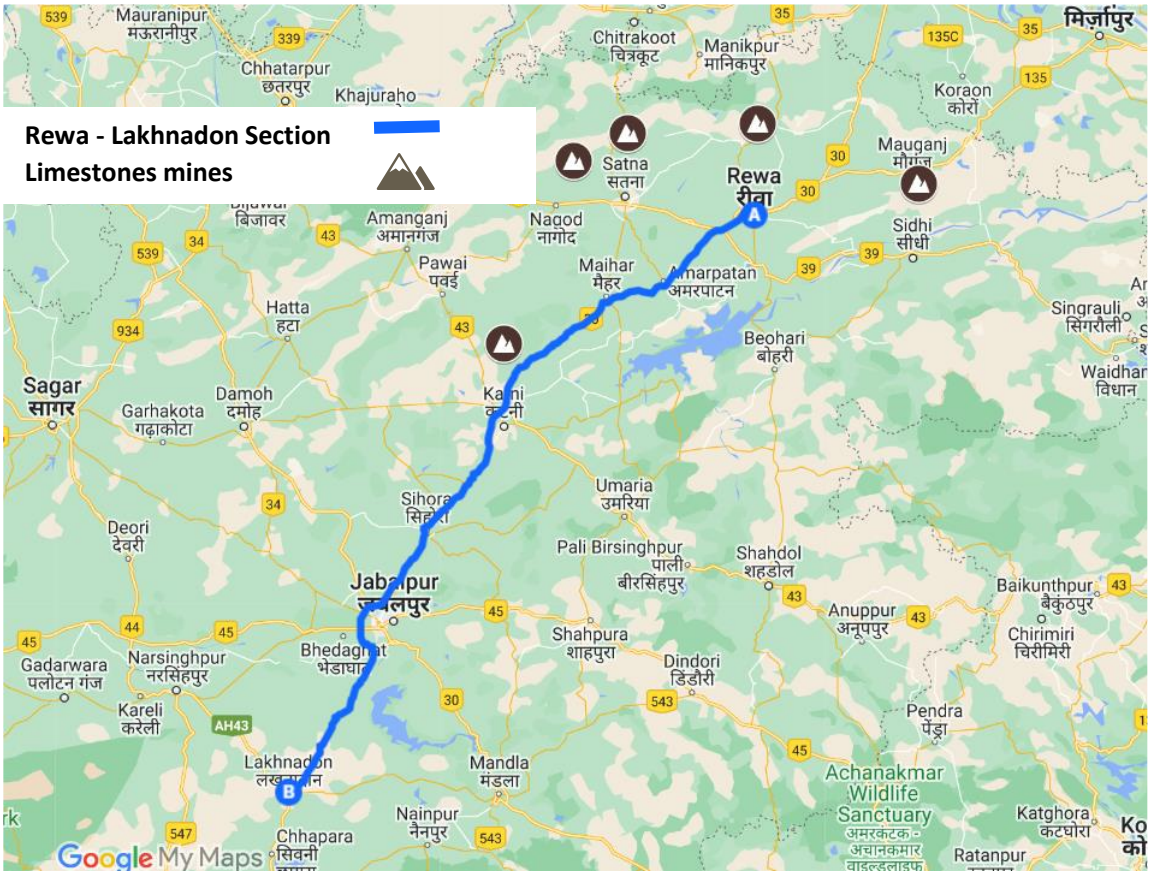


Source: Google maps, CRISIL MI&A CONSULTING

RKJL section is rich with limestone mines mostly towards northern region – Katni and Rewa.

MP is the second largest limestone producer state contributing ~15% of the country's production. Limestone from Madhya Pradesh is used in cement, sugar, paper, steel, and lime industries. Districts Satna, Katni, Rewa and Sidhi, which lie on the stretch are rich in limestone reserves. While All India limestone production has grown at 2.7% CAGR from FY18 to FY20, states limestone production grew by 4.4%. Historical limestones production growth has been around at 3-4%

Figure 26: Limestones mines in and around the project stretch



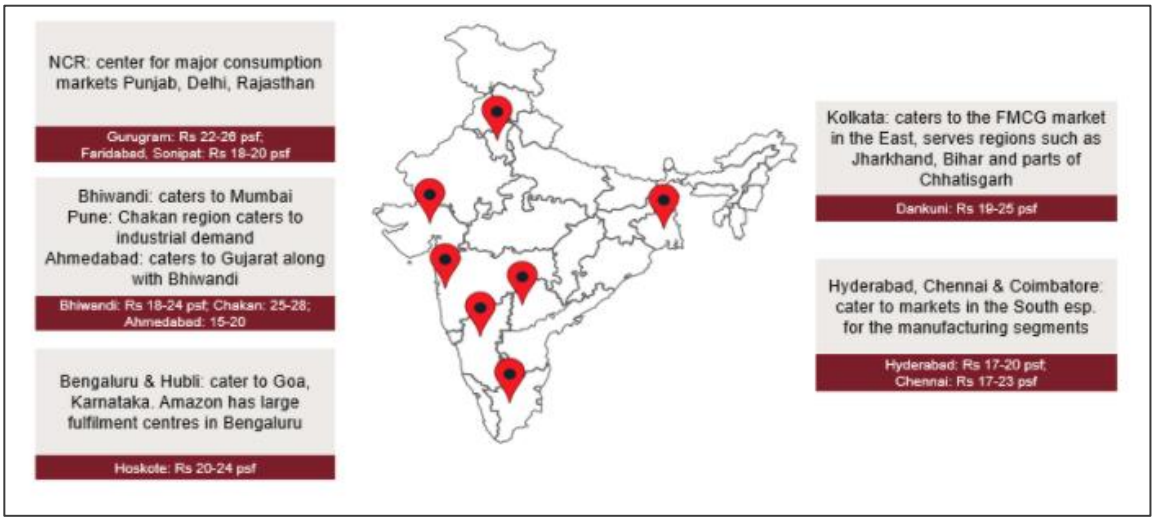
Source: Google maps, CRISIL MI&A CONSULTING

Key warehousing cluster and connectivity to key cities drive courier and parcel traffic

MP and UP are the key origination and destination states for the courier and parcel traffic of the project stretch. The stretch connects warehouse centres like Nagpur, Jabalpur at one end and Prayagraj & Patna at the other end. Proximity of these clusters and connectivity of consumption centres such as Jabalpur, Rewa, Satna, Prayagraj, and Varanasi is expected to lead strong growth for this category. The origination regions are key warehousing clusters such as Jabalpur, Indore, and Prayagraj. Smaller warehousing regions which have fair amount of origination on the stretch include Rewa, Katni and Varanasi.

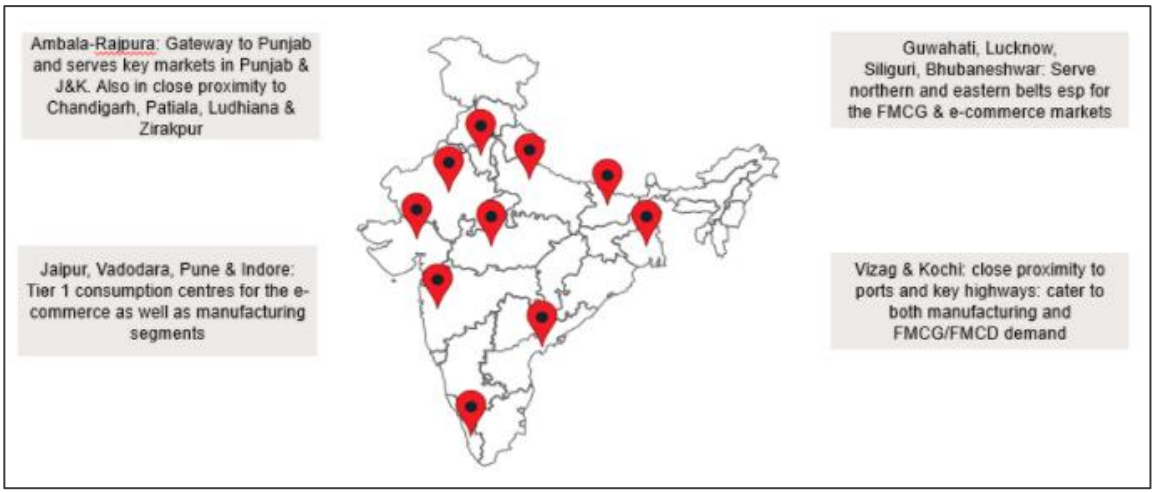
We expect traffic to have a strong growth of 7% over the short term and ~5-6% CAGR over the long term. Demand will be driven by robust consumption demand potential of MP and UP, along with the optimistic outlook of the major cities such as Jabalpur, Rewa, Satna, Prayagraj and Varanasi

Figure 27: Key hubs of warehousing in India



Source: CRISIL MI&A CONSULTING

Figure 28: Emerging small warehousing hubs in India



Source: CRISIL MI&A CONSULTING

Strong pipeline of infrastructure projects to boost growth in the region

Top 100 projects across the districts Jabalpur, Rewa, Satna, Seoni, Katni have been considered at a total project cost of Rs 1,587 billion. Coal-based power plants, cement, Irrigation, roadways and airways form nearly 78% of the total project cost.

Table 65: Key upcoming infrastructure projects in the influence area of the project stretch

Key upcoming projects in Jabalpur, Rewa, Satna, Seoni, Katni	Implementation stage	Project cost (Rs billion)
Coal Based Power (Dabhaura) Project	Nascent	204.9

Key upcoming projects in Jabalpur, Rewa, Satna, Seoni, Katni	Implementation stage	Project cost (Rs billion)
Coal Based Power (Barahi) Project	Planning	192.0
Coal Based Power (Seoni) Project	Planning	105.6
Ken-Betwa River Link Project- [Phase-I]	Planning	93.9
Lalitpur-Khajuraho-Satna-Rewa-Singrauli SL Railway Line	Under Execution	82.5
Mumbai-Nagpur-Jharsuguda Natural Gas Pipeline (MNJPL)	Under Execution	78.4
Coal Based Power (Rewa) Project	Planning	75.0
Integrated Cement (Amanganj) Project	Under Execution	61.6
Bansagar Irrigation Project	Under Execution	51.4
Bargi Diversion Irrigation Project - RBC	Under Execution	51.3
Cement (Devari Hatai) Project	Planning	32.0
Cement (Katni) Project	Planning	21.0
Cement (Katni) Project	Under Execution	10.0
Road Upgradation (Barela-Manegaon) Project [Package-I]	Planning	30.2
Road Upgradation (Rajmarg Crossing - Jabalpur) Project	Planning	25.5
Pench Diversion Irrigation Project	Under Execution	25.5
Katni-Singrauli DL Railway Line Project	Under Execution	24.7
Coal Based Power (Satna) Project	Planning	24.3
Cement (Saha) Project	Planning	20.0
Clinker (Jamuna) Project	Planning	18.8

Source: Projects Today, CRISIL MI&A CONSULTING

Table 66: Sectors in the influence area of the project stretch

Sectors of upcoming projects in Jabalpur, Rewa, Satna, Seoni, Katni	Project cost (Rs billion)
Coal/Lignite Based Power	601.8
Cement	234.8
Irrigation	172.8
Roadways	172.8
Railways	110.6

Source: Projects Today, CRISIL MI&A CONSULTING

7 Assessment of impact factors

Kandla-Sagar-Lucknow Economic Corridor pose long term risks to the project stretch, as they offer comparable speed and distance benefits

As discussed earlier, there exists an alternative route between Lucknow and Indore which passes through Chhatarpur and Sagar. This route takes 16-17 hours, and the distance is 955 km. The key reason for this higger time is that the alternative route is a mix of two and four lanes. Banda to Bhopal section of the alternative route, of nearly 430 km, is 2-lane. The Maharashtra and Gujarat traffic can also use this road, as they converge at Indore, where they will have the option to go towards the project stretch or towards Sagar and use the alternative road.

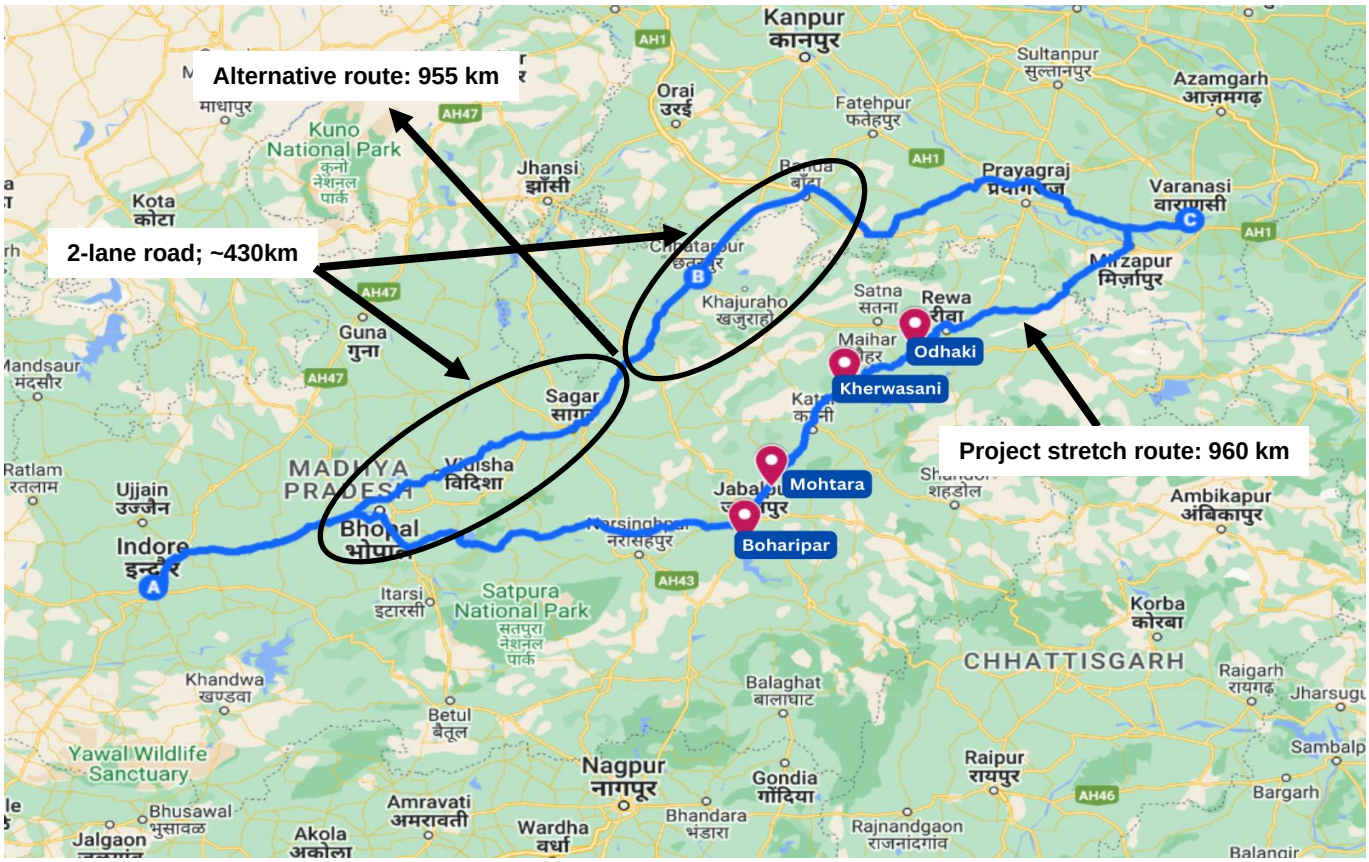
Under the Bharatmala programme, the sections from Kandla to Sagar and Sagar to Lucknow are proposed for augmentation. Hence, in the future, when the augmentation gets completed, the alternative route will be a feasible route in competition to the project stretch.

Bhopal to Banda section update

1. 4L from km 0.000 to 42.040 Bhopal (Ratnaigiri Tiraha) to Vidisha (Morikodi) - RFP issued, bids pending, likely to be awarded in next few months.
2. Kabarai-Banda Section from Km 178.00 to Km 215.00 of NH-76 of 37 K length is also announced.

With the above updates in considerations, we maintain the impact of this augmented road to partially begin by fiscal 2028 and with a full impact by fiscal 2030.

Figure 29: Alignment of key alternative routes to the project stretch



Source: NHAI, Google Maps, CRISIL MI&A CONSULTING

The generalised cost ratio has been defined by calculating the vehicle operating time cost, vehicle operating cost and toll rates. The toll rates considered for cost analysis are for fiscal 2023. Toll rates for the upcoming augmented Kandla-Sagar corridor and Sagar-Lucknow corridor are based on actual DME rates, after dividing by 1.25 as per NHAI rules. Based on the cost assessment, diversion percentages are derived as per IRC norms. A generalised cost ratio (GCR) greater than one indicates that the cost of travelling on the project stretch is cheaper than the alternative. A GCR of one denotes ~50% diversion to the alternative stretch.

To assess the at-risk traffic for Kandla-Sagar corridor and Sagar-Lucknow corridor, traffic between Indore (Traffic originating from Gujarat and Northern Maharashtra could choose to come via Indore) and Eastern UP have been considered. The at-risk traffic is then multiplied with the diversion percentage, which is defined based on IRC-defined formulae and considering that the project stretch as part of a national corridor. This process yields the percentage of diverted traffic.

Table 67: Generalised cost ratio* of travelling Indore-Varanasi

Vehicle type	Post upgradation scenario of Kandla-Sagar-Lucknow
Cars/Jeep/Van	0.96
Bus	0.93
LCV	0.96
2-Axle	0.93
3-Axle	0.94
MAV	0.93

Note: GCR > 1 indicates cost of travelling on project stretch is cheaper than the alternative and the GCR = 1 denotes ~50% diversion to the alternative stretch

Source: NHAI, Google Maps, CRISIL MI&A CONSULTING

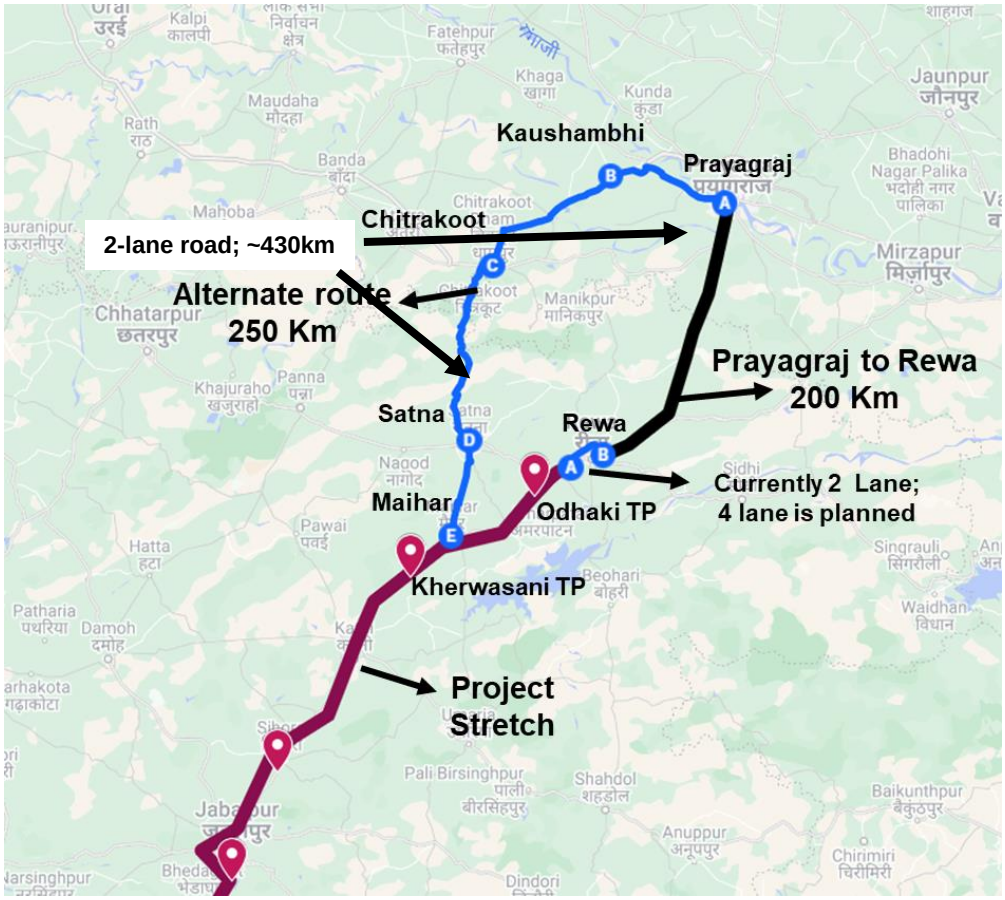
Prayagraj to Maihar alternate route - No diversion impact

Rewa Katni Jabalpur Lakhnadon stretch is a part of new NH-30 (Old NH-7), while Jabalpur Lakhnadon is part of new NH-34. The stretch has 4 toll plazas, Odhaki (TP1), Kherwasani (TP2), Mohtara (TP3) and Boharipar (TP4). TP1 has an influence of Uttar Pradesh traffic, TP2 and TP3 largely caters to the traffic within state only, while TP4 has an influence of Maharashtra traffic.

There is an alternate route which starts from Prayagraj and passes through districts like Kaushambhi, Chitrakoot, Satna and Maihar which is currently a mix of 4 Lane and 2 Lane. The traffic coming through this alternate route only bypasses single toll plaza, which is Odhaki as it joins back the project stretch before Kherwasani toll plaza.

- Prayagraj to Kaushambhi – It is a ~60 km 4 Lane comprising Grand trunk road and a part of NH731A.
- Kaushambhi to Chitrakoot – It is a ~70 Km 2 Lane comprising a part of NH731A.
- Chitrakoot to Satna – It is a ~80 Km 2 Lane comprising a part of NH135BG – Based on primary interactions, it is found that this road may also go for widening to a 10-metre road and may be completed in the next 3-4 years.
- Satna to Maihar - It is a ~40 Km 2 Lane comprising a part of NH135BG. The widening of the road to a 10-metre road is in progress under Bharatmala Pariyojna Phase-I, which is expected to be completed within a year.

Figure 30: Project stretch & alternate route map



Source: NHAI, Google Maps, CRISIL MI&A CONSULTING

Considering the expected developments on the alternate route, we conducted a VOC and VOT analysis of the alternate route along with the original route which passes through Odhaki, and it is concluded that the alternate route will have no impact on the vehicle traffic at our project stretch. Below is the generalised cost analysis table.

Table 68: Generalised cost ratio* of travelling Prayagraj to Maihar

Vehicle type	Post upgradation scenario alternate Prayagraj to Maihar road
Cars/Jeep/Van	1.12
Bus	1.24
LCV	1.24
2-Axle	1.27
3-Axle	1.37
MAV	1.36

Note: GCR > 1 indicates cost of travelling on project stretch is cheaper than the alternative and the GCR = 1 denotes ~50% diversion to the alternative stretch

Source: NHAI, Google Maps, CRISIL MI&A CONSULTING

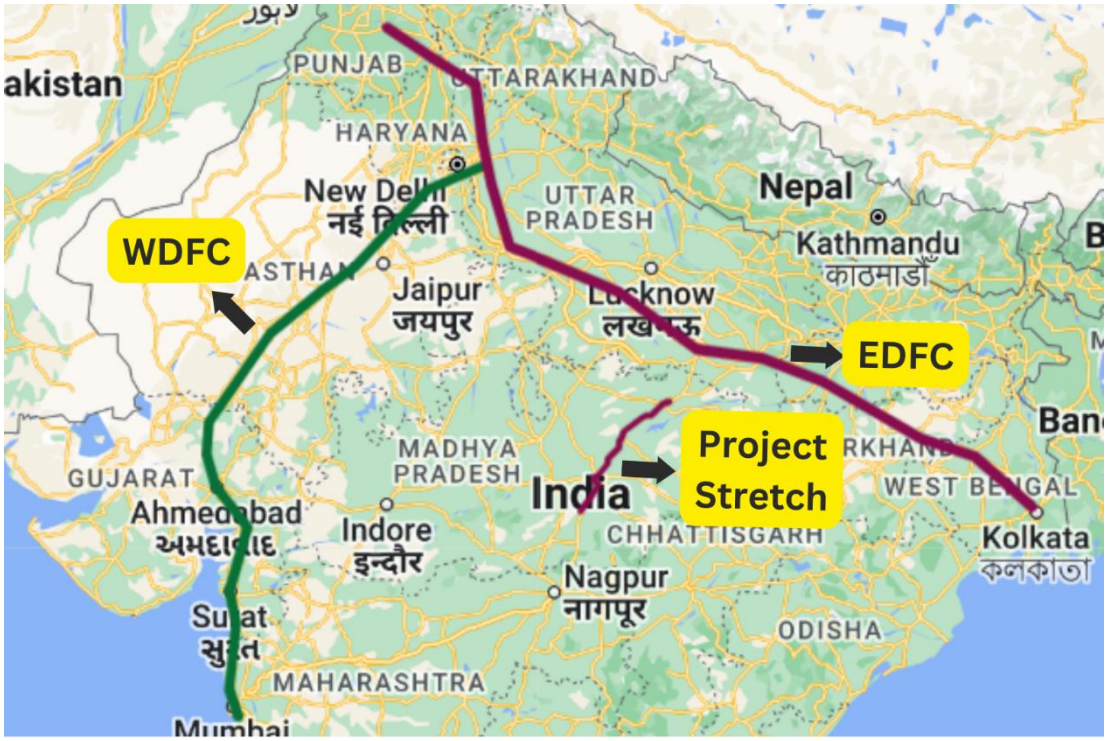
The ratio of 1.36 for MAV signifies that the alternate route is expensive by 36%. Hence, there will be no diversion. Also, there is a 13 Km 4L Rewa bypass missing link adjoining our project stretch (from Ratahara Jn. to Bela Jn. of NH30), the construction of which is expected to be completed in the next 3 years. Once this is completed, it will further increase the attractiveness of the project stretch vis-à-vis alternate route.

Rewa-Katni-Jabalpur-Lakhnadon section traffic to remain unaffected by the DFCs

Dedicated freight corridors (DFCs) are constructed exclusively for movement of goods. The first phase of the project includes construction of the Western DFC from Mumbai to Dadri, near Delhi, and the Eastern DFC from Dankuni in West Bengal to Ludhiana in Punjab. The former will mainly cater to containers as 60% of container traffic originates from this region. The later will cater to dry bulk cargo. The DFCs aim to regain railway's lost share in handling of key commodities such as coal, steel, iron ore, cement, food grains, fertilisers, petroleum products, and containers.

The project stretch has a very small proportion of the commodities, with none travelling on to the stretch from the northern region. Given the high proportion of Agri produce on the stretch originating in Madhya Pradesh, the same could be transported to eastern parts of the country via DFCs. Thus, West Bengal and Bihar could benefit from this arrangement to a limited extent.

Figure 31: Alignment of DFCs with regards to the project stretch

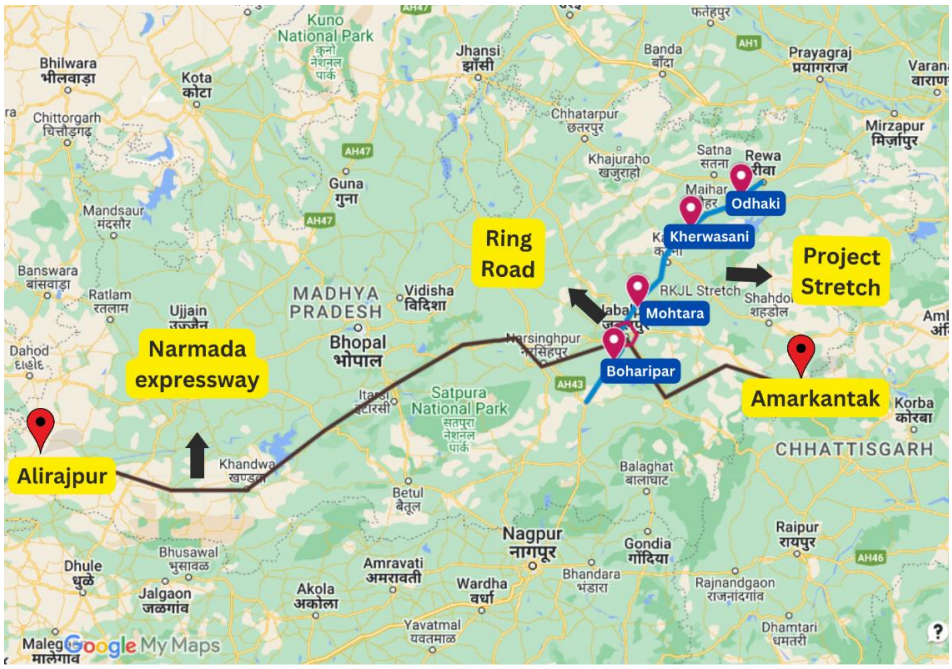


Source: DFCCIL, Google Maps, CRISIL MI&A CONSULTING

Proposed Narmada Pragati Path and Jabalpur Ring Road to have no impact on the stretch

Narmada expressway aka Narmada Pragati Path will run perpendicular to the project stretch and will not have any future potential impact. The preparation of the detailed project report (DPR) is going on. Even though the route plan is completed, the land acquisition is yet to be initiated. Contracts and tenders have not been announced yet.

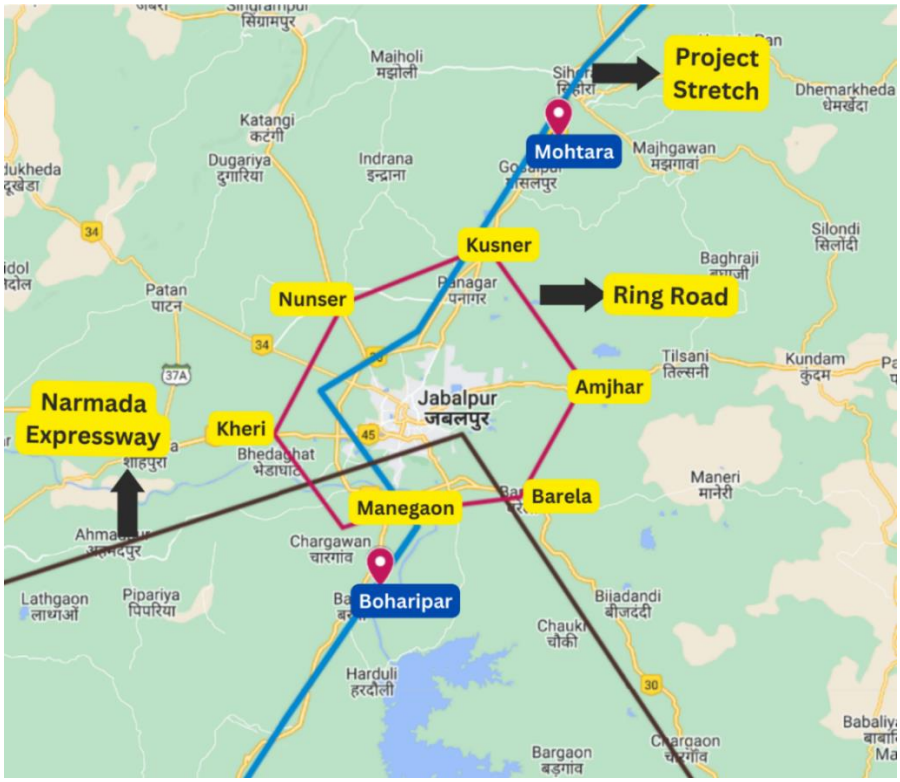
Figure 32: Narmada expressway & Jabalpur ring road project



Source: Google Maps, CRISIL MI&A CONSULTING

Jabalpur Ring Road project is being envisaged for efficient evacuation of heavy vehicles traversing through the city. This project will not have any impact as all the toll plazas are outside the ring road.

Figure 33: Jabalpur ring road project map



Source: Google Maps, CRISIL MI&A CONSULTING

Sidhi-Rewa tunnel - Commencement of the tunnel to have a positive impact on the vehicle traffic on the project stretch

Sidhi-Rewa tunnel opened for public traffic in Dec 2022. With this tunnel, the travel time between Rewa and Siddhi is reduced by close to 2 hours, leading to traffic augmentation on the project stretch. The major impact in terms of vehicle growth (YoY) has been seen across passenger and commercial categories across the toll plazas of the project stretch for a period of Apr 2023 to Nov 2023. This trend is also substantiated by a rise in traffic numbers on the nearby toll plazas, Khadda and Sonvarsha as tabulated below.

Figure 34: Sidhi Rewa tunnel and project stretch map

Source: Google Maps, CRISIL MI&A CONSULTING

Table 69: Khadda toll plaza – YoY growth

YoY Growth	CJV	LCV	2A	3A	MAV
April	16%	11%	36%	71%	774%
May	52%	-50%	21%	6%	591%
Jun	51%	4%	35%	27%	504%
Jul	33%	13%	41%	46%	560%
Aug	39%	2%	59%	33%	874%

Source: IHMCL

Table 70: Sonvarsha toll plaza – YoY growth

YoY Growth	CJV	LCV	2A	3A	MAV
April	12%	-1%	-1%	66%	50%
May	37%	-44%	-6%	-13%	54%
Jun	45%	1%	4%	-9%	44%
Jul	23%	14%	2%	-4%	32%
Aug	21%	22%	2%	7%	55%

Source: IHMCL

OD pairs comparison with OD surveys conducted in Jan 2024 vs Nov 2022

The recent OD survey conducted in Jan 2024 indicates that the share of traffic plying from Sidhi, Singrauli to Katni and return has increased substantially. Below are the top OD pairs along with their share in the overall OD sample gathered.

3Axle and MAV

Odhaki TP	Jan-24	Nov-22
Katni To Singrauli	5.00%	0.00%
Katni To Sidhi	2.43%	0.55%
Jabalpur To Singrauli	1.36%	0.00%
	8.79%	**0.55%**

Kherwsani TP	Jan-24	Nov-22
West MP To Singrauli	0.35%	0.12%
West MP To Sidhi	0.42%	0.06%
	0.76%	**0.17%**

Mohtara TP	Jan-24	Nov-22
Jabalpur To Singrauli	**1.91%**	**0.92%**

CJV

Odhaki TP	Jan-24	Nov-22
Katni To Sidhi	3.20%	0.63%
Jabalpur To Sidhi	1.60%	1.18%
Katni To Singrauli	1.37%	0.00%
	6.17%	**1.80%**

Kherwasai TP	Jan-24	Nov-22
Jabalpur To Sidhi	0.55%	0.24%
Jabalpur To Singrauli	0.43%	0.47%
	0.98%	**0.71%**

Samruddhi expressway to have a positive impact on the vehicle traffic on the project stretch

Samruddhi expressway is a 701 km, partially operational and under construction 6 lane access-controlled road with a greenfield route alignment connecting Village Shivmadka in Nagpur District to Village Amne in Thane District, consisting of 16 civil packages, out of which 13 are complete. The first phase (502 km) connecting Nagpur – Shirdi was opened in Dec 2022 and the second phase (80 km) connecting Shirdi and Bharvir was opened in May 2023. The expressway connects the districts of Nagpur, Wardha, Amravati, Washim, Buldhana, Aurangabad, Jalna, Ahmednagar, Nashik and Thane.

Figure 35: Samruddhi expressway alignment

Source: Google Maps, CRISIL MI&A CONSULTING

Samruddhi Mahamarg expressway will also be connected to the following upcoming expressways:

- 141 km Nagpur – Bhandara – Gondia Expressway
- 152 km Nagpur – Gadchiroli Expressway
- 760 km Nagpur – Goa Expressway (Shaktipeeth Expressway)
- 225 km Pune – Aurangabad Expressway
- 180 km Pune – Nashik Expressway
- 1220 km Surat – Chennai Expressway

Remaining Packages (Length) & Section	Contractor
Package 14 (13.10 km): From Km. 623.379 to Km. 636.479 in section – Village Taranganpada- Pimpri Sadroddin to Village Vashala BK in District Thane	Afcons Infrastructure
Package 15 (28.00 km) From Km. 636.479 to Km. 664.479 in section – Village Vashala BK to Village Birwadi in District Thane	Navayuga Engineering Company
Package 16 (37.00 km) From Km. 664.479 to Km. 701.362 in section – Village Birwadi to Village Amne in District Thane	Navayuga Engineering Company

Due to the expressway, the traffic with respect to East UP, Bihar and Maharashtra states has started moving to our project as it provides a shorter alternative for Maharashtra & East connectivity. The Igatpuri to Mumbai section is not yet complete. And thus, once complete, it will further boost the Mumbai Metropolitan Region connectivity as well.

OD pairs comparison with OD surveys conducted in Jan 2024 vs Nov 2022

The recent OD survey conducted in Jan 2024 indicates that the share of traffic plying from Maharashtra to East UP, Bihar has increased substantially. Below are the top OD pairs along with their share in the overall OD sample gathered.

3Axle and MAV

Odhaki TP	Jan-24	Nov-22
Maharashtra To Bihar	5.86%	1.57%
Maharashtra To East UP	3.65%	0.82%
	9.51%	**2.39%**

Kherwsani TP	Jan-24	Nov-22
Maharashtra To Bihar	3.20%	1.38%
Maharashtra To East UP	3.20%	0.58%
Maharashtra To Prayagraj	1.81%	0.69%
	8.20%	**2.65%**

Mohtara TP	Jan-24	Nov-22
Maharashtra To Bihar	3.81%	1.42%
Maharashtra To East UP	2.38%	2.25%
Maharashtra To Prayagraj	1.81%	0.89%
Maharashtra To Assam	1.24%	0.47%
	9.25%	**5.02%**

Boharipar TP	Jan-24	Nov-22
Maharashtra To Bihar	5.50%	1.22%
Maharashtra To Lucknow	2.12%	0.83%
	7.62%	**2.05%**

CJV

Odhaki TP	Jan-24	Nov-22
Maharashtra To East UP	1.37%	0.16%
Nagpur To Prayagraj	0.91%	0.47%
	2.29%	**0.63%**

Kherwasai TP	Jan-24	Nov-22
Maharashtra To Prayagraj	0.68%	0.16%
Maharashtra To East UP	0.62%	0.08%
	1.29%	**0.24%**

Mohtara TP	Jan-24	Nov-22
Maharashtra To East UP	0.29%	0.18%
	0.29%	**0.18%**

Boharipar TP	Jan-24	Nov-22
Maharashtra To West MP	0.49%	0.00%
Maharashtra To Bihar	0.35%	0.00%
Maharashtra To Prayagraj	0.28%	0.16%
	1.11%	**0.16%**

Source: CRISIL MI&A CONSULTING

Diversion to alternative routes could lead to ~2-4% loss in traffic across toll plazas, except Boharipar

The impact of the alternative routes shown below represent a loss of traffic for the project stretch. We have calculated an impact, denoting that the traffic would have been higher by the same percentage in fiscal 2044 had there been zero diversions. The upcoming Kandla-Sagar-Lucknow economic corridor poses a threat of traffic loss. We have assumed the impact of Kandla-Sagar-Lucknow corridor from fiscal 2028.

Table 71: Odhaki - Impact of various factors on the project stretch traffic

Factors	Natural Shift	Truck Aggregation	Kandla-Sagar-Lucknow economic corridor (Impact begins in FY28)	AADT	
Vehicle Type/Year	FY44	FY44	FY44	FY44 (Without diversions)	FY44 (With diversions)
LCV*	-0.8%	-0.3%	-2.2%	365	357
2-Axle*	-1.7%	-0.2%	-3.6%	1,097	1,058
3- Axle*	-0.7%	0.0%	-7.3%	516	478
MAV*	0.2%	0.0%	-3.7%	4,116	3,962
Car*	0.0%	0.0%	-1.4%	8,596	8,473
Overall PCU	**-0.1%**	**0.0%**	**-3.2%**	**33,426**	**32,370**

*Note: The impact is based on traffic volume in vehicle terms

Source: CRISIL MI&A CONSULTING

Table 72: Kherwasani - Impact of various factors on the project stretch traffic

Factors	Natural Shift	Truck Aggregation	Kandla-Sagar-Lucknow economic corridor (Impact begins in FY28)	AADT	
Vehicle Type/Year	FY44	FY44	FY44	FY44 (Without diversions)	FY44 (With diversions)
LCV*	-0.8%	-0.3%	-1.2%	572	565
2-Axle*	-1.5%	-0.2%	-2.0%	1,548	1,516
3- Axle*	-0.8%	0.0%	-4.1%	658	631
MAV*	0.3%	0.0%	-3.4%	4,750	4,587
Car*	0.0%	0.0%	-1.4%	9,552	9,414
Overall PCU	**-0.1%**	**0.0%**	**-2.7%**	**39,421**	**38,364**

*Note: The impact is based on traffic volume in vehicle terms

Source: CRISIL MI&A CONSULTING

Table 73: Mohtara - Impact of various factors on the project stretch traffic

Factors	Natural Shift	Truck Aggregation	Kandla-Sagar-Lucknow economic corridor (Impact begins in FY28)	AADT	
Vehicle Type/Year	FY44	FY44	FY44	FY44 (Without diversions)	FY44 (With diversions)
LCV*	-0.8%	-0.3%	-1.0%	710	703
2-Axle*	-2.0%	-0.2%	-2.0%	1,748	1,713
3- Axle*	-0.6%	0.0%	-3.5%	1,019	983
MAV*	0.5%	0.0%	-3.7%	3,479	3,349
Car*	0.0%	0.0%	-2.4%	16,017	15,629
Overall PCU	**-0.1%**	**0.0%**	**-2.8%**	**42,175**	**40,982**

*Note: The impact is based on traffic volume in vehicle terms

Source: CRISIL MI&A CONSULTING

Table 74: Boharipar - Impact of various factors on the project stretch traffic

Factors	Natural Shift	Truck Aggregation	Kandla-Sagar-Lucknow economic corridor (Impact begins in FY28)	AADT	
Vehicle Type/Year	FY44	FY44	FY44	FY44 (Without diversions)	FY44 (With diversions)
LCV*	-0.8%	-0.3%	0.0%	445	445
2-Axle*	-2.2%	-0.2%	0.0%	1,429	1,429
3- Axle*	0.5%	0.0%	0.0%	471	471
MAV*	0.3%	0.0%	0.0%	2,651	2,651
Car*	0.0%	0.0%	0.0%	9,379	9,379
Overall PCU	**-0.3%**	**-0.1%**	**0.0%**	**28,598**	**28,598**

*Note: The impact is based on traffic volume in vehicle terms

Source: CRISIL MI&A CONSULTING

Traffic on the project stretch is commodity-specific, and there no major warehousing hubs on the stretch where the impact of GST is prominent. Hence, we do not expect GST to affect traffic on the project stretch significantly. Truck aggregation will majorly impact LCVs and 2-axle vehicles on the stretch. We do not expect MAV traffic to be impacted by truck aggregation. The share of LCVs in total PCU is low, and hence, it would also have a small impact overall. A natural shift towards heavy vehicle categories in the long term to meet higher demand as economy grows, could lead to increase in the proportion of heavy vehicles.

8 Traffic and revenue projection for the remaining concession

8.1 Traffic projections

The traffic will be negatively impacted by the upcoming Kandla-Sagar and Sagar-Lucknow corridor. Impact of the corridor will begin in fiscal 2028, with full impact seen in fiscal 2030 (Impact factors - FY28 – 0.5, FY29 – 0.75, FY30 – 1). The stretch will undergo capacity augmentation when the traffic exceeds 40,000 PCU for three consecutive years. As per our projections, there will be risk of capacity augmentation in FY49 and FY46 respectively for Kherwasani and Mohtara toll plazas, which is beyond the concession period.

Table 75: Odhaki - Projected AADT, FY24-44

Year	Cars	Bus	Minibus	LCV	2A	3A	MAV	Total PCU	On-year growth (%)
FY24E	3,324	130	121	199	557	272	1,948	15,447	
FY25P	3,576	135	125	206	581	283	2,041	16,257	**5.3%**
FY26P	3,835	140	130	214	603	294	2,128	17,038	**4.8%**
FY27P	4,098	145	134	221	626	305	2,217	17,834	**4.7%**
FY28P	4,333	149	138	226	638	304	2,266	18,352	**2.9%**
FY29P	4,585	154	143	232	654	308	2,332	18,989	**3.5%**
FY30P	4,837	159	147	238	671	312	2,398	19,633	**3.4%**
FY31P	5,107	163	151	245	694	323	2,491	20,451	**4.2%**
FY32P	5,378	167	155	253	719	333	2,587	21,288	**4.1%**
FY33P	5,650	172	159	261	744	344	2,686	22,145	**4.0%**
FY34P	5,920	176	163	269	770	356	2,789	23,021	**4.0%**
FY35P	6,189	180	166	278	796	367	2,895	23,914	**3.9%**
FY36P	6,457	184	170	286	823	379	3,004	24,817	**3.8%**
FY37P	6,722	187	174	295	851	391	3,116	25,736	**3.7%**
FY38P	6,984	191	177	303	879	403	3,229	26,658	**3.6%**
FY39P	7,243	195	180	312	908	416	3,346	27,595	**3.5%**
FY40P	7,498	198	183	321	937	428	3,465	28,534	**3.4%**
FY41P	7,749	201	186	330	967	440	3,586	29,486	**3.3%**
FY42P	7,995	204	189	339	997	453	3,711	30,452	**3.3%**
FY43P	8,237	208	192	348	1,027	466	3,836	31,409	**3.1%**
FY44P	8,473	211	195	357	1,058	478	3,962	32,370	**3.1%**
CAGR (FY24-44P)	**4.8%**	**2.4%**	**2.4%**	**3.0%**	**3.3%**	**2.9%**	**3.6%**	**3.8%**	

Source: CRISIL MI&A CONSULTING

Odhaki - Traffic volume CAGR (FY24-44) excluding diversions would have been higher by ~0.1%

Table 76: Traffic growth rates without diversions to expressway and other alternative routes

CAGR	FY24-26	FY26-31	FY31-41	FY24-44
Car	7.4%	6.2%	4.3%	4.9%
Bus	3.7%	3.1%	2.1%	2.4%
Minibus	3.7%	3.1%	2.1%	2.4%
LCV	3.7%	3.3%	3.0%	3.1%
2-axle	4.0%	3.6%	3.4%	3.4%
3-axle	4.0%	3.5%	3.2%	3.3%
MAV	4.5%	4.0%	3.7%	3.8%
Total PCU	5.0%	4.4%	3.7%	3.9%

Source: CRISIL MI&A CONSULTING

Table 77: Traffic growth rates with diversions to expressway and other alternative routes

CAGR	FY24-26	FY26-31	FY31-41	FY24-44
Car	7.4%	5.9%	4.3%	4.8%
Bus	3.7%	3.1%	2.1%	2.4%
Minibus	3.7%	3.1%	2.1%	2.4%
LCV	3.7%	2.8%	3.0%	3.0%
2-axle	4.0%	2.9%	3.4%	3.3%
3-axle	4.0%	1.9%	3.2%	2.9%
MAV	4.5%	3.2%	3.7%	3.6%
Total PCU	5.0%	3.7%	3.7%	3.8%

Source: CRISIL MI&A CONSULTING

Table 78: Kherwasani - Projected AADT, FY24-44

Year	Cars	Bus	Minibus	LCV	2A	3A	MAV	Total PCU	On-year growth (%)
FY24E	3,693	180	60	317	771	363	2,284	18,482	
FY25P	3,974	187	62	328	805	377	2,390	19,423	**5.1%**
FY26P	4,261	194	65	339	837	390	2,489	20,330	**4.7%**
FY27P	4,553	200	67	351	870	403	2,590	21,256	**4.6%**
FY28P	4,815	207	69	360	894	408	2,649	21,908	**3.1%**
FY29P	5,094	213	71	370	922	417	2,726	22,676	**3.5%**
FY30P	5,374	219	73	380	950	425	2,804	23,455	**3.4%**
FY31P	5,674	226	75	392	985	438	2,910	24,412	**4.1%**
FY32P	5,976	232	77	404	1,020	451	3,019	25,393	**4.0%**
FY33P	6,277	237	79	416	1,057	465	3,133	26,395	**4.0%**
FY34P	6,578	243	81	429	1,094	479	3,251	27,421	**3.9%**
FY35P	6,877	249	83	442	1,133	494	3,372	28,465	**3.8%**
FY36P	7,174	254	85	455	1,173	509	3,496	29,523	**3.7%**
FY37P	7,469	259	87	468	1,214	524	3,624	30,598	**3.6%**
FY38P	7,760	264	88	482	1,255	538	3,753	31,678	**3.5%**
FY39P	8,048	269	90	495	1,297	554	3,887	32,775	**3.5%**
FY40P	8,331	274	92	509	1,340	569	4,021	33,874	**3.4%**
FY41P	8,610	278	93	523	1,383	584	4,159	34,989	**3.3%**

Year	Cars	Bus	Minibus	LCV	2A	3A	MAV	Total PCU	On-year growth (%)
FY42P	8,883	283	95	537	1,428	600	4,301	36,119	**3.2%**
FY43P	9,152	287	96	551	1,472	616	4,443	37,239	**3.1%**
FY44P	9,414	291	97	565	1,516	631	4,587	38,364	**3.0%**
CAGR (FY24-44P)	**4.8%**	**2.4%**	**2.4%**	**2.9%**	**3.4%**	**2.8%**	**3.6%**	**3.7%**	

Source: CRISIL MI&A CONSULTING

Kherwasani - Traffic volume CAGR (FY24-44) excluding diversions would have been higher by ~0.2%

Table 79: Traffic growth rates without diversions to expressway and other alternative routes

CAGR	FY24-26	FY26-31	FY31-41	FY24-44
Car	7.4%	6.2%	4.3%	4.9%
Bus	3.7%	3.1%	2.1%	2.4%
Minibus	3.7%	3.1%	2.1%	2.4%
LCV	3.5%	3.2%	2.9%	3.0%
2-axle	4.2%	3.7%	3.5%	3.5%
3-axle	3.7%	3.2%	2.9%	3.0%
MAV	4.4%	3.9%	3.6%	3.7%
Total PCU	4.9%	4.3%	3.7%	3.9%

Source: CRISIL MI&A CONSULTING

Table 80: Traffic growth rates with diversions to expressway and other alternative routes

CAGR	FY24-26	FY26-31	FY31-41	FY24-44
Car	7.4%	5.9%	4.3%	4.8%
Bus	3.7%	3.1%	2.1%	2.4%
Minibus	3.7%	3.1%	2.1%	2.4%
LCV	3.5%	2.9%	2.9%	2.9%
2-axle	4.2%	3.3%	3.5%	3.4%
3-axle	3.7%	2.3%	2.9%	2.8%
MAV	4.4%	3.2%	3.6%	3.6%
Total PCU	4.9%	3.7%	3.7%	3.7%

Source: CRISIL MI&A CONSULTING

Table 81: Mohtara - Projected AADT, FY24-44

Year	Cars	Bus	Minibus	LCV	2A	3A	MAV	Total PCU	On-year growth (%)
FY24P	6,193	186	96	391	930	587	1,664	19,520	
FY25P	6,664	193	100	405	966	608	1,740	20,554	**5.3%**
FY26P	7,145	200	103	419	1,001	627	1,812	21,570	**5.0%**
FY27P	7,635	207	107	433	1,036	647	1,886	22,605	**4.8%**
FY28P	8,034	214	110	445	1,062	655	1,926	23,330	**3.2%**
FY29P	8,479	221	114	458	1,091	668	1,981	24,191	**3.7%**
FY30P	8,922	227	117	471	1,121	681	2,037	25,058	**3.6%**
FY31P	9,421	234	120	486	1,157	701	2,114	26,119	**4.2%**
FY32P	9,921	240	123	501	1,195	721	2,195	27,200	**4.1%**
FY33P	10,421	246	127	516	1,234	741	2,278	28,299	**4.0%**

Year	Cars	Bus	Minibus	LCV	2A	3A	MAV	Total PCU	On-year growth (%)
FY34P	10,920	252	130	532	1,274	762	2,364	29,415	**4.0%**
FY35P	11,417	257	133	548	1,315	783	2,454	30,547	**3.9%**
FY36P	11,910	263	135	565	1,357	805	2,545	31,686	**3.7%**
FY37P	12,400	268	138	582	1,399	827	2,639	32,838	**3.6%**
FY38P	12,883	274	141	599	1,442	849	2,734	33,990	**3.5%**
FY39P	13,361	279	143	616	1,486	871	2,832	35,152	**3.4%**
FY40P	13,831	284	146	633	1,531	893	2,931	36,312	**3.3%**
FY41P	14,294	288	148	650	1,576	916	3,033	37,480	**3.2%**
FY42P	14,748	293	151	668	1,622	939	3,138	38,657	**3.1%**
FY43P	15,193	297	153	686	1,667	961	3,243	39,820	**3.0%**
FY44P	15,629	302	155	703	1,713	983	3,349	40,982	**2.9%**
CAGR (FY24-44P)	**4.7%**	**2.4%**	**2.4%**	**3.0%**	**3.1%**	**2.6%**	**3.6%**	**3.8%**	

Source: CRISIL MI&A CONSULTING

Mohtara - Traffic volume CAGR (FY24-44) excluding diversions would have been higher by ~0.1%

Table 82: Traffic growth rates without diversions to expressway and other alternative routes

CAGR	FY24-26	FY26-31	FY31-41	FY24-44
Car	7.4%	6.2%	4.3%	4.9%
Bus	3.7%	3.1%	2.1%	2.4%
Minibus	3.7%	3.1%	2.1%	2.4%
LCV	3.5%	3.2%	3.0%	3.0%
2-axle	3.8%	3.4%	3.1%	3.2%
3-axle	3.4%	3.0%	2.7%	2.8%
MAV	4.4%	3.9%	3.7%	3.8%
Total PCU	5.1%	4.5%	3.7%	3.9%

Source: CRISIL MI&A CONSULTING

Table 83: Traffic growth rates with diversions to expressway and other alternative routes

CAGR	FY24-26	FY26-31	FY31-41	FY24-44
Car	7.4%	5.7%	4.3%	4.7%
Bus	3.7%	3.1%	2.1%	2.4%
Minibus	3.7%	3.1%	2.1%	2.4%
LCV	3.5%	3.0%	3.0%	3.0%
2-axle	3.8%	2.9%	3.1%	3.1%
3-axle	3.4%	2.2%	2.7%	2.6%
MAV	4.4%	3.1%	3.7%	3.6%
Total PCU	5.1%	3.9%	3.7%	3.8%

Source: CRISIL MI&A CONSULTING

Table 84: Boharipar - Projected AADT, FY24-44

Year	Cars	Bus	Minibus	LCV	2A	3A	MAV	Total PCU	On-year
FY24P	3,626	173	34	247	739	256	1,191	12,908	
FY25P	3,902	179	35	256	768	265	1,247	13,588	**5.3%**
FY26P	4,184	186	36	265	798	275	1,305	14,283	**5.1%**
FY27P	4,471	192	37	274	828	284	1,363	14,982	**4.9%**

Year	Cars	Bus	Minibus	LCV	2A	3A	MAV	Total PCU	On-year
FY28P	4,762	198	39	283	858	294	1,423	15,698	**4.8%**
FY29P	5,057	204	40	291	887	303	1,482	16,408	**4.5%**
FY30P	5,354	210	41	300	917	313	1,544	17,135	**4.4%**
FY31P	5,653	216	42	309	949	323	1,608	17,878	**4.3%**
FY32P	5,953	222	43	319	981	333	1,674	18,638	**4.3%**
FY33P	6,254	228	44	329	1,014	344	1,743	19,414	**4.2%**
FY34P	6,553	233	46	339	1,049	355	1,815	20,206	**4.1%**
FY35P	6,851	238	47	349	1,084	366	1,890	21,012	**4.0%**
FY36P	7,147	243	48	359	1,120	377	1,966	21,826	**3.9%**
FY37P	7,441	248	49	370	1,157	388	2,045	22,653	**3.8%**
FY38P	7,731	253	49	380	1,194	400	2,126	23,483	**3.7%**
FY39P	8,018	258	50	391	1,232	412	2,209	24,325	**3.6%**
FY40P	8,300	262	51	402	1,270	423	2,293	25,167	**3.5%**
FY41P	8,578	267	52	413	1,310	435	2,380	26,020	**3.4%**
FY42P	8,850	271	53	424	1,350	447	2,470	26,884	**3.3%**
FY43P	9,118	275	54	435	1,389	459	2,559	27,739	**3.2%**
FY44P	9,379	279	55	445	1,429	471	2,651	28,598	**3.1%**
CAGR (FY24-44P)	**4.9%**	**2.4%**	**2.4%**	**3.0%**	**3.4%**	**3.1%**	**4.1%**	**4.1%**	

Source: CRISIL MI&A CONSULTING

Boharipar - Traffic volume CAGR (FY24-44)

Table 85: Traffic growth rates without diversions to expressway and other alternative routes

CAGR	FY24-26	FY26-31	FY31-41	FY24-44
Car	7.4%	6.2%	4.3%	4.9%
Bus	3.7%	3.1%	2.1%	2.4%
Minibus	3.7%	3.1%	2.1%	2.4%
LCV	3.5%	3.2%	2.9%	3.0%
2-axle	3.9%	3.5%	3.3%	3.4%
3-axle	3.7%	3.3%	3.0%	3.1%
MAV	4.7%	4.3%	4.0%	4.1%
Total PCU	5.2%	4.6%	3.8%	4.1%

Source: CRISIL MI&A CONSULTING

Table 86: Traffic growth rates with diversions to expressway and other alternative routes

CAGR	FY24-26	FY26-31	FY31-41	FY24-44
Car	7.4%	6.2%	4.3%	4.9%
Bus	3.7%	3.1%	2.1%	2.4%
Minibus	3.7%	3.1%	2.1%	2.4%
LCV	3.5%	3.2%	2.9%	3.0%
2-axle	3.9%	3.5%	3.3%	3.4%
3-axle	3.7%	3.3%	3.0%	3.1%
MAV	4.7%	4.3%	4.0%	4.1%
Total PCU	5.2%	4.6%	3.8%	4.1%

Source: CRISIL MI&A CONSULTING

8.2 Revenue assumptions

For revenue and traffic assessment, we have assumed impact of Kandla-Sagar-Lucknow section to begin by fiscal 2028 and complete impact by 2030. NHAI has indicated the completion of Katni Bypass by June 2024. However, as per discussions with management, the revenue from Katni Bypass has been factored in from 01 Jan 2025 for Kherwasani toll plaza.

Trip segmentation

Trip segmentation has been derived from the average share of a single journey, return journey and other categories, based on ETC, cash and exemption data. April 2023 – Nov 2023 period is considered for trip segmentation.

For revenue calculation, the trip factor used for a return journey is two, and for a monthly pass it is 45. Exemptions have been estimated based on the TMS dataset of the toll plazas data from Apr-22 to July-23. The trip segmentation has been assumed to remain constant throughout the projection period i.e., over fiscals 2024 to 2053.

Table 87: Odhaki - Details of trip segmentation across vehicle categories

Vehicle category	Single journey	Return journey	Local Monthly pass	Local Commercial Vehicles	Exemption
Car, jeep, van or LMV	43.76%	45.60%	2.21%	0.00%	8.43%
LCV, light goods vehicle, or minibus	40.86%	44.69%	0.00%	3.80%	10.65%
Bus or truck (2-axle)	73.61%	24.95%	0.00%	0.00%	1.44%
3-axle CV	80.61%	18.24%	0.00%	0.00%	1.15%
HCM, EME or MAV (4-6 axle)	76.42%	23.40%	0.00%	0.00%	0.18%

Source: Toll Plaza data, CRISIL MI&A CONSULTING

Table 88: Kherwasani - Details of trip segmentation across vehicle categories

Vehicle category	Single journey	Return journey	Local Monthly pass	Local Commercial Vehicles	Exemption
Car, jeep, van or LMV	46.25%	42.75%	0.33%	0.01%	10.66%
LCV, light goods vehicle, or minibus	46.23%	41.56%	0.00%	2.75%	9.46%
Bus or truck (2-axle)	72.20%	26.84%	0.00%	0.09%	0.87%
3-axle CV	78.27%	20.17%	0.00%	0.00%	1.56%

HCM, EME or MAV (4-6 axle)	78.62%	21.00%	0.00%	0.06%	0.33%

Source: Toll Plaza data, CRISIL MI&A CONSULTING

Table 89: Mohtara - Details of trip segmentation across vehicle categories

Vehicle category	Single journey	Return journey	Local Monthly pass	Local Commercial Vehicles	Exemption
Car, jeep, van or LMV	33.44%	47.07%	8.46%	1.93%	9.10%
LCV, light goods vehicle, or minibus	36.94%	31.93%	0.00%	17.32%	13.82%
Bus or truck (2-axle)	63.44%	28.97%	0.00%	6.14%	1.45%
3-axle CV	51.95%	26.33%	0.00%	21.51%	0.21%
HCM, EME or MAV (4-6 axle)	87.13%	11.62%	0.00%	1.08%	0.17%

Source: Toll Plaza data, CRISIL MI&A CONSULTING

Table 90: Boharipar - Details of trip segmentation across vehicle categories

Vehicle category	Single journey	Return journey	Local Monthly pass	Local Commercial Vehicles	Exemption
Car, jeep, van or LMV	37.74%	40.70%	7.70%	0.05%	13.80%
LCV, light goods vehicle, or minibus	44.59%	38.94%	1.84%	0.91%	15.57%
Bus or truck (2-axle)	59.15%	37.23%	0.59%	0.73%	2.89%
3-axle CV	72.22%	20.97%	0.43%	4.25%	2.56%
HCM, EME or MAV (4-6 axle)	92.76%	6.71%	0.00%	0.07%	0.47%

Source: Toll Plaza data, CRISIL MI&A CONSULTING

Wholesale Price Index projections

The projected toll rates are dependent on Wholesale Price Index (WPI) assumptions for fiscals 2023 to 2053. For WPI projection, CRISIL MI&A Consulting has relied on inputs from CRISIL's economic research team.

Table 91: WPI projections till December 2051

Month-year	WPI	Expected on-year growth
Dec-20 (actual)	385.4	
Dec-21 (actual)	440.4	14.3%

Month-year	WPI	Expected on-year growth
Dec-22 (actual)	462.6	5.0%
Dec-23	466.0	0.7%
Dec-24	490.4	5.3%
Dec-25	512.5	4.5%
Dec-26	530.4	3.5%
Dec-27	549.0	3.5%
Dec-28	568.2	3.5%
Dec-29	588.1	3.5%
Dec-30	608.7	3.5%
Dec-31 to Dec-41	↓	3.5%
Dec-42	919.8	3.5%

Source: Client inputs

Other details for revenue calculations

The following details have been used for the toll rate calculations which have been sourced from the technical schedules,

Table 92: Base rates for toll calculation

Vehicle category	Base rate of fee per km (base year = FY08), in Rs
Car, jeep, van or LMV	0.65
LCV, light goods vehicle or minibus	1.05
Bus or truck (2-axle)	2.20
3-axle CV	2.40
HCM, EME or MAV (4-6 axles)	3.45
Oversized vehicles (seven or more axles)	4.20

Source: Technical schedules, CRISIL MI&A CONSULTING

Table 93: Details of toll rate calculation for multiple journeys

Amount payable	Maximum number of one-way journeys allowed	Period of validity
One-and-a-half times of the fee for one-way journey	Two	Twenty-four hours from the time of payment

Two-thirds of amount of the fee payable for 50 singles journeys or more	50 or more	One month from date of payment

Source: Technical schedules, CRISIL MI&A CONSULTING

Table 94: Details of road length, structures and bypass on the project stretch

Name of toll plaza	Location of toll plaza (chainage)	Tollable Length excluding length of Bypass for which fee is payable	Length of bypass (in km) for which additional fee is payable	2 Lane Length of structures (in km) converted into equivalent road length	4 Lane Length of structures (in km) converted into equivalent road length	Tollable length (Km)
Odhaki Paipkhar Toll Plaza	Km 656+000 to Km 725+185 of NH-30 (old NH-7)	55.044	13.912	0.640	1.650	71.246
Kherwasani Toll Plaza	Km 725+185 to km. 813+257 excluding Katni Bypass of NH-30 (old NH-7)	45.278	23.797	-	1.793	70.868
Kherwasani Toll Plaza	Km 725+185 to km. 813+257 including Katni Bypass of NH-30 (old NH-7)	45.278	42.615	-	1.793	89.686
Mohtara Toll Plaza	4 Km 813+257 to Km 880+600 of NH-30 (old NH-7)	40.612	26.245	0.720	4.140	71.717
Boharipar Toll Plaza	Km 880+600 of NH-30 (old NH-7) to Km 1428+557 of NH-34	68.097	11.240	5.100	18.900	103.337

Source: Technical schedules, CRISIL MI&A CONSULTING

8.3 Revenue projections

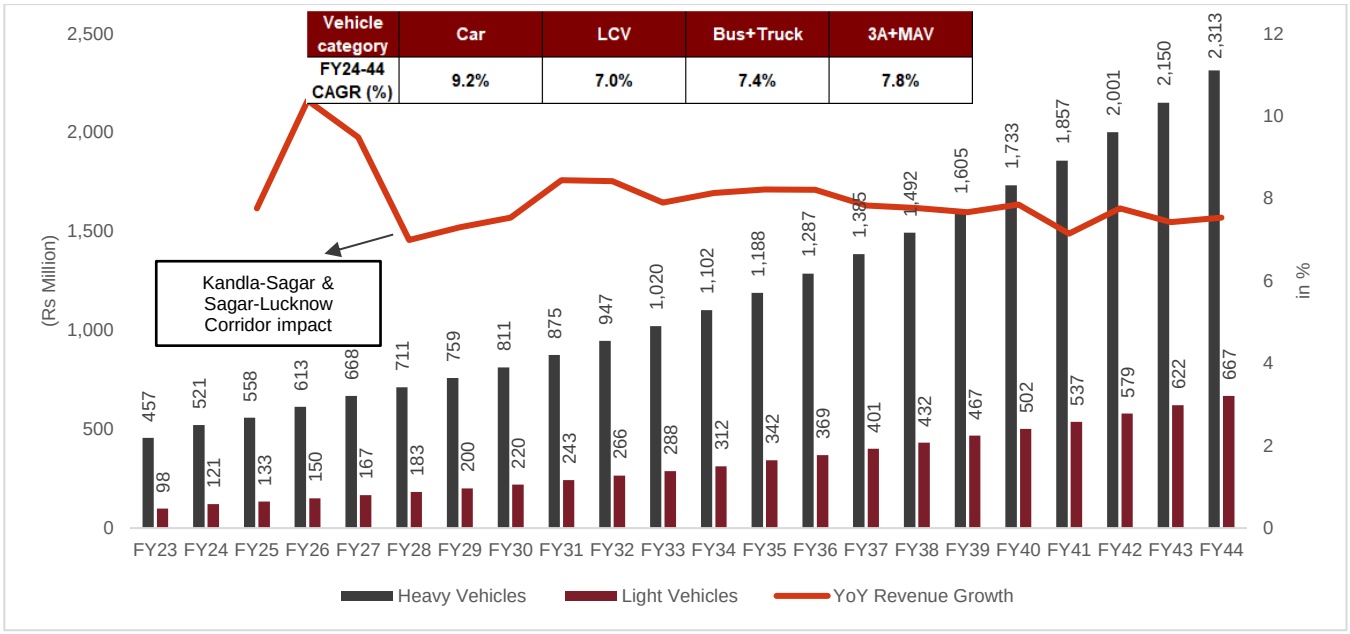
Table 95: Projected revenue (Rs million) for FY24-44

Year – Rs million	Odhaki TP	Kherwasani TP	Mohtara TP	Boharipar TP	Total
FY24E	641.5	806.8	817.8	703.5	2969.6
FY25P	691.2	946.5	881.5	752.6	3271.8
FY26P	762.9	1304.4	966.7	832.0	3866.1
FY27P	835.3	1426.2	1059.6	913.6	4234.7

Year – Rs million	Odhaki TP	Kherwasani TP	Mohtara TP	Boharipar TP	Total
FY28P	893.7	1530.4	1139.2	997.7	4560.9
FY29P	958.9	1644.0	1225.1	1078.7	4906.6
FY30P	1031.1	1768.0	1319.3	1171.6	5290.0
FY31P	1118.1	1916.5	1426.7	1272.1	5733.5
FY32P	1212.2	2079.3	1546.9	1379.5	6217.9
FY33P	1307.9	2239.3	1675.5	1492.3	6715.0
FY34P	1414.2	2422.1	1804.4	1618.7	7259.4
FY35P	1530.4	2609.2	1957.1	1749.7	7846.3
FY36P	1655.9	2824.5	2112.5	1896.3	8489.3
FY37P	1785.5	3042.9	2273.6	2043.5	9145.5
FY38P	1924.2	3281.8	2443.3	2205.6	9855.0
FY39P	2071.6	3528.4	2631.7	2376.4	10608.1
FY40P	2234.3	3807.4	2838.1	2563.7	11443.5
FY41P	2393.9	4084.5	3041.8	2759.6	12279.9
FY42P	2579.6	4382.4	3271.2	2965.3	13198.4
FY43P	2771.1	4710.8	3503.4	3182.9	14168.3
FY44P	2979.9	5061.9	3764.5	3426.0	15232.3
CAGR (FY24-44P)	8.0%	9.6%	7.9%	8.2%	8.5%

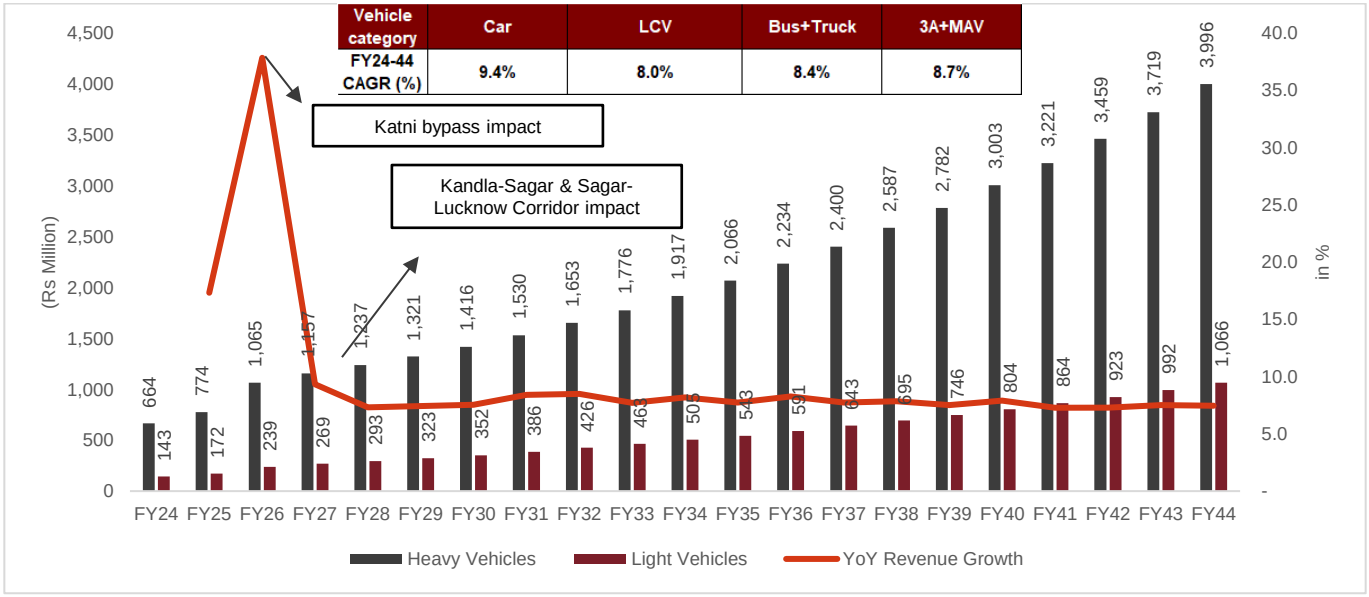
Source: CRISIL MI&A CONSULTING

Figure 36: Odhaki - Revenue expected to clock 8.0% CAGR between FY24-44



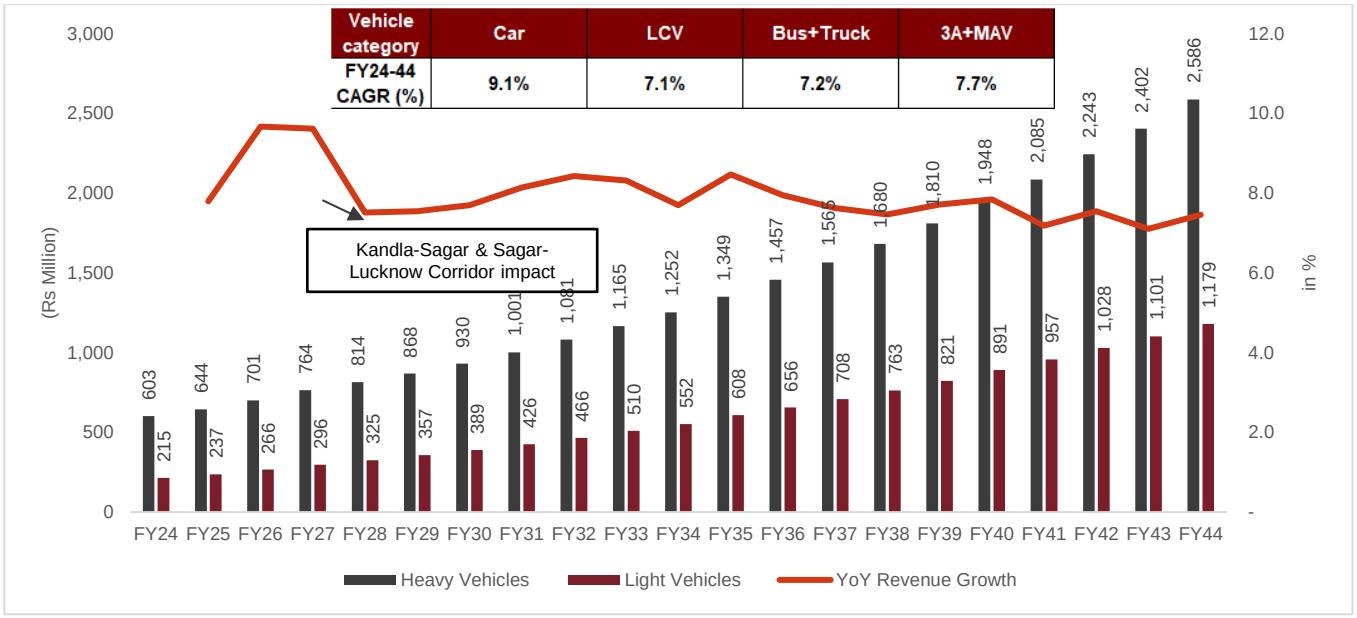
Source: CRISIL MI&A CONSULTING

Figure 37: Kherwasani - Revenue expected to clock 8.9% CAGR between FY24-44



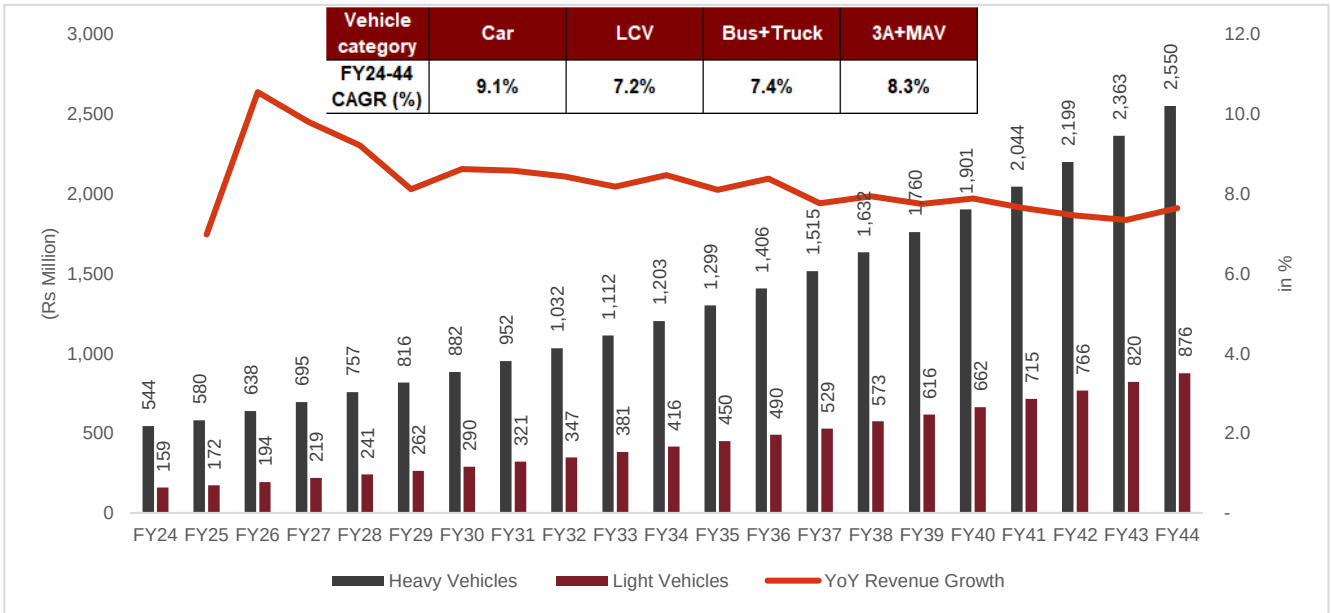
Source: CRISIL MI&A CONSULTING

Figure 38: Mohtara - Revenue expected to clock 7.9% CAGR between FY24-44



Source: CRISIL MI&A CONSULTING

Figure 39: Boharipar - Revenue expected to clock 8.2% CAGR between FY24-44



Source: CRISIL MI&A CONSULTING

9 Annexure

9.1 Traffic profile for Odhaki toll plaza

Naini bridge repair work to have temporary impact on Odhaki MAV traffic

Naini bridge, one of important bridges which connects Uttar Pradesh and Madhya Pradesh, was closed for heavy vehicles movement from 1st Jun 2023 to 31st Jul 2023. This impacted Odhaki MAV traffic. UP accounts for about close to 30% MAV traffic for Odhaki, while 2A and 3A have a relatively lower share at about~10-15%, hence the impact is largely seen in MAVs. Harro toll plaza, which is operational between Prayagraj and Rewa on NH-27 has also recorded reduced traffic for the month of Jun, Jul, and Aug 2023 owing to Naini bridge repair work.

Figure 40: Naini bridge and Harro Toll Plaza location map

Source: CRISIL MI&A CONSULTING

Table 96: Harro toll plaza – YoY change in ETC traffic for FY24

YoY Change	Cars	Mini LCV	LCV	Minibus	Bus	Truck	3 Axle Truck	MAV
Apr-23	-1%	-11%	-13%	-7%	8%	-6%	-3%	13%
May-23	30%	-5%	-37%	52%	8%	3%	0%	30%
Jun-23	16%	-21%	-6%	50%	-8%	-45%	-64%	-59%
Jul-23	12%	-22%	-4%	23%	-4%	-32%	-53%	-29%
Aug-23	10%	1%	-8%	15%	-3%	-27%	-49%	-5%

Source: IHMCL data

9.2 Monthly traffic and revenue projection for fiscal 2024

Monthly Average Daily ETC Traffic - Odhaki TP

Table 97: Odhaki - Table below shows Fiscal 2023 & Fiscal 2024 MADT

Month	CJV	LCV	2A	3A	MAV	Total	PCU
Apr-22	2,708	181	510	291	2,181	5,871	15,196
May-22	2,807	279	609	268	1,884	5,846	14,333
Jun-22	2,509	250	507	269	1,906	5,441	13,790
Jul-22	2,225	250	482	260	1,669	4,886	12,335
Aug-22	2,060	247	540	257	1,659	4,763	12,288
Sep-22	1,991	255	545	288	1,627	4,706	12,193
Oct-22	2,535	249	556	252	1,523	5,114	12,184
Nov-22	2,414	276	585	277	1,679	5,232	12,971
Dec-22	2,347	290	681	279	1,750	5,347	13,538
Jan-23	2,303	268	542	269	1,643	5,026	12,534
Feb-23	2,952	287	694	295	1,891	6,120	14,862
Mar-23	2,884	277	745	296	2,098	6,301	15,866
Apr-23	2,769	283	701	292	2,125	6,170	15,735
May-23	3,540	288	679	282	1,986	6,775	15,794
Jun-23	3,258	268	566	264	1,702	6,058	13,811
Jul-23	2,460	251	496	244	1,619	5,069	12,339
Aug-23	2,466	249	592	239	1,702	5,248	12,991
Sep-23	2,380	267	638	253	1,832	5,370	13,697
Oct-23	2,844	280	679	272	1,854	5,929	14,460
Nov-23	3,057	280	725	261	1,787	6,110	14,477

Source: Toll Plaza data, CRISIL MI&A CONSULTING

Monthly Average Daily ETC Traffic - Kherwasani TP

Table 98: Kherwasani - Table below shows Fiscal 2023 & Fiscal 2024 MADT

Month	CJV	LCV	2A	3A	MAV	Total	PCU
Apr-22	2,663	354	813	404	2,193	6,426	16,712
May-22	3,028	320	771	381	1,931	6,432	15,657
Jun-22	2,707	308	685	373	1,947	6,021	15,107
Jul-22	2,241	304	650	374	1,842	5,411	14,057
Aug-22	2,120	283	707	352	1,800	5,262	13,823
Sep-22	2,188	294	695	372	1,847	5,396	14,141
Oct-22	2,524	280	697	341	1,653	5,495	13,496
Nov-22	2,796	326	759	390	1,925	6,195	15,391
Dec-22	2,901	341	886	377	1,994	6,500	16,176
Jan-23	2,770	319	829	367	2,007	6,291	15,866
Feb-23	3,269	351	966	404	2,347	7,337	18,468
Mar-23	2,781	335	1,005	394	2,475	6,990	18,617
Apr-23	2,923	345	969	394	2,446	7,076	18,536
May-23	3,891	337	912	380	2,234	7,753	18,323
Jun-23	3,536	331	802	367	2,107	7,143	17,022
Jul-23	2,608	308	716	335	1,967	5,933	15,072
Aug-23	2,650	302	825	325	1,998	6,100	15,542
Sep-23	2,687	326	846	332	2,135	6,325	16,315
Oct-23	2,973	319	899	351	2,300	6,841	17,549
Nov-23	3,393	322	938	344	2,084	7,081	17,100

Source: Toll Plaza data, CRISIL MI&A CONSULTING

Monthly Average Daily ETC Traffic - Mohtara TP

Table 99: Mohtara - Table below shows Fiscal 2023 & Fiscal 2024 MADT

Month	CJV	LCV	2A	3A	MAV	Total	PCU
Apr-22	4,376	455	925	551	1,685	7,992	17,069
May-22	4,980	439	914	562	1,507	8,403	16,850
Jun-22	4,501	398	850	571	1,513	7,832	16,166
Jul-22	3,804	370	793	514	1,486	6,968	14,970
Aug-22	3,751	356	846	489	1,376	6,818	14,481
Sep-22	3,648	364	852	520	1,401	6,785	14,616
Oct-22	4,008	345	843	474	1,331	7,002	14,469
Nov-22	4,572	401	941	568	1,549	8,031	16,669
Dec-22	4,522	405	1,067	600	1,513	8,107	16,939
Jan-23	4,432	393	1,008	572	1,544	7,948	16,708
Feb-23	5,616	435	1,156	595	1,777	9,580	19,522
Mar-23	4,845	421	1,137	580	1,818	8,801	18,811
Apr-23	5,047	465	1,135	614	1,780	9,040	18,999
May-23	6,466	461	1,095	638	1,706	10,367	20,035
Jun-23	5,943	440	978	584	1,541	9,487	18,227
Jul-23	4,707	402	864	512	1,434	7,919	15,892
Aug-23	4,835	357	954	456	1,466	8,069	16,200
Sep-23	4,749	361	986	544	1,608	8,248	17,116
Oct-23	5,015	370	1,028	576	1,675	8,664	17,921
Nov-23	5,439	361	1,070	600	1,557	9,027	17,998

Source: Toll Plaza data, CRISIL MI&A CONSULTING

Monthly Average Daily ETC Traffic - Boharipar TP

Table 100: Boharipar - Table below shows Fiscal 2023 & Fiscal 2024 MADT

Month	CJV	LCV	2A	3A	MAV	Total	PCU
Apr-22	2,169	211	756	261	1,239	4,636	11,112
May-22	2,500	206	735	250	1,120	4,811	10,803
Jun-22	2,305	196	657	258	1,043	4,459	10,038
Jul-22	1,948	178	602	244	1,101	4,074	9,708
Aug-22	2,184	188	653	223	1,042	4,289	9,782
Sep-22	1,986	207	677	230	1,001	4,102	9,523
Oct-22	2,355	199	679	233	933	4,398	9,586
Nov-22	2,446	224	743	269	1,035	4,717	10,477
Dec-22	2,483	213	737	246	1,056	4,736	10,504
Jan-23	2,390	195	719	238	1,170	4,713	10,820
Feb-23	2,926	209	852	235	1,203	5,425	11,915
Mar-23	2,709	205	906	242	1,222	5,285	11,959
Apr-23	2,847	247	976	260	1,353	5,684	13,016
May-23	3,370	246	906	260	1,260	6,042	12,905
Jun-23	3,177	254	789	254	1,082	5,557	11,558
Jul-23	2,592	230	704	244	1,017	4,786	10,355
Aug-23	2,884	233	806	220	1,010	5,152	10,855
Sep-23	2,736	242	852	241	1,131	5,202	11,468
Oct-23	2,839	246	892	270	1,211	5,458	12,143
Nov-23	3,166	226	828	267	1,142	5,629	11,929

Source: Toll Plaza data, CRISIL MI&A CONSULTING

9.3 Fiscal 2024 ETC AADT vs Fiscal 2023 ETC AADT

Table 101: FY24 Estimated AADT based on ETC data:

Toll Plaza	CJV	LCV	2 Axle	3 Axle	MAV	Total	PCU
Fiscal 2024 ETC AADT (Estimated)							
Odhaki	2,945	277	676	268	1,944	6,110	14,941
Kherwasani	3,239	333	942	357	2,276	7,147	17,876
Mohtara	5,537	410	1,098	585	1,660	9,290	18,671
Boharipar	3,118	242	891	250	1,185	5,687	12,238
Fiscal 2023 ETC AADT (Actuals)							
Odhaki	2,475	259	582	275	1,791	5,382	13,496
Kherwasani	2,662	318	788	377	1,994	6,138	15,606
Mohtara	4,413	398	943	549	1,540	7,844	16,417
Boharipar	2,364	203	725	244	1,096	4,632	10,510
Year-on-Year growth							
Odhaki	19.0%	7.1%	16.2%	-2.5%	8.5%	13.5%	10.7%
Kherwasani	21.7%	4.8%	19.5%	-5.3%	14.1%	16.4%	14.5%
Mohtara	25.5%	2.9%	16.5%	6.5%	7.8%	18.4%	13.7%
Boharipar	31.9%	19.3%	22.9%	2.6%	8.1%	22.8%	16.4%

Source: Client, CRISIL MI&A Consulting

9.4 Traffic projections scenario based on econometric model

We have projected the traffic based on an econometric model where the traffic growth is linked to GDP growth of India and the respective states. For the current assessment, we have used a traffic growth to GDP growth multiple methodology based on an internal study. The multiple used is 1.00 for car, 0.60 for bus, 0.66 for minibus/LCV, 0.66 for 2-axle, 0.66 for 3-axle and 0.60 for MAV. We have used this multiple along with India and state GDP forecasts to derive the traffic growth rate for fiscals 2024 to 2053.

Table 102: Odhaki - AADT projections as per econometric method (no diversions) for FY24-44

Year	Cars	Bus	Minibus	LCV	2-Axle	3-Axle	MAV	Total	Total PCU	CRISIL - Total PCUs	Difference
FY24E	3,324	130	121	199	557	272	1,948	6,550	15,447	15,447	
FY25P	3,533	135	126	207	580	283	2,021	6,884	16,120	16,257	137
FY26P	3,759	140	131	216	605	295	2,098	7,242	16,836	17,038	202
FY27P	3,999	146	136	225	630	307	2,177	7,620	17,586	17,834	248
FY28P	4,247	151	142	234	655	319	2,257	8,006	18,346	18,650	305
FY29P	4,501	156	148	243	681	332	2,338	8,399	19,115	19,453	338
FY30P	4,753	162	153	252	706	344	2,416	8,785	19,866	20,277	411
FY31P	5,019	167	159	261	732	357	2,496	9,190	20,647	21,120	473

Year	Cars	Bus	Minibus	LCV	2-Axle	3-Axle	MAV	Total	Total PCU	CRISIL - Total PCUs	Difference
FY32P	5,300	173	164	271	758	370	2,579	9,615	21,461	21,984	523
FY33P	5,597	179	171	280	786	383	2,665	10,061	22,309	22,868	559
FY34P	5,911	185	177	291	815	397	2,753	10,529	23,193	23,772	579
FY35P	6,237	191	183	301	844	412	2,844	11,012	24,101	24,692	592
FY36P	6,577	197	190	312	874	426	2,936	11,512	25,033	25,625	592
FY37P	6,929	203	197	323	905	441	3,029	12,028	25,988	26,573	584
FY38P	7,296	210	204	334	936	456	3,124	12,560	26,968	27,525	557
FY39P	7,675	216	210	345	968	472	3,221	13,107	27,970	28,493	523
FY40P	8,067	223	218	357	1,000	488	3,318	13,671	28,995	29,463	468
FY41P	8,474	230	225	369	1,033	504	3,418	14,251	30,043	30,446	403
FY42P	8,894	236	232	381	1,067	520	3,518	14,848	31,115	31,444	329
FY43P	9,328	243	240	393	1,101	537	3,620	15,461	32,209	32,432	223
FY44P	9,775	250	247	405	1,135	554	3,723	16,090	33,326	33,426	100
CAGR (FY24-44)	**5.5%**	**3.3%**	**3.7%**	**3.6%**	**3.6%**	**3.6%**	**3.3%**	**4.6%**	**3.9%**	**3.9%**	

Note: *The CAGR given is based on a scenario where there are no diversions;

Source: CRISIL MI&A CONSULTING

Table 103: Odhaki - AADT projections as per econometric method (considering diversions) for FY24-44

Year	Cars	Bus	Minibus	LCV	2-Axle	3-Axle	MAV	Total	Total PCU	CRISIL - Total PCUs	Difference
FY24E	3,324	130	121	199	557	272	1,948	6,550	15,447	15,447	
FY25P	3,533	135	126	207	580	283	2,021	6,884	16,120	16,257	137
FY26P	3,759	140	131	216	605	295	2,098	7,242	16,836	17,038	202
FY27P	3,999	146	136	225	630	307	2,177	7,620	17,586	17,834	248
FY28P	4,247	151	142	234	655	319	2,257	8,006	18,346	18,352	7
FY29P	4,501	156	148	243	681	332	2,338	8,399	19,115	18,989	-127
FY30P	4,753	162	153	252	706	344	2,416	8,785	19,866	19,633	-233
FY31P	5,019	167	159	261	732	357	2,496	9,190	20,647	20,451	-196
FY32P	5,300	173	164	271	758	370	2,579	9,615	21,461	21,288	-173
FY33P	5,597	179	171	280	786	383	2,665	10,061	22,309	22,145	-164
FY34P	5,911	185	177	291	815	397	2,753	10,529	23,193	23,021	-172
FY35P	6,237	191	183	301	844	412	2,844	11,012	24,101	23,914	-187
FY36P	6,577	197	190	312	874	426	2,936	11,512	25,033	24,817	-216
FY37P	6,929	203	197	323	905	441	3,029	12,028	25,988	25,736	-253
FY38P	7,296	210	204	334	936	456	3,124	12,560	26,968	26,658	-310
FY39P	7,675	216	210	345	968	472	3,221	13,107	27,970	27,595	-374
FY40P	8,067	223	218	357	1,000	488	3,318	13,671	28,995	28,534	-461

Year	Cars	Bus	Minibus	LCV	2-Axle	3-Axle	MAV	Total	Total PCU	CRISIL - Total PCUs	Difference
FY41P	8,474	230	225	369	1,033	504	3,418	14,251	30,043	29,486	-557
FY42P	8,894	236	232	381	1,067	520	3,518	14,848	31,115	30,452	-663
FY43P	9,328	243	240	393	1,101	537	3,620	15,461	32,209	31,409	-800
FY44P	9,775	250	247	405	1,135	554	3,723	16,090	33,326	32,370	-955
CAGR (FY24-44)	**5.5%**	**3.3%**	**3.7%**	**3.6%**	**3.6%**	**3.6%**	**3.3%**	**4.6%**	**3.9%**	**3.8%**	

Note: *The CAGR given is based on a scenario where there are diversions onto alternative routes

Source: CRISIL MI&A CONSULTING

Table 104: Kherwasani - AADT projections as per econometric method (no diversions) for FY24-44

Year	Cars	Bus	Minibus	LCV	2-Axle	3-Axle	MAV	Total	Total PCU	CRISIL - Total PCUs	Difference
FY24E	3,693	180	60	317	771	363	2,284	7,669	18,482	18,482	
FY25P	3,926	187	63	330	803	378	2,370	8,057	19,286	19,423	136
FY26P	4,178	194	65	344	837	394	2,461	8,473	20,141	20,330	189
FY27P	4,445	201	68	358	872	411	2,555	8,911	21,036	21,256	220
FY28P	4,722	209	71	373	908	427	2,650	9,359	21,944	22,208	264
FY29P	5,005	217	74	387	943	444	2,745	9,816	22,862	23,143	282
FY30P	5,286	224	76	402	978	461	2,837	10,264	23,757	24,103	346
FY31P	5,583	231	79	416	1,014	478	2,932	10,733	24,689	25,085	397
FY32P	5,896	239	82	432	1,052	495	3,030	11,226	25,659	26,092	432
FY33P	6,227	247	85	448	1,090	513	3,131	11,742	26,670	27,121	451
FY34P	6,576	255	88	464	1,130	532	3,236	12,283	27,723	28,174	451
FY35P	6,940	264	92	481	1,172	552	3,343	12,843	28,805	29,247	443
FY36P	7,319	273	95	498	1,213	571	3,452	13,421	29,914	30,334	419
FY37P	7,712	281	98	516	1,256	592	3,563	14,018	31,052	31,439	386
FY38P	8,120	290	102	534	1,300	612	3,675	14,633	32,218	32,548	330
FY39P	8,543	299	105	552	1,344	633	3,789	15,266	33,410	33,676	266
FY40P	8,981	309	109	570	1,390	654	3,905	15,917	34,630	34,805	176
FY41P	9,434	318	112	589	1,436	676	4,023	16,588	35,876	35,951	75
FY42P	9,902	327	116	609	1,482	698	4,142	17,276	37,150	37,113	-37
FY43P	10,386	337	120	628	1,530	720	4,262	17,984	38,450	38,264	-186
FY44P	10,885	347	124	648	1,578	743	4,385	18,709	39,777	39,421	-356
CAGR (FY24-44)	**5.6%**	**3.3%**	**3.7%**	**3.6%**	**3.6%**	**3.6%**	**3.3%**	**4.6%**	**3.9%**	**3.9%**	

Note: *The CAGR given is based on a scenario where there are no diversions

Source: CRISIL MI&A CONSULTING

Table 105: Kherwasani - AADT projections as per econometric method (considering diversions) for FY24-44

Year	Cars	Bus	Minibus	LCV	2-Axle	3-Axle	MAV	Total	Total	CRISIL -	Difference
FY24E	3,693	180	60	317	771	363	2,284	7,669	18,482	18,482	
FY25P	3,926	187	63	330	803	378	2,370	8,057	19,286	19,423	136
FY26P	4,178	194	65	344	837	394	2,461	8,473	20,141	20,330	189
FY27P	4,445	201	68	358	872	411	2,555	8,911	21,036	21,256	220
FY28P	4,722	209	71	373	908	427	2,650	9,359	21,944	21,908	-35
FY29P	5,005	217	74	387	943	444	2,745	9,816	22,862	22,676	-186
FY30P	5,286	224	76	402	978	461	2,837	10,264	23,757	23,455	-302
FY31P	5,583	231	79	416	1,014	478	2,932	10,733	24,689	24,412	-276
FY32P	5,896	239	82	432	1,052	495	3,030	11,226	25,659	25,393	-267
FY33P	6,227	247	85	448	1,090	513	3,131	11,742	26,670	26,395	-275
FY34P	6,576	255	88	464	1,130	532	3,236	12,283	27,723	27,421	-303
FY35P	6,940	264	92	481	1,172	552	3,343	12,843	28,805	28,465	-339
FY36P	7,319	273	95	498	1,213	571	3,452	13,421	29,914	29,523	-391
FY37P	7,712	281	98	516	1,256	592	3,563	14,018	31,052	30,598	-454
FY38P	8,120	290	102	534	1,300	612	3,675	14,633	32,218	31,678	-540
FY39P	8,543	299	105	552	1,344	633	3,789	15,266	33,410	32,775	-635
FY40P	8,981	309	109	570	1,390	654	3,905	15,917	34,630	33,874	-755
FY41P	9,434	318	112	589	1,436	676	4,023	16,588	35,876	34,989	-887
FY42P	9,902	327	116	609	1,482	698	4,142	17,276	37,150	36,119	-1,031
FY43P	10,386	337	120	628	1,530	720	4,262	17,984	38,450	37,239	-1,211
FY44P	10,885	347	124	648	1,578	743	4,385	18,709	39,777	38,364	-1,413
CAGR (FY24-44)	**5.6%**	**3.3%**	**3.7%**	**3.6%**	**3.6%**	**3.6%**	**3.3%**	**4.6%**	**3.9%**	**3.7%**	

Note: *The CAGR given is based on a scenario where there are diversions onto alternative routes

Source: CRISIL MI&A CONSULTING

Table 106: Mohtara - AADT projections as per econometric method (no diversions) for FY24-44

Year	Cars	Bus	Minibus	LCV	2-Axle	3-Axle	MAV	Total	Total PCU	CRISIL - Total PCUs	Difference
FY24E	6,193	186	96	391	930	587	1,664	10,047	19,520	19,520	
FY25P	6,588	194	100	407	968	611	1,727	10,595	20,440	20,554	114
FY26P	7,015	201	104	424	1,009	637	1,793	11,185	21,420	21,570	150
FY27P	7,470	209	109	442	1,052	664	1,862	11,808	22,451	22,605	154
FY28P	7,939	217	113	460	1,095	691	1,932	12,447	23,501	23,663	163
FY29P	8,422	225	118	479	1,138	719	2,001	13,101	24,567	24,713	146
FY30P	8,900	232	122	496	1,180	745	2,069	13,745	25,609	25,784	174
FY31P	9,405	240	127	515	1,224	773	2,138	14,421	26,699	26,876	176

Year	Cars	Bus	Minibus	LCV	2-Axle	3-Axle	MAV	Total	Total PCU	CRISIL - Total PCUs	Difference
FY32P	9,939	248	132	534	1,269	801	2,210	15,133	27,839	27,987	149
FY33P	10,503	257	136	553	1,316	831	2,284	15,881	29,029	29,118	89
FY34P	11,099	266	142	574	1,365	862	2,361	16,668	30,274	30,267	-7
FY35P	11,720	275	147	595	1,415	893	2,439	17,484	31,557	31,431	-126
FY36P	12,367	284	152	616	1,466	925	2,519	18,328	32,878	32,604	-274
FY37P	13,039	293	158	638	1,517	958	2,600	19,203	34,238	33,789	-449
FY38P	13,737	302	163	660	1,570	991	2,683	20,107	35,636	34,975	-661
FY39P	14,460	312	169	683	1,624	1,025	2,766	21,039	37,070	36,172	-898
FY40P	15,209	322	175	706	1,679	1,060	2,851	22,001	38,543	37,366	-1,176
FY41P	15,985	331	180	730	1,735	1,095	2,938	22,994	40,053	38,570	-1,484
FY42P	16,787	341	186	753	1,792	1,131	3,025	24,016	41,601	39,781	-1,820
FY43P	17,616	351	193	778	1,849	1,168	3,113	25,068	43,187	40,979	-2,208
FY44P	18,472	362	199	802	1,908	1,204	3,203	26,150	44,810	42,175	-2,634
CAGR (FY24-44)	**5.6%**	**3.4%**	**3.7%**	**3.7%**	**3.7%**	**3.7%**	**3.3%**	**4.9%**	**4.2%**	**3.9%**	

Note: *The CAGR given is based on a scenario where there are no diversions;

Source: CRISIL MI&A CONSULTING

Table 107: Mohtara - AADT projections as per econometric method (considering diversions) for FY24-44

Year	Cars	Bus	Minibus	LCV	2-Axle	3-Axle	MAV	Total	Total PCU	CRISIL - Total PCUs	Difference
FY24E	6,193	186	96	391	930	587	1,664	10,047	19,520	19,520	
FY25P	6,588	194	100	407	968	611	1,727	10,595	20,440	20,554	114
FY26P	7,015	201	104	424	1,009	637	1,793	11,185	21,420	21,570	150
FY27P	7,470	209	109	442	1,052	664	1,862	11,808	22,451	22,605	154
FY28P	7,939	217	113	460	1,095	691	1,932	12,447	23,501	23,330	-171
FY29P	8,422	225	118	479	1,138	719	2,001	13,101	24,567	24,191	-376
FY30P	8,900	232	122	496	1,180	745	2,069	13,745	25,609	25,058	-552
FY31P	9,405	240	127	515	1,224	773	2,138	14,421	26,699	26,119	-580
FY32P	9,939	248	132	534	1,269	801	2,210	15,133	27,839	27,200	-639
FY33P	10,503	257	136	553	1,316	831	2,284	15,881	29,029	28,299	-731
FY34P	11,099	266	142	574	1,365	862	2,361	16,668	30,274	29,415	-859
FY35P	11,720	275	147	595	1,415	893	2,439	17,484	31,557	30,547	-1,011
FY36P	12,367	284	152	616	1,466	925	2,519	18,328	32,878	31,686	-1,192
FY37P	13,039	293	158	638	1,517	958	2,600	19,203	34,238	32,838	-1,400
FY38P	13,737	302	163	660	1,570	991	2,683	20,107	35,636	33,990	-1,647
FY39P	14,460	312	169	683	1,624	1,025	2,766	21,039	37,070	35,152	-1,918
FY40P	15,209	322	175	706	1,679	1,060	2,851	22,001	38,543	36,312	-2,231

Year	Cars	Bus	Minibus	LCV	2-Axle	3-Axle	MAV	Total	Total PCU	CRISIL - Total PCUs	Difference
FY41P	15,985	331	180	730	1,735	1,095	2,938	22,994	40,053	37,480	-2,573
FY42P	16,787	341	186	753	1,792	1,131	3,025	24,016	41,601	38,657	-2,944
FY43P	17,616	351	193	778	1,849	1,168	3,113	25,068	43,187	39,820	-3,367
FY44P	18,472	362	199	802	1,908	1,204	3,203	26,150	44,810	40,982	-3,828
CAGR (FY24-44)	**5.6%**	**3.4%**	**3.7%**	**3.7%**	**3.7%**	**3.7%**	**3.3%**	**4.9%**	**4.2%**	**3.8%**	

Note: *The CAGR given is based on a scenario where there are diversions onto alternative routes

Source: CRISIL MI&A CONSULTING

Table 108: Boharipar - AADT projections as per econometric method (no diversions) for FY24-44

Year	Cars	Bus	Minibus	LCV	2-Axle	3-Axle	MAV	Total	Total PCU	CRISIL - Total PCUs	Difference
FY24E	3,626	173	34	247	739	256	1,191	6,265	12,908	12,908	
FY25P	3,857	179	35	257	770	266	1,235	6,600	13,500	13,588	87
FY26P	4,106	186	37	268	802	277	1,283	6,959	14,131	14,283	151
FY27P	4,371	193	38	279	836	289	1,332	7,338	14,794	14,982	188
FY28P	4,644	201	40	291	870	301	1,381	7,727	15,468	15,698	230
FY29P	4,926	208	41	302	904	313	1,430	8,124	16,151	16,408	257
FY30P	5,204	215	43	313	937	324	1,478	8,515	16,819	17,135	316
FY31P	5,498	222	44	325	972	336	1,528	8,925	17,516	17,878	362
FY32P	5,809	230	46	337	1,007	348	1,579	9,356	18,244	18,638	394
FY33P	6,138	237	48	349	1,044	361	1,631	9,810	19,004	19,414	410
FY34P	6,485	246	50	362	1,083	375	1,686	10,286	19,798	20,206	408
FY35P	6,847	254	51	375	1,122	388	1,742	10,779	20,616	21,012	396
FY36P	7,223	262	53	389	1,162	402	1,798	11,289	21,457	21,826	370
FY37P	7,614	271	55	402	1,203	416	1,856	11,817	22,321	22,653	332
FY38P	8,021	279	57	416	1,245	431	1,914	12,363	23,209	23,483	274
FY39P	8,441	288	59	431	1,287	445	1,974	12,925	24,119	24,325	206
FY40P	8,877	297	61	445	1,331	460	2,034	13,505	25,052	25,167	115
FY41P	9,329	306	63	460	1,375	475	2,095	14,103	26,009	26,020	12
FY42P	9,796	315	65	475	1,419	491	2,157	14,718	26,988	26,884	-105
FY43P	10,278	325	67	490	1,465	507	2,220	15,351	27,991	27,739	-251
FY44P	10,777	334	70	505	1,511	523	2,283	16,002	29,016	28,598	-418
CAGR (FY24-44)	**5.6%**	**3.4%**	**3.7%**	**3.6%**	**3.6%**	**3.6%**	**3.3%**	**4.8%**	**4.1%**	**4.1%**	

Note: *The CAGR given is based on a scenario where there are no diversions.

Source: CRISIL MI&A CONSULTING

Table 109: Historical WPI data (December 2001 to December 2021)

Month-year	All commodities - WPI series (base: FY12)	On-year growth
Dec-2001	55.3	
Dec-2002	57.2	3.3%
Dec-2003	60.5	5.7%
Dec-2004	64.6	6.8%
Dec-2005	67.2	4.1%
Dec-2006	71.9	7.0%
Dec-2007	74.8	4.0%
Dec-2008	79.8	6.7%
Dec-2009	85.5	7.1%
Dec-2010	93.5	9.4%
Dec-2011	100.8	7.7%
Dec-2012	107.1	6.3%
Dec-2013	113.4	5.9%
Dec-2014	112.1	-1.1%
Dec-2015	109.4	-2.4%
Dec-2016	111.7	2.1%
Dec-2017	115.7	3.6%
Dec-2018	119.7	3.5%
Dec-2019	123.0	2.8%
Dec-2020	125.4	2.0%
Dec-2021	143.3	14.3%

Linking factor for WPI (base FY05 to FY12) is 1.561; linking factor for WPI (base FY94 to FY05) is 1.873

Source: Office of the Economic Adviser, CRISIL MI&A CONSULTING

Table 110: Pan-India historical growth rate of various industries

Commodity	Remark
Agri produce	Production (volume terms): CAGR (FY12-22), Rice: ~2.2%, Wheat: ~1.2%, Fruits: ~3.4%,
Iron and steel products	Steel domestic demand growth trend (volume-wise) CAGR (FY17-22) = ~5%
Courier and parcel	Market size of Indian e-commerce industry (value-wise) CAGR (FY19-22) = ~7%
Consumer products	Organised retailing industry market size, value terms CAGR(FY17-22): ~8%
Construction materials	Cement demand in UP and MP (volume terms) CAGR (FY17-22) = ~5-6%
Plastic products	PVC demand (volume terms), CAGR(FY17-22) = ~0-1%
Consumer foods	Organised consumer food industry (value terms), CAGR(FY16-20) = ~14%
Textile and footwear	Domestic readymade garment (value terms), CAGR (FY16-20) = ~5-6%
Automobiles	• Cars & utility vehicles (volume terms), CAGR (FY12-22) = ~1-2%

Commodity	Remark
	• Two-wheeler segment (volume-terms), CAGR (FY17-22) = ~(-5)%
Chemical products	Total chemicals industry (value-terms), CAGR (FY15-20) = ~4%
Tiles and ceramic products	Domestic ceramic tile market (volume terms), CAGR (FY18-21) = ~7%
Paper products	Paper demand (volume terms), CAGR (FY17-22) = ~4-5%
Pharmaceuticals	Domestic formulations (value terms), CAGR (FY17-22) = ~9%
Coal	Non-coking coal domestic consumption (volume terms), CAGR (FY17-22) = ~4%
Rubber products	Tyre demand (volume terms), CAGR (FY17-22) = ~2%
Milk and animal food	Milk production (volume terms), CAGR (FY18-22) = ~7%

Source: MOSPI, CRISIL MI&A CONSULTING

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Final Report
February 2024

Final Report – Kochugaon-Patacharkuchi: Traffic and Revenue Due Diligence

National Highway Infra Investment Managers Private Limited
February 2024
Our ref: 24265607

steer

Final Report
February 2024

Final Report – Kochugaon-Patacharkuchi: Traffic and Revenue Due Diligence

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Appendices

A **Data collection exercise**
B **Traffic and revenue forecasts**
C **Vehicle Classification**
D **Elevation Profile**
E **Current Road Improvement Plans of Falakata- Guwahati section of NH17: NHIDCL (2023)**

Disclaimer

This Report is prepared by Steer Davies & Gleave India Private Limited (the "Traffic Consultant") for the benefit of NHIIMPL (the "Client") solely in its capacity as the Traffic Advisor for the Project Drone (the "Project") pursuant to an engagement letter and related schedules (collectively, the "Agreement"), dated January 8, 2024. This Report, information contained herein, and any statements contained within are all based upon information provided to the Traffic Consultant and obtained from proprietary data purchased or confidential information provided by the Client, from publicly available information or sources, in the course of evaluations of the Project. The Traffic Consultant provides no assurance as to the accuracy of any such third-party information and bears no responsibility for the results of any actions taken on the basis of the third-party information contained in the Report, except to the extent that such actions result from the wilful misconduct, recklessness, fraud or gross negligence of the Traffic Consultant. Certain forward-looking statements are based upon interpretations or assessments of best available information at the time of writing. Actual events may differ from those assumed, and events are subject to change. Findings are time-sensitive and relevant only to current conditions at the time of writing. The Report speak only as of the date of issuance and the Traffic Consultant undertakes no obligation to update the Report for any reason.

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Traffic Consultant developed the relationships in the models used to produce the forecasts for the projects based on data available through November 2023. Since March 2020, the outbreak of the virus known as COVID- 19 has spread throughout the world and has been defined by the World Health Organization as a "pandemic". The COVID-19 outbreak had a material impact on global economic and political affairs including having a significant impact on all the transportation industries, including toll road traffic, where in particular vehicle volumes fell in response to quarantine and self-care measures that governments imposed as a response to the different waves of infection rates in different parts of the country.

As of the date of distribution of this Report, the COVID-19 outbreak is continuing to have a material and uncertain impact on economic and political affairs in some jurisdictions, which may have a significant impact on the transportation sector including the actual usage of tolled highways. In such jurisdictions, these factors may introduce additional uncertainty into forward looking outputs included in our Report. Further, there are a wide range of views by authoritative sources concerning future travel patterns post-COVID, which adds uncertainty to forecasting in this regard.

As a result, no assurance can be provided by Traffic Consultant that the scenarios and assumptions Traffic Consultant has identified will prove to be accurate. Given the uncertainty

inherent in this unprecedented pandemic, Traffic Consultant advises that all readers of the Reports consider the Reports in the context of their own assessment of the impact of COVID19 on travel patterns post-COVID.

TO THE FULLEST EXTENT PERMITTED BY APPLICABLE LAW, THE LIABILITY OF THE TRAFFIC CONSULTANT FOR ANY LOSS, DAMAGE, COST OR EXPENSE SUFFERED OR INCURRED BY ALL PERSONS OR ENTITIES AND FOR ALL CLAIMS RESPECTING ITS WORK PERFORMED IN CONNECTION WITH THE ISSUE OR THE REPORTS IS HEREBY LIMITED IN THE AGGREGATE TO THE AMOUNT OF FEES ACTUALLY PAID BY THE CLIENT TO THE TRAFFIC CONSULTANT IN RESPECT OF THE REPORTS AND CONNECTED SERVICES.

Glossary Items

Acronym	Meaning
AADT	Annual Average Daily Traffic
ADT	Average Daily Traffic
CAGR	Compound Annual Growth Rate
CJV	Cars / Jeeps / Vans
COD	Commercial Operations Date
DPR	Detailed Project Report
ETC	Electronic Toll Collection
FY	Financial Year
GDP	Gross Domestic Product
GJC	Generalised Journey Cost
GSDP	Gross State Domestic Product
HCM	Heavy Commercial Vehicles
IAOI	Immediate Area of Influence
LCV	Light Commercial Vehicles
LoS	Level of Service
MAV	Multi Axle Vehicle
MLCV	Mini LCV
NE	National Expressway
NH	National Highway
NHAI	National Highways Authority of India
NHDP	National Highways Development Project
NSDP	Net State Domestic Product
NHIDCL	National Highway Infrastructure and Development Corporation Limited
OD	Origin Destination
PCI	Per Capita Income
PCOD	Partial Commercial Operations Date
PCU	Passenger Car Unit
RNP	Registered Number Plate
RoS	Rest of State
SCF	Seasonality Correction Factors
SH	State Highway
T&R	Traffic and Revenue

Acronym	Meaning
TMS	Traffic Management System
TP	Toll plaza
TVC	Traffic Volume Count
VOC	Vehicle Operating Costs
VOT	Value of Time
WADT	Weekly Average Daily Traffic
YTD	Year to Date

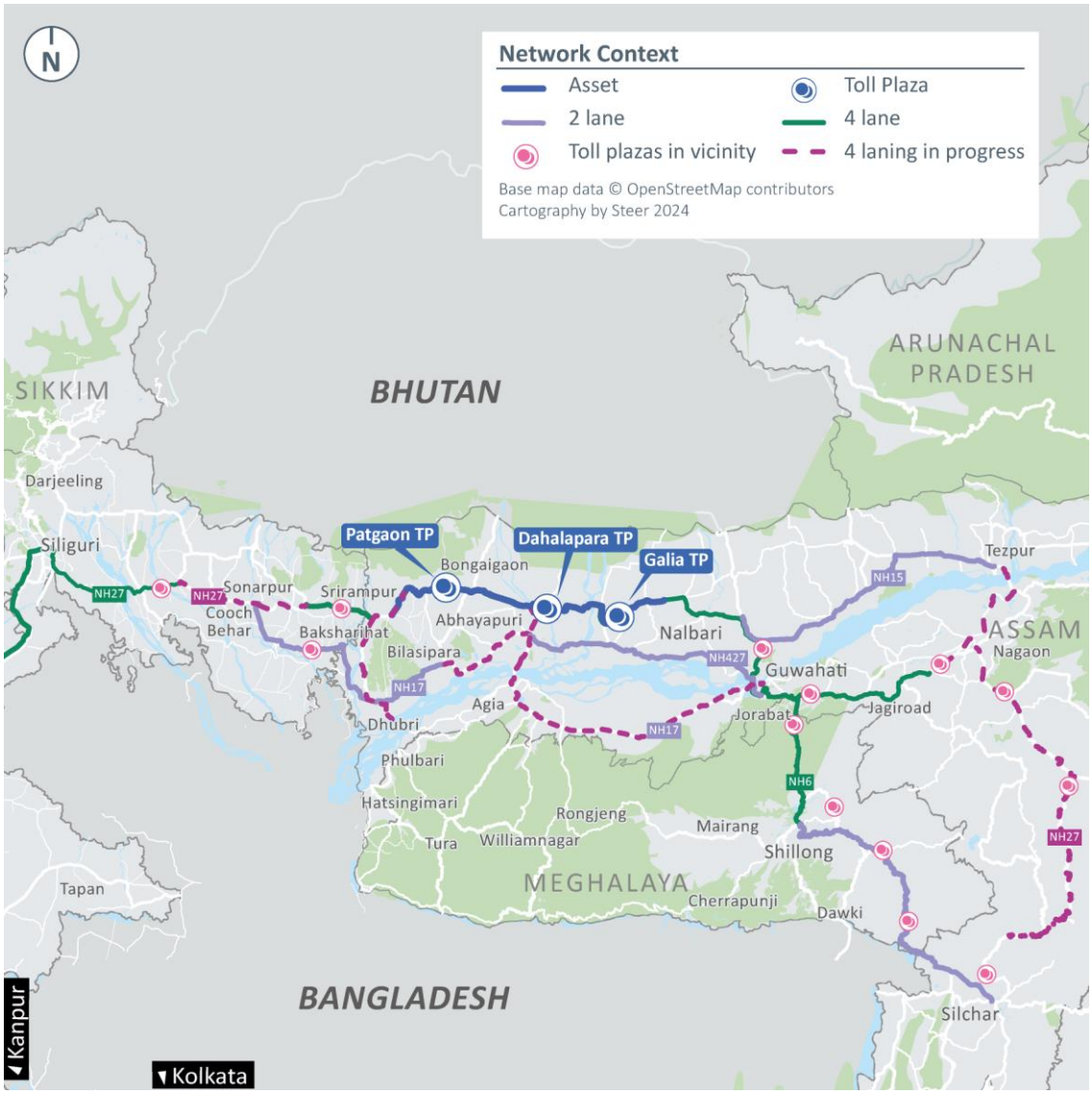
Executive Summary

Project overview

The Asset is located on the National Highway (NH) 27, the east-west corridor of India. The highway starts in Porbandar in Gujarat and ends in Silchar in Assam and passes though the states of Gujarat, Rajasthan, Madhya Pradesh, Uttar Pradesh, Bihar, West Bengal, and Assam.

The Asset consists of three toll plazas namely Patgaon (at KM 49+600, located 215km west of Guwahati), Dahalapara (at KM 971+200, located 160km west of Guwahati) and Galia (at KM 1017+350, located 120km west of Guwahati), as shown in the map below.

Figure: Asset context



Source: Steer cartography using OpenStreetMap data

Salient growth features and traffic generators

The Asset is located in the state of Assam, which is the most industrialized state within northeast (NE) India. The growth observed in NE region is largely driven by the state of Assam

which contributes ~ 65% to the region's economy. Some of the key industries in Assam include oil and gas, limestone and cement, and coal.

The Asset located on NH27, the east-west corridor of India, is connected via the Siliguri corridor, also called the Chicken Neck. The Siliguri Corridor and the Asset connects the seven states of northeast India to the rest of India. The Asset acts as a feeder for the NE India and caters to the long-distance traffic entering the region via Assam.

No major urban settlements are present near the Asset. Guwahati, one of the largest settlements in the northeast region, is located ~185 km from the Asset. It is a key manufacturing and industrial centre of the region and is home to numerous warehouse and storage depots. The traffic from rest of the country uses the Asset to reach Guwahati from where it is distributed to rest of northeast India, with Guwahati acting as a sink and as a source.

The north-eastern states of India, being consumption based in nature, depend heavily on the rest of India for their consumption needs. The commodities from West Bengal, central India, and north India are transported to the warehouses of Guwahati via the Asset, from where these goods are redistributed to the rest of northeast region. Key commodities observed are groceries, manufactured goods, industrial equipment, parcels and couriers, petroleum products etc. From Guwahati and rest of northeast region, trucks carry cement (from Jagiroad, Morigaon), petroleum products (from refineries in Bongaigaon, Guwahati), bamboo, tea, rubber, and groceries to the rest of country.

The state is famous for its tea cultivation and accounts for approximately half of India's tea production. Apart from tea cultivation, the state is also a major producer of rice, horticulture crops (mango, banana), spices (cardamom, ginger, and turmeric).

Assam is a major producer of crude oil and natural gas in India. Most of the oilfields in state are located in the upper Assan region with the refineries being located in Guwahati, Digboi, Numaligarh and Bongaigaon. Indian Oil Corporation Limited (IOCL) refinery at Bongaigaon is located on the Asset between Patgaon and Dahalapara plazas.

High-grade fossil limestone (Sylhet limestone) is found in Garo and Khasi hills of Assam and is majorly used for production of cement. The availability of raw material has facilitated the setting up of large cement industries in Assam. Guwahati/Kamrup district is home to the large-scale industries of Purbanchal Cement, Topcem Cement, Star Cement, Dalmia Cement etc.

Traffic volume and composite of vehicles

Historical traffic data

ETC daily-level data, segmented with ticket categories, was available from December 2021 – November 2023 for Patgaon, from November 2021 – November 2023 for Dahalapara and from November 2021 – November 2023 for Galia. For Patgaon and Dahalapara, FY23 PCU is trending at 15,361 and 18,884 which grows to 15,932 and 18,937 in 8 months of FY24YTD. FY23 PCU at Galia is 19, 617 while 8 months FY24YTD is 19,102.

The revenue collection for FY23 is INR 61 Cr and INR 63 Cr for Patgaon and Dahalapara respectively. For FY24 YTD (Apr-Nov'23) it is INR 44 Cr and INR 43.5 Cr for Patgaon and Dahalapara respectively. For FY23, ETC collection including cash collection reported by Schedule V is INR 35Cr which for first 8 months of FY24 (Apr-Nov'23) is INR 23.7Cr at Galia.

Figure: MADT, PCU Patgaon

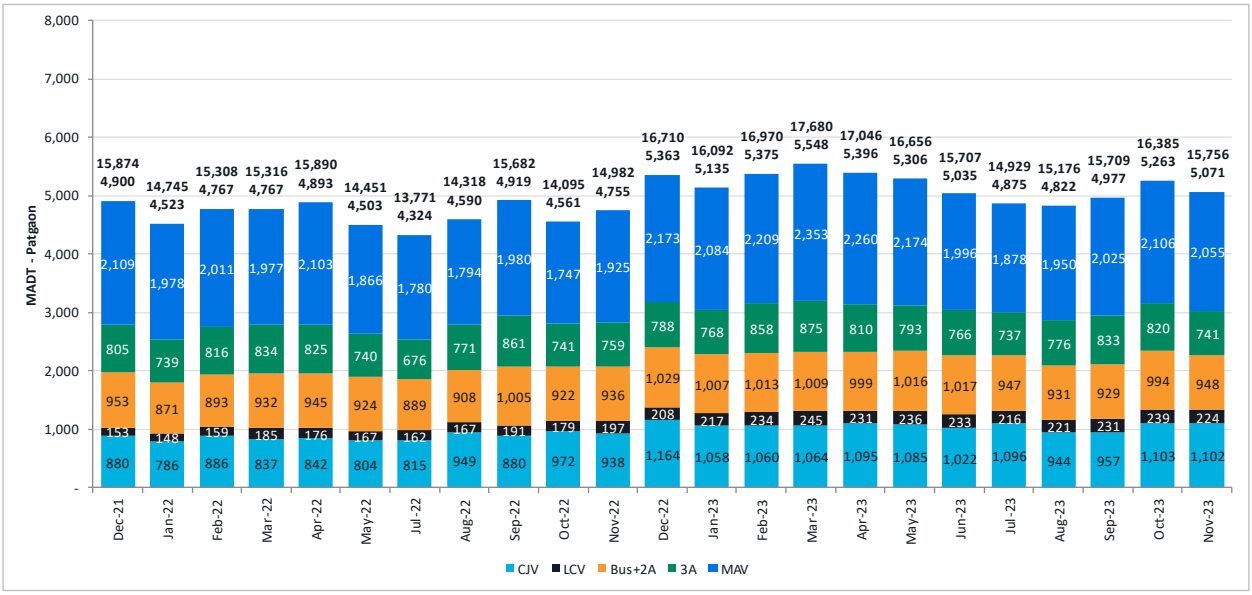


Figure: MADT, PCU Dahalapara

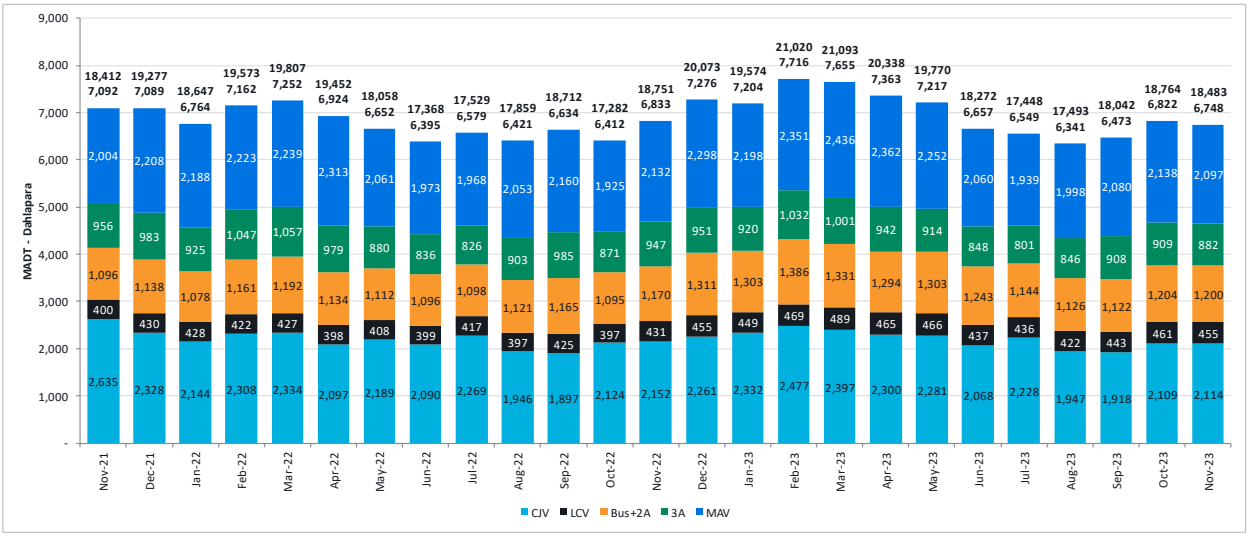
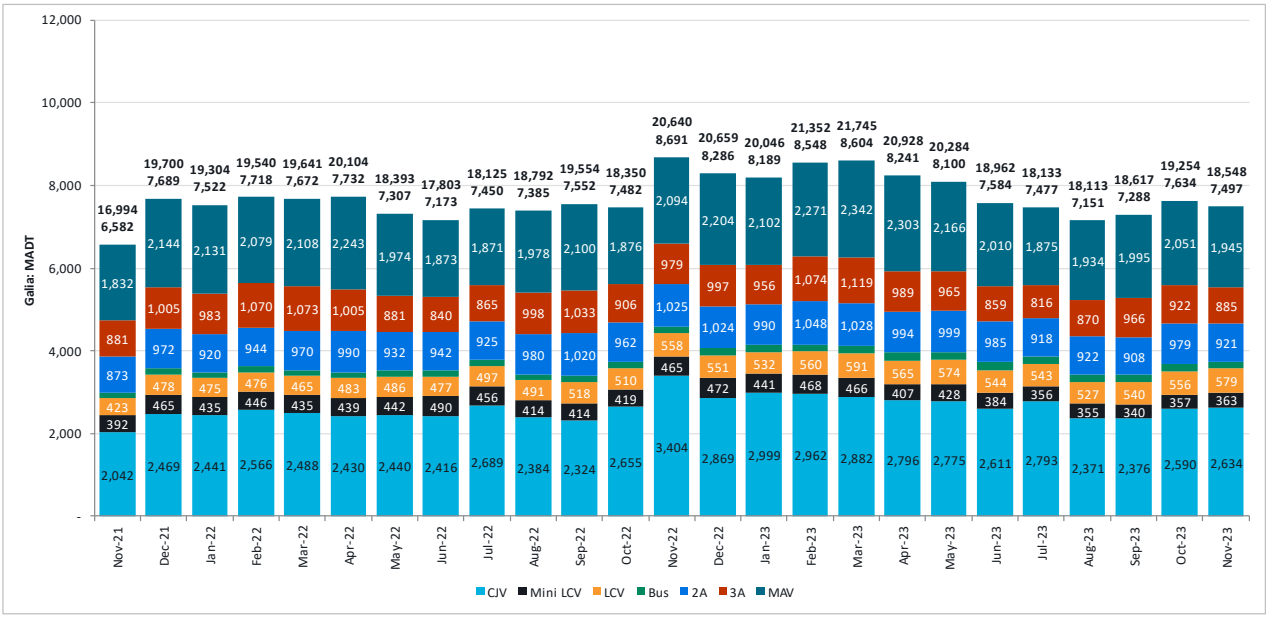


Figure: MADT, PCU Galia



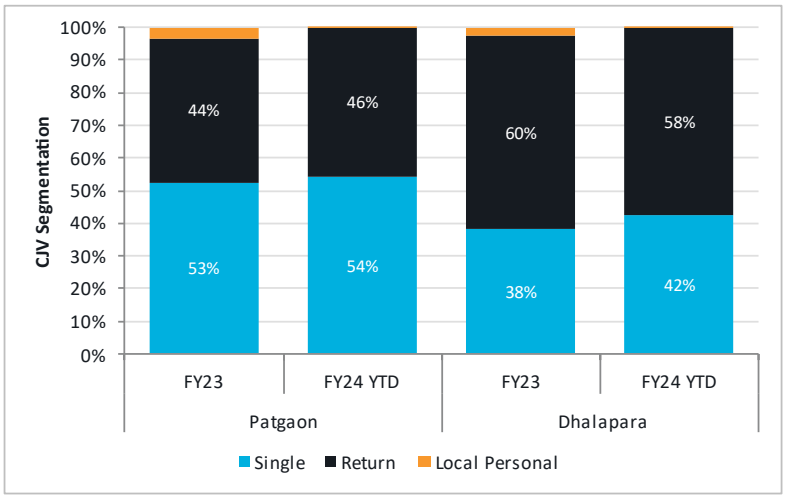
Source: Steer analysis

Toll segmentation

On the Asset, CJV ticket segmentation observes a healthy share of 'return' trips due to the local nature of movement. This is observed across all three toll plazas on the Asset.

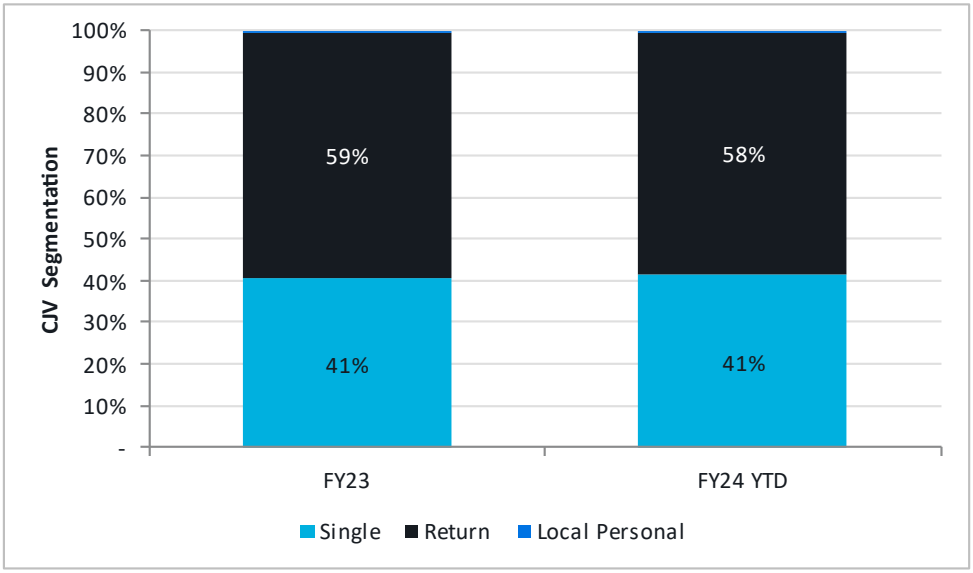
The majority of MAV traffic at Patgaon, Dahalapara and Galia is long-distance traffic which has one end in Guwahati/northeast and the other in the rest of the country (west of Patgaon). Patgaon has higher influence of long-distance traffic originating from West Bengal/Bihar and North India. Whereas moving east towards the Asset the influence of local traffic from Bongaigaon, Barpeta, Pathshala, Howly increases which is visible on Dahalapara and Galia. Overall, the travel patterns remain similar on all these plazas.

Figure: Segmentation CJV- Patgaon, Dahalapara



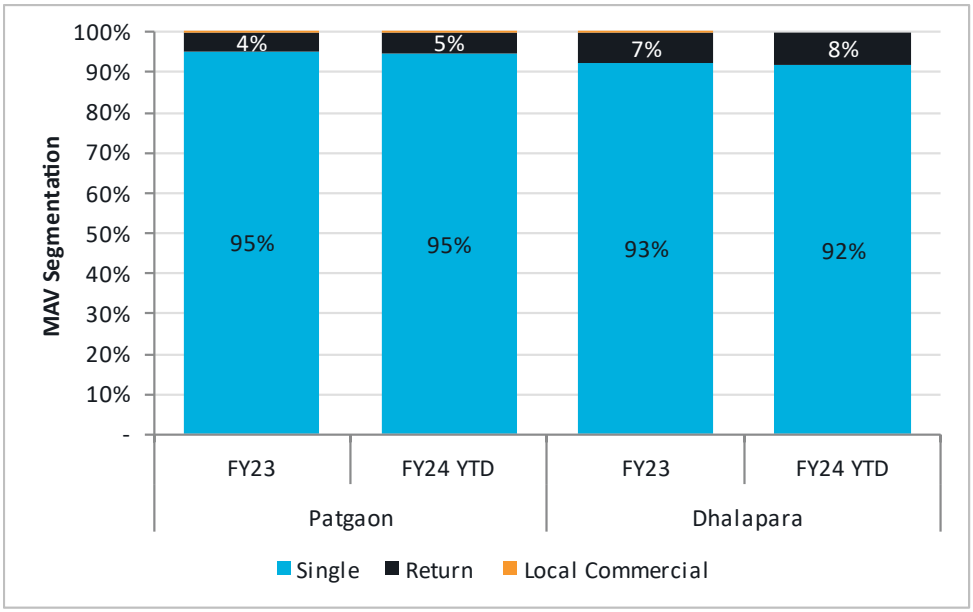
Source: Steer analysis

Figure: Segmentation CJV- Galia



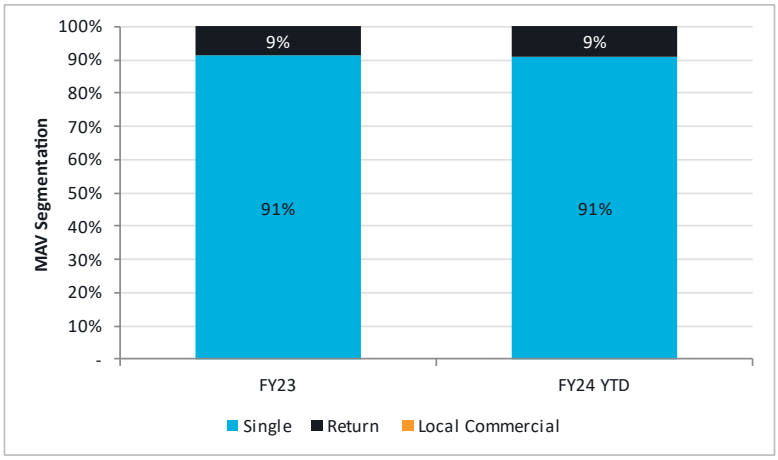
Source: Steer analysis

Figure: Segmentation MAV- Patgaon, Dahalapara



Source: Steer analysis

Figure: Segmentation MAV- Galia



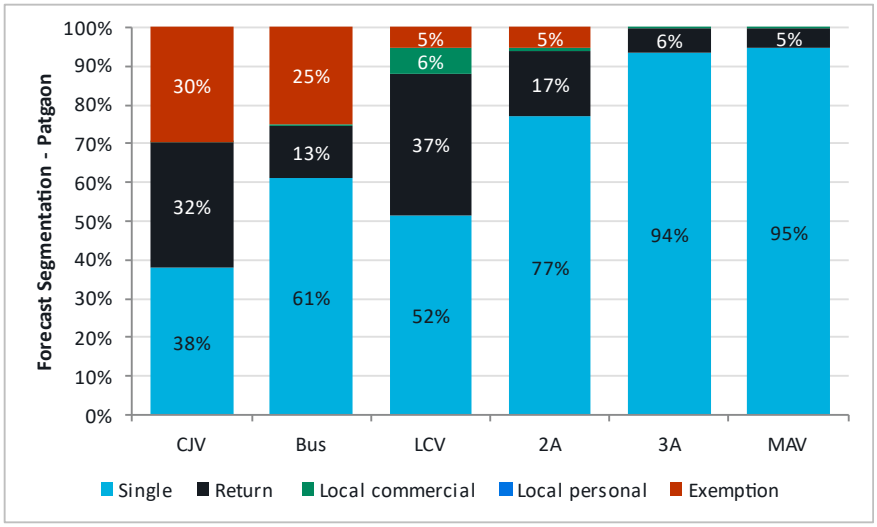
Source: Steer analysis

However, as the above-mentioned segmentation is sourced from the ETC (segmented) dataset Patgaon and Dahalapara the segmentation doesn't include information regarding cash/monthly pass-based trips and exemptions. Therefore, the difference between ETC (segmented) and TMS dataset is added (as a % of ETC traffic) as cash (single) and monthly pass-based trips. It should be noted that the TMS data had information regarding the number cash-based and the number of monthly passes sold per day.

While for Galia cash transactions at monthly were already provided. Additionally, for exemptions the difference between TVC and ETC dataset is added (as a % of ETC traffic) in the final adopted segmentation as non-paying traffic.

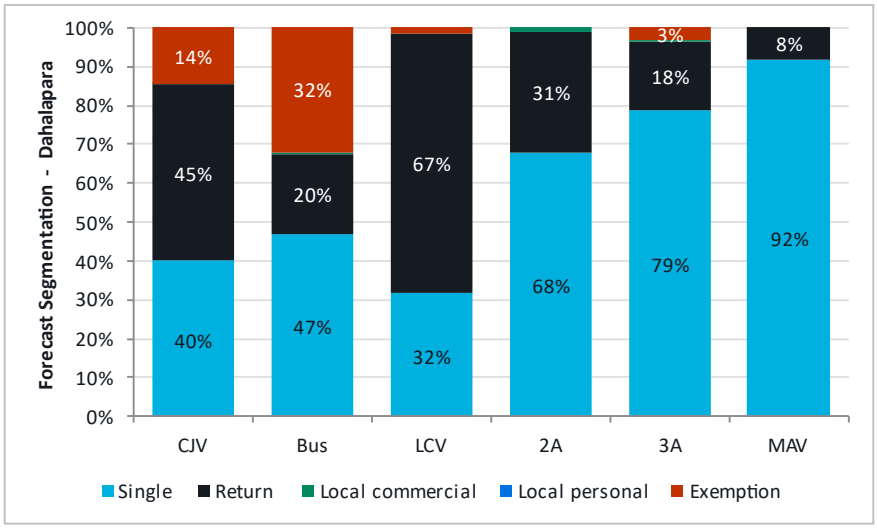
The adopted segmentation of FY24YTD is shown in the charts below. We have assumed the forecast segmentation to remain same across the concession life.

Figure: Toll segmentation (%) FY24 onwards– Patgaon



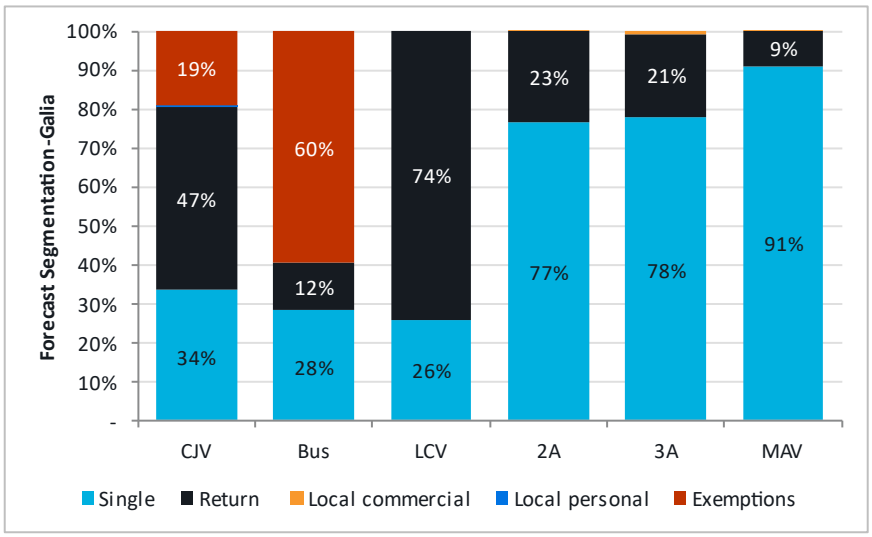
Source: Steer analysis

Figure: Toll segmentation (%) FY24 onwards– Dahalapara



Source: Steer analysis

Figure: Toll segmentation (%) FY24 onwards– Galia



Source: Steer analysis

Traffic forecast

The increase of traffic on any existing road alignment depends on how fast the background travel demand (background growth) will grow; and on how successfully the project road is in attracting that traffic (traffic capture). Background travel demand is driven by the prevalent socio-economic conditions in the region, which include:

- Changes in factors such as population, employment, and income distribution
- Economic growth (GSDP, and GDP).
- Growth of local industries near the Asset.

The model uses India GDP and Assam GSDP as the two macro-economic inputs which operate as growth drivers on our base year forecasts.

The network developments near the Asset's alignment which Steer believes would affect traffic on the Asset during the concession period are 4 Laning of NH17 (Hapachara to VIP Chowk) +New Goalpara bridge, Guwahati Ring Road, Flyover construction (Passenger), 4 laning of NH127B + Phulbari bridge and 4-laning of West Bengal Section (Cooch Bihar to Bilasparia to Guwahati).

Steer has developed traffic and revenue forecasts for the Asset by taking into consideration all inputs discussed above – base year estimates, macro-economic assumptions, growth drivers, elasticities, and forecast ticket segmentation. The table below provides the final (background plus impacts) traffic growth on the Asset.

Table: Final (background plus impacts) AADT forecast – Patgaon

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
CJV	1,331	1,417	1,515	1,937	2,581	3,384	4,341
Mini LCV	314	320	327	352	384	418	451
Bus	133	135	138	147	158	169	180
LCV	265	270	276	297	324	351	379
2A	954	991	1,031	1,113	1,322	1,554	1,803
3A	807	827	850	893	1,002	1,117	1,234
MAV	2,178	2,297	2,429	2,768	3,529	4,437	5,477
OSV	2	2	2	2	3	3	4
AADT	**5,985**	**6,259**	**6,566**	**7,510**	**9,303**	**11,433**	**13,868**
PCU's	**17,536**	**18,345**	**19,249**	**21,661**	**26,789**	**32,828**	**39,675**

Table: Final (background plus impacts) AADT CAGR (%) – Patgaon

Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FY30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
CJV	6.4%	6.9%	6.3%	5.9%	5.6%	5.1%	5.8%
Mini LCV	1.9%	2.1%	1.9%	1.8%	1.7%	1.5%	1.7%
Bus	1.6%	1.7%	1.6%	1.5%	1.4%	1.3%	1.4%
LCV	1.9%	2.0%	1.9%	1.7%	1.6%	1.5%	1.7%
2A	3.8%	4.1%	1.9%	3.5%	3.3%	3.0%	3.1%
3A	2.5%	2.7%	1.3%	2.3%	2.2%	2.0%	2.0%
MAV	5.4%	5.8%	3.3%	5.0%	4.7%	4.3%	4.5%
OSV	5.5%	5.8%	5.4%	5.0%	4.7%	4.3%	4.9%
AADT	**4.6%**	**4.9%**	**3.4%**	**4.4%**	**4.2%**	**3.9%**	**4.1%**
PCU's	**4.6%**	**4.9%**	**3.0%**	**4.3%**	**4.1%**	**3.9%**	**4.0%**

Source: Steer analysis

Table: Final (background plus impacts) AADT forecast – Dahalapara

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
CJV	2,382	2,454	2,710	3,466	4,619	6,055	7,768
Mini LCV	460	464	479	517	564	613	661
Bus	231	235	239	254	274	293	313
LCV	495	504	515	549	599	649	700
2A	1,129	1,172	1,219	1,250	1,483	1,744	2,024
3A	938	962	988	934	1,048	1,168	1,291
MAV	2,200	2,320	2,454	2,602	3,317	4,170	5,147
OSV	1	1	1	2	2	3	3
AADT	**7,837**	**8,112**	**8,605**	**9,573**	**11,905**	**14,695**	**17,906**
PCU's	**20,386**	**21,225**	**22,348**	**23,836**	**29,431**	**36,034**	**43,536**

Source: Steer analysis

Table: Final (background plus impacts) AADT CAGR (%) – Dahalapara

Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FY30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
CJV	3.0%	10.4%	6.3%	5.9%	5.6%	5.1%	5.8%
Mini LCV	0.8%	3.2%	1.9%	1.8%	1.7%	1.5%	1.7%
Bus	1.6%	1.7%	1.6%	1.5%	1.4%	1.3%	1.4%
LCV	1.9%	2.0%	1.6%	1.7%	1.6%	1.5%	1.7%
2A	3.8%	4.1%	0.6%	3.5%	3.3%	3.0%	2.8%
3A	2.5%	2.7%	(1.4%)	2.3%	2.2%	2.0%	1.5%
MAV	5.4%	5.8%	1.5%	5.0%	4.7%	4.3%	4.1%
OSV	5.5%	5.8%	5.4%	5.0%	4.7%	4.3%	4.9%
AADT	**3.5%**	**6.1%**	**2.7%**	**4.5%**	**4.3%**	**4.0%**	**4.0%**
PCU's	**4.1%**	**5.3%**	**1.6%**	**4.3%**	**4.1%**	**3.9%**	**3.7%**

Source: Steer analysis

Table: Final (background plus impacts) AADT forecast – Galia

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
CJV	3,385	3,489	3,851	4,925	6,563	8,604	11,038
Mini LCV	392	394	405	431	464	497	530
LCV	574	585	597	644	703	764	824
Bus	465	474	483	521	569	618	667
2A	970	1,007	1,048	1,066	1,266	1,489	1,729
3A	941	965	991	956	1,072	1,195	1,320
MAV	2,113	2,227	2,354	2,436	3,099	3,890	4,794
OSV	2	2	2	2	3	3	4
AADT	**8,842**	**9,143**	**9,733**	**10,981**	**13,740**	**17,060**	**20,906**
PCU's	**21,283**	**22,128**	**23,324**	**24,922**	**30,764**	**37,673**	**45,542**

Source: Steer analysis

Table: Final (background plus impacts) AADT CAGR (%) – Galia

Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FY30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
CJV	3.1%	10.4%	6.3%	5.9%	5.6%	5.1%	5.8%
Mini LCV	0.6%	2.7%	1.6%	1.5%	1.4%	1.3%	1.4%
LCV	1.9%	2.1%	1.9%	1.8%	1.7%	1.5%	1.7%
Bus	1.9%	2.1%	1.9%	1.8%	1.7%	1.5%	1.7%
2A	3.8%	4.1%	0.4%	3.5%	3.3%	3.0%	2.8%
3A	2.5%	2.7%	(0.9%)	2.3%	2.2%	2.0%	1.6%
MAV	5.4%	5.7%	0.9%	4.9%	4.6%	4.3%	4.0%
OSV	5.4%	5.7%	5.3%	4.9%	4.6%	4.3%	4.8%
AADT	**3.4%**	**6.4%**	**3.1%**	**4.6%**	**4.4%**	**4.1%**	**4.2%**
PCU's	**4.0%**	**5.4%**	**1.7%**	**4.3%**	**4.1%**	**3.9%**	**3.7%**

Source: Steer analysis

Toll Rates

In India, toll rates are as per notification by the Ministry of Road Transport and Highways in the National Gazette. The present toll rates are determined with reference to the published base toll rates and are adjusted annually at the beginning of each fiscal year equal to 40% of the movement in the wholesale price index in December of the preceding year plus a fixed 3%.

According to the NHAI's toll notification for FY24, i.e., April 1, 2023, onwards, the toll rates at the toll plazas for Asset are as follows:

Table: FY24 single toll rates Patgaon, Dahalapara and Galia

Type of Vehicle	Patgaon	Dahalapara	Galia
CJV	100	90	45
LCV	165	145	75
Bus/Truck	340	300	155
3A	370	325	170
MAV/ HCM/EME	535	470	245

Source: NHAI Revision of User fee Rate w.e.f 01.04.2023

1 Introduction

1.1 The National Highways Authority of India (**'NHAI'**) has set up an Infrastructure Investment Trust ('**InvIT**') named as National Highways Infra Trust and is acting as its Sponsor to the said InvIT. The National Highways Infra Investment Managers Private Limited (NHIIMPL) has been incorporated and appointed as the Investment Manager for the proposed InvIT by NHAI.

1.2 The National Highways Infra Investment Managers Private Limited (**'NHIIMPL'** or the '**Client'**) has commissioned Steer Davies Gleave India Private Limited (hereafter called '**Steer**') for a traffic assessment study of the Kochugaon – Kaljhar-Patacharkuchi section **('Asset')** on NH27 in the state of Assam**.** The Asset includes a total of three toll plazas: Patgaon, Dahalapara and Galia.

Table 1.1 Description of Assets

Asset ID	A1	A2
Asset name	Kochugaon – Kaljhar	Kaljhar-Patacharkuchi
State	Assam	Assam
Existing Tollable Length (km)	• Patgaon: 70.402 Km • Dahalapara: 61.760 Km	Galia: 32.349 Km
Chainage	NH27: KM 30+000 – KM 92+671, KM 961+500 – KM 1013+000	KM 1013+000 – KM 1040+300
No. of toll plazas	2	1
Toll plaza locations	• Patgaon: KM 49+600 • Dahalapara: KM 971+200	• Galia: KM 1017+350
Operating since	• Patgaon: February 2020 • Dahalapara: January 2020	• Galia: November 2021
Proposed concession period	20 years	20 years

Source: NHAI

Scope of work

1.3 Our scope of work for carrying out a traffic and revenue due diligence exercise covered:

- Review of available data, concession agreements and bid documents.
- Primary traffic survey and analysis as per the schedule presented in the table below.
  - 1 week video based classified traffic volume count (TVC) in October 2023 for Galia and in January 2024 for Patgaon and Dahalapara.
  - 24 hours origin-destination (OD) survey and commodity analysis in October 2023 for Galia and in January 2024 for Patgaon and Dahalapara.

- Assembly of the toll plaza level base data from Project implementation Unit (PIU), where available, and review of the recent growth trends.
- Identify appropriate benchmarks for historical performance, seasonality, and ticket type segmentation for the Asset.
- Estimate the base traffic and revenue position utilising the above information.
- Establishing traffic growth estimates based on key economic growth drivers such as Gross Domestic Product (GDP), as Gross State Domestic Product (GSDP), commodity, etc. and estimating underlying growth elasticities based on these growth drivers.
- Assessing impacts from exogenous factors, including network change impacts.
- Developing traffic forecasts by vehicle class and segmentation categories; and
- Toll revenue estimation for the concession period.

Table 1.1: Data collection schedule

	Patgaon	Dahalapara	Galia
7-day TVC survey	05th – 11th Jan 2024 **Dudhnoi NH17** – 06th – 12th Jan, 2024		14th – 20th Oct, 2023
3-day TMC survey			**Abhaypuri, Dudhnoi** – 14th - 20th Oct, 2023
1 day OD survey	05th - 06th Jan, 2024	05th - 06th Jan, 2024	17th Oct'23 (24 hrs)
1-day Open OD	**NH17 (Agia-Boko)** - 06th Jan'24 (24 hrs)		-

Source: Steer

Our approach

1.4 The approach employed by Steer in the preparation of the traffic and revenue forecasts was developed to take advantage of the existing knowledge of the Asset and of the available data. We follow well established practices in addressing the issue of forecasting on-going traffic growth on a brownfield project. The key difference in this exercise as compared to a typical secondary market transaction, where the vendor provides detailed information on the historical performance of their asset, is that the historical traffic and revenue information provided by the client was limited and therefore less reliable than what could be expected. Significant efforts had to be put into developing a credible base year position and growth expectations through benchmarking with other asset in close vicinity of the Asset under consideration.

1.5 The analysis focused on two sets of issues:

- understanding and verifying the traffic which is, at present, using the Asset; and
- identifying how and why that traffic will change in the future.

1.6 Regarding the former (i.e., current traffic on the Asset), independent primary data collection was commissioned as part of this study and then compared against the available traffic data from various sources to validate the data available.

1.7 To arrive at the base position, we have utilised information from various sources – toll plaza data shared by the NHAI and the client, and Steer independent primary surveys and site visits to validate our network and contextual understanding. This helped to assess a reasonable demand on the corridor for the base year which formed the basis of future year forecasts.

1.8 A base year revenue validation exercise has been undertaken to ensure both base traffic and segmentation assumptions are robust.

1.9 The estimation of future traffic demand on the Asset is driven by:

- Growth of 'background' traffic: this depends to a certain extent on the on-going socio-economic and demographic development of the area served by the Asset.
- Change in the local and national industry: which drives heavy goods traffic on the Asset; and
- Change in the competitive position of the Asset: this reflects changes in highway capacity of competing roads and the relative changes in service levels (time, congestion, price, etc.) for the Asset, and their competitors.

1.10 We have analysed traffic data from multiple independent sources as well to understand the current traffic on the Asset. The list of data sources available and discussed in later chapters in detail are presented below:

Table 1.2: List of data sources available

Particulars	Frequency	Ticket-segmentation	Period	Overlap with Steer TVC
ETC – Segmented (used for base traffic estimation)	Daily	Available	**Patgaon:** Dec'21 – Nov'23 **Dahalapara:** Nov'21 – Nov'23	No
			Galia: Nov'21 – Nov'23	Yes
ETC – Totals	Daily	Not available	**Patgaon:** Feb'20 – Oct'22 **Dahalapara:** Jan'21 – Nov'22 (excluding Jul-Aug'20)	No
TMS	Daily	Available	**Patgaon:** Not available **Dahalapara:** Dec'22	No
IHMCL counts	Point-in-time weekly counts	Not available	Point-in-time counts from FY15-FY20	No
Schedule M	Monthly	Not available	**Galia:** Mar'22- Nov'23	Yes

Source: Steer's review of data points

1.11 The datasets mentioned in the above table are explained below:

- **ETC (segmented)**: ETC daily-level data, segmented with ticket categories, was available from Nov/Dec'21 – Nov'23. The dataset doesn't include information regarding cash-based trips, pass-based trips, and exemptions.
- **ETC (totals)**: ETC monthly-level data, without segmentation with ticket categories, was available from Apr'21 to Nov'23. The traffic in this dataset was in line with the traffic reported in ETC (segmented) dataset for the common months. Therefore, on Patgaon and Dahalapara the splits for Bus/2A category in the base traffic estimation were referred to from this dataset as the same wasn't available in the ETC (segmented) dataset.
- **TMS**: Daily level toll plaza data was available for Dahalapara for Dec'22. This was compared with ETC (segmented) data to get information regarding cash-based and local

pass-based trips. Cash traffic data for Galia was available from Mar'22 to Nov'23 at vehicle category level.

- **IHMCL**: The IHMCL counts reported for the Asset are available for varied timeframe for each of the toll plaza.

Contents of this Report

1.1 The report has been divided into 6 chapters, including.

- Chapter 2 describes the key characteristics of the Assets and its surrounding road network, primarily based on site visits.
- Chapter 3 presents analysis of historical data and data collected through primary surveys.
- Chapter 4 discusses the socio-economic context in the corridors containing the Asset.
- Chapter 5 presents our base year traffic estimates and our approach and results on estimating background traffic demand growth; and
- Chapter 6 summarises our key forecasting assumptions, assessment of network impacts, and presents our traffic and revenue forecasts for the Asset.

2 The Asset

Introduction

2.1 This chapter provides a description of the Asset, based on primary data (from site visits), our understanding of the region and network surrounding the Asset. We cover the strategic network context, followed by key economic activities and network developments around the Assets.

Figure 2.1: Asset location

Source: Steer cartography

Asset context

A1: Kochugaon – Kaljhar

2.2 The Asset is a 114.17 km four-lane road, forming part of NH27 in the state of Assam. The NH27, east-west corridor of India, starts in Porbandar in Gujarat and ends in Silchar in Assam. The 3,507 km long highway passes though the states of Gujarat, Rajasthan, Madhya Pradesh, Uttar Pradesh, Bihar, West Bengal, and Assam.

2.3 The Asset is located in Assam which forms part of the northeast (NE) India region. The Asset acts as a key connector between the NE India and the rest of India. The traffic enters the NE region mainly via NH27 to reach Guwahati from where it is redistributed to the respective destinations.

2.4 There are two toll plazas on the Asset and are located between Siliguri and Guwahati as shown in the map below:

- Patgaon: KM 49+600
- Dahalapara: KM 971+200

A2: Kaljhar to Patacharkuchi

2.5 The Asset is located on NH27, the east-west corridor of India. The highway starts in Porbandar in Gujarat and ends in Silchar in Assam and passes though the states of Gujarat, Rajasthan, Madhya Pradesh, Uttar Pradesh, Bihar, West Bengal, Assam. Out of the total length of 3,507 km of the highway, ~27 km of the length is under our Asset.

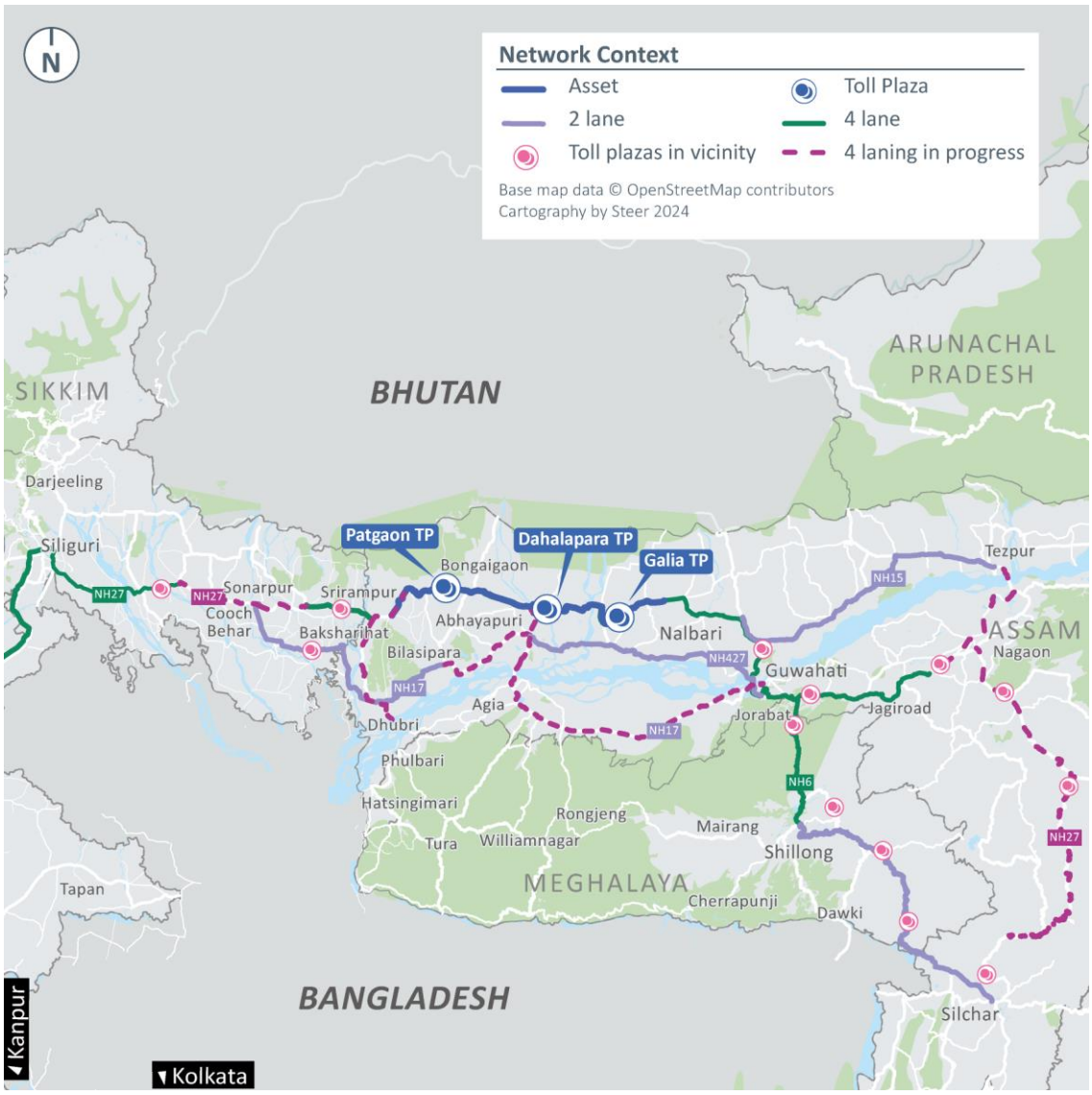
2.6 The Asset consists of the following toll plaza:

- **Galia**: KM 1017+350 (located 120km west of Guwahati)

2.7 The Asset acts as key connector between the northeastern states and the rest of India. The traffic enters the northeastern region mainly via NH27 to reach Guwahati and then being redistributed to the respective destinations.

- Guwahati, the biggest city of the northeast India, is also the most populous city in Assam with a population of ~1 million. It is also a key manufacturing and warehousing center and is home to industries in numerous sectors. The traffic from rest of the country uses the Asset to reach Guwahati from where it is distributed to rest of northeast India, with Guwahati acting as a sink and source.

Figure 2.2 Asset context



Source: Steer cartography using OpenStreetMap data

Concession details

2.8 The concession details of the Asset are shown in the table below. The tolling lengths of the toll plazas are being referred to from the revised Schedule M.

Table 2.1: Concession details

Asset ID	A1	A2
Asset name	Kochugaon – Kaljhar	Kaljhar - Patacharkuchi
State	Assam	Assam
Chainage	• Patgaon: KM 30+000 – KM 92+671 • Dahalapara: KM 961+500 – KM 1013+000	• Galia: KM 1013+000 – KM 1040+300
No. of toll plazas	2	1
Toll plaza locations	• Patgaon: KM 49+600	• Galia: KM 1017+350

Asset ID	A1	A2
	• Dahalapara: KM 971+200	
Operating since	• Patgaon: February 2020 • Dahalapara: January 2020	• Galia: November 2021
Proposed concession period	20 years	20 years
Road Length (km)	• Patgaon: 61.812 km • Dahalapara: 50.360 km	• Galia: 27.300 km
Existing tollable length	• Patgaon: 70.402 km (Road 61.812 km; Structure 0.859 km) • Dahalapara: 61.760 km (Road 50.360 km; Structure 1.140 km)	• Galia: 32.349 km (Road: 27.300 km; Structure 0.561km)
During construction tollable length	• Patgaon: 70.402 km (Road 61.812 km; Structure 0.859 km) • Dahalapara: 61.760 km (Road 50.360 km; Structure 1.140 km)	• Galia: 32.349 km (Road: 27.300 km; Structure 0.561km)
Post construction tollable length	• Patgaon: 71.203 km (Road 61.723 km; Structure 0.948 km) • Dahalapara: 62.705 km (Road 50.255 km; Structure 1.245 km)	• Galia: 33.249 km (Road: 27.300 km; Structure: 0.661 km)

Source: Review of concession documents

2.9 As seen in the table above, the increase in tollable lengths for all three plazas is due to construction of new flyovers on the Asset. According to the Schedule M, the tentative completion of construction on the Asset is August 2024. The same is explained in detail in Chapter 6.

Toll plaza details

2.10 Patgaon toll plaza has 3+3 lane configuration, Dahalapara toll plaza has 5+5 lane configuration and Galia has 3+3 lane configuration on each side for FASTag collection on all lanes except the end lanes.

2.11 The road users having valid FASTag installed on their respective vehicles approach the ETC lanes where the installed Radio-Frequency Identification (RFID) readers detect the tag and deduct toll charges equalling single trip or for Local/monthly pass/discounts wherever applicable. In case, the RFID reader is not able to detect the FASTag, handheld devices are used to read the vehicle's tag. Further, in cases where FASTag is blacklisted or not working, the

user can only buy single cash ticket and are charged twice the single trip fare. The users crossing toll plaza twice within 24 hours automatically get return discount.

2.12 Like the other National Highway plazas, the Asset has Single, Return, Local Commercial, Local Personal, and Monthly tickets. Single toll rates for each vehicle categories on each of the toll plaza for FY23 are presented in the table below.

Table 2.2: Single toll rates on the Asset (INR), applicable April 2023 to March 2024

Type of Vehicle	Patgaon	Dahalapara	Galia
CJV	100	90	45
LCV	165	145	75
Bus/Truck	340	300	155
3A	370	325	170
MAV/ HCM/EME	535	470	245

Source: NHAI Revision of User fee Rate w.e.f 01.04.2023

Regional context and site visit observations

2.13 Steer team visited the Asset as part of the site visit exercise to understand the traffic movement on the Asset and its surrounding network. In addition, we spoke with the road users and undertook a detailed reconnaissance of the Asset, including identification of any micro-diversions. The pictures below show a typical cross-section of the Asset and its toll plazas as captured during site visits.

Figure 2.3: Typical cross-sections and toll plazas on the Asset; Land clearing activity on NH17

Source: Steer site visit

2.14 As the Asset isn't located in vicinity of any major urban centre, a lower share of passenger traffic was observed. A low willingness to pay was noted amongst CJVs on the Asset. A significant volume of CJVs were seen crossing the plaza through the end lanes without paying.

2.15 The key commodities observed during the site visit were manufacturing products, petroleum products, courier/parcel, agricultural, and industrial goods. Additionally, a high share of loaded trucks coming from rest of India to NE region and empty trucks going back from Guwahati/NE region to the rest of India was also observed which hints towards the consumption-based nature of the region.

2.16 On both the toll plazas, through traffic movement was observed with trucks coming from West Bengal, central India, and north India and going towards Guwahati, Tezpur, Shillong and Silchar. An average trip length of more than 1,000 kms were observed in our OD data, which validated our understanding of long distance through traffic using the Asset. Guwahati was found to be a key destination for all the trips coming from rest of India. Additionally, from our discussion with the truckers we understood that the Asset also caters to local movements between Bongaigaon and Barpeta/Nalbari/Guwahati etc.

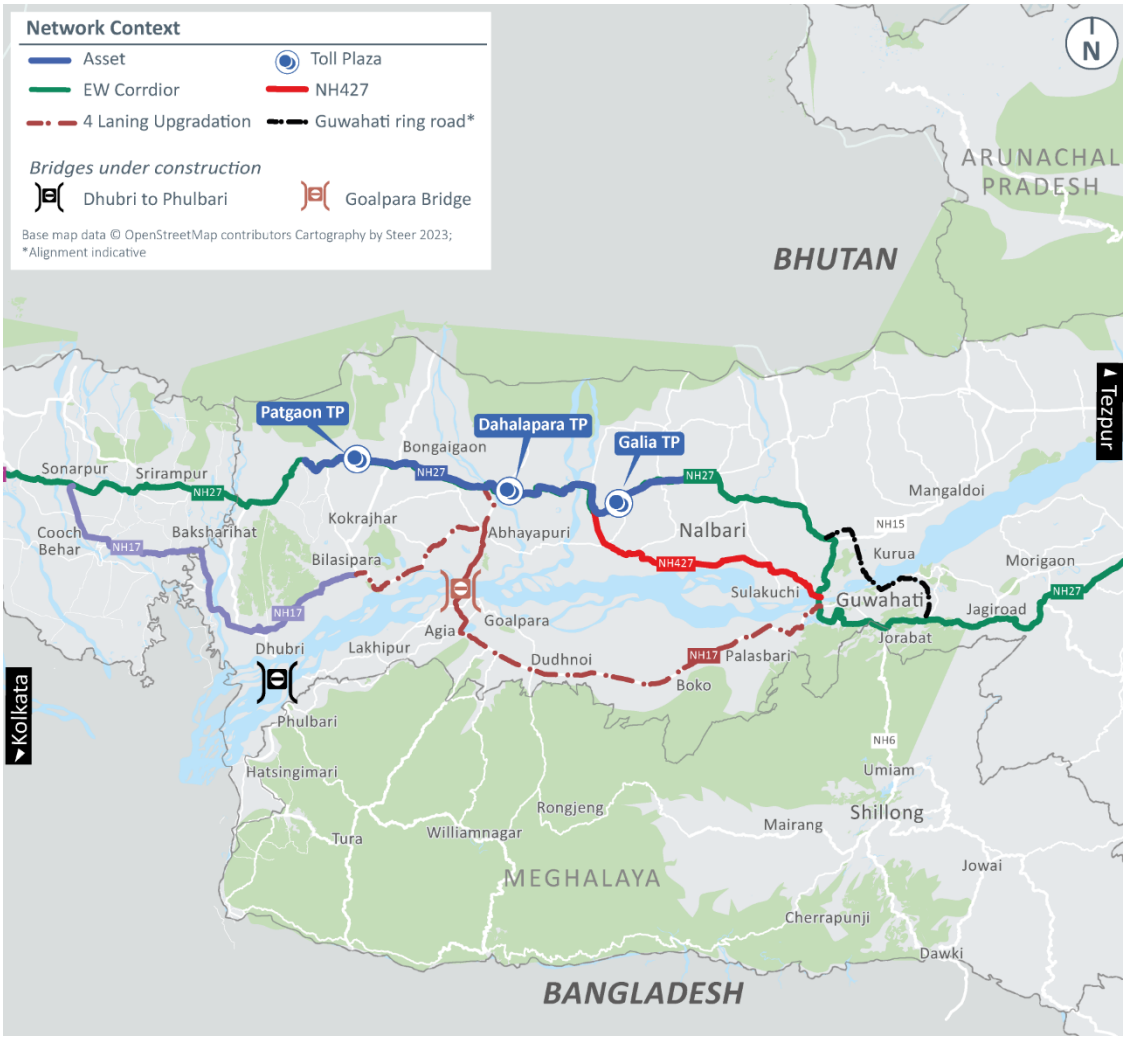
2.17 No micro-diversions were observed near the toll plazas. In terms of long-distance diversions, NH17, and NH427 offer an alternate to NH27 to reach Guwahati. However, as NH27 is the only 4-laned highway in the region which connects Guwahati to the rest of India, the highway is preferred by a majority of truck drivers.

NH17 (Hapachara to Guwahati)

2.18 NH17, an alternate route to reach Guwahati from Hapachara, is currently a 2-lane undivided road with paved shoulder and has dense urban settlements along the entire stretch. There are several large industries/warehouses along the route near Boko and Chhayagaon such as Flipkart, Nyaaka, ITC, Britannia, and IOCL bottling plant (near Sarpara). It was observed during the site visit that the truckers preferred NH17 to reach Guwahati only when they had a stop or one end of the trip on the route. It was also observed that truckers from West Bengal and Bihar also use the Srirampur - Cooch Bihar – route to access NH17 and are destined to

southern parts of Assam and other northeastern states. Overall volumes of commercial vehicles observed on the alternate are lower than observed on the Asset corridor, to verify these additional counts were undertaken on the NH17 section and are discussed later.

Figure 2.4: Regional context of NH27 and NH17



2.19 Through their site visit, the Steer team was able to verify and ascertain the following facts about the works on NH 17.

2.20 Sections on NH17 till Agia passing through Kahikuchi, Chhaygaon will be 4 laned, during the site visit it was observed that land clearance had been going on in various sections. The section between Agia and Guwahati (VIP junction) is expected to complete in 30 months, which is the construction period of the 2 to 4 laning. The section between Hapachara and Agia is about to complete 4 laning. A new 2 lane Goalpara bridge is currently under construction and is expected to complete in the next 12-18 months. However, at the existing bridge there is no traffic bottleneck hindering traffic movement.

2.21 Town bypassed will be constructed in the areas where there are towns and settlements like Bijoynagar, Boko, Dhupdhara, Dudhnoi, Agia since there is no space for 4 laning the existing alignment. This will add to the additional tolling length to the toll calculation.

2.22 As per information available from NHIDCL office it was confirmed that two toll plazas have been proposed on NH17,one near Goalpara and another near Bilasparia. Further there will be

additional toll plazas between the Agia and VIP chowk junction. Location of which is not available at the moment, however the tollable length details are provided which have been incorporated in calculating tolls on this road.

2.23 To ascertain the diversion volume and the present volume NH17, a 3-day turning movement count (TMC) count was also conducted on the NH17 junction near Abhyapuri, further as discussed, a 7 day count was undertaken between the Agia – Dudhnoi section to ascertain the total volume of traffic on this road. The results of the same are explained in the next chapter.

NH427: Howly via Hajo to Guwahati

2.24 NH427 between Howly via Hajo to Guwahati is a 2 lane section, passes through dense rural-urban corridor with settlements on both sides of the road. During site visit it was observed that the corridor currently caters to predominantly passenger traffic passing though various markets on both sides of the roads.

2.25 As per the information available there are no plans to expand the current section to a 4 lane corridor, and hence has not been considered as a viable alternate to Galia -Guwahati corridor

Regional context

Northeast India and Assam

2.26 The Asset is located in Assam, a state in the Northeast (NE) India. The NE India comprises of seven states: Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura, commonly known as the 'Seven Sisters'.

2.27 The NE India covers around 8% of India's total geographical area with a population of 45 million (as per Census 2011), which is about 4% of the country's total population. The region contributes ~3% to India's total GDP.

2.28 NE India is characterized by a consumption-based economy, where the majority of the population relies on spending their income on daily necessities and services. This region also has a large informal sector, with a significant proportion of the population engaged in agriculture and small-scale businesses. The region has a high dependence upon the government employment and subsidy schemes.

2.29 Presence of abundant natural resources has given Assam an advantage of producing oil, and gas, limestone, cement, and coal-related products. The same is validated by the OD survey results as well, as the trucks are observed to carry the above-mentioned commodities from Assam for consumption locally and to rest of NE India.

2.30 Guwahati, the biggest city of the NE India, is also the most populous city in Assam with a population of ~1 million. It is a key manufacturing and industrial centre of the region and is home to numerous warehouse and storage depots. The traffic from rest of the country uses the Asset to reach Guwahati (from where it is distributed to rest of northeast India), with Guwahati acting as both, a sink, and a source for the traffic to rest of NE India.

Northeast India's road network

2.31 The NH27 is the main highway of NE India. The highway is part of the east-west corridor connecting NE with the rest of India. Presently, the NH27 is the only highway with 4-lane configuration in Assam.

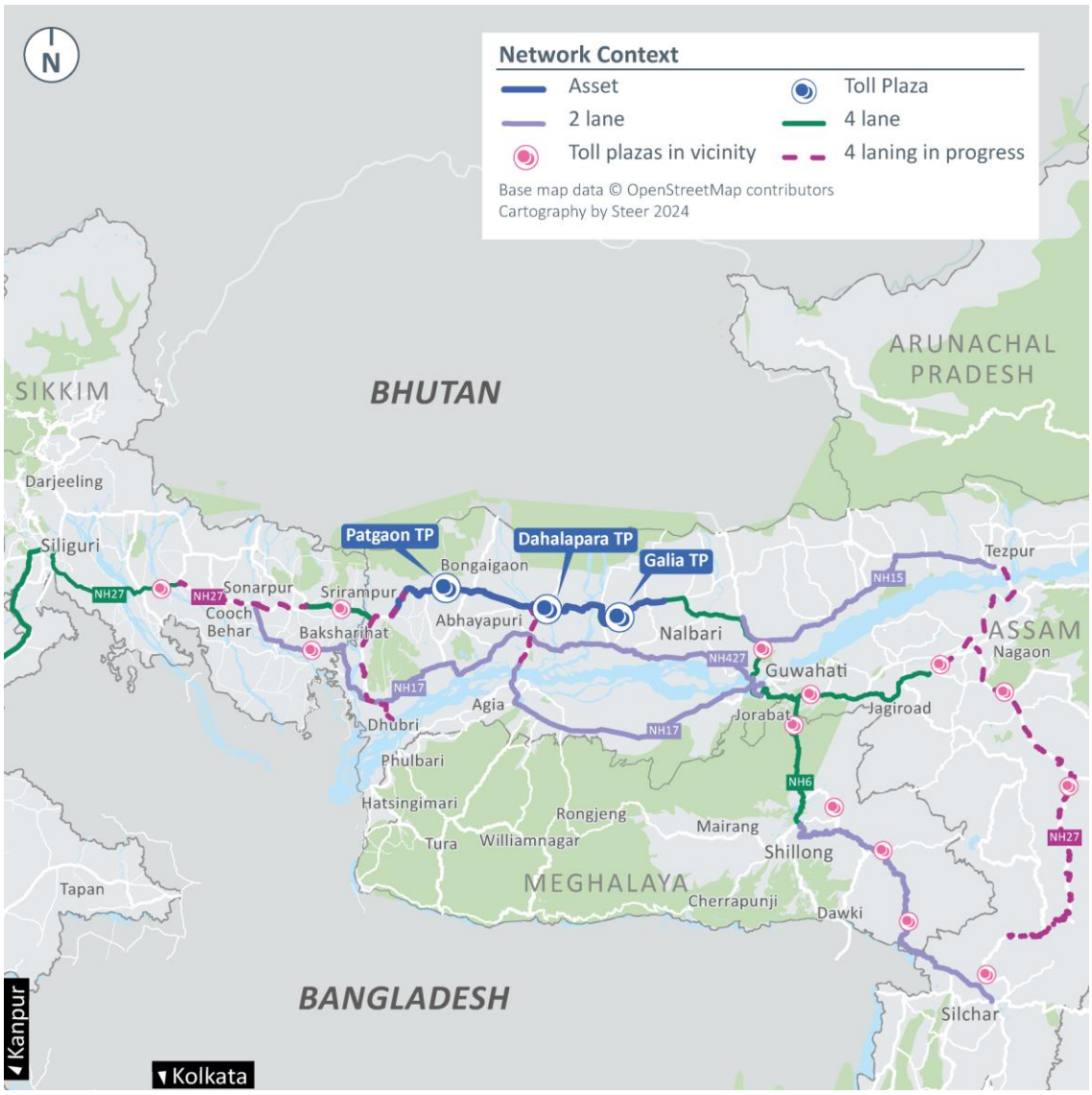
2.32 Several road sections in the NE region are getting upgraded to a 4-lane configuration from a 2-lane corridor. The status of road network in NE is as follows:

Table 2.3: Road network in NE India

Point on map	Section	Length	Lane configuration
NH27 – West Bengal			
A	Siliguri – Dhupguri	70 km	4-laned
	Dhupguri – Salsalabari	70 km	4-laning under progress
NH27 – Assam			
B	Srirampur – Kochugaon	30 km	4-laning under progress
Asset+ NH27 till Nagaon	Kochugaon – Guwahati bypass	230 km	4 laned
	Southern Guwahati bypass	17 km	6-laning under progress
	Southern Guwahati bypass - Nagaon	130 km	4-laned
C	Nagaon - Nrimbangloa	170 km	4-laned
	Nirmbangloa - Harangjao	50 km	4-laning yet to start
	Harnagjao - Balachera	26 km	4-laning under progress
	Balachera - Silchar	50 km	4-laned
NH17/NH17			
D	Hapachara – Abhaypuri - Jogihopa	37 km	4-laning under progress
	Jogihopa - Guwahati	151 km	4-laning under progress
	Falkata – Cooch Behar		2-laned
	Cooch Behar - Bilasipara		2 Laned
	Bilasipara - Abhaypuri		Proposed 4 laning
NH127B			
E	Srirampur - Dhubri	28 km	4-laning under progress
	Milanpur - Shillong	350 km	2-laned
NH6			
F	Jorabat – Shillong	85 km	4-laned
	Shillong - Silchar	210 km	2-laned
Other sections			
G	Nagaon – Tezpur NH127	65 km	4-laning under progress
H	Baihata Chairali – Tezpur NH15	131 km	2-laned
I	Howly – Guwahati NH427	100 km	2-laned

Source: NHIDCL, NHAI

Figure 2.5 Road network in NE India



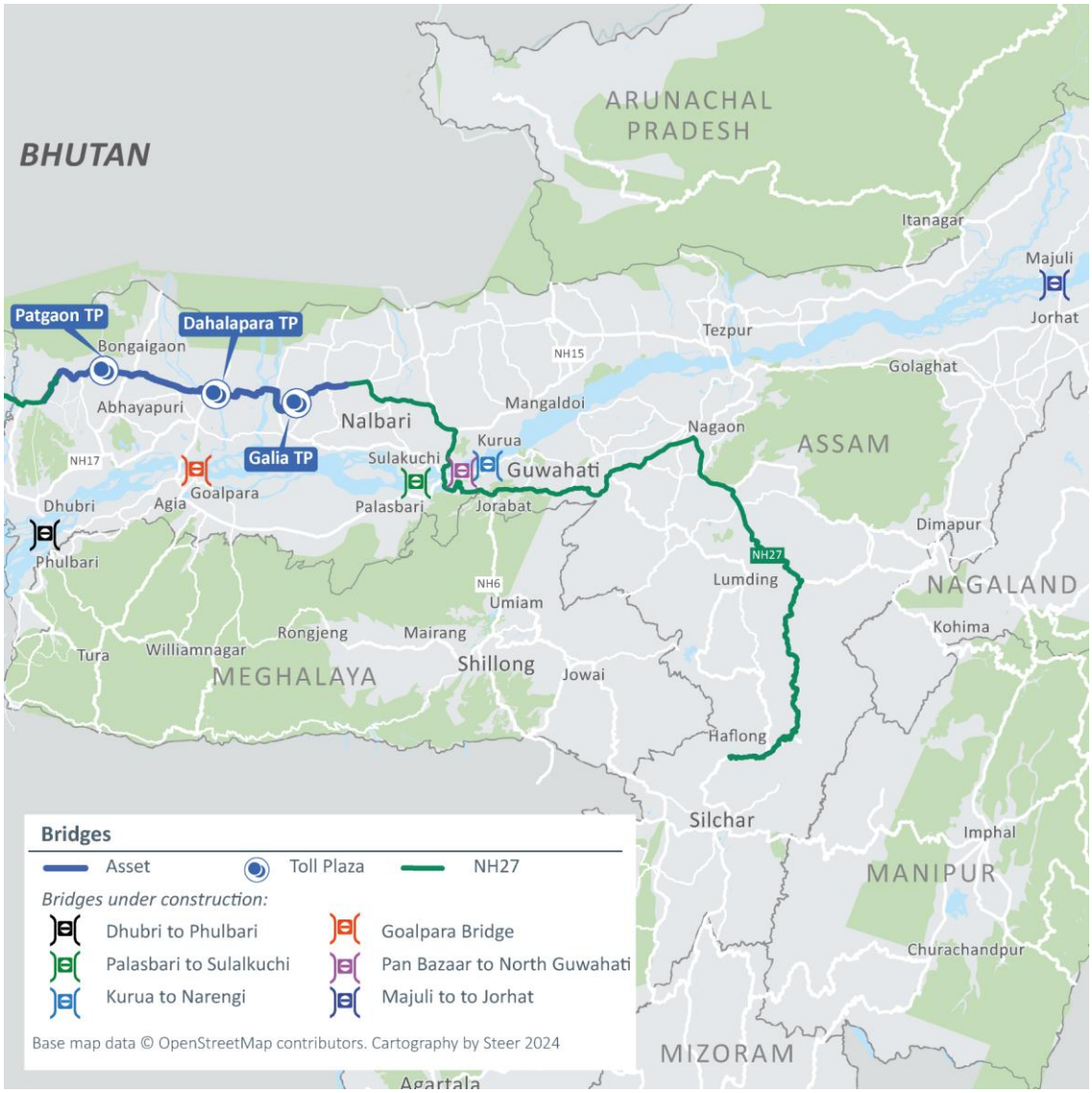
Source: Steer cartography

2.33 As the traffic to the NE states enters via Siliguri towards upper Brahmaputra, any potential movement from upper Brahmaputra towards lower Brahmaputra requires a bridge crossing. Several bridges are being planned and constructed over river Brahmaputra in Assam to improve the state's accessibility. The bridges once constructed, are believed to provide a boost to the connectivity in the state. The following bridges are planned for construction in the state:

- **Dhubri – Phulbari** bridge would be India's second longest bridge and would span more than 19 kms. The bridge will connect Dhubri in Assam and Phulbari in Meghalaya.
- **Goalpara bridge** is being constructed parallel to an existing bridge at Jogihopa. The 2-laned bridge will provide better connectivity of NH27 with NH17.
- **Sualkuchi – Palasbari bridge and Pan Bazar - North Guwahati bridge** is being constructed on west and east of Guwahati city respectively. The bridges will provide better accessibility for the northern and southern banks.
- **Kurua – Narengi** bridge will be constructed as part of the northern bypass of Guwahati. The bypass and bridge, once completed, will the ease the congestion on the present

Guwahati bypass and will provide the option to the road users to completely bypass the city and avoid the entry restrictions into Guwahati for commercial traffic.

Figure 2.6 Upcoming bridges in Assam



Source: Steer cartography

Network context

Entry into Northeast India

2.34 The NE India is a gateway to Southeast Asia and is of significant strategic importance since it shares an international border with Bhutan, China, Myanmar, and Bangladesh. The region is connected to the rest of India by a narrow 20 km wide corridor of land in Sikkim known as the 'Chicken Neck'. The Asset acts as a feeder for the NE India and caters to the long-distance traffic entering the region in Assam via the Chicken Neck.

2.35 This share of traffic, after crossing the Chicken Neck, can enter the region through the following two points:

- Srirampur – entry via NH27

- Baxarihat – entry via NH17

Figure 2.7 entry into NE India

Source: Steer cartography

2.36 As observed during the site visit, majority of the truckers enter via Srirampur as NH27 is of 4-lane configuration and is considered as the main east-west corridor. The traffic entering via Srirampur stays on NH27 to reach the eastern destinations. This share of traffic crosses Patgaon and Dahalapara plazas and then divert either to Guwahati or to Tezpur/Upper Assam. As observed during the site visit, a few trucks divert at NH17 at Bongaigaon to reach the industries on NH17 primarily near Boko and Chhayagaon (west of Guwahati). This share of traffic only appears at the Patgaon toll plaza and not at other two plazas Dahalapara and Galia.

2.37 The trucks entering the northeast via Baxarihat ply on NH17 and NH17 before reaching NH27 at Bongaigaon. The route via this entry point is currently 2-laned without tolls. As observed on site, this route is either used by trucks to prevent toll at Patgaon or by trucks originating in the northern parts of West Bengal (Cooch Bihar, Toofanganj).

2.38 Sonpur (West Bengal) becomes the decision point to use NH27 or NH17. The route via NH17 is approximately 50 kms longer but only has one toll plaza (Ghogakurthi) as compared to two toll plazas on NH27 till Bongaigaon (Guabari plaza and Patgaon plaza).

Distribution of traffic within northeast India

2.39 The Asset acts as a feeder for majority of the traffic in NE India. The two key components of this traffic are:

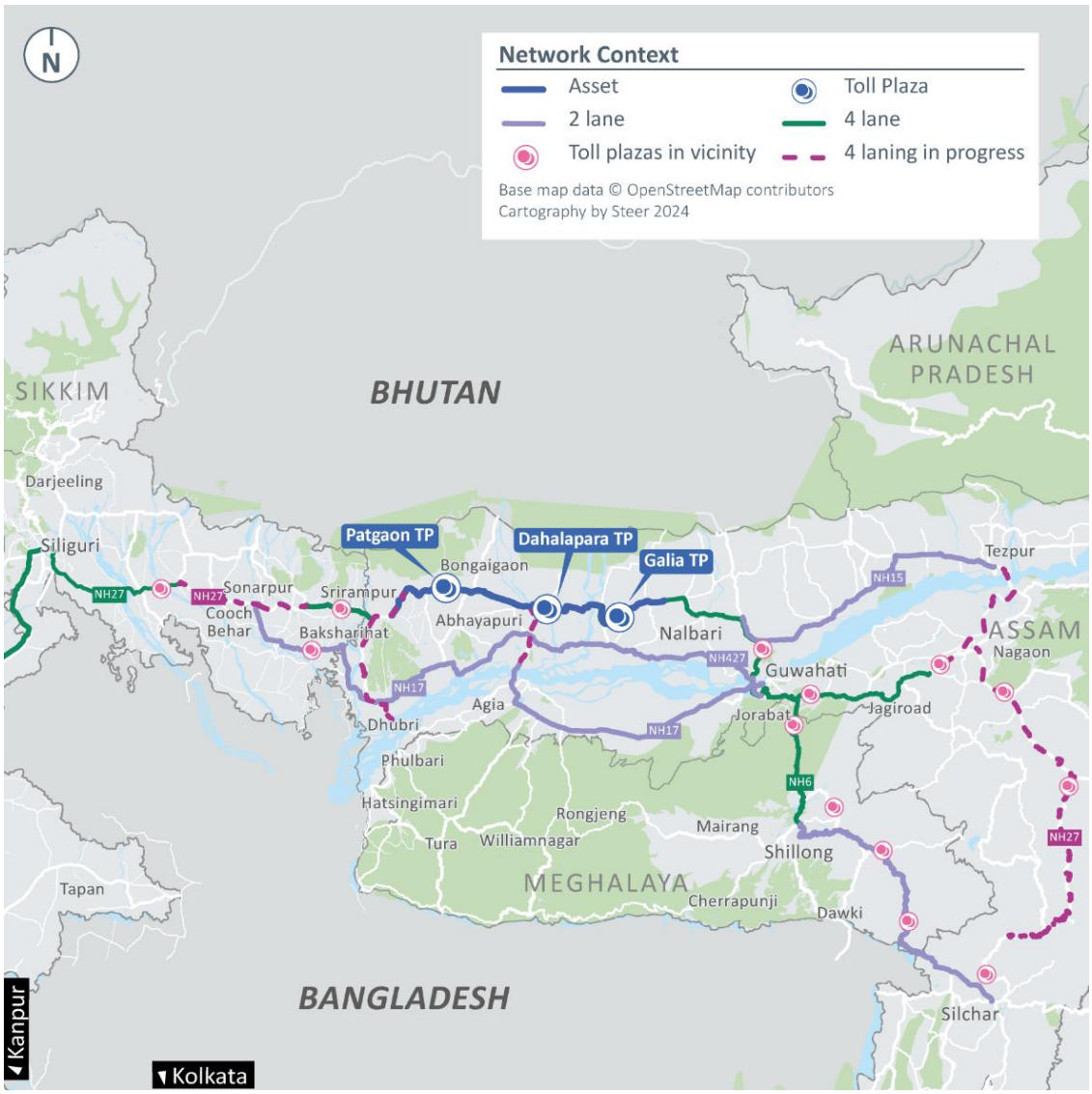
- Traffic destined to northern Assam/Arunachal Pradesh; and
- Traffic destined to south/central Assam, Meghalaya, Shillong, Tripura, Mizoram

2.40 The Traffic destined to upper Assam/Arunachala Pradesh diverts to NH15 at Baihata Chairali after crossing Patgaon, Dahalapara and Galia to reach key destinations of Tezpur, Lakhimpur, Dibrugarh, and Arunachal Pradesh. NH15 is a two-lane road without tolls and is ~70 kms shorter than the route via Guwahati (NH27).

2.41 As observed during the site visit, the truckers prefer to use NH15 versus NH27 due to its shorter lengths, no tolls and getting through connectivity, as they must wait for day-time restrictions to be uplifted to enter Guwahati to use NH27. Traffic destined to south/central Assam, Meghalaya, Shillong, Tripura, and Mizoram stays on NH27 to reach respective destinations.

2.42 The traffic towards Shillong and other parts of Meghalaya diverts to NH6 from Jorabat. The route via NH6 also connects till Silchar which further connects the traffic to Mizoram, Tripura, and Manipur. It should be noted that the traffic destined to these regions is currently using the NH6 (four laned road with four toll plazas) as the Jorabat – Nagaon – Silchar route via NH27 is currently under construction (near Haflong).

Figure 2.8 Distribution of traffic in NE India



Source: Steer cartography

Key economic activities

2.43 The Asset is situated in Assam, the state with the largest economic contribution to the Northeast. The economy of Assam is predominantly agricultural in nature. Assam has an advantage in generating large quantities of goods linked to tea, bamboo, coal, limestone, cement, oil, and gas due to the presence of abundant natural resources. Some of the key economic activities in the region are:

- **Agriculture**: The state is famous for its tea cultivation and accounts for approximately half of India's tea production. Apart from tea cultivation, the state is also a major producer of rice, horticulture crops (mango, banana), spices (cardamom, ginger, and turmeric). The same is validated by the OD survey results as ~10-14% trucks on the Asset carry tea and other agri-related products.
- **Oil and gas**: Assam is a major producer of crude oil and natural gas in India. Most of the oilfields in state are located in the upper Assan region with the refineries being located in Guwahati, Digboi, Numaligarh and Bongaigaon. Indian Oil Corporation Limited (IOCL)

refinery at Bongaigaon is located on the Asset between Patgaon and Dahalapara plazas. ~15% MAVs carry Petroleum, Oil, and Lubricants (POL) goods according to the OD survey results.

- **Limestone and cement**: High-grade fossil limestone (Sylhet limestone) is found in Garo and Khasi hills of Assam and is majorly used for production of cement. The availability of raw material has facilitated the setting up of large cement industries in Assam. Guwahati/Kamrup district is home to the large-scale industries of Purbanchal Cement, Topcem Cement, Star Cement, Dalmia Cement etc. The same is validated by the OD survey results as well as ~15% 3As are observed to carry construction-related goods.
- **Coal**: Found in Makum and Jaipur belts (near Dibrugarh), coal is one of the key mineral resources of Assam. However, due environmental degradation, loss of forest land, and resistance from local communities due to displacement and loss of livelihoods, the government has implemented strict measures to regulate mining activity.
- **Tourism**: Assam is a key tourist destination in the northeast as it has numerous regions of natural beauty. The state is home to wild forests, mighty rivers, and large tea plantations. Some of the notable tourist destinations include Kaziranga National Park, Manas National Park, Kamakhya Temple, Ahom Dynasty, and the basins along river Brahmaputra.

Network developments

2.44 The section below details the impacts which we believe would influence the traffic levels on the Assets during the concession period. The development impacts are discussed in detail in chapter 6.

- **NH17 4-laning**: The section of NH17 between Hapachara and VIP Chowk is getting upgraded to four lanes. A 2-laned bridge is also getting constructed parallel to the existing bridge at Goalpara as part of the upgrade. Once the construction is completed, the 4-laned NH17 will act as an alternate route for traffic moving between Bijni/west and Guwahati/east. Due to the upgrade, loss of traffic is expected on the Dahalapara and Galia toll plaza. Also, 4 laning of the West Bengal section of NH17 (Cooch Behar – Bilasipara) has also been proposed due to which loss of traffic is expected on the Patgaon plaza.

- **Guwahati Ring Road**: In the view to decongest Guwahati city in 2023, the government of Assam proposed a six-lane greenfield 55km long Ring Road of Guwahati. It will decongest Guwahati city and take major traffic coming from Rest of India and moving towards Silchar, Nagaland, Shillong, Mizoram and Tripura. As a part of the alignment, there is a bridge proposed over Brahmaputra river connecting north and south Assam mainly Kuruwa to Narengi. The Ring Road is proposed to connect NH27 Asset at Behata Chalari section before Madanpur toll plaza. There is also proposed user fee collection near Dumnichowki on Guwahati Ring Road. It is assumed that all traffic originating west of Hapachara and moving eastern Assam including Guwahati, Tezpur, Silchur, Mizoram and Tripura will shift back to NH27 Asset once the Ring Road is operational with traffic shifting back to Dahalapara and Galia plaza of the Asset.

- **Srirampur – Dhubri 4 laning**: The section of NH127B between Srirampur and Dhubri is getting upgraded to four lanes. A 4-laned bridge is also getting constructed between Dhubri and Phulbari as part of the upgrade. Once the construction is completed, it is expected that traffic destined to Meghalaya and Tripura can shift to the upgraded NH127B. Due to the upgrade, all the plazas are expected to lose traffic.

3 Traffic description

Introduction

3.1 This chapter outlines the current traffic and revenues on the corridor, as well as our analysis of data collected through primary surveys covering origin-destination (OD) data and traffic video count data.

3.2 Traffic demand data is generally collected and analysed to understand the volume and vehicle composition of demand currently using the Asset while OD data is used to obtain a better understanding of travel patterns, trip lengths, trip purposes and areas of influence in the vicinity of the Asset, as well as the commodities being moved by goods vehicles. This analysis, combined with our understanding of the Assets (based on our site visits), enables us to identify the key drivers of demand on the Assets. Actual toll plaza data is used as the basis from which the current/base year annual average daily traffic (AADT) is established. This data is typically provided by the Client and independently analysed and validated by us using traffic volume count (TVC) information.

3.3 For a traffic and revenue due diligence exercise, the data provided by the toll plaza is typically the primary source of establishing a road Asset's base position, as well as historical performance in terms of growth trends by vehicle type. However due to the unique nature of the Asset under consideration in this assignment, the Asset being operated under different Operate Manage and Transfer (OMT) contracts by independent contractors, the toll plaza based historical data available was for limited history. Therefore, it was important to validate the toll plaza data against other independent data sources to entrust confidence in the data used for base year estimation.

3.4 These data sources, described in detail below, were helpful in establishing the base position as well as the historical trends that could be relied upon for developing a robust set of forecasts.

Historical traffic and revenue analysis from various sources

3.5 The section below presents the current and historical traffic and revenue position of the Assets. For this study, traffic data is made available from different sources shared by the Client, namely:

- **ETC (segmented)**: ETC daily-level data, segmented with ticket categories, was available from Nov/Dec'21 – Nov'23. The dataset doesn't include information regarding cash-based trips, pass-based trips, and exemptions.
- **ETC (totals)**: ETC monthly-level data, without segmentation with ticket categories, was available from Apr'21 to Nov'23. The traffic in this dataset was in line with the traffic reported in ETC (segmented) dataset for the common months. Therefore, on Patgaon and Dahalapara the splits for Bus/2A category in the base traffic estimation were referred to from this dataset as the same wasn't available in the ETC (segmented) dataset.

- **TMS**: Daily level toll plaza data was available for Dahalapara for Dec'22. This was compared with ETC (segmented) data to get information regarding cash-based and local pass-based trips. Cash traffic data for Galia was available from Mar'22 to Nov'23 at vehicle category level.
- **IHMCL**: The IHMCL counts reported for the Asset are available for varied timeframe for each of the toll plaza

3.6 The following section outlines the analysis of datasets described above. In addition to the data available through secondary sources, we have conducted our own independent TVC counts to validate the AADT and estimate shares of vehicle classes, the same is presented in the later sections along with the OD survey analysis results.

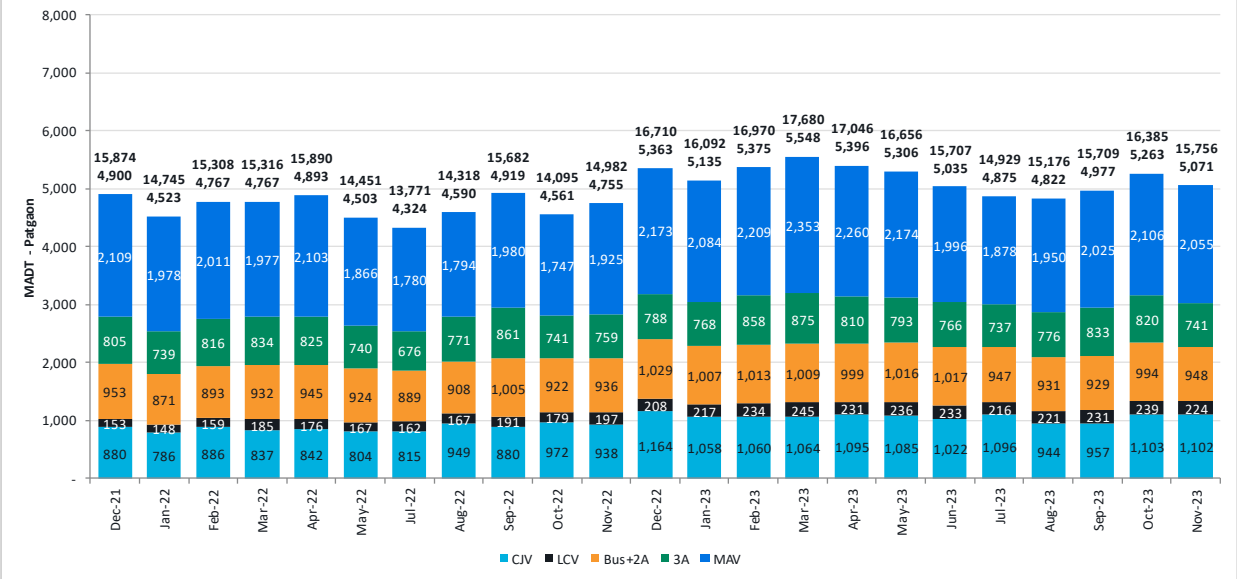
Historical traffic

ETC (segmented) dataset

3.7 ETC daily-level data, segmented with ticket categories, was available from December 2021 – November 2023 for Patgaon, from November 2021 – November 2023 for Dahalapara and from November 2021 – November 2023 for Galia. The ETC dataset has trip information regarding single, return, and local commercial trips. It should be noted that ETC (segmented) dataset is referred for base traffic estimation as it has the information regarding tickets sold on the Asset which is a key input for revenue calculation in the forecasts.

3.8 For Patgaon and Dahalapara, FY23 PCU is trending at 15,361 and 18,884 while grows to 15,932 and 18,937 in 8 months of FY24YTD. Dahalapara is at higher PCU with higher share of 2A and MAV traffic with influence of local region including Bongaigaon, Barpeta, Howly, Dahalapara and more. Galai toll plaza which is at 50kms distance from Dahalapara shares similar traffic profile with higher local influence of Howly, Pathshala and Barpeta. FY23 PCU at Galia is 19, 617 while 8 months FY24YTD is 19,102.

Figure 3.1: ETC (segmented) MADT, PCU – Patgaon



Source: Steer analysis

3.9 At Patgaon, 3As and MAVs, the highest revenue generating category, together constitute ~57% of the total traffic observed on the toll plaza. CJVs make up ~20%, LCVs make up around 4%, and Bus/2As make up around remaining 19% of the total vehicle share.

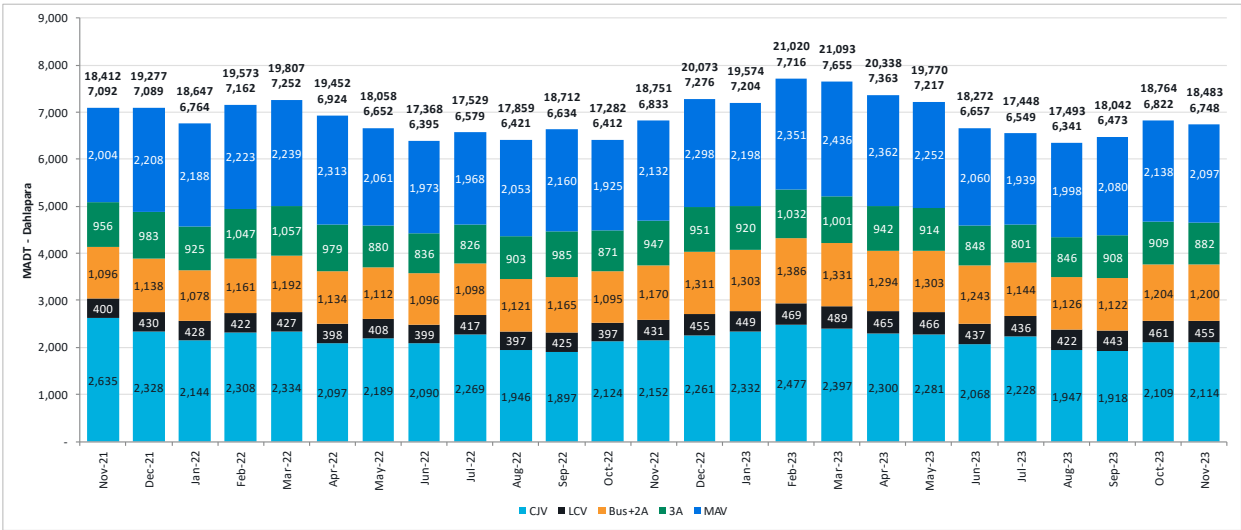
3.10 As the plaza isn't in vicinity of any major urban centre, low CJV volumes are observed. In FY24, the plaza recorded ~1050 CJVs per day. It should be noted that the due to lower willingness to pay amongst CJV users, as witnessed during the site visit, a significant volume of CJVs were using the last lanes of the plaza to cross without paying. This volume doesn't get recorded in the ETC data. We have relied upon the volumes witnessed in Steer's TVC counts to estimate the number of non-paying CJVs. The same has been explained in detail in later sections.

3.11 In FY23, the Patgaon plaza catered to ~190 LCVs, ~960 Bus/2As and ~2,760 3A/MAVs and in FY24 plaza catered to ~230 LCVs, ~970 Bus/2As and ~2,840 3A/MAVs

3.12 At Dahalapara, 3As and MAVs together constitute the major share of the total traffic observed on the toll plaza at ~45%, with ~3,080 3A/MAVs crossing the plaza daily. The LCVs and Bus/2As make up around 6% and 17% of the total traffic share on the plaza.

3.13 CJVs at Dahalapara constitute 30-32% of the total traffic. The share of CJVs increase as compared to Patgaon due to closer proximity to urban settlements in Bongaigaon.

Figure 3.2: ETC (segmented) MADT, PCU - Dahalapara



Source: Steer analysis

3.14 As observed in the charts above, Dahalapara and Galia caters to a slightly higher volume of commercial traffic due to the following reasons:

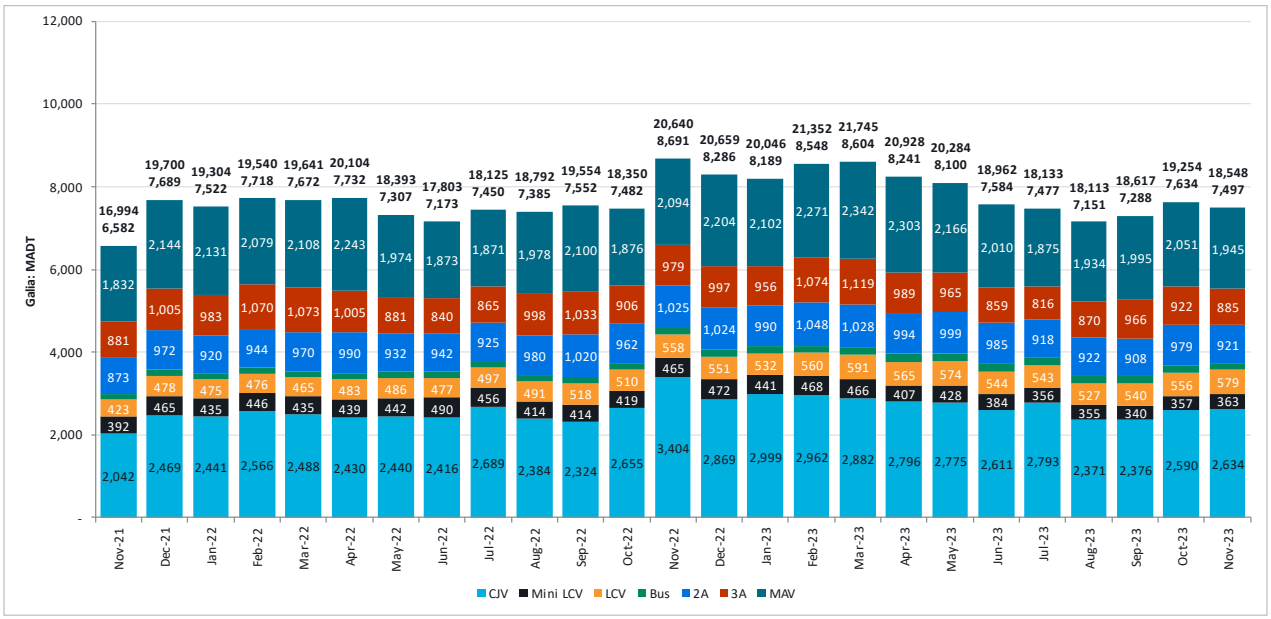
- Traffic from NH17, destined to Guwahati, joins the Asset at Bijni and appears only at Dahalapara and Galia. This share of traffic is greater than the share of traffic coming from Patgaon and diverting to NH17 at Bijni. However as validated from OD, such trips on Dahalapara and Galai are similar in volume.
- The share of traffic originating at Bongaigaon (primarily IOCL refinery) and moving east (towards Guwahati) is higher than the share moving west (towards Patgaon), contributing to the difference in traffic at both plazas.

3.15 These observations have been validated through our OD Analysis as well, which shows that Dahalapara is characterised by a higher share of both local and through traffic when compared to Patgaon.

3.16 All the toll plazas observed similar traffic profile, consistent with FY23 in FY24YTD (till Nov'23) as well. However, one-time regional events and disruptions such as Manipur violence and unseasonal rainfalls in the region impacted the traffic slightly in FY24YTD.

3.17 At Galia, 3As and MAVs, the highest revenue generating category, together constitute ~39% of the total traffic observed on the toll plaza. CJVs make up ~39%, LCVs make up around 7%, and Bus/2As make up around remaining 15% of the total vehicle share.

Figure 3.3: ETC (segmented) MADT, PCU – Galia



Source: Steer analysis

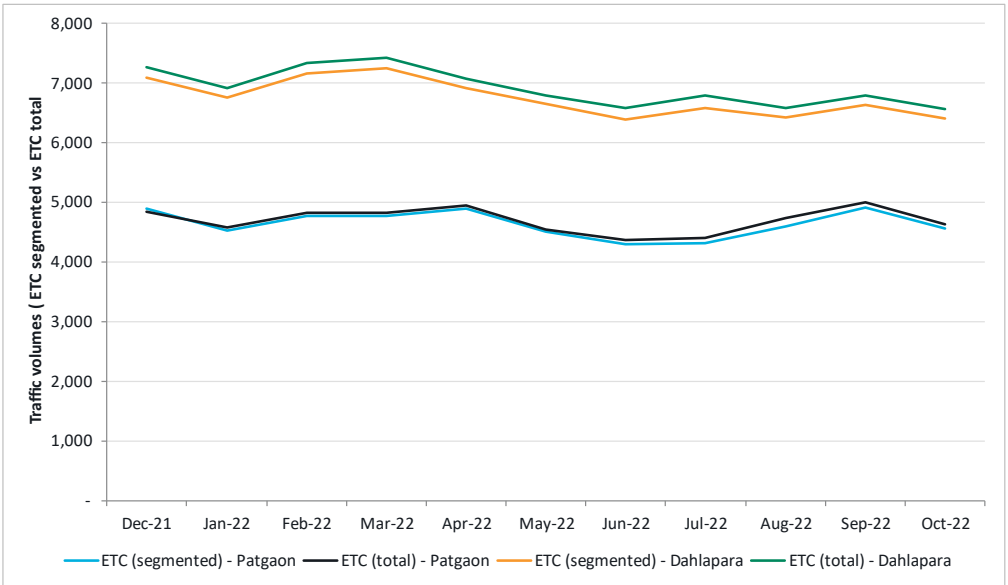
3.18 In FY24 YTD, the Galia Plaza recorded ~2,618 CJVs per day. We have relied upon the volumes witnessed in Steer's TVC counts to estimate the number of non-paying CJVs. The same has been explained in detail in later sections. In FY24 YTD, the Galia Plaza catered to ~553 LCVs, ~1,130 Bus/2As and ~2,940 3A/MAVs.

ETC (total) dataset

3.19 ETC daily-level traffic data (on a total level, without ticket segmentation) was available from February 2020 – October 2022 for Patgaon and from January 2020 – November 2022 for Dahalapara.

3.20 The dataset provides a longer history of traffic on the plazas as compared to ETC (segmented) data. For the months common in both datasets, ETC (totals) dataset reported traffic volumes within 1-2% of the total traffic volume reported in ETC (segmented) dataset as shown in the chart below.

Figure 3.4: Traffic volume comparison: ETC (segmented) vs ETC (total)



Source: Steer analysis

3.21 A strong growth in traffic is observed in the data in Q4 FY21 for both the plazas. It should be noted that payment via FASTag was made mandated by the government in February 2021 due to which the road users had to get a valid FASTag installed which led to a strong growth in ETC reported traffic February 2021 onwards.

3.22 Similar to traffic reported in ETC (Segmented) dataset, Patgaon reported 14,640 PCUs and Dahalapara reported 18,197 PCUs in FY23 YTD. The FY23YTD traffic increased at 7% and 5% at Patgaon and Dahalapara respectively. As discussed above, this growth incorporates growth in reporting of ETC traffic due to government's mandate of toll payment via FASTag.

3.23 The dataset also reports the number of buses. As the split between Bus/2As wasn't available in ETC (segmented) dataset, the same is derived from this dataset for base traffic estimation. In FY23 YTD, the total Bus/2A volume is made up 10% buses and 90% 2As at Patgaon and 12% buses and 88% 2As at Dahalapara.

Toll Management System (TMS) data

3.24 TMS data was available for Dahalapara plaza for the month of December 2022. The traffic volume and its comparison with ETC (segmented) traffic volume for the same period is shown below.

Table 3.1: TMS vs ETC Dec'22 MADT comparison - Dahalapara

Vehicle category	TMS - Dec'22 MADT	ETC - Dec'22 MADT
CJV	2,529	2,261
LCV	480	455
2A	1,328	1,311
3A	956	951
MAV	2,311	2,298
OSV	1	1
Total	**7,606**	**7,276**

PCU	**20,509**	**20,073**

Source: Steer analysis of ETC and TMS data

3.25 Across all vehicle categories, TMS reports higher volumes as compared to ETC traffic. The difference in volumes is due to fact that TMS data contains information regarding cash-based and monthly pass-based trips which isn't reported in any of the ETC datasets.

3.26 Since, ETC (segmented) dataset is being referred to for the base traffic estimation the difference between ETC and TMS, as a percent of vehicle category-wise reported ETC traffic, is added as 'cash' and 'monthly' trips in our base estimates. The same is explained in detail in chapter 6.

IHMCL data

3.27 IHMCL or Indian Highways Management Company Limited undertakes 7-day traffic volume counts on NHAI toll plazas. The counts are classified by vehicle type and present a reasonable position of the traffic that appears on the Asset for that time period. These counts are undertaken by IHMCL at different times of the year and over multiple years. These counts can be analysed to represent a traffic profile of different vehicle types over the years and their evolution.

3.28 The IHMCL counts (without seasonality adjusted) for both the plazas are shown below.

Table 3.2: IHMCL counts - Patgaon

Patgaon	Nov-2016	Apr-2017	Mar-2018	Jan-2019	Oct-2019	Oct-19 vs Nov-16
CJV	1,979	2,323	1,720	2,798	2,138	2.6%
LCV	162	166	451	407	410	36.3%
2A	399	325	454	686	724	22.0%
3A	447	473	787	1,162	1,181	38.2%
MAV	761	991	1,479	1,453	1,369	21.6%
OSV	0	1	0	0	0	-
Total	**3,748**	**4,279**	**4,891**	**6,506**	**5,822**	**15.8%**
PCU	**8,185**	**9,430**	**12,775**	**15,491**	**14,629**	**21.4%**

Source: Steer analysis

Table 3.3: IHMCL counts - Dahalapara

Dahalapara	Apr-2015	Jan-2016	Nov-2016	Mar-2017	Mar-2018	Jan-2019	Aug-2019	Mar-2020	Mar20 vs Mar17	Jan19 vs Jan16
CJV	2,410	3,874	3,418	4,767	4,836	6,638	4,292	3,077	(13.6%)	19.7%
LCV	243	574	348	494	740	1,058	560	573	5.1%	22.6%
2A	1,000	1,041	952	1,104	1,058	1,032	901	1,186	2.4%	(0.3%)
3A	1,077	909	949	1,168	1,003	1,357	1,196	1,573	10.4%	14.3%
MAV	820	473	846	1,041	1,451	1,701	1,572	1,840	20.9%	53.2%

OSV	6	1	0	0	1	0	1	0	-	-
Total	**5,556**	**6,872**	**6,513**	**8,574**	**9,089**	**11,786**	**8,522**	**8,249**	**(1.3%)**	**19.7%**
PCU	**12,723**	**12,718**	**13,450**	**17,009**	**18,663**	**23,047**	**18,502**	**20,494**	**6.4%**	**21.9%**

Source: Steer analysis

3.29 Point-in-time analysis for both the plazas suggest that the Asset has observed healthy growth in the past. However, the same cannot be relied upon as the dataset reports traffic on a weekly basis. Traffic on a weekly basis isn't representative of annual volumes. Furthermore, the growth shown in point-in-time counts cannot be validated using any other secondary sources.

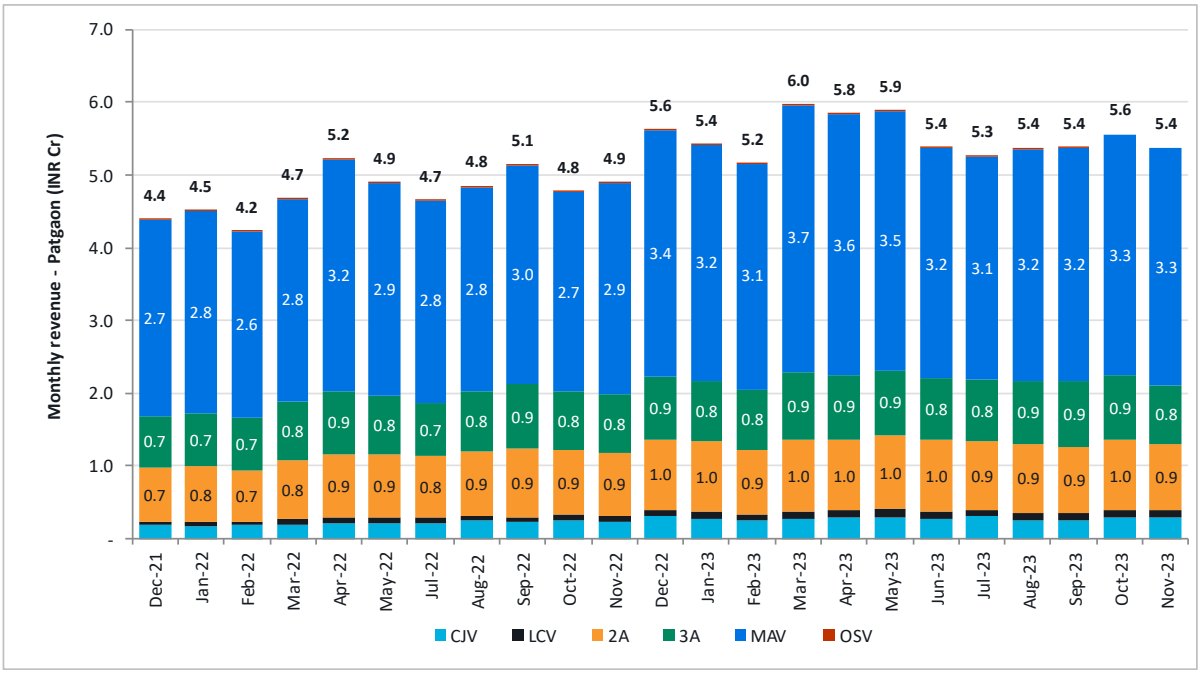
Historical Revenue

3.30 Revenue details were available by vehicle category and ticket in the ETC (segmented) dataset from November/December 2021 – November 2023 for Patgaon and Dahalapara and from November 2021 – November 2023 for Galia.

Reported revenue – ETC (segmented)

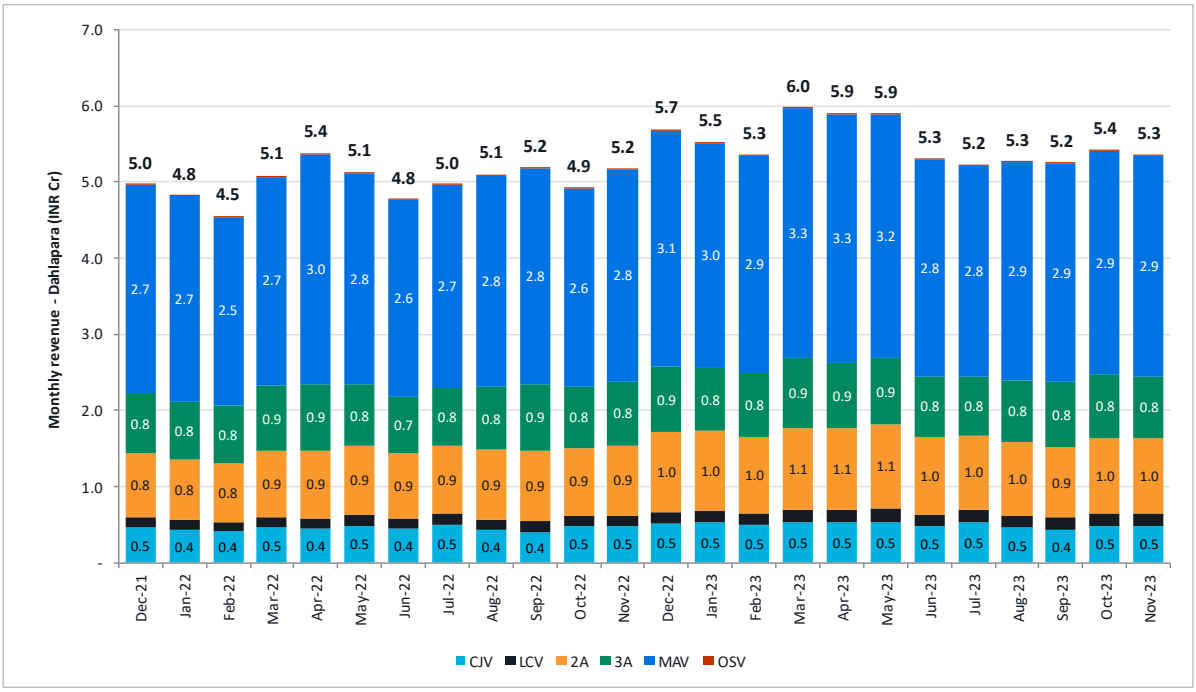
3.31 According to ETC (segmented) dataset, the revenue collection for FY23 is INR 61 Cr and INR 63 Cr for Patgaon and Dahalapara respectively. For FY24 YTD (Apr-Nov'23) it is INR 44 Cr and INR 43.5 Cr for Patgaon and Dahalapara respectively. Per day collection at Patgaon increased from 15.74 Lakh in FY23 to 18.03 Lakhs in FY24 YTD. While at Dahalapara, increased from 17.29 Lakhs in FY23 to 17.85 Lakhs in FY24YTD.

Figure 3.5: Monthly ETC Collection – Patgaon (INR Cr)



Source: Steer analysis

Figure 3.6: Monthly ETC Collection – Dahalapara (INR Cr)



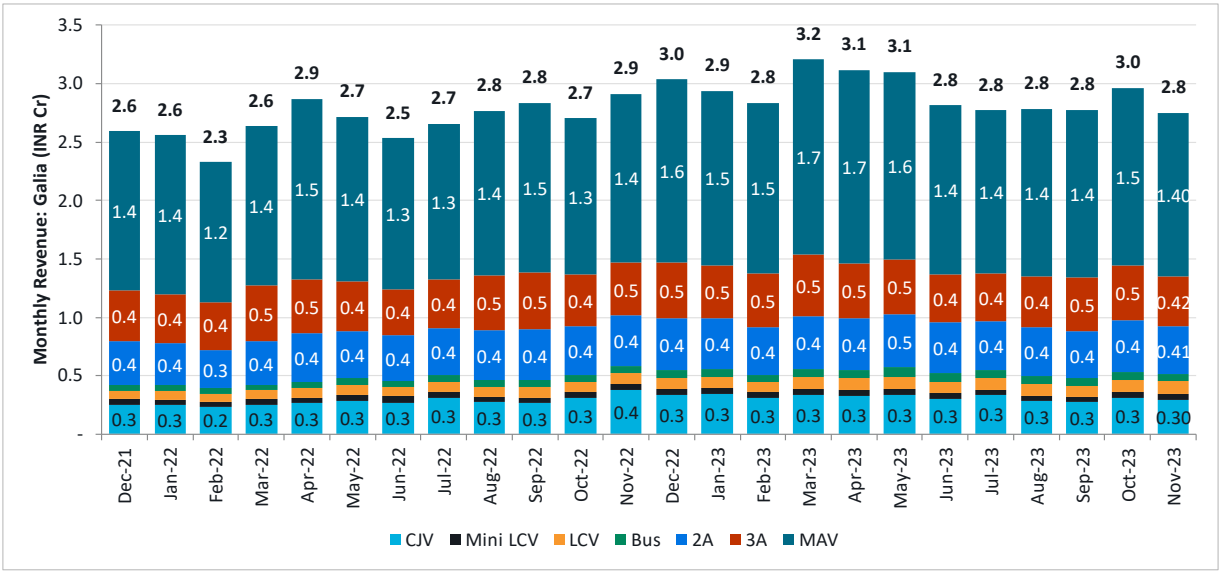
Source: Steer analysis

3.32 3A/MAVs are the major revenue generating vehicle categories for both the plazas, accounting for 70-75% of the total revenue. The high share in revenue is due to both, higher share of truck volume and higher toll rates as compared to other categories.

3.33 Since, Patgaon and Dahalapara are located far from urban centers, the plazas observe low CJV volumes. Therefore, the CJVs contribute a lesser share in the total revenue. The share of CJVs in total revenue is less than 10% on the plazas.

3.34 For FY23, ETC collection including cash collection reported by Schedule V is INR 35Cr which for first 8 months of FY24 (Apr-Nov'23) is INR 23.7Cr at Galia.

Figure 3.7: Monthly ETC Collection – Galia (INR Cr)



Source: Steer analysis

3.35 On an average, Galia collected ~INR 2.8 Cr per month and the per day collection of plaza stood at ~INR 9.3 lakhs for FY23 and in FY24 YTD Galia collected ~INR 2.9 Cr per month and The per day collection of plaza stood at ~INR 9.5 lakhs

3.36 3A/MAVs are the major revenue generating vehicle categories for both the plazas, accounting for 45-50% of the total revenue. The high share in revenue is due to both, higher share of truck volume and higher toll rates as compared to other categories.

Reported revenue – ETC (totals)

3.37 Similar to traffic volumes, the revenue volumes reported in ETC (total) dataset were within 1% of the revenue reported in ETC (segmented) dataset.

3.38 For Patgaon and Dahalapara, FY23 PCU is trending at 15361 and 18884 while grows to 15932 and 18937 in 8 months of FY24YTD. Dahalapara is at higher PCU with higher share of 2A and MAV traffic with influence of local region including Bongaigaon, Barpeta, Howly, Dahalapara and more. Galai toll plaza which is at 50kms distance from Dahalapara shares similar traffic profile with higher local influence of Howly and Barpeta. FY23 PCU at Galia is 19, 617 while 8 months FY24YTD is 19,102

3.39 On an average, in FY23 per month collection at Patgaon is ~INR 5.1Cr which at Dahalapara is ~INR 5.3Cr due to higher volumes of high paying categories like 2A, 3A and MAV. On Galia, this goes to an average of ~INR 2.8Cr per month with effect of lower 3A and MAV and comparatively lower toll rates. Per day collection at Galia increased to 9.5 lakh in FY24YTD from 9.3 Lakh in FY23.

Required remittance

3.40 As the toll plazas of the Asset are under Operate, Manage and Toll contract (OMT), the tolling contractor is contractually obligated to pay a required amount, known as remittance, on a daily level to the authority (NHAI).

3.41 The following tables provide the historical remittance figures as well the latest remittance amount for both the plazas.

Table 3.4: Remittance amount - Patgaon

Remittance (INR Cr)	Period	Daily (INR Lakh)
Remittance (FY24 Avg.) – Daily (INR lakh)	Nov'23 – Nov'24	**19.20**
Toll Collections (FY24)** – Daily (INR lakh)		**18.03**
Toll Collections (FY24) * – Daily (INR lakh)	Apr-23- Apr-24	**19.07**

Source: Steer analysis, *toll collection for FY24 estimated ** toll collection reported from ETC Segmented data for 8 months

Table 3.5: Remittance amount – Dahalapara

Remittance (INR Cr)	Period	Daily (INR Lakh)
Remittance (FY24 Avg.) – Daily (INR lakh)	Nov'23 – Nov'24	**19.04**
Toll Collections (FY24)** – Daily (INR lakh)		**17.85**
Toll Collections (FY24) * – Daily (INR lakh)	Apr-23- Apr-24	**18.94**

Source: Steer analysis, *toll collection for FY24 estimated ** toll collection reported from ETC Segmented data for 8 months

Table 3.6: Remittance amount – Galia

Remittance (INR Cr)	Period	Daily (INR Lakh)
Remittance (FY24 Avg.) – Daily (INR lakh)	Aug'23- Aug'24	**9.99**
Toll Collections (FY24)** – Daily (INR lakh)		**9.70**
Toll Collections (FY24)* – Daily (INR lakh)	Apr-23- Apr-24	**9.37**

Source: Steer analysis, *toll collection for FY24 estimated ** toll collection reported from ETC Segmented data for 8 months

Toll Frequencies

3.42 Toll frequency or segmentation is typically the share of each ticket category recorded for a particular vehicle type. Each vehicle category has different segmentation. As a part of historical analysis, we calculate the toll frequency for each vehicle category from the monthly data shared by the client. The most common ticket categories observed on a typical national highway concession are: Single, Return, Monthly, Local and Exempt. Brief description of different ticket-types is given in table below.

3.43 Understanding the toll frequency gives insights into the nature of traffic. CJVs (Cars) generally have higher shares of return passes or monthly passes as the CJV users on Indian national highways tend to make shorter distance and more frequent trips. However heavy trucks mostly have single tickets since they travel long distance. This varies from asset to asset or even toll plaza to toll plaza. The asset catering to short distance local traffic generally observes high share of return or other local monthly passes while the asset catering to strategic long-distance traffic generally observes high share of single ticket traffic.

3.44 The following are the types of tickets are assumed to be sold at the plazas of both the Asset as per the concession agreement.

Table 3.7: Typical ticket types sold at NHAI plazas

Category	Description
Single	Allows the vehicle to cross the toll plaza once
Return	Daily pass for crossing the toll plaza multiple times within 24 hours. Charged 1.5 times the single toll
Monthly	Monthly pass
Local Personal	Discounted monthly pass only for private cars of residents within 20km radius of toll plaza
Local Commercial	50% discount on single trips for commercial vehicles registered in the local district
Exemptions	Officially exempted vehicles like ambulance, police cars, key political personnel etc.

Source: NHAI

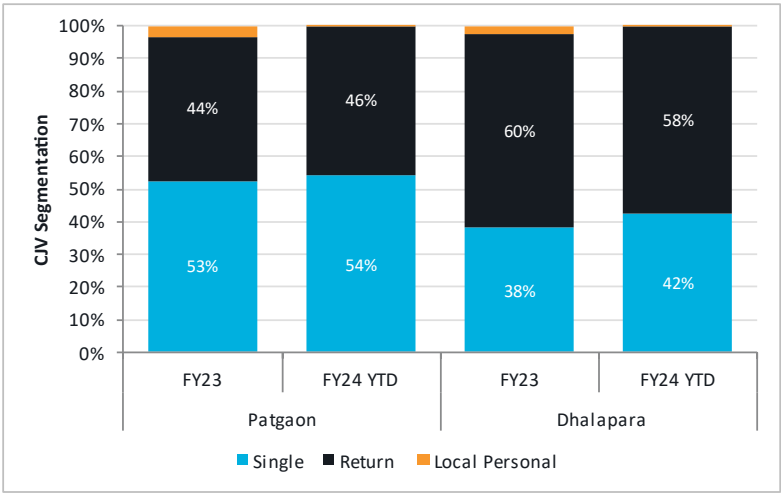
3.45 On the Asset, CJV ticket segmentation observes a healthy share of 'return' trips due to the local nature of movement. This is observed across the plazas.

3.46 The majority of MAV traffic at Patgaon, Dahalapara is long-distance traffic which has one end in Guwahati/northeast and the other in the rest of the country (west of Patgaon). While on Galia it is medium distance traffic majorly. This observation has also been supported by our OD analysis, which reveals that the average trip length on Patgaon and Dahalapara is 1,000 km or more, resulting in high proportion of 'single' tickets. Whereas the majority of MAV traffic at Galia is medium-distance traffic which has one end in Guwahati/northeast and the other in the rest of the country and the average trip length for MAV on the Galia is 600 km or more, resulting in high proportion of single tickets.

3.47 As compared to MAVs, a higher share of 'return' ticket is observed for 2As. This is due to 2As being comparatively more local in nature as compared to MAVs. Furthermore, as the 2A traffic also includes Bus traffic in Patgaon and Dahalapara, the daily trips of buses lead to higher share of 'return' ticket in 2A.

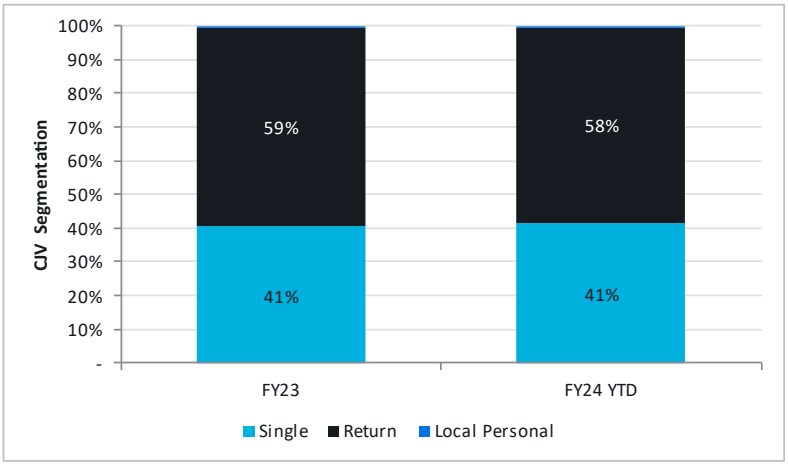
3.48 The ETC dataset doesn't include information regarding exemptions and numbers of passes sold. The share of these tickets has been calculated by analysis of TVC and TMS datasets, explained in detail in later sections.

Figure 3.8: Ticket segmentation (%) CJV – Patgaon, Dahalapara



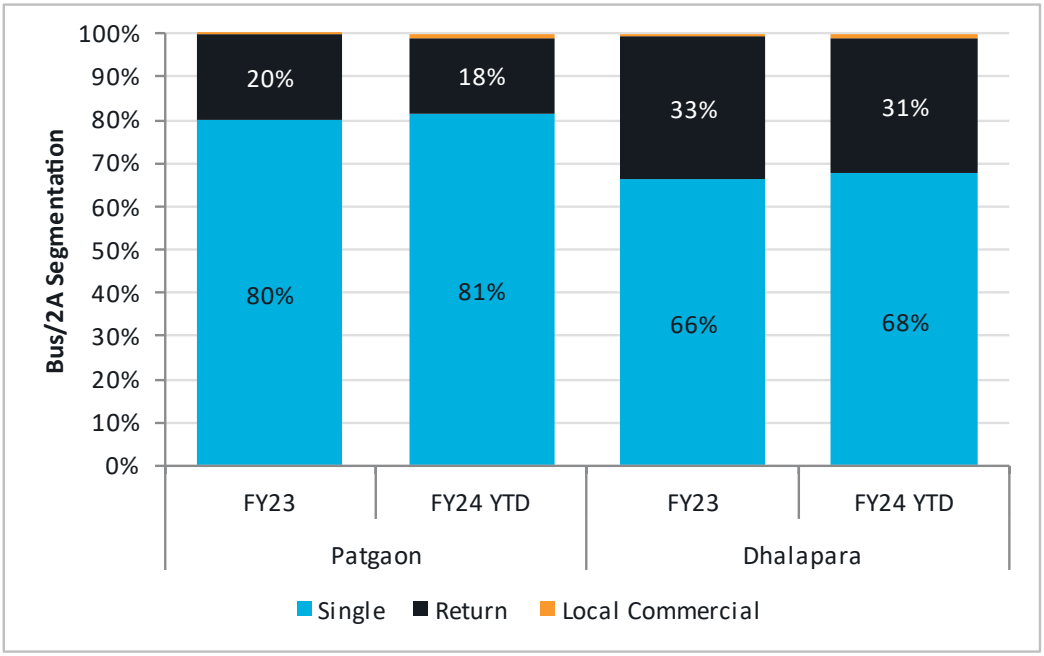
Source: Steer analysis of client data

Figure 3.9: Ticket segmentation (%) CJV – Galia



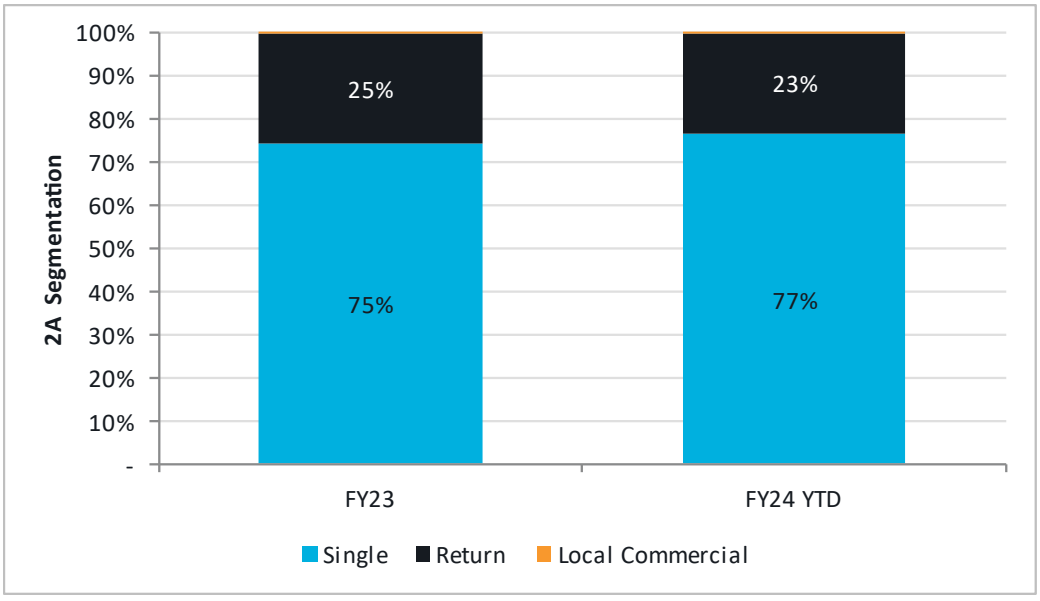
Source: Steer analysis of client data

Figure 3.10: Ticket segmentation (%) Bus/2As – Patgaon, Dahalapara



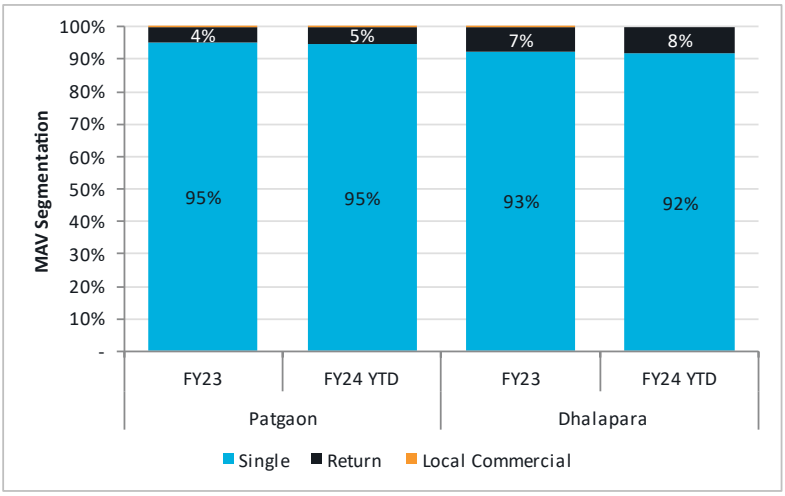
Source: Steer analysis of client data

Figure 3.11: Ticket segmentation (%) 2As – Galia



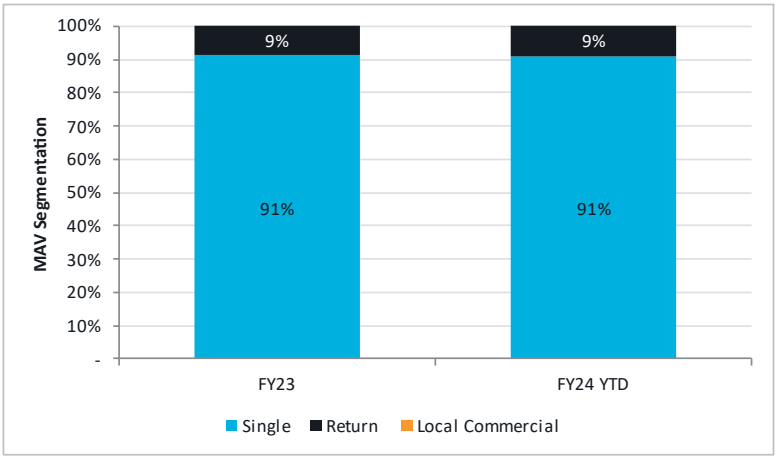
Source: Steer analysis of client data

Figure 3.12: Ticket segmentation (%) MAVs – Patgaon, Dahalapara



Source: Steer analysis of client data

Figure 3.13: Ticket segmentation (%) MAVs – Galia



Source: Steer analysis of client data

3.49 As compared to Patgaon, Dahalapara and Galia observes a slightly higher share of 'return' ticket in the commercial categories. This can be attributed to the fact that Dahalapara and Galia caters to local and short/medium distanced movements between Bongaigaon and Barpeta/Nalbari/Guwahati. The same is also the reason behind the higher volume of trucks on Dahalapara as mentioned before.

Survey data analysis

3.50 As mentioned earlier, to validate and inform various inputs used in our forecasting, we undertook primary data collection on the Asset, comprising the surveys listed below. OD data collection typically involves manual data entry by enumerators based on oral surveys with road users crossing toll plazas, which Steer commissioned with a third party. TVC data collection involves video-graphic capture of traffic passing crossing the toll plazas, followed by manual as well as software-based counting.

3.51 It should be noted that, in our experience, traffic on national highways shows variation across the week due to the economic activities surrounding each road. To derive a representative

TVC count considering daily variation, three-day to seven-day traffic counts are generally recommended, and hence, in order to fully understand the impact of this weekly fluctuation on the Asset, we collected seven-day counts at each toll plaza and a three-day count at the junction between the toll plazas to understand the traffic volumes and diversion patterns.

3.52 Steer commissioned the following primary data collection at the Asset:

- 7-day 24-hour Traffic Volume Count (TVC) at the toll plazas
- 3-day and 7 day 24-hour Turning Movement Count (TMC) at the NH17/NH17 junction between the toll plazas
- 24-hour Origin-Destination (OD) survey at the toll plazas

3.53 This chapter presents the analysis of the primary data collected and its use thereof.

Key findings of the TVC data analysis

WADT estimates

3.54 As mentioned earlier, camera based Total Vehicle Counts (TVC) forms a key part of our primary data collection exercise. Using the TVC data and taking a simple average of the traffic counts, we obtained the Average Daily Traffic (ADT) for each toll plaza. The WADT excludes non-tollable vehicle such as tractors, two-wheelers, bullock-carts, etc., but includes officially exempt vehicles such as police cars, ambulances, emergency response vehicle, government vehicle and other vehicle types officially allowed as 'exempted' under the concession agreement.

3.55 During the site visits, our team makes sure that the cameras are located at a location where complete tollable traffic is captured. Additionally, emphasis is laid on positioning of camera location such that the traffic from local leakages or bypass is also captured, if any.

3.56 In order to check the reliance of the TVC data, several checks are applied before using it in our analysis. Directional counts are verified by matching the sum of both the directions with the total counts. The table below present the 7-day average (ADT), from 05th - 11th January 2024 on Dahalapara and Patgaon and from 14th - 20th Oct 2023 on Galia, of independent counts undertaken by Steer.

Table 3.8: WADT at Asset arrived using TVC counts

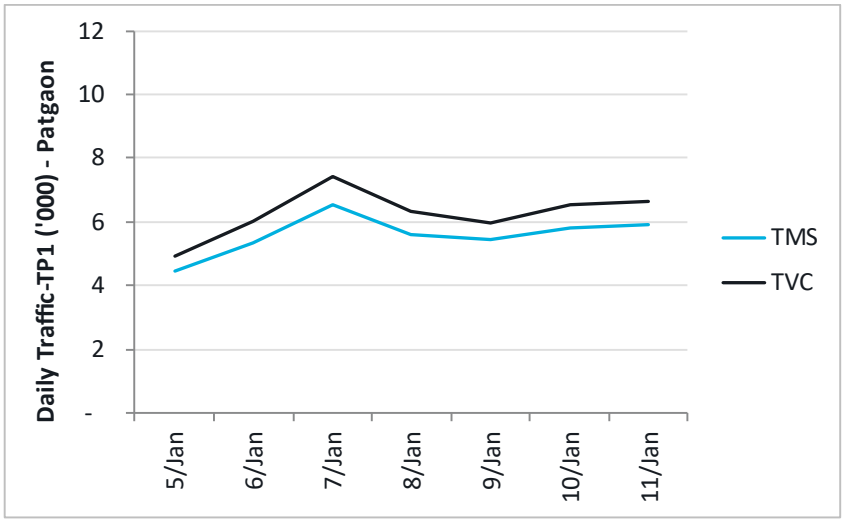
Vehicle Category	Patgaon	Dahalapara	Galia	NH17
CJV	1,590	2,521	3,287	4,651
Mini LCV	375	487	658	867
LCV	451	783	768	544
Bus	165	358	508	582
2 Axle	719	869	843	327
3 Axle	779	948	1,028	325
MAV	2,180	2,179	2,227	654
OSV	1	1	1	-
Total	**6,260**	**8,147**	**9,320**	**7,760**
PCU	**17,445**	**20,520**	**22,257**	**12,790**

Source: Steer analysis of TVC data

TVC (Total Volume Count) analysis

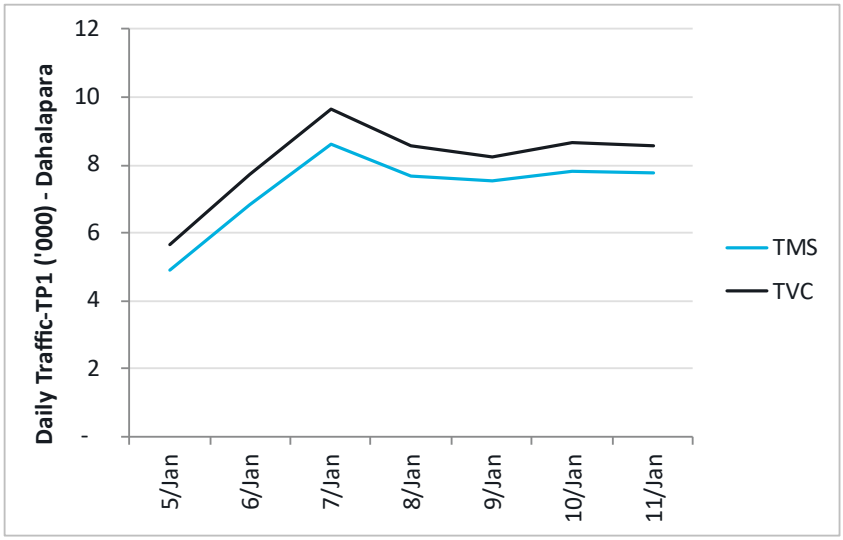
3.57 The below figure presents the analysis of data based on TVC counts undertaken by Steer. The following figure shows the daily traffic observed in our TVC and ETC (segmented) counts for the toll plazas.

Figure 3.14 TVC vs ETC - Patgaon



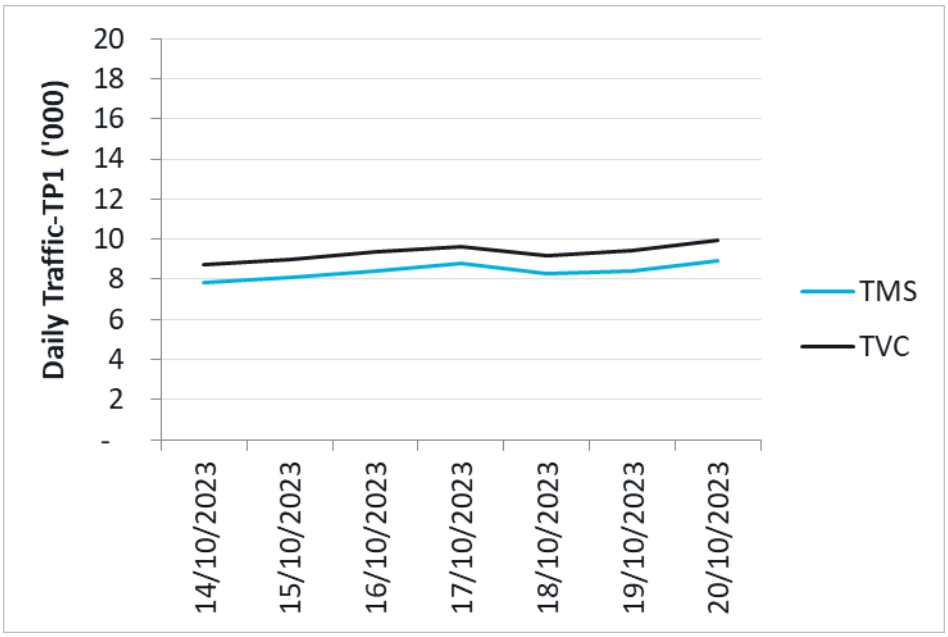
Source: Steer analysis

Figure 3.15 TVC vs ETC - Dahalapara



Source: Steer analysis

Figure 3.16 TVC vs ETC - Galia

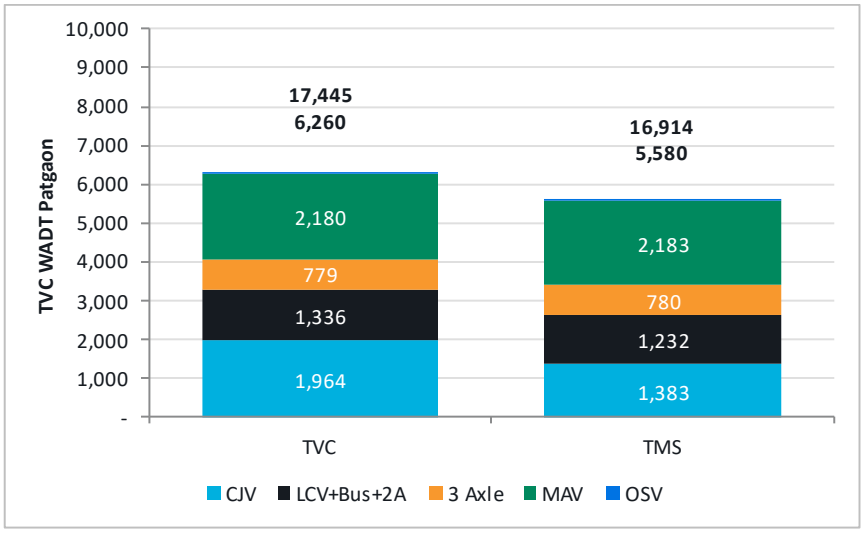


Source: Steer analysis

3.58 TVC and ETC traffic data on the Asset follows similar trend on all days, the difference in the two sources can be attributed to the vehicles which pay in cash or are not paying at the toll plaza not being accounted in the ETC dataset.

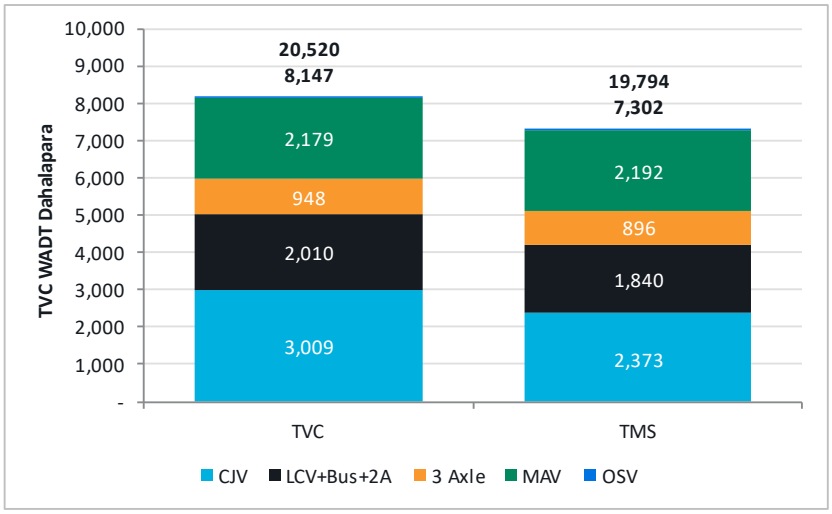
3.59 The figure below compares the vehicle wise shares as recorded by TVC on the toll plazas. Similar to the trends observed in the ETC datasets, the traffic on the plazas is dominated by commercial traffic. Lower share of CJV traffic validates the site visit observations that the plazas aren't located in vicinity of major urban centres.

Figure 3.17: Vehicle TVC comparison - Patgaon



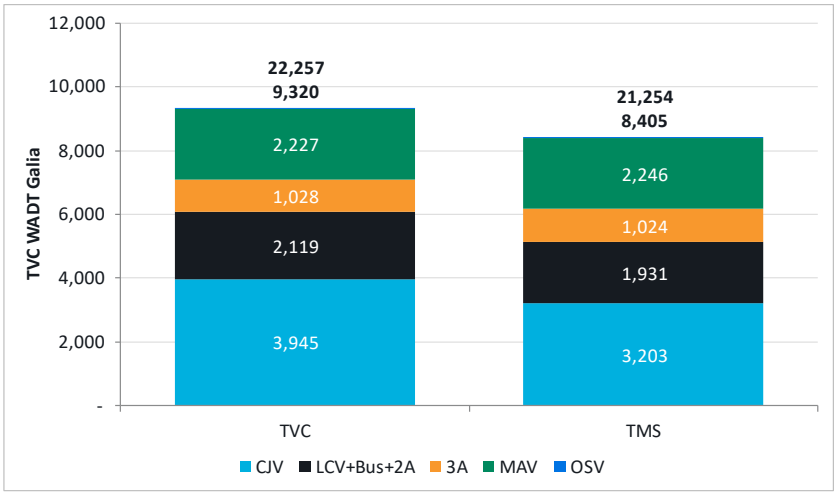
Source: Steer analysis of TVC counts and TMS data

Figure 3.18: Vehicle TVC comparison - Dahalapara



Source: Steer analysis of TVC counts and TMS data

Figure 3.19: Vehicle TVC comparison - Galia



Source: Steer analysis of TVC counts and TMS data

3.60 TVC survey was conducted for Patgaon and Dahalapara plazas from 05th - 11th January 2024 and from 14th - 20th Oct 2023 on Galia. The result of the TVC data is compared with the ETC volumes during the same period. Difference across all vehicle categories is observed where the TVC resulted in higher traffic volumes.

3.61 The difference in TVC and ETC+ Cash (segmented) ADT is majorly driven by the difference in CJVs and combined LCV+ Bus+ 2A. As mentioned in the earlier chapters, low willingness to pay amongst CJV users was observed during the site visit. Significant volume of CJVs was crossing the plazas using the end lanes due to which this share wasn't getting recorded in the ETC servers, leading to difference in ETC (segmented) and TVC counts. In case of LCV+ Bus + 2A category, there is mis-categorisation observed post FASTag, the difference in this category is subject to Bus being un-reported in the ETC + Cash.

3.62 The difference in commercial traffic between the datasets is believed to be driven by the local commercial traffic which crosses the plazas without paying.

3.63 As the ETC (segmented) dataset is being referred to for base traffic estimation, the difference between TVC and ETC+ Cash, is added as 'exemptions' in the base traffic.

Outputs from TVC analysis

3.64 We have further analysed the TVC and ETC (segmented) data at vehicular category level to ascertain the following outputs:

- **Base Correction:** As observed in the TVC-ETC + Cash (segmented) analysis, the volume of traffic saw a difference in the counts. While estimating the base using ETC+ Cash (segmented) data, these differences were accounted for in the form of base correction factors. The delta, where the difference is negligible, is not being incorporated as it can be attributed to the reconciliation of traffic numbers with the data received from the bank**.** This adjustment was necessary to understand the capacity at which the Asset is operating and capture the actual traffic on the Asset.

Table 3.9: Base Correction Factors

Vehicle category	Patgaon	Dahalapara	Galia
CJV	42.4%	27.1%	23.4%
LCV	5.7%	5.6%	-
Bus	33.3%	53.8%	147.4%
2A	5.7%	-	-
3A	-	3.6%	-
MAV	-	-	-

Source: Steer analysis of TVC/TMS data

3.65 The traffic which is being added in the form of correction in the ETC (segmented) data, is added as exemptions. The difference between ETC+ Cash and TVC, is added as exemptions, i.e., the non-paying traffic.

Turning movement counts (TMC) at key junctions

3.66 As mentioned earlier, NH17 is alternate route for the traffic destined to Guwahati. Therefore, apart from the 7-day TVC survey at the toll plazas, a 7-day count on alternate NH17 at Dudhnoi was conducted in January 2024. Also, in October 2023 3-day TMC Abhaypuri junctions was done to understand the traffic diversion at NH17 and traffic movement at NH17 (long-distance alternate route).

3.67 The result of the survey is shown below:

Table 3.10: 3-day TMC survey results

	CJV/Mini LCV	LCV	Bus	2A	3A	MAV	Total	PCU
3 day TMC								
Abhaypuri - Khagarpur	5,364	205	202	75	144	231	**6,221**	**8,190**
Tulungia - Abhaypuri	2,169	126	210	150	295	206	**3,156**	**5,693**

	CJV/Mini LCV	LCV	Bus	2A	3A	MAV	Total	PCU
Tulungia - Khagarpur	1,068	133	243	94	70	149	**1,757**	**3,265**
7-day TVC								
NH 17 Dudhnoi	5,328	544	582	327	325	654	**7,760**	**12,790**

Key findings of the OD survey data analysis

Overview

3.68 OD surveys were conducted using roadside interviews for 24 hours at each toll location, typically starting at 8am and finishing at same time on the following day. Each toll lane had an interviewer filling OD records and a supervisor monitoring them to minimise errors in data collected. This was accompanied by Steer staff visiting the toll plaza to ensure the data is being collected to quality and standards required to understand the traffic patterns on the Asset.

3.69 The OD survey was undertaken on the locations mentioned below on the following dates.

- 5th January 2024 at Patgaon,
- 6th January 2024 at Dahalapara and
- 17th October 2023 at Galia.
- Roadside OD on 6th Jan'24 between Agia and Guwahati section

3.70 Data collected was segregated into vehicle types, origin area, origin zone, destination area, destination zones, commodity being carried, and frequency of travel. The zones were further segmented into Internal, Rest of State, and External zones. The zones were also used to calculate the trip distances of the traffic plying on the Asset.

3.71 Before using the data for final analysis, the data is first cleaned, and numerous checks are applied. Some of these checks include verifying that the zones are physically apart as well as these zones are located within a reasonable distance and boundary. Reliability checks are also used which confirms that the sample rates are 50-70% for goods. Sanity checks includes verifying the sanctity of direction wise origin and destination as well as establishing that the share of empty vehicles is in line with the site visit observations. The final check includes matching the OD numbers with the TVC counts of the particular day and substantiating that the OD numbers aren't greater than the TVC counts.

3.72 Origin-destination (OD) analysis enables the understanding of the nature of traffic movement on the Asset. We have analysed the regional drivers of demand based on the following analysis:

- Zonal influence
- Commodity distribution
- Top OD pairs
- Trip length distribution

3.73 While zonal analysis and the list of top OD pairs help to understand 'where' people and goods travel, commodity distribution sheds light on 'what' goods get transported on this asset. Trip length distribution shows 'how far' vehicles and people travel, and goods get transported. This

set of analysis is used to estimate key drivers of traffic and aid in making informed forecasting assumptions related to traffic demand elasticities, growth drivers and exogenous impacts.

Sample rates

3.74 Sample rates help understand the reliability of OD data. They are calculated by dividing OD samples by the TVC count observed on the same date for each vehicle category at the toll plaza. The table below presents the sample rates for key vehicle type aggregations at the toll plaza. We believe that the sample rates of the OD data are reasonable for the analysis required.

3.75 For NH17, it was on Open OD where roadside interviews are conducted considering adequate local and national health and safety measures and unrestricted traffic movement.

Table 3.11: Sample rates for OD data

OD Sample	Patgaon	Dahalapara	Galia
2A + LCV	56%	112%	46%
3A + MAV	61%	92%	57%

Source: Steer analysis of OD data

Zone categories

3.76 To facilitate better interpretation of key regional drivers of traffic as determined by their OD zones, and influenced by various towns, cities, states, and regions in the vicinity of the Asset, we have aggregated zonal data as described in the table below.

Table 3.12: Zone aggregations for zonal influence analysis

Aggregate Zone	Description
Local	Local zones are those that fall on or very close to the Asset.
IAOI	IAOI zones are the locations which generate traffic and lie within approximately 75-150 km distance from the Asset.
Rest of State	Rest of the cities/Districts in the state that Asset lies in (other than Local/IAOI)
West Bengal	West Bengal state
Nagaland	Nagaland state
Meghalaya	Meghalaya state
Sikkim	Sikkim state
Manipur	Manipur state
Mizoram	Mizoram state
Tripura	Tripura state
Arunachala Pradesh	Arunachala Pradesh state
Central India	Madhya Pradesh
North India	Uttar Pradesh, Delhi NCR, Haryana, Punjab, Himachal Pradesh, Uttarakhand, Jammu and Kashmir
West India	Rajasthan, Maharashtra, Gujarat, Goa
South India	Telangana, Karnataka, Andhra Pradesh, Tamil Nadu, Kerala
East India	Bihar, Jharkhand, Odisha

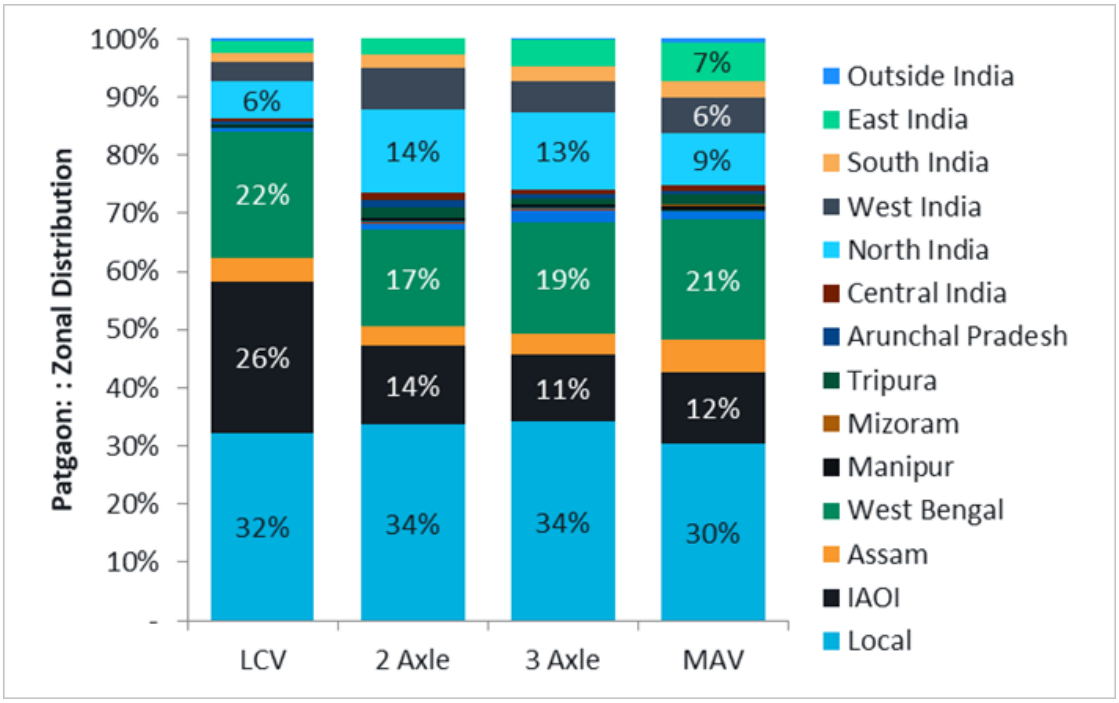
Outside India	Bhutan, Nepal

Source: Steer analysis

Zonal influence

3.77 The zonal influence is the contribution of the zone or the zonal aggregation to trips by a vehicle type. This section presents the zonal influence[1] at the toll plaza for the Asset, based on zonal aggregation listed in the previous sub-section. it should be noted that zonal influence is analysed on trip ends and not trips. Plaza wise zonal influence is presented as follows.

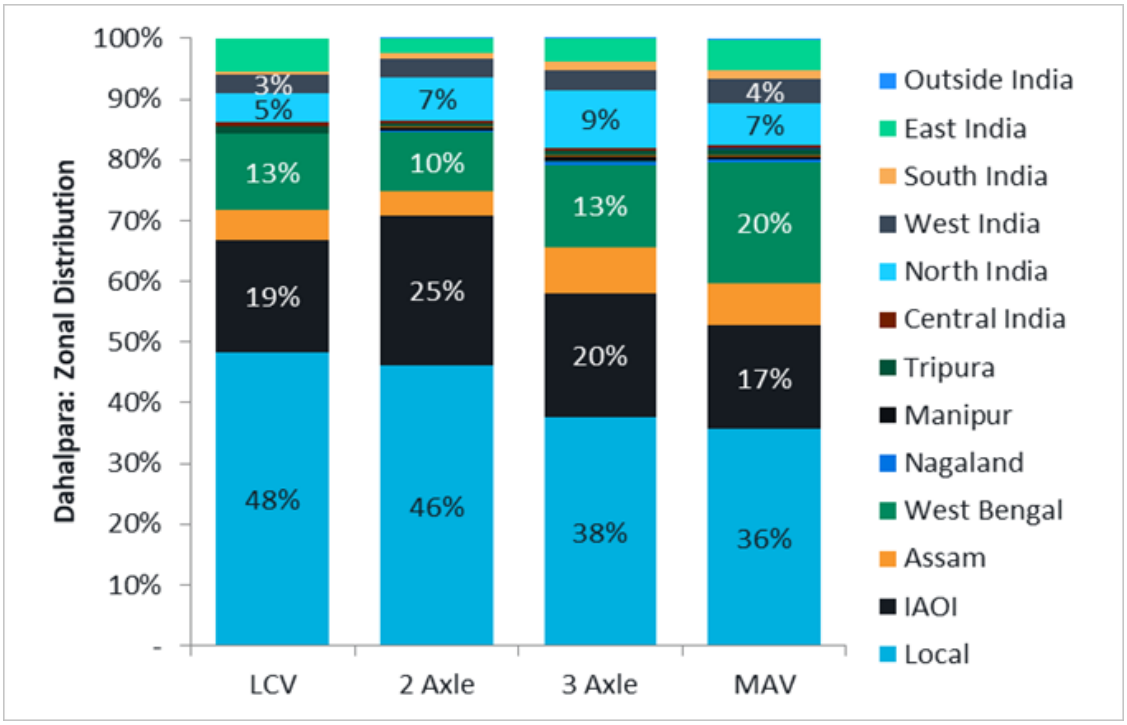
Figure 3.20: Zonal distribution - Patgaon



Source: Steer analysis of OD data

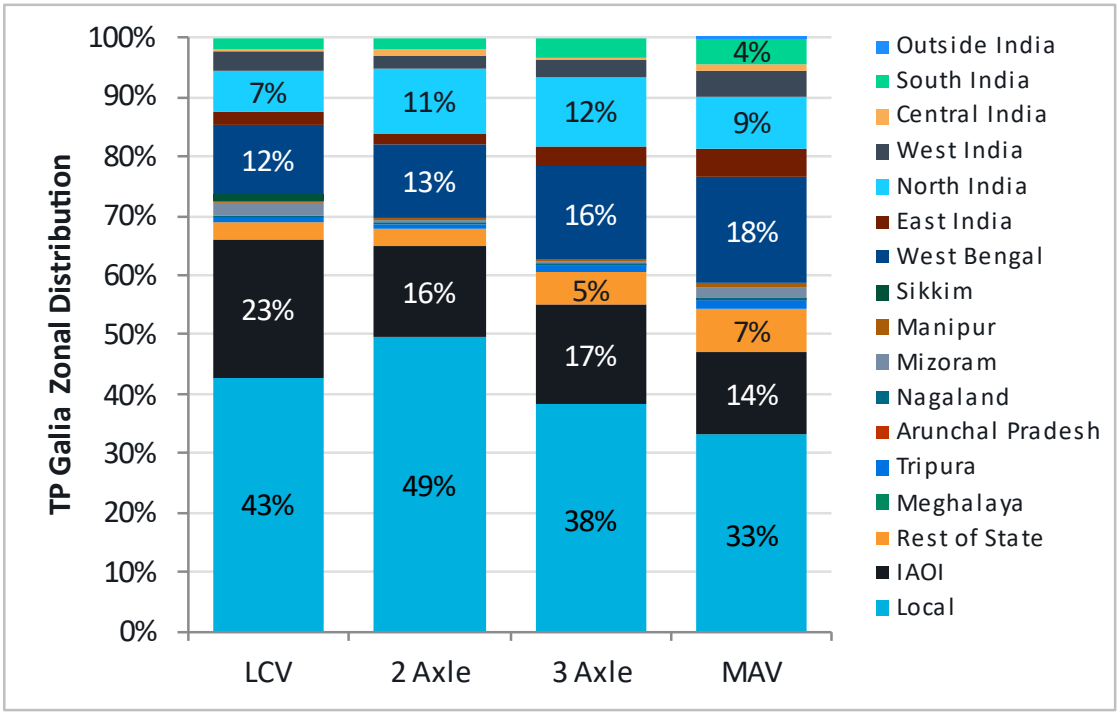
[1] For example, if out of 100 trips at a toll plaza on an Asset, 10 trips are between Hyderabad and Delhi and 90 trips are between Hyderabad and Chennai, then zonal influence of Hyderabad would be 50% since one end of all trips are at Hyderabad. Likewise, zonal influence of Delhi and Chennai would be 5% and 45%, respectively.

Figure 3.21: Zonal distribution - Dahalapara



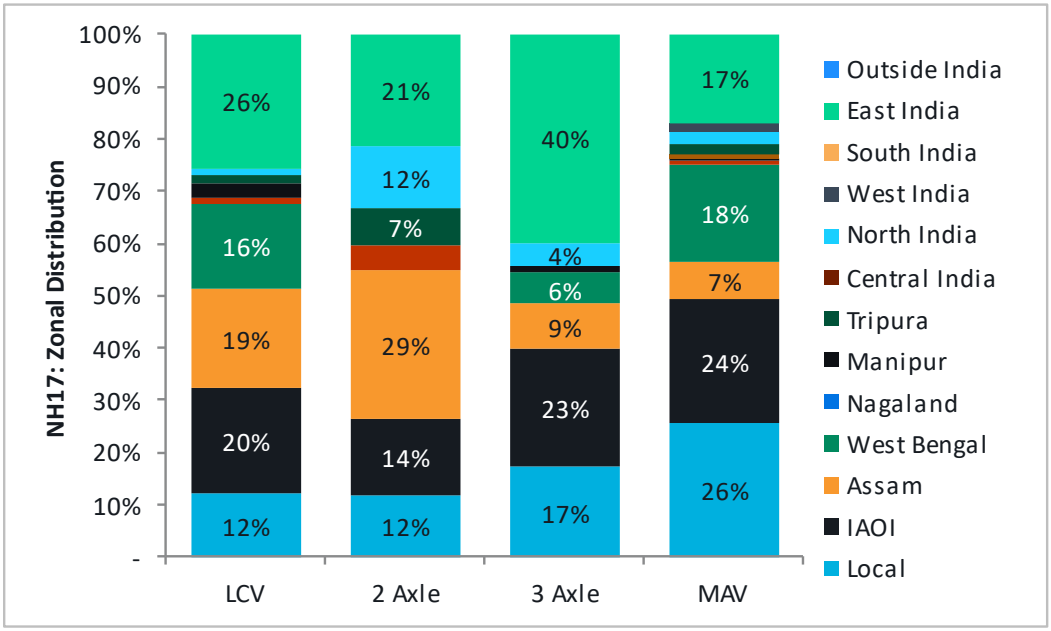
Source: Steer analysis of OD data

Figure 3.22: Zonal distribution – Galia



Source: Steer analysis of OD data

Figure 3.23: Zonal distribution – NH17



Source: Steer analysis of OD data

3.78 As CJVs and buses traverse local movements, the zonal influence is largely dominated by local and IAOI zones.

3.79 Given the long-distance and strategic nature of trips, ~40% of the total trip ends are outside the NE region for 2A/3A/MAVs. This share is dominated by trips from West Bengal as the state shares boundary with the project corridor.

3.80 As mentioned before, the NE region is primarily consumption-based in nature and depends heavily on other states for the local demand. Due to this nature of the region, goods are transported from Delhi NCR, West Bengal, North India, Maharashtra, and Gujarat etc to Guwahati and other NE regions.

3.81 The goods from rest of states are transported to Guwahati from where the goods are redistributed to other cities in the NE region. Due to this, Guwahati acts as both, a source and sink of traffic, and is one of the key destinations of the trucks on the Asset. In order to reach Guwahati, the trucks have to cross the plazas therefore, leading to through movement on the plazas. The same is the reason behind high share of 'local' across all vehicle categories. Similar zonal influence is observed on both the plazas because of this through movement of trucks.

3.82 Patgaon observes slightly higher influence of West Bengal due to the plaza's close proximity to the state. Dahalapara and Galia observe slightly higher influence of IAOI zones due to additional local movement in Bongaigaon. This movement doesn't appear at Patgaon.

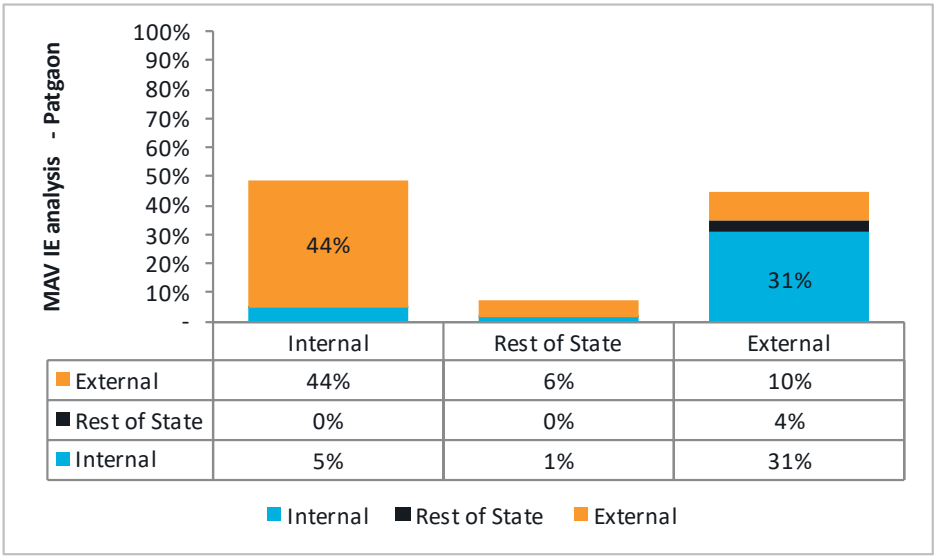
3.83 As witnessed from Zonal analysis above and Top OD pairs in Appendix of this report, NH17 has maximum influence of West Bengal, Bihar traffic after Assam and local which is visible with more than 18% trip share in MAVs and 40% in 3A. There is a large proportion of trips appearing from North India/bordering states moving towards Guwahati/Silchar/Mizoram taking NH17 currently. Apart of this, there is large proportion of local traffic in Cars, LCV and 2A on NH17 moving between Agia, Boko, Dudhnoi, Bongaigaon and Guwahati.

Internal - External analysis

3.84 Internal-External analysis helps in identifying the trips which have both an origin and destination on or near the Asset i.e., local/IAOI zones (Internal-Internal or I-I), any one end on the Asset (Internal-External or I-E), or neither end on the Asset i.e., through trips (External-External or E-E). Rest of State here represents areas within the state which are neither local nor IAOI. Internal zones are those that were analysed as local and IAOI in the zonal influence analysis, i.e., lying on the Asset, while External zones are areas lying outside the state.

3.85 As the plazas observe through movement, similar results are observed in the IE analysis charts of MAVs as shown in charts below.

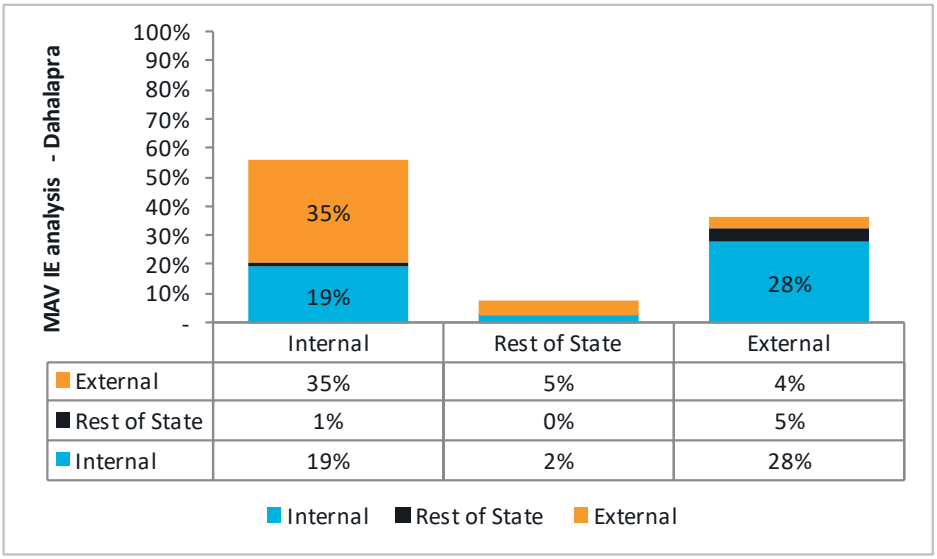
Figure 3.24: MAV IE analysis - Patgaon



	Internal	Rest of State	External
External	44%	6%	10%
Rest of State	0%	0%	4%
Internal	5%	1%	31%

Source: Steer analysis

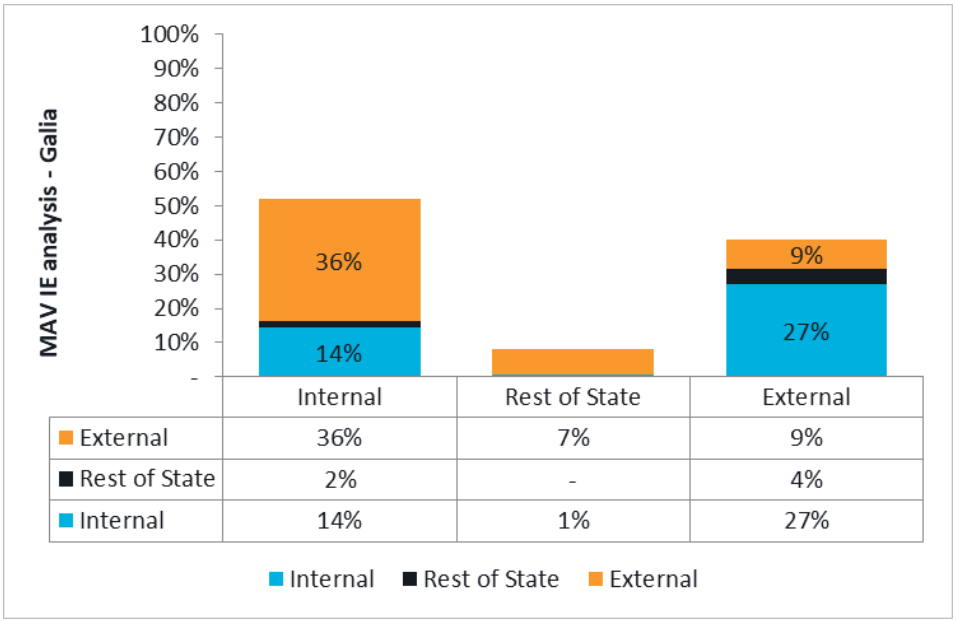
Figure 3.25: MAV IE analysis - Dahalapara



	Internal	Rest of State	External
External	35%	5%	4%
Rest of State	1%	0%	5%
Internal	19%	2%	28%

Source: Steer analysis

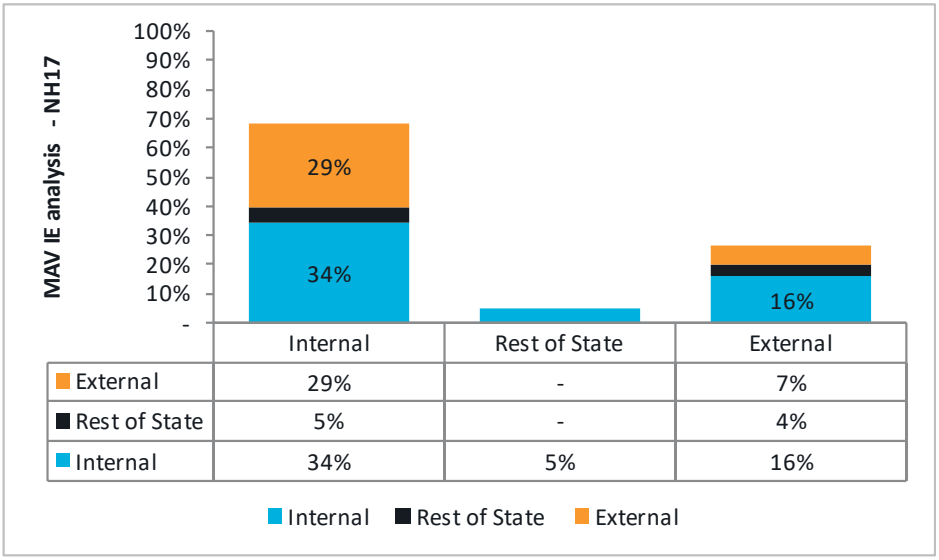
Figure 3.26: MAV IE analysis – Galia



	Internal	Rest of State	External
External	36%	7%	9%
Rest of State	2%	-	4%
Internal	14%	1%	27%

Source: Steer analysis

Figure 3.27: MAV IE analysis – NH17



	Internal	Rest of State	External
External	29%	-	7%
Rest of State	5%	-	4%
Internal	34%	5%	16%

Source: Steer analysis

3.86 As observed in the zonal influence analysis earlier, the IE analysis of the plazas also yields similar results where one end of the trip is inside Assam and one end of the trip is outside the NE region and is external.

3.87 More than 80% trips on the plazas have one internal end and one external end. This is in line with the fact that the NE region is consumption-based in nature and depends heavily on other states for good's demand leading to high share of external zones. 05-20% of the trips originate and end within Assam as these are local trips and are catering to state-centric demands.

3.88 The internal trips are generally made between Guwahati, Bongaigaon, Barpeta, Nalbari etc. to meet the local demands as well as to maintain supply chain of the nearby industrial centres. The rest of state trips are generally medium-distance trips and provide inter-state

connectivity. The External trips are the long-distance trips plying between northern states of Delhi and Haryana, West Bengal and Gujarat and Maharashtra which have one end in NE region primarily in Guwahati/nearby industrial areas. This is the through traffic on the Assets plying to meet the demands of the NE region.

Commodity distribution

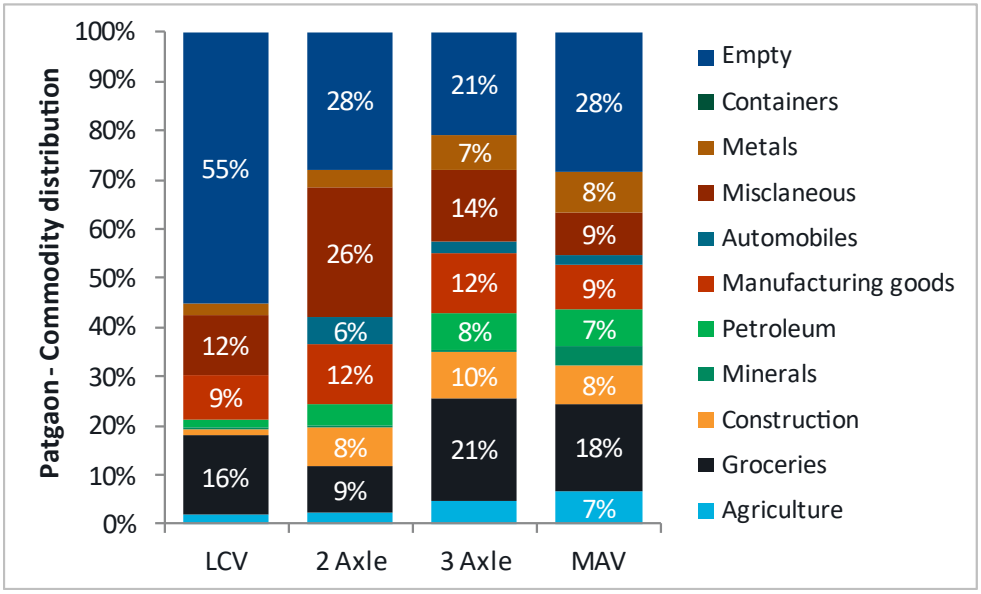
3.89 We have grouped various commodities into aggregate categories for ease of interpretation, as shown in the table below. The charts in the following sub-section present information in terms of aggregate commodity categories.

Table 3.13: Aggregate commodity categories

Commodity code	Category code	Aggregate code
Agriculture Products / Cash crops (Wheat, Rice, Sugar cane, Maize etc.)	AGR	AGR
Perishable Items (Fruits, vegetables)	PER	GRO
Animal Products/Dairy/Eggs/Fish/Meat/Animals	DFM	
Cement	CMT	CNS
Bricks	BRK	
Building Material / Construction (Lime, Brick, fly ash, etc)	CNS	
Sand/Clay	SND	
Stone (Kota stone, marble, Granite, Aggregate stone etc.)	STN	
Groceries / Food items (Soap, Salt, Sugar, Pulses, Spices, Biscuits, bread, cold drinks, beer etc.)	GRO	GRO
Cattle Food / Livestock (sheep, goat, cow, cattle food etc)	LIV	
Mining Minerals (Coal, Gypsum, Cobalt etc.)	MIN	MIN
Ceramic	CRM	CNS
Petroleum Products (Oil, LPG, CNG, etc.)	PET	PET
Chemicals / Fertilizers (Acids, Fertilizers etc.)	CHM	
Electrical/Manufacturing items (Electronic items, Medicine, Leather, Wine, Rubber/ Tyre, Plastics, Cloth, Paper etc.)	MAN	MAN
Automobiles (Finished products, auto parts, Car/bike manufacturing, New Chassis)	AUT	AUT
Miscellaneous (Parcel, Courier, Household items etc.)	MSC	MSC
Basic / Fabricated Metals (Iron, Steel / Metal)	MET	MET
Machinery / Spare parts	MAC	MAN
Raw Wood, Cork & Wood Products, Furniture	WUD	CNS
Container	CTR	CTR
Empty	EMT	EMT
Passengers	PAS	MSC
Scrap	SCR	

Source: Steer Analysis

Figure 3.28: Commodity distribution, Patgaon



Source: Steer OD analysis

Table 3.14: Directional commodity distribution – Patgaon

Srirampur to Bongaigaon					Bongaigaon to Srirampur			
LCV	2 Axle	3 Axle	MAV	Commodity	LCV	2 Axle	3 Axle	MAV
2%	2%	6%	10%	Agriculture	2%	3%	2%	3%
23%	14%	24%	25%	Groceries	10%	2%	15%	8%
2%	4%	4%	8%	Construction	1%	13%	20%	8%
-	1%	-	1%	Minerals	1%	1%	1%	8%
3%	5%	9%	10%	Petroleum	-	2%	6%	4%
18%	12%	16%	9%	Manufacturing goods	2%	13%	4%	9%
-	8%	3%	3%	Automobiles	-	1%	2%	1%
16%	31%	17%	11%	Miscellaneous	9%	18%	10%	5%
5%	5%	10%	13%	Metals	-	2%	1%	1%
-	-	-	-	Containers	-	-	-	-
31%	18%	12%	10%	Empty	76%	45%	39%	53%

Source: Steer Analysis of OD data

3.90 The direction wise distribution of commodities for each vehicle types helps to gauge a better understanding of the distribution as per the direction of goods movement. ~30-40% of trucks return empty from Guwahati in the direction towards Srirampur validating the consumption-based nature of the region. The same share of trucks carries manufacturing goods, miscellaneous goods, and metals in the direction towards Guwahati. As cement industries are present near Guwahati, the trucks carry cement related goods out of the region to rest of states in the country.

3.91 At Galia, Trucks carry groceries, agricultural goods, construction materials, parcels and couriers etc from different parts of the country to the northeast region via the plaza. From Guwahati and rest of northeast region, trucks carry cement (from Jagiroad, Morigaon), POL (from refineries in Bongaigaon, Guwahati), bamboo, tea, rubber, and groceries to the rest of country.

Figure 3.29: Commodity distribution: Dahalapara

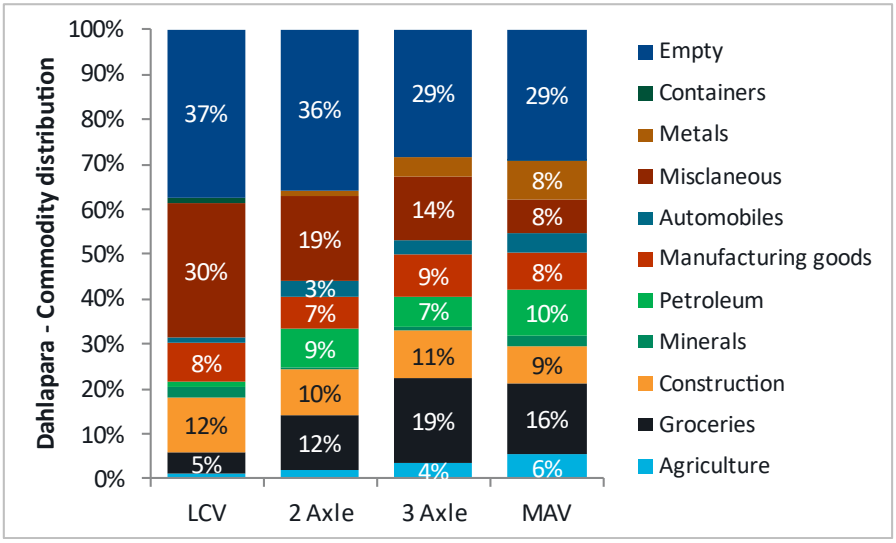
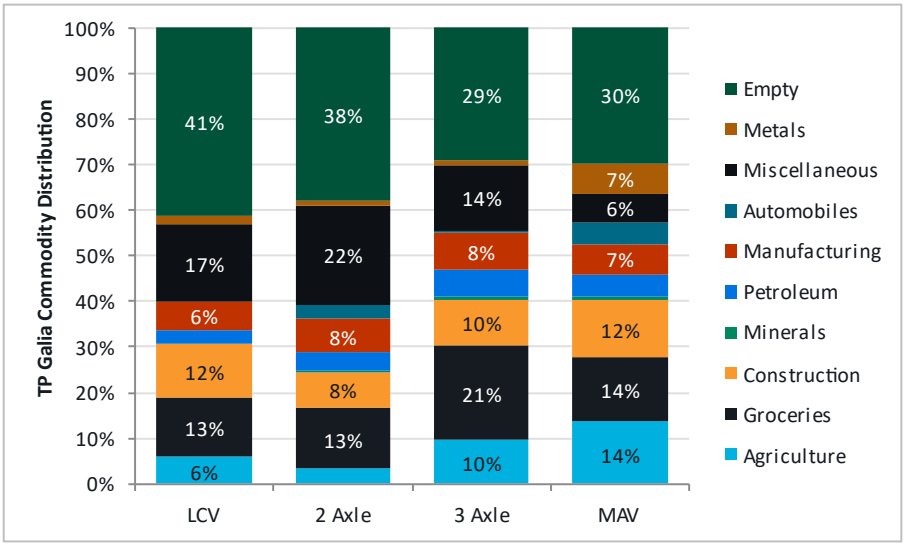


Table 3.15: Directional commodity distribution – Dahalapara

Bongaigaon to Barpeta					Barpeta to Bongaigaon			
LCV	2 Axle	3 Axle	MAV	Commodity	LCV	2 Axle	3 Axle	MAV
2%	3%	5%	9%	Agriculture	-	1%	3%	2%
2%	17%	31%	26%	Groceries	9%	9%	8%	5%
16%	16%	6%	8%	Construction	6%	5%	14%	9%
-	0%	1%	0%	Minerals	6%	1%	1%	4%
2%	9%	10%	14%	Petroleum	-	9%	4%	6%
10%	12%	15%	12%	Manufacturing goods	6%	3%	5%	4%
2%	6%	3%	6%	Automobiles	-	2%	4%	3%
43%	23%	16%	8%	Miscellaneous	12%	15%	12%	8%
-	1%	5%	13%	Metals	-	1%	3%	3%
-	-	-	-	Containers	3%	-	-	0%
22%	13%	8%	4%	Empty	59%	53%	46%	56%

Source: Steer Analysis of OD data

Figure 3.30: Commodity distribution: Galia



Source: Steer Analysis of OD data

Table 3.16: Directional commodity distribution – Galia

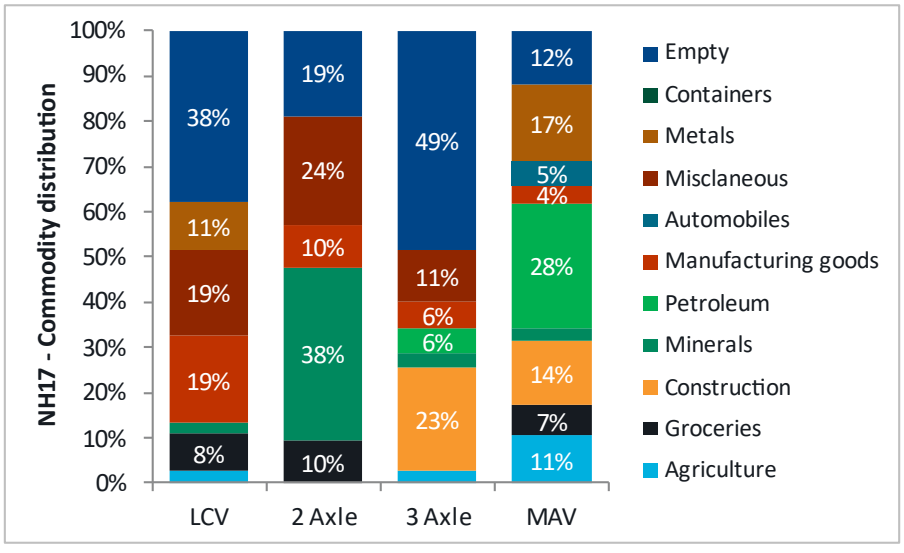
Pathshala to Howly					Howly to Pathshala			
LCV	2 Axle	3 Axle	MAV	Commodity	LCV	2 Axle	3 Axle	MAV
3%	2%	1%	1%	Agriculture	9%	6%	17%	25%
12%	14%	10%	10%	Groceries	14%	12%	30%	18%
7%	6%	13%	21%	Construction	16%	10%	7%	5%
-	0%	0%	0%	Minerals	-	0%	1%	1%
1%	2%	4%	3%	Petroleum	5%	6%	8%	7%
1%	4%	3%	3%	Manufacturing goods	11%	12%	13%	10%
-	-	-	-	Automobiles	-	6%	1%	9%
8%	14%	9%	4%	Miscellaneous	24%	31%	19%	8%
3%	1%	1%	1%	Metals	1%	1%	2%	12%
65%	57%	59%	57%	Empty	21%	16%	4%	5%

Source: Steer Analysis of OD data

3.92 The direction wise distribution of commodities for each vehicle types helps to gauge a better understanding of the distribution as per the direction of goods movement. ~30-40% of trucks return empty from Guwahati in the direction towards Srirampur validating the consumption-based nature of the region. The same share of trucks carries manufacturing goods, miscellaneous goods, and metals in the direction towards Guwahati. As cement industries are present near Guwahati, the trucks carry cement related goods out of the region to rest of states in the country.

3.93 At Galia, Trucks carry groceries, agricultural goods, construction materials, parcels and couriers etc from different parts of the country to the northeast region via the plaza. From Guwahati and rest of northeast region, trucks carry cement (from Jagiroad, Morigaon), POL (from refineries in Bongaigaon, Guwahati), bamboo, tea, rubber, and groceries to the rest of country.

Figure 3.31: Commodity distribution: NH17



Source: Steer Analysis of OD data

Table 3.17: Directional commodity distribution – NH17

Agia to Boko					Boko to Agia			
LCV	2 Axle	3 Axle	MAV	Commodity	LCV	2 Axle	3 Axle	MAV
-	-	5%	16%	Agriculture	4%	-	-	3%
7%	9%	-	2%	Groceries	9%	10%	-	12%
-	-	5%	9%	Construction	-	-	47%	21%
-	9%	-	-	Minerals	4%	70%	7%	6%
-	-	-	30%	Petroleum	-	-	13%	24%
-	18%	5%	5%	Manufacturing goods	30%	-	7%	3%
-	-	-	-	Automobiles	-	-	-	12%
7%	45%	-	-	Miscellaneous	26%	-	27%	-
-	-	-	19%	Metals	17%	-	-	15%
-	-	-	-	Containers	-	-	-	-
86%	18%	85%	19%	Empty	9%	20%	-	3%

Source: Steer Analysis of OD data

3.94 On NH17 as validated in the OD results above , there is an LPG bottling plant in Bijoynagar between Agia to Guwahati which explains the influence of petroleum which is ~27% for MAVs in both the directions. Also, there is movement of construction material in Boko to Agia direction which is material coming for the construction of Goalpara bridge which also explains the movement of empty trucks in the opposite direction towards Boko.

Trip length analysis

3.95 Trip-length distribution provides the distance-based profile of various vehicle categories. This aids in validating assumptions around the share of macro-economic drivers, inputs from zonal influence and toll segmentation. For ease of interpretation, we have categorised distances into 4 groups – local and short distance (0-250km), medium-distance (250-500 km), long-distance (500-1000 km) and very-long-distance (+1,000 km). The trip distances were derived as driving distances from Google Distance Matrix Tool based on zonal coordinates for OD pairs.[2]

3.96 The following table states the average trip lengths of traffic plying on the Asset across the toll plazas.

Table 3.18: Average trip lengths (Kms)

Toll plaza	LCV	2 Axle	3 Axle	MAV
Patgaon	996	1,453	1,403	1,336
Dahalapara	827	812	1,072	1,100
Galia	913	1,035	1,218	1,347
NH17	795	1,537	647	779

Source: Steer analysis of OD data

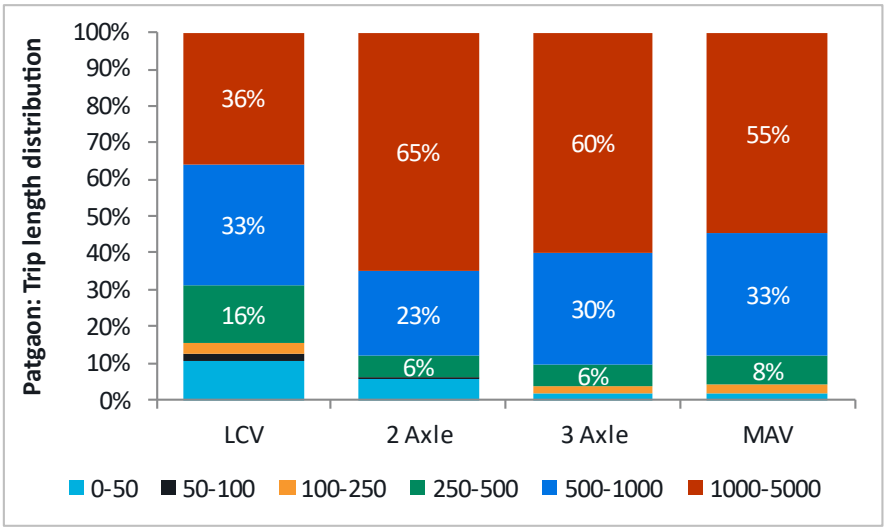
[2] Google Distance API is a tool that is available on a chargeable basis from Google Maps Platform. Link: https://developers.google.com/maps/documentation/distance-matrix/start. Travel distance and time information for driving/transit under various congestion scenarios can be extracted through this tool by using macro-enabled Excel, R, etc.

3.97 As discussed in the above sections, the Asset caters to long-distance and strategic traffic which transports goods to NE region from rest of India. The same is observed in the trip length analysis as well as all truck categories observe 1,000+ average trip distance.

3.98 As understood from the zonal distribution and IE analysis, the strategic nature of this Asset serves long-distance east-west movements. Accordingly, over 50-70% at Patgaon, 30-50% at Dahalapara and at Galia 45-65% of the trip distances of 2 Axle, 3 Axle and MAV are traveling very long-distance movement of over 1,000 km. LCVs, also serving more local areas, have a healthy mix of both short and long-distance trips.

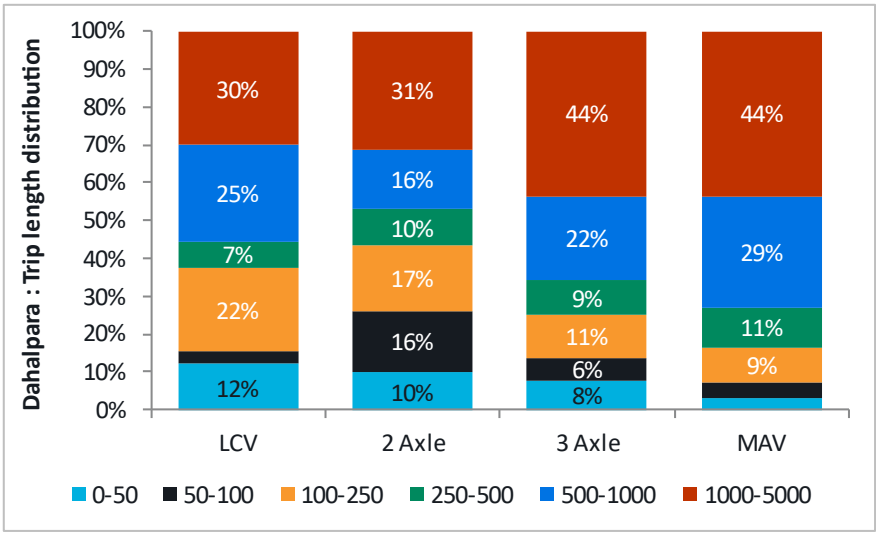
3.99 3A/MAVs on all plazas are observed to have nearly 45-65% trips traversing a distance between 1000-5000 kms per trip. These trips are the ones which have their one trip-end in rest of states of the country and other in NE region. As observed in the zonal analysis, a considerable movement is between north/central India and Guwahati which contributes to these long-distance trips. While on moving towards low paying categories, the share of short- medium distance trips increases significantly catering to local demands.

Figure 3.32: Trip length distribution: Patgaon



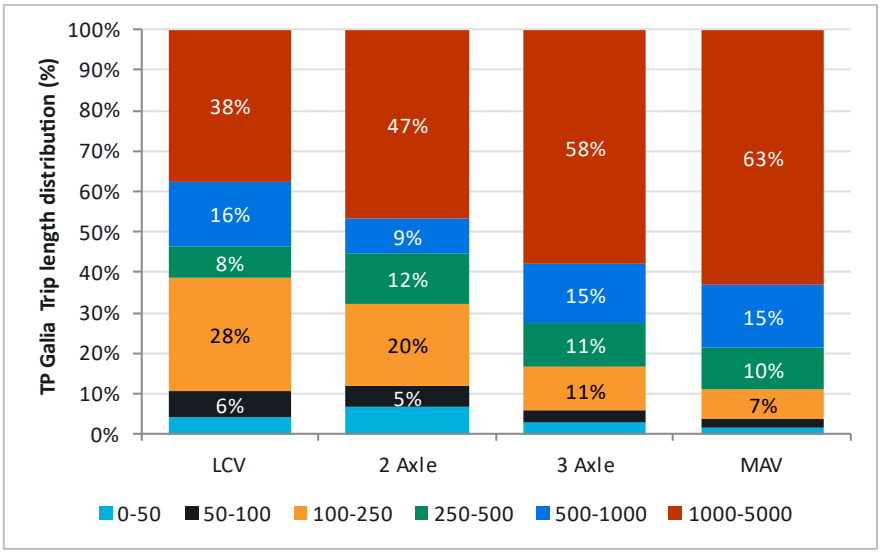
Source: Steer analysis of OD data

Figure 3.33: Trip length distribution: Dahalapara



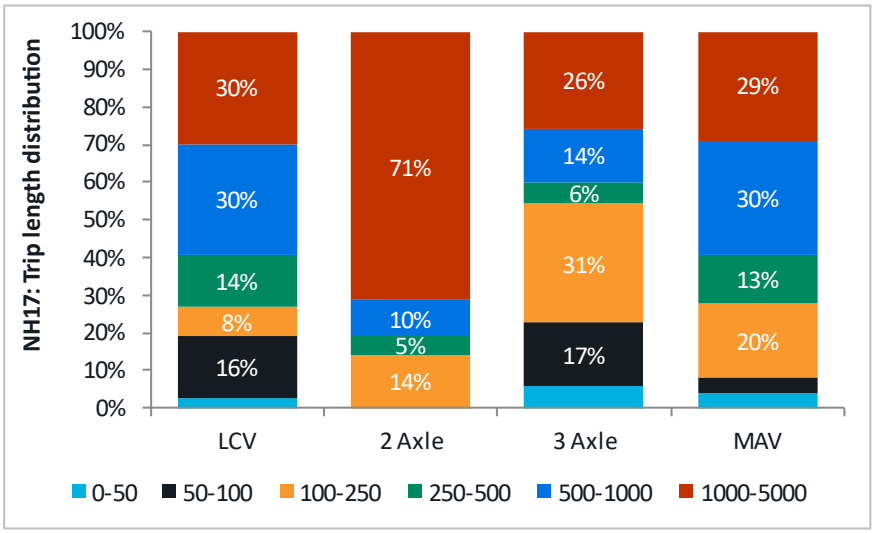
Source: Steer analysis of OD data

Figure 3.34: Trip length distribution: Galia



Source: Steer analysis of OD data

Figure 3.35: Trip length distribution: NH17



Source: Steer analysis of OD data

Conclusions

3.100 The chapter outlined the historical traffic and revenue datasets available on the Asset, as well as our analysis of primary traffic count data, collected as a part of this project. Historical data records were obtained from several sources (ETC, TMS, IHMCL) and a review of all the sources was done to estimate the robust traffic and revenue numbers.

3.101 Multiple data sources including traffic data provided by client and Steer survey results for the Asset have been analysed and presented in detail in this chapter.

3.102 Both traffic and revenue information are available for the toll plaza for a relatively short period. Independent TVC counts, and OD surveys undertaken by Steer helps us to understand

the primary traffic movements on each of the Asset. The analysis of these data sets confirms that the Asset acts as a feeder for the NE region, carries a higher share of commercial traffic as compared to passenger traffic, and caters to long-distance and strategic movement.

3.103 Both traffic and revenue information are available for the toll plazas for a relatively short period. For both the plazas, the following datasets were available:

- **ETC (segmented)**: ETC daily-level data, segmented with ticket categories, was available from Nov/Dec'21 – Nov'23. The dataset doesn't include information regarding cash-based trips, pass-based trips, and exemptions.
- **ETC (totals)**: ETC monthly-level data, without segmentation with ticket categories, was available from Apr'21 to Nov'23. The traffic in this dataset was in line with the traffic reported in ETC (segmented) dataset for the common months. Therefore, on Patgaon and Dahalapara the splits for Bus/2A category in the base traffic estimation were referred to from this dataset as the same wasn't available in the ETC (segmented) dataset.
- **TMS**: Daily level toll plaza data was available for Dahalapara for Dec'22. This was compared with ETC (segmented) data to get information regarding cash-based and local pass-based trips. Cash traffic data for Galia was available from Mar'22 to Nov'23 at vehicle category level.
- **IHMCL**: The IHMCL counts reported for the Asset are available for varied timeframe for each of the toll plaza

3.104 Both, ETC (segmented) and ETC (totals) reported similar volumes across the months where the difference in total traffic was within 1-2% in both the datasets. As both the plazas cater to long-distance traffic coming from rest of India and destined to Guwahati/NE, through movement is observed and therefore, similar volumes ply on both the plazas.

3.105 For Patgaon and Dahalapara, FY23 PCU is trending at 15361 and 18884 while grows to 15932 and 18937 in 8 months of FY24YTD. Dahalapara is at higher PCU with higher share of 2A and MAV traffic with influence of local region including Bongaigaon, Barpeta, Howly, Dahalapara and more. Galai toll plaza which is at 50kms distance from Dahalapara shares similar traffic profile with higher local influence of Howly and Barpeta. FY23 PCU at Galia is 19, 617 while 8 months FY24YTD is 19,102

3.106 Key takeaways from the data analysis obtained from primary and secondary sources are:

- The strategic and long-distance nature of traffic on the Asset was validated by the zonal distribution of the OD analysis as for MAVs, ~40% of the total trip ends are outside the NE region. The same was confirmed by the internal-external analysis too as more than 80% trips on the plazas have one internal end and one external end. In line with these observations, the trip length analysis saw greater than 60% of commercial traffic covered 1,000+ kms per trip. The Asset, being situated in consumption-based region, observed commodities like manufacturing, metals, parcels and couriers coming from rest of India. Subsequently, high share of empty trucks was observed from Guwahati moving back towards Srirampur to rest of India. From Guwahati and rest of northeast region, trucks carry cement, POL, bamboo, tea, rubber, and groceries to the rest of country.
- Steer TVC counts when compared to the ETC + Cash data on the overlapping dates observed a similar trend across all days. However, difference in the traffic volumes for across categories was also observed. The difference was largely driven by CJVs
- As the ETC (segmented) dataset is being referred to for base traffic estimation, the difference between TVC and ETC+ Cash, is added as 'exemptions' in the base traffic.

4 Socio Economic Context

Introduction

4.1 The growth of traffic on existing (brownfield) roads depends on, firstly, how quickly the background travel demand grows (background growth); and secondly, how successful the Asset is in attracting that traffic (traffic capture). Background travel demand is driven by the socio-economic conditions of the region where the Asset is located and conditions at a national level. These include:

- Changes in macro-economic factors such as population, economic growth (regional and national) and industrial production; and
- Other local factors such as strategic port growth, and growth of industries in the vicinity of the Asset.

4.2 The change in the competitive position of the Asset (and thus of the traffic capture it will achieve) derives from the level of service and associated cost on the Asset in comparison to competing roads; and whether any new competing road facilities are available.

4.3 In this chapter, we assess the socio-economic indicators relevant to traffic growth on the Asset. The relevant growth drivers where reliable information was available have been selected for establishing growth trends in the traffic forecasts.

Population growth

National Level

4.4 The total population in India has grown at a Compound Annual Growth Rate (CAGR) of 1.5% since 2000, and have been showing decreasing trends over the years, as presented in the table below. The World Bank forecasts this growth to decrease to 0.6% CAGR by the 2030-45 period.

Table 4.1: CAGR of population in India

Years	CAGR		
	Total Population (m)	Rural Population (m)	Urban Population (m)
1970 - 1985	2.3%	1.9%	3.8%
1985 - 2000	2.0%	1.7%	2.9%
2000 - 2015	1.5%	1.0%	2.6%
2015 – 2030*	1.0%	0.3%	2.3%
2030 – 2045*	0.6%	-0.3%	1.9%

Source: World Bank Data on Health Nutrition and Population Statistics, *forecast population growth

4.5 The Asset lie in the state of Assam and is also directly influenced by the other states in the NE region.

4.6 The NE India covers around 8% of India's total geographical area with a population of 45 million (as per Census 2011), which is about 4% of the country's total population.

4.7 Amongst the NE India, Assam is the most populous state (31 million), accounting for ~70% of NE population. Overall, NE India has a higher proportion of people living in rural areas. The higher concentration of people in rural areas also indicates that the economies of the NE India states remain highly dependent on agriculture and allied activities.

4.8 Assam, with 70% of the population of NE India, is a major consumption hub for this region. The growth in Assam and Northeast India's population is expected to drive consumption in the region going forward.

Table 4.2: Proportion of NE population

State	1961	1971	1981	1991	2001	2011	2011 population (m)
Assam	75%	75%	73%	71%	69%	69%	31.21
Meghalaya	5%	5%	5%	6%	6%	7%	2.97
Nagaland	3%	3%	3%	4%	5%	4%	1.98
Tripura	8%	8%	8%	9%	8%	8%	3.67
Manipur	5%	5%	6%	6%	6%	6%	2.86
Mizoram	2%	2%	2%	2%	2%	2%	1.10
Arunachal Pradesh	2%	2%	3%	3%	3%	3%	1.38
NE % of India	3.3%	3.6%	3.6%	3.7%	3.7%	3.7%	45.16

Source: Census 2011 Data

4.9 The major consumption centers of NE India are presented in the table below along with their population.

Table 4.3: Key consumption centres in NE India

State	Key cities	Population (2011 census) Lakhs
Assam	Kamrup district - Guwahati	27.67
	Nagaon	28.23
	Jorhat	10.92
	Dibrugarh	13.26
	Tinsukia	13.28
Meghalaya	Shillong	1.43
Tripura	Agartala (West Tripura district)	4.00
Mizoram	Aizawl	2.93
Manipur	Imphal	2.68
Nagaland	Kohima	2.68
	Dimapur	3.79

Source: Census 2011 Data

4.10 However, due to complexities in urbanisation trends, and the dynamic nature of local population migration (which are very difficult to forecast), we do not use population growth as

a proxy for understanding future travel demand growth on the Asset. It has been included in this section to provide the overall context of the region in which the Assets are located.

Economic Indicators

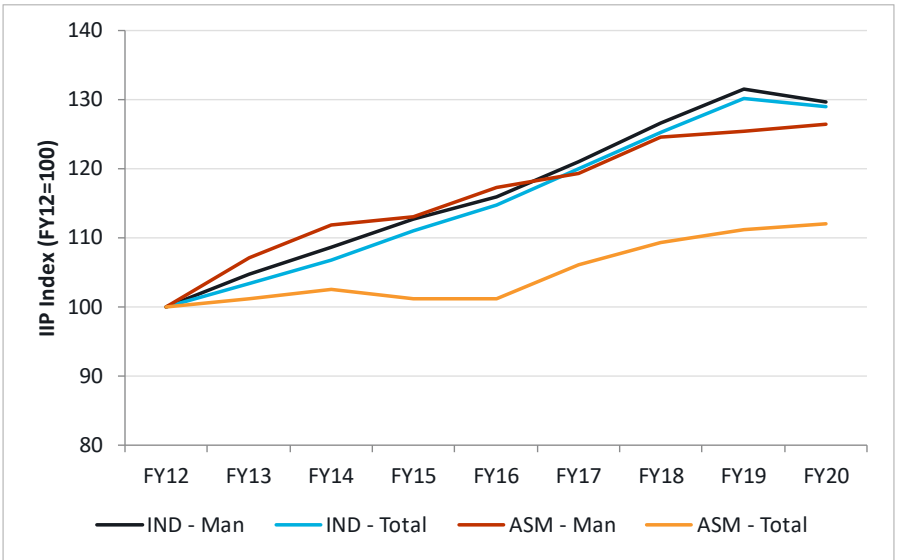
Industrial Production

4.11 The Index of Industrial Production (IIP) is a composite indicator that measures the short-term changes in the volume of production for a basket of industrial products. The IIP data tracks the manufacturing activity in different sectors of an economy, with mining, manufacturing, and electricity being the three broad sectors in which IIP constituents fall.

4.12 At an annual level, the IIP was growing on an average of 4% between FY15-19, before being hit by liquidity crisis and the overall economic slowdown in FY20. Post that, the IIP shrank by over 8% in FY21, due to a decline in economic activities in the wake of global lockdowns associated with the Covid19 pandemic. However, with gradual opening of the economy and rebound in consumer demand, the IIP grew by 11.3% in FY22, indicting a revival in economic growth.

4.13 The Assam state's manufacturing industrial production index (IIP) has grown at a similar CAGR (FY12-20) to the India's manufacturing IIP, ~3%.

Figure 4.1: Annual growth - Index of Industrial Production



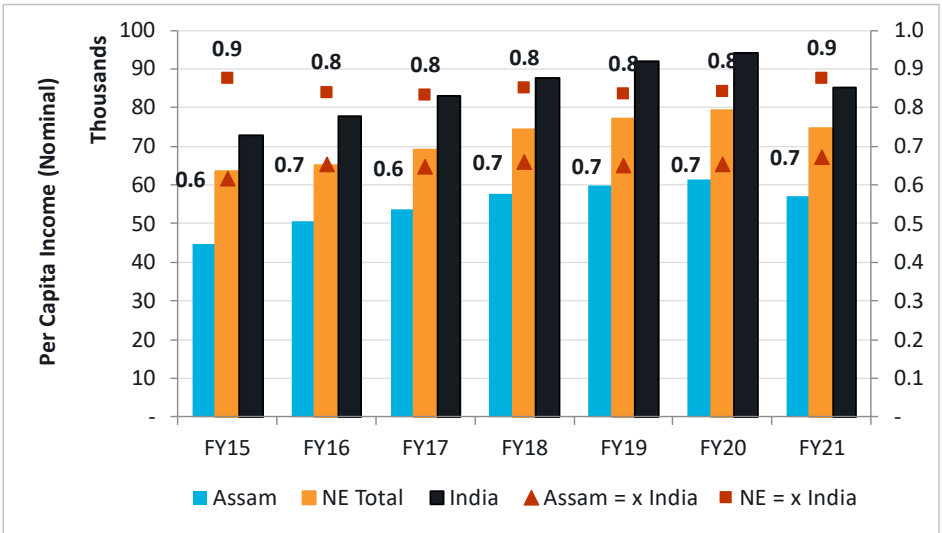
Source: Central Statistical Organisation (CSO) Note: Assam

4.14 As, availability of long-term forecast is the key for using an indicator as a growth driver, and as the long-term forecast for IIP is not available we refrain from using it to forecast traffic, however it is an important proxy to understand the state's historical growth.

Per Capita Income (PCI)

4.15 The per capita income of the NE India is less than that of India at 0.7x, while Assam's per capita income has lately grown to 0.9x of India. However, in dollar terms, PCI of just $1,000-$2,000 per head indicates that the India is at a very early stage of consumption curve. Going forward, we expect local consumption would be strong with increasing per capita income which would result in growth of both passenger and commercial traffic on the Asset.

Figure 4.2: Per capita income



Source: Central Statistical Organisation (CSO)

4.16 However, given the difficulty in obtaining granular district level PCI data, it is not advisable to use this as a growth driver. Also, the long-term forecast for PCI is not available, we therefore refrain from using it to forecast traffic.

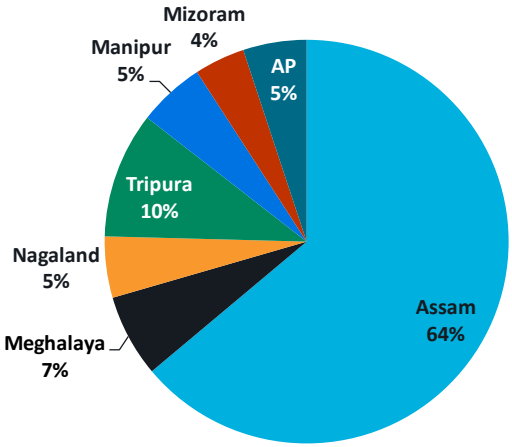
GDP and GSDP Growth

4.17 The Indian economy has grown at a CAGR of 6.6% during FY12-20, aided by a strong growth in the services/tertiary sector. The economic growth of Assam (GSDP)[3] has been similar to that of the country overall. In terms of per capita income, Assam has lower per capita than the country.

4.18 Around 8% of India's total geographic area with a population of 45 million (as per Census 2011) lie in the NE region and contributes ~3% to India's total GDP. The economy of NE India has grown in line with the Indian GDP at a CAGR of 6.6% during FY12-20. The growth observed in NE region is largely driven by the state of Assam which contributes ~ 65% to the region's economy.

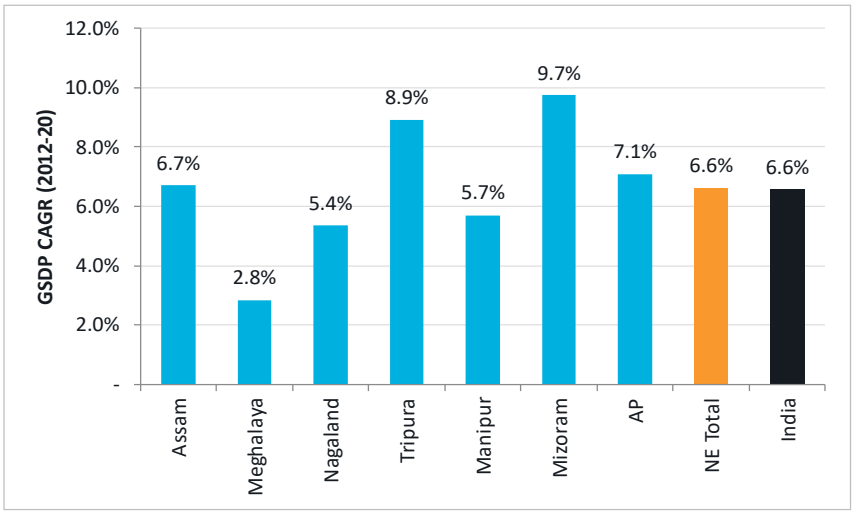
[3] GSDP is the Gross State Domestic Product i.e., the GDP equivalent for a particular state, it is the final value of goods and services produced by a particular state

Figure 4.3: Contribution to NE Economy



Source: Ministry of Statistics and Programme Implementation

Figure 4.4: GSDP CAGR (FY12-20)



Source: Ministry of Statistics and Programme Implementation; Note: AP: Arunachal Pradesh

4.19 In terms of sectoral contribution, Assam is the most industrialized state within NE India, with the share of 27% of GSDP coming from secondary sector. Some of the key industries in Assam include oil and gas, limestone and cement, and coal.

4.20 The state also has considerably high share of primary industries, with agriculture accounting for one third of the state's income. The state is famous for its tea cultivation and accounts for approximately half of India's tea production.

4.21 Assam is a major producer of crude oil and natural gas in India. Most of the oilfields are in the upper Assan region with the refineries located in Guwahati, Digboi, Numaligarh and Bongaigaon.

4.22 The official historical GDP and GSDP data for India are released by the Central Statistical Organisation (CSO). The GDP forecasts for India are available from various reliable sources such Consensus Economics, but the state level GSDP forecasts are not published. However, using the long-term historical trends between GDP and GSDP, we have developed factors

which are used to forecast GSDPs for each state. Therefore, in our view, GDP is the best source to be used as a growth driver for long term forecasts of traffic.

4.23 The other key indicators which are proxy to the state's industrial growth are credit to industry by commercial banks, power requirement and fuel consumption, all these three indicators have grown in line with the Assam GSDP **~6.5%.**

Table 4.4: Summary of key economic indicators

CAGR FY12-20	GSDP/GDP	Credit to Industry by commercial banks	Power requirement	Fuel consumption
Assam	**6.7%**	**6.5%**	**6.3%**	**6.0%**
Meghalaya	2.8%	10.2%	1.1%	2.3%
Nagaland	5.4%	1.7%	4.7%	5.0%
Tripura	8.9%	14.4%	6.2%	2.6%
Manipur	5.7%	16.7%	6.9%	8.3%
Mizoram	9.7%	13.5%	6.3%	4.3%
Arunachal Pradesh	7.1%	(1.4%)	2.8%	7.7%
NE Total	**6.6%**	**7.3%**	**5.3%**	**5.4%**
India	**6.6%**	**6.5%**	**4.1%**	**3.9%**

Source: Ministry of Statistics and Programme Implementation

Summary

4.24 For any indicator to be used as a growth driver to forecast traffic, a reliable source of historical and forecast available for that indicator is the key requirement. Of the key socioeconomic indicators discussed above GDP seems to be the only growth driver for which reliable data is available both in terms of historical and forecast data, therefore, to forecast traffic we would be using GDP/GSDP as our key growth drivers.

Table 4.5: Summary of key growth drivers

Indicator	Remarks
GDP/GSDP	Available annually ***National level reliable historical and forecast available***
Population/Urbanisation	Revised every 10 years, last available 2011. Population estimates are not available annually, making it difficult to run regressions. Also, the very dynamic nature of local population migration (which are very difficult to forecast with accuracy), we do not use population growth as a proxy for understanding future travel demand growth on the Asset. *Forecast available but historical data is a constraint*
Per Capita income	Forecasts on national and state level per capita income is not available *Historical data available but forecast data is a constraint*
IIP Index (Industrial production)	Unlike GDP, reliable IIP forecasts are not available.

Source: Steer analysis

5 Base traffic and forecasting assumptions

5.1 In this chapter, we present our approach to arrive at the base traffic position and assumptions for baseline (or background) traffic growth for each vehicle category on the Asset.

5.2 The two most important inputs that go into traffic and revenue forecasts are:

- The base position – both in terms of traffic and revenue levels currently being generated by an Asset; and
- The future growth trends – which can be correlated to the various growth drivers and used to develop an informed view of the forecasts.

5.3 The following sections discuss our approach to arrive at each of these inputs for both the Assets.

FY24 Base year AADT estimates

5.4 The base year is the year on which long-term background forecast growth rates are applied to derive year-wise average annual daily traffic (AADT) estimates for forecast years. This is therefore an important aspect of our forecasting approach as traffic and ultimately revenue forecasts for future years are built on top of the base year traffic estimate. We have used FY24 as the base year for AADT estimates of the forecast years.

5.5 As described previously in Chapter 3, to establish the base year (FY24) traffic position, we utilised information from various sources – including from the Client and our background understanding, to assess a reasonable demand on the corridor.

5.6 Traffic data for the Asset for all three plazas Patgaon, Dahalapara and Galia was available in form of the following datasets:

- **ETC (segmented)**: ETC daily-level data, segmented with ticket categories, was available from Nov/Dec'21 – Nov'23. The dataset doesn't include information regarding cash-based trips, pass-based trips, and exemptions.
- **ETC (totals)**: ETC monthly-level data, without segmentation with ticket categories, was available from Apr'21 to Nov'23. The traffic in this dataset was in line with the traffic reported in ETC (segmented) dataset for the common months. Therefore, on Patgaon and Dahalapara the splits for Bus/2A category in the base traffic estimation were referred to from this dataset as the same wasn't available in the ETC (segmented) dataset.
- **TMS**: Daily level toll plaza data was available for Dahalapara for Dec'22. This was compared with ETC (segmented) data to get information regarding cash-based and local pass-based trips. Cash traffic data for Galia was available from Mar'22 to Nov'23 at vehicle category level.
- **IHMCL**: The IHMCL counts reported for the Asset are available for varied timeframe for each of the toll plaza

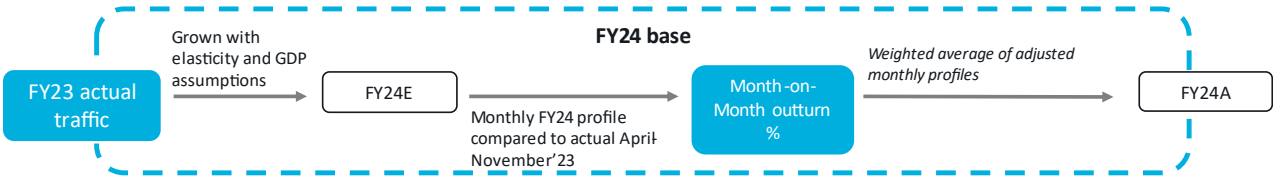
5.7 Since, ETC (segmented) dataset had information regarding the current ticket segmentation on the Asset, it has been referred to for base estimation. Furthermore, the traffic in ETC (segmented) was in line with the traffic reported in ETC (total) across all months as explained in Chapter 3. The uniformity in traffic across these datasets establishes confidence in the quality of data.

Methodology

5.8 As the actual traffic for all the month for of FY23 is available for all three plazas which is used to estimate the SCF for each of the toll plazas along with macro economic factors of GDP/ GSDP and growth assumptions of each vehicle category.

5.9 The figure below spells out the base traffic estimation (FY)24A methodology:

Figure 5.1: Base traffic estimation (FY24 Adopted)



Source: Steer analysis

5.10 The FY24 base traffic (without correction) is shown in the table below.

Table 5.1: FY24 base traffic (without correction)

FY24 base	Patgaon	Dahalapara	Galia
CJV	1,156	2,237	3,134
LCV	251	469	574
Bus	100	150	188
2A	903	1,129	970
3A	807	905	941
MAV	2,178	2,200	2,113
OSV	2	1	2
Total	**5,396**	**7,091**	**7,922**
PCU	**16,771**	**19,399**	**19,809**

Source: Steer analysis

FY24 Base correction

5.11 To arrive at the true base traffic position, we have used a base correction factor to adjust the traffic volumes. The percentage of this correction has been calculated by comparing the ETC+Cash (segmented) traffic volumes with TVC data as explained earlier in the report. As the base AADT of our forecasts is derived using the ETC+Cash (segmented) data, it is imperative to validate the robustness of the reported traffic volumes with independent counts.

5.12 The difference between reported ETC+Cash (segmented) data and Steer independent TVC counts is added to the FY24 base (without correction) to account for the vehicles which are crossing the plaza as unreported and non-paying traffic.

5.13 To correctly account for true traffic levels, we have added the difference between Steer TVC and ETC (segmented) counts (as a % of ETC) on the previously mentioned FY24 base traffic estimate (without correction). We believe that this share of additional isn't reported as it is 'exempt' traffic. The adjustment of this additional traffic in ticket segmentation is explained in the later sections. The table below illustrates the adjustment for the difference in TVC-ETC+Cash traffic, and how it is factored into our base position:

Table 5.2: Base correction factor adjustment for Patgaon and Dahalapara

	Patgaon			Dahalapara		
	FY24 base (without correction)	***Base Correction Factor***	***FY24 Base (final)***	***FY24 base (without correction)***	***Base Correction Factor***	***FY24 Base (final)***
CJV	1,156	42.4%	1,645	2,237	27.1%	2,843
LCV	251	5.7%	265	469	5.6%	495
Bus	100	33.3%	133	150	53.8%	231
2A	903	5.7%	954	1,129	-	1,129
3A	807	-	807	905	3.6%	938
MAV	2,178	-	2,178	2,200	-	2,200
Total	**5,396**		**5,985**	**7,091**		**7,837**
PCU	**16,771**		**17,536**	**19,399**		**20,386**

Source: Steer analysis, base correction factor is difference between TVC and ETC+Cash traffic as a % of ETC traffic

Table 5.3: Base correction factor adjustment for Galia

	Galia		
	FY24 base (without correction)	***Base Correction Factor***	***FY24 Base (final)***
CJV	3,134	23.4%	3,777
LCV	574	-	574
Bus	188	147.4%	465
2A	970	-	970
3A	941	-	941
MAV	2,113	-	2,113
Total	**7,922**		**8,842**
PCU	**19,809**		**21,283**

Source: Steer analysis, base correction factor is difference between TVC and ETC+Cash traffic as a % of ETC traffic

Elasticity and growth drivers

5.14 In this section, we present our approach, and assumptions around estimation of elasticities and forecast assumptions of macro parameters for each vehicle category on the Asset.

5.15 Traffic growth is commonly related to a variety of macro-economic and industry- or commodity-specific factors (hereafter referred to as 'traffic growth drivers'). These growth drivers are typically identified from the results of the OD data analysis and the site visits that help us appreciate the nature of traffic movement – 'what' travels 'where' and 'why'.

5.16 On Asset where long time series historical data is available, we typically carry out regression analysis, to determine the historical relationship between traffic belonging to each major vehicle category and its macroeconomic growth driver at the toll plaza. The dynamics of traffic demand is the dependent variable while the dynamics of one or more identified growth drivers are the independent or explanatory variables. This is the primary approach to determine the elasticity relationships. However, for Asset under consideration where limited historical data is available, we have adopted a benchmark approach for our elasticity estimates.

5.17 While working on several Assets across the country where historical data is available, it has been observed that typically, growth of passenger and light commercial vehicles like cars, buses and LCVs which have relatively shorter trip lengths (<200-250 km) is more closely linked to the local economic growth drivers where the Asset is located. These categories are generally driven by the demand of local production/consumption centres and are in most cases captive to the Asset. Local factors coupled with tourism driven demand is often seen as the key driver for consumption of goods and services in the areas. Therefore, we typically link the growth rate of these vehicle categories with GSDP growth rates of the state where the asset is located as that is closest proxy of the local economic activity in the region.

5.18 Whereas heavy vehicle traffic like 3A trucks (sometimes 2A trucks as well) and MAVs tend to have a much longer average trip lengths (>350-500 km) and serve multiple economic activity centres located along an Asset as well beyond the Asset across multiple states of the country. For these vehicle categories we therefore assume these vehicle categories to grow in line with the national GDP.

5.19 This is because most light goods vehicles tend to travel shorter distances within the state, whereas a significant proportion of heavy vehicles carry commodities for long - distances across the country and have much longer trip lengths. These commodities also tend to be part of industry ecosystems whose demand-supply relationships are scattered across the country and therefore relate more with GDP growth.

5.20 Therefore, the OD data trip lengths of various vehicle types and the commodity carried by these goods vehicles form the basis for estimating the elasticity relationships.

5.21 To arrive at the proportion of trucks growing with GDP and/or with GSDP, we have referred to following two trips from the OD data:

- The trucks which are loaded in the NE for consumption in rest of the country
- Trucks coming empty to NE from rest of India, i.e., the truck which are coming empty to NE to get loaded.

5.22 The findings from the OD survey analysis are summed in the table below:

Table 5.4: Growth driver share analysis

Direction of traffic	Patgaon/Dahalapara/Galia	
	LCV/2A/3A	MAV

(A) Non-empty trucks to rest of India from NE, i.e., the trucks which are loaded in the NE for consumption in rest of the country (A) – Guwahati to Srirampur direction	63%	41%
(B) Trucks coming empty to NE from rest of India, i.e., the truck which are coming empty to NE to be loaded (B) –Srirampur to Guwahati direction	17%	8%
(C) Proportion of traffic growing with respect to GDP (A+B)/2	**~40%**	**~25%**
(D) Proportion of traffic growing with respect to Assam GSDP (1-C)	**60%**	**75%**

Source: Steer analysis

5.23 As the CJVs and buses are local in nature, we have assumed 100% of the growth of these categories to be linked with Assam's GSDP.

Estimation of background elasticities

Overview

5.24 For brownfield Asset, where sufficient historical traffic evolution is available, it is common practice to use regression model analysis to determine the relationship, expressed as elasticity, between traffic growth and key socioeconomic drivers. This relationship is then applied to assumptions of future socio-economic evolution to estimate future traffic growth.

5.25 For the Asset under consideration, long-term historical traffic was not available, as discussed in Chapter 3. Therefore, we undertook a benchmarking analysis to estimate our forecast elasticities. The sources used included our understanding of the Asset gained from site visits and our understanding of the corridor from previous traffic studies, outputs of the OD data analysis (OD pairs, trip lengths, zonal influence, and commodity mix) and knowledge of working on the Asset serving similar consumption-based demand. We also took account of the regional Assets having similar traffic profiles, which give us reasonable confidence in the relationships proposed.

5.26 The forecast elasticities are assumed to remain constant over the concession period as the logistics sector in still in early stages of development in India (95% of trucks still owned by operators owning less than 5 trucks). Car ownership levels are still around 22 per 1000 people, and it is likely to take a few years before the market reaches maturity. These trends are based on a long-term understanding of historical relationships and an overall outlook on the growth of the region and the country.

5.27 The table below detail out the reasoning for selection of respective growth driver(s) and elasticity adopted for each vehicle category for the plazas.

Table 5.5: Adopted Elasticities

Vehicle Category	Adopted elasticity	Growth Driver	Comments
CJV	Patgaon: 1.0 Dahalapara: 1.0 Galia: 1.0	100% Assam GSDP	Car traffic is largely driven by the local demand. CJVs are expected to grow with 1 elasticity on the Asset, as the car ownership levels continue to increase in the region with the increase in per capita income levels in future years. An increase in car ownership levels and overall economic growth of the region is likely to result in a healthy growth of CJVs on the asset.
Bus	Patgaon: 0.25 Dahalapara: 0.25 Galia: 0.30	100% Assam GSDP	Buses are primarily a mix of public and private inter-city. Buses currently are serving local intercity demand. As these cities grow, the buses are also expected to grow to serve the increasing demand however only at a muted rate.
MLCV/LCV	Patgaon: 0.30 Dahalapara: 0.30 Galia: 0.30	40% GDP 60% Assam GSDP	LCVs are also found to undertake long distance trips with lengths up to 1,00km in addition to catering to the local demand. The emergence of e-commerce companies which transport high value low tonnage products over long distances prefer the use of LCV/2A vehicles. It is evident from the survey data that LCV/2A trucks are being used for transporting such materials. Further both LCV and 2A are also serving the manufactured goods industry. Therefore, we believe that the LCV/2A category will continue to grow in the future.
2A	Patgaon: 0.60 Dahalapara: 0.60 Galia: 0.60	40% GDP 60% Assam GSDP	
3A	Patgaon: 0.40 Dahalapara: 0.40 Galia: 0.40	40% GDP 60% Assam GSDP	3A and MAVs traverse long distance movements between rest of country and the NE region. The Asset benefits from manufacturing, POL, metals, and industrial goods movement. More than 60% of the 3A and MAV are traversing an average trip length of more than 1000 kms on the Asset. Due to the consumption-based nature of the NE region, trucks carry goods from the industrial centres of West Bengal, Maharashtra, Delhi NCR etc. An average trip length of around 1000kms just aids the fact that the Asset has significant long-distance traffic and is expected to have a closer growth relationship with national GDP. Therefore, an assumption of 0.85 to GDP has been assumed for the forecasts. Although the trip nature of 3As is similar to MAVs, a lower elasticity parameter is considered for 3As due to gradual shift observed from lower to higher axle trucks after a new Axle Load Policy was implemented in FY19, and economies of scale achieved by
MAV	Patgaon: 0.85 Dahalapara: 0.85 Galia: 0.85	25% GDP 75% Assam GSDP	

Vehicle Category	Adopted elasticity	Growth Driver	Comments
			carrying higher loads per km of distance covered.

Source: Steer analysis

Forecasts for growth drivers

5.28 In this section, we have described our assumptions in relation to forecasts of the key macro-economic drivers of traffic growth. India's GDP and the relevant state GSDPs are the primary macroeconomic variables that have been used to drive our traffic growth forecasts.

Macro assumptions: GDP and GSDP

5.29 India's GDP and Assam GSDP are the primary macroeconomic variables that have been modelled to drive our traffic growth forecasts.

5.30 After the last period of economic slowdown in FY11-12, the country has been experiencing an economic downturn since late FY19 with the FY20 reporting 4% GDP growth. India's GDP growth declined as domestic investment and consumption demand were already under stress because of the liquidity crunch before Covid-19. Related events to the economic slowdown include reduced growth rates in automobile sales and production, liquidity crunch, rising number of non-performing assets, lower manufacturing outputs and lower rural consumption.

5.31 There was a substantial impact of the Covid19 outbreak on the Indian economy during the first two quarters of FY21. The growth momentum eventually picked up in Q3 FY21. A sharp rebound was observed in FY22 with economy growing by 8.7%.

5.32 In the long term, Indian GDP would reduce gradually after 2030, to reach 5.7% by 2030 and 5.2% by FY40. Our national GDP forecasts are sourced from Consensus Economics. The state of Assam has grown in line with the national GDP from FY12-20. However, in the recent years (FY18-20) the state has grown at a slightly higher rate compared to the national GDP ~ 1.04x (4% higher than the national GDP).

5.33 Due to the increasing focus on the northeast India and its strategic importance, there has been increasing government expenditure and push towards infrastructure development in the region. This is expected to push the economy of the region and especially Assam to grow faster than the national growth. For the future GSDP forecast, we have assumed Assam GSDP to grow 1.04x of India GDP.

Table 5.6: GDP and GSDP assumptions

	GDP	Assam GSDP
FY25	6.2%	6.4%
FY26	6.6%	6.9%
FY27	6.4%	6.7%
FY28	6.3%	6.6%
FY29	6.0%	6.2%
FY30	5.7%	5.9%
FY31	5.7%	5.9%

	GDP	Assam GSDP
FY32	5.7%	5.9%
FY33	5.7%	5.9%
FY34	5.7%	5.9%
FY35	5.6%	5.8%
FY36	5.5%	5.7%
FY37	5.4%	5.7%
FY38	5.4%	5.6%
FY39	5.3%	5.5%
FY40	5.2%	5.4%
FY41	5.1%	5.3%
FY42	5.0%	5.2%
FY43	4.9%	5.1%
FY44	4.8%	5.0%
FY45	4.7%	4.9%

Source: Consensus Economics;

6 Traffic and Revenue forecasts

Introduction

6.1 The following table lists key intermediate and final outputs that have presented in previous Chapters and this chapter.

Table 6.1: Key intermediate and final outputs in the forecast

Forecast	Final outputs	Intermediate outputs	Inputs	Chapter
Traffic	Base year AADT	ADT estimate for base year	Year-to-date AADT	Chapter 3, 5
	Background traffic growth	Background forecast elasticity	Background historical elasticities with respect to growth drivers	Chapter 5
		Forecasts for growth drivers	Historical performance of growth drivers along with Macro assumptions (GDP and GSDP)	Chapter 4, 5
	Impact growth rates and staging	Impacts	Network analysis	Chapters 6
Revenue	Annual/daily revenue forecasts	Forecast toll segmentation: Trip frequencies and trip factors	Ticket segmentation	Chapter 6
			Trip factors	Chapter 6
		Future toll rates	Toll evolution	Chapter 6

Source: Steer

Seasonal Correction Factor

6.2 Traffic on any Asset varies on a month-on-month level owing to variations such as monsoons, festivity, local events specific to the Asset. In order to normalize for these variations across the year to provide an AADT estimate, Seasonality Correction Factors (SCF) are used. These are typically estimated using historical data for the toll plaza for vehicle category over multiple years. An SCF >1 means that the traffic for the month is lower than the annual average and vice-versa. The SCF assumed for the Assets is the SCF derived from actual traffic for FY23.

6.3 SCF assumed for each toll plaza are presented below:

Table 6.2: SCF for Patgaon plaza

Patgaon	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
CJV	1.12	1.17	1.26	1.16	0.99	1.07	0.97	1.00	0.81	0.89	0.89	0.88

Patgaon	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
LCV	1.09	1.15	1.13	1.19	1.16	1.01	1.08	0.98	0.93	0.89	0.82	0.79
Bus	1.01	1.04	1.06	1.08	1.05	0.95	1.04	1.02	0.93	0.95	0.94	0.95
2A	1.01	1.04	1.06	1.08	1.05	0.95	1.04	1.02	0.93	0.95	0.94	0.95
3A	0.95	1.05	1.11	1.15	1.01	0.91	1.05	1.03	0.99	1.02	0.91	0.89
MAV	0.94	1.06	1.12	1.11	1.10	1.00	1.13	1.03	0.91	0.95	0.90	0.84

Table 6.3: SCF for Dahalapara plaza

Dahalapara	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
CJV	1.04	1.00	1.05	0.96	1.12	1.15	1.03	1.02	0.97	0.94	0.88	0.91
LCV	1.07	1.05	1.07	1.03	1.08	1.01	1.08	0.99	0.94	0.95	0.91	0.87
Bus	1.05	1.07	1.09	1.09	1.06	1.02	1.09	1.02	0.91	0.91	0.86	0.90
2A	1.05	1.07	1.09	1.09	1.06	1.02	1.09	1.02	0.91	0.91	0.86	0.90
3A	0.95	1.05	1.11	1.12	1.03	0.94	1.06	0.98	0.97	1.01	0.90	0.93
MAV	0.93	1.05	1.09	1.09	1.05	1.00	1.12	1.01	0.94	0.98	0.92	0.88

Table 6.4: SCF for Galia plaza

Galia	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
CJV	1.11	1.11	1.12	1.01	1.13	1.16	1.02	0.79	0.94	0.90	0.91	0.94
LCV	1.08	1.07	1.09	1.05	1.06	1.01	1.02	0.93	0.95	0.98	0.93	0.88
Bus	1.11	1.03	1.15	1.05	1.12	1.08	1.00	0.93	0.91	0.91	0.93	0.88
2A	1.00	1.06	1.05	1.07	1.01	0.97	1.03	0.96	0.96	1.00	0.94	0.96
3A	0.97	1.10	1.15	1.12	0.97	0.94	1.07	0.99	0.97	1.02	0.90	0.87
MAV	0.93	1.05	1.11	1.11	1.05	0.99	1.11	0.99	0.94	0.99	0.91	0.89

Analysis of potential impacts

Summary of alternate routes and impact assessments

6.4 The section below details the impacts which we believe would affect traffic on the Asset during the concession period. As discussed in earlier Chapters, in order to assess the impacts on the Asset, whether positive or negative, we have studied developments (alternate roads, feeder roads and regulatory) in the surrounding road network.

6.5 The following table lists the impacts considered on the Asset.

Table 6.5: Summary of impact

Impact	Toll plaza	Probability/Scale of impact	Year of impact	Direction of impact (+/-)
4 Laning of NH17 (Hapachara to VIP Chowk) +New Goalpara bridge	Dahalapara, Galia	High/High	FY27 onwards	Negative

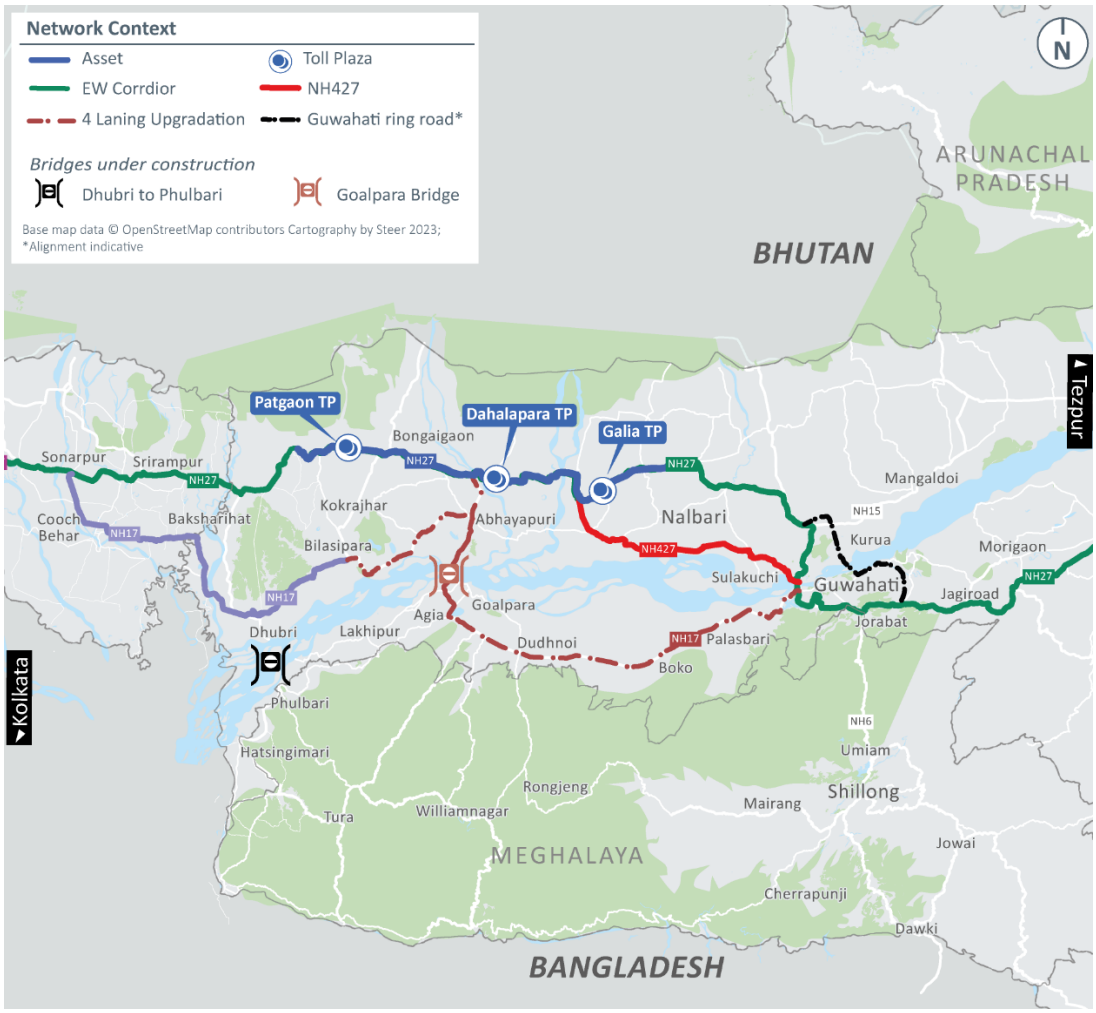
Guwahati Ring Road	Dahalapara, Galia	High/Medium	FY29 onwards	Positive
Flyover construction (Passenger)	Dahalapara, Galia	Low/Low	FY25 only	Negative
4 laning of NH127B + Phulbari bridge	Patgaon, Dahalapara, Galia	High/Low	FY28 onwards	Negative
4-laning of West Bengal Section (Cooch Bihar to Bilasparia to Guwahati)	Patgaon	High/Medium	FY28 onwards	Negative

Source: Steer analysis of OD data

4-laning of NH17 (Hapachara to VIP Chowk) +New Goalpara bridge)

6.6 As per the latest information released by NHIDCL, the section of NH17 between Hapachara (Abhaypuri) and VIP Chowk is getting upgraded to four lanes. A 2-laned bridge is also getting constructed parallel to the existing bridge at Goalpara as part of the upgrade.

Figure 6.1: NH17 upgrade



Source: Steer cartography

6.7 As of January 2023, according to National Highways & Infrastructure Development Corporation Ltd (NHIDCL) and site visit observations, construction of Hapachara- Agia on NH17 is ~80-90% completed with 2 lane bridge being under construction. The construction of Agia to Guwahati (VIP Chowk) junction has commenced in December'23.

6.8 Once the construction is completed, the 4-laned NH17 will act as an alternate route for traffic moving between Hapachara/Abhaypuri/west and Guwahati/east. Due to the upgrade, loss of traffic at Dahalapara and Galia Plaza is expected as the long-distance traffic destined to Guwahati will have the option to divert to NH17 at Hapachara to reach the destinations. It should be noted that route from Bijni to Guwahati via NH27 will have three toll plazas (Dahalapara, Galia, and Madanpur) and the route from Bijni to Guwahati via NH17 will also be tolled. Presently, there is no toll on NH17. However, once the 4-laning of Hapachara – VIP Chowk section is completed along with completion of new Goalpara bridge, we have assumed that the section will get tolled as per the lengths available from NHIDCL.

6.9 The expected timeline for completion of NH-17 Agia to Guwahati which is on EPC contract is 30 months and of Guwahati Ring Road which is BOT is 48 months. We have assumed the same in our impact estimation.

6.10 Section wise tollable lengths and length of NH17 sourced from NHIDCL is presented below:

Table 6.6: Section wise tollable lengths and length of NH17

Section	Section	Total tollable length (in km)*	Total length (in km)
A	Bilasipara- Tulungia NH17	68	44.288
B	Tulungia - Guwahati NH17	285	147.851
C=A+B	Bilasipara - VIP Junction NH17	353	
D	Hapachara - Tulungia NH17 + 2 lane Bridge	32	14.660+2.69 (New bridge)
E=B+D	Hapachara-Guwahati	317	

Source: NHIDCL, 2023; * Estimated tollable length

6.11 Once Hapachara- VIP Chowk is 4 laned, it will act as direct competitive alternate to Asset NH27 where some proportion of Guwahati and beyond traffic will shift to NH17. However, considering the toll comparison below NH27 Asset via Dahalapara and Galia will remain cheaper route where tolls of MAV at alternate NH17 is over 2,400 and NH27 is 1,405 for almost similar distance.

6.12 Toll comparisons of various sections of NH17 is presented below:

Table 6.7: Toll comparisons of various sections of NH17

	CJV	LCV	2A	3A	MAV
Hapachara to Guwahati (via NH17)					
Hapachara- Guwahati via NH17	452	732	1,532	1,672	2,405
Hapachara to Guwahati/NE (via Asset, NH27)					
Hapachara- Guwahati via Asset	**265**	**430**	**895**	**975**	**1,405**

Source: Steer analysis

6.13 The generalised journey cost (GJC) comparison for both the routes is shown below.

Table 6.8: GJC comparison – NH27 vs NH17

	CJV	LCV	2A	3A	MAV
Hapachara to Guwahati/NE (via Asset, NH27)					
GJC	1,334	2,864	3,840	4,713	7,414
Hapachara to Guwahati/NE (via NH17)					
GJC	1,567	3,271	4,604	5,571	8,672
Outputs					
Till Guwahati (A)					
Impact till Guwahati			(118)	(118)	(306)
Impacts % (Dahalapara)			(10.5%)	(13.0%)	(13.9%)
Impacts % (Galia)			(12.2%)	(12.5%)	(14.5%)
Beyond Guwahati (B)					
Impact beyond Guwahati			(46)	(77)	(156)
Impacts % (Dahalapara)			(4.1%)	(8.5%)	(7.1%)
Impacts % (Galia)			(4.8%)	(8.2%)	(7.4%)
Total Impact (A+B)					
Impacts % (Dahalapara)			(14.6%)	(21.5%)	(21.0%)
Impacts % (Galia)			(16.9%)	(20.7%)	(21.8%)
Impact (Dahalapara & Galia)			(164)	(195)	(461)

Source: Steer analysis

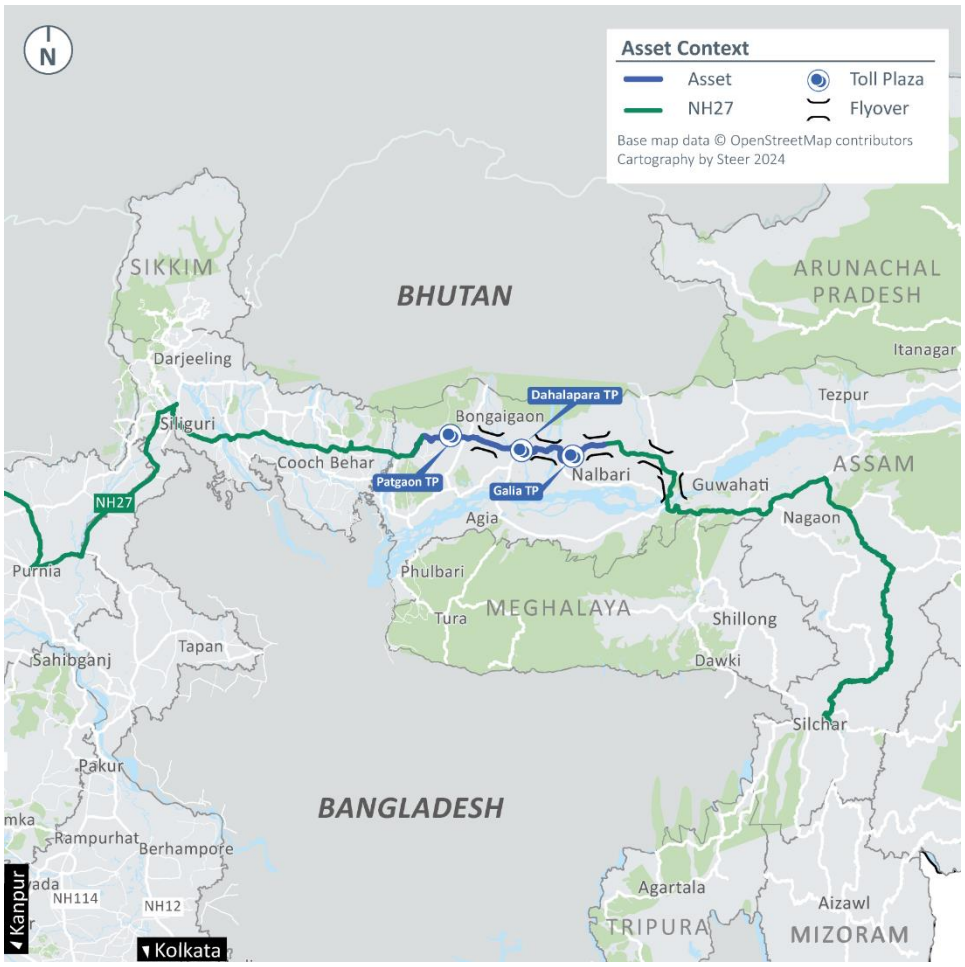
6.14 The upgrade is assumed to get completed by FY28. The impact on traffic is assumed to be in a phased manner where 60% of the impacted traffic is lost in the first year and 100% of the total impacted traffic is lost in the subsequent years.

6.15 The information regarding NH17 4 laning sourced from NHIDCL is given in the appendix E.

Flyover Construction on NH27

6.16 Currently there is construction of five six-lane flyovers on NH27 in the state of Assam is being undertaken and are in advance stages of construction at Bongaigaon, Chapaguri, Pathshala, Simalguri Chowk and Baihata Bypass junctions. These are expected to be completed in FY25. Because of this construction due to the reduced level of service, some proportion of local trips are expected to be supressed in the next financial year. Hence passenger vehicles are expected to experience lower growth in FY25. Once the flyovers are constructed on the Asset corridor, FY26 onwards growth of the CJV category is expected to return to normal.

Figure 6.2: Location of flyover construction on Asset NH27



Source: Steer cartograph

Table 6.9: Impact Assumed for Flyover Construction

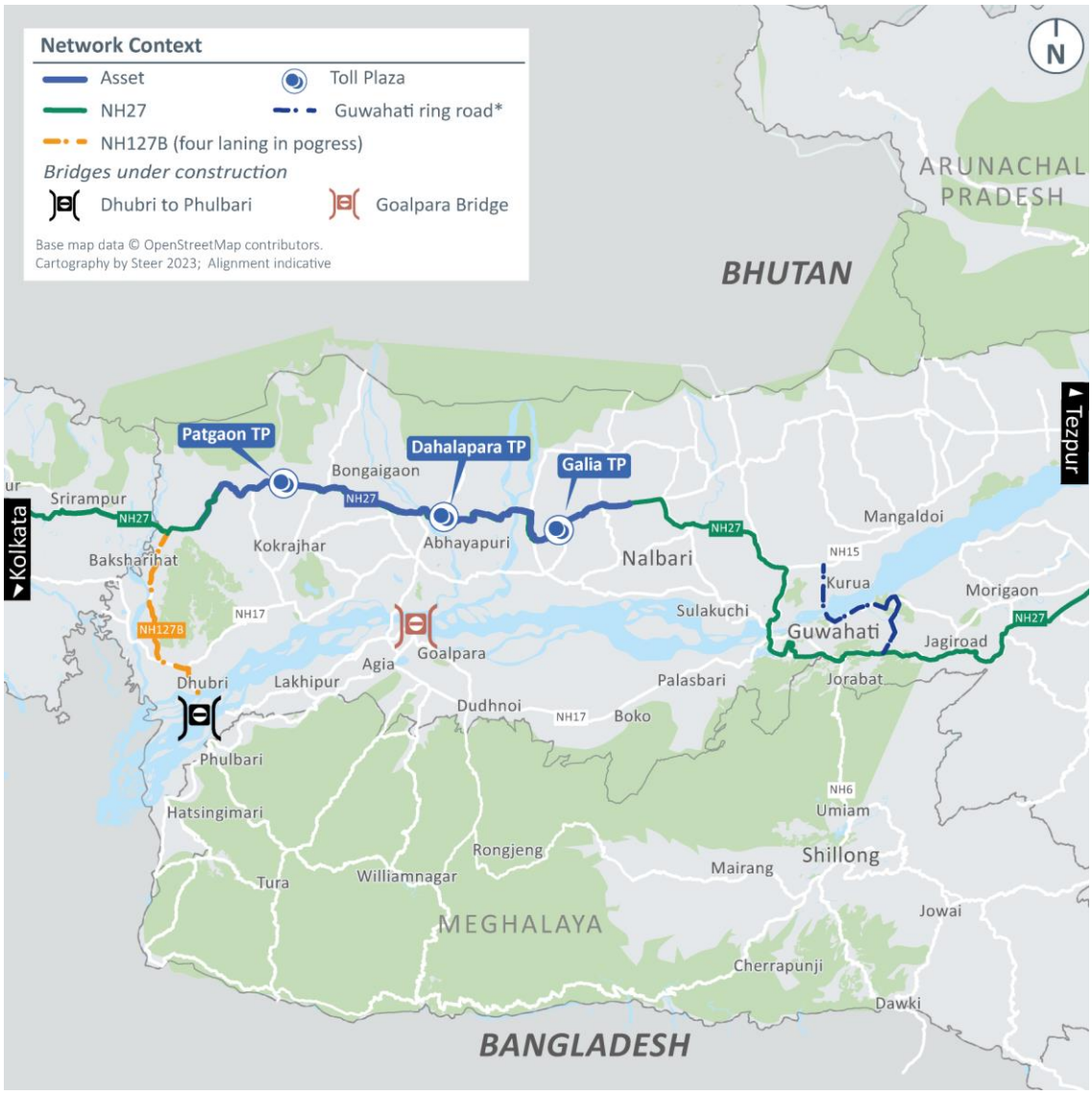
Plaza	CJV	Year
Dahalapara %	(3.2%)	FY25 only
Galia %	(3.2%)	FY25 only

Source: Steer analysis

4-laning of NH127B + Phulbari Bridge

6.17 The section of NH127B between Srirampur and Dhubri (~54 km long) is getting upgraded to four lanes. A 4-laned, 19 km long bridge is also getting constructed between Dhubri and Phulbari as part of the upgrade.

Figure 6.3: NH127 upgrade



Source: Steer cartography

6.18 Once the construction is completed in FY28, it is expected that traffic from on the Asset destined to Meghalaya and Tripura can shift to the upgraded NH127B as the bridge will provide connectivity to the states. Due to the upgrade all three plazas Dahalapara, Galia and Patgaon are expected to lose traffic.

6.19 The trips destined to Meghalaya, as observed in the OD analysis, primarily ends in Shillong. Once the upgrade is completed, there will be following three route options available to reach Shillong:

- Via NH27 + NH6: Srirampur - Guwahati – Shillong (via Asset)
- Via NH127 + NH106: Srirampur – Dhubri – Phulbari bridge – Tura – Ronjeng – Shillong
- Via NH127 + NH17 + NH106: Srirampur – Dhubri – Phulbari bridge -Agia – Rongjeng – Shillong

6.20 The upgrade is assumed to be completed in FY28. The impact due to the upgrade is shown below:

Table 6.10: Impact due 4-laning of NH127B + Phulbari Bridge

	CJV	LCV	2A	3A	MAV
Via NH27 + NH6 (via Asset)					
GJC	2,991	6,547	9,063	11,823	18,622
Via NH127 + NH106					
GJC	3,938	8,692	12,892	17,504	28,133
Outputs					
Inscope Volume	-	-	18	16	48
Impact volume	-	-	(5)	(5)	(20)
Patgaon Impact %	**-**	**-**	**(0.5%)**	**(0.6%)**	**(1.0%)**
Dahalapara Impact %	**-**	**-**	**(1.0%)**	**(1.1%)**	**(1.3%)**
Galia Impact%	**-**	**-**	**(0.1%)**	**(0.1%)**	**(1.4%)**

Source: Steer analysis

6.21 It should be noted that currently there are no tolls on NH127B. However, once the upgrade is completed, we believe that the 54 km long 4-laned section between Srirampur and Dhubri as well as the 19 km long Phulbari bridge will be tolled according to the general NHAI tolling norms. The same has been assumed in the GJC comparison. The route via the Asset will have the maximum share of inscope traffic due to lower GJC. Furthermore, the route via NH27 has the lowest gradient as compared to the other two routes. The comparison between elevation profile is shown in Appendix D.

Guwahati Ring Road

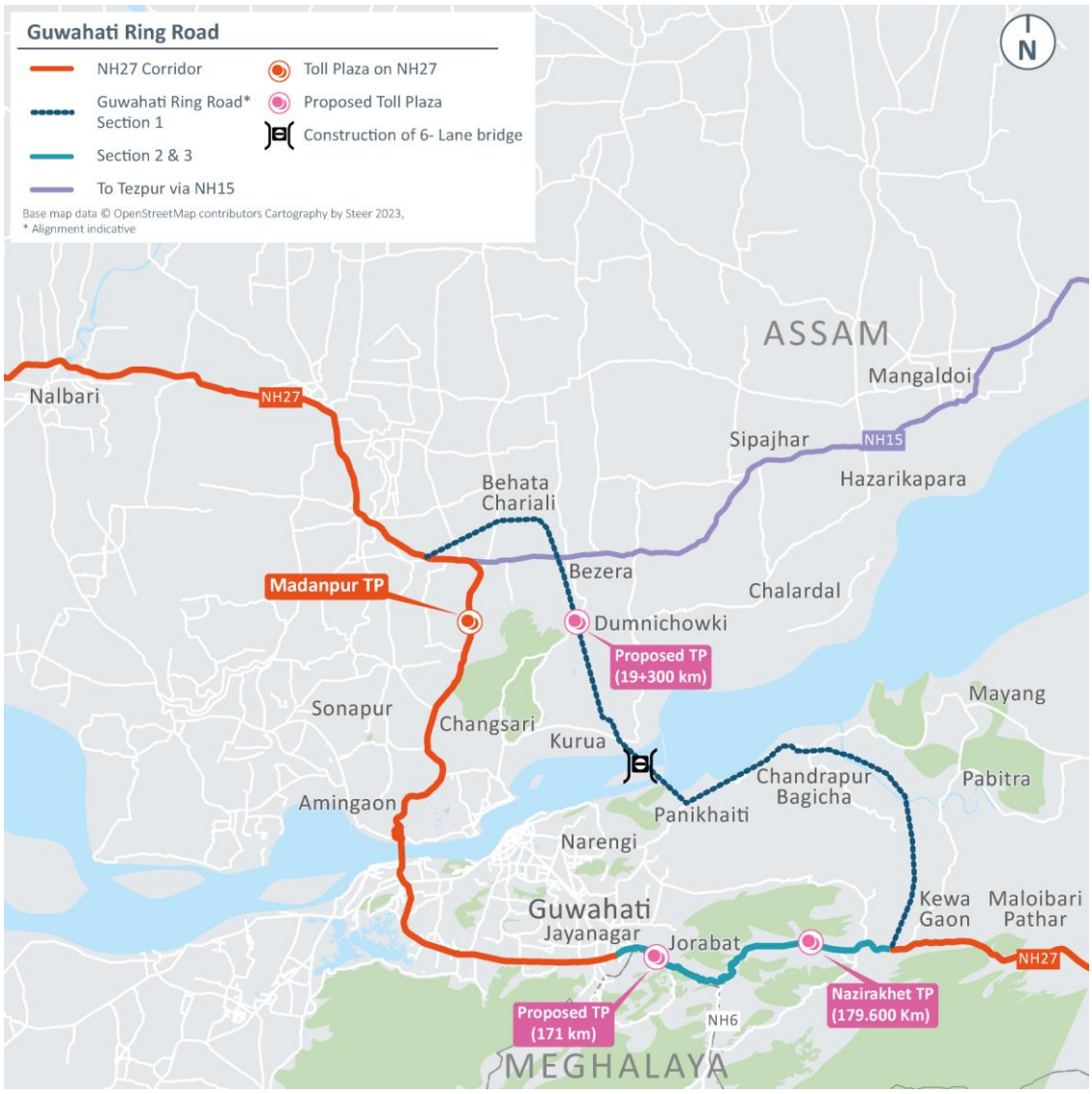
6.22 In the view to decongest Guwahati city, In 2023 the government of Assam proposed a six lane greenfield 55km long Ring Road of Guwahati. It will decongest Guwahati city and take major traffic coming from rest of India and moving towards Silchar, Nagaland, Shillong, Mizoram and Tripura. Currently, this traffic enters Guwahati city and moves to eastern Assam. As a part of the alignment, there is a bridge proposed over Brahmaputra river connecting north and south Assam mainly Kuruwa to Narengi. The Ring Road is proposed to connect NH27 Asset at Behata Chalari section before Madanpur toll plaza. There is also proposed user fee collection near Dumnichowki on Guwahati Ring Road.

6.23 As per the latest information, the Ring Road is expected to complete in 2028 and is being built on Build Operate Transfer (BOT) model of PPP. Currently, the project is under DPR stage[4] and expected to begin construction in February 2024.

6.24 It is assumed that traffic originating west of Hapachara and moving eastern Assam including Silchur, Mizoram and Tripura will prefer to use NH27 once the Ring Road is operational. Currently, this traffic has to enter Guwahati to travel to these destinations where they face congestion and time restrictions. In post ring road scenario, this traffic will get benefit of avoiding the current time restrictions to bypass Guwahati. Before crossing Madanpur toll plaza at Behata Chalari junction where the Ring Road Connects NH27, East and South Guwahati traffic without entering Guwahati can take Ring Road thereby avoid any city congestion and time restrictions.

[4] DPR preparations underway for Guwahati Ring Road Project (sentinelassam.com)

Figure 6.4: Guwahati Ring Road alignment



Source: Steer cartography

6.25 The table below summarises the impact of the Ring Road.

Table 6.11: Impact due to Guwahati Ring Road

	CJV	LCV	2A	3A	MAV
Hapachara to Guwahati/NE (via Asset, NH27)					
GJC	1,624	3,498	4,661	5,719	8,997
Hapachara to Guwahati/NE (via NH17)					
GJC	2,206	4,686	6,390	7,780	12,185
Outputs					
Impact % (Dahalapara)			4.1%	8.6%	7.1%
Impact % (Galia)			4.8%	8.2%	7.4%

Source: Steer analysis

Bilasipara- Cooch Behar Proposed 4 lane

6.26 As per the information from stakeholder consultation and information released by NHIDCL, there are future plans to expand existing 2 lane section of Bilasipara to Abhyapuri section of NH17 to 4 lane. However, currently there is no information released for 4 laning of the Falakata- Cooch Behar and Bilasipara section. However, in the base case we have assumed the full 4 laning of the Cooch Bihar to Bilasipara section.

6.27 Nevertheless, once the section is expanded to 4 lane will act as a direct competitor route to Asset NH27 especially for trips originating from North India, Delhi, West Bengal, Bihar, Rajasthan, Gujarat moving towards Guwahati and East. In an existing scenario these trips are taking the Asset and appearing on Patgaon plaza. Therefore, once the section is improved some proportion of such trips will shift to NH17. Based on the GJC analysis undertaken not all inscope traffic will shift to NH17 due to higher tolling operated on the alternate NH17 for same distance when compared to Asset NH27. The impact of traffic shift is presented below.

Figure 6.5: Bilasipara- Cooch Behar Proposed 4 lane

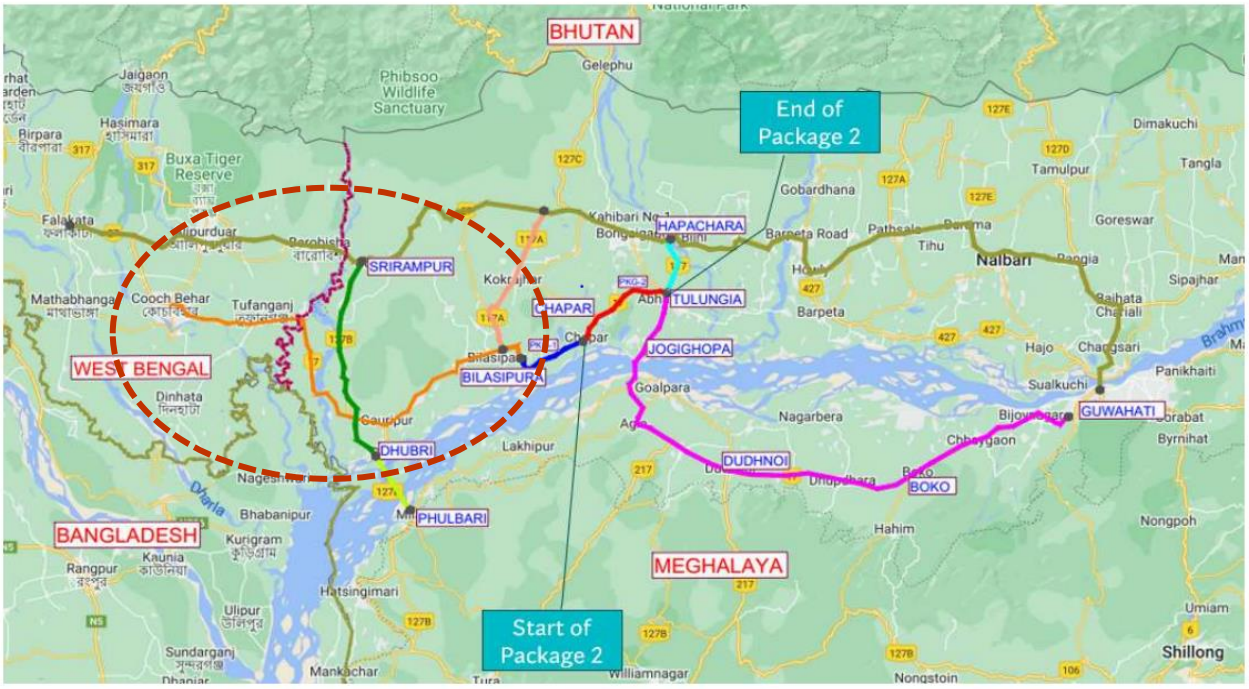


Table 6.12: Impact due to 4 laning of Cooch Behar – Bilasipara- NH17

	CJV	LCV	2A	3A	MAV
Falakata to Guwahati/NE (via Asset, NH27)					
GJC	**2,450**	**5,353**	**6,968**	**8,618**	**13,639**
Falakata to Guwahati/NE (via NH17)					
GJC	**3,074**	**6,504**	**8,945**	**10,898**	**17,048**
Outputs					
Impact			(56)	(35)	(141)
Patgaon Impact %			(6.2%)	(4.4%)	(6.5%)

Source: Steer analysis

Revenue Forecasting Assumptions

6.28 To forecast the revenues for a particular financial year, the traffic forecast for each vehicle type is converted into tickets sold, which is then multiplied with the corresponding toll rate, which grows over the years as defined in the Concession Agreement. While "trip factors" provide the conversion factor to the former, i.e., traffic (trips) to tickets sold, "toll segmentation" provides the latter i.e., the breakup of trips paying each ticket type. This section discusses assumptions related to trip factors, and toll rates for the forecast period.

6.29 To estimate the base revenue for the toll plaza, we used the estimated FY24 AADT, established as part of the analysis above. We then use the segmentation assumptions, discussed in chapter 3, as a starting point to arrive at the base year revenue. This is further discussed in the section below.

Toll evolution for Asset

6.30 Based on the concession agreement and the gazetted toll notification, the toll rates increase every year on 1st April based on Wholesale Price Index (WPI)-linked inflation (December print of previous FY). The calculated toll rates in the rate revision order are rounded up to the nearest five to estimate the rounded toll rates charged to the road user. We have used actual toll rates of FY24 toll notifications to validate the modelling of toll evolution.

6.31 The WPI for FY24 is the 5.02%, the actual inflation for December 2022. For all forecast years FY25 onwards, the WPI as per Client inputs has been illustrated in the table below.

Table 6.13: WPI forecast

	WPI
FY24*	5.0%
FY25	0.7%
FY26	5.3%
FY27	4.5%
FY28 onwards	3.5%

Source: FY24 from Office of Economic Advisor, FY25 onwards based on Client's input

Tolling length for Asset

6.32 The tolling length for both the toll plazas has been sourced from the latest Schedule M provided by the Client. New flyovers are supposed to be constructed on the Asset. Due to this construction, the length of structures on the Asset will change which will in turn change the tolling length of the Asset. The tolling length, during and after construction, has been shown in the table below.

Table 6.14: Tollable length - Patgaon

	Fee payable	FY24 (before and during construction)	Sch M (after construction)
Length of road (excluding structures)	100% of the base rate	61.812	61.723
Bypass length	150% of the base rate	-	-
Structure length on road	100% of the base rate on equivalent length	0.859	0.948

	Fee payable	FY24 (before and during construction)	Sch M (after construction)
Structure length on bypass	100% of the base rate on equivalent length	-	-
Total road length		**62.671**	**62.671**
Total tollable length		**70.402**	**71.203**

Source: Steer analysis

Table 6.15: Tollable length - Dahalapara

	Fee payable	FY24 (before and during construction)	FY25 onwards (after construction)
Length of road (excluding structures)	100% of the base rate	50.360	50.255
Bypass length	150% of the base rate	-	-
Structure length on road	100% of the base rate on equivalent length	1.140	1.245
Structure length on bypass	100% of the base rate on equivalent length	-	-
Total road length		**51.500**	**51.500**
Total tollable length		**61.760**	**62.705**

Source: Steer analysis

Table 6.16: Tollable length - Galia

	Fee payable	FY24 (before construction)	FY25 onwards (after construction)
Length of road (excluding structures)	100% of the base rate	26.739	26.639
Bypass length	150% of the base rate	-	-
Structure length on road	100% of the base rate on equivalent length	0.561	0.661
Structure length on bypass	100% of the base rate on equivalent length	-	-
Total road length		**27.300**	**27.300**
Total tollable length		**32.349**	**33.249**

Source: Steer analysis

6.33 According to the latest Schedule M provided by the Client, the completion of construction is expected be completed in August 2024. We have assumed the toll rates to incorporate new tolling lengths from August 2024 (FY25).

Toll Segmentation

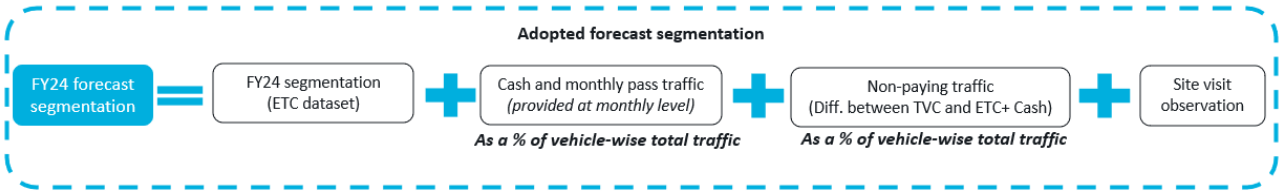
6.34 The ticket segmentation trends have largely been stabilising over the last few months, with FASTag now being compulsory since February 2021. With more than 95% of transactions now being via FASTag, it can be assumed that travel patterns have stabilised. Therefore, we believe that the average of the ETC segmentation of April – November 2023 period is representative of the travel patterns on the Asset and is free from any travel related disruptions.

6.35 However, as the above-mentioned segmentation is sourced from the ETC (segmented) dataset Patgaon and Dahalapara the segmentation doesn't include information regarding cash/monthly pass-based trips and exemptions. Therefore, the difference between ETC (segmented) and TMS dataset is added (as a % of ETC traffic) as cash (single) and monthly pass-based trips. It should be noted that the TMS data had information regarding the number cash-based and the number of monthly passes sold per day.

6.36 While for Galia cash transactions at monthly were already provided. Additionally, for exemptions the difference between TVC and ETC dataset is added (as a % of ETC traffic) in the final adopted segmentation as non-paying traffic.

6.37 The methodology for adopted segmentation has been explained in the figure below:

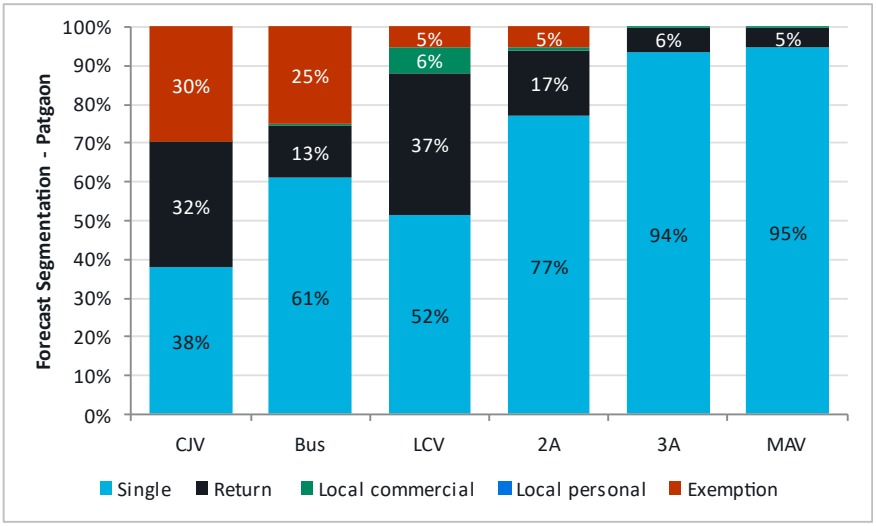
Figure 6.6: Adopted forecast segmentation methodology



Source: Steer analysis

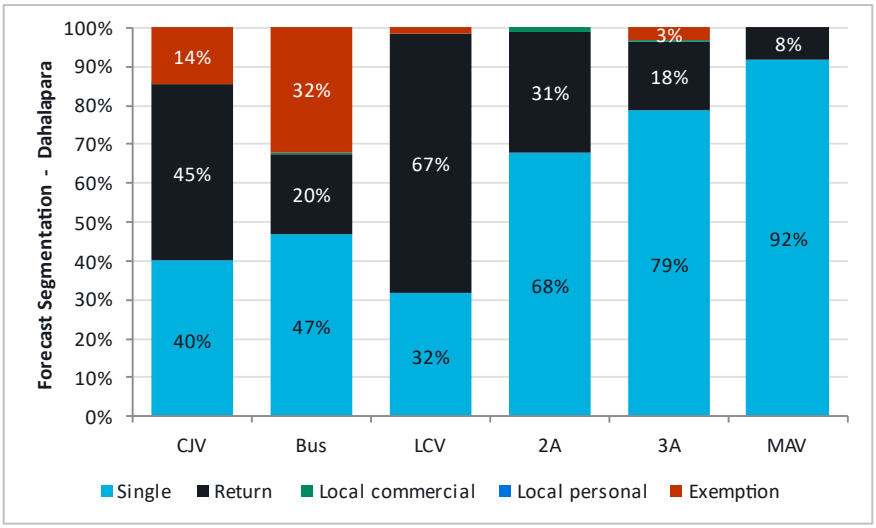
6.38 The final forecast segmentation is shown in the charts below. We have assumed the forecast segmentation to remain same across the concession life.

Figure 6.7: Toll segmentation (%) FY24 onwards– Patgaon



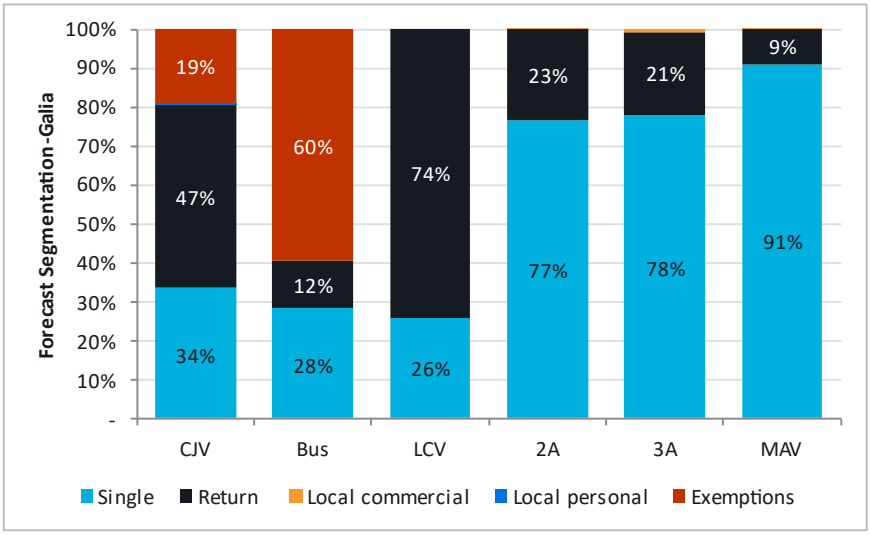
Source: Steer analysis

Figure 6.8: Toll segmentation (%) FY24 onwards– Dahalapara



Source: Steer analysis

Figure 6.9: Toll segmentation (%) FY24 onwards– Galia



Source: Steer analysis

Trip factors

6.1 A user can buy different type of tickets to pay toll depending on the vehicle type. Apart from the Single trips, trips such as Return, Monthly, Local Commercial, and Local Personal are discounted tickets that are offered to the users. The revenue realised from these discounted trips is lower than a single trip fare. Therefore, in order to calculate the revenue for the trips made on discounted tickets (or passes) a trip factor is applied to calculate revenue realised from that particular pass sold.

6.2 As for trip factors, since the onset of FASTag, the trip factors have stabilised to the assumed levels of 1 and 2 for Single and Return categories, respectively, as now the user only pays toll for the trip that has been actually made, hence there will be no unused return tickets.

6.3 There is no major toll category being charged, apart from the official list of toll categories in the toll notification. This assumes that further changes in toll categories, unless specific discounts are offered, are unlikely.

6.4 The trip factors assumed based on the latest FY23 data available are listed in the table below.

Table 6.17: Trip factors for the forecast years - Patgaon

Ticket category	CJV	LCV	Bus	2A	3A	MAV
Single	1	1	1	1	1	1
Return	2	2	2	2	2	2
Monthly	50	50	50	50	50	50
Local Commercial	1	1	1	1	1	1
Local Personal	30	30	30	30	30	30
Non-Paying	1	1	1	1	1	1

Source: Steer analysis

Table 6.18: Trip factors for the forecast years - Dahalapara

Ticket category	CJV	LCV	Bus	2A	3A	MAV
Single	1	1	1	1	1	1
Return	2	2	2	2	2	2
Monthly	50	50	50	50	50	50
Local Commercial	1	1	1	1	1	1
Local Personal	18	30	30	30	30	30
Non-Paying	1	1	1	1	1	1

Source: Steer analysis

Table 6.19: Trip factors for the forecast years - Galia

Ticket category	CJV	LCV	Bus	2A	3A	MAV
Single	1	1	1	1	1	1
Return	2	2	2	2	2	2
Monthly	45	45	45	45	45	45
Local Commercial	1	1	1	1	1	1
Local Personal	24	1	1	1	1	1
Non-Paying	1	1	1	1	1	1

Source: Steer analysis

Revenue reconciliation – validation of forecast segmentation

6.5 As part of validating the data provided by the Client, as well as our assumptions around toll calculations and forecast segmentation, we have reconciled the actual reported revenue on a monthly level for the Asset for the month of April FY24. To reconcile we have used our FY24 segmentation as mentioned in the previous section, MADT of the month and compared it with the reported revenue for these months.

6.6 The Steer revenue calculations have been built up from monthly raw traffic data files, containing monthly data and ticket type information; and the toll notifications – all shared by the Client. The comparison, as shown in the table below, depicts the difference between modelled revenue and the reported revenue is within 0.0-0.3% for all the Assets, this gives us the confidence on the assumptions around segmentation and trip factors used for estimating forecasting revenue.

6.7 The table below shows the delta between our modelled revenue and the actual revenue reported in the toll plaza data:

Table 6.20: Revenue Reconciliation- April FY24

Revenue (AADC)	FY24 Modelled (INR Lakhs)	FY24 Reported (INR Lakhs)	Delta
Patgaon	19.43	19.44	(0.1%)
Dahalapara	19.63	19.64	(0.1%)
Galia	10.42	10.39	0.3%

Source: Steer analysis

Traffic and Revenue forecasts

PCU factor assumption for forecasts

6.8 The PCU factors considered are derived from IRC: 16-1990 code.

Table 6.21: PCU factors

Vehicle Category	PCU Factor
CJV	1.0
LCV	1.5
Bus	3.0
2A	3.0
3A	3.0
MAV	4.5
OSV	4.5

Source: Steer analysis, IRC Codes

6.9 Based on the traffic and revenue-related forecast assumptions discussed above, we have modelled the traffic and revenue forecasts for the forecast period for the Asset. The table below presents the traffic and revenue forecast growth rates and CAGRs on this Asset. Further, Appendix B presents the AADT and revenues for the forecast period.

Patgaon

Table 6.22: Final (background plus impacts) AADT forecast – Patgaon

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
CJV	1,331	1,417	1,515	1,937	2,581	3,384	4,341
Mini LCV	314	320	327	352	384	418	451
Bus	133	135	138	147	158	169	180

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
LCV	265	270	276	297	324	351	379
2A	954	991	1,031	1,113	1,322	1,554	1,803
3A	807	827	850	893	1,002	1,117	1,234
MAV	2,178	2,297	2,429	2,768	3,529	4,437	5,477
OSV	2	2	2	2	3	3	4
AADT	**5,985**	**6,259**	**6,566**	**7,510**	**9,303**	**11,433**	**13,868**
PCU's	**17,536**	**18,345**	**19,249**	**21,661**	**26,789**	**32,828**	**39,675**

Source: Steer analysis

Table 6.23: Final (background plus impacts) AADT CAGR (%) – Patgaon

Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FY30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
CJV	6.4%	6.9%	6.3%	5.9%	5.6%	5.1%	5.8%
Mini LCV	1.9%	2.1%	1.9%	1.8%	1.7%	1.5%	1.7%
Bus	1.6%	1.7%	1.6%	1.5%	1.4%	1.3%	1.4%
LCV	1.9%	2.0%	1.9%	1.7%	1.6%	1.5%	1.7%
2A	3.8%	4.1%	1.9%	3.5%	3.3%	3.0%	3.1%
3A	2.5%	2.7%	1.3%	2.3%	2.2%	2.0%	2.0%
MAV	5.4%	5.8%	3.3%	5.0%	4.7%	4.3%	4.5%
OSV	5.5%	5.8%	5.4%	5.0%	4.7%	4.3%	4.9%
AADT	**4.6%**	**4.9%**	**3.4%**	**4.4%**	**4.2%**	**3.9%**	**4.1%**
PCU's	**4.6%**	**4.9%**	**3.0%**	**4.3%**	**4.1%**	**3.9%**	**4.0%**

Source: Steer analysis

Table 6.24: Final (background plus impacts) revenue (INR crores) forecast – Patgaon

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
CJV	3.0	3.4	3.8	5.7	9.4	15.0	23.2
Mini LCV	0.7	0.8	0.8	1.0	1.4	1.8	2.4
Bus	1.2	1.3	1.3	1.7	2.2	2.9	3.8
LCV	1.3	1.4	1.5	1.9	2.5	3.3	4.3
2A	10.7	11.5	12.5	16.1	23.2	33.5	47.4
3A	10.8	11.4	12.4	15.4	21.1	28.8	38.8
MAV	42.1	45.9	51.2	68.8	106.8	165.0	247.6
OSV	0.0	0.0	0.0	0.1	0.1	0.2	0.2
Total Revenue	**69.8**	**75.7**	**83.5**	**110.7**	**166.6**	**250.5**	**367.7**

Source: Steer analysis

Table 6.25: Final (background plus impacts) revenue CAGR (%) – Patgaon

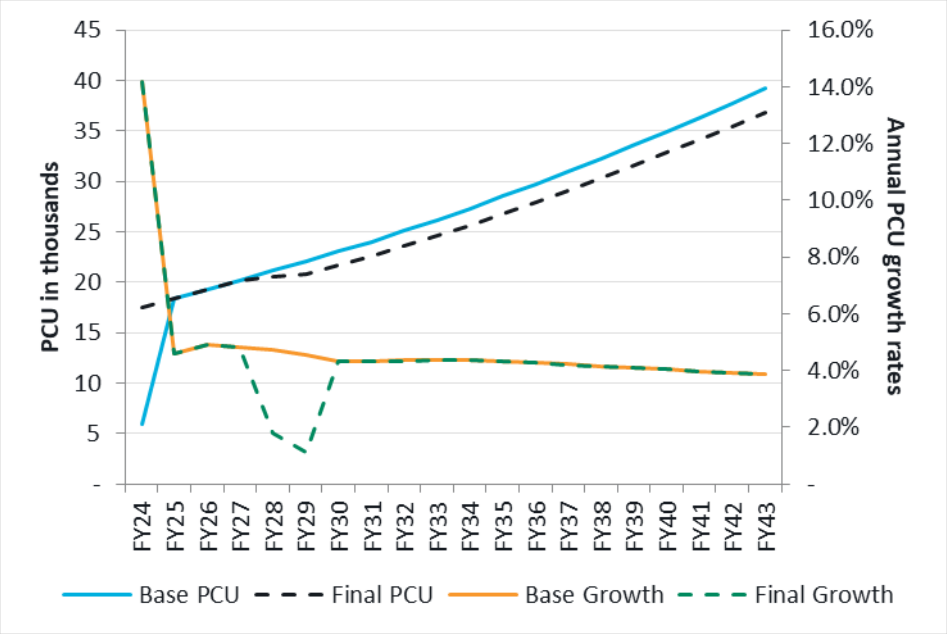
Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FY30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
CJV	10.8%	12.7%	10.9%	10.4%	9.8%	9.2%	10.2%
Mini LCV	6.1%	7.6%	6.2%	6.1%	5.8%	5.5%	6.0%

Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FY30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
Bus	5.7%	6.1%	6.1%	5.5%	5.6%	5.3%	5.7%
LCV	5.2%	5.5%	6.5%	5.8%	6.0%	5.4%	5.9%
2A	8.0%	8.5%	6.5%	7.6%	7.6%	7.2%	7.3%
3A	6.4%	8.0%	5.7%	6.5%	6.4%	6.2%	6.3%
MAV	9.1%	11.5%	7.7%	9.2%	9.1%	8.4%	8.8%
OSV	9.2%	11.3%	9.9%	9.3%	9.0%	8.6%	9.3%
Total Revenue	**8.4%**	**10.3%**	**7.3%**	**8.5%**	**8.5%**	**8.0%**	**8.2%**

Source: Steer analysis

6.10 The growth rates and PCU projections are presented in the chart below:

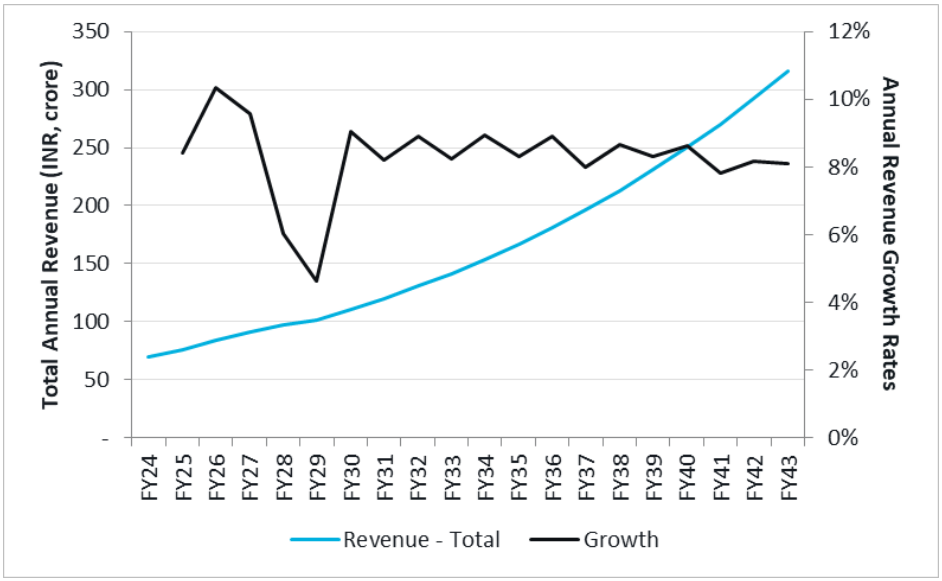
Figure 6.10: PCU growth rates (Base and Final)- Patgaon



Source: Steer analysis

6.11 Annual revenue and associated growth rates are presented in the chart below.

Figure 6.11: Revenue Estimates (INR Crore) and growth rates- Patgaon



Source: Steer analysis

Dahalapara

Table 6.26: Final (background plus impacts) AADT forecast – Dahalapara

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
CJV	2,382	2,454	2,710	3,466	4,619	6,055	7,768
Mini LCV	460	464	479	517	564	613	661
Bus	231	235	239	254	274	293	313
LCV	495	504	515	549	599	649	700
2A	1,129	1,172	1,219	1,250	1,483	1,744	2,024
3A	938	962	988	934	1,048	1,168	1,291
MAV	2,200	2,320	2,454	2,602	3,317	4,170	5,147
OSV	1	1	1	2	2	3	3
AADT	**7,837**	**8,112**	**8,605**	**9,573**	**11,905**	**14,695**	**17,906**
PCU's	**20,386**	**21,225**	**22,348**	**23,836**	**29,431**	**36,034**	**43,536**

Source: Steer analysis

Table 6.27: Final (background plus impacts) AADT CAGR (%) – Dahalapara

Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FY30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
CJV	3.0%	10.4%	6.3%	5.9%	5.6%	5.1%	5.8%
Mini LCV	0.8%	3.2%	1.9%	1.8%	1.7%	1.5%	1.7%
Bus	1.6%	1.7%	1.6%	1.5%	1.4%	1.3%	1.4%
LCV	1.9%	2.0%	1.6%	1.7%	1.6%	1.5%	1.7%
2A	3.8%	4.1%	0.6%	3.5%	3.3%	3.0%	2.8%
3A	2.5%	2.7%	(1.4%)	2.3%	2.2%	2.0%	1.5%
MAV	5.4%	5.8%	1.5%	5.0%	4.7%	4.3%	4.1%

Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FY30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
OSV	5.5%	5.8%	5.4%	5.0%	4.7%	4.3%	4.9%
AADT	**3.5%**	**6.1%**	**2.7%**	**4.5%**	**4.3%**	**4.0%**	**4.0%**
PCU's	**4.1%**	**5.3%**	**1.6%**	**4.3%**	**4.1%**	**3.9%**	**3.7%**

Source: Steer analysis

Table 6.28: Final (background plus impacts) revenue (INR crores) forecast – Dahalapara

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
CJV	5.7	6.1	7.0	10.7	17.5	28.0	44.2
Mini LCV	1.1	1.2	1.2	1.6	2.1	2.8	3.8
Bus	1.6	1.7	1.8	2.2	3.0	3.9	5.0
LCV	2.1	2.3	2.4	3.0	4.0	5.4	7.0
2A	11.4	12.2	13.3	16.1	23.6	33.9	47.8
3A	10.3	11.0	11.8	13.2	18.2	24.8	33.4
MAV	37.1	40.6	45.2	56.3	87.7	135.3	203.4
OSV	0.0	0.0	0.0	0.0	0.1	0.1	0.2
Total Revenue	**69.3**	**75.0**	**82.7**	**103.2**	**156.2**	**234.2**	**344.7**

Source: Steer analysis

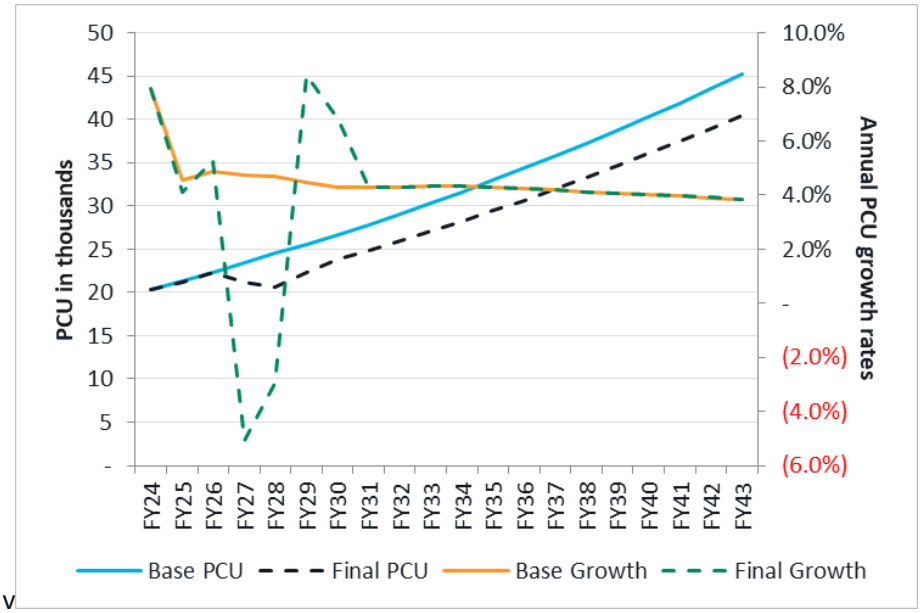
Table 6.29: Final (background plus impacts) revenue CAGR (%) – Dahalapara

Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FY30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
CJV	6.3%	15.6%	11.1%	10.3%	9.8%	9.6%	10.2%
Mini LCV	4.0%	8.0%	6.5%	6.0%	5.8%	5.9%	6.0%
Bus	4.7%	6.8%	6.0%	5.8%	5.6%	5.3%	5.6%
LCV	5.9%	6.1%	5.9%	6.0%	5.8%	5.5%	5.8%
2A	7.0%	9.2%	5.0%	7.9%	7.5%	7.1%	7.1%
3A	6.9%	7.3%	2.9%	6.6%	6.4%	6.1%	5.8%
MAV	9.6%	11.2%	5.7%	9.3%	9.0%	8.5%	8.4%
OSV	9.8%	11.2%	9.9%	9.3%	9.1%	8.5%	9.3%
Total Revenue	**8.2%**	**10.4%**	**5.7%**	**8.6%**	**8.4%**	**8.0%**	**7.9%**

Source: Steer analysis

6.12 The growth rates and PCU projections are presented in the chart below:

Figure 6.12: PCU growth rates (Base and Final)- Dahalapara

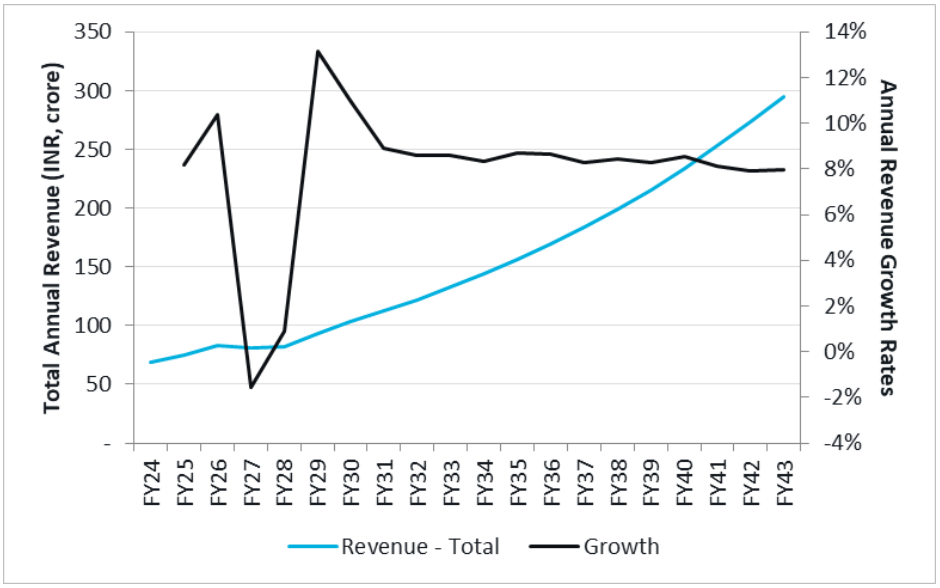


v

Source: Steer analysis

6.13 Annual revenue and associated growth rates are presented in the chart below.

Figure 6.13: Revenue Estimates (INR Crore) and growth rates- Dahalapara



Galia

Table 6.30: Final (background plus impacts) AADT forecast – Galia

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
CJV	3,385	3,489	3,851	4,925	6,563	8,604	11,038
Mini LCV	392	394	405	431	464	497	530
LCV	574	585	597	644	703	764	824
Bus	465	474	483	521	569	618	667
2A	970	1,007	1,048	1,066	1,266	1,489	1,729

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
3A	941	965	991	956	1,072	1,195	1,320
MAV	2,113	2,227	2,354	2,436	3,099	3,890	4,794
OSV	2	2	2	2	3	3	4
AADT	**8,842**	**9,143**	**9,733**	**10,981**	**13,740**	**17,060**	**20,906**
PCU's	**21,283**	**22,128**	**23,324**	**24,922**	**30,764**	**37,673**	**45,542**

Source: Steer analysis

Table 6.31: Final (background plus impacts) AADT CAGR (%) – Galia

Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FY30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
CJV	3.1%	10.4%	6.3%	5.9%	5.6%	5.1%	5.8%
Mini LCV	0.6%	2.7%	1.6%	1.5%	1.4%	1.3%	1.4%
LCV	1.9%	2.1%	1.9%	1.8%	1.7%	1.5%	1.7%
Bus	1.9%	2.1%	1.9%	1.8%	1.7%	1.5%	1.7%
2A	3.8%	4.1%	0.4%	3.5%	3.3%	3.0%	2.8%
3A	2.5%	2.7%	(0.9%)	2.3%	2.2%	2.0%	1.6%
MAV	5.4%	5.7%	0.9%	4.9%	4.6%	4.3%	4.0%
OSV	5.4%	5.7%	5.3%	4.9%	4.6%	4.3%	4.8%
AADT	**3.4%**	**6.4%**	**3.1%**	**4.6%**	**4.4%**	**4.1%**	**4.2%**
PCU's	**4.0%**	**5.4%**	**1.7%**	**4.3%**	**4.1%**	**3.9%**	**3.7%**

Source: Steer analysis

Table 6.32: Final (background plus impacts) revenue (INR crores) forecast – Galia

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
CJV	3.9	4.2	4.8	7.4	12.3	19.6	30.6
Mini LCV	0.6	0.7	0.7	0.9	1.2	1.5	2.0
LCV	1.3	1.4	1.5	1.9	2.5	3.3	4.4
Bus	1.0	1.1	1.2	1.5	1.9	2.6	3.4
2A	5.2	5.7	6.3	7.5	10.9	15.7	22.3
3A	5.5	6.0	6.5	7.4	10.1	13.8	18.6
MAV	18.5	20.3	22.7	27.8	43.7	66.8	100.1
OSV	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Total Revenue	**36.0**	**39.3**	**43.7**	**54.4**	**82.6**	**123.3**	**181.4**

Source: Steer analysis

Table 6.33: Final (background plus impacts) revenue CAGR (%) – Galia

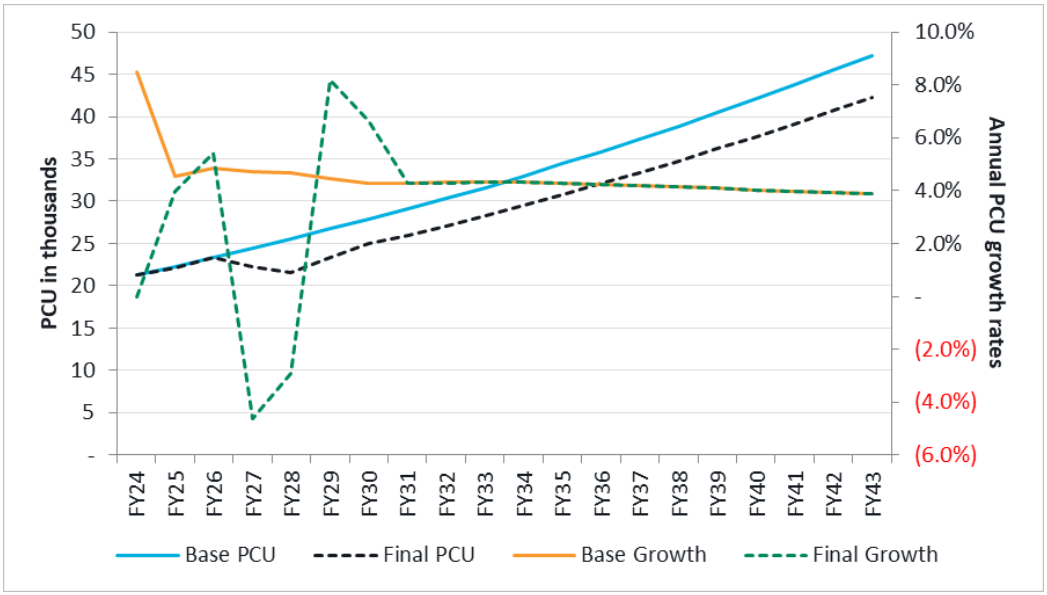
Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FY30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
CJV	8.2%	14.3%	11.3%	10.5%	9.8%	9.4%	10.3%
Mini LCV	8.8%	4.3%	6.3%	6.0%	5.3%	5.4%	5.8%
LCV	7.0%	10.1%	5.9%	6.0%	5.8%	5.8%	6.1%

Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FY30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
Bus	7.7%	8.3%	6.1%	5.9%	5.9%	5.7%	6.1%
2A	9.8%	10.4%	4.6%	7.7%	7.6%	7.3%	7.2%
3A	7.9%	8.7%	3.3%	6.5%	6.4%	6.2%	6.0%
MAV	9.4%	12.0%	5.2%	9.4%	8.9%	8.4%	8.4%
OSV	8.6%	12.5%	9.8%	9.4%	8.9%	8.5%	9.2%
Total Revenue	**9.0%**	**11.2%**	**5.6%**	**8.7%**	**8.3%**	**8.0%**	**8.0%**

Source: Steer analysis

6.14 The growth rates and PCU projections are presented in the chart below:

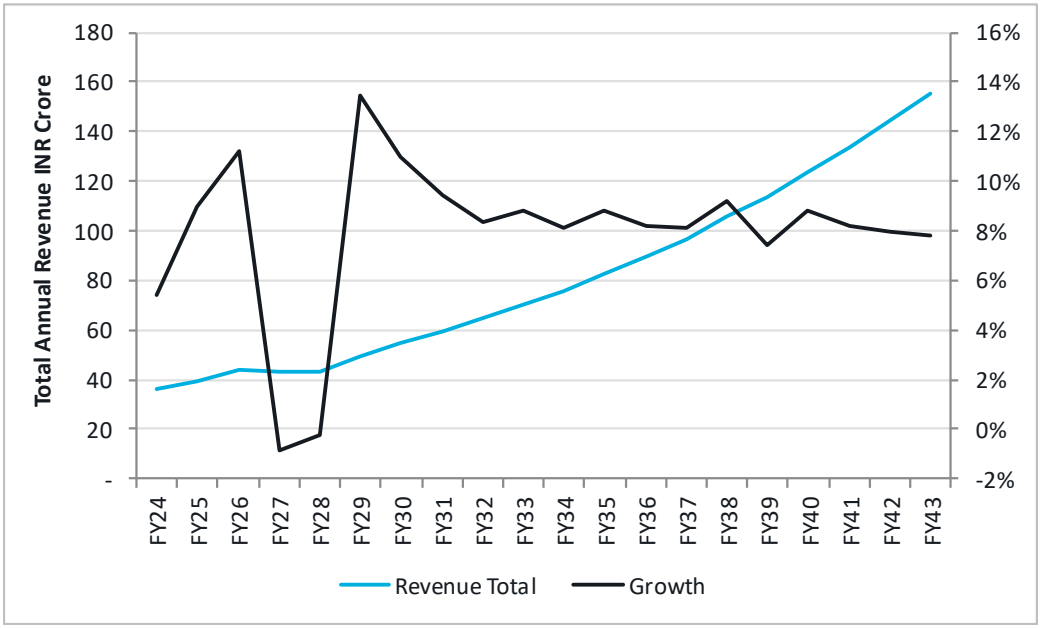
Figure 6.14: PCU growth rates (Base and Final)- Galia



Source: Steer analysis

6.15 Annual revenue and associated growth rates are presented in the chart below.

Figure 6.15: Revenue Estimates (INR Crore) and growth rates- Galia



Source: Steer analysis

6.16 The traffic and revenue forecast presented above are our base case scenario considering a balanced view on the risks associated with input assumptions around GDP growth and traffic growth elasticities. The base case represents a central case scenario given the risks of variation of input assumptions.

Summary outlook

6.17 The analysis presented in this report and the methodology followed adopted presents a custom approach compared to a standard traffic and revenue forecasting approach. We have utilised information from various sources, backed by our knowledge of toll roads in the regional setting of the Asset, in order to triangulate a robust base T&R position before presenting our views on other key topics, such as base year AADT and revenue, growth forecasts, and traffic segmentation.

6.18 Overall, we believe, we have tabled a robust set of forecast numbers underpinned by a rigorous base T&R position, background growth, exogenous impacts coupled with our unparallel market knowledge of the toll road industry in India.

6.19 The Asset forms parts of NH27, the east-west corridor of India, and act as the key connector of between the NE states and rest of India. The Asset benefits from its geographic location as the majority of goods movement destined to the NE states has to enter the region via the Asset. The goods are transported to Guwahati city from where they are redistributed to other parts of the region. Thus, the Asset observes strategic long-distance movement.

6.20 The Asset is located in the state of Assam, which is the most populous as well as the most industrialised state of the NE region. Assam contributes ~64% to the region's economy. Presence of abundant natural resources has given Assam an advantage of producing oil, and gas, limestone, cement, and coal-related products. Further, the Asset is connected to Guwahati, the most populous city of Assam and the key distribution centre of the region. The

future growth of Guwahati city, the state of Assam, and the NE region will directly add to the growth of the Asset.

6.21 The 4-laning of NH17 and NH127 B have been identified as the potential key development risk that will impact the traffic in the future. The developments expected to get completed in FY27 and FY28 respectively have been assumed to impact the traffic in a phased manner wherein, 60% of the total impacted traffic will be lost in the first year of impact and 100% of the impacted traffic to be lost in the subsequent years. However, FY29 onwards once Guwahati Ring Road comes share of traffic moving beyond Guwahati and east will shift back to the Asset.

6.22 Overall, we see a positive outlook for the region, and we believe that the Asset will have a robust traffic profile as it is a key connector for the strategically important NE region with the rest of country. The underlying growth drivers of the corridor are strong given the strong infrastructure boost and increased government spending in the region, which is expected to increase the income and consumption levels in the region and deliver long term sustained growth on the corridor.

Appendices

A Data collection exercise

A.1 Below you can find the Zone list used for OD Analysis for both Assets:

OD analysis

Zone list

Table A.1: Zone list used for OD analysis

Zone No	Zone name	Description/State
1	Patgaon	Assam
2	Dahalapara	Assam
3	Galia	Assam
4	Madanpur	Assam
5	Nazirakhat	Assam
6	Raha	Assam
7	Guwahati	Assam
8	Rest of Guwahati	Assam
9	Lokhra	Assam
10	Dispur	Assam
11	Gauripur	Assam
12	Changsari	Assam
13	Amingaon	Assam
14	Baihata Charairali	Assam
15	Kamalpur	Assam
16	Ghopla	Assam
17	Rangia	Assam
18	Nalbari	Assam
19	Barama	Assam
20	Pathsala	Assam
21	Bhawanipur	Assam
22	Howly	Assam
23	Bala Bhitha	Assam
24	Bijni	Assam
25	Bongaigaon	Assam
26	Rest of Bongaigaon	Assam
27	Chirang	Assam

Zone No	Zone name	Description/State
28	Kachugaoan	Assam
29	Hablubil	Assam
30	Srirampur	Assam
31	Golakganj	Assam
32	Alomganj	Assam
33	Bilasipara	Assam
34	Kokrajhar	Assam
35	Dhubri	Assam
36	Abhaypuri	Assam
37	Gopalpara	Assam
38	Dudhnoi	Assam
39	Dhudhpara	Assam
40	Boko	Assam
41	Chhaygaon	Assam
42	Barapeta	Assam
43	Hajo	Assam
44	Bhabanipur	Assam
45	Gelephu	Assam
46	Samdrup Jonghkar	Assam
47	Jorabat	Assam
48	Jagiroad	Assam
49	Morigaon	Assam
50	Nagaon	Assam
51	Tezpur	Assam
52	Biswanath	Assam
53	Darrang	Assam
54	Sonitpur	Assam
55	Udalguri	Assam
56	Karimganj	Assam
57	Mangaldoi	Assam
58	Hojai	Assam
59	Lanka	Assam
60	Lumdig	Assam
61	Haflong	Assam
62	Silchar	Assam
63	Diphu	Assam
64	Bokakhat	Assam
65	Golghat	Assam

Zone No	Zone name	Description/State
66	Jorhat	Assam
67	Majuli	Assam
68	Lakhimpur	Assam
69	Dibrugarh	Assam
70	Tinsukia	Assam
71	Namsai	Assam
72	Daboka	Assam
73	Kampur	Assam
74	Kathiatali	Assam
75	Nilbangan	Assam
76	Maibang	Assam
77	Kamrup	Assam
78	Digboi	Assam
79	Noonmati	Assam
80	Sivasagar	Assam
81	Rest of Assam	Assam
82	Shillong	Meghalaya
83	Cherrapunji	Meghalaya
84	Jowai	Meghalaya
85	Ampati	Meghalaya
86	Mairang	Meghalaya
87	Tura	Meghalaya
88	Baghmara	Meghalaya
89	Williamnagar	Meghalaya
90	Nongpoh	Meghalaya
91	Umiam	Meghalaya
92	Lumshnong	Meghalaya
93	MendiPathar	Meghalaya
94	Nongstoin	Meghalaya
95	Byrnihat	Meghalaya
96	Rest of Meghalaya	Meghalaya
97	Agartala	Tripura
98	Udaipur	Tripura
99	Dharamnagar	Tripura
100	Bishramganj	Tripura
101	Khowai	Tripura
102	Belonia	Tripura
103	Bodhjungnaga	Tripura

Zone No	Zone name	Description/State
104	Tulakona Industrial Area	Tripura
105	Baramura	Tripura
106	Gojalia	Tripura
107	Manikyanagar	Tripura
108	Konaban	Tripura
109	Agartala Dome	Tripura
110	Tichna	Tripura
111	Gournagar	Tripura
112	Rest of Tripura	Tripura
113	Itanagar	Arunachal Pradesh
114	Tawang	Arunachal Pradesh
115	Siang	Arunachal Pradesh
116	Longding	Arunachal Pradesh
117	Anjaw	Arunachal Pradesh
118	Changlang	Arunachal Pradesh
119	Tirap	Arunachal Pradesh
120	Kameng	Arunachal Pradesh
121	Rest of Arunachal Pradesh	Arunachal Pradesh
122	Kohima	Nagaland
123	Dimapur	Nagaland
124	Longleng	Nagaland
125	Rest of Nagaland	Nagaland
126	Aizawl	Mizoram
127	Lunglei	Mizoram
128	Champhai	Mizoram
129	Khawzawl	Mizoram
130	Rest of Mizoram	Mizoram
131	Imphal	Manipur
132	Chandel	Manipur
133	Senapati	Manipur
134	Kamjong	Manipur
135	Kakching	Manipur
136	Rest of Manipur	Manipur
137	Gangtok	Sikkim
138	Siliguri	Sikkim
139	Darjeeling	West Bengal
140	Jalpaiguri	West Bengal
141	Cooch Behar	West Bengal

Zone No	Zone name	Description/State
142	Malda	West Bengal
143	Murshidabad	West Bengal
144	Birbhum	West Bengal
145	Bardhhaman	West Bengal
146	Bankura	West Bengal
147	Purulia	West Bengal
148	Dinajpur	West Bengal
149	Nadia	West Bengal
150	Raiganj	West Bengal
151	Hooghly	West Bengal
152	Kolkata	West Bengal
153	Howrah	West Bengal
154	Medinapur	West Bengal
155	Haldia Port	West Bengal
156	Rest of West Bengal	West Bengal
157	Patna	Bihar
158	Gaya	Bihar
159	Kishanganj	Bihar
160	Muzaffarpur	Bihar
161	Darbhanga	Bihar
162	Begusarai	Bihar
163	Rest of Bihar	Bihar
164	Lucknow	Uttar Pradesh
165	Kanpur	Uttar Pradesh
166	Gorakhpur	Uttar Pradesh
167	Varanasi	Uttar Pradesh
168	Allahabad	Uttar Pradesh
169	Agra	Uttar Pradesh
170	Bareilly	Uttar Pradesh
171	East Uttar Pradesh	Bahriach, Gonda, Basti, Ghazipur, Mirzapur
172	West Uttar Pradesh	Meerut, Saharanpur, Moradabad, Aligarh
173	North Uttar Pradesh	Shahjahanpur, Lakhimpur Kheri, Hardoi, Sitapur
174	South Uttar Pradesh	Jhansi, Banda, Fatehpur, Prayagraj, Raebareli, Amethi
175	Ranchi	Jharkhand
176	Jamshedpur	Jharkhand
177	Dumka	Jharkhand
178	Rest of Jharkhand	Jharkhand
179	Jaipur	Rajasthan

Zone No	Zone name	Description/State
180	Udaipur	Rajasthan
181	Kota	Rajasthan
182	Sirohi	Rajasthan
183	Bhilwara	Rajasthan
184	Chittorgarh	Rajasthan
185	Rest of Rajasthan	Rajasthan
186	Porbandar	Gujarat
187	Rajkot	Gujarat
188	Morbi	Gujarat
189	Palanpur	Gujarat
190	Deesa	Gujarat
191	Ahmedabad	Gujarat
192	Gandhinagar	Gujarat
193	Vadodara	Gujarat
194	Kandla Port	Gujarat
195	Mundra Port	Gujarat
196	Rest of Gujarat	Gujarat
197	Delhi NCR	Delhi NCR
198	Haryana	Haryana
199	Punjab	Punjab
200	Raipur	Chhattisgarh
201	Bhilai	Chhattisgarh
202	Rest of Chhattisgarh	Chhattisgarh
203	Bhubaneshwar	Odisha
204	Paradip	Odisha
205	Gopalpur Port	Odisha
206	Rest of Odisha	Odisha
207	Himachal Pradesh	Himachal Pradesh
208	Uttarakhand	Uttarakhand
209	Jammu and Kashmir	Jammu and Kashmir
210	Madhya Pradesh	Madhya Pradesh
211	Aurangabad	Maharashtra
212	Chandrapur	Maharashtra
213	Mumbai	Maharashtra
214	Nagpur	Maharashtra
215	Pune	Maharashtra
216	Thane	Maharashtra
217	Ratnagiri	Maharashtra

Zone No	Zone name	Description/State
218	East Maharashtra	Gondia, Naded, Gadchiroli, Wardha
219	West Maharashtra	Palghar, Raigad, Nashik, Dhule, Nandurbar
220	North Maharashtra	Dhule, Jalgaon, Amravati, Akola, Hingoli, Ahmednagar
221	South Maharashtra	Kohlapur, Sangli, Satara, Osmanabad
222	Telangana	Telangana
223	Karnataka	Karnataka
224	Andhra Pradesh	Andhra Pradesh
225	Tamil Nadu	Tamil Nadu
226	Kerala	Kerala
227	Odisha	Odisha
228	Chhattisgarh	Chhattisgarh
229	Sikkim	Sikkim
230	Bhutan	Bhutan
231	Nepal	Nepal
232	Bangladesh	Bangladesh
233	Goa	Goa

Source: Steer representation

Top OD pairs

A.2 Further to the OD analysis presented in Chapter 3 this appendix presents the OD maps for 3A+MAVs along with top 10 OD pairs at each toll plaza

Table A.2: Patgaon: 3A/MAV top 10 OD pair shares

	Origin	Destination	Share
1.	Guwahati	Klkata	10.77%
2.	Guwahati	Rest of West Bengal	5.52%
3.	Guwahati	Delhi NCR	4.36%
4.	Guwahati	Siliguri	3.00%
5.	Guwahati	Rest of Bihar	2.52%
6.	Guwahati	Punjab	1.84%
7.	Guwahati	Patna	1.50%
8.	Guwahati	Haryana	1.30%
9.	Guwahati	Andhra Pradesh	1.16%
10.	Guwahati	East Uttar Pradesh	1.16%

Source: Steer analysis

Table A.3: Dahalapara: 3A/MAV top 10 OD pair shares

	Origin	Destination	Share
1.	Guwahati	Klkata	6.95%
2.	Guwahati	Siliguri	3.67%
3.	Guwahati	Delhi NCR	3.38%
4.	Guwahati	Bongaigaon	3.09%
5.	Guwahati	Rest of West Bengal	2.90%
6.	Guwahati	Rest of Bihar	2.41%
7.	Bongaigaon	Barapeta	2.27%
8.	Guwahati	Punjab	1.64%
9.	Barapeta	Siliguri	1.59%
10.	Guwahati	Rest of Guajarat	1.50%

Source: Steer analysis

Table A.4: NH17: 3A/MAV top 10 OD pair shares

	Origin	Destination	Share
1.	Guwahati	Bongaigaon	6.31%
2.	Gopalpara	Dudhnoi/Darranggiri	3.60%
3.	Bongaigaon	Dudhnoi/Darranggiri	3.60%
4.	Agia	Boko	2.70%
5.	Kamrup	Boko	2.70%
6.	Guwahati	Siliguri	2.70%
7.	Kamrup	Agia	2.70%
8.	Kokrajhar	Dudhnoi/Darranggiri	1.80%
9.	Kokrajhar	Rest of Jharkhand	1.80%
10.	Nalbari	Gopalpara	1.80%

Source: Steer analysis

Table A.5: Galia: 3A/MAV top 10 OD pair shares

	Origin	Destination	Share
1.	Guwahati	Klkata	9.5%
2.	Guwahati	North Maharashtra	5.6%
3.	Guwahati	Patna	5.0%
4.	Agartala	Klkata	3.1%
5.	Silchar	Klkata	1.8%
6.	Dimapur	Klkata	1.8%
7.	Guwahati	Ahmedabad	1.7%
8.	Guwahati	Uttrakhand	1.6%

9.	Guwahati	Rest of Guajarat	1.3%
10.	Guwahati	Madhya Pradesh	1.3%

Source: Steer analysis

7 days TVC count

A.3 The TVC counts recorded at each toll plaza can be seen below. These counts form an important part of TVC-toll plaza data analysis which contributes significantly to our base estimation exercise:

Table A.6: Patgaon: Daily TVC counts

Date	CJV	Mini LCV	LCV	Bus	2 Axle	3 Axle	MAV	OSV	Total
05-01-2024	1,348	168	354	82	552	625	1,778	1	4,908
06-01-2024	1,587	372	405	140	700	795	2,016	-	6,015
07-01-2024	2,168	379	524	181	731	910	2,541	4	7,438
08-01-2024	1,631	481	475	179	742	734	2,085	-	6,327
09-01-2024	1,208	399	443	186	740	779	2,218	-	5,973
10-01-2024	1,619	391	479	198	769	788	2,297	-	6,541
11-01-2024	1,567	433	480	191	800	822	2,323	2	6,618

Source: Steer analysis

Table A.7: Dahalapara: Daily TVC counts

Date	CJV	Mini LCV	LCV	Bus	2 Axle	3 Axle	MAV	OSV	Total
05-01-2024	2,172	179	406	76	564	615	1,635	1	5,648
06-01-2024	2,514	410	660	300	901	959	1,975	-	7,719
07-01-2024	3,108	552	908	405	986	1,152	2,533	4	9,648
08-01-2024	2,676	594	856	477	894	946	2,110	-	8,553
09-01-2024	2,110	581	910	416	923	983	2,327	-	8,250
10-01-2024	2,598	570	846	444	908	982	2,315	-	8,663
11-01-2024	2,471	525	892	388	908	1,002	2,358	3	8,547

Source: Steer analysis

Table A.8: Galia: Daily TVC counts

Date	CJV	Mini LCV	LCV	Bus	2 Axle	3 Axle	MAV	OSV	Total
14/10/2023	2,846	631	729	497	813	1,026	2,184	2	8,728
15/10/2023	3,110	546	755	495	805	1,006	2,253	2	8,972
16/10/2023	3,517	694	687	421	877	961	2,219	-	9,376
17/10/2023	3,429	673	858	520	822	1,031	2,313	1	9,647

Date	CJV	Mini LCV	LCV	Bus	2 Axle	3 Axle	MAV	OSV	Total
18/10/2023	2,942	701	835	527	914	1,028	2,219	-	9,166
19/10/2023	3,259	706	720	553	861	1,099	2,225	-	9,423
20/10/2023	3,904	656	793	546	808	1,047	2,177	-	9,931

Source: Steer analysis

B Traffic and revenue forecasts

B.1 Further to the summary of forecasts presented in Chapter 6, this appendix presents detailed forecasts.

Traffic forecasts

B.2 This section presents the detailed traffic forecasts for the forecast period until FY43, year of expected close of the concession. The following tables show the year-on-year AADT and traffic growth rates.

Table B.1: Patgaon Forecasts for final (background + impacts) AADT

Vehicle Category	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32
CJV	1,331	1,417	1,515	1,615	1,721	1,829	1,937	2,052	2,174
Mini LCV	314	320	327	333	340	346	352	358	365
LCV	265	270	276	281	287	292	297	302	307
Bus	133	135	138	140	142	145	147	149	151
2A	954	991	1,031	1,071	1,079	1,076	1,113	1,152	1,193
3A	807	827	850	872	874	873	893	914	935
MAV	2,178	2,297	2,429	2,566	2,610	2,637	2,768	2,906	3,051
OSV	2	2	2	2	2	2	2	2	2
Total	**5,985**	**6,259**	**6,566**	**6,880**	**7,055**	**7,198**	**7,510**	**7,836**	**8,179**
PCU	**17,536**	**18,345**	**19,249**	**20,173**	**20,533**	**20,766**	**21,661**	**22,598**	**23,579**

Source: Steer analysis

Table B.2: Patgaon: Forecasts for final (background + impacts) AADT

Vehicle Category	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40	FY41	FY42	FY43	FY44
CJV	2,302	2,439	2,581	2,730	2,884	3,044	3,211	3,384	3,563	3,748	3,940	4,137
Mini LCV	371	378	384	391	398	404	411	418	424	431	437	444
LCV	313	318	324	329	335	340	346	351	357	362	368	373
Bus	153	156	158	160	162	165	167	169	171	174	176	178
2A	1,234	1,278	1,322	1,367	1,412	1,459	1,506	1,554	1,602	1,652	1,702	1,752
3A	957	980	1,002	1,025	1,048	1,071	1,094	1,117	1,140	1,164	1,187	1,210
MAV	3,204	3,364	3,529	3,700	3,876	4,057	4,244	4,437	4,634	4,837	5,045	5,259
OSV	2	3	3	3	3	3	3	3	4	4	4	4
Total	**8,538**	**8,914**	**9,303**	**9,704**	**10,118**	**10,544**	**10,982**	**11,433**	**11,896**	**12,371**	**12,858**	**13,357**
PCU	**24,606**	**25,681**	**26,789**	**27,931**	**29,106**	**30,314**	**31,555**	**32,828**	**34,135**	**35,473**	**36,843**	**38,244**

Source: Steer analysis

Table B.3: Dahalapara: Forecasts for final (background + impacts) AADT

Vehicle Category	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32
CJV	2,382	2,454	2,710	2,890	3,080	3,272	3,466	3,671	3,889
Mini LCV	460	464	479	489	498	508	517	526	535
LCV	495	504	515	525	530	540	549	559	568
Bus	231	235	239	243	247	251	254	258	262
2A	1,129	1,172	1,219	1,156	1,110	1,185	1,250	1,293	1,339
3A	938	962	988	882	802	876	934	956	978
MAV	2,200	2,320	2,454	2,265	2,161	2,396	2,602	2,732	2,868
OSV	1	1	1	1	2	2	2	2	2

Total	**7,837**	**8,112**	**8,605**	**8,452**	**8,429**	**9,029**	**9,573**	**9,997**	**10,441**
PCU	**20,386**	**21,225**	**22,348**	**21,211**	**20,581**	**22,316**	**23,836**	**24,857**	**25,927**

Source: Steer analysis

Table B.4: Dahalapara: Forecasts for final (background + impacts) AADT

Vehicle Category	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40	FY41	FY42	FY43	FY44
CJV	4,120	4,364	4,619	4,884	5,160	5,447	5,745	6,055	6,375	6,706	7,049	7,403
Mini LCV	545	554	564	574	583	593	603	613	622	632	642	651
LCV	578	588	599	609	619	629	639	649	660	670	680	690
Bus	266	270	274	278	282	286	290	293	297	301	305	309
2A	1,385	1,434	1,483	1,534	1,585	1,637	1,690	1,744	1,798	1,854	1,910	1,966
3A	1,001	1,025	1,048	1,072	1,096	1,120	1,144	1,168	1,192	1,217	1,241	1,266
MAV	3,011	3,161	3,317	3,477	3,643	3,813	3,989	4,170	4,355	4,546	4,742	4,942
OSV	2	2	2	2	2	2	3	3	3	3	3	3
Total	**10,908**	**11,398**	**11,905**	**12,429**	**12,970**	**13,528**	**14,103**	**14,695**	**15,303**	**15,929**	**16,572**	**17,230**
PCU	**27,048**	**28,221**	**29,431**	**30,678**	**31,962**	**33,282**	**34,640**	**36,034**	**37,464**	**38,929**	**40,430**	**41,966**

Source: Steer analysis

Table B.5: Galia: Forecasts for final (background + impacts) AADT

Vehicle Category	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32
CJV	3,385	3,489	3,851	4,107	4,377	4,650	4,925	5,217	5,527
Mini LCV	392	394	405	412	418	425	431	438	444
LCV	465	474	483	493	503	512	521	531	540
Bus	574	585	597	609	621	633	644	656	667

2A	970	1,007	1,048	979	939	1,007	1,066	1,103	1,142
3A	941	965	991	891	826	899	956	978	1,001
MAV	2,113	2,227	2,354	2,160	2,013	2,240	2,436	2,557	2,683
OSV	2	2	2	2	2	2	2	2	2
Total	**8,842**	**9,143**	**9,733**	**9,652**	**9,698**	**10,367**	**10,981**	**11,481**	**12,006**
PCU	**21,283**	**22,128**	**23,324**	**22,246**	**21,595**	**23,366**	**24,922**	**25,988**	**27,104**

Source: Steer analysis

Table B.6: Galia: Forecasts for final (background + impacts) AADT

Vehicle Category	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40	FY41	FY42	FY43	FY44
CJV	5,854	6,201	6,563	6,940	7,333	7,741	8,164	8,604	9,059	9,530	10,017	10,520
Mini LCV	451	457	464	471	477	484	491	497	504	510	517	523
LCV	550	559	569	579	589	599	608	618	628	638	648	657
Bus	679	691	703	715	727	740	752	764	776	788	800	812
2A	1,182	1,224	1,266	1,309	1,353	1,398	1,443	1,489	1,536	1,583	1,631	1,680
3A	1,024	1,048	1,072	1,096	1,121	1,145	1,170	1,195	1,220	1,245	1,270	1,295
MAV	2,816	2,955	3,099	3,248	3,402	3,560	3,722	3,890	4,062	4,238	4,419	4,604
OSV	2	3	3	3	3	3	3	3	4	4	4	4
Total	**12,558**	**13,139**	**13,740**	**14,362**	**15,005**	**15,669**	**16,354**	**17,060**	**17,788**	**18,536**	**19,305**	**20,095**
PCU	**28,274**	**29,499**	**30,764**	**32,067**	**33,410**	**34,792**	**36,213**	**37,673**	**39,171**	**40,708**	**42,282**	**43,894**

Source: Steer analysis

B.3 This section presents the detailed revenue forecasts in INR crore for the forecast period until FY43, year of expected close of the concession. The following tables show the revenue forecasts.

Table B.7: Patgaon: Revenue forecasts

Vehicle Category	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32
CJV	3.0	3.4	3.8	4.2	4.7	5.2	5.7	6.3	6.9
Mini LCV	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.2
LCV	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1
Bus	1.2	1.3	1.3	1.4	1.5	1.6	1.7	1.8	1.9
2A	10.7	11.5	12.5	13.7	14.4	14.9	16.1	17.2	18.7
3A	10.8	11.4	12.4	13.3	13.9	14.4	15.4	16.4	17.5
MAV	42.1	45.9	51.2	56.4	59.9	62.7	68.8	74.9	82.1
OSV	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Total	**69.8**	**75.7**	**83.5**	**91.5**	**97.0**	**101.5**	**110.7**	**119.7**	**130.4**

Source: Steer analysis

Table B.8: Patgaon Revenue forecasts

Vehicle Category	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40	FY41	FY42	FY43	FY44
CJV	7.6	8.4	9.4	10.3	11.2	12.4	13.5	15.0	16.3	17.9	19.7	21.2
Mini LCV	1.2	1.3	1.4	1.5	1.5	1.7	1.7	1.8	1.9	2.1	2.2	2.3
LCV	2.2	2.3	2.5	2.6	2.8	3.0	3.1	3.3	3.5	3.7	3.9	4.1
Bus	2.0	2.1	2.2	2.3	2.5	2.6	2.7	2.9	3.1	3.2	3.4	3.6
2A	20.1	21.6	23.2	25.2	26.9	29.0	31.2	33.5	36.1	38.5	41.4	44.5
3A	18.6	19.9	21.1	22.5	23.9	25.4	26.9	28.8	30.5	32.4	34.3	36.6
MAV	89.4	98.1	106.8	116.9	127.0	138.8	151.3	165.0	178.6	194.2	210.8	228.9
OSV	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
Total	**141.2**	**153.8**	**166.6**	**181.5**	**196.0**	**213.0**	**230.6**	**250.5**	**270.1**	**292.2**	**315.8**	**341.3**

Source: Steer analysis

Table B.9: Dahalapara: Revenue forecasts

Vehicle Category	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32
CJV	5.7	6.1	7.0	7.8	8.8	9.7	10.7	11.9	13.1
Mini LCV	1.1	1.2	1.2	1.3	1.4	1.5	1.6	1.7	1.8
LCV	2.1	2.3	2.4	2.6	2.7	2.8	3.0	3.2	3.4
Bus	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.4	2.5
2A	11.4	12.2	13.3	13.3	13.2	14.7	16.1	17.5	18.9
3A	10.3	11.0	11.8	11.1	10.6	11.9	13.2	14.1	15.0
MAV	37.1	40.6	45.2	43.3	43.4	50.1	56.3	61.5	67.4
OSV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total	**69.3**	**75.0**	**82.7**	**81.5**	**82.2**	**93.0**	**103.2**	**112.5**	**122.2**

Source: Steer analysis

Table B.10: Dahalapara: Revenue forecasts

Vehicle Category	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40	FY41	FY42	FY43	FY44
CJV	14.5	15.9	17.5	19.3	21.0	23.4	25.6	28.0	30.8	33.5	36.6	40.2
Mini LCV	1.9	2.0	2.1	2.3	2.4	2.5	2.7	2.8	3.0	3.2	3.3	3.5
LCV	3.6	3.8	4.0	4.3	4.5	4.8	5.0	5.4	5.6	6.0	6.3	6.7
Bus	2.6	2.8	3.0	3.1	3.3	3.5	3.7	3.9	4.1	4.3	4.5	4.8
2A	20.2	21.8	23.6	25.3	27.1	29.3	31.4	33.9	36.1	38.8	41.5	44.8
3A	16.0	17.1	18.2	19.4	20.6	21.8	23.3	24.8	26.3	28.0	29.6	31.6
MAV	73.7	80.3	87.7	96.0	104.8	113.9	124.1	135.3	147.1	159.3	172.9	188.7
OSV	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2
Total	**132.6**	**143.7**	**156.2**	**169.7**	**183.8**	**199.3**	**215.8**	**234.2**	**253.2**	**273.2**	**295.0**	**320.5**

Source: Steer analysis

Table B.11: Galia: Revenue forecasts

Vehicle Category	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32
CJV	3.9	4.2	4.8	5.6	6.2	6.8	7.4	8.4	9.2
Mini LCV	0.6	0.7	0.7	0.8	0.8	0.8	0.9	1.0	1.0
LCV	1.0	1.4	1.2	1.2	1.3	1.4	1.5	1.6	1.6
Bus	1.3	1.1	1.5	1.6	1.7	1.8	1.9	2.0	2.1
2A	5.2	5.7	6.3	6.1	6.1	6.8	7.5	8.1	8.7
3A	5.5	6.0	6.5	6.1	5.8	6.6	7.4	7.9	8.3
MAV	18.5	20.3	22.7	22.0	21.3	24.8	27.8	30.5	33.6
OSV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**36.0**	**39.3**	**43.7**	**43.3**	**43.2**	**49.0**	**54.4**	**59.6**	**64.5**

Source: Steer analysis

Table B.12: Galia: Revenue forecasts

Vehicle Category	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40	FY41	FY42	FY43	FY44
CJV	10.3	10.9	12.3	13.3	14.8	16.4	17.7	19.6	21.5	23.6	25.7	28.1
Mini LCV	1.1	1.1	1.2	1.2	1.3	1.4	1.4	1.5	1.6	1.7	1.8	1.9
LCV	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.6	2.7	2.9	3.1	3.2
Bus	2.2	2.3	2.5	2.6	2.8	2.9	3.1	3.3	3.5	3.8	3.9	4.1
2A	9.3	10.1	10.9	11.7	12.6	13.7	14.6	15.7	16.9	18.0	19.4	20.8
3A	8.8	9.5	10.1	10.8	11.4	12.2	12.9	13.8	14.7	15.4	16.4	17.5
MAV	36.7	40.0	43.7	47.6	51.6	56.5	61.1	66.8	72.5	78.6	85.1	93.0
OSV	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	**70.2**	**75.9**	**82.6**	**89.4**	**96.6**	**105.5**	**113.3**	**123.3**	**133.4**	**144.1**	**155.4**	**168.8**

Source: Steer analysis

C Vehicle Classification Chart

Vehicle Type	Description
2-Wheeler	
Auto-Rickshaw	
Car/Jeep/Van	
Taxi- shared/private	
Buses (govt/Pvt)	
Mini Bus	

Vehicle Type	Description
Mini LCV	
LCV 4 Tyre	
LCV 6 Tyre	
2 Axle Truck	
3 Axle Truck	
4 Axle Truck (MAV)	
5 Axle Truck (MAV)	

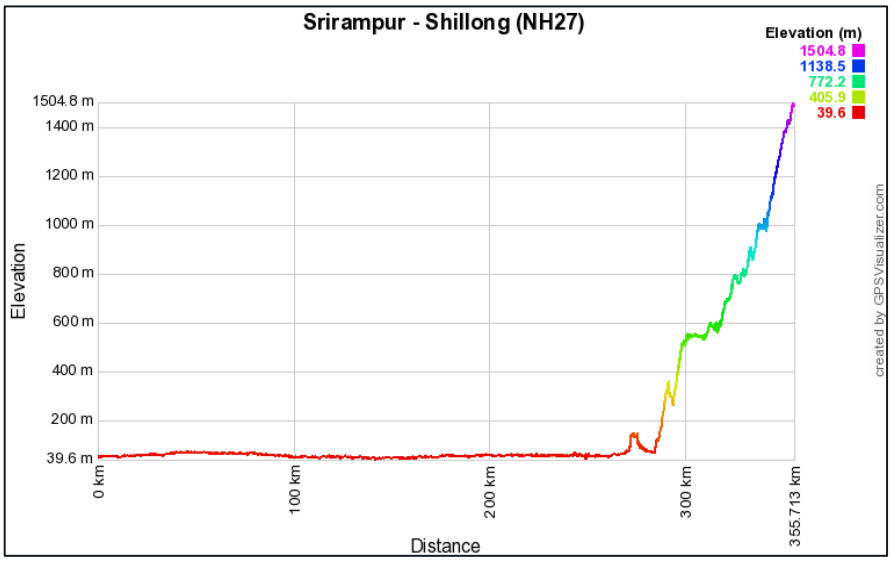
Vehicle Type	Description
6 Axle Truck (MAV)	
Oversized Vehicle/ Earth moving equipment (OSV)	

D Elevation profile

Srirampur - Shillong

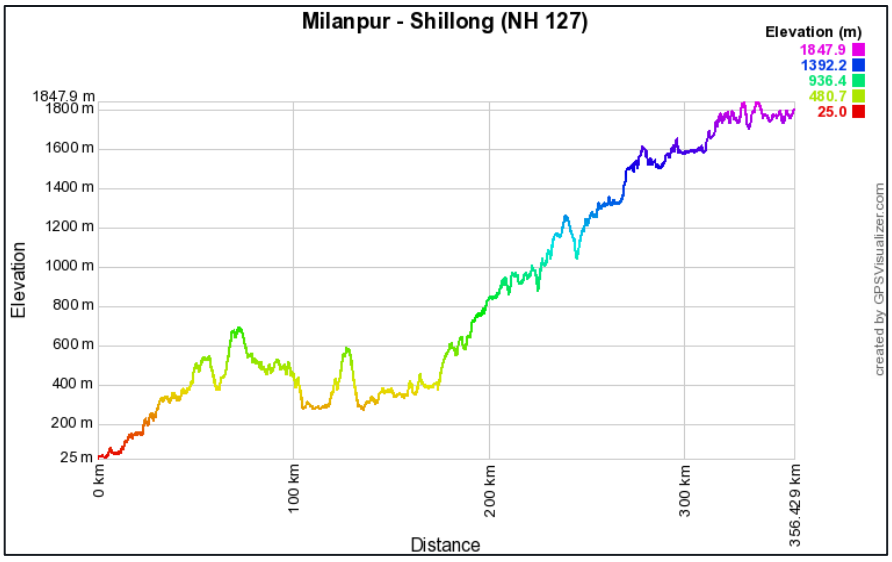
D.1 The elevation profile for the routes destined to Shillong from Srirampur is shown below.

Figure D.1: Elevation profile – Srirampur to Shillong via NH27 (Asset)



Source: Steer analysis

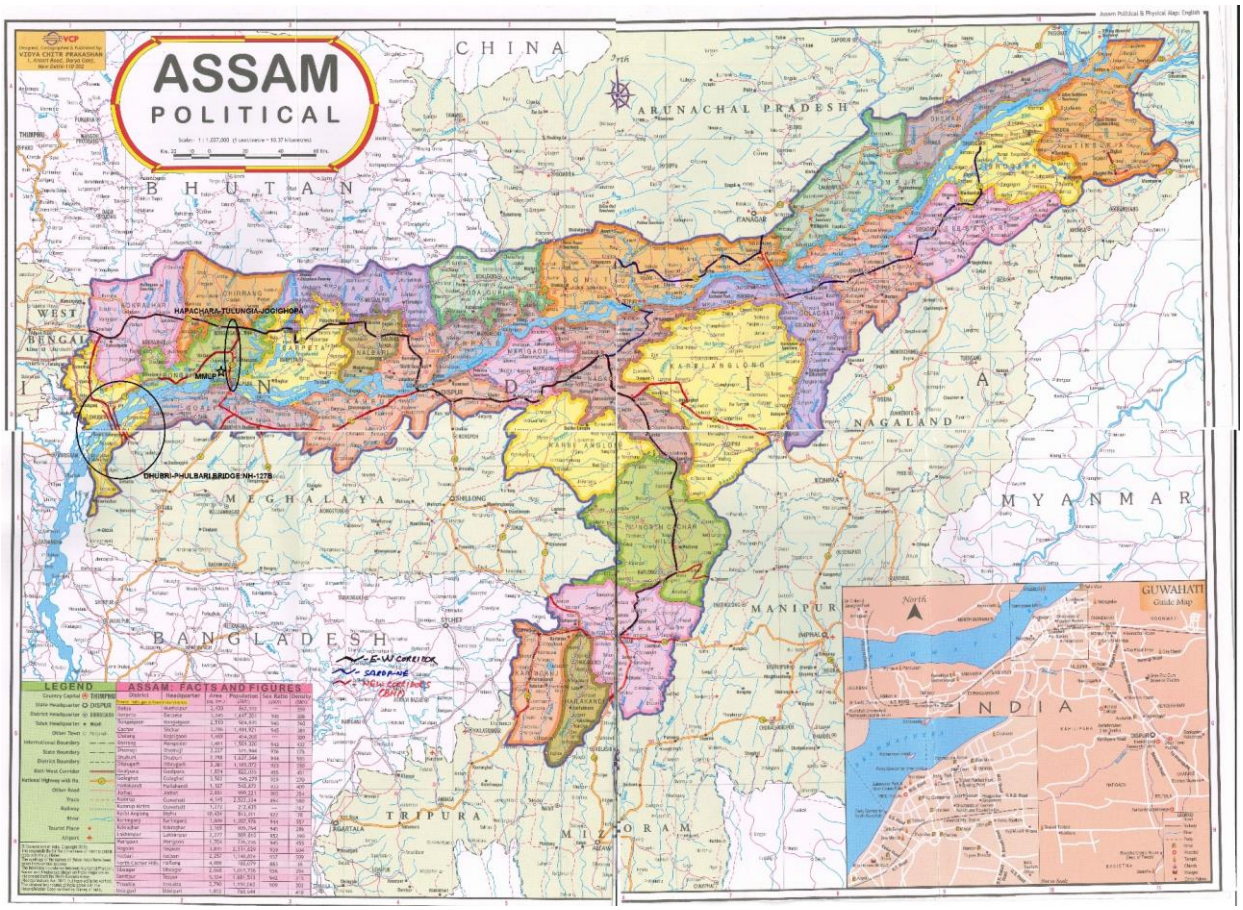
Figure D.2: Elevation profile – Srirampur to Shillong via Milanpur (NH127)



Source: Steer analysis

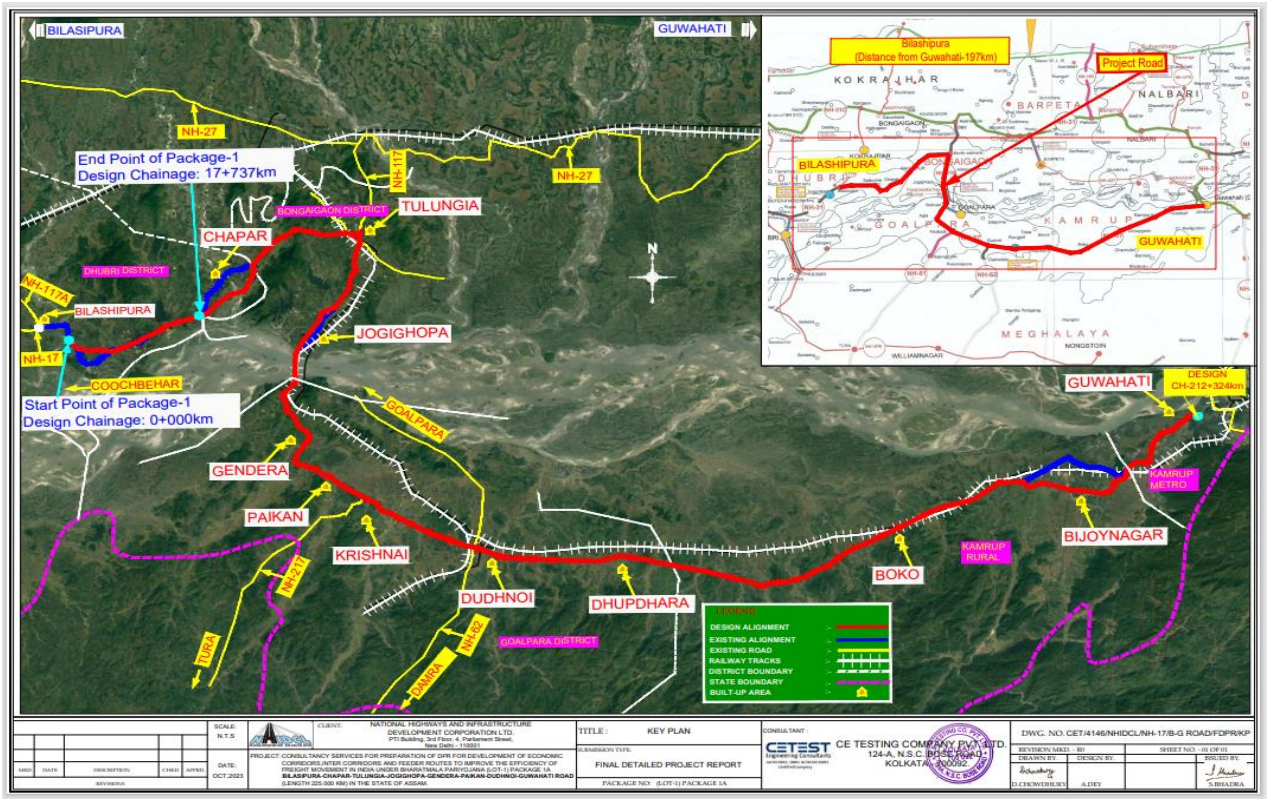
E Current Road Improvement Plans of Falakata- Guwahati section of NH17: NHIDCL (2023)

Figure E.1: Current Plans of Road Network Improvement in Assam: NHIDCL



Source: NHIDCL, 2023

Figure E.2: Alignment of 4 lane improvement of NH17 Bilasipara- Guwahati : NHIDCL



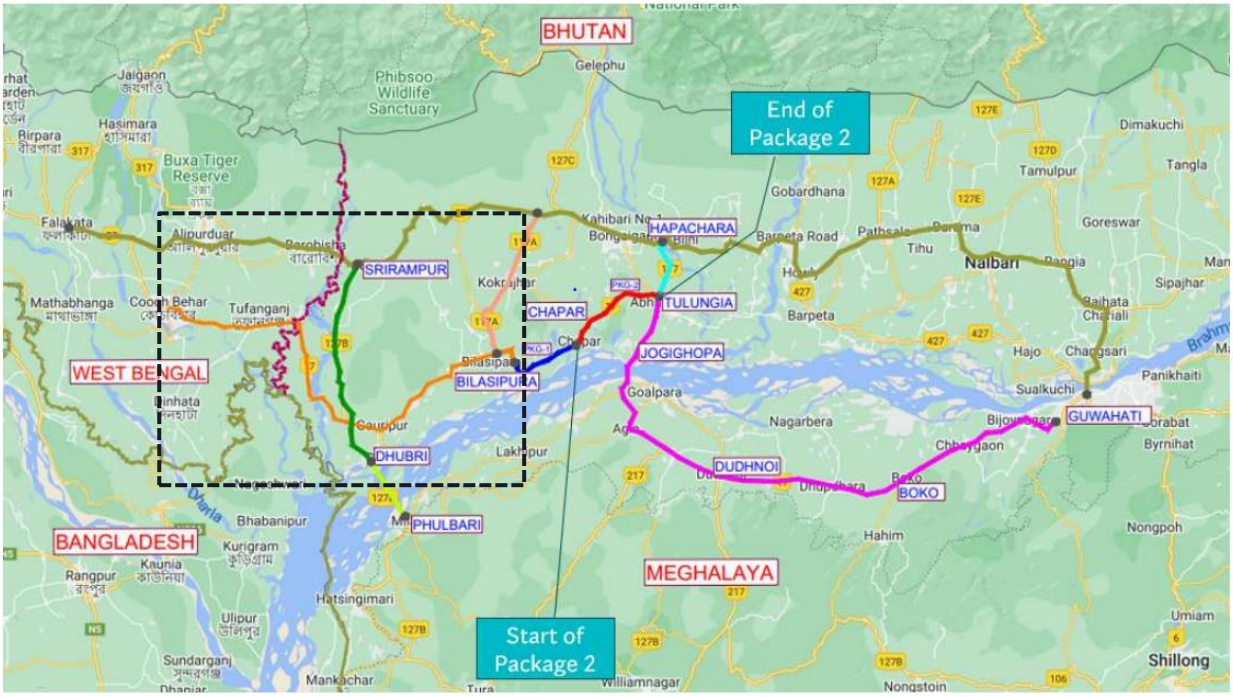
Source: NHIDCL - nhidcl.com/tenders/tendors/uploads/23eb5/PP-1-61.pdf

Figure E.3: Current Packages Awarded for Road Improvement in Assam by NHIDCL, 2023

SL. No.	State/UT	Name of Project (Completed Projects)	Length (Km)	Sanctioned Cost/TPC Rs. in Cr.	Awarded Cost Rs. in crore	Date of Award	Appointed Date	Cumulative Physical progress %	Cumulative Financial progress %	Original Schedule Completion Date	Likely Date of completion/ Actual Date of Completion	Name of the Contractor	Official Mail IDs of Contractor
24	Assam	Construction and up gradation to 4-Lane of existing two lane with paved shoulder from Hapachara to Tulungia road of NH-117 of existing Km 0.00 to km 14.050 and (Design Km 0.000 to km 14.660), (Design length- 14.660 km) under BMP	14.66	220.19	138.25	26-03-2020	26-06-2020	84.05	82.07	26-12-2022	31-12-2023	B.K.Sons Infra Pvt. Ltd.	bksonsbong@gmail.com
25	Assam	Widening/Improvement to 4 -Lane with Paved Shoulder from Ch. 52.470km to Ch.71.500 km (DesignCh.48.655km to Ch.67.556km)of Tulungia Jogighopa Bridge Approach Section (Package-5) of Bilasipura- Guwahati road (NH 17)	18.90	636.42	418.49	22-03-2021	09-07-2021	92.56	84.9	10-01-2023	31-12-2023	Rajendra Singh Bhamboo Infra Pvt. Ltd.	rajendrabhamboo@yahoo.co.in
26	Assam	Construction of New 2-Lane Bridge with its approaches from km 0+000 to Km 4+385 across River Brahmaputra on NH-17 at Jogighopa	4.39	746.76	402.75	10-08-2021	12-11-2021	34.31	30.48	10-11-2024	10-11-2024	S.P. Singla Private Limited	spsjogighopa@spsingla.com
27	Assam	Widening/Improvement to 4-Lane with paved shoulder from Ch.75.330Km to Ch.88.00km (Design Ch.71.800 to 84.100 km) of Jogighopa Bridge Approach (Near Pancharatna)-Agia (near Nichinta) section (Pkg. 6) of Bilasipura-Guwahati road (NH-17) on EPC under BMP	12.30	208.84	114.31	25-08-2020	26-10-2020	62.19	61.09	19-04-2022	31-12-2023	Mayasheel Construction	msc.pkg6@gmail.com
28	Assam	Widening/Improvement to 4 -Lane with Paved Shoulder from Ch. 88.000km to Ch.99.930 km (Design Ch.84.100km to Ch.96.000 km) of Sagunbashi forest (near Nichinta) to starting of Krishnai Bypass Section (Package-7) of Bilasipura Guwahati road (NH 17)	11.63	286.72	135.89	24-03-2023	to be given	0	0	-	-	Mayasheel Construction	mayasheelconstruction@gmail.com
29	Assam	Widening/Improvement to 4-Lane with paved shoulder from Km 99+930 to Km 143+680 (Design Chainage 96+000 to 139+750) of (Paikan to Dhupdhara Sahar) of Bilasipura-Guwahati Road on NH-17 in the state of Assam on EPC mode under Bharatmala Pariyojana in Economic Corridors (Project Length – 43.750km) under NH(O)-NE (Package-8)	43.75	1457.59	742.00	14-03-2023	to be given	0	0	-	-	M/s YFC Projects Pvt. Ltd.- M/s TTC Infra India (JV)	rohit.yadav@yfcprojects.com
30	Assam	Widening/Improvement to 4-Lane with Paved Shoulder from Ch. 143+680km to Ch.177+372km (Design Ch.139+750km to Ch.173+434km) of Bilasipura- Guwahati road on NH-17 (Section: Dhupdhara Sahar to Milmila Reserve Forest (before Chayagaon Market)) in the state of Assam on EPC mode under Bharatmala Pariyojana in Economic Corridors (Project Length – 33.684km) NH(O)-NE (Package-9)	33.68	1000.27	458.47	20-03-2023	to be given	0	0	-	-	ANIL Das - SAILAJA Commercial Construction Pvt. Ltd. (JV)	das1969anil@gmail.com
31	Assam	Widening/Improvement to 4-Lane with Paved Shoulder from Ch. 177+372km to Ch.203+783km (Design Ch.173+434km to Ch.200+750km) of Bilasipura- Guwahati road (NH 17) (Section: Milmila R.F (before Chayagaon Market) to Approach of Airport Junction (VIP Chowk) in the State of Assam on EPC mode under Bharatmala Pariyojana in Economic Corridors (Project Length – 27.316km) for (Package-10)	27.31	1264.90	539.93	31-03-2023	to be given	0	0	-	-	ANIL Das - SAILAJA Commercial Construction Pvt. Ltd. (JV)	das1969anil@gmail.com
32	Assam	Widening/Improvement to 4(Four) Lane with Paved Shoulder From Km 38+500 to Km 51.246 (Design Chainage 38.500 to 50.959) with Proposed Daboka Bypass of Daboka - Parokhaowa (Package -1) of NH-29 in the State of Assam on EPC mode.	12.46	516.88	229.82	24-02-2023	to be given	0	0	-	-	M/s Mehta Contruction Company	mehtaconst09@gmail.com
33	Assam	Widening/Improvement to 4-Lane of Daboka Dimapur Stretch from Km 95+400 to Km 113+830 (Design Chainage 96+400 Km to 113+830 Km) of Ganpath Gaur Gaon- Kwaram Taro Village- (Package-5)	17.43	288.85	141.46	31-03-2021	12-07-2021	39.61	38.31	12-01-2023	31-12-2023	B.K.Sons Infra Pvt. Ltd.	bksonsinfra@gmail.com bksonsmanjapkg5@gmail.com
34	Assam	Widening/Improvement to 4-Lane with Paved Shoulder from KM 113+300 to Km 146+230 (Design Chainage 113+830 to 145+712) of Kwaram Taro Village - Dilai Section (Package-6)	31.88	625.64	282.11	10-09-2021	14-07-2022	41.88	35.35	13-07-2024	13-07-2024	Ashoka Buildcon Ltd.	ablnh29pkg6@ashokabuildcon.in

Source: NHIDCL - nhidcl.com/tenders/tendors/uploads/23eb5/PP-1-61.pdf

Figure E.4: Falakata- Bilasipara Package: Current information on length and structure on Falakata – Bilasipara package not available from NHIDCL



Source: NHIDCL - **nhidcl.com/tenders/tendors/uploads/23eb5/PP-1-61.pdf**

Figure E.5: Project Status including Length of Road and Structure Bilasipara- Guwahati Package of NH17: NHIDCL, 2023

Status of Various Sections

Pkg	Name of Stretch	Length (km)	Project Status
	Spur to Connect NH17 to East West Corridor (NH27)		
HT	Hapachara to Tulungia road	14.660	Work in Progress
	Total Length	**14.660**	
	Tulungia – Guwahati Section		
5	Tulungia to Jogighopa (before Naranarayan Setu)	18.901	Work in Progress
6	Panchratna to Nichinta	12.300	Work in Progress
7	Nichinta to Paikan	11.900	Work in Progress
8	Paikan to Dhupdhara Sahar	43.750	Work in Progress
9	Dhupdhara Sahar to Milmila R.F	33.684	Work in Progress
10	Milmila R.F to Approach of Airport Junction VIP Chowk	27.316	Work in Progress

Pkg	Name of Stretch	Length (km)	Project Status
	Total Length	**147.851**	
	Bilasipura - Tulungia Section		
1	Chirakuta to Mowatari, before Chapar Bypass)	17.468	DPR in Progress
2	Mowatari, before Chapar Bypass to Tulungia (Junction with NH 117)	26.820	Instant Package
	Total Length	**44.288**	

Source: NHIDCL - [Microsoft Word - Chap-1_Executive Summary_PKG-2_Final_19.09.2023 Rev.docx (nhidcl.com)]

Figure E.6: Towns/Settlements between Falakata- Abhaypuri section of NH17 with proposed bypass once 4 laned

Source: NHIDCL - [Microsoft Word - Chap-1_Executive Summary_PKG-2_Final_19.09.2023 Rev.docx (nhidcl.com)]

- The map shows towns between the route through NH17 till Abhaypuri. These towns have a lot of congestion around them because of which bypass will be constructed around these towns when NH17 gets 4 laned. There is Ghogarkuthi toll plaza near Cooch Behar which has been highlighted on the map.

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steer

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D **Solapur Chennai Package Details**
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Disclaimer

This Report is prepared by Steer Davies & Gleave India Private Limited (the "Traffic Consultant") for the benefit of NHIIMPL (the "Client") solely in its capacity as the Traffic Advisor for the Project Drone (the "Project") pursuant to an engagement letter and related schedules (collectively, the "Agreement"), dated January 8, 2024. This Report, information contained herein, and any statements contained within are all based upon information provided to the Traffic Consultant and obtained from proprietary data purchased or confidential information provided by the Client, from publicly available information or sources, in the course of evaluations of the Project. The Traffic Consultant provides no assurance as to the accuracy of any such third-party information and bears no responsibility for the results of any actions taken on the basis of the third-party information contained in the Report, except to the extent that such actions result from the wilful misconduct, recklessness, fraud or gross negligence of the Traffic Consultant. Certain forward-looking statements are based upon interpretations or assessments of best available information at the time of writing. Actual events may differ from those assumed, and events are subject to change. Findings are time-sensitive and relevant only to current conditions at the time of writing. The Report speak only as of the date of issuance and the Traffic Consultant undertakes no obligation to update the Report for any reason.

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Traffic Consultant developed the relationships in the models used to produce the forecasts for the projects based on data available through November 2023. Since March 2020, the outbreak of the virus known as COVID- 19 has spread throughout the world and has been defined by the World Health Organization as a "pandemic". The COVID-19 outbreak had a material impact on global economic and political affairs including having a significant impact on all the transportation industries, including toll road traffic, where in particular vehicle volumes fell in response to quarantine and self-care measures that governments imposed as a response to the different waves of infection rates in different parts of the country.

As of the date of distribution of this Report, the COVID-19 outbreak is continuing to have a material and uncertain impact on economic and political affairs in some jurisdictions, which may have a significant impact on the transportation sector including the actual usage of tolled highways. In such jurisdictions, these factors may introduce additional uncertainty into forward looking outputs included in our Report. Further, there are a wide range of views by authoritative sources concerning future travel patterns post-COVID, which adds uncertainty to forecasting in this regard.

As a result, no assurance can be provided by Traffic Consultant that the scenarios and assumptions Traffic Consultant has identified will prove to be accurate. Given the uncertainty

inherent in this unprecedented pandemic, Traffic Consultant advises that all readers of the Reports consider the Reports in the context of their own assessment of the impact of COVID19 on travel patterns post-COVID.

TO THE FULLEST EXTENT PERMITTED BY APPLICABLE LAW, THE LIABILITY OF THE TRAFFIC CONSULTANT FOR ANY LOSS, DAMAGE, COST OR EXPENSE SUFFERED OR INCURRED BY ALL PERSONS OR ENTITIES AND FOR ALL CLAIMS RESPECTING ITS WORK PERFORMED IN CONNECTION WITH THE ISSUE OR THE REPORTS IS HEREBY LIMITED IN THE AGGREGATE TO THE AMOUNT OF FEES ACTUALLY PAID BY THE CLIENT TO THE TRAFFIC CONSULTANT IN RESPECT OF THE REPORTS AND CONNECTED SERVICES.

Glossary Items

Acronym	Meaning
AADT	Annual Average Daily Traffic
ADT	Average Daily Traffic
LK	Lakhnadon Khawasa
CAGR	Compound Annual Growth Rate
CAGR	Compound Annual Growth Rate
CJV	Cars / Jeeps / Vans
COD	Commercial Operations Date
DPR	Detailed Project Report
DME	Delhi Mumbai Expressway
ETC	Electronic Toll Collection
FY	Financial Year
GDP	Gross Domestic Product
GJC	Generalised Journey Cost
GQ	Golden Quadrilateral
GSDP	Gross State Domestic Product
HCM	Heavy Commercial Vehicles
IAOI	Immediate Area of Influence
IHMCL	Indian Highways Management Company Limited
INR	Indian Rupee
LCV	Light Commercial Vehicles
LoS	Level of Service
MAV	Multi Axle Vehicle
MLCV	Mini LCV
NE	National Expressway
NH	National Highway
NHAI	National Highways Authority of India
NHDP	National Highways Development Project
NSDP	Net State Domestic Product
OD	Origin Destination
PCI	Per Capita Income
PCU	Passenger Car Unit
RNP	Registered Number Plate

Acronym	Meaning
RoS	Rest of State
SCF	Seasonality Correction Factors
SH	State Highway
T&R	Traffic and Revenue
TMS	Traffic Management System
TP	Toll plaza
TVC	Traffic Volume Count
VOC	Vehicle Operating Costs
VOT	Value of Time
WADT	Weekly Average Daily Traffic
YTD	Year to Date

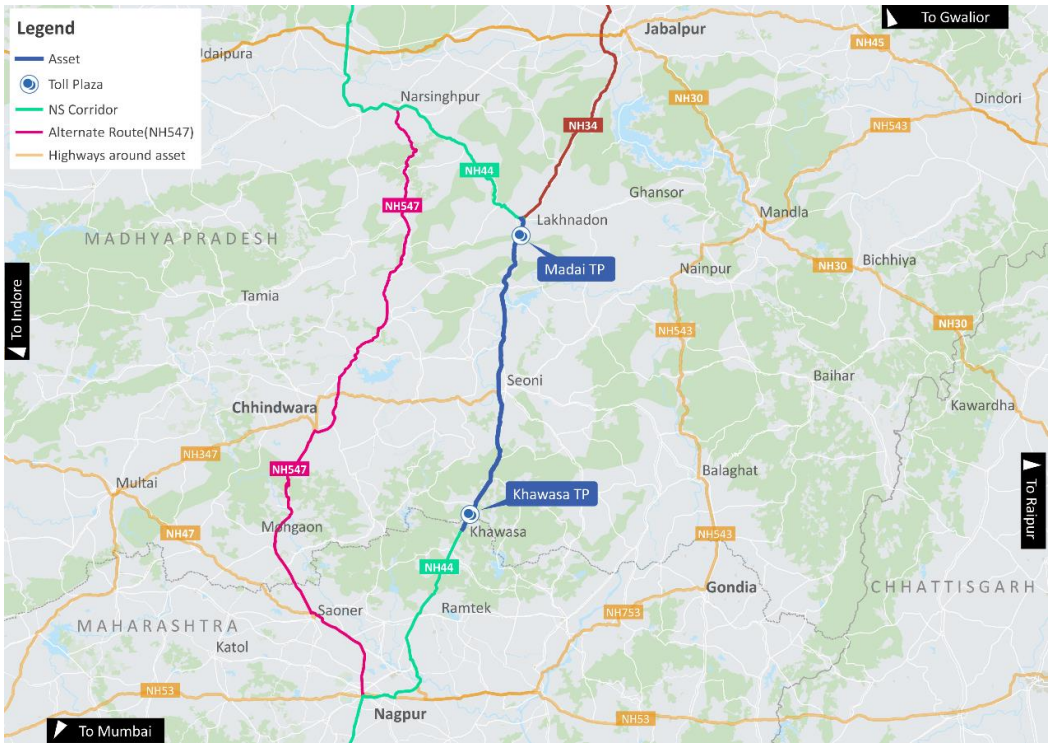
Executive Summary

Project overview

The Asset forms part of NH44 north-south long-distance strategic corridor. The Asset is a 4-laned divided section between Lakhnadon and Khawasa traversing through the districts of Mandai, Chhapara and Seoni in the state of Madhya Pradesh. There are two toll plazas on the asset and are located at and is shown in the map below:

- Khawasa (KM 651+718)
- Madai (KM 549+200)

Figure: Asset context - LK



Source: Steer cartography using OpenStreetMap data

Salient growth features and traffic generators

The Asset is present in the state of Madhya Pradesh close to Madhya Pradesh and Maharashtra border. The Asset forms part of the strategic NH44 corridor catering to the north-south movement.

The Asset caters to the demand generated by the states connected through the above-mentioned highway. NH44 runs over 4,112 kms completing the north-south movement and connects some of the major states and industrial centres of northern states/UTs of Jammu and Kashmir, Punjab, Haryana, Delhi, Uttar Pradesh, Rajasthan, Madhya Pradesh, Maharashtra with the southern states of Telangana, Andhra Pradesh, Karnataka, and Tamil Nadu. The traffic profile is predominantly goods vehicles undertaking both medium and long-distance movements between Nagpur, Jabalpur, Chhindwara, Delhi, Bangalore, Hyderabad and more.

The Asset lies between the urban centres of Jabalpur and Nagpur. Jabalpur has medium to large scale industries alongside agriculture-based economy. Whereas Nagpur being the

manufacturing and food processing hub has industries like Butibori, Umred generating goods demand. The key economic activities are detailed below:

- **Manufacturing** segment includes products ranging from agriculture equipment, aluminium products, castings, cement, chemicals, paper and packaging, electrical equipment and fittings, textile engineering goods, tools manufacturing, fabrication and machining, ferro alloys, paints, furniture, plastic and moulding products, etc.
- **Food processing** giants having presence at Nagpur includes Haldiram, Dinshaw, Patanjali and other medium scales orange and spices processing units, etc.
- **Agriculture production** In Jabalpur, some of the important commercial crops cultivated are cotton, pulses, sugarcane, oilseeds and medicinal crops. The fertile alluvial soil of Narmada basin also provides other crops like wheat, sorghum, millet and rice. Jabalpur is the largest producer of soyabeans in Madhya Pradesh.

Apart from the above-mentioned industrial segments present in Nagpur, the following are some additional developments announced by the government for the region:

- Government of Maharashtra has set-up Multi-Modal International Passenger and Cargo Hub Airport at Nagpur (MIHAN). That will upgrade existing domestic airport along with a Special Economic Zone which is abutting to the boundary of the airport. MIHAN houses plant of Tata Aeronautics which manufactures parts for Boeing and Air India and Dassault's assembly plants.
- Container Corporations of India Limited (CONCOR) constructed Multi Modal Logistic Park along with a rail terminal connecting MIHAN with different ports in country.

Butibori industrial area established by Maharashtra Industrial Development Corporation (MIDC), north of the Asset, is one of the country's largest industrial hubs. It houses textile, machine and metal fabrication and manufacturing units and is home to industrial giants like KEC, Hyundai, and Unitech. Koradi Thermal Power Station and Khaparkheda Thermal Power Station are the two major thermal power stations located in vicinity of the hub.

Yavatmal industrial area, in west of the Asset, has textile and cotton processing industries including Raymond India's garment plant. The industrial hub is also home to export units of machineries, cement, medicines, limestones, and clothes.

Chandrapur is key coal mining centre in close vicinity of the Asset and has thermal plant, cement, paper and ferro alloy manufacturing industries.

Chhindwara is home to brands like Raymond's & Hindustan Unilever. The city has rich market areas such as Mansarover Complex, Fawwara Chowk, Nagpur Road, Gole Gunj & Gandhi Gunj. The city is home to old industries of pottery, leather moots and ornaments of zinc, brass and bell metal. On the outskirts, vegetables, especially potatoes, are raised in large quantities for export to nearby districts. Western Coalfields Limited is the major company of Chhindwara approximate ten thousand people work together here.

Seoni railway station and its goods yard work as an important agricultural export hub. It is one of the 24 districts in Madhya Pradesh currently receiving funds from the Backward Regions Grant Fund Programme (BRGF). Railway connectivity to Seoni has increased the agricultural import export business from Seoni.

The agricultural stretches present along the Asset as well as in Nagpur generate a considerable share of traffic on the Asset. Nagpur, also known as Orange City, is famous for the production of oranges in addition to being home to large number of paddy, jowar, cotton, tur and

soyabean fields. Also, Jabalpur is the largest producer of soyabeans in Madhya Pradesh. The city serves as a major wholesale market for food grains and other commodities. It is also a market center for its agricultural production of wheat, rice, green peas, maize, oil seeds and pulses.

Long-distance goods traffic has seen an increase in proportion in recent years due to the shift of traffic from other corridors to NH44 as this is the shortest route between Hyderabad/Bengaluru and Delhi.

Traffic volume and composite of vehicles

Historical traffic data

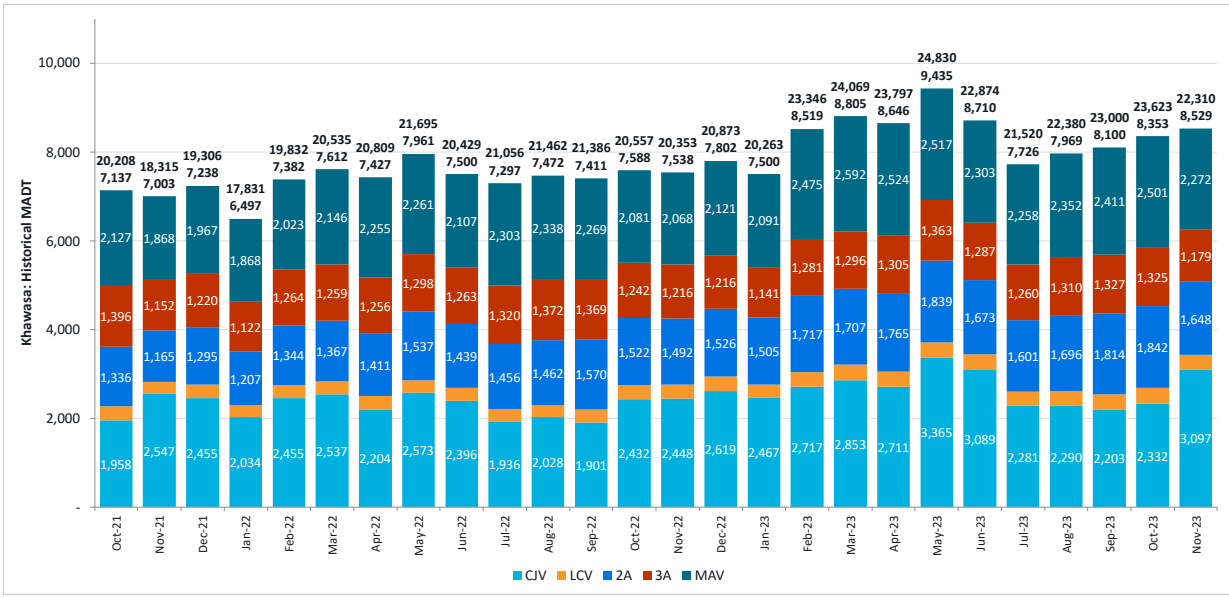
Toll plaza data from Oct-21 to Nov-23 and Dec'21 to Nov'23 for Khawasa and Madai, respectively, was shared by the Client. Therefore, to build the base estimate for FY24, we have considered:

- There are three data sources as mentioned in the table above, the Electronic Toll Collection (ETC) data provided by NHAI, IHMCL data and Schedule V data. For the purpose of base estimation and analysis of traffic trends ETC and cash data has been used. For the purpose for cash transactions Schedule V has been relied upon.
- All these data sets together have been considered for historical analysis and revenue reconciliation.

The Asset is trending at ~23,000 PCU for 8 months of FY24. On both the plazas, traffic composition is majorly dominated by trucks (2A/3A/MAV) with over 2/3rd of total traffic on Khawasa and Madai each, as they primarily serve long-distance north-south traffic movement. Khawasa toll plaza observed an average of ~8,433 AADT and Madai ~9,303 AADT in FY24YTD.

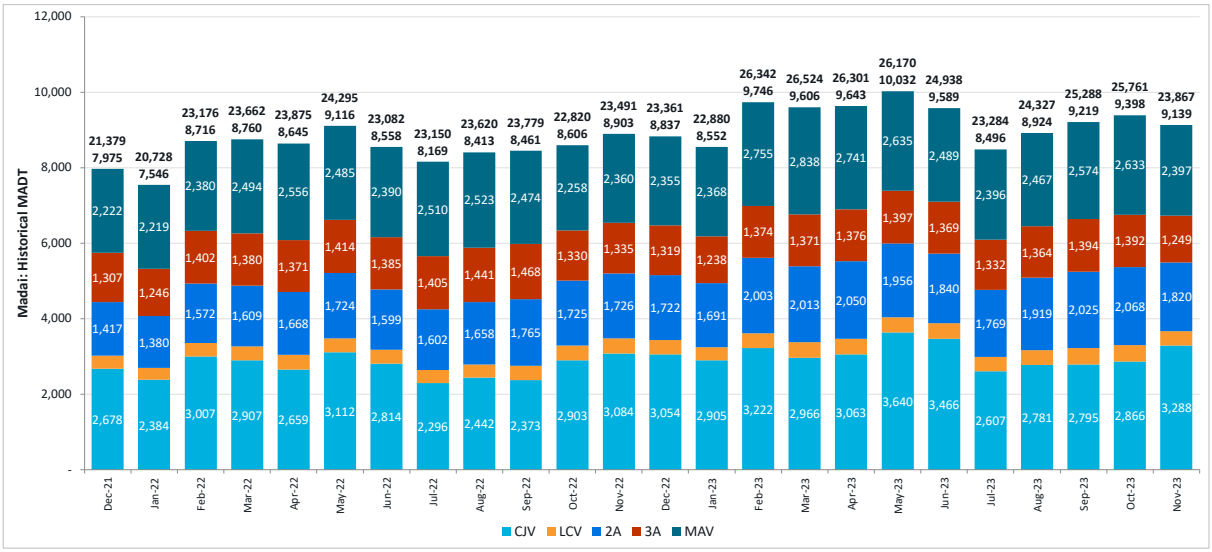
Per day Collection increased ~11% in FY24 compared to FY23 on the Asset. Total annual collection of 186 Cr in FY23 is increasing to 138 Cr in 8months for FY24YTD. On an average, the daily revenue collection on the Asset is ~INR 57 lakhs.

Figure: Khawasa Historical Traffic (ETC + Cash MADT, PCU)



Source: Steer analysis of client toll plaza data

Figure: Madai Historical Traffic (ETC + Cash MADT, PCU)

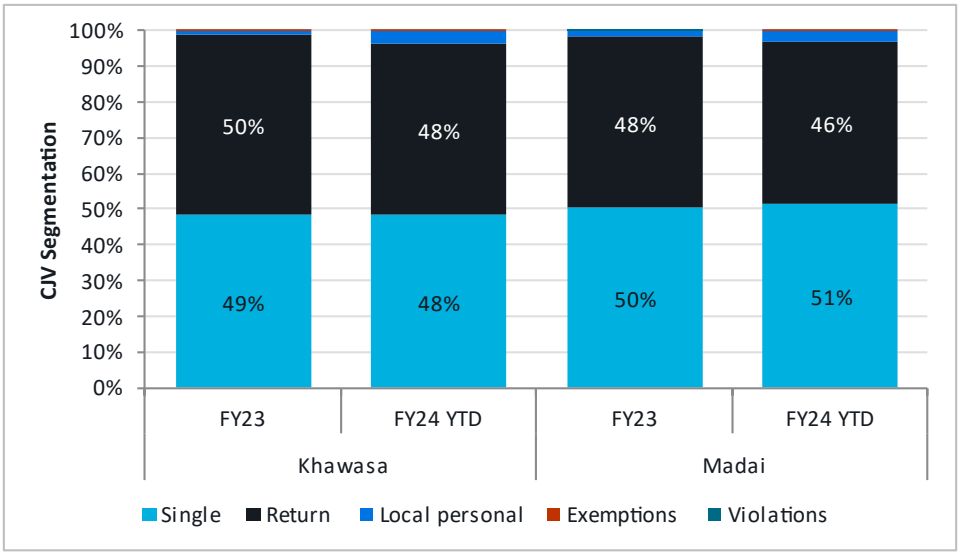


Source: Steer analysis of client toll plaza data

Toll segmentation

On the Asset, CJVs observe approximately equal split between single and return tickets on both Khawasa and Madai as the plazas cater to inter-urban movement influenced by the presence of major consumption centres, Nagpur and Jabalpur on either ends of the asset.

Figure: Segmentation CJV

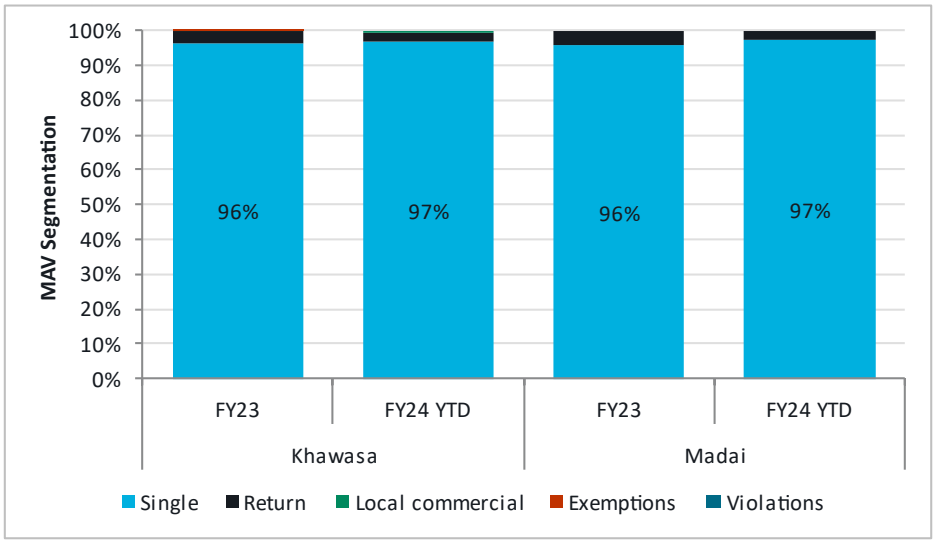


Source: Steer analysis

Over ~95% of the commercial vehicles (2A/3A/MAVs) plying on the Asset are observed to buy single tickets suggesting through-movement on the Asset. The observation is in line with the fact that the Asset is key connector for Delhi/NCR and Maharashtra/neighbouring zones and

hence caters to long-distance traffic. The Asset observed negligible level of exemptions and violations for trucks.

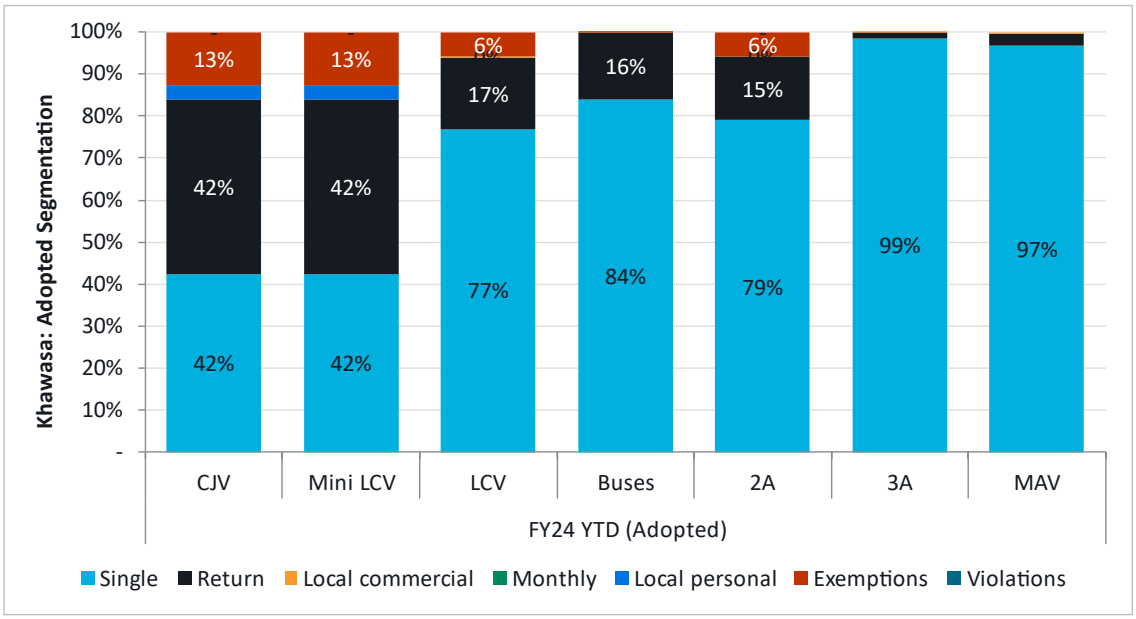
Figure: Segmentation MAV



Source: Steer analysis

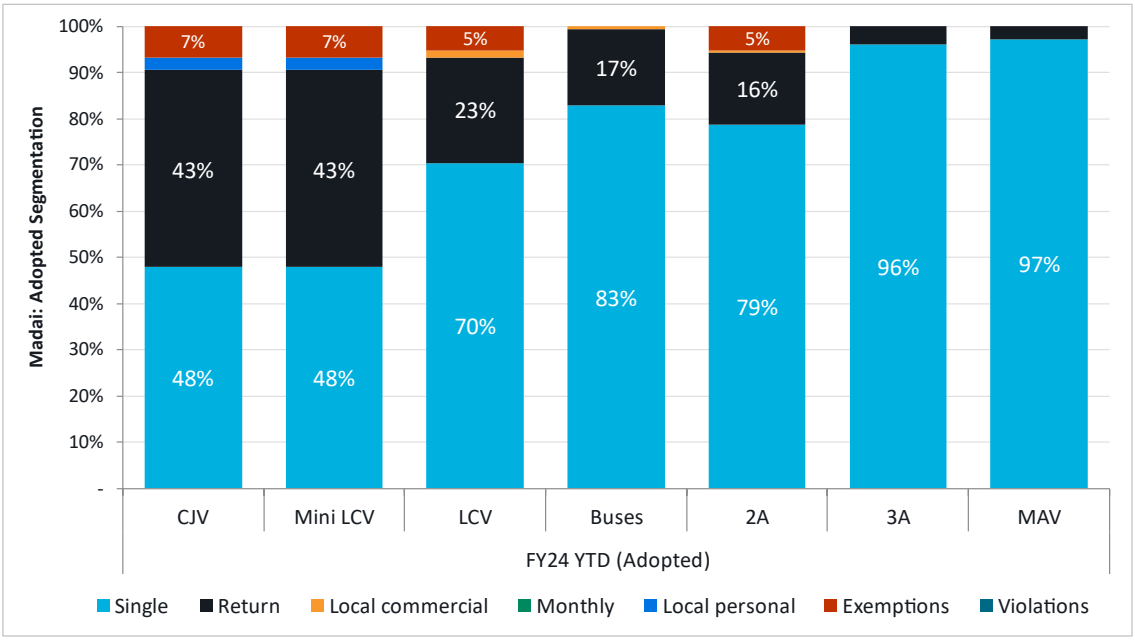
However, as the above-mentioned segmentation doesn't correctly reflect the share of non-toll paying traffic, i.e., violations and exemptions. The same has been assessed based on the difference between TMS and TVC dataset in the final adopted segmentation.

Figure: Adopted Toll segmentation (%) for Khawasa – FY24YTD



Source: Steer analysis

Figure: Adopted Toll segmentation (%) for Madai- FY24YTD



Source: Steer analysis

For Madai, Schedule V reported cash transactions at monthly were already provided for overlapping period from Nov'21 onwards. Additionally, for exemptions the difference between TVC and ETC+ Cash dataset is added (as a % of ETC traffic) in the final adopted segmentation as non-paying traffic. In data availability, same proportion of cash traffic is assumed on Khawasa as well considering their similar profile and travel pattern.

Traffic forecast

The increase of traffic on any existing road alignment depends on how fast the background travel demand (background growth) will grow; and on how successfully the project road is in attracting that traffic (traffic capture). Background travel demand is driven by the prevalent socio-economic conditions in the region, which include:

- Changes in factors such as population, employment, and income distribution
- Economic growth (GSDP, and GDP).
- Growth of local industries near the Asset.

The model uses India GDP and GSDP of Madhya Pradesh & Maharashtra as the two macro-economic inputs which operate as growth drivers on our base year forecasts.

The network developments near the Asset's alignment which Steer believes would affect traffic on the Asset during the concession period are DME & SCE put together and 2 lane improvement of NH547+ Nagpur Ring Road.

Steer has developed traffic and revenue forecasts for the Asset by taking into consideration all inputs discussed above – base year estimates, macro-economic assumptions, growth drivers, elasticities, and forecast ticket segmentation. The table below provides the final (background plus impacts) traffic growth on the Asset.

Table: Final (background plus impacts) AADT forecast – LK – Khawasa

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
CJV	2,962	3,172	3,407	4,394	5,859	7,632	9,712
Mini LCV	285	292	301	333	374	417	459
LCV	372	382	386	404	454	506	558
Bus	251	256	262	282	308	334	360
2A	1,633	1,714	1,781	1,965	2,454	3,026	3,670
3A	1,275	1,315	1,340	1,361	1,566	1,787	2,017
MAV	2,433	2,584	2,724	3,225	4,252	5,518	7,013
OSV	2	2	2	3	4	5	7
AADT	**9,213**	**9,718**	**10,203**	**11,968**	**15,272**	**19,225**	**23,796**
PCU	**24,241**	**25,530**	**26,705**	**30,687**	**39,053**	**49,105**	**60,738**

Table: Final (background plus impacts) AADT CAGR (%) – LK – Khawasa

Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FY30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
CJV	7.1%	7.4%	6.6%	5.9%	5.4%	4.9%	5.8%
Mini LCV	2.6%	2.8%	2.6%	2.4%	2.2%	2.0%	2.3%
LCV	2.6%	1.0%	1.2%	2.4%	2.2%	2.0%	1.9%
Bus	2.0%	2.1%	1.9%	1.8%	1.6%	1.5%	1.7%
2A	5.0%	3.9%	2.5%	4.5%	4.3%	3.9%	3.9%
3A	3.1%	1.9%	0.4%	2.8%	2.7%	2.5%	2.2%
MAV	6.2%	5.4%	4.3%	5.7%	5.3%	4.9%	5.2%
OSV	6.2%	6.6%	6.1%	5.7%	5.3%	4.9%	5.6%
AADT	**5.5%**	**5.0%**	**4.1%**	**5.0%**	**4.7%**	**4.4%**	**4.6%**
PCU's	**5.3%**	**4.6%**	**3.5%**	**4.9%**	**4.7%**	**4.3%**	**4.5%**

Source: Steer analysis

Table: Final (background plus impacts) AADT forecast – LK – Madai

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
CJV	2,672	2,862	3,074	3,965	5,287	6,886	8,763
Mini LCV	741	760	782	866	973	1,084	1,195
LCV	434	445	446	457	514	572	631
Bus	264	269	274	296	324	351	378
2A	1,820	1,910	1,962	2,094	2,616	3,225	3,911
3A	1,337	1,379	1,398	1,399	1,610	1,837	2,074
MAV	2,588	2,749	2,890	3,396	4,477	5,810	7,385
OSV	3	3	3	4	5	6	8
AADT	**9,858**	**10,377**	**10,830**	**12,477**	**15,805**	**19,772**	**24,344**

PCU	**25,984**	**27,344**	**28,449**	**32,186**	**40,848**	**51,242**	**63,259**

Table: Final (background plus impacts) AADT CAGR (%) – LK – Madai

Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FY30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
CJV	7.1%	7.4%	6.6%	5.9%	5.4%	4.9%	5.8%
Mini LCV	2.6%	2.8%	2.6%	2.4%	2.2%	2.0%	2.3%
LCV	2.6%	0.3%	0.6%	2.4%	2.2%	2.0%	1.8%
Bus	2.0%	2.1%	1.9%	1.8%	1.6%	1.5%	1.7%
2A	5.0%	2.7%	1.6%	4.5%	4.3%	3.9%	3.7%
3A	3.1%	1.4%	0.0%	2.8%	2.7%	2.5%	2.1%
MAV	6.2%	5.1%	4.1%	5.7%	5.3%	4.9%	5.1%
OSV	6.2%	6.6%	6.1%	5.7%	5.3%	4.9%	5.6%
AADT	**5.3%**	**4.4%**	**3.6%**	**4.8%**	**4.6%**	**4.2%**	**4.4%**
PCU's	**5.2%**	**4.0%**	**3.1%**	**4.9%**	**4.6%**	**4.3%**	**4.3%**

Source: Steer analysis

Tollable Length and Toll Rates

In terms of tollable length, Khawasa currently (FY24) comprises 72.305 km whereas at Madai the tolling length is 74.086 km. In India, toll rates are as per notification by the Ministry of Road Transport and Highways in the National Gazette. The present toll rates are determined with reference to the published base toll rates and are adjusted annually at the beginning of each fiscal year equal to 40% of the movement in the wholesale price index in December of the preceding year plus a fixed 3%.

According to the NHAI's toll notification for FY24, i.e., April 1, 2023, onwards, the toll rates at the toll plazas for Asset are as follows:

Table: Single toll rates on the Asset (INR), applicable for FY24

Type of Vehicle	Khawasa	Madai
CJV	105	105
LCV	165	170
Bus/Truck	350	360
3A	380	390
MAV/ HCM/EME	550	560
OSV	670	685

Source: NHAI Revision of User fee Rate w.e.f 01.04.2023

1 Introduction

1.1 The National Highways Authority of India ('**NHAI**') has set up an Infrastructure Investment Trust ('**InvIT**') namely National Highways Infra Trust and is acting as its Sponsor to the said InvIT. The National Highway Infrastructure Investment Managers Private Limited (NHIIMPL) has been incorporated and appointed as the Investment Manager for the proposed InvIT by NHAI and NHIPPL is the entity under NHIIMPL, which is responsible for the operation and maintenance of this Asset.

1.2 National Highways Infra Projects Private Limited (**'NHIPPL'** or the '**Client'**) has commissioned Steer Davies Gleave India Private Limited (hereafter called '**Steer**') for an Annual review traffic assessment study for the following project road **('Asset').** This Asset includes a total of two toll plazas.

- **Asset:** Lakhnadon-Khawasa section on NH44 (old NH7) in the state of Madhya Pradesh with two toll plazas: Khawasa and Madai.

Table 1.1: Description of Assets

Asset ID	Asset: LK
Asset name	Lakhnadon-Khawasa section of NH44
State	Madhya Pradesh
NH	NH44
Road Length (km)	107
Tollable Length (km)	146.39
Chainage	Km 546+420 to Km 653+770
Nos. of toll plaza	2
Toll plaza locations	Khawasa (km 651+718) Madai (km 549+200)
Operating since*	TP1: Khawasa: Sept 2010 TP2: Allonia: June 2010 TP2: Madai: 2021
Proposed concession period	20 years
Tollable length (km)	• Khawasa TP: 72.305 Km • Madai TP: 74.086 Km

Source: NHAI

Scope of work

1.3 Our scope of work for carrying out a T&R due diligence exercise covered:

- Review of available data, and concession agreements.
- Primary traffic survey and analysis as per the schedule presented in the table below:

  - 7-days video based classified traffic volume count (TVC).
  - 24 hours origin-destination (OD) survey and commodity analysis
- Assembly of the toll plaza level base data from PIU, where available, and review of the recent growth trends.
- Identify appropriate benchmarks for historical performance, seasonality, ticket type segmentation for the asset.
- Estimate the base traffic and revenue position utilising the above information.
- Establishing traffic growth estimates based on key economic growth drivers such as GDP, GSDP, commodity, etc. and estimating underlying growth elasticities based on these growth drivers.
- Assessing impacts from exogenous factors, including network change impacts.
- Developing traffic forecasts by vehicle class and segmentation categories; and
- Toll revenue estimation for entire concession period.

Table 1.2: Data collection schedule

Survey	LK-Khawasa	LK-Madai
7 day TVC survey	10th - 16th Oct'23	10th - 16th Oct'23
1 day OD survey	11th Oct'23	12th Oct'23

Source: Steer

Our approach

1.4 The approach employed by Steer in the preparation of the traffic and revenue forecasts was developed to take advantage of the existing knowledge of the Asset and of the available data. It follows normal practices well established in addressing the issue of forecasting on-going traffic growth on a brownfield project. The key difference in this exercise as compared to a typical secondary market transaction, where the vendor provides detailed information on the historical performance of their asset, is that the historical traffic and revenue information provided by the client is very limited (and had reporting variations) and therefore less reliable than what could be expected. Therefore, significant efforts had to be put into developing a credible base year position and growth expectations through benchmarking with other asset in close vicinity of the asset under consideration.

1.5 The analysis focused on two sets of issues:

- understanding and verifying the traffic which is, at present, using the Asset; and
- identifying how and why that traffic will change in the future.

1.6 Regarding the former (i.e., current traffic on the asset), independent primary data collection was commissioned as part of this study and then compared against the available traffic data from various sources.

1.7 To arrive at the base position, we have utilised information from various sources – including toll plaza data shared by NHAI and client, Steer independent primary surveys to validate the network understanding and ensure quality in the data collection process, and our context knowledge, to assess a reasonable demand on the corridor for the base year which formed the basis of future year forecasts.

1.8 Further base year revenue validation exercise has been undertaken to ensure both base traffic and segmentation assumptions are robust.

1.9 This approach is be-spoke for such projects where long time series consistent historical data is not available. Therefore, significant efforts had to be put into developing a credible base year position and growth expectations.

1.10 The estimation of future traffic demand on the Asset is driven by:

- Growth of 'background' traffic: this depends to a certain extent on the on-going socio-economic and demographic development of the area served by the Asset; and
- Change in the local and international industry: which drives heavy goods traffic on the Asset; and
- Change in the competitive position of the Asset: this reflects changes in highway capacity of competing roads and the relative changes in service levels (time, congestion, price, etc.) for the Asset, and their competitors.

1.11 The information related to the concession agreements, toll notifications, toll calculations and target revenue and designed capacity was provided as part of the commission.

1.12 We have analysed traffic data from multiple independent sources as well to understand the current traffic on the Asset. The list of data sources available and discussed in later chapters in detail are presented below:

Table 1.3: List of data sources available

Data sources	Ticket-segmentation	Lakhnadon Khawasa (LK)	Overlap with Steer TVC
Monthly toll plaza data sourced by Client (ETC)	Available	**Khawasa & Madai:** Oct'2021-Nov'2023	Yes
Schedule V	Not available	**Madai:** Sep'22-Oct'23	No
IHMCL	Not available	**Khawasa & Madai:** Mar'22 – Aug'23	No

Source: Steer's review of data points

1.13 The datasets mentioned in the above table are explained below:

- **ETC (segmented)**: ETC daily-level data, segmented with ticket categories, was available from Oct'21 – Nov'23 for both Khawasa and Madai. The dataset doesn't include information regarding cash-based trips, pass-based trips, and exemptions.
- **IHMCL**: The IHMCL counts reported for the Asset are available for varied timeframe for each of the toll plaza
- **Schedule V:** Available for Madai toll plaza at monthly level included monthly cash transaction at Madai from Sept'22- Oct'23. Similar proportions of cash traffic are assumed for Khawasa due to data unavailability.

Contents of this Report

1.1 The report has been divided into 6 chapters, including:

- Chapter 2 describes the key features of the Asset.
- Chapter 3 provides a historic traffic and revenue overview of the Asset, and presents all the survey data collection, and analysis.
- Chapter 4 discusses the socio-economic context in the corridors containing the Asset.
- Chapter 5 presents our base year traffic estimates and forecasting assumptions.

- Chapter 6 summarises our key forecasting assumptions, assessment of network impacts, and presents our traffic and revenue forecasts for the Asset.

2 The Asset

Introduction

2.1 This chapter provides a description of the Assets, based on primary data (from site visits), our understanding of the region and network surrounding the Assets. We cover the strategic network context, followed by key economic activities and network developments around the Assets.

Figure 2.1: Regional Context of the Asset

Source: Steer cartography

Asset context

Context

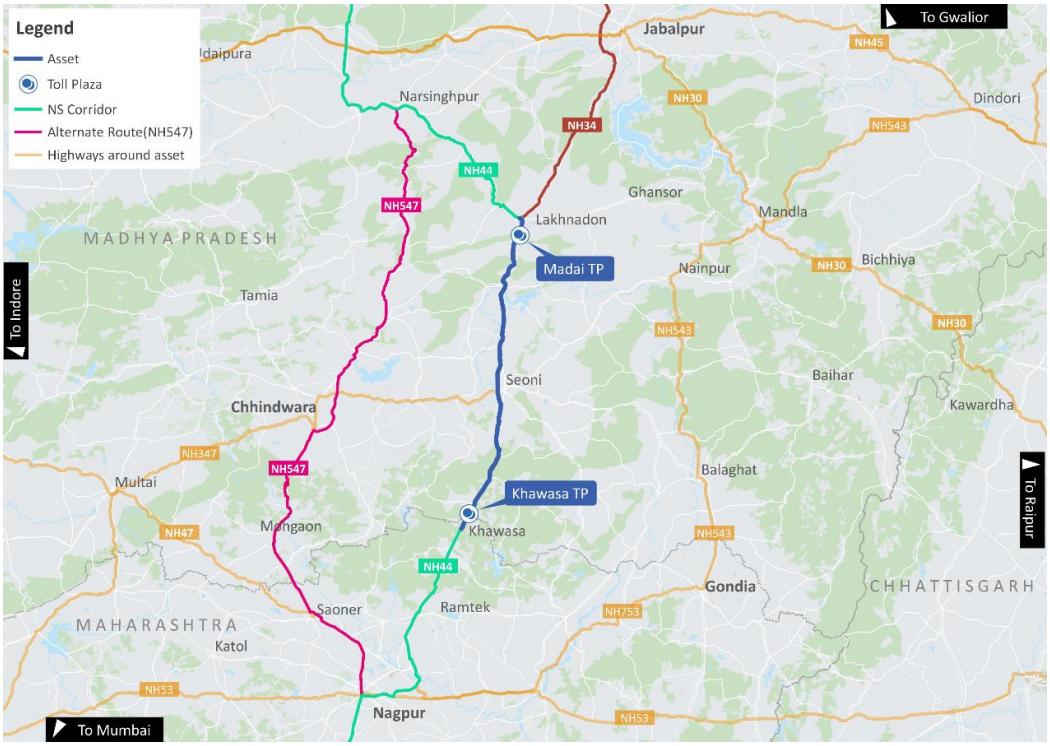
2.2 The Asset forms part of NH44 north-south long-distance strategic corridor. The Asset is a 4-laned divided section between Lakhnadon and Khawasa traversing through the districts of Mandai, Chhapara and Seoni in the state of Madhya Pradesh.

2.3 The location of the Asset is such that around 25kms of Asset length passes through reserve forest area of Pench and Bhandar. In the existing scenario, the section around forest cover is 4 lane with no provision of service lane.

2.4 There are two toll plazas on the Asset and are located at:

- **Khawasa** (KM 651+718)
- **Madai** (KM 549+200)

Figure 2.2: Asset context



Source: Steer cartography using OpenStreetMap data

2.5 The Asset lies between the cities of Jabalpur and Nagpur which lend to the short distance traffic. Nagpur southern send of Asset is the home to several manufacturing hubs, food processing units, and CONCOR's multi modal logistics logistic hub in Mihan. Yavatmal (textile/cotton), Butibori (MIDC), and Chandrapur & Umred (coal) are some of key traffic generators for the Asset.

2.6 Steer team visited the Asset as part the site visit exercise to understand the traffic movement on the and its surrounding network and in addition spoke to the users of the road and undertook a detailed reconnaissance of the Asset, including identification of any micro-diversions. The images below show a typical cross-section of the Asset and its toll plazas as captured during site visit and also the 2 lane sections and maintenance work at the alternate (NH547).

Figure 2.3: Khawasa toll plaza; 2 lane Chhindwara- Narsinghpur NH547 section; Cross Section of the Asset, 2 lane maintenance of Chhindwara- Seoni NH547

Source: Steer site visit, Oct'23

2.7 The Asset caters to the following traffic movements:

- **Long-distance traffic:**

  i. The Asset forms part of NH19/NH7 (new NH44) north-south long-distance strategic corridor connecting Srinagar in Kashmir (northernmost state) to Kanyakumari in Tamil Nadu (southernmost state).
  ii. The Asset has seen an increase in proportion of the long-distance goods traffic which may be attributed to shift of long-distance traffic from other corridors to NH7 (new NH44) corridor as it is the shortest route between Delhi and Hyderabad/Bengaluru.
  iii. Major influence regions include Uttar Pradesh, Haryana, Punjab, Madhya Pradesh, North-East states, Chattisgarh, Telengana and Karnataka. Major long distance(>500kms) commodities include Automobile, Parcels, Manufacturing and Agri Commodities. While short distance (<500kms) include Petroleum, Construction, Teakwood (Sagwan) and Perishables commodities.

- **Short-distance traffic**:

  iv. Jabalpur, northern end located on the banks of river Narmada. The region is also a tourism centre with many famous places like Bargi Dam, Marble rocks, Dhuandar Falls etc. Also, the plant of HPCL IRD in Jabalpur is a major traffic generator on the asset.

v. The Asset corridor Lakhnadon to Khawasa passes through reserve forest area of Pench National Park and Bhandar Range forest with settlements of Seoni, Lakhnadon and Bandol in between. Moreover, 20kms section of asset traversing through this forest area is in the form of elevated overbridge.

2.8 The traffic profile is predominantly goods vehicles undertaking long distance movements between the locations discussed above. The commodity mix carried by the vehicles observed at the toll plaza during site visit was mix of manufacturing, courier/parcel, automobile, and agriculture confirming the long-distance nature of the traffic.

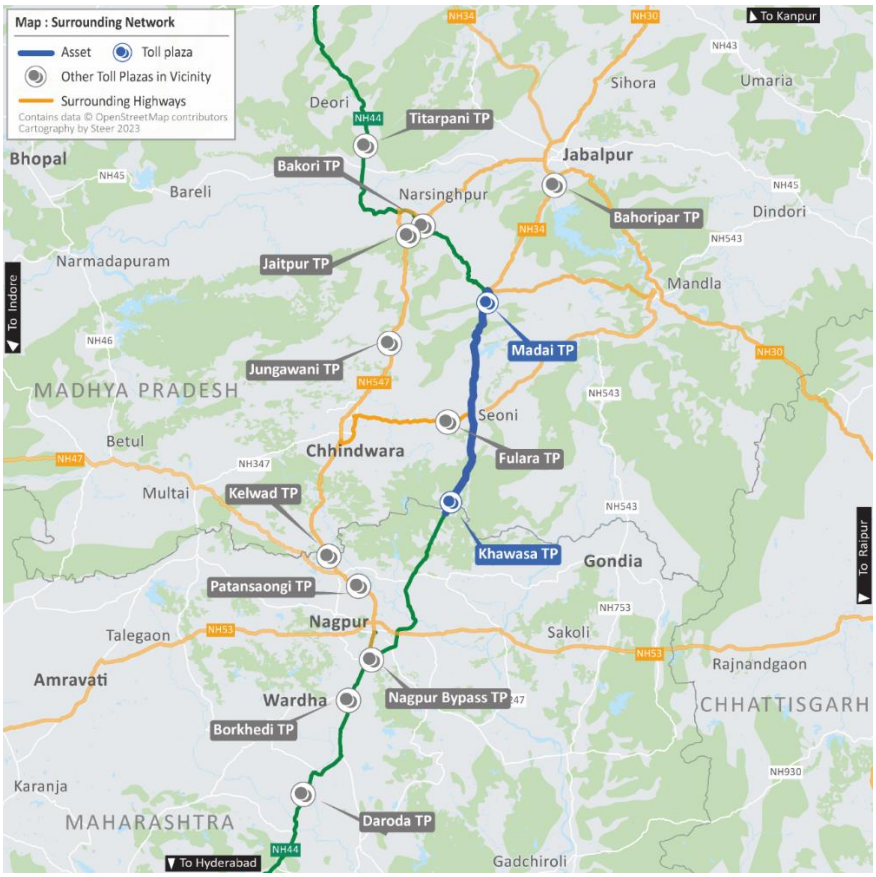
2.9 The key commodities observed are groceries, agriculture, electronics, chemicals, rice, automobiles and parcels. Average trip lengths of more than 1,000 kms for goods vehicles were observed on the toll plaza, this is validated by the analysis of the OD data as well presented in detail in later chapters.

2.10 The Asset has seen an increase in proportion of the long-distance goods traffic in recent years as compared to past performance which may be attributed to shift of long-distance traffic from other corridors to NH44 (old NH7) corridor as NH44 observed continuous Level of Service (LoS) upgrades. Being the shortest route between Delhi and Hyderabad/Bengaluru, the increased LoS on the corridor attracted traffic on NH44 post improvement.

Surrounding Network

2.11 The Asset is a part of NH44 which attracts traffic from Jabalpur Nagpur, Delhi, Bangalore, Prayagraj, Hyderabad. In the existing scenario, NH547 starting from Narsinghpur to Nagpur is which 2 lane paved road is the only alternate to the Asset. It currently has 4 operating toll plazas as presented below Jaitpur, Jungawani, Kelwad and Patswangi.

Figure 2.4: Surrounding Plazas of the Asset



Source: Steer Cartography

2.12 With the presence of steep ghat section over >800m and the section traversing through dense forest area and being 2 lane, it is currently not much preferred route for users moving from Jabalpur/North and Nagpur/South. The same is validated from the IHMCL volume presented above where NH547 plazas carry less than 400 trucks compared to over 4000 on the Asset.

2.13 The Asset location in the context of traffic volumes on surrounding assets is shown in the table and map above.

Table 2.1: IHMCL volumes of surrounding plazas for FY23 and FY24YTD (Apr'23-Aug'23)

Toll Plaza	CJV		2A+3A+MAV	
	FY23	**FY24 YTD**	**FY23**	**FY24 YTD**
Khawasa* **(Asset)**	2,380	2,669	5,046	5,422
Madai* **(Asset)**	2,817	3,062	5,598	5,831
Bakori	762	844	3,735	3,860
Titarpani	1,021	1,258	4,193	4,423
Jaitpur **(NH547)**	373	373	333	307
Jungwani **(NH547)**	477	503	342	327
Kelwad **(NH547)**	2,249	2,595	399	405
Patansaongi **(NH547)**	3,900	4,887	803	796
Nagpur Bypass	1,564	1,969	8,409	9,287

Fulara	1,606	1,653	554	477
Borkhedi	4,530	4,743	5,682	5,987
Daroda	1,442	1,556	4,676	4,903
Bahoripar	2,307	2,631	1,926	1,995
Joginihai**	4,902	5,859	2,936	3,071

*For Khawasa and Madai volumes taken from client data (ETC+Cash) and FY24YTD is from Apr'23-Nov'23.
** For Joginihai FY24YTD from Apr'23-June'23
Source: Steer Analysis

2.14 2A+3A+MAV Traffic at Khawasa and Madai essentially trend in the same range. Madai traffic is slightly higher on account of some regional traffic towards Chhindwara which appears at Madai but does not appear at Khawasa.

Concession and tolling details

Table 2.2: Summary of concession

Asset ID	Asset: LK
Asset name	Lakhnadon - Khawasa section of NH44
State	Madhya Pradesh
NH	NH44
Tollable Length (km)	146.39
Chainage	Km 546+420 to Km 653+770
Nos. of toll plaza	2
Toll plaza locations	Khawasa (KM 651+718) Madai (KM 549+200)
Operating since*	TP1: Sept 2010 TP2 Allonia: Jun 2010 TP2 Madai: 2021
Proposed concession period	20 years
Tollable length (km)	**Khawasa TP:** 72.305 km **Madai TP:** 74.086 km

Source: NHAI

Toll plazas and toll rates

2.15 As discussed earlier in section, the Asset has two toll plazas. TP1 has 8x8 and TP2 has 4X4 lane configuration with an additional lane on each direction on both plazas for exempted vehicles. Both have ETC infrastructure.

2.16 At TP1, to address the issue of traffic and revenue leakage due to Cross TAG mainly in Cars, ETC barrier for toll collection is placed at entrance of toll lanes with only 8 lanes being operational out of total 16. Currently, WIM system is present on TP1 plaza and not TP2. However, the proportion of overloaded traffic appearing on the plaza compared to daily traffic volume is negligible.

2.17 The road users having valid FASTag installed on their respective vehicles approach the ETC lanes where the installed RFID readers detect the tag and deduct toll charges equalling single trip or

for Local/monthly pass/discounts wherever applicable. In case, the RFID reader is not able to detect the FASTag, handheld devices are used to read the vehicle's tag. Further, in cases where FASTag is blacklisted or not working, the user can only buy single cash ticket and are charged twice the single trip fare. The users crossing toll plaza twice within 24 hours automatically get return discount.

2.18 Like the other National Highway plazas, the Asset has Single, Return, Local Commercial, Local Personal, Monthly and Local Monthly tickets. Single toll rates and categories on each of the toll plaza are presented in the table below.

Table 2.3: Single toll rates on the Asset (INR), applicable for FY24

Type of Vehicle	Khawasa	Madai
CJV	105	105
LCV	165	170
Bus/Truck	350	360
3A	380	390
MAV/ HCM/EME	550	560
OSV	670	685

Source: NHAI Revision of User fee Rate w.e.f 01.04.2023

Key economic activities

Industrial Influence

2.19 The Asset is present in the state of Madhya Pradesh, the second-largest state in India by area. The Asset forms part of the strategic NH44 corridor catering to the north-south movement.

2.20 The Asset lies between the urban centres of Jabalpur and Nagpur. This is known for medium to large scale industries alongside agriculture. The key industries in the region are manufacturing and food processing as described below.

- **Manufacturing** segment includes products ranging from agriculture equipment, aluminium products, castings, cement, chemicals, paper and packaging, electrical equipment and fittings, textile engineering goods, tools manufacturing, fabrication and machining, ferro alloys, paints, furniture, plastic and moulding products, etc.
- **Food processing** giants having presence at Nagpur includes Haldiram, Dinshaw, Patanjali and other medium scales orange and spices processing units, etc.
- **Agriculture production** In Jabalpur**,** some of the important commercial crops cultivated are cotton, pulses, sugarcane, oilseeds and medicinal crops. The fertile alluvial soil of Narmada basin also provides other crops like wheat, sorghum, millet and rice. Jabalpur is the largest producer of soyabeans in Madhya Pradesh.

2.21 Apart from the above-mentioned industrial segments present in the region, the following are some additional developments announced by the government for the region:

- Government of Maharashtra has set-up Multi-Modal International Passenger and Cargo Hub Airport at Nagpur (MIHAN). That will upgrade existing domestic airport along with a Special Economic Zone which is abutting to the boundary of the airport. MIHAN houses plant of Tata Aeronautics which manufactures parts for Boeing and Air India and Dassault's assembly plants.

- Container Corporations of India Limited (CONCOR) constructed Multi Modal Logistic Park along with a rail terminal connecting MIHAN with different ports in country.

2.22 **Butibori industrial area** established by Maharashtra Industrial Development Corporation (MIDC), south of the Asset, is one of the country's largest industrial hubs. It houses textile, machine and metal fabrication and manufacturing units and is home to industrial giants like KEC, Hyundai, and Unitech. Koradi Thermal Power Station and Khaparkheda Thermal Power Station are the two major thermal power stations located in vicinity of the hub.

2.23 **Yavatmal industrial area**, in west of the Asset, has textile and cotton processing industries including Raymond India's garment plant. The industrial hub is also home to export units of machineries, cement, medicines, limestones, and clothes.

2.24 **Chandrapur** is key coal mining centre in close vicinity of the Asset and has thermal plant, cement, paper and ferro alloy manufacturing industries.

2.25 **Chhindwara** is home to brands like Raymond's & Hindustan Unilever. The city has rich market areas such as Mansarover Complex, Fawwara Chowk, Nagpur Road, Gole Gunj & Gandhi Gunj. The city is home to old industries of pottery, leather moots and ornaments of zinc, brass and bell metal. On the outskirts, vegetables, especially potatoes, are raised in large quantities for export to nearby districts. Western Coalfields Limited is the major company of Chhindwara approximate ten thousands people work together here.

2.26 **Seoni** railway station and its goods yard work as an important agricultural export hub. It is one of the 24 districts in Madhya Pradesh currently receiving funds from the Backward Regions Grant Fund Programme (BRGF).Railway connectivity to Seoni has increased the agricultural import export business from Seoni.

Agricultural influence

2.27 The agricultural stretches present along the Asset as well as in Nagpur generate a considerable share of traffic on the Asset. Nagpur, also known as Orange City, is famous for the production of oranges in addition to being home to large number of paddy, jowar, cotton, tur and soyabean fields. Also, Jabalpur is the largest producer of soyabeans in Madhya Pradesh. The city serves as a major wholesale market for food grains and other commodities. It is also a market center for its agricultural production of wheat, rice, green peas, maize, oil seeds and pulses. The same is observed in our 'commodity analysis', a part of survey results, as well as ~18% of the MAVs were found to carry agricultural products.

Potential Leaks/Network Risks

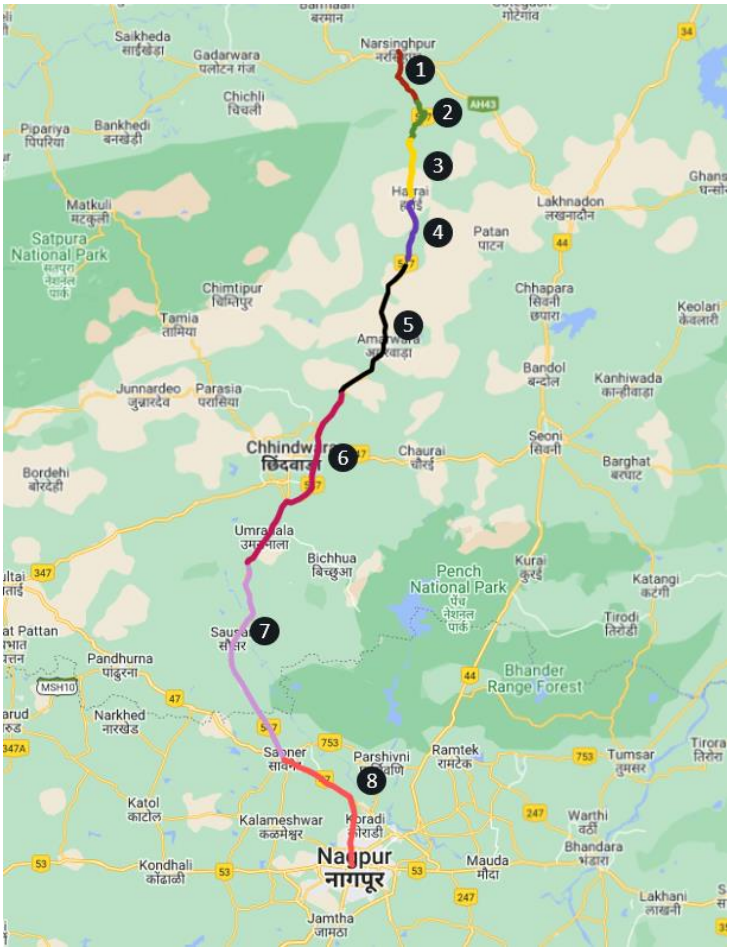
2.28 The Asset is surrounded by dense forest reserve of Pench and Bhandar on both sides with elevated sound and light proof bridge of 20kms passing through the forest area. Therefore there are no local leaks/micro diversion identified on the Asset.

2.29 On a higher level, existing NH547 section adjacent to our asset from Jabalpur to Nagpur via Chhindwara is a potential alternate once improved for level of service. The alternate is 350km 2 lane road with 7 toll collections points between Jabalpur- Narsinghpur- Chhindwara- Nagpur section. Based on the site observation and stakeholder consultation, the alternate in the current scenario is a non-preferred route for road users moving between Nagpur/South and Jabalpur/South because:

- **Presence of Ghat section and higher elevation on NH547-** It's a ghat section with hilly terrain making it difficult for loaded trucks to drive. 112km of total 252km has steep

elevation above >600ms on NH547 as presented below. This steep section exists between Harrai and Chhindwara of NH547. While on the Asset, elevation level is low and for less than 50kms.

Figure 2.5: Elevation Profile: Through NH547 (Narsinghpur – Nagpur)



Source: Steer Analysis, Google my Maps

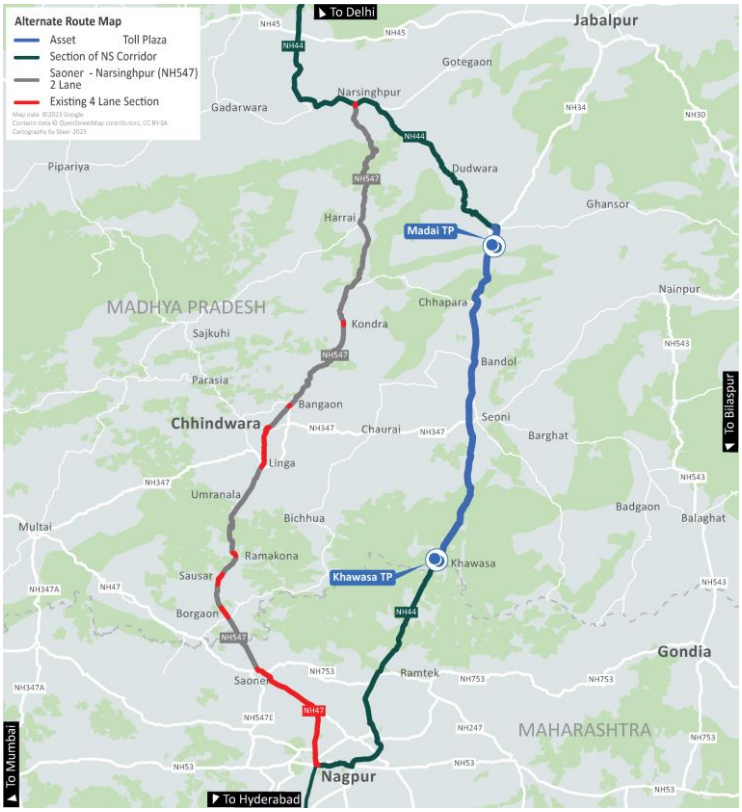
Table 2.4: Elevation Profile: (Narsinghpur – Nagpur) via NH547

S. No.	Section	Elevation	Length (in Km)
1.	Narsinghpur - Jaitpur Toll plaza	300 - 400 m	16
2.	Jaitpur Toll plaza - NH547 Dunda	400 - 500 m	14.5
3.	NH547 Dunda – Harrai	500 - 600 m	16
4.	Harrai – Budhena	600 - 700 m	16
5.	Budhena - Singori, Chhindwara	700 – 870 m	43
6.	Singori, Chhindwara - Sillewani	600 - 700 m	53.5
7.	Sillewani – Saoner	300 - 600 m	58
8.	Saoner – Nagpur	200 – 300 m	37
Total	**Narsinghpur - Nagpur**		**254**

Reference: **GPS Visualizer: Assign DEM elevation data to coordinates**

- **Lower Level of Service on NH547**- 2 lane section on NH547 with lower speed and more time. Further, few 2 lane sections between Seoni- Chhindwara- Narsinghpur is currently under road maintenance as well. Currently, of total 252 kms on alternate NH547, 62 km is 4 lane. Sections around Kondra, Linga, Chhindwara, Sausar, Borgaon, Saoner, Nagpur is 4 lane. In comparison our Asset being provides better LOS with entire section between Narsinghpur- Nagpur currently 4 laned.

Figure 2.6: 2 lane and 4 lane sections NH547 between Narsinghpur-Nagpur



Source: Steer Cartography

Table 2.5: Length of 4 lane sections: Narsinghpur- Nagpur via NH547

S. No.	Section	4 lane section (in km)
1.	Narsinghpur - Amarwara	1.5
2.	Amarwara - Chhindwara	3.5
3.	Chhindwara - Sausar	10.5
4.	Sausar - Nagpur	46.5
	Total	**62.0**

Source: Google Distance

- **High tolls with low level of service**- The NH547 section is currently 2 laned where from Narsinghpur to Nagpur, there are 4 plazas on NH547 (Jaitpur, Jungawani, Kelwad and Patswangi) and 3 plazas on NH44 (Bakori, Madai and Khawasa). For almost equal distance, below table shows similar user fee charged on Asset and alternate NH547 despite difference in LOS. Difference in MAV tolls for using 2 lane NH547 and 4 lane NH44 Asset is just INR25.

Table 2.6: Toll rate, distance & Time comparison between the alternate and asset

		CJV	LCV	2A	3A	MAV
Via Asset NH44						
Toll rates	(in INR)	345	550	1,160	1,260	1,815
Length	(in KM)	258	258	258	258	258
Via Alternate NH547						
Toll rates	(in INR)	335	630	1,140	1,245	1,790
Length	(in KM)	254	254	254	254	254

Source: Steer Analysis

2.30 However, we understand with the existing ongoing economic activities and increasing government focus in the region there is a future possibility of the alternate NH547 expanded to 4 lane which will then act as a competitive route for the Asset. Hence, with no existing information available on 4 lane alternate from NHAI, the diversion impact has been assumed in the downside scenario.

Network developments

2.31 The section below details the impacts which we believe would influence the traffic levels on the Assets during the concession period.

Delhi Mumbai Expressway & Surat Chennai Expressway

2.32 Delhi Mumbai Expressway (DME) will connect Delhi to Mumbai with a dual carriageway with six lanes per direction. At 1,350km long, it will drastically reduce travel length and times. The section between Sohna (Haryana) to Dausa (Rajasthan) was made operational in Feb-23. The latest status[1] as posted by NHAI projects that by Mar-24 the section between Delhi and Ratlam-Indore will be operational. Similar to DME, 707 km long Surat Chennai Expressway will connect Surat and Chennai via Solapur, Kurnool, Kadappa, and Tirupati. Once both these expressways are constructed, traffic coming from Delhi/ north and travelling to Kurnool/south will have the option to use DME till Indore followed by NH52 till Solapur followed by SCE from Solapur to Kurnool and beyond. This new alternative will provide the option of using expressways for ~60% of the total journey distance and hence, a share of Delhi-Kurnool traffic is expected to have an alternate route choice.

2.33 Further, DME provides a faster access to Indore and post which the users can reach Solapur via Dhule – Aurangabad. After Solapur, the route to reach Bangalore can either be via Kurnool or via Vijaypura – Hospete section.

NH547 2 lane improvement including completion of Nagpur Ring Road

2.34 On NH547, currently 2 lane pavement improvement work is being undertaken between Narsinghpur to Nagpur. This route directs joins the eastern section of Nagpur Ring Road at Saoner. As per the current information, western section of Nagpur Ring Road is already

[1]DME status as on March'2023, https://nhai.gov.in/nhai/sites/default/files/mix_file/Delhi-Mumbai-Award-Status-Mar-23_v1.pdf

constructed where eastern section is still under construction which connects to manufacturing hubs Butibori, Mihan and more[2]. The Ring Road is under construction[3] where to pace up the completion of this BOT project, the section is divided into 2 packages. Both the packages were supposed to be finished by Sept'23 although now due to several delays the new deadline is Mar'24.

Other Developments

2.35 The under-construction 317-km-long Nagpur-Jabalpur Natural Gas Pipeline which will originate from Nagpur in Maharashtra and pass through Chhindwara, Seoni and Jabalpur districts in Madhya Pradesh is an upcoming project part of the PM Gati Shakti Master Plan initiative.

2.36 The proposed Raipur Seoni Expressway (Lakhnadon Raipur Expressway) project is a greenfield expressway in the states of Madhya Pradesh and Chhattisgarh, connecting Lakhnadon in Seoni District, Madhya Pradesh to near Raipur in Raipur District, Chhattisgarh.

[2] **Irr: 50km Inner Ring Road To Be Concretized By Nov | - Times of India (indiatimes.com)**

[3] **Project Summary (cspm.gov.in)**

3 Traffic and revenue description

Introduction

3.1 This Chapter outlines the historical and current traffic and revenues on the Asset and how these are used to establish the current/base year demand (in terms of AADTs), which forms the basis of our forecasts. We then use our independent traffic volume counts (TVC) to validate the AADTs and estimate shares of toll violations and unreported exemptions.

3.2 For a traffic and revenue due diligence exercise, the data provided by the toll plaza is typically the primary source of establishing a road asset's base position, in terms of vehicle level AADT and PCU levels, as well as historical performance in terms of growth trends by vehicle type. However due to the unique nature of the asset under consideration in this assignment, being operated under different Operate Manage and Transfer (OMT) contracts, basically independent contractors, the toll plaza based historical data available was very limited for the Asset. Therefore, it was important to validate the toll plaza data against other independent data sources to entrust confidence in the data used for base position estimation.

3.3 An independent traffic count is often a good way to validate the toll plaza information which has been used in combination with data shared by the Client team. A fresh set forecasting approach was also developed using this independent data and benchmarks available from other studies. These data sources, described in detail below, were helpful in establishing the base position as well as the historical trends that could be relied upon for developing a robust set of forecasts.

Historical traffic and revenue analysis from various sources

3.4 This section below presents the sources from which the historical traffic and revenue of the Asset has been analysed. For this study, traffic data is made available from different sources shared by the Client, namely:

- IHMCL counts; and
- Schedule V; and
- NHAI data (ETC) sourced from Client.

3.5 During the due diligence, these data sources were analysed in addition to the independent primary survey data being collected by Steer. During that study it was established that Toll Plaza data along with primary survey data as mentioned above was the most reliable data source. Therefore, For the purposes of this study, we now have this dataset available for a longer time series i.e., from October'21 to November'23. Therefore, for the purposes of historical analysis and FY24 base AADT estimation we have utilised only this data source (along with steer primary survey).

3.6 The following section outlines the current and historical traffic and revenue datasets available on the Asset, as well as our analysis of primary traffic count data, collected as a part of this project. In addition to the data available through secondary sources we have conducted our

own independent Traffic Volume Counts (TVC) counts to validate the AADT and estimate shares of vehicle classes, where data are not available or aggregated.

Historical traffic

3.7 Based on our experience of studying toll roads across the country, tolling via FASTag has significantly improved the methods of reporting as the traffic, apart from getting recorded by the toll plaza, also gets recorded by centrally monitored bank servers. Therefore, we believe toll plaza (ETC+cash) dataset is reliable and has been used for our base traffic estimation. To further enhance the confidence on our base traffic position, we have compared the daily level toll plaza data traffic for each vehicle category with Steer's independent TVC counts for the same dates.

3.8 Toll plaza data from Oct-21 to Nov-23 and Dec'21 to Nov'23 for Khawasa and Madai, respectively, was shared by the Client. Therefore, to build the base estimate for FY24, we have considered:

- There are three data sources as mentioned in the table above, the Electronic Toll Collection (ETC) data provided by NHAI, IHMCL data and Schedule V data. For the purpose of base estimation and analysis of traffic trends ETC and cash data has been used. For the purpose for cash transactions Schedule V has been relied upon.
- Both these data sets together have been considered for historical analysis and revenue reconciliation.

3.9 The following table shows the yearly AADT by vehicle class, at the Asset's toll plaza over the period of 26 months from Oct'21 to Nov'23 for Khawasa and for 24 months from Dec'21 to Nov'23 for Madai.

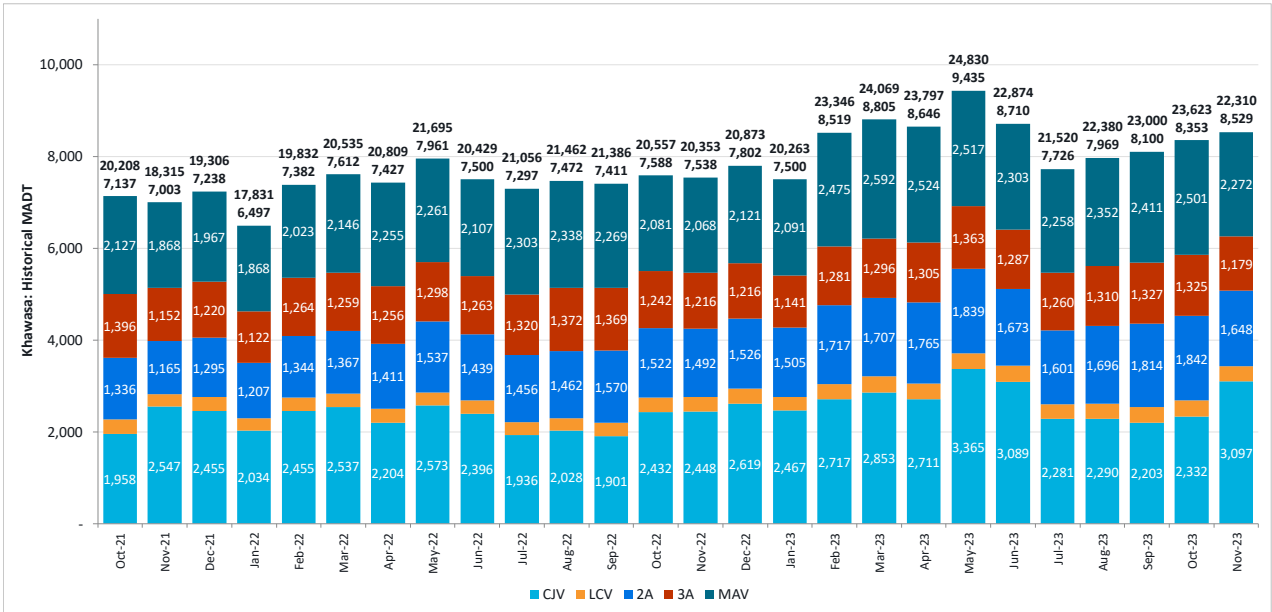
Table 3.1 Historical Traffic (ETC + Cash)

Vehicle	FY22*	FY23	FY24YTD	FY22*	FY23	FY24YTD
	Khawasa			Madai		
CJV	2,328	2,380	2,669	2,737	2,817	3,062
LCV	291	304	339	347	378	408
Bus/ 2A	1,285	1,528	1,735	1,492	1,740	1,931
3A	1,236	1,272	1,295	1,332	1,371	1,359
MAV	2,000	2,246	2,393	2,328	2,488	2,541
OSV	2	2	2	2	2	2
Total	**7,142**	**7,731**	**8,433**	**8,238**	**8,795**	**9,303**
PCUs	**19,335**	**21,349**	**23,043**	**22,213**	**23,919**	**24,990**

Source: Steer analysis. FY22* data is for 6 months.

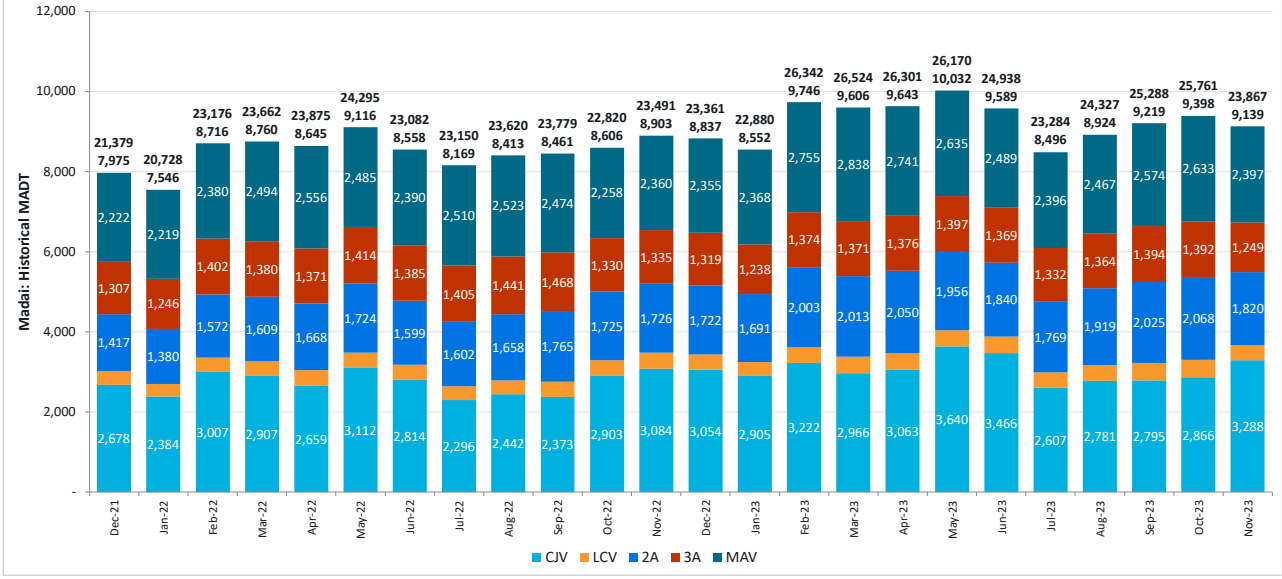
3.10 Figure below shows the PCU and MADT historically reported for the Asset.

Figure 3.1: Khawasa Historical Traffic (ETC + Cash MADT, PCU)



Source: Steer analysis

Figure 3.2: Madai Historical Traffic (ETC + Cash MADT, PCU)



Source: Steer analysis

Table 3.2: Proportion of Cash Traffic

FY24YTD	CJV	LCV	Bus	2A	3A	MAV	Asset
Khawasa	0.9%	0.7%	0.1%	0.1%	0.02%	0.01%	**0.3%**
Madai	0.8%	0.6%	0.01%	0.01%	0.02%	0.01%	**0.24%**

Source: Steer analysis

3.11 The Asset is trending at ~23,000 PCU for 8 months of FY24. On both the plazas, traffic composition is majorly dominated by trucks (2A/3A/MAV) with over 2/3rd of total traffic on

Khawasa and Madai each, as they primarily serve long-distance north-south traffic movement. Due to long-distance nature of traffic, the plazas observe similar 3A/MAV volumes as the traffic traverses through movement. The difference in total traffic across the plazas is due to the local movement to locations like Chhindwara which appears at Madai but does not appear at Khawasa. In FY24 YTD, Khawasa witnessed ~2669 CJVs whereas Madai witnessed ~3062 CJVs per day.

3.12 For LCV, ~408 were observed at Madai as compared to ~339 at Khawasa. Madai observed ~1931 Bus/2As in FY24 YTD, slightly higher than ~1735 Bus/2As in FY24 YTD at Khawasa. Buses and 2As are reported in a combined manner on the Asset as the toll rates are same for the categories. We have referred to the traffic reported in independent TVC counts for Bus/2A splits. The same has been explained in detail in later sections. This is further discussed in the data collection section.

3.13 The traffic in FY24 has witnessed growth at both Khawasa & Madai toll plazas with the decline in Covid19 induced restrictions and resumptions in the economic activity. Khawasa observed a higher PCU growth of ~7.9% as compared to 4.5% at Madai in FY24 YTD as compared to FY23.

3.14 The growth at both the toll plazas is mainly led by 2A and MAVs. CJV and 3As have observed to remain flattish, whereas LCVs have witnessed a slowdown. The figures below show the category-wise share of traffic at the toll plazas for FY23 and FY24 YTD. It can be seen that CJVs make up the highest proportion of vehicle share at both the toll plazas followed by MAVs. Accordingly, as expected, 2A+3A+MAVs derive the highest proportion of revenue with an average of 88% of total revenue in FY24 YTD, for the Asset as a whole.

Figure 3.3: Vehicle Share at Khawasa

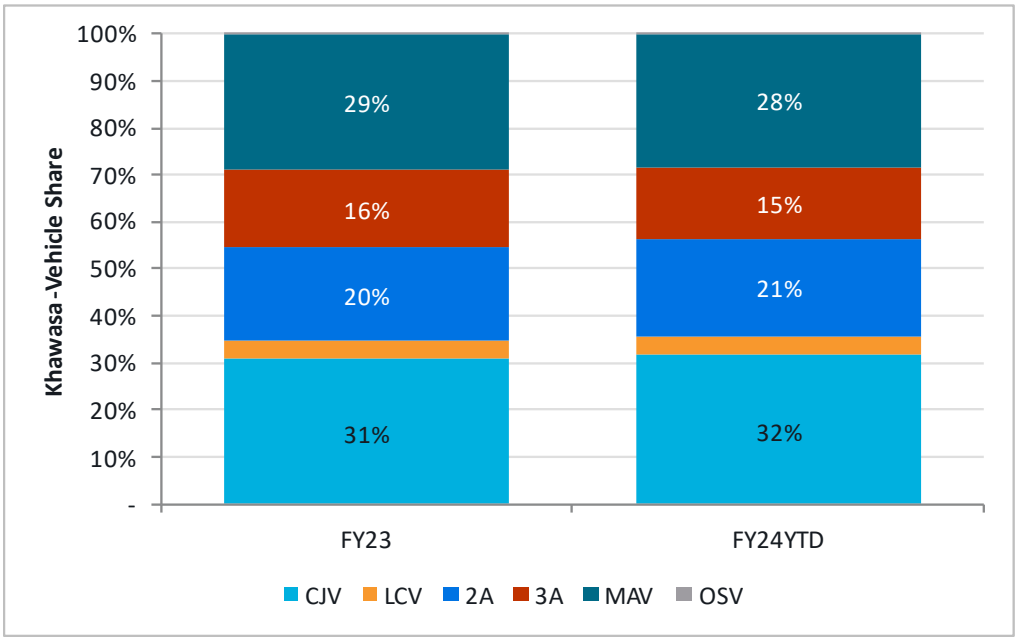
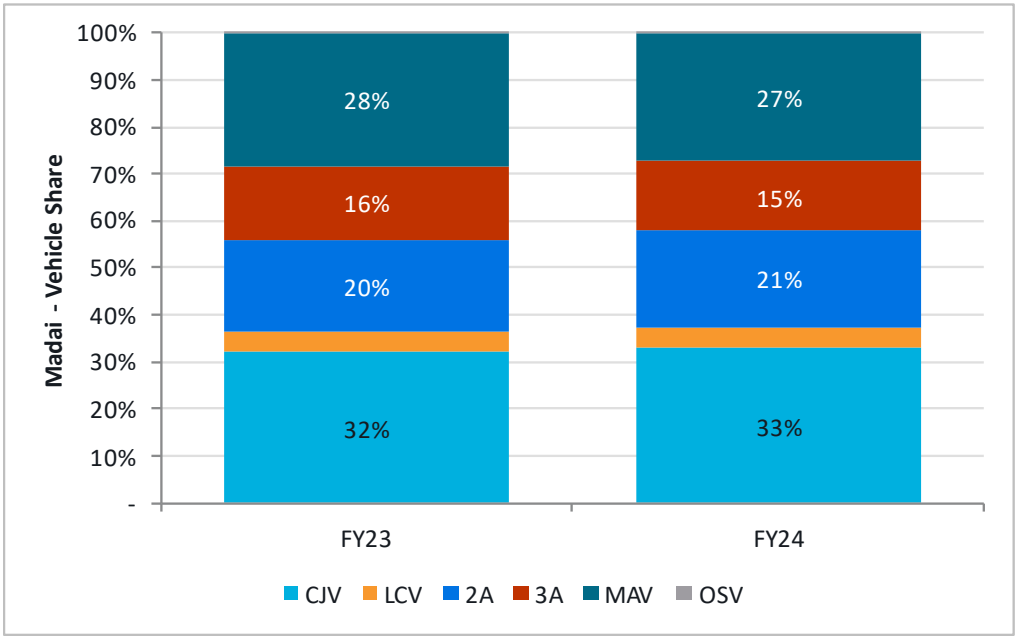


Figure 3.4: Vehicle Share at Madai



Source: Steer analysis of client data

3.15 We have verified the traffic volumes by conducting our own independent TVC counts. The difference between TVC counts and the 'paying' traffic (cash + ETC) for CJV/ LCV and total traffic (cash + ETC + violations/ exemptions) for 2A/3A/ MAV/OSV and is being treated as unreported 'exemptions/violations' (non-paying traffic) in our forecasts explained in detail in TVC comparison section.

Historical Revenue

3.16 Revenue details were available split by vehicle category and ticket in the ETC+cash dataset. The ETC+cash dataset reported revenue on a daily level split by payment via FASTag and via cash. Over 99% of the total revenue is being collected via FASTag. The revenue details from the datasets are shown in the charts below.

Table 3.3: Plaza wise annual revenue (INR Cr)

	Khawasa				Madai			
	FY22*	**FY23**	**FY24 YTD**	**FY24 YTD vs FY23**	**FY22**	**FY23**	**FY24 YTD**	**FY24 YTD vs FY23**
CJV	3.1	7.8	6.0		2.7	9.6	7.3	
LCV	0.7	1.7	1.3		0.6	2.1	1.6	
2A	6.3	17.9	14.2		5.2	20.6	16.2	
3A	6.8	16.9	12.0		5.3	18.3	12.8	
MAV	15.9	42.2	31.8		13.2	48.1	34.5	
Total (INR Cr)	**33**	**87**	**65**		**27**	**99**	**72**	
AADC (INR Lakhs)	**18.0**	**23.7**	**26.7**	**12.7%**	**22.2**	**27.0**	**29.7**	**9.8%**

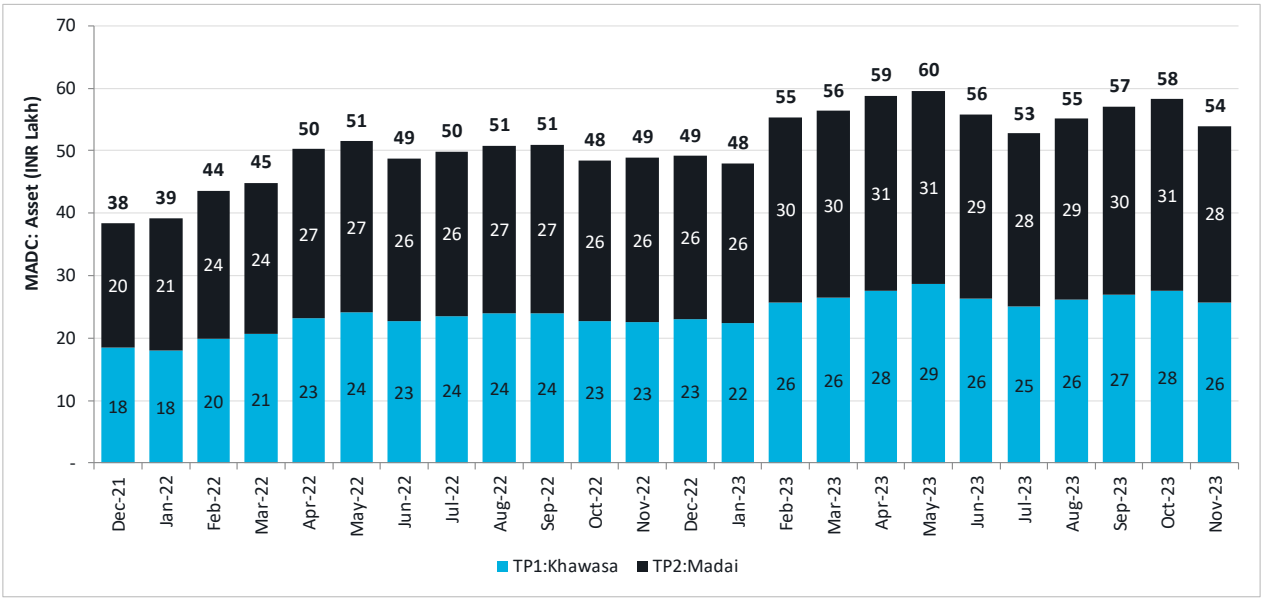
Source: Steer analysis of client data

3.17 Per day Collection increased ~11% in FY24 compared to FY23 on the Asset. Total annual collection of 186 Cr in FY23 is increasing to 138 Cr in 8months for FY24YTD.

3.18 Similar to commercial traffic volumes, both the plazas observe similar revenue levels as well. In FY23, the Khawasa plaza collected INR 87 crores whereas Madai plaza collected INR 99 crores. On both the plazas, ~90% of revenue is being collected from the commercial traffic.

3.19 The monthly daily revenue collection (ETC+cash) for the plazas is shown in the charts below.

Figure 3.5: Monthly daily revenue reported in toll plaza data (INR Lakhs)



Source: Steer analysis of client data

Required remittance

3.20 As the toll plazas of the Asset are under Operate, Manage and Toll contract (OMT), the tolling contractor is contractually obligated to pay a required amount, known as remittance, on a daily level to the authority (NHAI).

3.21 The following tables provide the historical remittance figures as well the latest remittance amount for both the plazas.

Table 3.4: Remittance amount - Khawasa

Remittance (INR Cr)	Period	Daily (INR Lakh)
Remittance (FY24 Avg.) – Daily (INR lakh)	Aug'23-Aug'24	**26.8**
Toll Collections (FY24)** – Daily (INR lakh)		**26.7**
Toll Collections (FY24) * – Daily (INR lakh)	Apr-23- Apr-24	**27.1**

Source: Steer analysis, *toll collection for FY24 estimated ** toll collection reported from ETC Segmented data for 8 months (Apr-Nov'23)

Table 3.5: Remittance amount – Madai

Remittance (INR Cr)	Period	Daily (INR Lakh)
Remittance (FY24 Avg.) – Daily (INR lakh)	Aug'23-Aug'24	**30.1**

Remittance (INR Cr)	Period	Daily (INR Lakh)
Toll Collections (FY24)** – Daily (INR lakh)		**29.7**
Toll Collections (FY24) * – Daily (INR lakh)	Apr-23- Apr-24	**29.9**

Source: Steer analysis, *toll collection for FY24 estimated ** toll collection reported from ETC Segmented data for 8 months (Apr-Nov'23)

Toll Frequencies

3.22 Toll frequency or segmentation is typically the share of each ticket category recorded for a particular vehicle type. Each vehicle category has different segmentation. As a part of historical analysis, we calculate the toll frequency for each vehicle category from the monthly data shared by the client. The most common ticket categories observed on a typical national highway concession are: Single, Return, Monthly, Local and Exempt. Given the local nature of traffic, the Asset offers bespoke local passes to attract the local commuters to opt for these category passes instead of evading toll. Brief description of different ticket-types is given in table below.

3.23 Understanding the toll frequency gives insights into the nature of traffic. CJVs (Cars) generally have higher shares of return passes or monthly passes as the CJV users on Indian national highways tend to make shorter distance and more frequent trips. However heavy trucks mostly have single tickets since they travel long distance. This varies from asset to asset or even toll plaza to toll plaza. The asset catering to short distance local traffic generally observes high share of return or other local monthly passes while the asset catering to strategic long-distance traffic generally observes high share of single ticket traffic.

FASTag implementation

3.24 Generally, over the period the shares of single/return/monthly tickets tend to stabilise within 2-3 years from start of an asset operation. This is related to the stability of trip patterns are not expected to change significantly in absence of any major external events. During the last two years, two key events impacted the traffic patterns throughout the country: Covid19 and FASTag implementation.

3.25 With the FASTag implementation in December 2019, it was ensured that only FASTag users benefited from discounted tickets such as return/monthly and cash users were only allowed to buy single tickets, thus leading to a drastic increase in single ticket users between January 2020 till Feb- 2021. The removal of discounts for cash users and significant push by NHAI and toll plaza operators to promote use of FASTag has resulted in significant increase in %age transactions via FASTag. This in turn has resulted in ticket type use patterns have begun to return to their previous segmentation levels as observed prior to the FASTag implementation.

3.26 The following are the types of tickets are assumed to be sold at the plazas of both the Asset as per the concession agreement.

Table 3.6: Typical ticket types sold at NHAI plazas

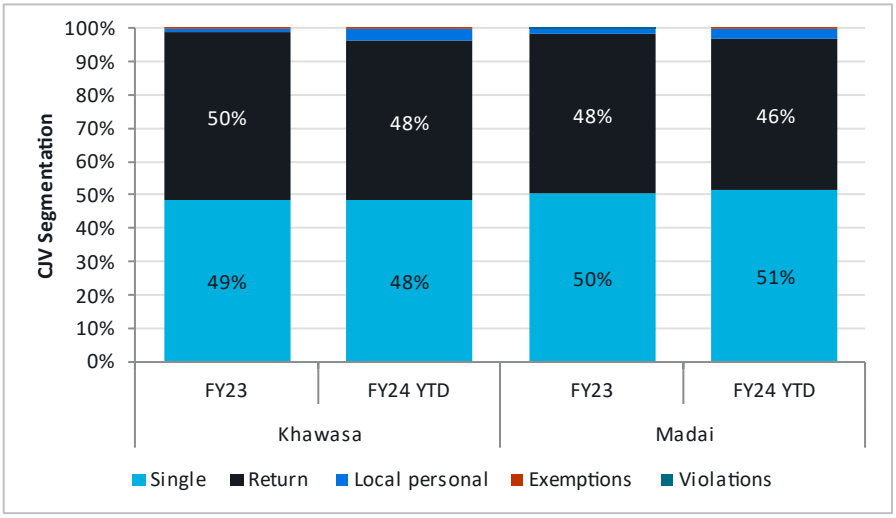
Category	Description
Single	Allows the vehicle to cross the toll plaza once
Return	Daily pass for crossing the toll plaza multiple times within 24 hours. Charged 1.5 times the single toll
Monthly	Monthly pass

Category	Description
Local Personal	Discounted monthly pass only for private cars of residents within 20km radius of toll plaza
Local Commercial	50% discount on single trips for commercial vehicles registered in the local district
Exemptions	Officially exempted vehicles like ambulance, police cars, key political personnel etc.

Historical ticket segmentation

3.27 This section presents the toll segmentation used for Asset. As discussed in the earlier sections toll plaza data provided by the Client incudes traffic level at a ticket level for each of the transactions undertaken. The segmentation as per toll plaza data is presented below for the Asset:

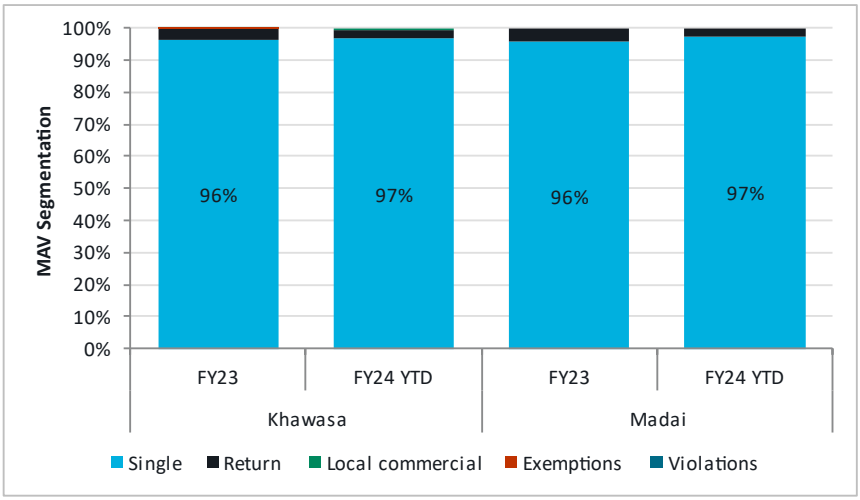
Figure 3.6: LK: Ticket segmentation (%) – CJV



Source: Steer analysis

3.28 CJVs observe approximately equal split between single and return tickets on both Khawasa and Madai as the plazas cater to inter-urban movement influenced by the presence of major consumption centres, Nagpur and Jabalpur on either ends of the asset.

Figure 3.7: LK: Ticket segmentation (%) – MAV



Source: Steer analysis

3.29 Over ~95% of the commercial vehicles (2A/3A/MAVs) plying on the Asset are observed to buy single tickets suggesting through-movement on the Asset. The observation is in line with the fact that the Asset is key connector for Delhi/NCR and Maharashtra/neighboring zones and hence caters to long-distance traffic. The Asset observed negligible level of exemptions and violations for trucks.

Conclusions – historical traffic and revenue analysis

3.30 The chapter outlined the current and historical traffic and revenue datasets available on the Asset, as well as our analysis of primary traffic count data, collected as a part of this project. Historical data records were obtained from several sources (ETC, DPR, etc.) and a review of all the sources was done to estimate the robust traffic and revenue numbers.

3.31 Multiple data sources including traffic data provided by the Client have been analysed and presented in detail in this chapter.

3.32 The analysis of these data sets confirms that the Asset carries high volumes of goods traffic which connect large urban centres and industrial clusters located in various parts of the country and facilitates long-distance strategic north-south movement.

3.33 Both traffic and revenue information are available for the toll plaza for a relatively short period. For the traffic data was available as reported in toll plaza ETC datasets. Schedule V was relied for cash transactions on Madai where same proportions are assumed are Khawasa plaza as well.

3.34 The Asset trends is trending at 23,000 PCU levels in FY24YTD with Madai catering to slightly higher traffic volumes than Khawasa. Commercial volumes are similar across both the plazas as they cater to long-distance through movement. The traffic is dominated by 2A/3A/MAVs. On an average, the daily revenue collection on the Asset is ~INR 57 lakhs.

3.35 Further, the Asset has observed strong traffic performance, recording a PCU CAGR of ~6.2% on the Asset as a whole.

Survey data analysis

3.36 As mentioned earlier, to validate and inform various inputs used in our forecasting, we undertook primary data collection on the Asset, comprising the surveys listed below. OD survey data was collected on behalf of the Client, TVC surveys were commissioned by Steer with a third party. OD data collection typically involves manual data entry by enumerators based on oral surveys with road users crossing toll plazas, which Steer also commissioned with a third party. TVC data collection involves video-graphic capture of traffic passing crossing the toll plazas, followed by manual counting.

3.37 It should be noted that, in our experience, traffic on national highways shows variation across the week due to the economic activities surrounding each road. To derive a representative TVC count considering daily variation, three-day to seven-day traffic counts are generally recommended, and hence, in order to fully understand the impact of this weekly fluctuation on the Asset, we collected seven-day counts at each toll plaza.

3.38 Steer commissioned the following primary data collection at the Asset:

- 7-day 24-hour Traffic Volume Count (TVC)
- 24-hour Origin-Destination (OD) survey

Key findings of the TVC data analysis

WADT estimates

3.39 As mentioned earlier, camera based Total Vehicle Counts (TVC) forms a key part of our primary data collection exercise. Using the TVC data and taking a simple average of the seven-day TVC counts, we obtained the Weekly Average Daily Traffic (WADT) for each toll plaza. The WADT excludes non-tollable vehicle such as tractors, two-wheelers, bullock-carts, etc., but includes officially exempt vehicles such as police cars, ambulances, emergency response vehicle, government vehicle and other vehicle types officially allowed as 'exempted' under the concession agreement.

3.40 During the site visits, our team makes sure that the cameras are located at a location where complete tollable traffic is captured. Additionally, emphasis is laid on positioning camera at such a location that the traffic from local leakages or bypass is also captured, if any.

3.41 In order to check the reliance of the TVC data, several checks are applied before using it in our analysis. Directional counts are verified by matching the sum of both the directions with the total counts. Our TVC data is directly used for validating our base year AADT and benchmarked with respect to traffic volumes on the sections in close vicinity of the Asset (discussed in Chapter 6).

3.42 The table below present the 7-day average (WADT) of independent counts undertaken by Steer.

Table 3.7: WADT at Asset arrived using TVC

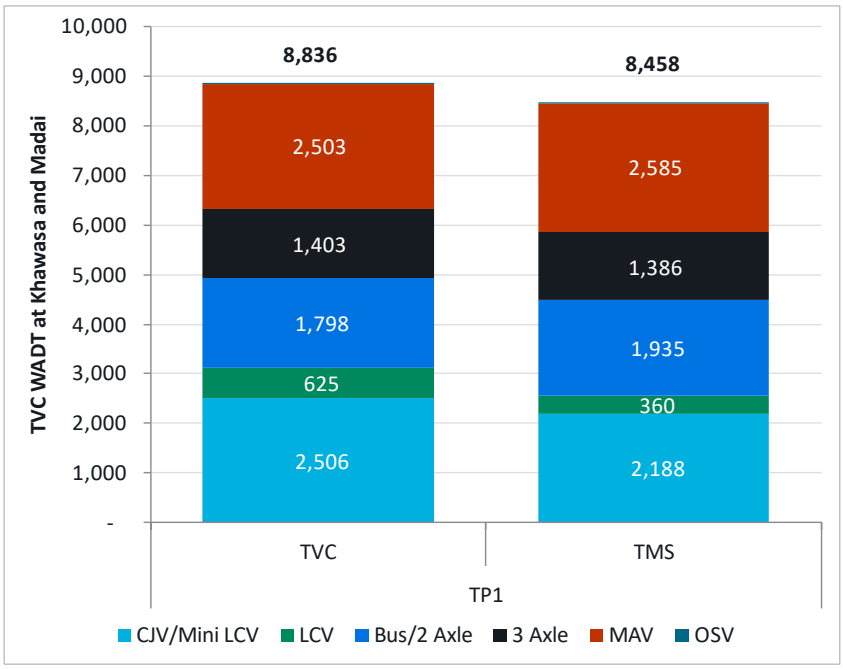
Vehicle Category	Khawasa	Madai
CJV	2,506	3,052
LCV	625	825
Bus + 2 Axle	1,798	1,948
3 Axle	1,403	1,443

Vehicle Category	Khawasa	Madai
MAV	2,503	2,693
OSV	2	1
Total	**8,836**	**9,963**
PCU	**24,316**	**26,590**

Source: Steer analysis of TVC data

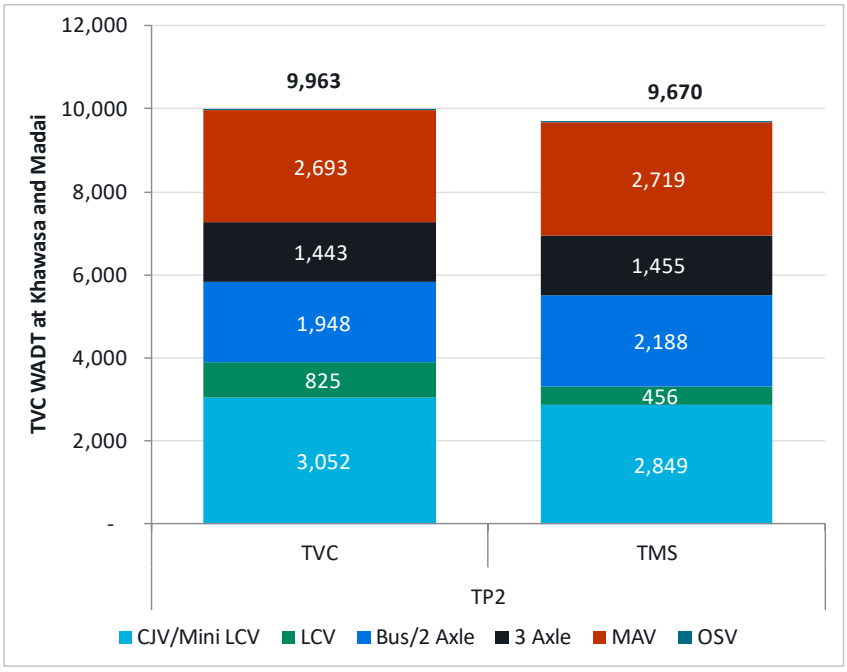
3.43 The figure below compares the vehicle wise shares as recorded by TVC.

Figure 3.8: Khawasa: Vehicle TVC comparison



Source: Steer analysis of TVC counts, and TMS data

Figure 3.9: Madai: Vehicle TVC comparison

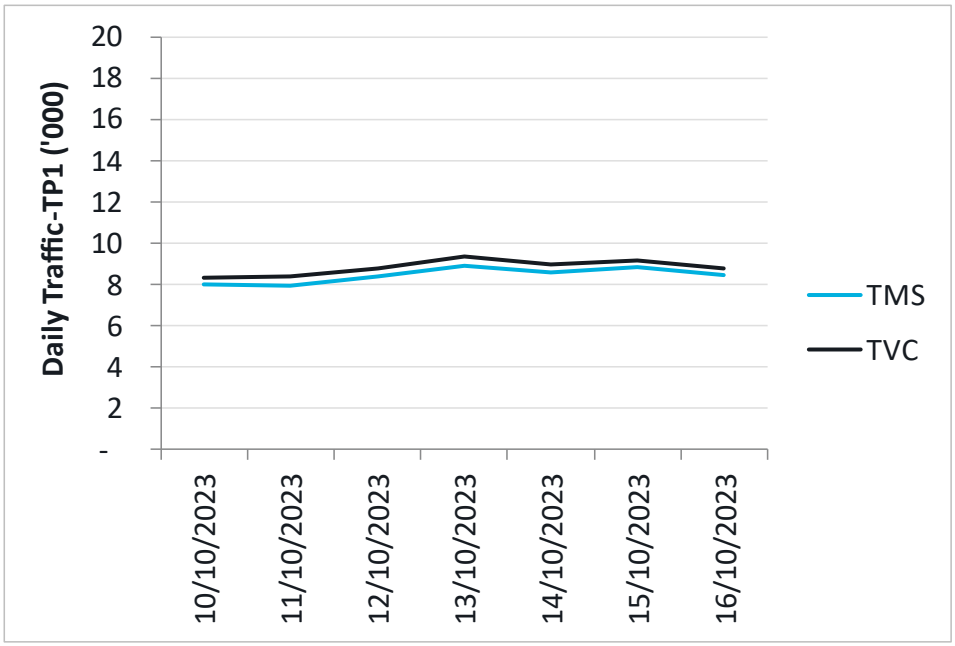


Source: Steer analysis of TVC counts, and TMS data

3.44 The TVC counts conducted in the month of Oct-23 were observed to be 8,836 WADT at Khawasa, and 9,963 WADT at Kelapur. Moreover, the Asset was dominated by the traffic shares of CJVs followed by MAVs.

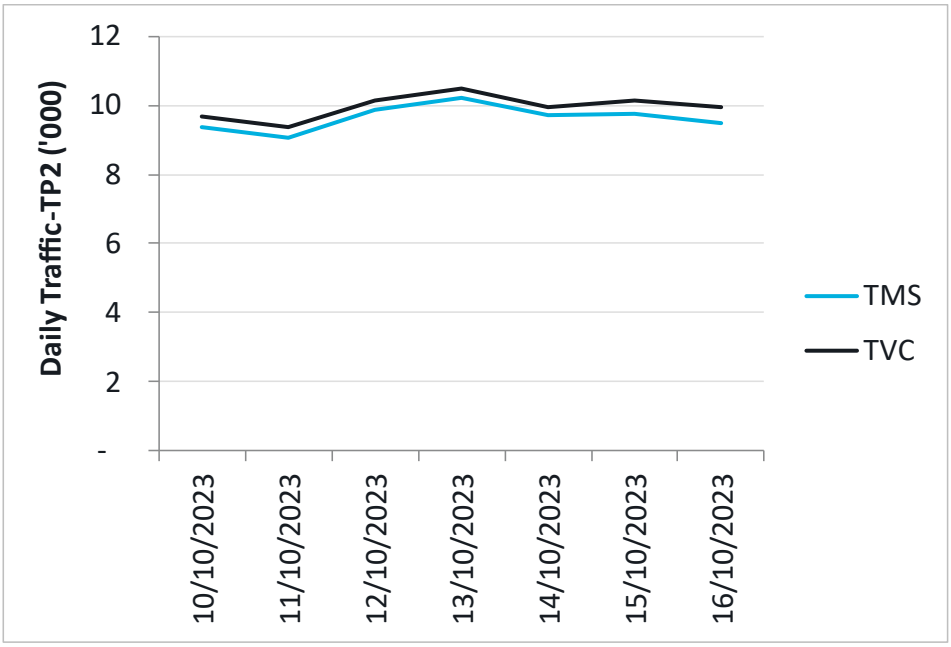
3.45 The following figure shows the daily traffic observed in our TVC-TMS counts for the toll plaza.

Figure 3.10: Khawasa – Daily Traffic Counts



Source: Steer analysis of TVC counts, and TMS data

Figure 3.11: Madai – Daily Traffic Counts



Source: Steer analysis of TVC counts, and TMS (ETC only) data, cash data not available

3.46 On an overall level, Steer independent TVC has reported higher traffic volumes than the TMS data. The difference is primarily observed in CJV's 2As and LCVs. The trend is similar across all days, the difference in the two sources may be due to some vehicles which pay in cash or are not paying at the toll plaza.

3.47 TVC counts report lower 2As, but higher LCVs as compared to TMS counts. This could be due to the error in categorization of LCVs and 2As post FASTag implementation. On the whole, TVC reports higher LCV+Bus+2A traffic which can be attributed to the fact that a share of this traffic crosses the plaza without paying and hence isn't getting recorded. The same is the reason for additional CJVs being counted in TVC counts. 3A+MAV traffic levels are similar in both the counts.

Outputs from TVC analysis

3.48 We have further analysed the TVC and TMS data at vehicular category level to ascertain the following outputs:

- **Base Correction:** As observed in the TVC-TMS analysis, the volume of traffic in CJV, LCV, and 2A categories saw a difference in the counts. While estimating the base, these differences were accounted for in the form of 'base correction factors'. The base correction factor is the % delta between TVC and toll plaza data counts ETC+Cash for each vehicle category. The delta is added on the base traffic of FY24 to account for the unreported traffic is crossing the plaza without paying. The percentage of delta for 3A/MAVs is not being incorporated as the negligible delta can be attributed to the reconciliation of traffic numbers with the data received from the bank**.** This adjustment was necessary to understand the capacity at which the Asset is operating.

Table 3.8: Base Correction Factors

Vehicle Category	Khawasa	Madai
CJV	14.5%	7.1%

Vehicle Category	Khawasa	Madai
LCV	6.2%	5.4%
2A	6.2%	5.4%

Source: Steer analysis of TVC/TMS data

- **Exemption adjustment:** The additional traffic being added to the base of our forecasts, as mentioned in the previous paragraph, is being treated as 'non-paying' traffic as the traffic isn't getting reported in the ETC+Cash counts as provided by the Client. Hence, in the ticket segmentation, the additional traffic in the corrected base traffic is assumed to be unreported 'exemptions'.
- **Traffic splits:** TVC WADT of each plaza was considered to derive the traffic splits for CJV, Mini LCV and Bus,2A as the split is not present in the data we have received. It is summarized for both the toll plazas in the table below:

Table 3.9: Traffic splits from TVC analysis-CJV, Mini LCV

Vehicle Category	Khawasa	Madai
CJV	91.2%	78.3%
Mini LCV	8.8%	21.7%

Source: Steer analysis of TVC/TMS data

Table 3.10: Traffic splits from TVC analysis-Bus, 2A

Vehicle Category	Khawasa	Madai
Bus	13.8%	13.5%
2A	86.2%	86.5%

Source: Steer analysis of TVC/TMS data

3.61 The above traffic splits are applied back to TMS data prior to using it for arriving at base year estimates.

Key findings of origin-destination analysis

Overview

3.62 OD surveys were conducted using on the toll plaza locations across the Asset, interviews for 24 hours at the toll location, typically starting at 8 AM and finishing at same time on the following day. The interviews began on 11th Oct'23 on the Khawasa toll plaza and on 12th Oct'23 on the Madai Toll Plaza. Each toll lane had an interviewer filling OD records with supervisor monitoring them to minimise errors in data collected. This was accompanied by Steer staff visiting the toll plaza to ensure the data is being collected to quality and standards required to understand the traffic patterns on the Asset.

3.63 Data collected was segregated into vehicle types, origin area, origin zone, destination area, destination zones, commodity being carried, total load, and frequency of travel. The zones were further segmented into Internal, Rest of State, and External zones. The zones were also used to calculate the trip distances of the traffic plying on the Asset.

3.64 Before using the data for final analysis, the data is first cleaned, and numerous checks are applied. Some of these checks include verifying that the zones are physically apart as well as

these zones are located within a reasonable distance and boundary. Reliability checks are also used which confirms that the sample rates are 30-50% for passenger and 50-70% for goods. Sanity checks includes verifying the sanctity of direction wise origin and destination as well as establishing that the share of empty vehicles is in line with the site visit observations (not more than 50% in any case). The final check includes matching the OD numbers with the TVC counts of the particular day and substantiating that the OD numbers aren't greater than the TVC counts.

3.65 Origin-destination (OD) analysis enables the understanding of the nature of traffic movement on the Asset. We have analysed the regional drivers of demand based on the following analysis:

- Zonal influence
- Commodity distribution
- Top OD pairs
- Trip length distribution

3.66 While zonal analysis and the list of top OD pairs help to understand 'where' people and goods travel, commodity distribution sheds light on 'what' goods get transported on this asset. Trip length distribution shows 'how far' vehicles and people travel, and goods get transported. This set of analysis is used to estimate key drivers of traffic and aid in making informed forecasting assumptions related to traffic demand elasticities, growth drivers and exogenous impacts.

Sample rates

3.67 Sample rates help understand the reliability of OD data. They are calculated by dividing OD samples by the TVC count observed on the same date for each vehicle category at the toll plaza. The table below presents the sample rates for key vehicle type aggregations at the toll plaza. We believe that the sample rates of the OD data are reasonable for the analysis required.

Table 3.11: Sample rates for OD data

Vehicle type	Khawasa	Madai
Bus + 2 Axle	61%	78%
3 Axle + MAV	66%	59%

Source: Steer analysis of OD data

3.68 Sample rates achieved on commercials are above 50% which gives us confidence on the results of surveys.

Zone categories

3.69 To facilitate better interpretation of key regional drivers of traffic as determined by their OD zones, and influenced by various towns, cities, states, and regions in the vicinity of the Asset, we have aggregated zonal data as described in the table below.

Table 3.12: Zone aggregations for zonal influence analysis, BK

Aggregate Zone	Description
Local	Local zones are those that fall on or very close to the Asset.
IAOI	IAOI zones are the locations which generate traffic and lie within approximately 75-150 km distance from the Asset.

Aggregate Zone	Description
Rest of Madhya Pradesh	Rest of the cities/Districts in the state that Asset lies in (other than Local/IAOI)
Rest of Maharashtra	Rest of the cities/Districts in the state that Asset lies in (other than Local/IAOI)
Telangana	Telangana state
West India	Gujarat, Rajasthan
North India	Himachal Pradesh, Jammu and Kashmir, Punjab, Uttarakhand, Uttar Pradesh
South India	Andhra Pradesh, Kerala, Tamil Nadu, Karnataka
East India	Bihar, West Bengal, Arunachala Pradesh, Assam, Bihar, Jharkhand, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Tripura, Sikkim, Chhattisgarh
Outside India	Nepal, Bangladesh, Bhutan

Source: Steer analysis

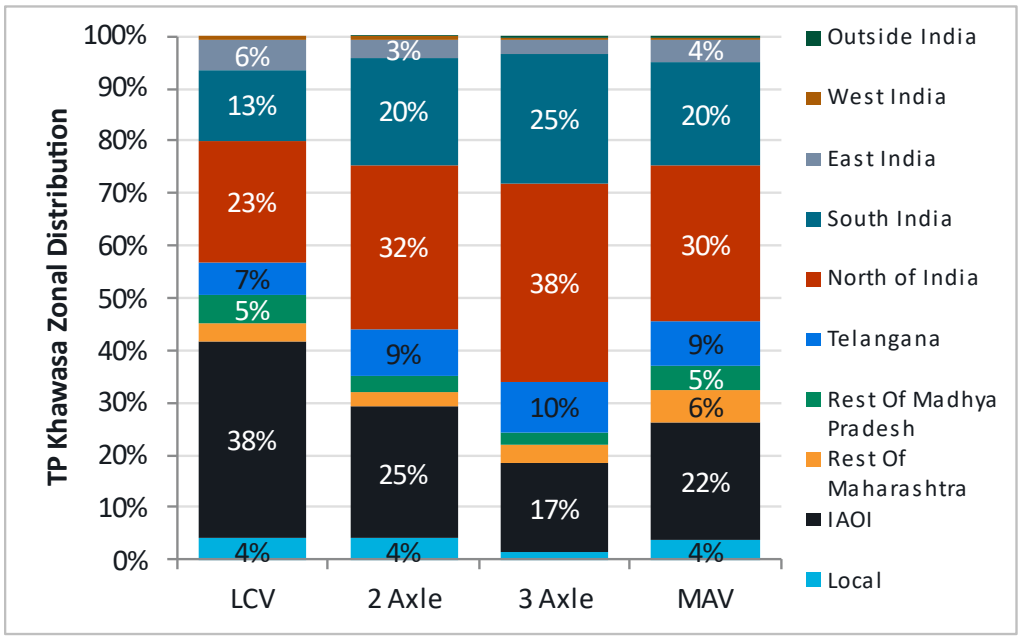
Zonal influence

3.70 As the Asset is located on Maharashtra-Madhya Pradesh border, the states influence 30%-40% of the truck trips on the Asset. Considerable share of influence is observed of Karnataka, Tamil Nadu, Delhi NCT, and northern Indian states since these zones are connected by the project highway NH44. The long-distance nature of trucks is validated by the zonal influence analysis as the trips are majorly influenced by southern and northern states of the country suggesting through movement on the Asset.

3.71 Car and bus trips are generally focused on catering to the local demands of the users and hence, the influence is dominated by local and rest of state movements. The local movement is typically observed between Jabalpur, Chhindwara, Nagpur.

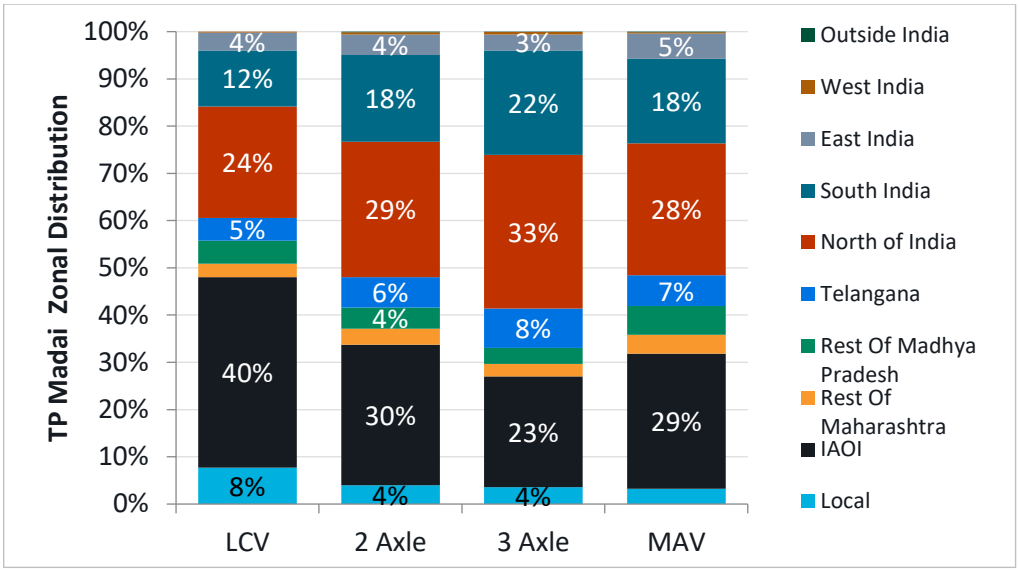
3.72 As both the plazas cater to the same movement of traffic, the zonal influence is also similar.

Figure 3.12: Khawasa: Zonal Distribution



Source: Steer analysis of OD data

Figure 3.13: Madai: Zonal Distribution

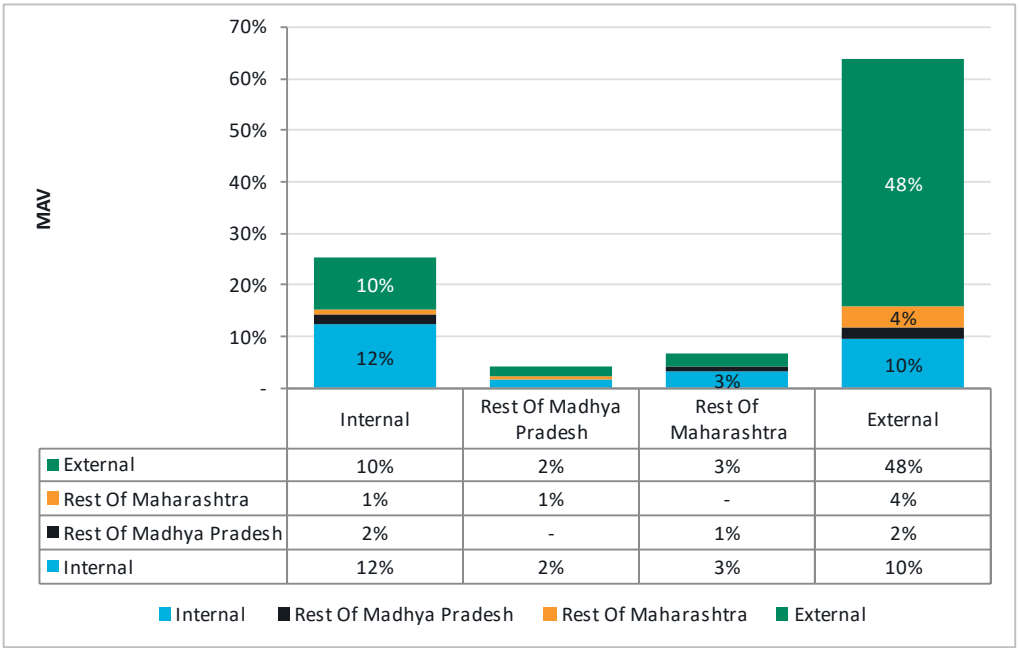


Source: Steer analysis of OD data

Internal External analysis

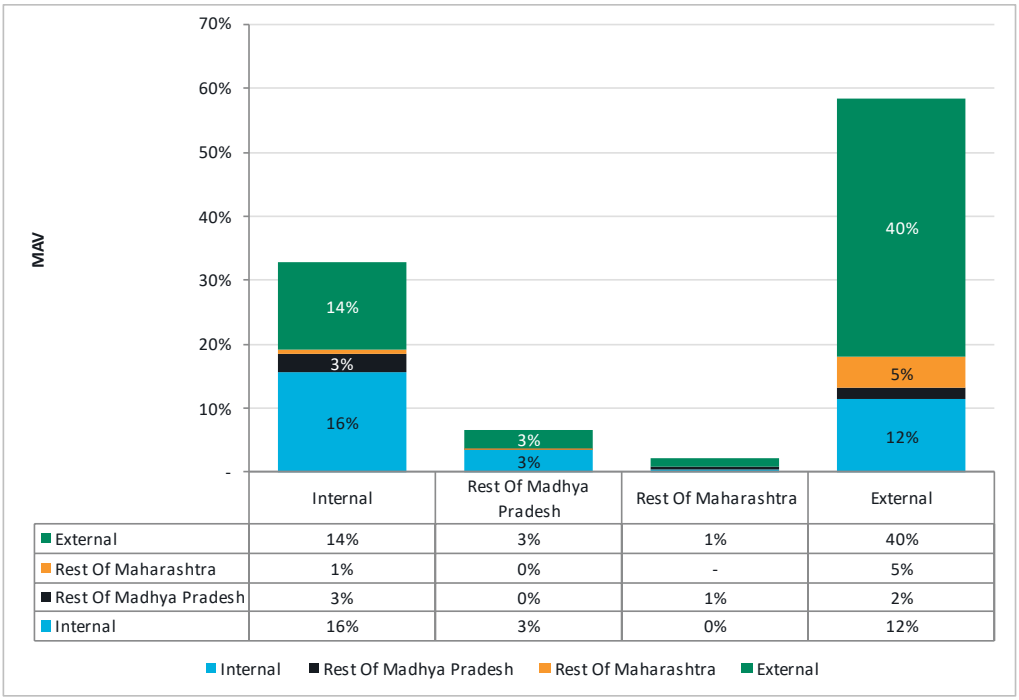
3.73 Internal-External analysis helps in identifying the trips which have both an origin and destination on or near the Asset i.e., local/IAOI zones (Internal-Internal or I-I), any one end on the Asset (Internal-External or I-E), or neither end on the Asset i.e., through trips (External-External or E-E). Internal' zones are those that were analysed as 'local' and 'IAOI' in the zonal influence analysis, i.e., lying on the Asset, while 'External' zones are areas lying outside the state.

Figure 3.14: Khawasa: Internal-External analysis



Source: Steer analysis of OD data

Figure 3.15: Madai: Internal-External Analysis



Source: Steer analysis of OD data

3.74 Given strategic nature of the Asset, facilitating North-South movement across NH44, the zonal influence shows movements between Northern and Central India and southern states of the country like Haryana, Punjab, Delhi NCR, Telangana, Maharashtra, Karnataka, and Tamil Nadu

3.75 The internal-external distribution further validates the strategic nature of the Asset, with 55-65% influence in MAVs pertaining to zones that are external. This is further to the zonal distribution that showed that Local and Rest of the State had relatively less influence on 2A/3A/MAVs on the Asset, while aggregate of the remaining zones categorized as External exert the significant proportion of influence on the traffic. This validates that the long-distance nature of the Asset, facilitating long distance through movement—that is trips that originate and end outside of Madhya Pradesh and Maharashtra, traversing via the Asset.

Commodity distribution

3.76 We have grouped various commodities into aggregate categories for ease of interpretation, as shown in the table below. The charts in the following sub-section present information in terms of aggregate commodity categories.

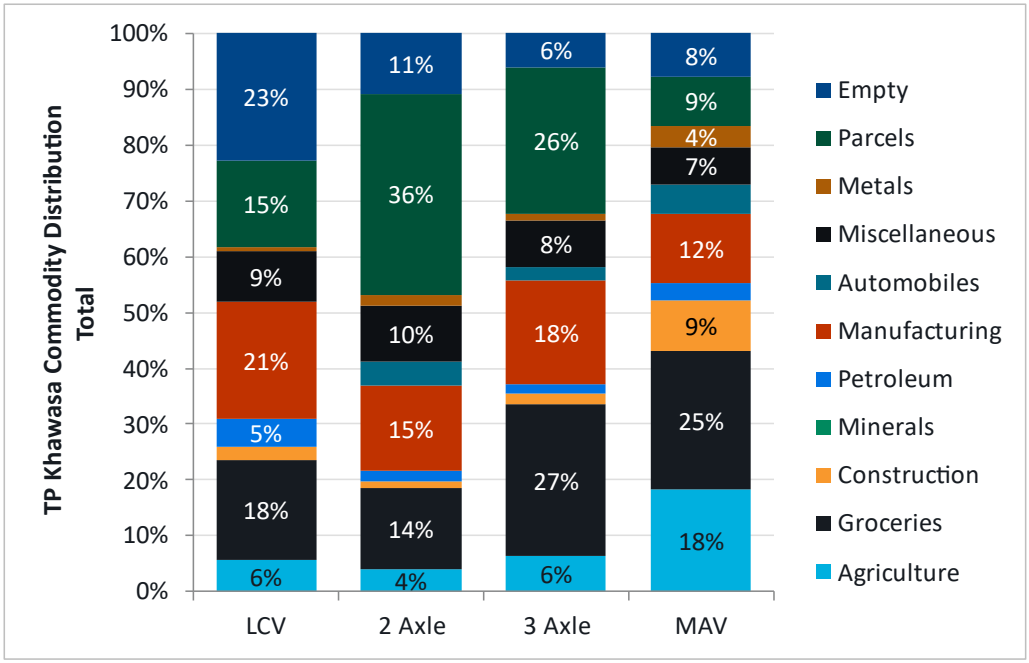
Table 3.13: Aggregate commodity categories

Commodity Description	Code	Combined codes used for charts
Agricultural Products / Cash crops (Wheat, Rice, Sugar cane, Maize etc.)	AGR	AGR
Perishable Items (Fruits, vegetables, milk, meat, fish etc.)	PER	
Cattle Food / Livestock (sheep, goat, cow, cattle food etc)	LIV	
Building Material / Construction (Cement, Lime, Brick etc)	CNS	CNS
Container	CTR	CTR

Commodity Description	Code	Combined codes used for charts
Empty	EMT	EMT
Groceries / Food items (Soap, Salt, Sugar, Pulses, Spices, Biscuits, bread, cool drinks, beer etc.)	GRO	GRO
Machinery / Spare parts	MAC	MAC
Steel / Metal (Iron, steel etc)	STL	MAN
Chemicals / Fertilizers (Acids, Fertilizers etc.)	CHM	
Manufacturing (Electronic items, Medicine, Leather, Wine, Rubber/ Tyre, Plastics, Cloth, Paper etc.)	MAN	
Automobiles (Finished products)	AUT	
Basic / Fabricated Metals (steel, iron)	MET	
Raw Wood, Cork & Wood Products, Fern	WUD	
Mining Minerals (Coal, Gypsum, Cobalt etc.)	MIN	MIN
Miscellaneous (Parcel, Courier, Household items etc.)	MSC	MSC
Passengers	PAS	
Petroleum Products (Oil, LPG, CNG, etc.)	PET	PET
Sand	SND	SND
Stone (Kota stone, marble, Granite, Aggregate stone etc.)	STN	STN
Cement	CMT	CMT

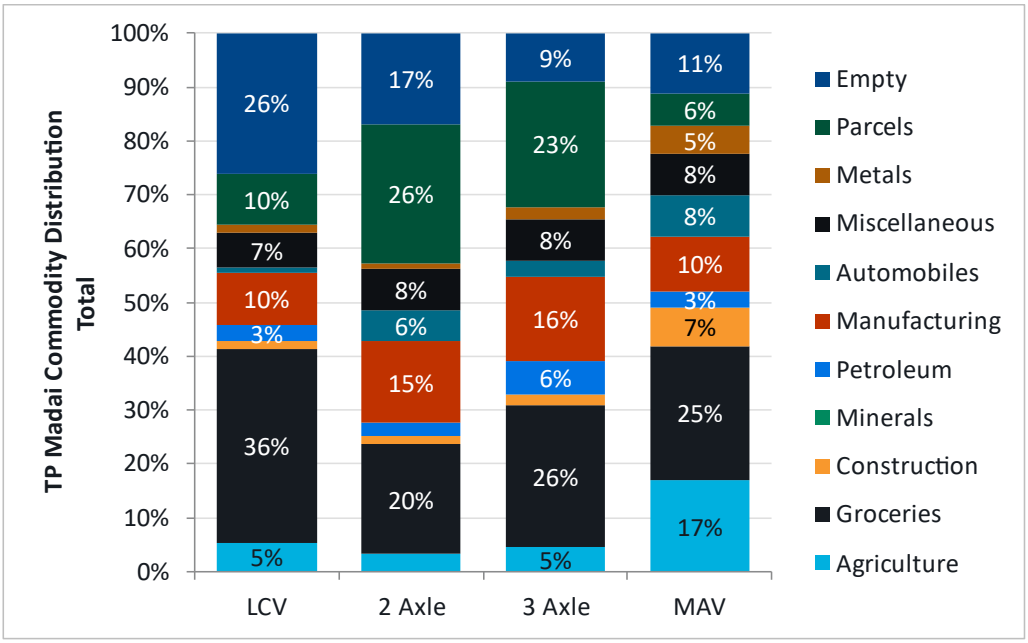
Source: Steer Analysis

Figure 3.16: Khawasa: Commodity Distribution



Source: Steer OD analysis

Figure 3.17: Madai: Commodity Distribution



Source: Steer OD analysis

3.77 The commodities carried on the Asset are majorly groceries, miscellaneous goods, manufacturing. Miscellaneous goods (generally parcels and couriers) and groceries are being carried from warehouses in Delhi NCR, Agra, Nagpur to the zones connected by NH44. As mentioned earlier, presence of industrial hubs near the Asset as well as along NH44 introduces manufacturing and metal related commodities on the Asset. For both the plazas, Parcels are a major contributor to the commodity distribution on the Asset, especially in Jabalpur to Nagpur direction moving from Delhi NCR, Punjab, Haryana towards Nagpur, Bangalore, Chennai, Hyderabad.

3.78 The traffic on both plazas have a high share of agriculture and groceries movement. This includes movement of food crops like onions, potatoes, tomatoes and apples. Vegetables are being carried from North India from cities like Delhi NCR, Agra and moving towards southern part of India. Potatoes are being carried from Agra towards Bangalore, Chennai and coconuts on the Asset are carried from Bangalore towards Northern India. Also, since there are two major consumption centres of Nagpur and Jabalpur on either ends of the asset there is local movement of groceries as well. Direction wise commodity splits are given below:

Table 3.14: Directional commodity distribution – Khawasa

Nagpur to Jabalpur					Jabalpur to Nagpur			
LCV	**2 Axle**	**3 Axle**	**MAV**	**Commodity**	**LCV**	**2 Axle**	**3 Axle**	**MAV**
5%	5%	6%	14%	Agriculture	6%	3%	7%	21%
39%	20%	32%	23%	Groceries	8%	10%	22%	26%
5%	2%	3%	8%	Construction	1%	1%	1%	10%
5%	3%	2%	4%	Petroleum	5%	1%	1%	2%
21%	19%	18%	13%	Manufacturing	21%	12%	19%	12%
-	6%	4%	7%	Automobiles	-	3%	1%	4%
5%	10%	8%	8%	Miscellaneous	11%	10%	9%	6%
3%	2%	2%	5%	Metals	-	2%	1%	3%
11%	26%	20%	10%	Parcels	18%	44%	34%	8%
5%	8%	6%	8%	Empty	31%	13%	6%	8%

Source: Steer Analysis of OD Data

Table 3.15: Directional commodity distribution – Madai

Nagpur to Jabalpur					Jabalpur to Nagpur			
LCV	2 Axle	3 Axle	MAV	Commodity	LCV	2 Axle	3 Axle	MAV
3%	4%	4%	16%	Agriculture	8%	2%	6%	19%
54%	29%	24%	27%	Groceries	19%	10%	30%	22%
2%	1%	2%	6%	Construction	1%	2%	3%	9%
4%	2%	6%	3%	Petroleum	2%	3%	6%	3%
6%	15%	18%	11%	Manufacturing	13%	16%	12%	9%
1%	6%	4%	9%	Automobiles	1%	5%	2%	6%
4%	8%	11%	10%	Miscellaneous	10%	7%	4%	4%
2%	1%	2%	7%	Metals	1%	2%	3%	3%
9%	25%	24%	7%	Parcels	11%	26%	22%	5%
17%	9%	6%	5%	Empty	35%	28%	13%	20%

Source: Steer Analysis of OD Data

3.79 The direction wise distribution of commodities for each vehicle types helps to gauge a better understanding of the distribution as per the direction of goods movement. The profile of commodities being carried in both the directions is overall is somewhat similar.

Trip length analysis

3.80 Trip-length distribution provides the distance-based profile of various vehicle categories. This aids in validating assumptions around the share of macro-economic drivers, inputs from zonal influence and toll segmentation. For ease of interpretation, we have categorised distances into 4 groups – local and short distance (0-250km), medium-distance (250-500 km), long-distance (500-1000 km) and very-long-distance (+1,000 km). The trip distances were derived as driving distances from Google Distance Matrix Tool based on zonal coordinates for OD pairs.[4]

3.81 The following table states the average trip lengths of traffic plying on the Asset across the toll plazas.

Table 3.16: Average trip lengths (Kms)

	CJV	LCV	2 Axle	3 Axle	MAV
Khawasa	410	1,138	1,386	1,605	1,374
Madai	725	990	1,294	1,440	1,291

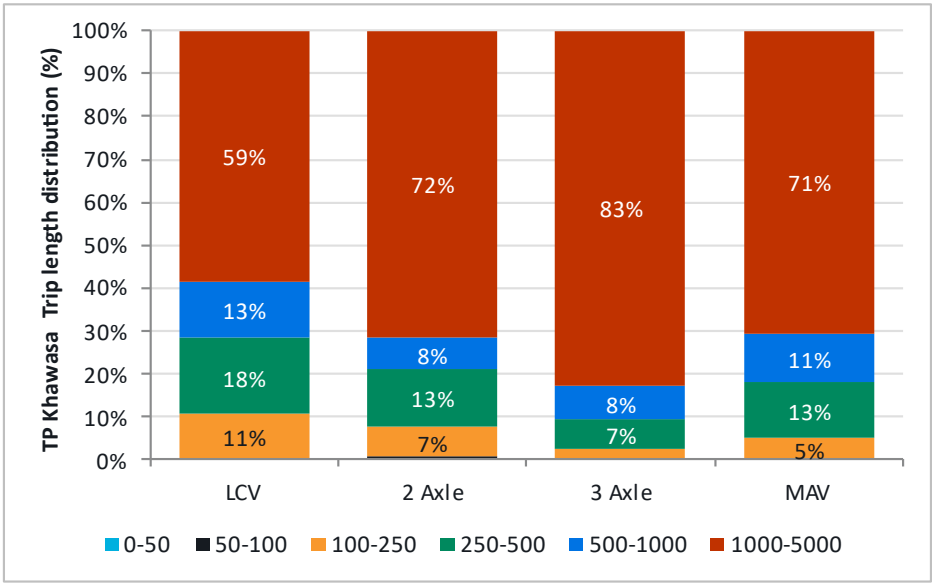
Source: Steer analysis of OD data

3.82 As discussed in the above sections, the Asset caters to the demands of long-distance strategic movements of mainly north – south movements. The same is validated by the average trip lengths observed in the table above where 2A/3A/MAV trucks are travelling nearly 1,500 kms per trip.

3.83 The trip length proportions for each vehicle type for each of the toll plaza is shown below.

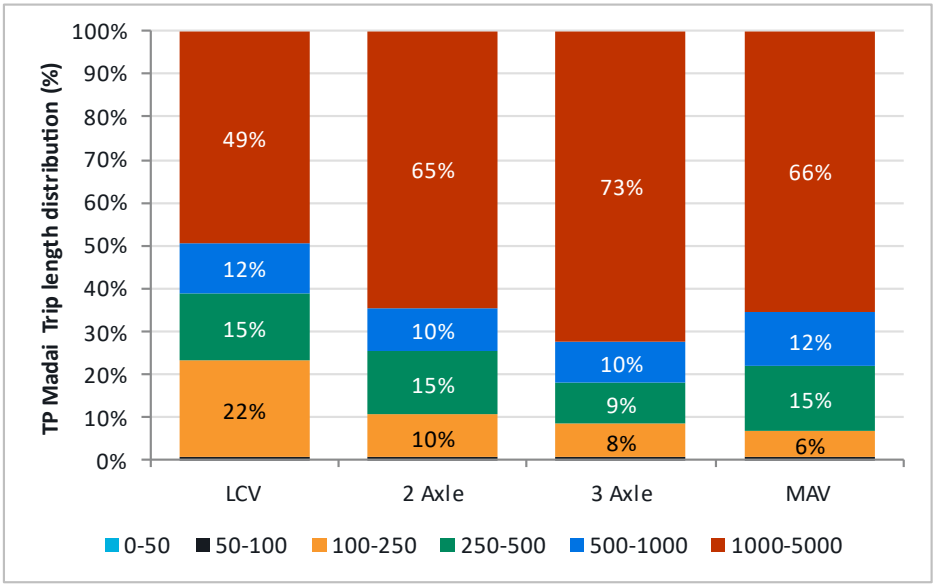
[4] Google Distance API is a tool that is available on a chargeable basis from Google Maps Platform. Link: https://developers.google.com/maps/documentation/distance-matrix/start. Travel distance and time information for driving/transit under various congestion scenarios can be extracted through this tool by using macro-enabled Excel, R, etc.

Figure 3.18: Khawasa: Trip length distribution



Source: Steer analysis of OD data

Figure 3.19: Madai: Trip length distribution



Source: Steer analysis of OD data

3.84 Due to the strategic nature of this Asset, over 70-75% of the trip distances of 2 Axle, 3 Axle and MAV are traveling distances greater than 1,000 km. LCVs, also serving more local areas have a healthy mix of both short and long-distance trips.

3.85 The Asset acts as a facilitator between northern and southern India, connecting Haryana, Punjab, and Delhi NCR to states such as Telangana, Maharashtra, Karnataka and Tamil Nadu.

3.86 The trip lengths are higher for 2A, 3A and MAVs, as they traverse relatively longer distance carrying agricultural materials, couriers & parcels and manufacturing goods to southern parts of the country.

3.87 As seen in the commodity distribution, these long-distance movements form a part of the through traffic on the asset which meets demand requirements of manufacturing, agriculture, and miscellaneous goods.

Conclusions – primary surveys

3.88 The chapter outlined the current and historical traffic and revenue datasets available on the Asset, as well as our analysis of primary traffic count data, collected as a part of this project. Historical data records were obtained from several sources and a review of all the sources was done to estimate the robust traffic and revenue numbers.

3.89 Steer survey results Asset have been analysed and presented in detail in this chapter. Independent TVC counts and OD surveys were undertaken by Steer to understand the primary traffic movements on each of the Asset. The analysis of these data sets confirms that the Asset carries high volumes of goods traffic which connect large urban centres and industrial clusters located in various parts of the country.

3.90 The analysis of the available data sets confirms that the Asset carries high volumes of goods traffic which connect large urban centres and industrial clusters located in various parts of the country, mainly moving along the corridor of NH-44 from north to south. In addition to role as national connector, the Asset provides important regional connectivity between neighbouring states i.e., Maharashtra and Telangana.

3.91 Key takeaways from the data analysis obtained from primary and secondary sources are:

- The strategic nature of traffic on the Asset was validated by the zonal distribution of the OD analysis as for MAVs, more than 80% of influence was from the states connected via NH44. The same was confirmed by the internal-external analysis too as the Asset was dominated by the share of External trips and hence, suggesting the presence of through traffic. In line with these observations, the trip length analysis saw that 3As and MAVs cover more than 1,300 kms per trip.
- The Asset observed a considerable share of agricultural and grocery-related commodities being transported. Furthermore, miscellaneous goods (parcels and couriers) also hold a considerable share as they are transported from the warehouses in the neighbouring states, along the strategic corridor of the Asset, towards the other states of the country. Other commodities observed on the Asset were manufacturing, metals, and automobile goods.
- Steer TVC counts when compared to the ETC+Cash data on the overlapping dates observed a difference in the traffic volumes for CJVs, LCVs and 2As. This difference can be attributed to relatively lower efficiency in reporting and management since the Asset is currently under an OMT contract.
- To account for the delta, we found in the TVC-TMS analysis, the observed unreported vehicle traffic has been added as ‘Exemptions’ during the calculation of our base position. This is necessary to identify the true traffic currently moving on the toll plazas. The same has been explained in detail in later sections.

4 Socio Economic Context

Introduction

4.1 The growth of traffic on existing (brownfield) roads depends on, firstly, how quickly the background travel demand grows (background growth); and secondly, how successful the Asset is in attracting that traffic (traffic capture). Background travel demand is driven by the socio-economic conditions of the region where the Asset is located and conditions at a national level. These include:

- Changes in macro-economic factors such as population, economic growth (regional and national) and industrial production; and
- Other local factors such as strategic port growth, and growth of industries in the vicinity of the Asset.

4.2 The change in the competitive position of the Asset (and thus of the traffic capture it will achieve) derives from the level of service and associated cost on the Asset in comparison to competing roads; and whether any new competing road facilities are available.

4.3 In this chapter, we assess the socio-economic indicators relevant to traffic growth on the Asset. The relevant growth drivers where reliable information was available have been selected for establishing growth trends in the traffic forecasts.

Population growth

National Level

4.4 The total population in India has grown at a Compound Annual Growth Rate (CAGR) of 1.5% since 2000, and have been showing decreasing trends over the years, as presented in the table below. The World Bank forecasts this growth to decrease to 0.6% CAGR by the 2030-45 period.

Table 4.1: CAGR of population in India

Years	CAGR		
	Total Population (m)	Rural Population (m)	Urban Population (m)
1970 - 1985	2.3%	1.9%	3.8%
1985 - 2000	2.0%	1.7%	2.9%
2000 - 2015	1.5%	1.0%	2.6%
2015 – 2030*	1.0%	0.3%	2.3%
2030 – 2045*	0.6%	-0.3%	1.9%

Source: World Bank Data on Health Nutrition and Population Statistics, *forecast population growth

4.5 The Asset lies in the state of Madhya Pradesh on the Maharashtra & Madhya Pradesh border with both of the state's influence. Maharashtra represents 9.3% of India's population, with the

total state population of 112 million (2011 Census). While Madhya Pradesh represents 5.99% of India's population according to 2011 Census.

4.6 The growth rate of urban population in both Madhya Pradesh and Maharashtra have been consistently higher than that of the national population estimates with urban population proportion being 31% for India and 45% for Maharashtra and 28% for Madhya Pradesh.

4.7 The table below shows population evolution in Maharashtra compared to that of the country.

Table 4.2: Population Growth in India (2001 – 2011)

State	2001 Population (m)			2011 Population (m)			CAGR (2001 – 2011)		
	Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban
Maharashtra	96.9	55.8	41.1	112.4	61.6	50.8	1.5%	1.0%	2.1%
Madhya Pradesh	60.3	44.4	15.9	72.6	52.5	20.1	1.9%	1.7%	2.4%
India	1,028.7	742.6	286.1	1,210.9	833.7	377.1	1.6%	1.2%	2.8%

Source: Census 2011 Data

4.8 However, due to complexities in urbanisation trends, and the dynamic nature of local population migration (which are very difficult to forecast), we do not use population growth as a proxy for understanding future travel demand growth on the Asset. It has been included in this section to provide the overall context of the region in which the Assets are located.

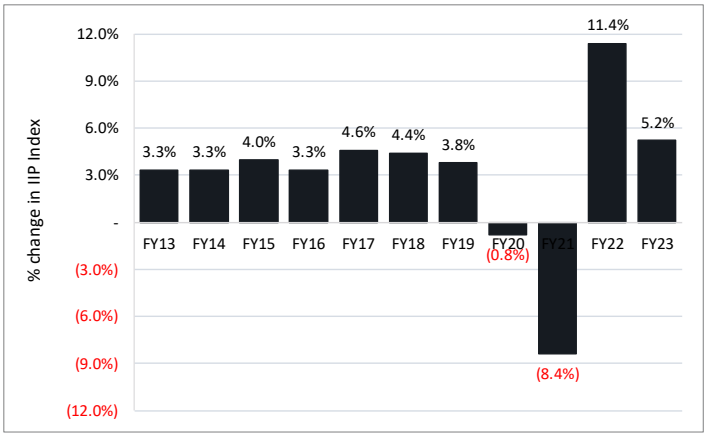
Economic Indicators

Industrial Production

4.9 The Index of Industrial Production (IIP) is a composite indicator that measures the short-term changes in the volume of production for a basket of industrial products. The IIP data tracks the manufacturing activity in different sectors of an economy, with mining, manufacturing, and electricity being the three broad sectors in which IIP constituents fall.

4.10 At an annual level, the IIP was growing on an average of 4% between FY15-19, before being hit by liquidity crisis and overall economic slowdown in FY20. Post that, the IIP shrank by over 8% in FY21, due to a decline in economic activities in the wake of global lockdowns introduced to curb coronavirus pandemic. However, with the gradual opening up of economy and rebound observed in demand, the IIP grew over 5% in FY23.

Figure 4.1: Annual growth - Index of Industrial Production



Source: Central Statistical Organisation (CSO)

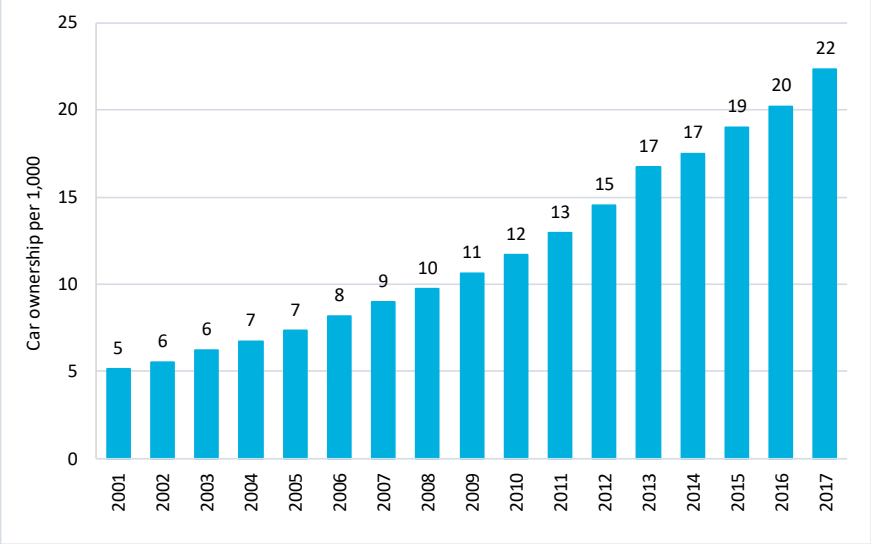
4.11 Since the IIP data in India is released only at a national level and not at the state level, we do not use IIP growth as a proxy for understanding future travel demand growth on the Asset. Also, availability of long-term forecast is the key for using an indicator as a growth driver, while long-term forecast for IIP is not available we refrain from using it to forecast traffic.

Vehicle Ownership

4.12 Car ownership in India has traditionally been very low, however this is slowly changing with the increasing per capita income levels. Between 2007-17, number of cars per 1,000 people has more than doubled and increased at a CAGR of about 11%. The corresponding ownership rates for urban cities like Delhi, Mumbai, Bengaluru, and Chennai are over 100 cars per 1,000 people. The region where the Asset lie is highly urbanised, therefore the car ownership in Mumbai and Pune are higher than the India average with 50 cars per 1,000.

4.13 However, India overall still stands at a very nascent stage in the vehicle saturation curve, offering a huge potential, as the income per capita of India and the region itself grow further, we expect the car ownership levels to increase. As per the India Energy Outlook, the car ownership is projected to grow steeply to 175 cars per 1,000 population by 2040 in India[5]

Figure 4.2: Car ownership in India per 1,000 population



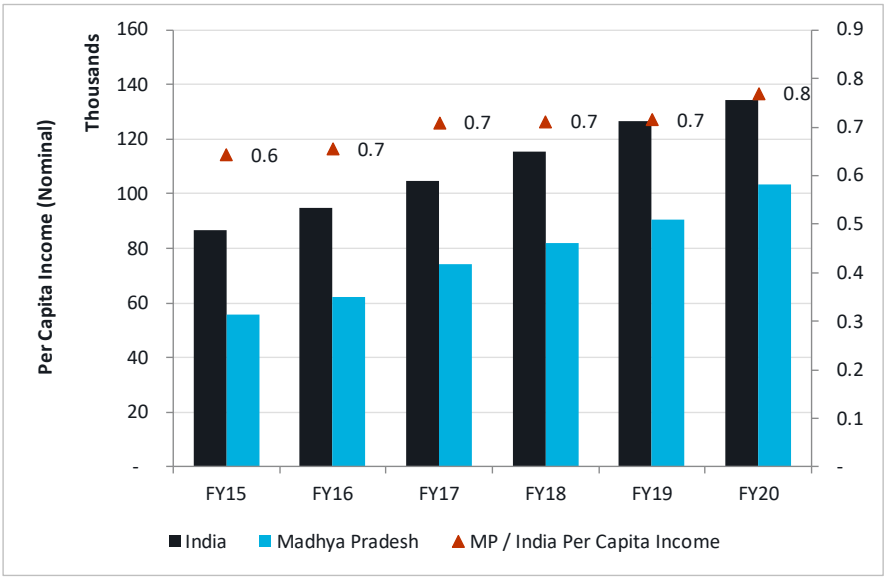
Source: Central Statistical Organisation (CSO)

Per Capita Income (PCI)

4.14 The per capita income of the state where the Assets lies i.e., Madhya Pradesh is lower as compared to the national average. This indicates that the state is at a very early stage of consumption curve. Going forward, we therefore expect local consumption to be strong which would drive the growth in both passenger and commercial traffic.

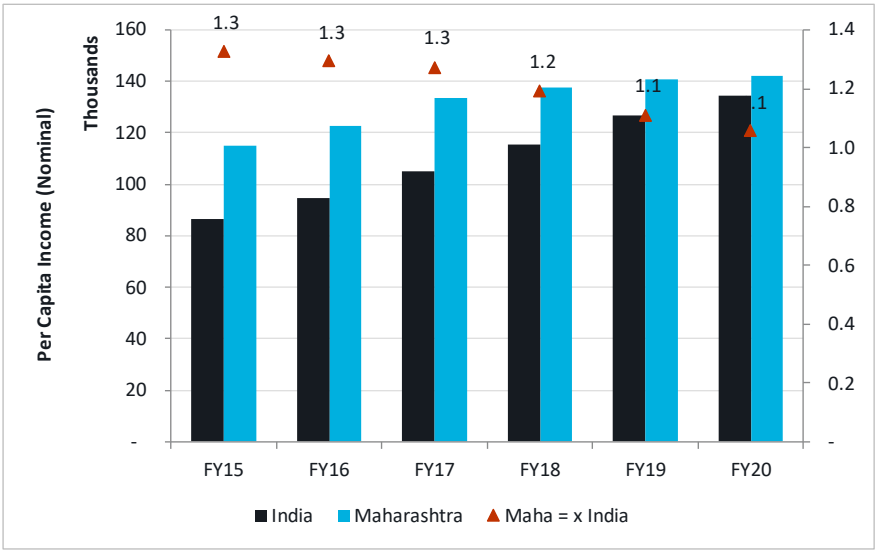
[5] https://www.gita.org.in/Attachments/Reports/IndiaEnergyOutlook_WEO2015.pdf

Figure 4.3: Per capita income – Madhya Pradesh



Source: Central Statistical Organisation (CSO)

Figure 4.4: Per capita income - Maharashtra



Source: Central Statistical Organisation (CSO)

4.15 However, given the difficulty in obtaining granular district level PCI data it is not advisable to use this as a growth driver. Also, the long-term forecast for PCI is not available we therefore refrain from using it to forecast traffic.

GDP and GSDP Growth

4.16 The Indian economy has grown at a CAGR of 6.6% during FY12-20, aided by a strong growth in the agriculture/services/tertiary sector. Madhya Pradesh's (GSDP)[6] has been faster than India's GDP. Madhya Pradesh approximately contributes 7.8% to the India's GDP. Whereas,

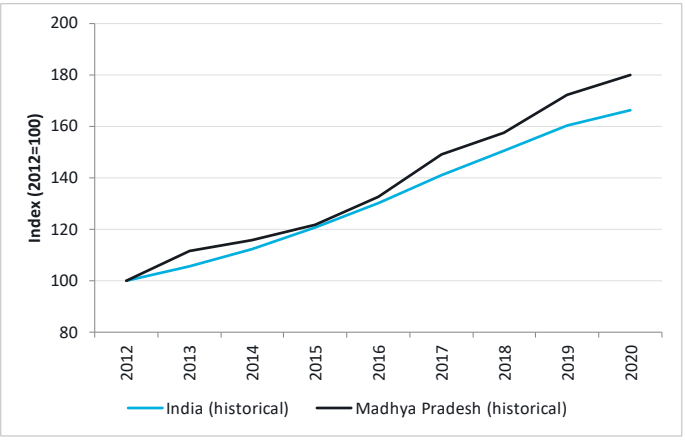
[6] GSDP is the Gross State Domestic Product i.e., the GDP equivalent for a particular state, it is the final value of goods and services produced by a particular state

Maharashtra has being 10% slower contributing 5.6% during FY12-20. In terms of per capita income, Madhya Pradesh has a lower per capita income than the country.

4.17 Madhya Pradesh is a relatively agricultural state. However, there are several industries present, notably the Bharat Petroleum refinery in Bina of Vidisha district. Also, agriculture industries related to sugarcane, spices, wheat notable in Madhya Pradesh. Madhya Pradesh, as the most forested state in the country is also home to numerous national parks, including the Pench National Park, which is along the Asset corridor.

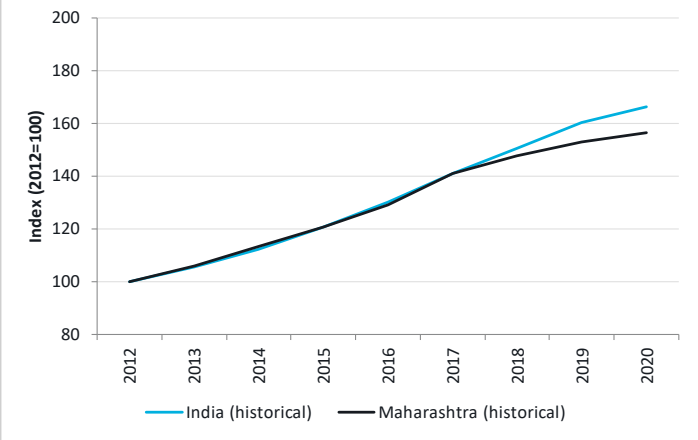
4.18 On the other hand, Maharashtra is large manufacturing and service hub with several manufacturing hubs, food processing units, and CONCOR's multi modal logistics logistic hub in Mihan proximity to the Asset.

Figure 4.5: GDP/GSDP index (2012=100)- Madhya Pradesh



Source: Central Statistical Organisation (CSO)

Figure 4.6: GDP/GSDP index (2012=100)- Maharashtra



Source: Central Statistical Organisation (CSO)

4.19 The official historical GDP and GSDP data for India are released by the Central Statistical Organisation (CSO). The GDP forecasts for India are available from various reliable sources such as Oxford and Consensus, but the state level GSDP forecasts are not published. However, using the long-term historical trends between GDP and GSDP, we have developed factors which are used to forecast GSDPs for each state.

4.20 Therefore, in our view, GDP is the best source to be used as a growth driver for long term forecasts of traffic.

Summary

4.21 For any indicator to be used as a growth driver to forecast traffic, a reliable source of historical and forecast available for that indicator is the key requirement. Of the key socioeconomic indicators discussed above GDP seems to be the only growth driver for which reliable data is available both in terms of historical and forecast data, therefore, to forecast traffic we would be using GDP/GSDP as our key growth drivers.

Indicator	Remarks
GDP/GSDP	Available annually ***National level reliable historical and forecast available***
Population/Urbanisation	Revised every 10 years, last available 2011. Population estimates are not available annually, making it difficult to run regressions. Also, the very dynamic nature of local population migration (which are very difficult to forecast with accuracy), we do not use population growth as a proxy for understanding future travel demand growth on the Asset. *Forecast available but historical data is a constraint*

Source: Steer analysis

5 Base traffic, revenue validation, and forecasting assumptions

5.1 In this chapter, we present our approach to arrive at the base pose position and assumptions for baseline (or background) traffic growth for each vehicle category on the Asset.

5.2 The two most important inputs that go into traffic and revenue forecasts are:

- The base position – both in terms of traffic and revenue levels currently being generated by an asset; and
- The future growth trends – which can be correlated to the various growth drivers and used to develop an informed view of the forecasts.

5.3 The following sections discuss our approach to arrive at each of these inputs for both the Assets.

FY24 Base year AADT estimates

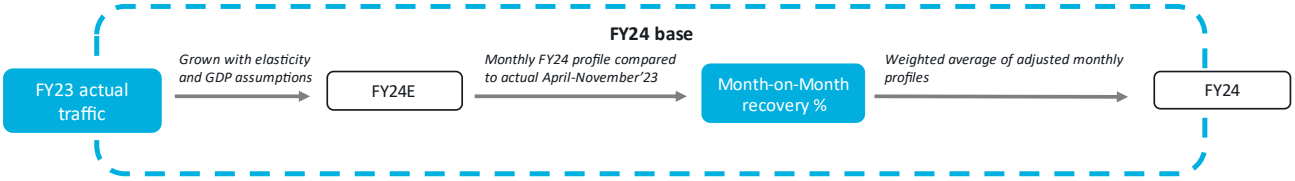
5.4 The base year is the year on which long-term background forecast growth rates are applied to derive year-wise average annual daily traffic (AADT) estimates for forecast years. This is therefore an important aspect of our forecasting approach as baseline traffic and ultimately revenue forecasts for future years are built on top of the base year traffic estimate. We have used FY24 as the base year for AADT estimates for the forecast years.

5.5 As described previously in Chapter 3, to establish the base year (FY24) traffic position, we utilised information from provided by the Client and our context knowledge, to assess a reasonable demand on the corridor for the base year FY24 which formed the basis of future year forecasts.

5.6 FY24 has not been affected by any unexpected event(s) and can be considered as a normal year for the purposes of base year estimation. Toll plaza data is available for the Asset since Oct'21 –Nov'2023 on Khawasa and Dec'21 –Nov'2023 on Madai toll plaza.

5.7 Methodology to arrive at FY24 base traffic is shown below.

Figure 5.1: Base traffic estimation



Source: Steer analysis

5.8 Base correction factors are then applied on FY24 base (without correction) to incorporate the unreported share of traffic. The corrected FY24 is the base of traffic forecasts.

Table 5.1: FY24 Base year traffic (without correction)

	Khawasa				Madai			
Vehicle Category	**FY23**	**FY24 YTD**	**FY24 A (Adop)**	**FY24 A vs FY23**	**FY23**	**FY24 YTD**	**FY24 A (Adop)**	**FY24 A vs FY23**
CJV	2,380	2,669	2,836	19.1%	2,817	3,062	3,186	13.1%
LCV	304	339	350	15.2%	378	408	411	8.9%
Bus	211	240	251	19.0%	235	261	264	12.0%
2A	1,317	1,495	1,537	16.8%	1,504	1,669	1,726	14.7%
3A	1,272	1,295	1,275	0.2%	1,371	1,359	1,337	(2.4%)
MAV	2,246	2,393	2,433	8.3%	2,488	2,541	2,588	4.0%
OSV	2	2	2	-	2	2	3	-
Total	**7,731**	**8,433**	**8,685**	**12.3%**	**8,795**	**9,303**	**9,515**	**8.2%**
PCU	**21,349**	**23,043**	**23,510**	**10.1%**	**23,919**	**24,990**	**25,442**	**6.4%**

Source: Steer analysis

5.9 PCU growth at Khawasa is 10.1% and at Madai is 6.4% mostly driven by high growth in CJV and 2A on the asset. Also, lower MAV growth at Madai by ~4% is due to significant influence of local activities in Seoni, Chhindwara, Narsinghpur and Lakhnadon.

5.10 In case of 2A's, high growth over ~15% is due to two reasons, firstly due to mis-categorization of LCV and 2A post Fastag implementation and secondly, with the growing demand for 2As for long distance e-commerce commodity travel. This has also been validated from the OD where the top pairs for 2As are Delhi- Nagpur/Hyderabad/Bangalore/Chennai.

5.11 Similarly, there has been a shift from 3A across the regions in country to MAV for the benefit of carrying excess tonnage. Also, a rise in the 2A category can be said to have offset the slight decline in 3As.

Base correction for FY24

5.12 To arrive at the true base traffic position, we have used a base correction factor to adjust the traffic volumes for CJVs, LCVs and 2As. The percentage of this correction has been calculated by comparing the toll plaza traffic volumes with TVC data as explained earlier in the report. As the base AADT of our forecasts is derived using the TMS data, it is imperative to validate the robustness of the reported traffic volumes with independent counts.

5.13 The difference between reported TMS data and the traffic in Steer independent TVC counts is added as part of the base to account for the vehicles which are crossing the plaza as 'unreported' traffic. The TMS data is for the same dates as the TVC and an average of 7 days.

5.14 To correctly account for true traffic levels, we have added the difference between Steer TVC and TMS counts (as a % of TMS) on the FY24 base position. We believe that this share of additional and unreported traffic does not pay at the plaza and hence, we treat this share as 'Exemptions' in our forecasts, allowing us to estimate the correct capacity of operations at both the toll plazas.

5.15 The table below illustrates the adjustment for the delta, and how it is factored into our base position:

Table 5.2: Base correction factor adjustment

	Khawasa			Madai		
	FY24	***Base correction Factor***	***FY24 Corrected Base***	***FY24***	***Base correction Factor***	***FY24 Corrected Base***
CJV	2,836	14.5%	3,246	3,186	7.1%	3,413
LCV	350	6.2%	372	411	5.4%	434
Bus	251		251	264		264
2A	1,537	6.2%	1,633	1,726	5.4%	1,820
3A	1,275		1,275	1,337		1,337
MAV	2,433		2,433	2,588		2,588
OSV	2		2	3		3
Total	**8,685**		**9,213**	**9,515**		**9,858**
PCU	**23,510**		**24,241**	**25,442**		**25,984**

Source: Steer analysis

Revenue Estimates

5.16 To estimate the base revenue for the toll plaza, we used the estimated FY24 AADT, established as part of the analysis above, as the assumptions for base FY24 traffic. We then used the segmentation assumptions, discussed in chapter 3, as a starting point to arrive at the base year revenue. This is further discussed in the section below.

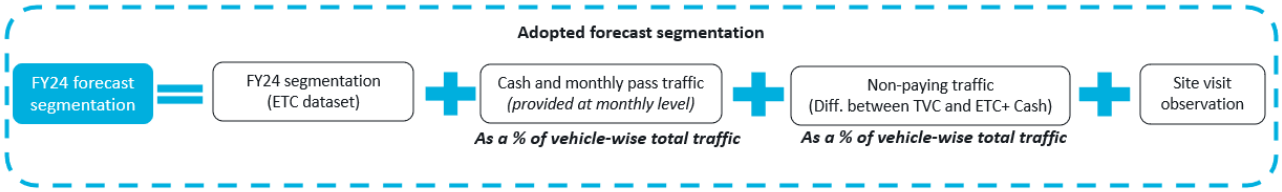
Toll Segmentation

5.17 As discussed in chapter 3, segmentation trends have largely been stabilising over the last few months, with FASTag now being in a compulsory implementation since Feb'21 and more than 95% of transactions are via FASTag, it can be assumed that travel patterns have stabilised. Therefore, we believe the that average of the segmentation in actual 8 months traffic for FY24 (Apr-Nov'23) is representative of the travel patterns on the Asset. The adopted segmentation after adjustment from base correction factor is presented below. We have assumed the forecast segmentation to remain same across the concession life.

5.18 For Madai, Schedule V reported cash transactions at monthly were already provided for overlapping period from Nov'21 onwards. Additionally, for exemptions the difference between TVC and ETC+ Cash dataset is added (as a % of ETC traffic) in the final adopted segmentation as non-paying traffic. In data availability, same proportion of cash traffic is assumed on Khawasa as well considering their similar profile and travel pattern.

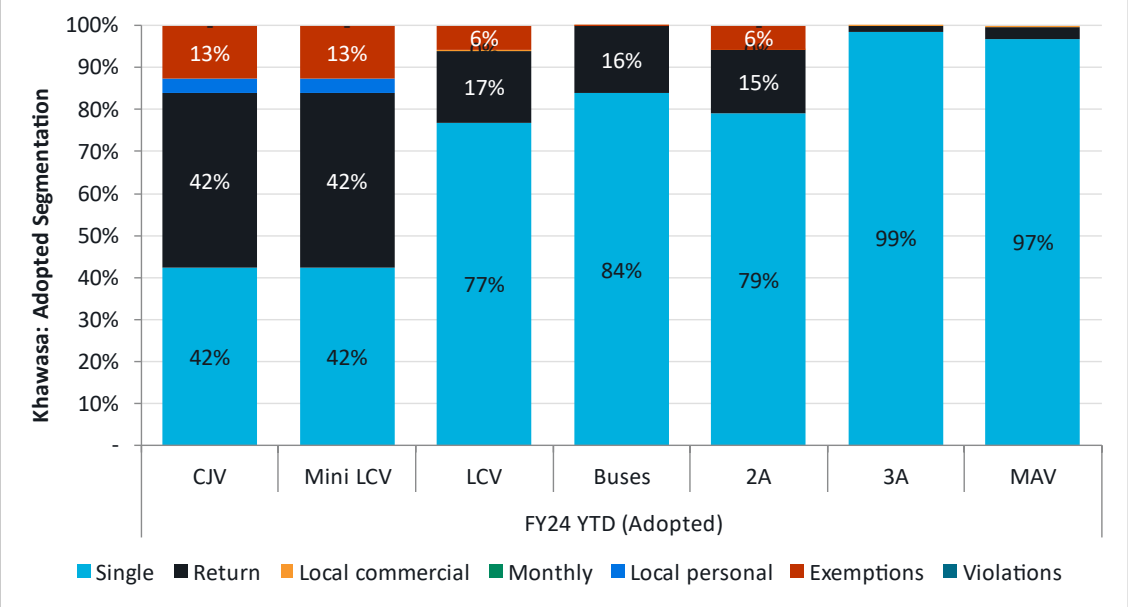
5.19 The methodology for adopted segmentation has been explained in the figure below:

Figure 5.2: Adopted forecast segmentation methodology



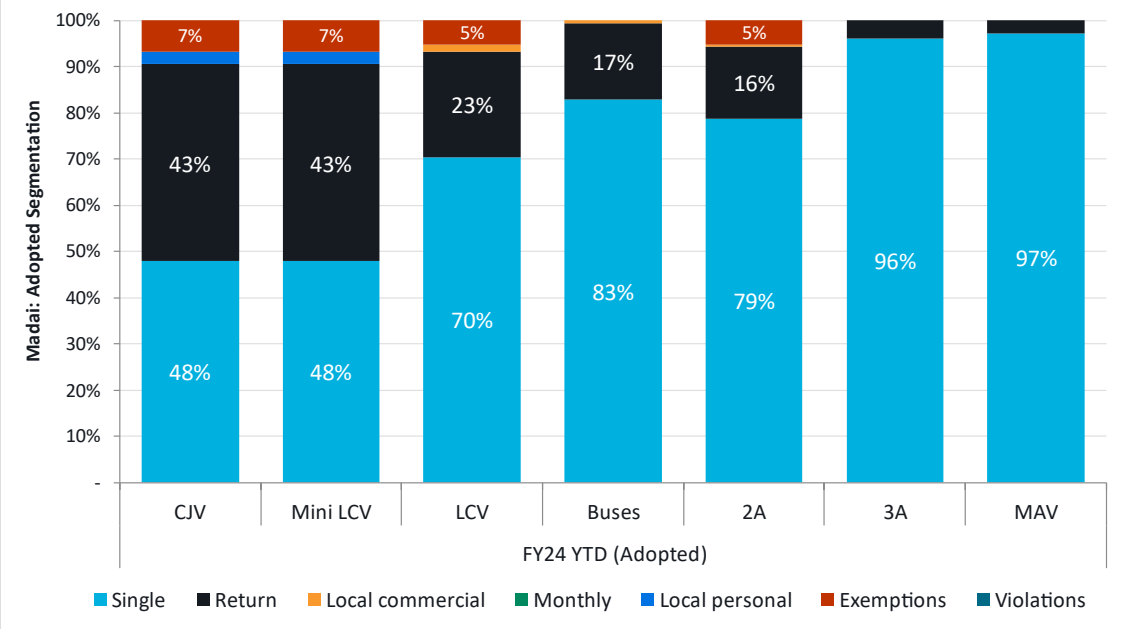
Source: Steer analysis

Figure 5.3: Adopted Toll segmentation (%) for Khawasa



Source: Steer analysis

Figure 5.4: Adopted Toll segmentation (%) for Madai



Source: Steer analysis

Forecasts for growth drivers

5.20 In this section, we have described our assumptions in relation to forecasts of the key macro-economic drivers of traffic growth. India's GDP and the relevant state GSDPs are the primary macroeconomic variables that have been used to drive our traffic growth forecasts.

Macro assumptions: GDP, GSDP and WPI

National GDP

5.21 India's GDP and Assam GSDP are the primary macroeconomic variables that have been modelled to drive our traffic growth forecasts.

5.22 After the last period of economic slowdown in FY11-12, the country has been experiencing an economic downturn since late FY19 with the FY20 reporting 4% GDP growth. India's GDP growth declined as domestic investment and consumption demand were already under stress because of the liquidity crunch before Covid-19. Related events to the economic slowdown include reduced growth rates in automobile sales and production, liquidity crunch, rising number of non-performing assets, lower manufacturing outputs and lower rural consumption.

5.23 There was a substantial impact of the Covid19 outbreak on the Indian economy during the first two quarters of FY21. The growth momentum eventually picked up in Q3 FY21. A sharp rebound was observed in FY22 with economy growing by 8.7%.

5.24 In the long term, Indian GDP would reduce gradually after 2030, to reach 5.9% by 2030 and 5.2% by FY40. Our national GDP forecasts are sourced from Consensus Economics. The state of Maharashtra and Madhya Pradesh has grown in line with the national GDP from FY12-20. However, in the last couple of years (FY17-29) Madhya Pradesh has grown at a slightly higher rate compared to the national GDP ~ 1.2x (20% higher than the national GDP). In the same period, Maharashtra has grown 0.8x (national GDP).

5.25 In the long term, we believe that as other smaller state economies of India catch up with the national economic growth, the gap between growth rates of larger state economies, such as Maharashtra, Gujarat, Telangana and Karnataka, and the national GDP growth rate will start reducing more.

Table 5.3: GDP, GSDP and WPI assumptions

	GDP	GSDP Madhya Pradesh	GSDP Maharashtra	WPI
FY25	6.2%	7.0%	6.2%	0.7%
FY26	6.6%	7.4%	6.6%	5.3%
FY27	6.4%	7.1%	6.4%	4.5%
FY28	6.3%	7.0%	6.3%	3.5%
FY29	6.0%	6.7%	6.0%	3.5%
FY30	5.7%	6.4%	5.7%	3.5%
FY31	5.7%	6.3%	5.7%	3.5%
FY32	5.7%	6.2%	5.7%	3.5%
FY33	5.7%	6.2%	5.7%	3.5%
FY34	5.7%	6.1%	5.7%	3.5%
FY35	5.6%	5.9%	5.6%	3.5%
FY36	5.5%	5.8%	5.5%	3.5%

	GDP	GSDP Madhya Pradesh	GSDP Maharashtra	WPI
FY37	5.4%	5.6%	5.4%	3.5%
FY38	5.4%	5.5%	5.4%	3.5%
FY39	5.3%	5.3%	5.3%	3.5%
FY40	5.2%	5.2%	5.2%	3.5%
FY41	5.1%	5.2%	5.1%	3.5%
FY42	5.0%	5.1%	5.0%	3.5%
FY43	4.9%	5.0%	4.9%	3.5%
FY44	4.8%	4.9%	4.8%	3.5%
FY45	4.7%	4.8%	4.7%	3.5%

Source: Projections from Consensus, *RBI Estimates, **https://www.rbi.org.in/Scripts/PublicationsView.aspx?id=20931,** WPI future input FY25 provided by client

5.26 WPI is sourced from the Dec'23 release of RBI estimates. According to the concession agreement, the RBI release of December is to be referred to vehicle incorporating WPI in the toll rate revision. We have assumed 3.5% WPI growth each year FY28 onwards based on the inputs provided by the Client.

Elasticity and growth drivers

5.27 In this section, we present our approach, and assumptions around estimation of elasticities and forecast assumptions of macro parameters for each vehicle category on the Asset.

5.28 Traffic growth is commonly related to a variety of macro-economic and industry- or commodity-specific factors (hereafter referred to as 'traffic growth drivers'). These growth drivers are typically identified from the results of the OD data analysis and the site visits that help us appreciate the nature of traffic movement – 'what' travels 'where' and 'why'.

5.29 On Asset where long time series historical data is available, to understand the historical traffic trends in relation to these growth drivers, we typically carry out regression analysis, to determine the historical relationship between traffic belonging to each major vehicle category and its macroeconomic growth driver at the toll plaza. The dynamics of traffic demand is the dependent variable while the dynamics of one or more identified growth drivers are the independent or explanatory variables. This is the primary approach to determine the elasticity relationships. However, for Assets under consideration where only limited historical data is available, we have adopted a benchmark approach to finalise our elasticity estimates.

5.30 While working on several Asset across the country where historical data is available, it has been observed that typically, growth of passenger and light commercial vehicles like cars, buses and LCVs which have relatively shorter trip lengths (<200-250 km) is more closely linked to the local economic growth drivers where the Asset is located. These categories are generally driven by the demand of local production/consumption centres and are in most cases captive to the Asset. Local factors coupled with tourism driven demand is often seen as the key driver for consumption of goods and services in the areas. Therefore, we typically link the growth rate of these vehicle categories with GSDP growth rates of the state where the asset is located as that is closest proxy of the local economic activity in the region.

5.31 This is because most light goods vehicles tend to travel shorter distances within the state, whereas a significant proportion of heavy vehicles carry commodities for long - distances

across the country and have much longer trip lengths. These commodities also tend to be part of industry ecosystems whose demand-supply relationships are scattered across the country and therefore relate more with GDP growth. Therefore, using the OD data trip lengths of various vehicle types and the commodity carried by these goods vehicles form the basis for estimating the elasticity relationships.

5.32 Whereas heavy vehicle traffic like 3A/MAV trucks and on this Asset 2A trucks as well are doing long distance trips (>500km) and serve multiple economic activity centres located along an Asset as well beyond the Asset across multiple states of the country. For these vehicle categories we therefore assume these vehicle categories to grow in line with the national GDP.

5.33 Compared to other similar Assets in surrounding network, 2A's on the Asset are doing long distance movement to Delhi, Bangalore, Nagpur, Chennai, Hyderabad majorly driven by demand of parcel, courier, miscellaneous & logistics items. Therefore, they are assumed to grow closely with GDP.

5.34 The forecast elasticities are assumed to remain constant over the concession period as the logistics sector in still in early stages of development in India (95% of trucks still owned by operators owning less than 5 trucks). Car ownership levels are still around 22 per 1000 people, and it is likely to take a few years before the market reaches maturity. These trends are based on a long-term understanding of historical relationships and an overall outlook on the growth of the region and the country.

5.35 The table below detail out the reasoning for selection of respective growth driver(s) and elasticity adopted for each vehicle category for Khawasa and Madai toll plaza.

Table 5.4: Assumed Elasticities for the LK: Khawasa and Madai toll plaza

Vehicle Category	Proposed Khawasa/ Madai Elasticity	Growth Driver	Comments
CJV	1.1 till FY28 & 1.0 FY29 onwards	50% GSDP of Madhya Pradesh & 50% GSDP of Maharashtra	Car traffic is largely driven by the local demand from Jabalpur, Nagpur, Seoni, Chhindwara, Lakhnadon, Balaghat & Mandla. The Asset is also influenced by Hyderabad, Chennai & Delhi bound traffic. CJVs are expected to grow with 1.1 elasticity on the Asset as the car ownership levels continue to increase in the region in future years like Nagpur and Jabalpur.
Buses	0.3	50% GSDP of Madhya Pradesh & 50% GSDP of Maharashtra	Buses are primarily a mix of public and private inter-city buses. It seems that buses currently are serving local intercity demand with some share of long-distance movement. As these cities grow, the buses are also expected to respond to the increasing demand however only at a muted rate.
MLCV/LCV	0.4	50% GSDP of Madhya Pradesh & 50% GSDP of Maharashtra	LCV have been observed to carry a mix of commodities, doing short to medium distances mostly catering to local demand alongside Jabalpur, Nagpur, Chhindwara, Seoni, corridor including groceries, agricultural and perishable products. As the region grows, we expect the consumption of these to also increase, combined with an increase in demand due to manufacturing industry along the Asset corridor.

Vehicle Category	Proposed Khawasa/ Madai Elasticity	Growth Driver	Comments
2A	0.8	GDP	2A,3A, MAVs are assumed to carry a mix of commodities over medium to long distance trips catering to national as well as local demand between Nagpur and Jabalpur. The demand for high value low tonnage products over long distances makes 2A trucks as preferred mode. 2A trucks in the region are observed to be carrying such materials including courier, parcel etc. on this corridor between Delhi and Nagpur, Hyderabad, Chennai and Bangalore including local areas in-between. In case of 2A's, high growth has been seen due to two reasons, firstly due to mis-categorization of LCV and 2A post Fastag implementation and secondly, with the growing demand for 2As for long distance e-commerce commodity travel. Also, there has been a shift from 3A across the regions in country to MAV for the benefit of carrying excess tonnage. A rise in the 2A category can be said to have offset the slight decline in 3As.Further both 2A and 3As have also serving the manufactured goods industry. Therefore, we believe that the 2A category will grow in the future with 0.8 elasticity to GDP. 3A trucks are also influenced long distance courier, parcel, and agricultural commodities along with local commodity movement including construction, groceries and perishable items. Therefore, elasticity of 0.5 has been assumed.
3A	0.5	GDP	
MAV	1.0	GDP	The Asset is part of the strategic NH44 north south corridor with MAV traversing long distance movements catering to the New Delhi and north India towards Hyderabad and southern parts of India. The Assets benefit from agricultural, groceries and industrial movement from industries along the corridor and in the vicinity. Therefore, an assumption of 1.0 to GDP has been assumed for the forecasts expecting the long-distance traffic to grow more in line with the national GDP.

Source: Steer analysis

Revenue Forecasting Assumptions

5.36 To forecast the revenues for a particular financial year, the traffic forecast for each vehicle type is converted into tickets sold, which is then multiplied with the corresponding toll rate, which grows over the years as defined in the Concession Agreement. While "trip factors" provide the conversion factor to the former, i.e., traffic (trips) to tickets sold, "toll segmentation" provides the latter i.e., the breakup of trips paying each ticket type. This section discusses assumptions related to trip factors, and toll rates for the forecast period.

Trip factors

5.37 As discussed in chapter 3, a user can by different type of tickets to pay toll depending on the vehicle type. Apart from the single trips, trips such as return, monthly, local commercial, local

personal, are discounted tickets that are offered to the users. The revenue realised from these discounted trips is lower than a single trip fare. Therefore, in order to calculate the revenue for the trips made on discounted tickets (or passes) a trip factor is applied to calculate revenue realised from that particular pass sold. For the purpose of revenue forecasting, FY24YTD (Apr-Nov'23) trip factor are calculated and assumed.

5.38 The following presents FY24YTD trip factors for both Khawasa and Madai:

Table 5.5: Trip factors for the forecast years - Khawasa

Ticket category	CJV/MLCV	LCV	Bus	2A	3A	MAV	OSV
Single	1	1	1	1	1	1	1
Return	2	2	2	2	2	2	2
Monthly	45	45	45	45	45	45	45
Local commercial	1	1	1	1	1	1	1
Local personal	91	1	1	1	1	1	1
Concession Entry (LDV)	1	1	1	1	1	1	1

Source: Steer analysis of toll plaza data

Table 5.6: Trip factors for the forecast years - Madai

Ticket category	CJV/MLCV	LCV	Bus	2A	3A	MAV	OSV
Single	1	1	1	1	1	1	1
Return	2	2	2	2	2	2	2
Monthly	45	45	45	45	45	45	45
Local commercial	1	1	1	1	1	1	1
Local personal	16	1	1	1	1	1	1
Concession Entry (LDV)	1	1	1	1	1	1	1

Source: Steer analysis of toll plaza data

Toll evolution

5.39 Based on the concession agreement and the gazetted toll notification, we see that base toll rates increase every year on 1st April based on WPI-linked inflation (December print of previous FY) to provide us unrounded toll rates. These are rounded up to the nearest five to estimate the rounded toll rates charged to the road user. We have used actual toll rates of FY24 toll notifications to validate the modelling of toll evolution. These toll lengths are presented in the table below:

Table 5.7: Existing & Proposed tolling lengths for toll evolution assumed - LK

Length (km)	Khawasa	Madai
	FY24 onwards	**FY24 onwards**
Road length excluding bypass	43.370	50.680
Structure on road	3.215	0.384
Converted length of structures	32.150	3.840
Net Tollable length	**72.305**	**74.086**

Source: Steer analysis of toll notifications and concession agreement (CA), 2023-24

Traffic and Revenue forecasts

PCU factor assumption for forecasts

5.40 The PCU factors considered are given in the table below. These are derived from IRC: 16-1990 code. The splits for the same have been derived from the TVC counts that we have undertaken.

Table 5.8: PCU factors

Vehicle Category	PCU Factor
CJV	1.0
LCV	1.5
Bus	3.0
2A	3.0
3A	3.0
MAV	4.5
OSV	4.5

Source: Steer analysis, IRC Codes

5.41 Based on the traffic and revenue-related forecast assumptions discussed above, we have modelled the traffic and revenue forecasts for the forecast period for the Asset. The table below presents the traffic and revenue forecast growth rates and CAGRs on this Asset. Further, Appendix B presents the AADT and revenues for the forecast period.

Revenue reconciliation – validation of forecast segmentation

5.42 As part of validating the data provided by the Client, as well as our assumptions around toll calculations and forecast segmentation, we have reconciled the actual reported revenue on a monthly level for the Asset for the month of April FY24. To reconcile we have used our FY24 segmentation as mentioned in the previous section, MADT of the month and compared it with the reported revenue for these months.

5.43 The Steer revenue calculations have been built up from monthly raw traffic data files, containing monthly data and ticket type information; and the toll notifications – all shared by the Client. The comparison, as shown in the table below, depicts the difference between modelled revenue and the reported revenue is within 0.0-0.3% for all the Assets, this gives us the confidence on the assumptions around segmentation and trip factors used for estimating forecasting revenue.

5.44 The table below shows the delta between our modelled revenue and the actual revenue reported in the toll plaza data:

Table 5.9: Revenue Reconciliation for LK- April FY24

Revenue	Modelled (Steer)- INR Lakh	Reported (ETC)- INR Lakh	Delta
Khawasa	27.51	27.54	(0.1%)
Madai	30.99	31.19	(0.6%)

Source: Steer analysis

6 Traffic and Revenue forecasts

Introduction

6.1 Following the discussion on our forecast of background growth elasticity relationships in the previous chapter, this chapter first covers the forecasting assumptions around estimation of base year AADT and potential network impacts on traffic growth on the Asset. Thereafter, we present our assumptions around toll segmentations, trip factors and evolution of toll rates for the forecast period which are used to forecast revenues as derived from forecast traffic. In the final section, this chapter summarises traffic growth rates for the forecast years.

6.2 The following table lists key intermediate and final outputs that have presented in previous Chapters and in this chapter.

Table 6.1: Key intermediate and final outputs in the forecast

Forecast	Final outputs	Intermediate outputs	Inputs	Chapter
Traffic	Base year AADT	AADT	Historical and year-to-date AADT	Chapter 3, 5
	Background traffic growth	Background forecast elasticity	Background historical elasticities with respect to growth drivers	Chapter 3,4
		Forecasts for growth drivers	Historical performance of growth drivers along with Macro assumptions (GDP and GSDP)	Chapter 6
	Impact growth rates and staging	Impacts	Network analysis	Chapters 6
Revenue	Annual/daily revenue forecasts	Forecast toll segmentation: Trip frequencies and trip factors	Historical trip frequencies	Chapter 3
			Historical trip factors	Chapter 6
		Future toll rates	Toll evolution	Chapter 6

Source: Steer

Seasonal Correction Factor

6.3 Traffic on any Asset varies on a month-on-month level owing to variations such as monsoons, festivity, local events specific to the Asset. In order to normalize for these variations across the year to provide an AADT estimate, Seasonality Correction Factors (SCF) are used. These are typically estimated using historical data for the toll plaza for vehicle category over multiple years. An SCF >1 means that the traffic for the month is lower than the annual average and vice-versa. The SCF assumed for the Assets is the SCF derived from actual traffic for FY23.

6.4 The monthly traffic variation of the Asset is also validated from the surrounding benchmark Assets where the travel pattern across vehicle categories remains similar.

6.5 SCF assumed for each toll plaza are presented below:

Table 6.2: SCF for Khawasa plaza

Khawasa	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
CJV	1.07	0.91	0.98	1.21	1.16	1.24	0.97	0.96	0.90	0.95	0.86	0.82
LCV	1.01	1.04	1.03	1.08	1.11	1.00	0.97	0.96	0.94	1.02	0.92	0.85
Bus	1.01	1.04	1.03	1.08	1.11	1.00	0.97	0.96	0.94	1.02	0.92	0.85
2A	1.08	0.99	1.06	1.05	1.04	0.97	1.00	1.02	1.00	1.01	0.89	0.89
3A	1.01	0.98	1.01	0.96	0.93	0.93	1.02	1.05	1.05	1.12	0.99	0.98
MAV	1.00	0.99	1.07	0.97	0.96	0.99	1.08	1.09	1.06	1.07	0.91	0.87

Table 6.3: SCF for Madai plaza

Madai	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
CJV	1.05	0.89	0.99	1.21	1.14	1.17	0.96	0.90	0.91	0.96	0.86	0.94
LCV	0.96	1.00	1.01	1.06	1.08	0.99	0.97	0.94	0.97	1.07	0.96	0.90
Bus	0.96	1.00	1.01	1.06	1.08	0.99	0.97	0.94	0.97	1.07	0.96	0.90
2A	1.04	1.01	1.09	1.09	1.05	0.99	1.01	1.01	1.01	1.03	0.87	0.86
3A	1.00	0.97	0.99	0.98	0.95	0.93	1.03	1.03	1.04	1.11	1.00	1.00
MAV	0.97	1.00	1.04	0.99	0.99	1.01	1.10	1.05	1.06	1.05	0.90	0.88

Source: Steer analysis

Analysis of potential impacts

Summary of alternate routes and impact assessments

6.6 The section below details the impacts which we believe would affect traffic on the Asset during the concession period. As discussed in earlier Chapters, in order to assess the impacts on the Asset, whether positive or negative, we have studied developments (alternate roads, feeder roads and regulatory) in the surrounding road network.

6.7 The following table lists the impacts considered on the Asset.

Table 6.4: Summary of impact

Impact	Toll plaza	Probability/Scale of impact	Year of impact	Impact (+/-)
Delhi Mumbai Expressway + Surat Chennai Expressway (long-distance alternate)	Khawasa, Madai	High/medium	FY27 onwards	-ve
2 lane improvement of NH547 + Nagpur Ring Road	Khawasa, Madai	High/low	FY26 onwards	-ve

Source: Steer analysis of OD data

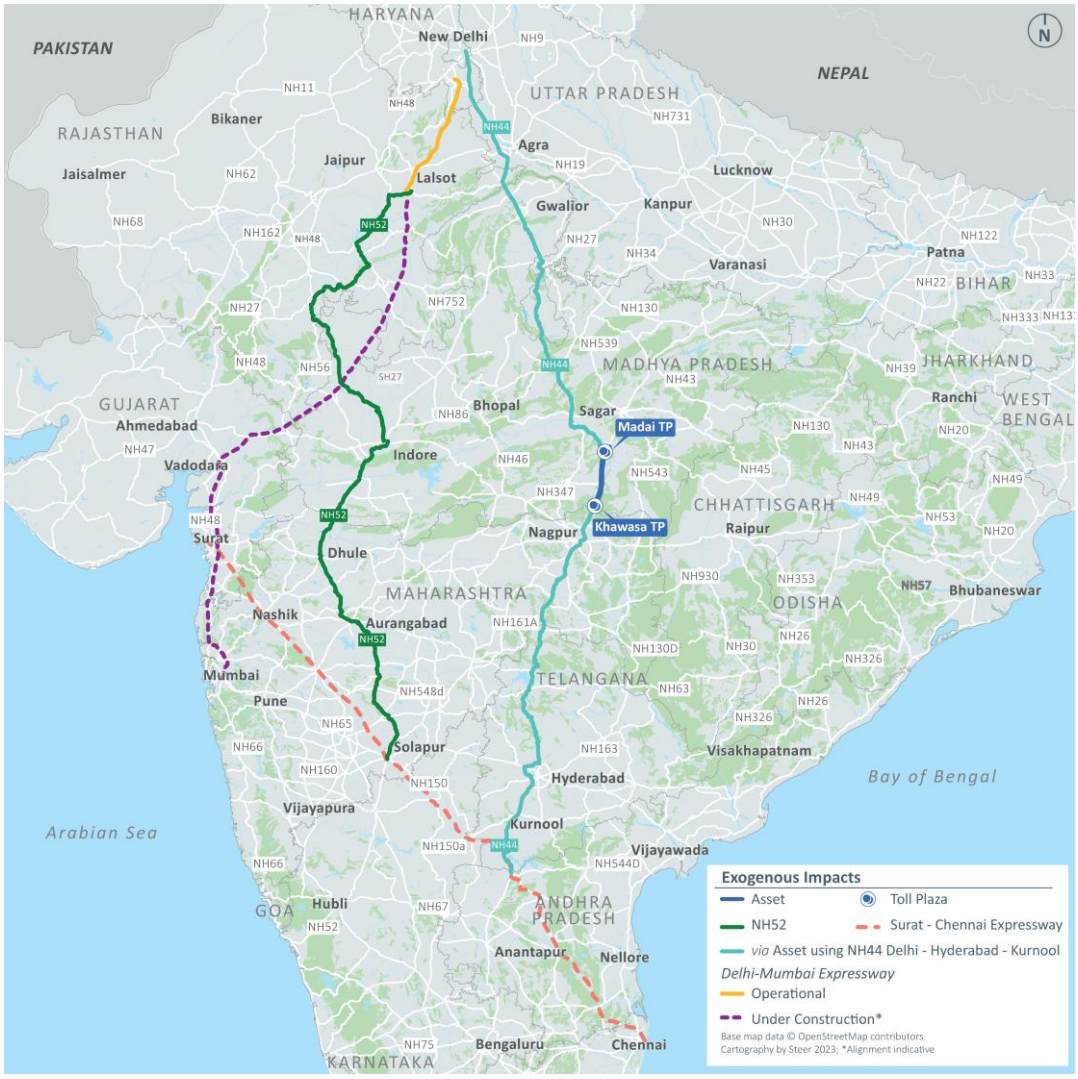
6.8 The subsections below include a narrative of each of the improvements, and impacts associated from each of these on our traffic forecasts. Please note that all traffic volumes for impacts were estimated as impact rates applied on FY24 AADT.

Delhi Mumbai Expressway + Surat Chennai Expressway (DME +SCE)

6.9 There are currently two key options for north south traffic movement between Delhi/north and Kurnool/south via Gwalior:

- using NH19/NH44 via Delhi-Agra-Gwalior-Sagar-Nagpur-Hyderabad-asset-Kurnool-Karnataka/Chennai
- using NH19/NH44/NH52 via Delhi-Agra-Gwalior-Indore-Dhule-Aurangabad-Solapur-Kurnool-Karnataka/Chennai.

Figure 6.1: DME+SCE alignment



Source: Steer cartography

6.10 Currently, the trucks are using NH44 corridor as it is cheaper and shorter for north-south movement. The proposed upgrades on NH52 coupled with upcoming Delhi-Mumbai Expressway (DME) and Surat-Solapur-Chennai Expressway (SCE) will improve the alternate route's overall attractiveness as long-distance corridor for traffic moving north and south.

6.11 The in-scope traffic includes all the trips with origins and destinations in Delhi/north and Kurnool/south currently moving on the Asset.

6.12 The users travelling from Delhi/north to Kurnool/south will have the option to divert to DME at Delhi instead of taking NH44/NH52 route. The users can then exit from DME at Indore where they can travel till Solapur on an upgraded 4-lane highway (NH52). At Solapur, the users can divert on the upcoming SCE to reach Kurnool. Hence, the route via DME-NH52-SCE, which will be a mix of expressways and upgraded NH, will act as a competing route for the Asset.

6.13 The Chennai Surat expressway's alignment will pass through tier-II cities like Nashik, Ahmednagar, Solapur, Kalaburgi, Kurnool, Kadapa and Tirupati. There would be a six-lane greenfield between Surat and Solapur/Mehbubnagar. The rest of the corridor is expected to be a four-laned brownfield section, but not access-controlled. Tenders have been allotted in most packages (290 km) between Karnataka and Telangana borders. Solapur Chennai package details are given in appendix.

6.14 We have assumed the diversion of traffic to being from FY27 in a phased manner. Below table shows the GJC comparison between Asset and Alternate.

Table 6.5: GJC Comparison of DME+SCE

	CJV	LCV	2A	3A	MAV
Via Asset NH44					
GJC	19877	40295	72172	87162	104771
Via Alternate DME+NH52+SCE					
GJC	19659	40057	69572	81558	101566
Outputs					
Impact Volume			(77)	(75)	(79)
Impact % (Khawasa)			**(4.7%)**	**(5.8%)**	**(3.3%)**
Impact % (Madai)			**(4.3%)**	**(5.6%)**	**(3.1%)**

Source: Steer Analysis, overall impact, the impact will be phased over 3 years (FY27:40%, FY28:60%, FY29 onwards 100%)

2 lane improvement of NH547 + Nagpur Ring Road

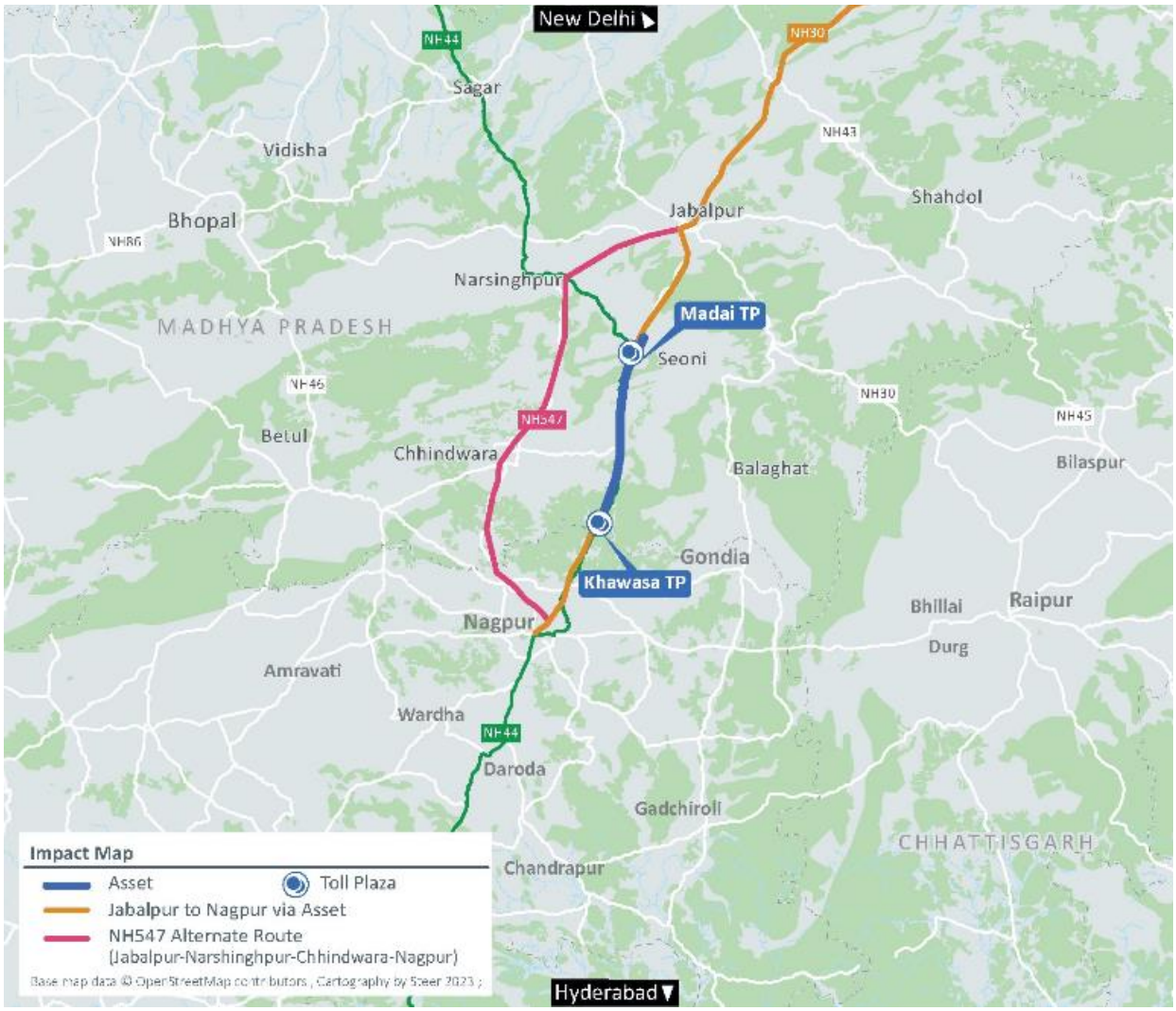
6.15 The Outer Ring Road is a 119 km under construction ring road around the city of Nagpur, in Maharashtra. A part of the road is between NH 44 (towards south of the city) and NH 56 towards east of the city is already operational. The National Highways Authority of India (NHAI) has issued work orders for execution of remaining stretch of 61 km. To pace up the completion of this BOT project, the section is divided into 2 packages. Both the packages were supposed to be finished by Sept'23 although now due to several delays the new deadline is Mar'24.

6.16 This impact has been divided into 3 parts:

- **Part 1: *the local trips between Chhindwara-Jabalpur*** which will impact Madai toll plaza. The share of local traffic between Jabalpur, Chhindwara, Seoni is higher on Madai toll plaza therefore 2 lane improvement of NH547 will take some local trips currently using Madai toll plaza between these OD pairs.

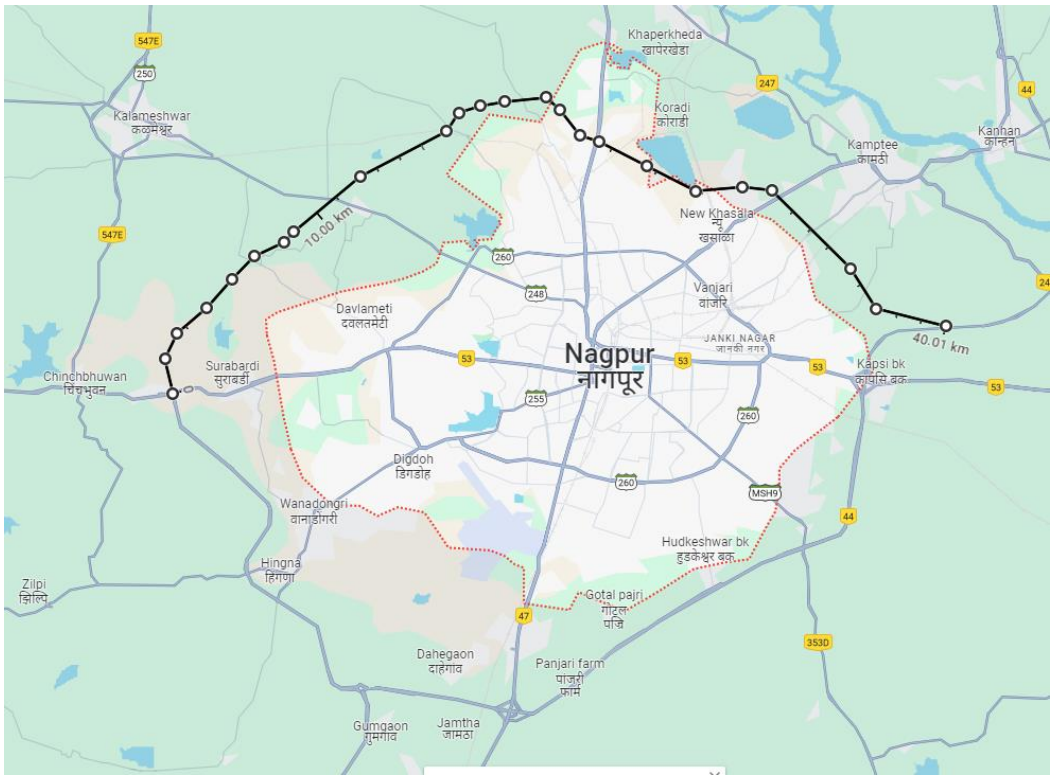
- **Part 2:** ***the long/medium-distance trips between Jabalpur-Nagpur*** *will* be impacted on both the plazas after the 2 lane improvement of NH547
- **Part 3:** ***Completion of Eastern Ring of Nagpur Ring Road*** **will** shift Nagpur/South bound traffic originating from Narsinghpur/North currently using the Asset to NH547 Alternate. Once completed, Nagpur Ring Road will act as a feeder to NH547 alternate thus making it a competing route.

Figure 6.2: Alternate at NH547 through Chhindwara



Source: Steer Cartography

Figure 6.3: Nagpur Ring Road alignment



Source: Steer Cartography

Table 6.6: GJC Comparison – Part1 of impact (local trips between Chhindwara-Jabalpur)

	CJV	LCV	2A	3A	MAV
Via Asset					
GJC	2052	4215	7886	9470	11306
Via NH547					
GJC	1976	3937	8067	9788	11988
Output					
Impact Volume		(16)	(86)	(30)	(36)
Impact % (Madai)		(3.8%)	(5.0%)	(2.2%)	(1.4%)

Table 6.7: GJC Comparison – Part2 of impact (long distance trips between Jabalpur-Nagpur)

	CJV	LCV	2A	3A	MAV
Via Asset					
GJC	2674	5493	9966	11817	14237
Via NH547					
GJC	3772	7752	15696	19381	23130
Output					
Impact Volume		(5)	(19)	(8)	(14)

Impact % (Khawasa)		(1.4%)	(1.2%)	(0.6%)	(0.6%)
Impact % (Madai)		(1.2%)	(1.1%)	(0.6%)	(0.6%)

Table 6.8: GJC Comparison – Part 3 of impact (local distance trips between Narsinghpur-Nagpur)

	CJV	LCV	2A	3A	MAV
Via Asset					
GJC	2,711	5,479	9,994	12,019	14,324
Via NH547					
GJC	2,749	5,574	11,629	14,399	17,217
Output					
Impact Volume		(20)	(62)	(60)	(91)
Impact % (Khawasa)		(5.7%)	(4.0%)	(4.7%)	(3.7%)
Impact % (Madai)		(4.9%)	(3.6%)	(4.5%)	(3.5%)

Source: Steer Analysis

Table 6.9: Total Impact of 2 lane improvement of NH547 + Nagpur Ring Road

Impact	LCV	2A	3A	MAV
Khawasa	(7.1%)	(5.3%)	(5.3%)	(4.3%)
Madai	(9.9%)	(9.7%)	(7.3%)	(5.5%)

Source: Steer Analysis, overall impact, the impact will be phased over 3 years (FY26:25%, FY27:80%, FY28 onwards: 100%)

Traffic and revenue forecasts

LK - Khawasa

Table 6.10: Final (background plus impacts) AADT forecast – LK - Khawasa

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
CJV	2,962	3,172	3,407	4,394	5,859	7,632	9,712
Mini LCV	285	292	301	333	374	417	459
LCV	372	382	386	404	454	506	558
Bus	251	256	262	282	308	334	360
2A	1,633	1,714	1,781	1,965	2,454	3,026	3,670
3A	1,275	1,315	1,340	1,361	1,566	1,787	2,017
MAV	2,433	2,584	2,724	3,225	4,252	5,518	7,013
OSV	2	2	2	3	4	5	7
AADT	**9,213**	**9,718**	**10,203**	**11,968**	**15,272**	**19,225**	**23,796**
PCU	**24,241**	**25,530**	**26,705**	**30,687**	**39,053**	**49,105**	**60,738**

Source: Steer analysis

Table 6.11: Final (background plus impacts) AADT CAGR (%) – LK - Khawasa

Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FY30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
CJV	7.1%	7.4%	6.6%	5.9%	5.4%	4.9%	5.8%
Mini LCV	2.6%	2.8%	2.6%	2.4%	2.2%	2.0%	2.3%
LCV	2.6%	1.0%	1.2%	2.4%	2.2%	2.0%	1.9%
Bus	2.0%	2.1%	1.9%	1.8%	1.6%	1.5%	1.7%
2A	5.0%	3.9%	2.5%	4.5%	4.3%	3.9%	3.9%
3A	3.1%	1.9%	0.4%	2.8%	2.7%	2.5%	2.2%
MAV	6.2%	5.4%	4.3%	5.7%	5.3%	4.9%	5.2%
OSV	6.2%	6.6%	6.1%	5.7%	5.3%	4.9%	5.6%
AADT	**5.5%**	**5.0%**	**4.1%**	**5.0%**	**4.7%**	**4.4%**	**4.6%**
PCU's	**5.3%**	**4.6%**	**3.5%**	**4.9%**	**4.7%**	**4.3%**	**4.5%**

Source: Steer analysis

Table 6.12: Final (background plus impacts) revenue (INR crores) forecast – LK - Khawasa

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
CJV	8.3	9.0	10.1	15.5	25.2	40.3	62.7
Mini LCV	0.8	0.8	0.9	1.2	1.6	2.2	3.0
LCV	2.0	2.1	2.3	2.8	3.9	5.3	7.1
Bus	3.1	3.2	3.4	4.4	5.9	7.8	10.3
2A	18.9	20.3	22.0	28.8	44.1	66.6	98.6
3A	17.7	18.6	20.0	24.0	33.9	47.2	65.3
MAV	48.5	52.3	58.2	81.7	131.5	209.2	323.5
OSV	0.1	0.1	0.1	0.1	0.2	0.3	0.4
Total Revenue	**99.4**	**106.6**	**116.9**	**158.6**	**246.3**	**378.8**	**570.8**

Source: Steer analysis

Table 6.13: Final (background plus impacts) revenue CAGR (%) – LK – Khawasa

Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FY30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
CJV	8.3%	11.8%	11.4%	10.2%	9.8%	9.2%	10.1%
Mini LCV	3.7%	7.0%	7.3%	6.5%	6.4%	6.2%	6.4%
LCV	5.3%	6.9%	5.7%	6.4%	6.5%	6.1%	6.2%
Bus	4.6%	6.4%	6.4%	6.0%	5.8%	5.6%	5.9%
2A	7.7%	8.3%	7.0%	8.9%	8.6%	8.2%	8.2%
3A	5.5%	7.2%	4.7%	7.1%	6.9%	6.7%	6.4%
MAV	7.8%	11.1%	8.9%	10.0%	9.7%	9.1%	9.5%
OSV	8.3%	12.0%	10.6%	10.0%	9.7%	9.2%	9.9%
Total Revenue	**7.2%**	**9.7%**	**7.9%**	**9.2%**	**9.0%**	**8.5%**	**8.7%**

Source: Steer analysis

6.17 The overall PCU traffic at Khawasa plaza is estimated to grow at a CAGR of 4.5% from FY24 to FY45, where the CJV would grow by 5.8% and MAV by 5.2%. The overall revenue CAGR for the same period is 8.7%.

LK - Madai

Table 6.14: Final (background plus impacts) AADT forecast – LK - Madai

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
CJV	2,672	2,862	3,074	3,965	5,287	6,886	8,763
Mini LCV	741	760	782	866	973	1,084	1,195
LCV	434	445	446	457	514	572	631
Bus	264	269	274	296	324	351	378
2A	1,820	1,910	1,962	2,094	2,616	3,225	3,911
3A	1,337	1,379	1,398	1,399	1,610	1,837	2,074
MAV	2,588	2,749	2,890	3,396	4,477	5,810	7,385
OSV	3	3	3	4	5	6	8
AADT	**9,858**	**10,377**	**10,830**	**12,477**	**15,805**	**19,772**	**24,344**
PCU	**25,984**	**27,344**	**28,449**	**32,186**	**40,848**	**51,242**	**63,259**

Source: Steer analysis

Table 6.15: Final (background plus impacts) AADT CAGR (%) – LK - Madai

Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FY30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
CJV	7.1%	7.4%	6.6%	5.9%	5.4%	4.9%	5.8%
Mini LCV	2.6%	2.8%	2.6%	2.4%	2.2%	2.0%	2.3%
LCV	2.6%	0.3%	0.6%	2.4%	2.2%	2.0%	1.8%
Bus	2.0%	2.1%	1.9%	1.8%	1.6%	1.5%	1.7%
2A	5.0%	2.7%	1.6%	4.5%	4.3%	3.9%	3.7%
3A	3.1%	1.4%	0.0%	2.8%	2.7%	2.5%	2.1%
MAV	6.2%	5.1%	4.1%	5.7%	5.3%	4.9%	5.1%
OSV	6.2%	6.6%	6.1%	5.7%	5.3%	4.9%	5.6%
AADT	**5.3%**	**4.4%**	**3.6%**	**4.8%**	**4.6%**	**4.2%**	**4.4%**
PCU's	**5.2%**	**4.0%**	**3.1%**	**4.9%**	**4.6%**	**4.3%**	**4.3%**

Source: Steer analysis

Table 6.16: Final (background plus impacts) revenue (INR crores) forecast – LK - Madai

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
CJV	8.3	9.2	10.3	15.8	25.7	40.5	63.2
Mini LCV	2.3	2.5	2.6	3.4	4.7	6.4	8.6
LCV	2.4	2.5	2.7	3.2	4.4	6.0	8.1
Bus	3.3	3.4	3.7	4.7	6.3	8.4	11.0
2A	21.7	23.1	25.0	31.6	48.5	72.8	108.1
3A	18.9	19.9	21.2	25.3	35.5	49.6	68.2

Vehicle Type	FY24	FY25	FY26	FY30	FY35	FY40	FY45
MAV	52.7	57.3	63.4	88.0	142.0	226.0	349.3
OSV	0.1	0.1	0.1	0.1	0.2	0.3	0.5
Total Revenue	**109.7**	**118.0**	**129.0**	**172.2**	**267.3**	**410.0**	**617.0**

Source: Steer analysis

Table 6.17: Final (background plus impacts) revenue CAGR (%) – LK – Madai

Vehicle Type	FY24-FY25	FY25-FY26	FY26-FY30	FY30-FY35	FY35-FY40	FY40-FY45	FY24-FY45
CJV	11.2%	11.6%	11.2%	10.2%	9.5%	9.3%	10.1%
Mini LCV	6.5%	6.8%	7.1%	6.5%	6.2%	6.2%	6.5%
LCV	5.6%	5.5%	5.0%	6.3%	6.5%	6.2%	6.0%
Bus	3.2%	7.7%	6.3%	6.1%	5.7%	5.7%	5.9%
2A	6.2%	8.4%	6.0%	9.0%	8.5%	8.2%	7.9%
3A	5.5%	6.5%	4.5%	7.0%	6.9%	6.6%	6.3%
MAV	8.7%	10.6%	8.6%	10.0%	9.7%	9.1%	9.4%
OSV	8.2%	12.7%	10.5%	10.0%	9.8%	9.1%	9.9%
Total Revenue	**7.6%**	**9.3%**	**7.5%**	**9.2%**	**8.9%**	**8.5%**	**8.6%**

Source: Steer analysis

6.18 The overall PCU traffic is estimated to grow at a CAGR of 4.3% from FY24 to FY45, where the CJV would grow by 5.8% and MAV by 5.1%. The overall revenue is estimated to grow at a CAGR of 8.6% from FY24 to FY45. Compared to Khawasa, Madai Plaza has higher influence of local traffic moving towards Jabalpur, Seoni, Lakhnadon, Chhindwara due to its proximity because of which slightly lower growth is assumed on Madai. Whereas the growth of long-distance traffic remains same on the both plazas.

6.19 The traffic and revenue forecast presented above are our base case scenario considering a balanced view on the risks associated with input assumptions around GDP growth and traffic growth elasticities. There is always a risk that the outturn values of these inputs will vary as compared to the assumptions taken due to exogenous impacts, e.g., GDP growth could be influenced both positively and negatively by the impact of monsoons, export-import balances, political changes etc.

6.20 Similarly, traffic growth elasticities could be influenced by increased efficiencies achieved by technology, large shifts in commodity prices globally, changes in local manufacturing practices. However, at this stage we consider that the base case represents a central case scenario given the risks of variation of input assumptions.

Summary outlook

6.21 The analysis presented in this report and the methodology followed adopted presents a custom approach compared to a standard traffic and revenue forecasting approach. We have utilised information from various sources, backed by our knowledge of toll roads in the regional setting of the study Asset, in order to triangulate a robust base T&R position before

presenting our views on other key topics, such as base year AADT and revenue, growth forecasts, and traffic segmentation.

6.22 Overall, we believe, we have tabled a robust set of forecast numbers underpinned by a rigorous base T&R position, background growth, exogenous impacts coupled with our unparallel market knowledge of the toll road industry in India.

6.23 The Asset lies on the NH44 which is the key corridor for long distance traffic movements between Delhi and North India to southern states such as Telangana, Karnataka and Tamil Nadu. The traffic movement on the Asset is also supported by industries and agri-economies near Nagpur, Jabalpur, Hyderabad and Bengaluru.

6.24 The proposed upgrades on NH52 coupled with Delhi Mumbai Expressway and development of Solapur Kurnool section of Surat-Kurnool-Chennai Expressway would improve the overall attractiveness of the route in comparison to NH44 for long-distance North-South traffic movements.

6.25 NH547 Narsinghpur- Nagpur section once proposed and upgraded to 4 laned by NHAI, will act as a major risk for the Asset's for long distance movement majorly originating from North India moving towards Nagpur, Hyderabad Bangalore, Chennai and other southern region. In near future, completion of eastern ring of Nagpur Ring Road which is a feeder to NH547 alternate will take some proportion of Nagpur bound traffic from the Asset plazas Khawasa and Madai.

6.26 Overall, we believe that the Asset have a robust traffic profile as connects key centres of economic growth across the spinal cord of the country. As seen historically, all the industrial nodes along the corridor have grown in line with the country's economic growth. This along with salient features like shortest route among alternatives, local richness of agriculture and allied industry like sugarcane, wheat, spices, cotton and food processing and established and growing trade relationship with neighbouring state, it is reasonable to believe that the underlying growth drivers of the corridor are strong and are expected to deliver long term sustained growth.

Appendices

A Data collection exercise

A.1 Below you can find the Zone list used for OD Analysis for both Assets:

OD analysis

Zone list

Table A.1: Zone list used for OD Analysis at LK

Zone No	Zone name	Description/State
1	Hinganghat	Maharashtra
2	Karanji	Maharashtra
3	Deodhari	Maharashtra
4	Wadner	Maharashtra
5	Nirmal	Telangana
6	Adilabad(U)	Telangana
7	Jamb	Telangana
8	Kandlakoya	Telangana
9	Chegunta	Telangana
10	Kamareddy	Telangana
11	Nadepalle	Telangana
12	Gudihathinur	Telangana
13	Pandharkawada	Maharashtra
14	Wadki	Maharashtra
15	Khatara	Maharashtra
16	Bori	Maharashtra
17	Ramayampet	Telangana
18	Kallakal	Telangana
19	Armur	Telangana
20	Ichoda	Telangana
21	Sonegaon	Maharashtra
22	Shedgaon Pati	Maharashtra
23	Borkhedi	Maharashtra
24	Daroda	Maharashtra
25	Kelapur	Maharashtra
26	Adilabad	Telangana

27	Komaram Bheem Asifabad	Telangana
28	Bhadradri Kothagudem	Telangana
29	Hyderabad	Telangana
30	Jagtial	Telangana
31	Jangaon	Telangana
32	Jayashankar Bhupalpally	Telangana
33	Jogulamba Gadwal	Telangana
34	Karimnagar	Telangana
35	Khammam	Telangana
36	Mahabubabad	Telangana
37	Mahbubnagar	Telangana
38	Mancherial	Telangana
39	Medak	Telangana
40	Medchal	Telangana
41	Mulugu	Telangana
42	Narayanpet	Telangana
43	Nalgonda	Telangana
44	Nagarkurnool	Telangana
45	Nizamabad	Telangana
46	Peddapalli	Telangana
47	Rajanna Sircilla	Telangana
48	Ranga Reddy	Telangana
49	Sangareddy	Telangana
50	Siddipet	Telangana
51	Suryapet	Telangana
52	Vikarabad	Telangana
53	Wanaparthy	Telangana
54	Warangal (Urban)	Telangana
55	Warangal (Rural)	Telangana
56	Yadadri Bhuvanagiri	Telangana
57	Ahmednagar	Maharashtra
58	Aurangabad	Maharashtra
59	Beed	Maharashtra
60	Buldhana	Maharashtra
61	Chandrapur	Maharashtra
62	Dhule	Maharashtra
63	Hingoli	Maharashtra
64	Jalgaon	Maharashtra
65	Jalna	Maharashtra

66	Kolhapur	Maharashtra
67	Latur	Maharashtra
68	Mumbai City	Maharashtra
69	Mumbai Suburban	Maharashtra
70	Nanded	Maharashtra
71	Nandurbar	Maharashtra
72	Nagpur	Maharashtra
73	Osmanabad	Maharashtra
74	Palghar	Maharashtra
75	Parbhani	Maharashtra
76	Pune	Maharashtra
77	Raigad	Maharashtra
78	Ratnagiri	Maharashtra
79	Sangli	Maharashtra
80	Satara	Maharashtra
81	Sindhudurg	Maharashtra
82	Solapur	Maharashtra
83	Thane	Maharashtra
84	Wardha	Maharashtra
85	Washim	Maharashtra
86	Yavatmal	Maharashtra
87	Bhopal region	Madhya Pradesh
88	Gwalior and Chambal region	Madhya Pradesh
89	Chennai region	Tamil Nadu
90	Coimbatore region	Tamil Nadu
91	Madurai region	Tamil Nadu
92	Trichy region	Tamil Nadu
93	Bangalore	Karnataka
94	Anantapur	Andhra Pradesh
95	Chittoor	Andhra Pradesh
96	East Godavari	Andhra Pradesh
97	Guntur	Andhra Pradesh
98	Ysr Kadapa	Andhra Pradesh
99	Krishna	Andhra Pradesh
100	Kurnool	Andhra Pradesh
101	Prakasam	Andhra Pradesh
102	Nellore	Andhra Pradesh
103	Srikakulam	Andhra Pradesh
104	Vishakhapatnam	Andhra Pradesh

105	Vizianagaram	Andhra Pradesh
106	West Godavari	Andhra Pradesh
107	Delhi	Delhi (UT)
108	East Uttar Pradesh	Uttar Pradesh
109	West Uttar Pradesh	Uttar Pradesh
110	North Karnataka	Karnataka
111	South Karnataka	Karnataka
112	Andaman & Nicobar	Andaman & Nicobar
113	Sikkim	Sikkim
114	North eastern states	North eastern states
115	Bihar	Bihar
116	Chandigarh	Chandigarh
117	Rest of Chhattishgarh	Chhattishgarh
118	Daman and Diu and Dadra and Nagar Haveli	Daman and Diu and Dadra and Nagar Haveli
119	Goa	Goa
120	Gujarat	Gujarat
121	Himachal Pradesh	Himachal Pradesh
122	Jammu and Kashmir	Jammu and Kashmir
123	Jharkhand	Jharkhand
124	Kerala	Kerala
125	Ladakh	Ladakh
126	Lakshadweep	Lakshadweep
127	Odisha	Odisha
128	Puducherry	Puducherry
129	Punjab	Punjab
130	Rajasthan	Rajasthan
131	Uttarakhand	Uttarakhand
132	West Bengal	West Bengal
133	Haryana	Haryana
134	Rest of Andhra Pradesh	Andhra Pradesh
135	Raipur	Chhattishgarh
136	NTR district, Vijaywada	Andhra Pradesh
137	Lakhnadon	Madhya Pradesh
138	Chhindwara	Madhya Pradesh
139	Balaghat	Madhya Pradesh
140	Gondia	Maharashtra
141	Umred	Madhya Pradesh
142	Mandla	Madhya Pradesh
143	Saoner	Madhya Pradesh

144	Jabalpur	Madhya Pradesh
145	Seoni	Madhya Pradesh
146	Betul	Madhya Pradesh
147	Rewa	Madhya Pradesh
148	Prayagraj	Uttar Pradesh
149	Varanasi	Uttar Pradesh
150	Nashik	Maharashtra
151	Agra	Uttar Pradesh
152	Guwahati	Assam
153	Gorakhpur	Uttar Pradesh
154	Bedaghat	Madhya Pradesh
155	Kareli	Madhya Pradesh
156	Gadarwara	Madhya Pradesh
157	Pipariya	Madhya Pradesh
158	Bareli	Madhya Pradesh
159	Multai	Madhya Pradesh
160	Pandhurna	Madhya Pradesh
161	Warud	Maharashtra
162	Nainpur	Madhya Pradesh
163	Baihar	Madhya Pradesh
164	Waraseoni	Madhya Pradesh
165	Tumsar	Madhya Pradesh
166	Bhandara	Maharashtra
167	Tirora	Maharashtra
168	Sakoli	Maharashtra
169	Brahmapuri	Madhya Pradesh
170	Gadchiroli	Maharashtra
171	Dongargarh	Chhattisgarh
172	Butibori	Maharashtra
173	Morshi	Maharashtra
174	Katol	Maharashtra
175	Paratwada	Maharashtra
176	Amravati	Maharashtra
177	Akola	Maharashtra
178	Sihora	Uttar Pradesh
179	Dindori	Madhya Pradesh
180	Hatta	Madhya Pradesh
181	Damoh	Madhya Pradesh
182	Patharia	Madhya Pradesh

183	Garhakota	Madhya Pradesh
184	Khurai	Madhya Pradesh
185	Bina	Madhya Pradesh
186	Ganj Basoda	Madhya Pradesh
187	Sironj	Madhya Pradesh
188	Vidisha	Madhya Pradesh
189	Bhatkuli	Maharashtra
190	Arvi	Maharashtra
191	Dattapur Dhamangaon	Maharashtra
192	Pulgaon	Maharashtra
193	Kalamb	Maharashtra
194	Ralegaon	Maharashtra
195	Ghatanji	Maharashtra
196	O.F.Khamaria	Madhya Pradesh
197	Barela	Madhya Pradesh
198	Shahpura	Madhya Pradesh
199	Kaimur	Bihar
200	Majholi	Madhya Pradesh
201	Tendukheda	Madhya Pradesh
202	Ghansor	Madhya Pradesh
203	Katni	Madhya Pradesh
204	Mungeli	Chhattisgarh
205	Aligarh	Uttar Pradesh
206	Moradabad	Uttar Pradesh
207	Saharanpur	Uttar Pradesh
208	Noida	Uttar Pradesh
209	Firozabad	Uttar Pradesh
210	Jhansi	Uttar Pradesh
211	Ayodhya	Uttar Pradesh
212	Rampur	Uttar Pradesh
213	Mau	Uttar Pradesh
214	Hapur	Uttar Pradesh
215	Etawah	Uttar Pradesh
216	Bulandshahr	Uttar Pradesh
217	Sambhal	Uttar Pradesh
218	Amroha	Uttar Pradesh
219	Hardoi	Uttar Pradesh
220	Fatehpur	Uttar Pradesh
221	Raebareli	Uttar Pradesh

222	Orai	Uttar Pradesh
223	Sitapur	Uttar Pradesh
224	Bahraich	Uttar Pradesh
225	Modinagar	Uttar Pradesh
226	Unnao	Uttar Pradesh
227	Jaunpur	Uttar Pradesh
228	Lakhimpur	Uttar Pradesh
229	Hathras	Uttar Pradesh
230	Pilibhit	Uttar Pradesh
231	Barabanki	Uttar Pradesh
232	Khurja	Uttar Pradesh
233	Gonda	Uttar Pradesh
234	Mainpuri	Uttar Pradesh
235	Lalitpur	Uttar Pradesh
236	Etah	Uttar Pradesh
237	Deoria	Uttar Pradesh
238	Budaun	Uttar Pradesh
239	Ghazipur	Uttar Pradesh
240	Sultanpur	Uttar Pradesh
241	Azamgarh	Uttar Pradesh
242	Bijnor	Uttar Pradesh
243	Sahaswan	Uttar Pradesh
244	Basti	Uttar Pradesh
245	Chandausi	Uttar Pradesh
246	Akbarpur	Uttar Pradesh
247	Ballia	Uttar Pradesh
248	Tanda	Uttar Pradesh
249	Greater Noida	Uttar Pradesh
250	Shikohabad	Uttar Pradesh
251	Shamli	Uttar Pradesh
252	Awagarh	Uttar Pradesh
253	Kasganj	Uttar Pradesh
254	Bhilai	Chhattisgarh
255	Bilaspur	Chhattisgarh
256	Korba	Chhattisgarh
257	Rajnandgaon	Chhattisgarh
258	Raigarh	Chhattisgarh
259	Jagdalpur	Chhattisgarh
260	Ambikapur	Chhattisgarh

261	Chirimiri	Chhattisgarh
262	Dhamtari	Chhattisgarh
263	Mahasamund	Chhattisgarh
264	Indore	Madhya Pradesh
265	Bhopal	Madhya Pradesh
266	Gwalior	Madhya Pradesh
267	Ujjain	Madhya Pradesh
268	Sagar	Madhya Pradesh
269	Dewas	Madhya Pradesh
270	Satna	Madhya Pradesh
271	Ratlam	Madhya Pradesh
272	Singrauli	Madhya Pradesh
273	Burhanpur	Madhya Pradesh
274	Khandwa	Madhya Pradesh
275	Bhind	Madhya Pradesh
276	Guna	Madhya Pradesh
277	Shivpuri	Madhya Pradesh
278	Chhatarpur	Madhya Pradesh
279	Mandsaur	Madhya Pradesh
280	Khargone	Madhya Pradesh
281	Neemuch	Madhya Pradesh
282	Pithampur	Madhya Pradesh
283	Itarsi	Madhya Pradesh
284	Sehore	Madhya Pradesh
285	Chambal	Madhya Pradesh
286	Datia	Madhya Pradesh
287	Nagda	Madhya Pradesh
288	Raipur	Chhattishgarh
289	Banda	Uttar Pradesh
290	Rajapur	Uttar Pradesh
291	Jiwla	Madhya Pradesh
292	Mangawan	Madhya Pradesh
293	Deotalab	Madhya Pradesh
294	Ghoraha	Madhya Pradesh
295	Panni	Madhya Pradesh
296	Bahuti	Madhya Pradesh
297	Kudiya	Madhya Pradesh
298	Bijhauli Gaharwaran	Madhya Pradesh
299	Hanumana	Madhya Pradesh

300	Govindgarh	Madhya Pradesh
301	Maihar	Madhya Pradesh
302	Manikpur	Uttar Pradesh
303	Agar	Madhya Pradesh
304	Alirajpur	Madhya Pradesh
305	Anuppur	Madhya Pradesh
306	Ashoknagar	Madhya Pradesh
307	Barwani	Madhya Pradesh
308	Dhar	Madhya Pradesh
309	Harda	Madhya Pradesh
310	Narmadapuram	Madhya Pradesh
311	Jhabua	Madhya Pradesh
312	Narsinghpur	Madhya Pradesh
313	Raisen	Madhya Pradesh
314	Rajgarh	Madhya Pradesh
315	Shahdol	Madhya Pradesh
316	Shajapur	Madhya Pradesh
317	Sheopur	Madhya Pradesh
318	Tikamgarh	Madhya Pradesh
319	Umaria	Madhya Pradesh
320	Khawasa	Madhya Pradesh
321	Niwari	Madhya Pradesh
322	Panna	Madhya Pradesh
323	Hoshangabad	Madhya Pradesh
324	Bangladesh	Bangladesh
325	Nepal	Nepal

Source: Steer representation

Top OD pairs

A.2 Further to the OD analysis presented in Chapter 3 this appendix presents top 10 OD pairs for 3A+MAVs at each toll plaza.

Table A.2: LK Khawasa: 3A/MAV top 10 OD pair shares

	Origin	Destination	% of grand total
1.	Chennai region	Delhi	6.8%
2.	Nagpur	Jabalpur	5.6%
3.	Bangalore	Delhi	5.3%
4.	Hyderabad	Delhi	5.3%
5.	Nagpur	Delhi	4.7%
6.	Nagpur	Seoni	3.1%

7.	Chennai region	Agra	1.6%
8.	Nagpur	East Uttar Pradesh	1.4%
9.	Chennai region	Haryana	1.3%
10.	Hyderabad	Haryana	1.3%

Source: Steer analysis

Table A.3: LK Madai: 3A/MAV top 10 OD pair shares

	Origin	Destination	% of grand total
1.	Nagpur	Jabalpur	7.3%
2.	Chennai region	Delhi	7.2%
3.	Bangalore	Delhi	6.5%
4.	Nagpur	Delhi	6.0%
5.	Hyderabad	Delhi	4.8%
6.	Jabalpur	Seoni	1.9%
7.	Hyderabad	Jabalpur	1.7%
8.	Nagpur	Bihar	1.7%
9.	Chhindwara	Jabalpur	1.6%
10.	Hyderabad	East Uttar Pradesh	1.5%

Source: Steer analysis

TVC count

A.3 The TVC counts recorded at each toll plaza can be seen below. These counts form an important part of TVC-toll plaza data analysis which contributes significantly to our base estimation exercise:

Table A.4: LK Khawasa: Daily TVC

Date	CJV	Mini LCV	LCV	Bus	2 Axle	3 Axle	MAV	OSV	Total
10/10/2023	2,292	222	595	245	1,382	1,266	2,355	2	**8,359**
11/10/2023	2,334	208	621	244	1,364	1,209	2,442	1	**8,423**
12/10/2023	2,364	208	559	248	1,530	1,350	2,525	1	**8,785**
13/10/2023	2,364	243	669	273	1,655	1,487	2,641	1	**9,333**
14/10/2023	2,264	239	617	246	1,637	1,476	2,487	1	**8,967**
15/10/2023	2,207	218	673	230	1,672	1,502	2,673	3	**9,178**
16/10/2023	2,175	201	641	253	1,604	1,531	2,397	4	**8,806**

Source: Steer analysis

Table A.5: LK Madai: Daily TVC

Date	CJV	Mini LCV	LCV	Bus	2 Axle	3 Axle	MAV	OSV	Total

10/10/2023	2,493	687	736	278	1,445	1,349	2,710	-	**9,698**
11/10/2023	2,437	639	813	267	1,467	1,199	2,549	4	**9,375**
12/10/2023	2,542	721	904	267	1,633	1,420	2,652	-	**10,139**
13/10/2023	2,537	750	816	272	1,810	1,540	2,754	2	**10,481**
14/10/2023	2,199	650	797	264	1,820	1,470	2,765	-	**9,965**
15/10/2023	2,235	556	882	253	1,799	1,543	2,877	1	**10,146**
16/10/2023	2,284	635	826	245	1,819	1,581	2,546	2	**9,938**

Source: Steer analysis

B Traffic and revenue forecasts

B.1 Further to the summary of forecasts presented in Chapter 6, this appendix presents detailed forecasts.

Traffic forecasts

B.2 This section presents the detailed traffic forecasts for the forecast period until FY45.

Table B.1: LK Khawasa: Forecasts for final (background + impacts) AADT

Vehicle Category	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31
CJV	2,962	3,172	3,407	3,647	3,896	4,144	4,394	4,658
Mini LCV	285	292	301	309	317	325	333	341
LCV	372	382	386	380	385	394	404	414
Bus	251	256	262	267	272	277	282	288
2A	1,633	1,714	1,781	1,781	1,831	1,879	1,965	2,055
3A	1,275	1,315	1,340	1,309	1,319	1,323	1,361	1,400
MAV	2,433	2,584	2,724	2,791	2,920	3,052	3,225	3,409
OSV	2	2	2	3	3	3	3	3
Total	**9,213**	**9,718**	**10,203**	**10,487**	**10,941**	**11,398**	**11,968**	**12,567**
PCU	**24,241**	**25,530**	**26,705**	**27,170**	**28,206**	**29,246**	**30,687**	**32,203**

Vehicle Category	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39
CJV	4,936	5,230	5,539	5,859	6,191	6,534	6,889	7,254
Mini LCV	349	357	366	374	383	391	400	408
LCV	424	434	444	454	464	475	485	495
Bus	293	298	303	308	314	319	324	329
2A	2,148	2,246	2,349	2,454	2,563	2,674	2,789	2,906
3A	1,440	1,481	1,523	1,566	1,609	1,653	1,697	1,741
MAV	3,604	3,809	4,026	4,252	4,487	4,731	4,984	5,247
OSV	4	4	4	4	4	5	5	5
Total	**13,197**	**13,858**	**14,553**	**15,272**	**16,015**	**16,782**	**17,572**	**18,386**
PCU	**33,795**	**35,470**	**37,230**	**39,053**	**40,938**	**42,886**	**44,896**	**46,968**

Vehicle Category	FY40	FY41	FY42	FY43	FY44	FY45
CJV	7,632	8,023	8,427	8,843	9,272	9,712

Mini LCV	417	425	434	442	451	459
LCV	506	516	526	537	547	558
Bus	334	340	345	350	355	360
2A	3,026	3,150	3,276	3,404	3,536	3,670
3A	1,787	1,832	1,878	1,924	1,970	2,017
MAV	5,518	5,799	6,089	6,388	6,696	7,013
OSV	5	6	6	6	7	7
Total	**19,225**	**20,090**	**20,979**	**21,894**	**22,833**	**23,796**
PCU	**49,105**	**51,305**	**53,570**	**55,897**	**58,287**	**60,738**

Source: Steer analysis

Table B.2: LK Madai: Forecasts for final (background + impacts) AADT

Vehicle Category	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31
CJV	2,672	2,862	3,074	3,291	3,515	3,739	3,965	4,203
Mini LCV	741	760	782	803	824	845	866	886
LCV	434	445	446	433	435	446	457	468
Bus	264	269	274	280	286	291	296	302
2A	1,820	1,910	1,962	1,914	1,949	2,003	2,094	2,190
3A	1,337	1,379	1,398	1,351	1,355	1,361	1,399	1,439
MAV	2,588	2,749	2,890	2,943	3,072	3,213	3,396	3,590
OSV	3	3	3	3	3	3	4	4
Total	**9,858**	**10,377**	**10,830**	**11,019**	**11,439**	**11,902**	**12,477**	**13,082**
PCU	**25,984**	**27,344**	**28,449**	**28,638**	**29,599**	**30,693**	**32,186**	**33,756**

Vehicle Category	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39
CJV	4,454	4,719	4,997	5,287	5,586	5,896	6,216	6,545
Mini LCV	908	929	951	973	995	1,017	1,039	1,061
LCV	479	490	502	514	525	537	548	560
Bus	307	313	318	324	329	335	340	345
2A	2,290	2,394	2,503	2,616	2,731	2,850	2,972	3,097
3A	1,480	1,522	1,566	1,610	1,654	1,699	1,745	1,791
MAV	3,795	4,011	4,239	4,477	4,725	4,982	5,248	5,524
OSV	4	4	5	5	5	5	6	6
Total	**13,716**	**14,383**	**15,082**	**15,805**	**16,551**	**17,321**	**18,114**	**18,931**
PCU	**35,406**	**37,140**	**38,962**	**40,848**	**42,798**	**44,813**	**46,891**	**49,034**

Vehicle Category	FY40	FY41	FY42	FY43	FY44	FY45
CJV	6,886	7,239	7,603	7,979	8,366	8,763
Mini LCV	1,084	1,106	1,128	1,150	1,173	1,195

LCV	572	584	595	607	619	631
Bus	351	356	362	367	372	378
2A	3,225	3,357	3,491	3,628	3,768	3,911
3A	1,837	1,884	1,931	1,978	2,026	2,074
MAV	5,810	6,106	6,411	6,726	7,051	7,385
OSV	6	7	7	7	8	8
Total	**19,772**	**20,638**	**21,528**	**22,443**	**23,382**	**24,344**
PCU	**51,242**	**53,517**	**55,856**	**58,260**	**60,728**	**63,259**

Source: Steer analysis

Revenue forecasts

B.3 This section presents the detailed revenue forecasts in INR Cr for the forecast period until FY45. The following tables show the revenue forecasts.

Table B.3: LK Khawasa: Revenue forecasts (INR Cr)

Vehicle Category	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31
CJV	8.3	9.0	10.1	11.4	12.6	14.0	15.5	17.0
Mini LCV	0.8	0.8	0.9	1.0	1.0	1.1	1.2	1.2
LCV	2.0	2.1	2.3	2.4	2.5	2.6	2.8	3.0
Bus	3.1	3.2	3.4	3.7	3.9	4.2	4.4	4.7
2A	18.9	20.3	22.0	23.2	24.8	26.6	28.8	31.5
3A	17.7	18.6	20.0	20.5	21.6	22.4	24.0	25.7
MAV	48.5	52.3	58.2	62.6	68.3	74.0	81.7	90.0
OSV	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	**99.4**	**106.6**	**116.9**	**124.7**	**134.9**	**145.0**	**158.6**	**173.2**

Vehicle Category	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39
CJV	19.2	21.1	23.0	25.2	28.2	30.7	33.4	37.1
Mini LCV	1.4	1.4	1.5	1.6	1.7	1.8	1.9	2.1
LCV	3.2	3.4	3.6	3.9	4.1	4.4	4.7	5.0
Bus	5.0	5.3	5.6	5.9	6.2	6.6	7.0	7.4
2A	34.4	37.4	40.6	44.1	47.9	52.0	56.5	61.3
3A	27.6	29.6	31.6	33.9	36.4	38.8	41.3	44.3
MAV	99.3	108.9	119.4	131.5	144.9	158.3	174.0	190.7
OSV	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
Total	**190.2**	**207.2**	**225.5**	**246.3**	**269.6**	**292.7**	**319.0**	**348.1**

Vehicle Category	FY40	FY41	FY42	FY43	FY44	FY45
CJV	40.3	44.1	48.6	52.7	57.5	62.7
Mini LCV	2.2	2.3	2.5	2.6	2.8	3.0

LCV	5.3	5.6	5.9	6.3	6.7	7.1
Bus	7.8	8.3	8.7	9.2	9.7	10.3
2A	66.6	72.1	77.8	84.2	91.2	98.6
3A	47.2	50.3	53.6	57.4	61.4	65.3
MAV	209.2	227.6	248.9	272.7	297.6	323.5
OSV	0.3	0.3	0.3	0.3	0.4	0.4
Total	**378.8**	**410.6**	**446.3**	**485.4**	**527.4**	**570.8**

Source: Steer analysis

Table D.5: LK Madai: Revenue forecasts (INR Cr)

Vehicle Category	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31
CJV	8.3	9.2	10.3	11.6	12.9	14.3	15.8	17.3
Mini LCV	2.3	2.5	2.6	2.8	3.0	3.2	3.4	3.6
LCV	2.4	2.5	2.7	2.7	2.8	3.0	3.2	3.4
Bus	3.3	3.4	3.7	4.0	4.2	4.5	4.7	5.0
2A	21.7	23.1	25.0	25.7	27.2	29.2	31.6	34.4
3A	18.9	19.9	21.2	21.5	22.6	23.6	25.3	27.1
MAV	52.7	57.3	63.4	67.7	73.7	80.4	88.0	96.9
OSV	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	**109.7**	**118.0**	**129.0**	**136.1**	**146.4**	**158.2**	**172.2**	**187.9**

Vehicle Category	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39
CJV	19.1	21.0	23.5	25.7	28.2	31.1	33.9	37.3
Mini LCV	3.9	4.1	4.5	4.7	5.0	5.4	5.7	6.1
LCV	3.6	3.9	4.1	4.4	4.7	5.0	5.3	5.7
Bus	5.3	5.6	5.9	6.3	6.7	7.1	7.5	7.9
2A	37.6	40.8	44.4	48.5	52.6	57.1	62.0	67.2
3A	29.0	30.8	33.1	35.5	38.1	40.5	43.2	46.3
MAV	106.9	117.8	129.1	142.0	156.3	171.5	188.3	206.2
OSV	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3
Total	**205.6**	**224.1**	**244.7**	**267.3**	**291.7**	**318.0**	**346.1**	**376.9**

Vehicle Category	FY40	FY41	FY42	FY43	FY44	FY45
CJV	40.5	44.6	49.1	52.8	58.0	63.2
Mini LCV	6.4	6.8	7.3	7.6	8.1	8.6
LCV	6.0	6.4	6.8	7.1	7.6	8.1
Bus	8.4	8.8	9.3	9.9	10.4	11.0
2A	72.8	78.9	85.5	92.5	100.1	108.1
3A	49.6	52.8	56.2	60.1	64.3	68.2

Vehicle Category	FY40	FY41	FY42	FY43	FY44	FY45
MAV	226.0	246.7	269.6	293.8	321.6	349.3
OSV	0.3	0.3	0.4	0.4	0.4	0.5
Total	**410.0**	**445.4**	**484.1**	**524.2**	**570.5**	**617.0**

Source: Steer analysis

C Vehicle Classification Chart

Vehicle Type	Description
2-Wheeler	
Auto-Rickshaw	
Car/Jeep/Van	
Taxi- shared/private	
Buses (govt/Pvt)	
Minibus	

QUALITY SYSTEM CERTIFICATION DNV·GL ISO 9001:2015

Vehicle Type	Description
Mini LCV	
LCV 4 Tyre	
LCV 6 Tyre	
2 Axle Truck	
3 Axle Truck	
4 Axle Truck (MAV)	
5 Axle Truck (MAV)	

QUALITY SYSTEM CERTIFICATION
DNV·GL
ISO 9001:2015

Vehicle Type	Description
6 Axle Truck (MAV)	
Oversized Vehicle/ Earth moving equipment (OSV)	

QUALITY SYSTEM CERTIFICATION DNV·GL ISO 9001:2015

D Solapur Chennai Package Details

Section	Package & Chainage	Contractor	Deadline
Maharashtra – Karnataka Section (Greenfield) – Akkalkot, MH to Karnataka/Telangana Border)	Package 1 (26.00 km): Akkalkot to MH/KN Border at Badadal (km 0.000 to km 26.000)	Notice Pending	December 2025
	Package 2 (71 km): MH/KA Border at Badadal to Maradgi S. Andola (km 26.000 to km 97.000)	PNC Infratech Pvt. Ltd.	
	Package 3 (65.50 km): Maradgi S. Andola to Baswantpur (97.000 to km 162.500)	Dilip Buildcon Ltd.	
	Package 4 (40.6 km): Baswantpur to Singnodi (km 162.500 to km 203.100)	Montecarlo Ltd.	
Telangana Section (Greenfield)	Package 1 (39.3 km): Karnataka-Telangana border at Raichur Gadwal road to Julekal village (km 202.900 to km 242.200)	Megha Engineering & Infrastructure (MEIL)	
	Package 2 (38.2 km): Julekal village to Kurnool town terminating on NH-40 (km 242.200 to km 280.400)	Megha Engineering & Infrastructure (MEIL)	
Andhra Pradesh Section (Brownfield-Upgrade)	Package 1 (64.2 km): 4 laning of NH-716 from Kadapa to Chinna Orampadu (From km 260.652 to km 196.125 of NH-716)	Lakshmi Infrastructure Ltd.	
	Package 2 (57.735 km): 4 laning of NH-716 from Chinna Orampadu (Design km 64.200/existing km 196.125 of NH-716) to Renigunta on NH 565 near Tirupati Airport Rd (Design Km 121.935/existing km 137.000)	Lakshmi Infrastructure Ltd.	
	Widening of Chennai - Tirupati National Highway-Tiruvallur to the Tamil Nadu-Andhra Pradesh border		Tenders floated

Source: [Solapur Chennai Economic Corridor: Route Map & Status Update (themetrorailguy.com)]

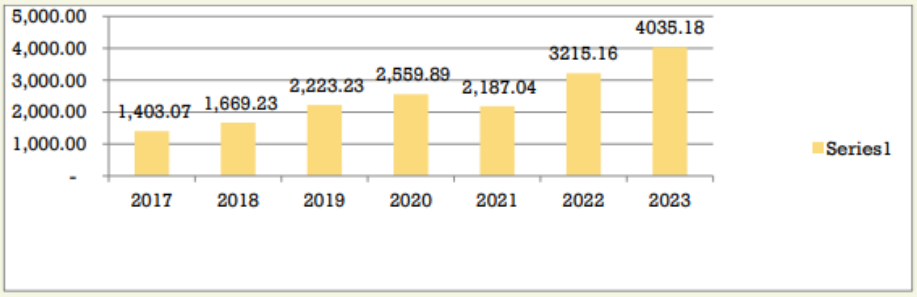
E Nagpur Bypass: Annual Revenue Performance

(In Millions)

Oriental Nagpur Bye Pass Construction Private Limited("ONBPCPL")

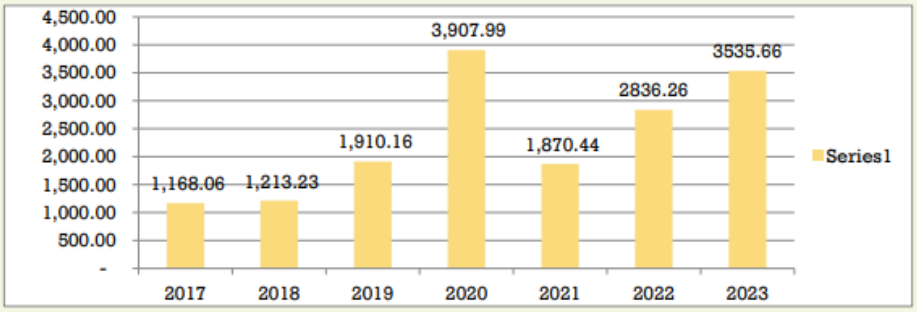
Total Project Cost (In Millions) 19,713	Operation Started on 11-July-2012	End of Concession Period 02-April-2037
Original Concession Period (i/c const. period) (In Years) 27	Total Income (FY 2022-23) (In Millions) 4147.62	EBITDA (FY 2022-23) (In Millions) 3535.66

Gross Toll Revenue



(In Millions)

EBIDTA

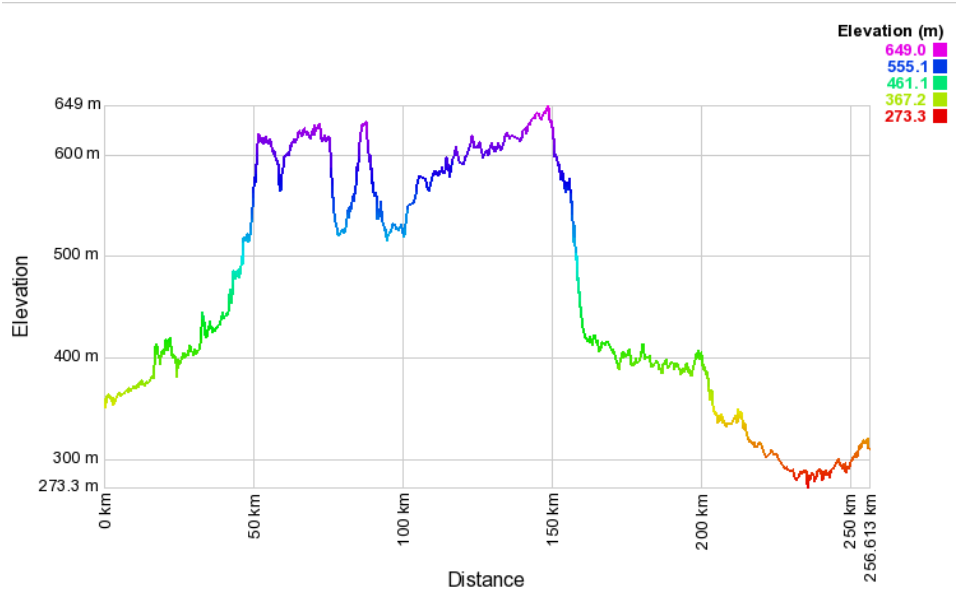


Source: orientalinfratrust.org/wp-content/uploads/2023/06/Annual-Report_2022-2023.pdf

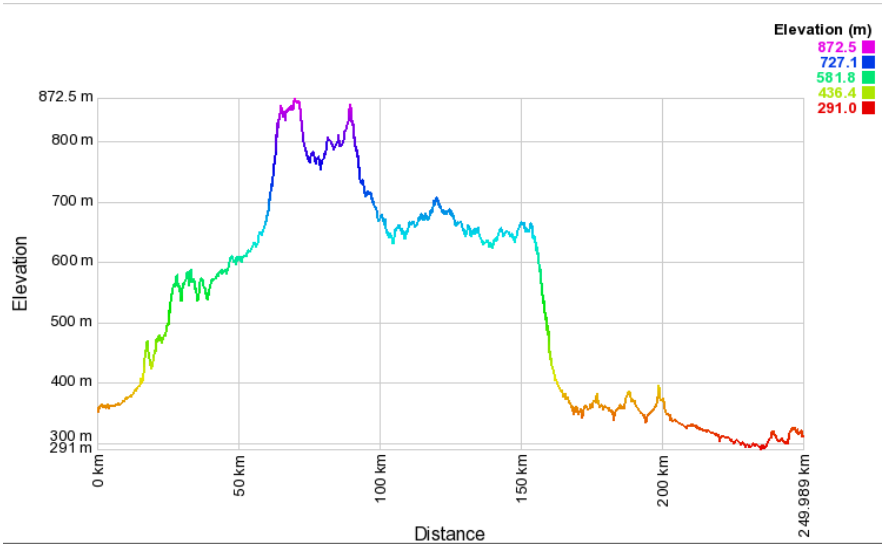
QUALITY SYSTEM CERTIFICATION DNV·GL ISO 9001:2015

F Elevation Profile

Narsinghpur-Seoni- Nagpur: Via Asset (NH44)



Narsinghpur-Chhindwara-Nagpur- via Alternate (NH547)



Source: GPS Visualizer: Assign DEM elevation data to coordinates

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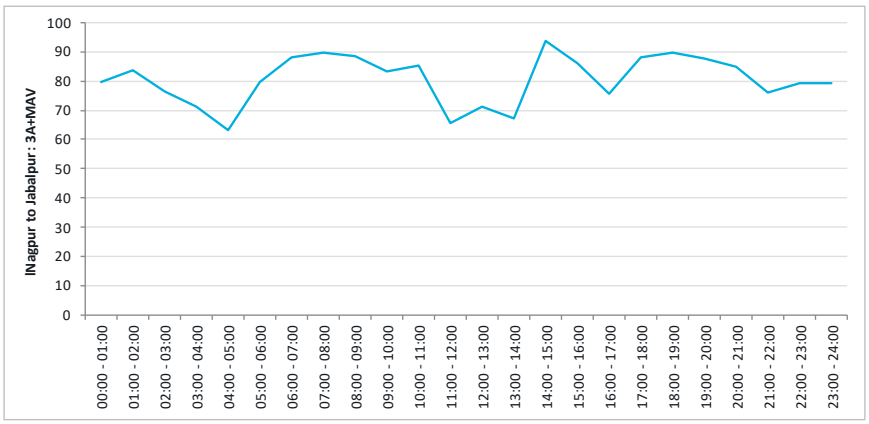
G Hourly Profile

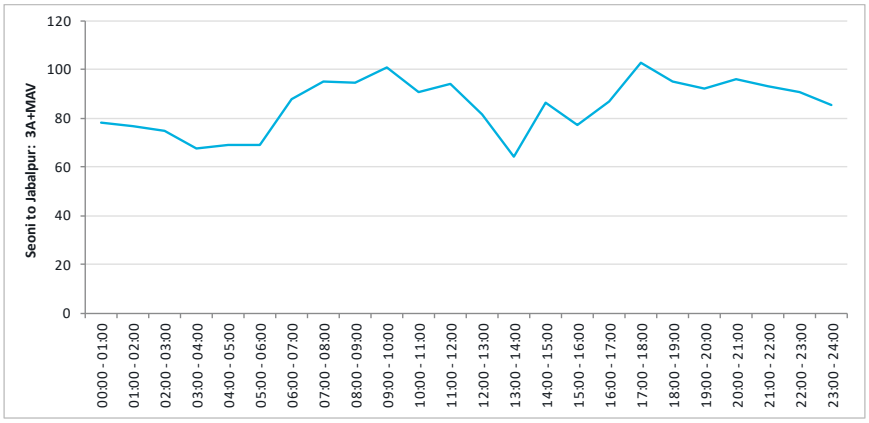
Movement of Traffic: Towards Jabalpur

Khawasa 3A+MAV: Hourly profile



Source: Steer Analysis

Madai 3A+MAV: Hourly profile



Source: Steer Analysis

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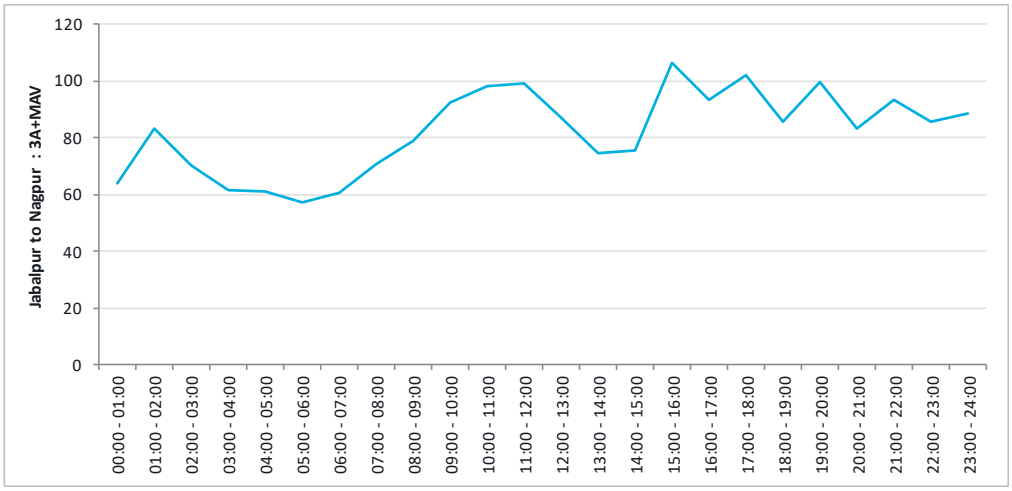
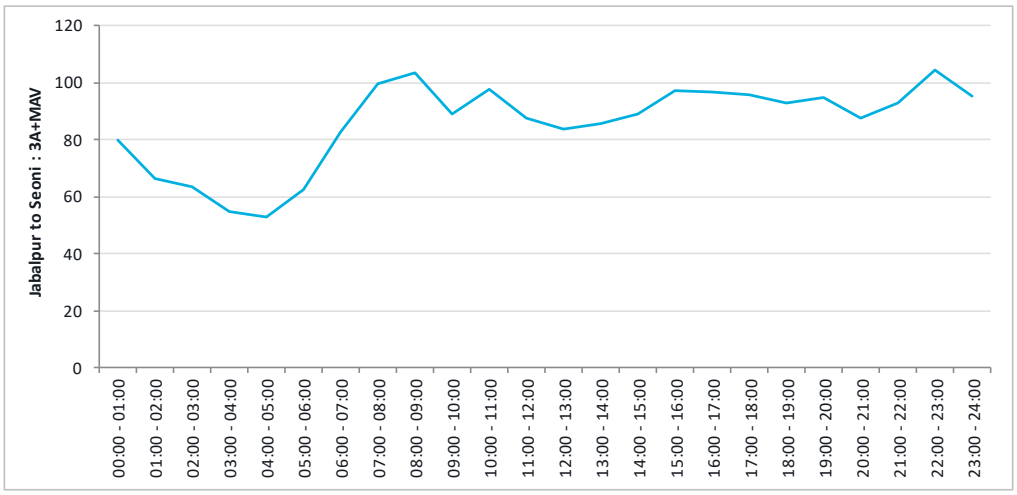
Movement of Traffic: Towards Nagpur

Khawasa 3A+MAV: Hourly profile



Source: Steer Analysis

Madai 3A+MAV: Hourly profile



Source: Steer Analysis

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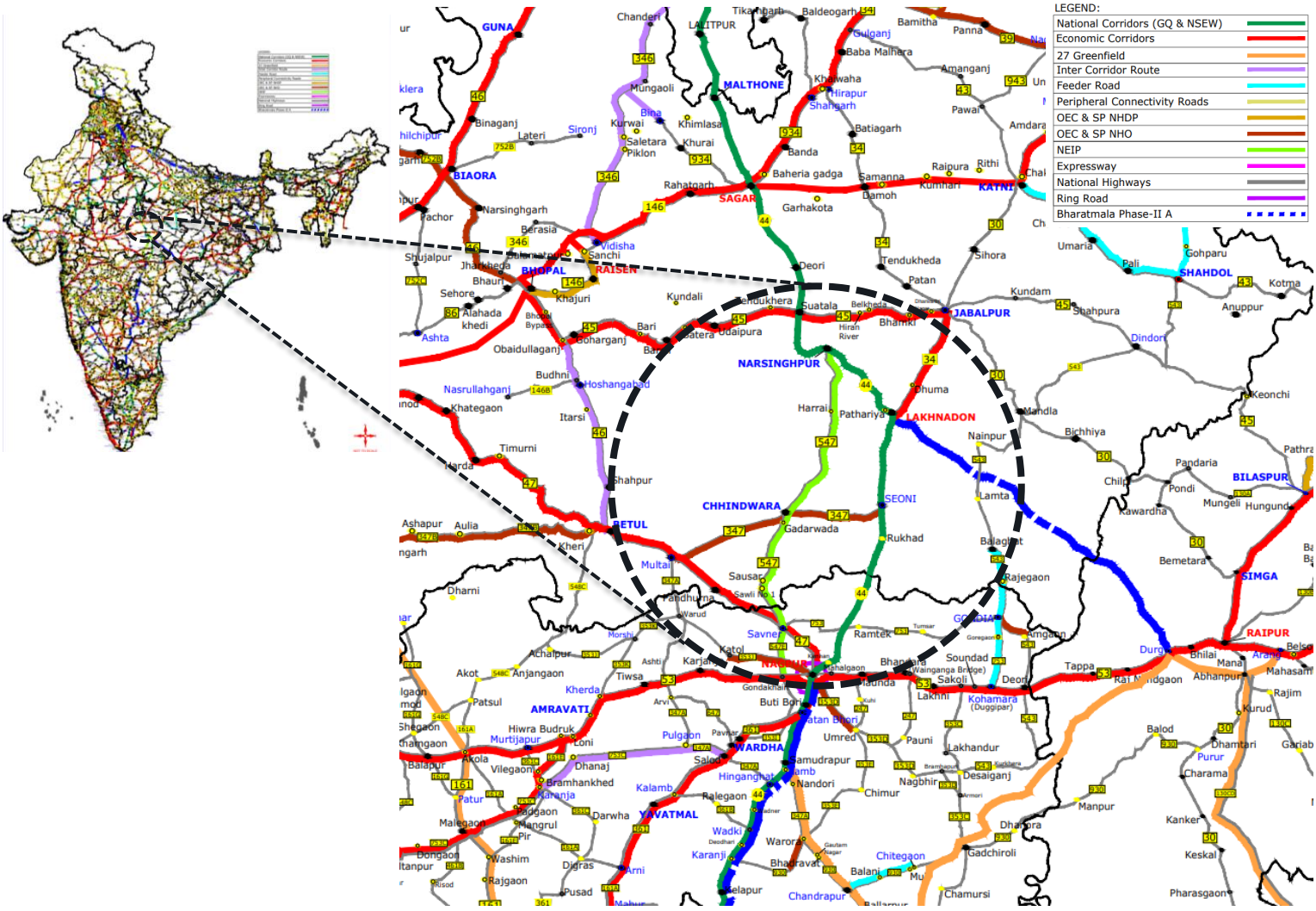
H NH547 Road Improvement Plan: Bharatmala Pariyojana (NHAI)

- As per the current 2023 information available from NHAI for road development under Bharatmala Pariyojna, NH547 section between Jabalpur to Nagpur is under North Eastern Investment Plan (NEIC).



Source: Bharatmala Pariyojna, NHAI 2023 [Model (nhai.gov.in)]

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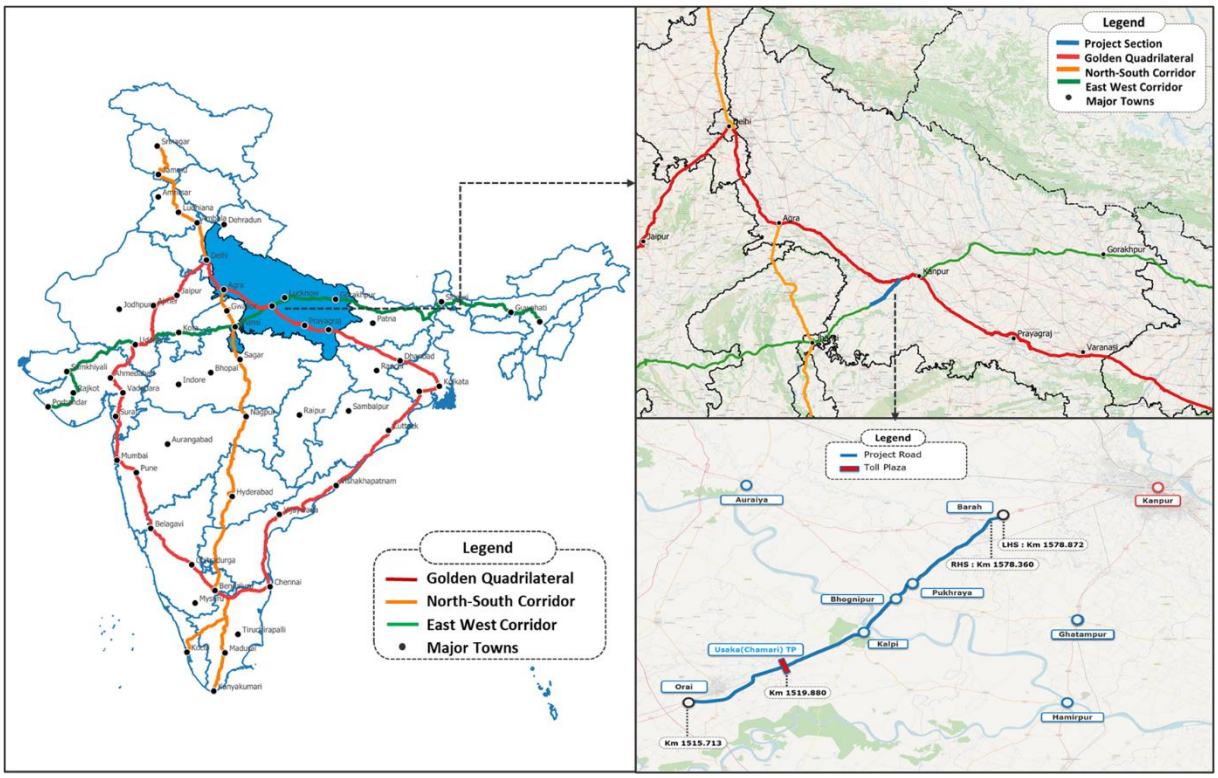

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ABBREVIATIONS

%	Percentage
2A	2 Axle truck
3A	3 Axle truck
AADT	Annual Average Daily Traffic
ADT	Average Daily Traffic
AR	Alternate Route
BAU	Business-As-Usual
BIA	Broad Influence Area
CAGR	Compounded Annual Growth Rate
CSO	Central Statistical Organisation
BOT	Build Operate Transfer
ETC	Electronic Toll Collection
FY	Financial Year
GDP	Gross Domestic Product
GoI	Government of India
GSDP	Gross State Domestic Product
IIA	Immediate Influence Area
IHMCL	Indian Highways Management Company Limited
InvIT	Infrastructure Investment Trust
IRC	Indian Road Congress
Km	Kilometre
LCV	Light Commercial Vehicle
M Bus	Minibus
MAV	Multi Axle Vehicle
MLCV	Mini LCV
MoRTH	Ministry of Road Transport and Highways
NH	National Highway
NHAI	National Highways Authority of India
NHDP	National Highway Development Program
NHIIMPL	National Highways Infra Investment Managers Private Limited
NPV	Net Present Value
OD	Origin-Destination survey
OMT	Operate, Maintain and Transfer
PCU	Passenger Car Unit
PIA	Project Influence Area
PR	Project Road
PV	Present Value
RBI	Reserve Bank of India
Rs/₹	Rupees
SCF	Seasonal Correction Factor
SH	State Highway
Sq.km	Square Kilometre
TP	Toll Plaza
UPEIDA	Uttar Pradesh Expressways Industrial Development Authority
WPI	Wholesale Price Index
YOY	Year on Year

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Appendix 2.1: Traffic Zoning System

Appendix 2.2: Travel pattern- Top 20 OD pairs

EXECUTIVE SUMMARY

Project Overview

The project highway, NH-27, is a crucial part of the East-West corridor, as envisioned in the National Highway Development Program (Phase-II). This project spans approximately 3,530 km, starting from Porbandar in Gujarat and ending in Silchar, Assam, passing through Rajasthan, Madhya Pradesh, Uttar Pradesh, Bihar, and West Bengal. The highway connects several prominent tourist and industrial cities, such as Porbandar (a port city), Rajkot, Palanpur, Udaipur, Chittorgarh, Jhansi, Kanpur, Lucknow, Muzaffarpur, Purnea, Siliguri, and Jalpaiguri etc.

The project road section Orai-Barah, with approximate length of 62.8 km, starts near Orai in Jalaun district and ends near Barah in Kanpur Dehat district. The project road has one operational toll plaza (Usaka TP) near Chamari.

Figure 0-1 shows the context and alignment of project road with major places along the highway.

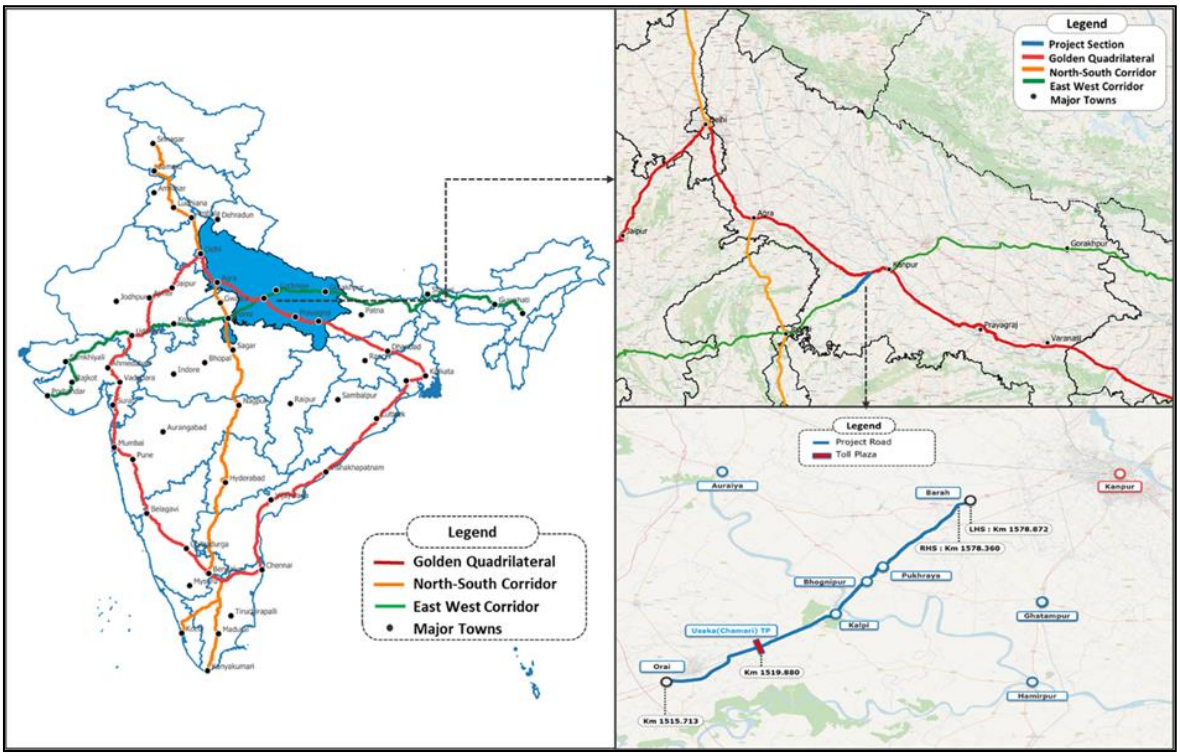


Figure 0-1: Orai-Barah Section and Location of Toll Plaza

Project Road Characteristics and Profile of Influencing Districts

The project road serves as a major route for east-west long-distance traffic between the Lucknow/Gorakhpur/eastern region and Palanpur/Rajkot/western region, while also catering to short-distance traffic between Orai/Jhansi and Kanpur/Lucknow/Unnao areas. The project road section is located in the districts of Jalaun and Kanpur Dehat.

The economy of Jalaun district broadly relies on agriculture with wheat, pea, lentil, gram, different types of pulses, mango, mushrooms and other crops being major agricultural

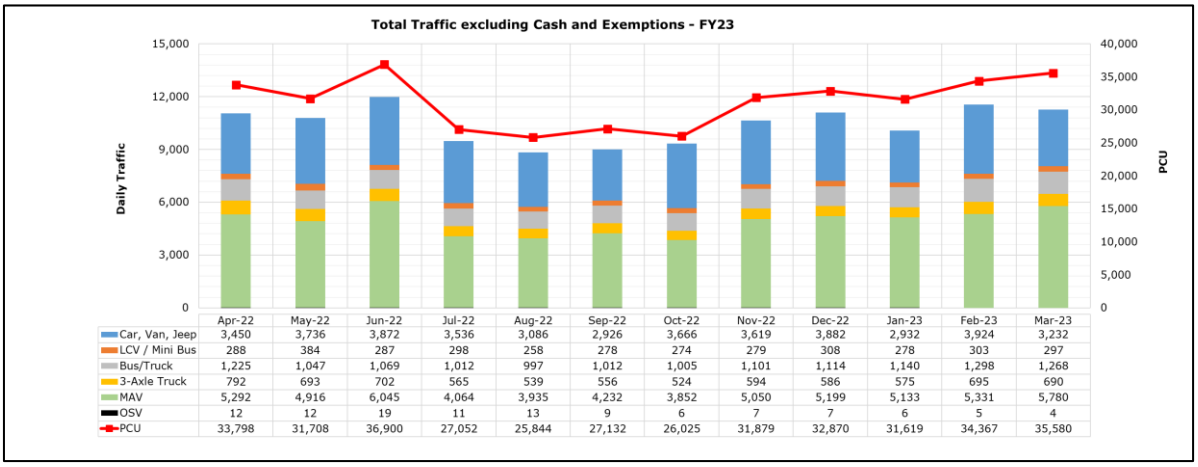
products. Despite being moderately industrialized, the district has a few industries of handloom, dairy, and agro food processing. Pea has been listed under the ODOP Programme by MOFPI, while handmade paper art has been listed by GoUP under its ODOP Programme.

Kanpur Dehat district is located in the central plain zone, with fertile agricultural hinterland being its advantage. The staple agricultural produce includes wheat, paddy, rice, pulses, sugarcane, oil seeds, maize, and potato. Fisheries and animal husbandry also contribute to its economy. The district is moderately industrialized, with leather, iron, food grains, yarn, wood, cloth, and fertilizer being some of the important commodities exported. Milk products have been listed under the ODOP Programme by MOFPI, while aluminium utensils have been listed by GoUP under its ODOP Programme.

Annual Average Daily Traffic (AADT)

Estimation of FY23 AADT

The month-on-month mode wise ETC data (excluding cash and exemptions) for the period April 2022 to March 2023 for the toll plaza is presented in **Figure 0-2**.



	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23
Car, Van, Jeep	3,450	3,736	3,872	3,536	3,086	2,926	3,666	3,619	3,882	2,932	3,924	3,232
LCV / Mini Bus	288	384	287	298	258	278	274	279	308	278	303	297
Bus/Truck	1,225	1,047	1,069	1,012	997	1,012	1,005	1,101	1,114	1,140	1,298	1,268
3-Axle Truck	792	693	702	565	539	556	524	594	586	575	695	690
MAV	5,292	4,916	6,045	4,064	3,935	4,232	3,852	5,050	5,199	5,133	5,331	5,780
OSV	12	12	19	11	13	9	6	7	7	6	5	4
PCU	33,798	31,708	36,900	27,052	25,844	27,132	26,025	31,879	32,870	31,619	34,367	35,580

Figure 0-2: Month on Month Traffic Data for Usaka TP – FY23

The AADT for FY23 has been derived using ETC data for the period of 12 months from the complete financial year data series of FY23 viz., April 2022 to March 2023. The daily cash and exemption data was available from the traffic count summary report of M/s PATH Ltd for the period of April 2022-December 2022. The FY23 AADT has been derived by adding these exemption and cash traffic to the estimated FY23 ETC AADT. The steps of derivation of FY23 AADT are presented in **Table 2-6**.

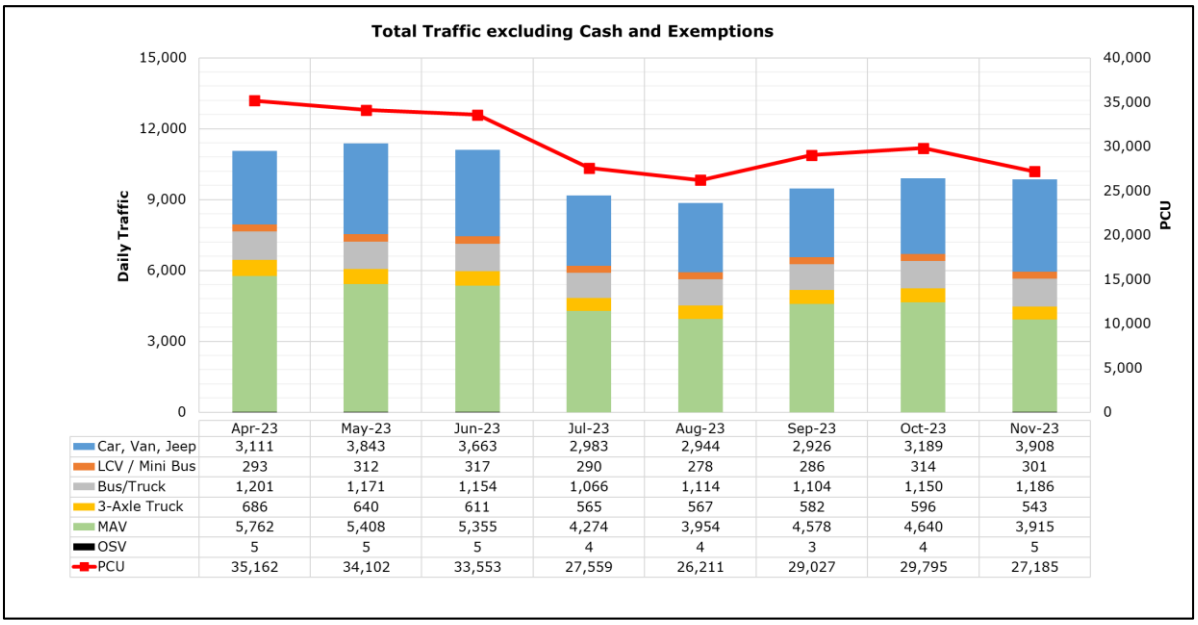
Sr. No.	Particulars	Car/Jeep/Van	LCV	2 Axle	3 Axle	MAV	OSV	PCU
Daily Total Traffic without Cash and Exemptions								
A = April 2022-March 2023 Monthly Traffic/365	Total Traffic without Cash and exemption	3,485	294	1,106	625	4,896	9	31,192
Daily Cash and Exemptions from the Traffic Count Summary Report of PATH								
B	Daily Cash (Apr-Dec 2022 Avg)	72	4	2	1	1	0	-

Sr. No.	Particulars	Car/Jeep/Van	LCV	2 Axle	3 Axle	MAV	OSV	PCU
C	Daily Exemptions (Apr-Dec 2022 Avg)	430	7	5	2	4	0	-
D = A+B+C	**Total Traffic with Cash and Exemption - AADT FY23**	3,987	304	1,112	628	4,901	9	31,760

Table 0-1: Estimation of FY23 AADT

Estimation of FY24 AADT

The month-on-month mode wise ETC data (excluding cash and exemptions) for the period April 2023 to November 2023 for the toll plaza is presented in **Figure 0-3**.



	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23
Car, Van, Jeep	3,111	3,843	3,663	2,983	2,944	2,926	3,189	3,908
LCV / Mini Bus	293	312	317	290	278	286	314	301
Bus/Truck	1,201	1,171	1,154	1,066	1,114	1,104	1,150	1,186
3-Axle Truck	686	640	611	565	567	582	596	543
MAV	5,762	5,408	5,355	4,274	3,954	4,578	4,640	3,915
OSV	5	5	5	4	4	3	4	5
PCU	35,162	34,102	33,553	27,559	26,211	29,027	29,795	27,185

Figure 0-3: Month on Month Traffic Data for Usaka TP – FY24

The ETC data has been made available for the period of 9 months from April 2023 to November 2023. Based on the analysis of the traffic, FY24 AADT for cars and LCVs have been estimated by applying 8-12 months factor on April-November 2023 average ETC traffic. For other modes of 2A/3A and MAV, it is found appropriate that the base traffic from Aug to November is utilised for estimating the AADT for FY24 as these months present the actual trend of traffic after opening of Bundelkhand Eway. In view of this, 4-12 months factor has been applied on August-November 2023 average traffic of these modes. The correction factors were derived from average ETC traffic for FY23 of the adjacent toll plazas of Ait, Semri and project road TP of Usaka.

The steps of derivation of FY24 AADT are presented in **Table 0-2**.

Sr. No.	Particulars	Car/Jeep/ Van	LCV	2 Axle	3 Axle	MAV	OSV	PCU
Daily Total Traffic without Cash and Exemptions								
A. April-Nov 2023 Average	Total Traffic without Cash and exemption	3,823	309					
B. Aug-Nov 2023 Average				1,145	575	4,276	4	
C. 8-12 months (April-Nov)	SCF	1.02	1.01					
D. 4-12 months (Aug-Nov)				1.05	1.09	1.10	1.09	
E. ETC AADT		3,888	312	1,205	625	4,702	4	31,021
Daily Cash and Exemptions from the Traffic Count Summary Report of PATH								
F	Daily Cash (Apr-Dec 2022 Avg)	72	4	2	1	1	0	
G	Daily Exemptions (Apr-Dec 2022 Avg)	430	7	5	2	4	0	
AADT FY24 Including cash and Exemptions								
I = E+F+G	**AADT**	4,389	322	1,211	628	4,706	4	31,589

Table 0-2: Estimation of FY24 AADT

Travel Pattern as per November 2022 OD Survey

- Provides direct connectivity to Kanpur/Lucknow & beyond in the east and Jhansi/Gwalior/Indore & beyond in the west.
- Project road is majorly influenced by the stone mining units located near Jhansi. About 50 percent of freight and around 90 percent of passenger traffic on the project road has interactions between Jhansi/Orai and Kanpur/Lucknow. About 15 percent of freight traffic is to/from Indore/Bhopal from/to Kanpur/Lucknow.
- The majority of car traffic (around 37.9 percent) has trip lead between 100 to 200 km at toll plaza location. These trips are observed mainly from/to Orai/Jhansi to/from Kanpur/Unnao/Lucknow/Kalpi/Daulatpur. In addition, short distance trips (>25 & <=50 km) of about 15.8 percent are found to be between Orai to Kalpi/ Daulatpur/Bhognipur/Pukhrayan.

Network Impacts

In context of the project road, two road network developments which may impact the traffic on the project road are:

- Improvement of Sagar-Kanpur-Lucknow corridor under Bharatmala Pariyojana - applicable traffic stream is from/to Indore/Bhopal & surroundings to/from Kanpur & beyond.
- Completion of Chambal Expressway (CE) and Delhi-Mumbai Expressway (DME) - Analysis done for two traffic streams:
    - Ahmedabad & surroundings – Kanpur & beyond
    - Mumbai & surroundings – Kanpur & beyond

The potential traffic and diverted traffic related to these two developments are presented in **Table 3-2**.

Modes	2A	3A	MAV
Potential Traffic as % of AADT			
Indore-Kanpur via Sagar Route			
Indore-Kanpur via Sagar traffic as % of AADT	4.6	5.8	8.1
Ahmedabad/Mumbai via DME & CE Route			
Ahmedabad-Kanpur Traffic via DME & CE	6.7	7.7	7.5
Mumbai-Kanpur Traffic via DME & CE	5.7	8.1	9.9
Loss as % of AADT			
Indore-Kanpur via Sagar Route	-0.9	-1.1	-1.7
Ahmedabad/Mumbai via DME & CE Route (A)	-8.7	-11.5	-11.6
Adopted Loss as % of AADT			
Indore-Kanpur via Sagar Route	-0.9	-1.1	-1.7
Ahmedabad/Mumbai via DME & CE Route			
B. Captive Traffic for PR (%)	33.3	33.3	33.3
C. Diverted to Expressway (%) = A*(1-B)	-5.8	-7.7	-7.7

Table 0-3: Diversion Analysis for Indore-Kanpur via Sagar Route

The Kandla – Lucknow economic corridor is expected to be completed in FY28. Therefore, the impact of Indore – Kanpur via Sagar diversion has been considered under the base case from FY28 onwards and phased over three years with 50% diversion in FY28, 75 percent in FY29 and 100% in FY30 onwards.

Similarly, the impact of Ahmedabad/ Mumbai via DME & CE route has been considered under the base case from FY29 onwards and phased over three years with 50 percent diversion in FY29, 75 percent in FY30 and 100 percent in FY31 onwards.

Traffic Growth rates

The estimated traffic growth rates for the project road based on the elasticity approach along with the implied growth rates after considering the impact of diversions have been presented in **Table 3-11**.

FY/Modes	Cars	LCV	Bus/ 2A Truck	3A	MAV	Cars	LCV	Bus/ 2A Truck	3A	MAV
	Normal Growth Rates					Implied Growth Rates				
2025	8.1	3.1	3.1	3.8	6.2	8.1	3.1	3.1	3.8	6.2
2026	8.6	3.3	3.3	4.0	6.7	8.6	3.3	3.3	4.0	6.7
2027	8.3	3.2	3.2	3.9	6.4	8.3	3.2	3.2	3.9	6.4
2028	8.2	3.2	3.2	3.8	6.3	8.2	3.2	2.9	3.2	5.4
2029	7.8	3.0	3.0	3.6	6.0	7.8	3.0	1.2	-0.7	1.5
2030	7.4	2.9	2.9	3.5	5.7	7.4	2.9	1.9	1.1	3.1
2031	6.8	2.9	2.9	3.5	5.2	6.8	2.9	2.0	1.3	3.0
2032	6.8	2.9	2.9	3.5	5.2	6.8	2.9	2.9	3.5	5.2
2033	6.8	2.9	2.9	3.5	5.2	6.8	2.9	2.9	3.5	5.2
2034	6.7	2.8	2.8	3.4	5.1	6.7	2.8	2.8	3.4	5.1
2035	6.6	2.8	2.8	3.3	5.0	6.6	2.8	2.8	3.3	5.0
2036	6.5	2.7	2.7	3.3	4.9	6.5	2.7	2.7	3.3	4.9
2037	6.4	2.7	2.7	3.2	4.9	6.4	2.7	2.7	3.2	4.9
2038	6.3	2.7	2.7	3.2	4.8	6.3	2.7	2.7	3.2	4.8
2039	6.2	2.6	2.6	3.1	4.7	6.2	2.6	2.6	3.1	4.7
2040	6.1	2.6	2.6	3.1	4.6	6.1	2.6	2.6	3.1	4.6
2041	5.5	2.0	2.0	2.5	4.1	5.5	2.0	2.0	2.5	4.1
2042	5.4	2.0	2.0	2.5	4.0	5.4	2.0	2.0	2.5	4.0
2043	5.4	2.0	2.0	2.5	3.9	5.4	2.0	2.0	2.5	3.9
2044	5.3	1.9	1.9	2.4	3.9	5.3	1.9	1.9	2.4	3.9

Table 0-4: Projected Traffic Growth Rates for Project Road (%)

Mode-wise Traffic Projections

Mode-wise traffic at the project road under the base case scenario after considering diversion impacts is presented in **Table 0-5**.

FY End	CJV	LCV	Bus/2A	3A	MAV	OSV	Total PCU
2024	4,389	322	1,211	628	4,706	4	31,584
2025	4,743	332	1,249	652	5,000	4	33,461
2026	5,150	343	1,290	678	5,332	5	35,585
2027	5,578	354	1,332	704	5,676	5	37,782
2028	6,035	366	1,370	727	5,985	5	39,832
2029	6,506	377	1,387	722	6,074	5	40,752
2030	6,988	387	1,412	730	6,263	6	42,206
2031	7,466	399	1,441	739	6,450	6	43,656
2032	7,976	410	1,482	765	6,783	6	45,886
2033	8,522	422	1,524	791	7,134	7	48,235
2034	9,095	434	1,567	818	7,496	7	50,667
2035	9,697	446	1,611	846	7,872	7	53,190
2036	10,330	458	1,655	873	8,260	8	55,806
2037	10,995	471	1,699	902	8,661	8	58,517
2038	11,691	483	1,744	931	9,076	9	61,322
2039	12,419	496	1,790	960	9,503	9	64,217
2040	13,181	509	1,836	990	9,944	9	67,209
2041	13,910	519	1,873	1,015	10,347	10	69,956
2042	14,668	529	1,910	1,040	10,760	10	72,777
2043	15,453	540	1,948	1,066	11,182	10	75,670
2044	16,268	550	1,985	1,092	11,614	11	78,634
CAGR (%) (FY24 to FY44)	6.8	2.7	2.5	2.8	4.6	5.1	4.7

Table 0-5: Projected Traffic Mode-Wise for Project Road (After Diversion)

Tolling Segmentation

The tolling stream distribution has been estimated from the ETC data of FY24 (August 2023 to November 2023) to which annualised Cash & Exemptions data available from April 2022 to December 2022 has been added. The resultant ticket distribution is presented **Table 0-6**.

Type	Car	LCV	Bus/ 2A Trucks	3A Trucks	MAV	OSV
Single	36.4	72.9	62.3	83.7	47.0	100.0
Return	44.5	24.9	36.5	15.0	51.9	
Monthly						
Local personal	2.7					
Local commercial	0.4	0.0	0.7	0.9	1.0	
Exemptions and Violations	16.0	2.3	0.4	0.4	0.1	
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 0-6: Tolling Distribution

1.1 Objective and Scope of Services

The scope of the study includes the following:

- Undertake Traffic Survey on the highway section as per the following:
  - Seven days 24 hours Videography Traffic Counts at the existing toll plaza location on the project road to derive the Average Daily Traffic (ADT)
  - One day Origin-Destination survey at the existing toll plaza location to assess the existing travel pattern of vehicles plying on the project road – origin and destination
- Establish seasonality factors using available past traffic data and/or from using fuel sales data or any relevant data
- Estimation of the base year AADT using seasonality factors for conversion of ADT to AADT
- Analysis of OD data to cover:
  - Regional distribution of traffic and influence factors for different zones contributing traffic on the corridor
  - Identification of Project Influence Area from analysis of travel pattern - regional distribution of traffic,
  - Main traffic generators (industrial areas, towns, ports etc.)
  - Commodity composition- Goods type distribution
  - Top OD pairs by vehicle types
- Review of past traffic studies, traffic/toll data and other relevant reports as may be available to determine category wise volume of traffic for past years as well as for current year

- To identify competing route and analyse the network conditions, traffic characteristics & level of toll charged and the advantage/ disadvantage of the competing road and their impact on the project traffic
- Carry out a study of past economic performance of influence area
- Diversion analysis, wherever needed – cost ratio-based diversion analysis using spreadsheets to be carried out for respective potential OD pairs.
- Preparation of traffic projections till year FY53 (maximum extendable concession period) in three scenarios – low, most likely and high
- Capacity analysis of the road or any other requirements for potential capacity augmentation
- Estimation of tollable traffic streams by toll category and estimation of toll revenue as per categories of traffic streams stipulated in the tolling schedule for the study period
- Review future road and transportation network developments in the area of influence of the project and identify those schemes that may impact positively or negatively traffic on the toll road
- Identify factors which may have a positive and / or negative impact on the traffic - all major developments like DFC, industrial corridors, economic corridors, ports, Bharatmala, Sagarmala
- Scenario Analysis of toll revenue – Critical parameters of diversion (if applicable) and three scenarios of traffic growth (most likely, low and high).

Tollable Length and Toll Rates

The details of normal tolling lengths, bypass length (at 1.5 times) and equivalent structure lengths being charged at toll plaza as per the information in Schedule M for the project road are presented in **Table 0-7**.

Usaka (TP01) at km 1519.880	FY24 onwards
A. Normal	61.729
B. Bypass	0.000
C. Eq. structure	11.74
Total Road Length	62.903
Tolling Length = A+(B*1.5) + (C*10)	73.469

Table 0-7: Tolling Length (in km) for the Project Road

The stream of toll rates to be charged at the toll plaza of the project road in cardinal years till FY44 is presented in **Table 0-8**.The toll fee has been rounded to nearest 5 Rupees as per toll fee rules.

FY	Car	LCV	Bus/ 2-axle Truck	3-axle Truck	MAV	O/size/ HME	Car Local
2024	105	170	355	390	560	680	330
2025	110	175	365	400	570	695	340
2030	135	215	455	495	710	865	420
2035	165	265	555	605	870	1,060	515
2040	200	325	675	740	1,060	1,290	630
2044	235	380	795	865	1,245	1,515	735

Table 0-8: Toll Rates at Toll Plaza (in Rs)

Project Road Revenue

The travel pattern and commodity distribution with prominence of building materials (Muram and Gitti) at Usaka toll plaza is similar to that of Ait and Semri toll plazas.

As observed from the seven-day axle load analysis, around 35 percent of the MAVs and 2 percent of 3A trucks are above 20 percent overloading limit at Usaka TP whereas 3 percent of 3A trucks and 8 percent of MAVs are in the 10 percent to 20 percent overloaded category.

Continuing with the practice of two times toll, since MAVs are heavily overloaded, with WIM in place at Usaka, the practice of charging them for one-time extra payment can be put in place.

Although the quantum of overloaded vehicles is high but after factoring in the practical number of vehicles from whom overloading can be charged, under a pragmatic scenario, it is assumed that around 25 percent of this 33 percent overloaded category is charged for one-time additional payment. This results in around 8.25 percent of MAV AADT of FY24 - paying one-time extra toll. With appointed date likely to be achieved in April 2025 and considering the time required for putting the systems in place for overloading revenue collection, this additional revenue from overloaded vehicles is considered from FY26. The estimated revenue from overloading in FY26 is Rs 96.3 million.

However, with strict overloading compliance in place in the future years, this overloading percentage of 33 percent (considered till FY26) is likely to decline over the years of concession - a decline of 1 percent every year has been considered starting from FY27 onwards. The project road revenue under the base case scenario is presented in **Table 0-9**.

FY Ending March	Base Case with one-time extra payment from overloaded MAVs
2024	1,197.4
2025	1,291.6
2026	1,540.8
2027	1,710.8
2028	1,876.2
2029	1,987.5
2030	2,127.3
2031	2,283.2
2032	2,496.9
2033	2,713.5
2034	2,957.1
2035	3,232.4
2036	3,522.7
2037	3,816.4
2038	4,158.8
2039	4,519.9
2040	4,919.1
2041	5,303.9
2042	5,724.8
2043	6,178.3
2044	6,680.1
PV12 FY24 to FY44	18,108
CAGR FY24 to FY44	9.0%

Table 0-9: Base Case Revenue in Rs Million

The project road revenues will have a CAGR of 9.0 percent for the period FY24 to FY44.

1. INTRODUCTION

1.1 General

National Highways Authority of India (NHAI) has setup NHAI InvIT to monetize its completed and operational National Highway projects with the objective of mobilizing additional resources through capital markets. The section viz., Orai-Barah of NH-27 in the state of Uttar Pradesh referred to as Project Road (PR), has been identified by National Highways Infra Investment Managers Private Limited (NHIIMPL) for transfer to InvIT in the third round.

The project highway, NH-27, is part of the East – West corridor envisaged under National Highway Development Program (Phase – II). The total length of NH-27 is roughly 3,530 km starting from Porbandar in the state of Gujarat and ending at Silchar in the state of Assam while passing through the states of Rajasthan, Madhya Pradesh, Uttar Pradesh, Bihar and West Bengal. NH–27 connects important tourist and industrial cities and towns like Porbandar (port city), Rajkot, Palanpur, Udaipur, Chittorgarh, Jhansi, Kanpur, Lucknow, Muzaffarpur, Purnea, Siliguri, Jalpaiguri etc. **Figure 1-1** shows the alignment of NH-27 with major places along the highway.

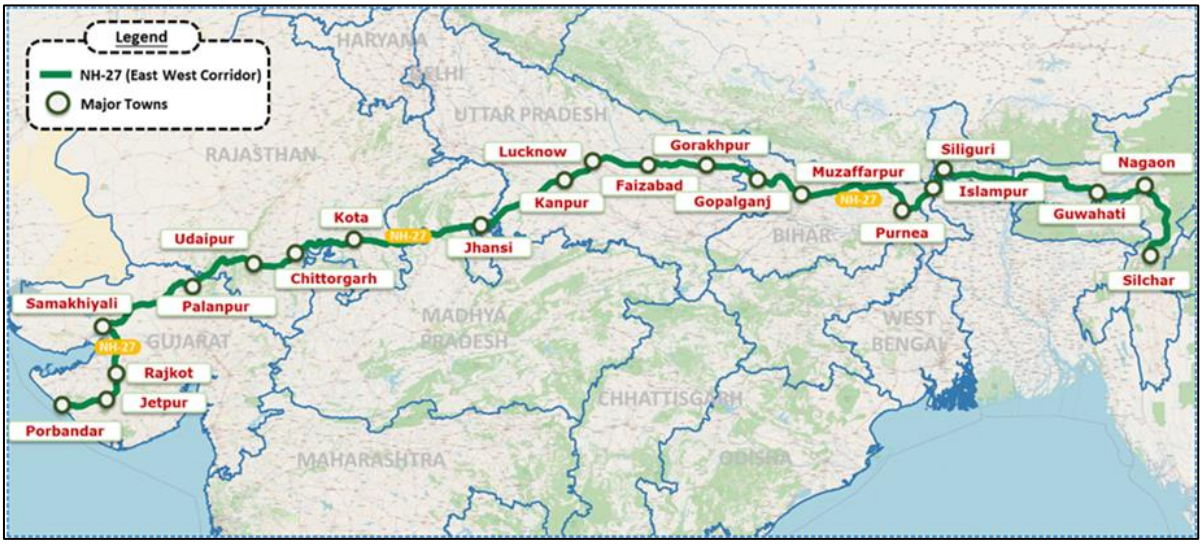


Figure 1-1: Alignment of NH-27 with Major Places

The project road section, Orai-Barah, starts near Orai in Jalaun district and ends near Barah in Kanpur Dehat district. Four laning work of Orai to Bara Section of NH-25 (new NH – 27) (approx. length – 62.8 km) was awarded to M/s O B Infrastructure Ltd in April 2006 on BOT Annuity Basis. The project road has one operational toll plaza (Usaka TP) near Chamari.

National Highways Infra Investment Managers Private Limited, has appointed Ramboll India Private Ltd as the Traffic Consultant to carry out a traffic study for assessing the present traffic levels, travel pattern and future traffic & revenue estimation for a concession period of 20 years duly considering the network characteristics, future economic perspective in the influence area of the project.

1.2 Report Structure

This report is divided into four chapters, including this introduction chapter. Chapter 2 details upon the project road characteristics and socio – economic profile of the districts in the project influence area including the estimation of AADT and travel characteristics in the Project Influence Area (PIA). Chapter 3 contains the details on the derivation of traffic growth rates used for traffic forecasting and presents traffic projections for the study period. Chapter 4 presents the details regarding tolling strategy, toll rates and the revenue projections for the duration of the concession.

2. TRAFFIC SURVEY AND ANALYSIS

2.1 General

In order to understand the traffic characteristics, the volume of traffic and travel pattern of vehicles plying on the project road were collected through primary surveys. This chapter presents the details of the project road characteristics, traffic surveys carried out, their analysis and the salient findings. The results of the analysis will be utilized in assessing the traffic growth and estimation of traffic and revenue forecast on the project road for the concession period.

2.2 Project Road Characteristics

The project road section, Orai-Barah, a part of the NH-27 in the state of Uttar Pradesh, starts at km 1515.713 near Orai and ends near Barah at km 1578.872 (LHS) & km 1578.360 (RHS) with a length of about 62.8 km. The project road falls under the jurisdiction of Jalaun district and Kanpur Dehat district passing through settlements of Kalpi, Bhognipur and Pukhraya. There is one operational toll plaza (Usaka TP) on the project road near Chamari (km 1519.880).

The alignment of project road and toll plaza location is shown in **Figure 2-1**.

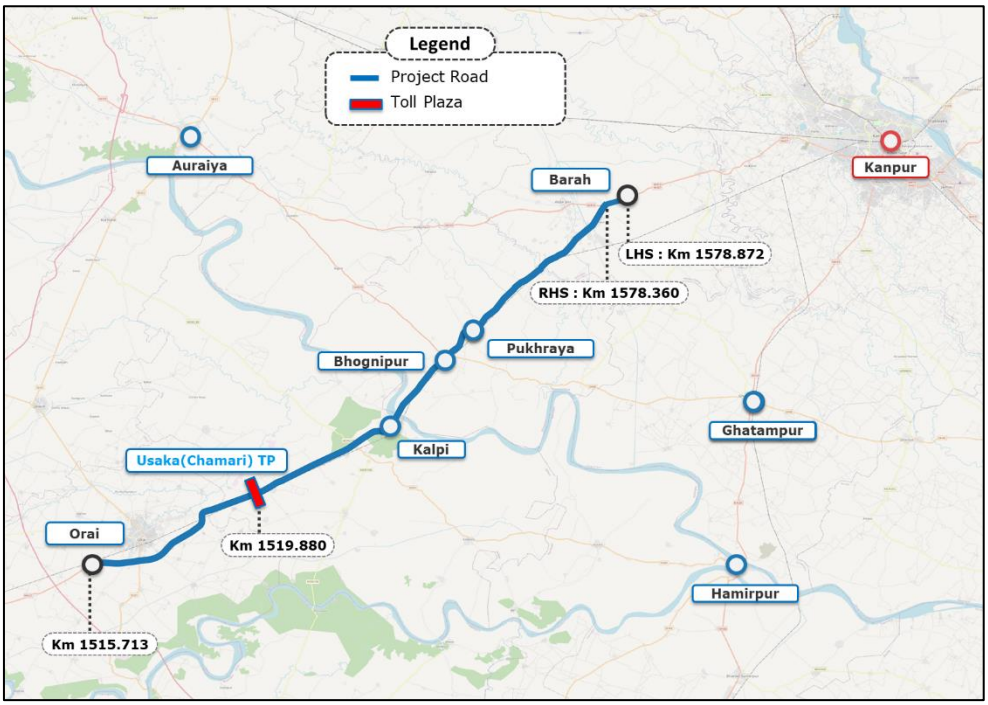


Figure 2-1: Orai-Barah Section and Location of Toll Plaza

The project road in wider context serves for east-west long-distance traffic which is majorly plying between Lucknow/Gorakhpur/eastern region and Palanpur/Rajkot/ western region. Apart from long distance traffic, it also serves the short distance traffic which is mainly generated between Orai/Jhansi and Kanpur/Lucknow/Unnao areas.

2.2.1 Toll Plazas in vicinity of the project road

The details of the toll plazas between Jhansi and Kanpur in the vicinity of the project section are presented in **Figure 2-2**.

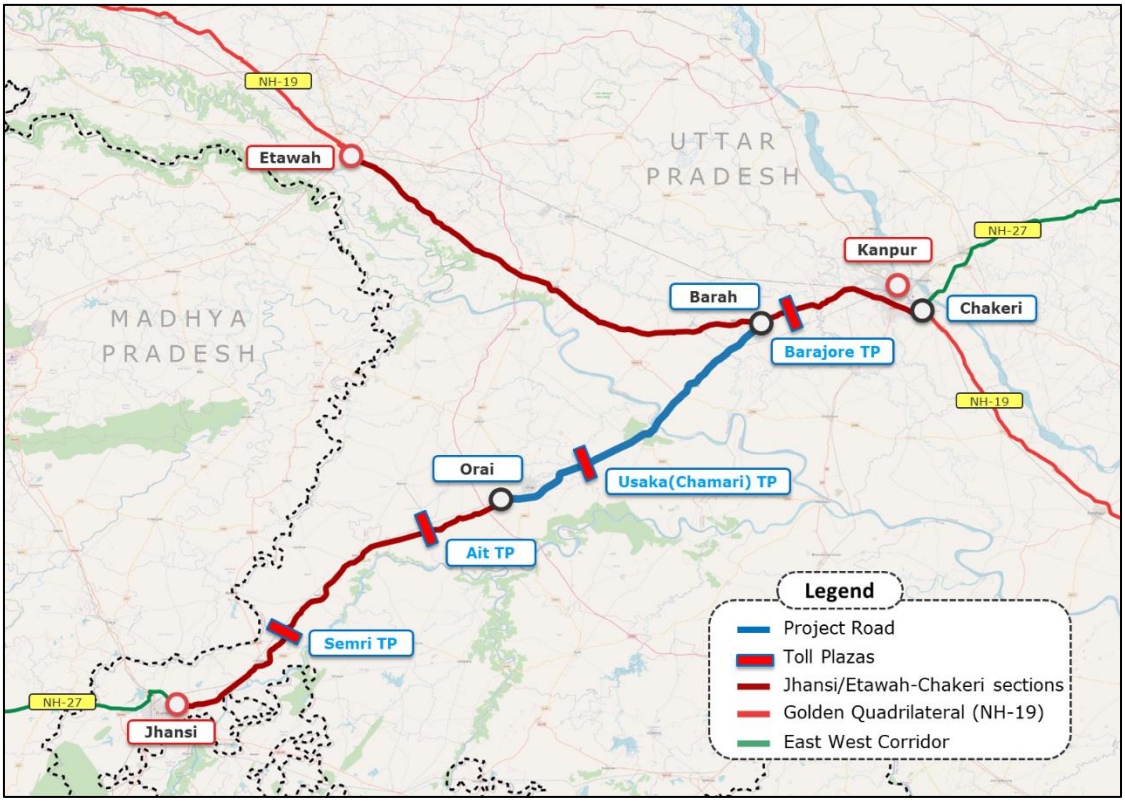


Figure 2-2: Toll Plazas in Vicinity of the Project Road

The section from Jhansi to Orai is currently under OMT contract with M/s PATH Ltd. and has 2 toll plazas at Ait and Semri. The section of Orai to Barah (Usaka TP) is subject of the current study. The toll plaza of Barajore between Barah to Chakeri is a part of 6 laned Etawah-Chakeri package under NHDP Phase-II Delhi-Kolkata corridor. The traffic levels for the month of December 2022 and November 2023 for these plazas as available from IHMCL are presented in **Table 2-1**.

Toll Plazas	LMV	LCV / M Bus	BUS	2A	3A	MAV	PCUs
December 2022							
Semri	3,872	304	330	838	621	4,934	31,898
Ait	3,651	300	298	848	654	5,036	32,163
Usaka	3,882	308	315	799	586	5,206	32,871
Barajore	13,885	1239	898	2,374	1,615	8,276	67,647
November 2023							
Semri	4,755	343	389	1,019	631	4,345	30,939
Ait	4,182	326	338	993	625	4,432	30,484
Usaka	3,908	301	339	847	543	3,920	27,185
Barajore	15,078	1,096	928	2,428	1,364	6,751	61,263

Table 2-1: Traffic Levels at Toll Plazas between Jhansi and Kanpur

Similar levels of mode wise traffic and overall PCUs (32,000 in FY23) have been observed at the three toll plazas of Semri, Ait and Usaka between Jhansi and Barah whereas November 2023 shows a variaton of around 3,500 PCUs between Usaka and Air/Semri Toll Plazas. However, the Barajore toll plaza indicates a higher level of around 68,000

PCUs due to the traffic merging from Etawah (NH-19) at Barah in FY 23 and 61,000 PCUs in FY24. Further a detailed analysis has been done to identify this variation between FY23 and FY24 ETC Traffic.

2.2.2 Profile of Project Influence Area Districts

The project road section falls under the district of Jalaun district and Kanpur Dehat District.

Jalaun District

Jalaun district lies in the western part of Uttar Pradesh with an area of 4,565 sq. km. It is bounded by Etawah district and Auraiya district on the north, Ramabai Nagar district on the north-east, Lalitpur district on the south, Hamirpur district on the south-east and Madhya Pradesh on the west. The district is divided into 5 tehsils namely Jalaun, Kalpi, Konch, Madhogarh and Orai having its district headquarter at Orai. According to the 2011 census, the district has a population of 1.68 million with decadal growth of about 16.19 percent.

Agriculture is the backbone of the economy of the district. The major agricultural crops of the district are wheat, pea, lentil, gram, different types of pulses, mango, mushrooms, etc. The district is scantily industrialised having only a few industries of handloom, dairy and agro food processing. For Jalaun district, pea is listed under ODOP Programme by MOFPI while handmade paper art has been listed by GoUP under its ODOP Programme.

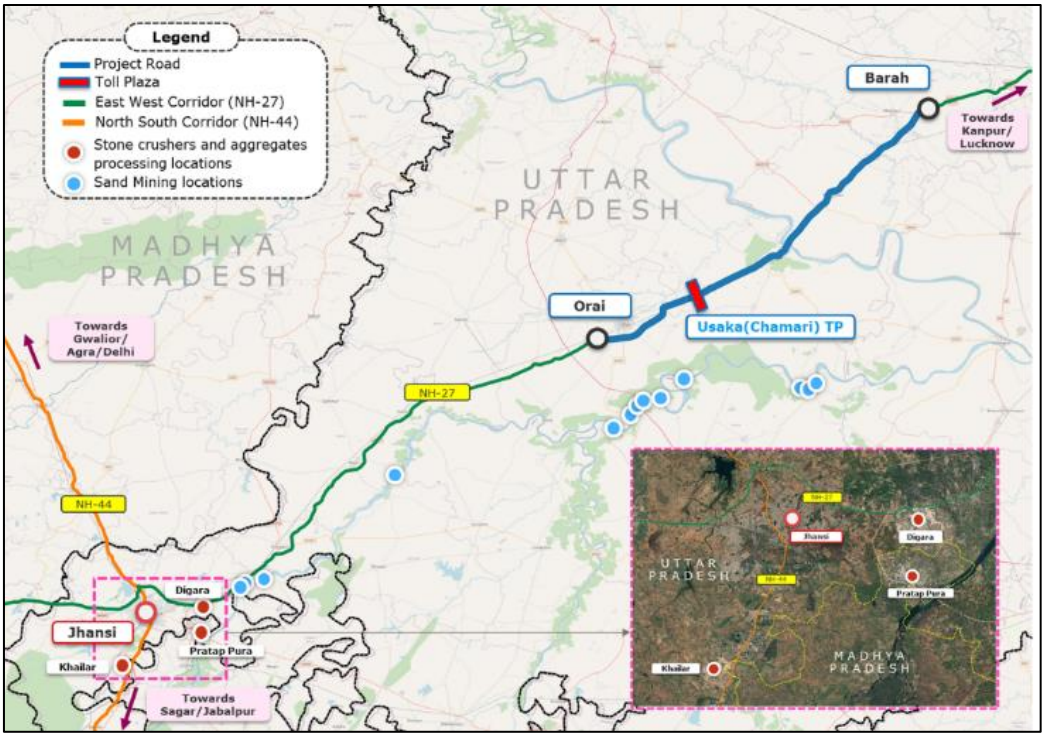


Figure 2-3: Location of Potential Sand Mining and Stone Crushers

The prominent rivers flowing through the district are Betwa and Yamuna. Sand mining is done along the deposits of Betwa river below Orai near the settlements of Bandhuali, Kharka, Jhansi etc, which in turn supply sand for increasing construction activities in

Kanpur/Unnao and other surrounding settlements. The mining lease renewal period for sand (Muram) is for a short duration of 1-2 years. Along with sand mining, in the district of Jhansi, many stone crushing units have been setup that provide stone aggregates also used for construction activities. The lease for stone aggregates (Gitti) is issued for a longer duration (mainly till 2032-2033). The location of potential sand mining, stone crushing and aggregates processing area are presented in **Figure 2-3**.

Kanpur Dehat District

Kanpur district was split into two districts namely Kanpur Nagar and Kanpur Dehat in year 1981. The district is located in the south-western part of the Uttar Pradesh state and falls under Kanpur division. The headquarter of Kanpur Dehat district is in Mati-Akbarpur, and the district has an area of 3,021 sq. km. According to 2011 census, the Kanpur Dehat district has a population of 1.79 million with decadal growth of about 14.89 percent.

Kanpur Dehat district is an agriculturally dominating district and it is in the central plain zone which has an advantage of fertile agricultural hinterland. The staple agricultural produce includes wheat, paddy, rice, pulses, sugarcane, oil seeds, maize, potato etc. Fisheries and animal husbandry also contribute to its economy to some extent. The district is moderately industrialized. The important commodities which are exported from the district are leather, iron, food grains, yarn, wood, cloth and fertilizer etc. Milk products is listed under ODOP Programme by MOFPI while aluminium utensils have been listed by GoUP under its ODOP Programme.

2.3 Traffic Surveys

In order to understand the characteristics and the volume of traffic using the project roads, data on road network, traffic and travel pattern of vehicles plying on the project road were collected through primary traffic surveys. Traffic volume video graphic survey for seven days and origin-destination (OD) survey as roadside interview for one day at toll plaza location were conducted on the project road. The schedule of the traffic surveys carried out as part of this study and location on the project road are given in **Table 2-2**.

Section	Location	Duration	Date(s)
Classified Traffic Volume Counts			
Orai-Barah	Usaka TP	7 Days	18/11/2022 to 24/11/2022
Origin and Destination Survey			
Orai-Barah	Usaka TP	1 Day	18/11/2022

Table 2-2: Traffic Survey Location and Schedule

Trained enumerators were engaged for conducting traffic surveys under the supervision of experienced transport planner. The vehicle classification as generally used in the traffic surveys of NHAI studies along with their PCU values, as suggested in IRC: 64 – 1990, are presented in **Table 2-3**.

Vehicle Type	PCU Factor
Motorized Vehicles	
Car, Jeep, Van &Taxi	1.0
Two –Wheeler	0.5
Three-Wheeler (Auto-Rickshaw)	1.0
Mini-Bus/ School Bus	1.5
Govt. Bus/ Private Bus	3.0
Mini LCV/Max Pick Up	1.0
Light Commercial Vehicle (LCV)	1.5
2-Axle Truck	3.0
3-Axle Truck	3.0
Multi-Axle Vehicle (MAV 4-6 Axle)	4.5
HME	4.5
Agricultural Tractor	1.5
Agricultural Tractor with Trailer	4.5
Non – Motorised Vehicles	
Cycle	0.5
Cycle Rickshaw	2.0
Animal Drawn Cart	6.0

Table 2-3: Vehicle Classification and PCU Factors

2.4 Traffic Characteristics As Per November 2022 surveys

The data collected from the traffic volume count survey was analysed in order to get the results with respect to existing traffic intensity, flow pattern, hourly variation and composition of traffic on the study road network. The various traffic characteristics have been analysed under the following heads:

- Average Daily Traffic (ADT)
- Daily variation, Hourly Variation and Traffic Composition
- Annual Average Daily Traffic (AADT)

2.4.1 Average Daily Traffic (ADT)

The traffic volume data collected at the toll plaza location during the seven days survey has been analysed. The summary of ADT in terms of vehicles and PCUs is presented in **Table 2-4**.

Mode	Usaka TP
Tollable vehicles	
Car/Jeep/Van/Taxi	3,506
Minibus	83
Standard Bus	327
Mini LCV	781
LCV	700
2 Axle	409
3 Axle	621
MAV (4-6 Axle)	5,178
HMV/ MAV (=>7 Axle)	4
Non Tollable vehicles	
Two-Wheeler	5,070
Auto Rickshaw	955
Agri. Tractors	281
Total Non-Motorised	39
Total Vehicles/PCUs	
Total Tollable Vehicles	**11,609**
Total Non Tollable Vehicles	**6,344**
Total Vehicles	**17,953**
Total PCU	**37,528**
Tollable PCU	**32,852**

Table 2-4: Average Daily Traffic

- The observed total vehicles are around 17,953 at toll plaza location.
- The share of passenger vehicles (including two-wheelers) in total traffic is 55.4 percent.
- Car traffic has a share of around 19.5 percent (3,506 vehicles) at toll plaza location of the total traffic. Freight vehicles account for a share of 44.4 percent at toll plaza.
- Within the freight traffic, MAV accounts for 44.6 percent (5,178 vehicles).
- The tollable traffic recorded at toll plaza are 64.6 percent. The remaining non-tollable traffic mainly comprise of two wheelers and auto rickshaws.

2.4.2 Daily Variation, Hourly Variation and Traffic Composition

The day wise variation, hourly variation, and the traffic composition at the toll plaza location on PR is presented in **Figure 2-4**.

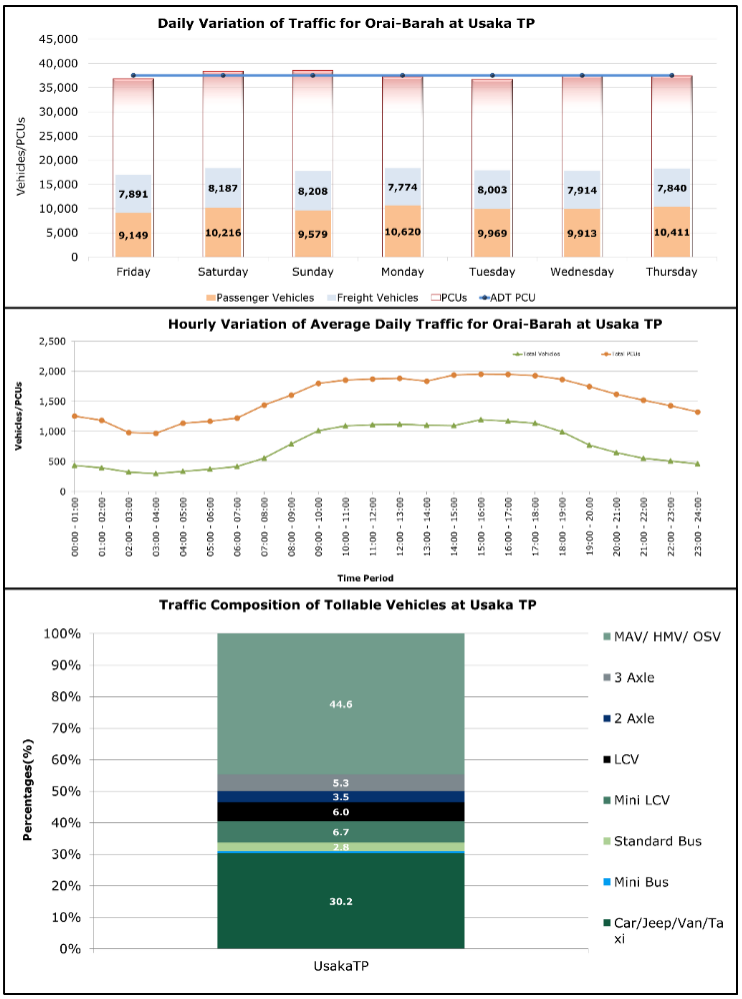


Figure 2-4: Daily Variation, Hourly Variation and Traffic Composition at Usaka TP

- It was observed that the traffic at the toll plaza is consistent with minor fluctuations during the days of volume count survey.
- The directional distribution at the toll plaza location is almost equal with Jhansi-Kanpur having a directional share of 51.4 percent.
- The peak hour at the toll plaza was observed to be in the afternoon between 15:00 - 16:00.
- Car traffic has a share of about 30.2 percent at the toll plaza location and MAV traffic has a share of 44.6 percent at the toll plaza location.

2.4.3 Comparison of Toll Data with TVC

Schedule M vs ETC

The past Schedule M data was made available by the client from July 2016 to November 2022 and past ETC data was made available from November 2017 to November 2022. Comparison of Schedule M and ETC in FY23 shows that Schedule M data is higher than ETC data in PCUs. The percent variation is about 2-3 percent except September where Schedule M data seems to be incomplete as it is not in line with other months. It is worth mentioning here that Schedule M also has cash paying and exemptions traffic.

ETC vs TVC

The TVC survey was conducted from 18th November 2022 to 24th November 2022. A comparison between TVC and ETC for the days of the survey is presented in **Table 2-5**.

Day/Date	Car	LCV	Bus/ 2 A	3 A Truck	4-6 A Truck	OSV	Total	Total excl Car
TVC								
Friday, Nov 18, 2022	3,866	737	727	535	5,231	1	11,097	7,231
Saturday, Nov 19, 2022	4,626	827	748	747	5,248	1	12,197	7,571
Sunday, Nov 20, 2022	4,331	780	731	675	5,418	3	11,938	7,607
Monday, Nov 21, 2022	4,289	773	713	566	5,107	0	11,448	7,159
Tuesday, Nov 22, 2022	4,374	831	737	573	4,961	0	11,476	7,102
Wednesday, Nov 23, 2022	4,260	752	749	656	5,172	1	11,590	7,330
Thursday, Nov 24, 2022	4,262	782	748	594	5,127	1	11,514	7,252
Average	4,287	783	736	621	5,181	1	11,609	7,322
ETC + Cash+ Exempt								
Friday, Nov 18, 2022	3,708	369	1,101	604	5,293	4	11,079	7,371
Saturday, Nov 19, 2022	4,320	355	1,136	758	5,285	6	11,860	7,540
Sunday, Nov 20, 2022	4,209	365	1,105	690	5,397	8	11,774	7,565
Monday, Nov 21, 2022	3,944	337	1,117	560	5,104	5	11,067	7,123
Tuesday, Nov 22, 2022	4,037	370	1,155	590	4,980	6	11,138	7,101
Wednesday, Nov 23, 2022	4,025	338	1,096	577	5,201	6	11,243	7,218
Thursday, Nov 24, 2022	4,023	303	1,148	586	5,145	3	11,208	7,185
Average	4,038	348	1,123	624	5,201	5	11,338	7,300
TVC MINUS ETC								
Friday, Nov 18, 2022	*158*	*368*	*-374*	*-69*	*-62*	*-3*	*18*	-140
Saturday, Nov 19, 2022	*306*	*472*	*-388*	*-11*	*-37*	*-5*	*337*	31
Sunday, Nov 20, 2022	*122*	*415*	*-374*	*-15*	*21*	*-5*	*164*	42
Monday, Nov 21, 2022	*345*	*436*	*-404*	*6*	*3*	*-5*	*381*	36
Tuesday, Nov 22, 2022	*337*	*461*	*-418*	*-17*	*-19*	*-6*	*338*	1
Wednesday, Nov 23, 2022	*235*	*414*	*-347*	*79*	*-29*	*-5*	*347*	112
Thursday, Nov 24, 2022	*239*	*479*	*-400*	*8*	*-18*	*-2*	*306*	67
Average	249	435	-386	-3	-20	-4	270	21

Table 2-5: Comparison Between TVC and ETC

The main observations from the comparison are:

- TVC data is higher than ETC data in total vehicles for all the survey days
- The variation in car is explained by the local pass reusage vehicles which are not included in ETC.
- The percent variation of total traffic excluding cars is less than 1 percent.
- The average variation of total traffic with respect to TVC is about 2.3 percent and about 0.3 percent excluding car.

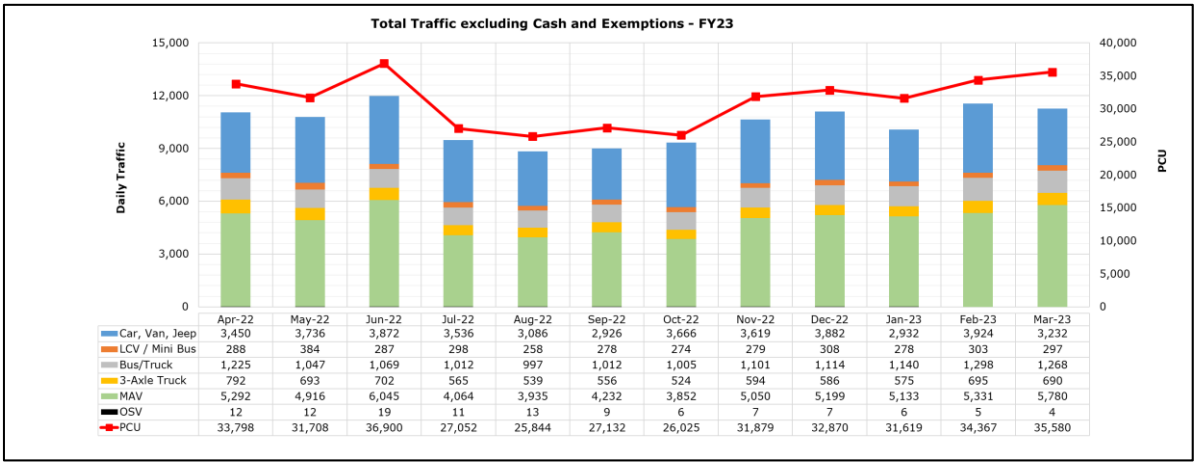
2.4.4 Annual Average Daily Traffic (AADT)

The traffic plying on any road generally varies over different periods of the year depending on the cycle of different socio-economic activities in the regions through which it passes. Therefore, in order to have a more realistic picture of the traffic on the project road, it is required to assess its seasonal variation to estimate the annual average daily traffic (AADT).

The Seasonal Correction Factor (SCF) is generally derived from secondary data sources such as past month-wise traffic data on the project road, monthly toll revenues from existing tolled highways in the immediate influence area, sales of fuel at different filling stations along the project highway, arrival of vehicles at establishments like APMC, truck terminals, railway goods stations, etc.

Estimation of FY23 AADT

The month-on-month mode wise ETC data (excluding cash and exemptions) for the period April 2022 to March 2023 for the toll plaza is presented in **Figure 2-5**.



	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23
Car, Van, Jeep	3,450	3,736	3,872	3,536	3,086	2,926	3,666	3,619	3,882	2,932	3,924	3,232
LCV / Mini Bus	288	384	287	298	258	278	274	279	308	278	303	297
Bus/Truck	1,225	1,047	1,069	1,012	997	1,012	1,005	1,101	1,114	1,140	1,298	1,268
3-Axle Truck	792	693	702	565	539	556	524	594	586	575	695	690
MAV	5,292	4,916	6,045	4,064	3,935	4,232	3,852	5,050	5,199	5,133	5,331	5,780
OSV	12	12	19	11	13	9	6	7	7	6	5	4
PCU	33,798	31,708	36,900	27,052	25,844	27,132	26,025	31,879	32,870	31,619	34,367	35,580

Figure 2-5: Month on Month Traffic Data for Usaka TP – FY23

The onset of the second wave of Covid-19 and the lockdowns announced by the state government during April-June 2021 was a setback to the continuous recovery of traffic to normal levels. With the opening of economic activities, the traffic has started to pick up and shows a recovery from July 2021 onwards.

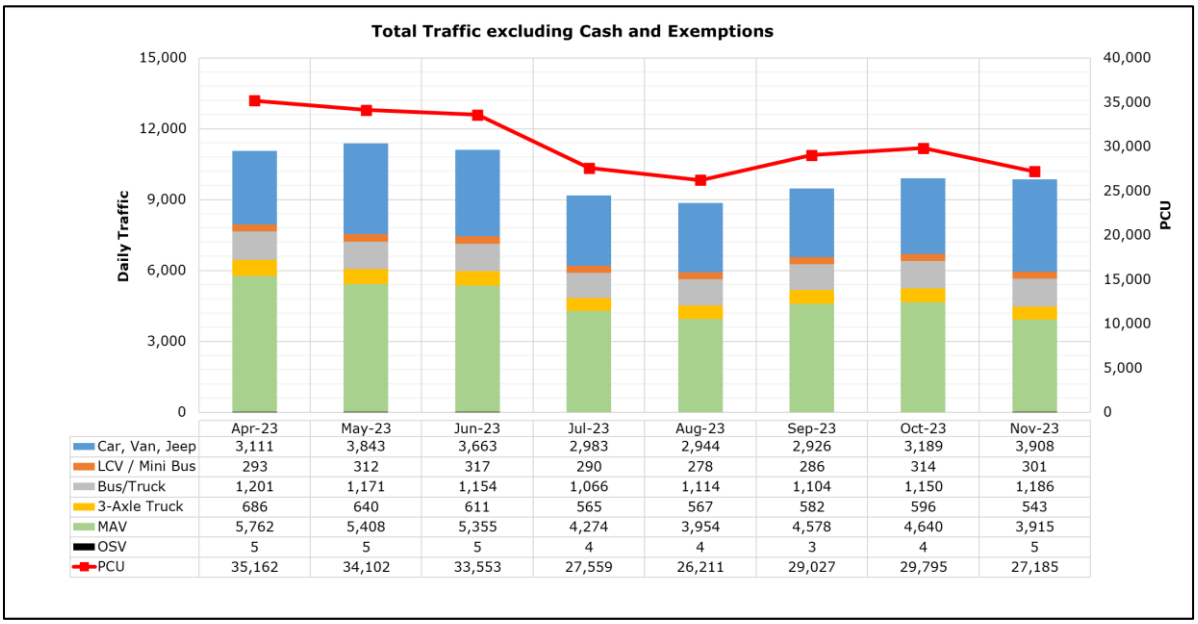
The AADT for FY23 has been derived using ETC data for the period of 12 months from the complete financial year data series of FY23 viz., April 2022 to March 2023. The daily cash and exemption data was available from the traffic count summary report of M/s PATH Ltd for the period of April 2022-December 2022. The FY23 AADT has been derived by adding these exemption and cash traffic to the estimated FY23 ETC AADT. The steps of derivation of FY23 AADT are presented in **Table 2-6**.

Sr. No.	Particulars	Car/Jeep/ Van	LCV	2 Axle	3 Axle	MAV	OSV	PCU
Daily Total Traffic without Cash and Exemptions								
A = April 2022-March 2023 Monthly Traffic/365	Total Traffic without Cash and exemption	3,485	294	1,106	625	4,896	9	31,192
Daily Cash and Exemptions from the Traffic Count Summary Report of PATH								
B	Daily Cash (Apr-Dec 2022 Avg)	72	4	2	1	1	0	-
C	Daily Exemptions (Apr-Dec 2022 Avg)	430	7	5	2	4	0	-
D = A+B+C	**Total Traffic with Cash and Exemption - AADT FY23**	3,987	304	1,112	628	4,901	9	31,760

Table 2-6: Estimation of FY23 AADT

Estimation of FY24 AADT

The month-on-month mode wise ETC data (excluding cash and exemptions) for the period April 2023 to November 2023 for the toll plaza is presented in **Figure 2-5**.



	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23
Car, Van, Jeep	3,111	3,843	3,663	2,983	2,944	2,926	3,189	3,908
LCV / Mini Bus	293	312	317	290	278	286	314	301
Bus/Truck	1,201	1,171	1,154	1,066	1,114	1,104	1,150	1,186
3-Axle Truck	686	640	611	565	567	582	596	543
MAV	5,762	5,408	5,355	4,274	3,954	4,578	4,640	3,915
OSV	5	5	5	4	4	3	4	5
PCU	35,162	34,102	33,553	27,559	26,211	29,027	29,795	27,185

Figure 2-6: Month on Month Traffic Data for Usaka TP - FY24

The ETC data has been made available for the period of 9 months from April 2023 to November 2023. The daily cash and exemption data was available from the traffic count summary report of M/s PATH Ltd for the period of April 2022-December 2022. The month-on-month freight traffic for April-June 2023 showed normal trend of growth over the last year. There was a decline observed in freight traffic especially MAVs from August 2023 onwards whereas Car and LCV traffic was not impacted. To understand this dip in month-on month traffic, a more detailed analysis of adjacent TPs was done along with an Origin and Destination survey and interviews with truckers conducted on 5th Jan,2024.

A comparison of Aug-Nov MAV traffic at the adjacent toll plazas of Ait, Semri and Barajore and the project road toll plaza of Usaka is presented in **Table 2-7**.

Particulars	AIT	Semri	Chamari	Barajore
FY23 (Aug-Nov Avg.)	4,386	4,290	4,267	6,836
FY24 (Aug-Nov Avg.)	4,827	4,733	4,275	6,876
Difference	441	443	7	41
% Variation	10.0%	10.3%	0.2%	0.6%

Table 2-7: Aug-Nov MAV Traffic Comparison of Usaka and Adjacent TPs

The comparison shows there is a growth observed at Ait and Semri Toll Plazas whereas Usaka and Barajore TPs does not exhibit any growth. This shows the behavioural change in travel pattern of truckers due to some alternate route availability.

As per the site reconnaissance survey and interviews with truckers, Bundelkhand expressway was open to traffic in July 2022, but heavy vehicles were not allowed till 28th July 2023 when the commercial fee collection on Bundelkhand for heavy vehicles started. The interviews suggest that truckers find Bundelkhand Eway as an excellent facility and are able to make 2 trips a day to Etawah mandi. Also, Bundelkhand Eway is charging a flat rate of Rs 1500 per trip for overloaded vehicles irrespective of the distance and weight carried, thus, the truckers have extended their dumper trolleys to increase the heights. MAVs which used to supply sand to Kanpur/ Lucknow sand mandis using Project Road have now started selling in the Etawah/Agra mandis and travel using Bundelkhand Expressway. The traffic which is destined to Prayagraj/Varanasi and beyond also has a route choice via Bundelkhand Eway which could have also impacted the MAV traffic on PR. The alignment of Bundelkhand Eway, along with the PR and other network is presented in **Figure 2-7**.

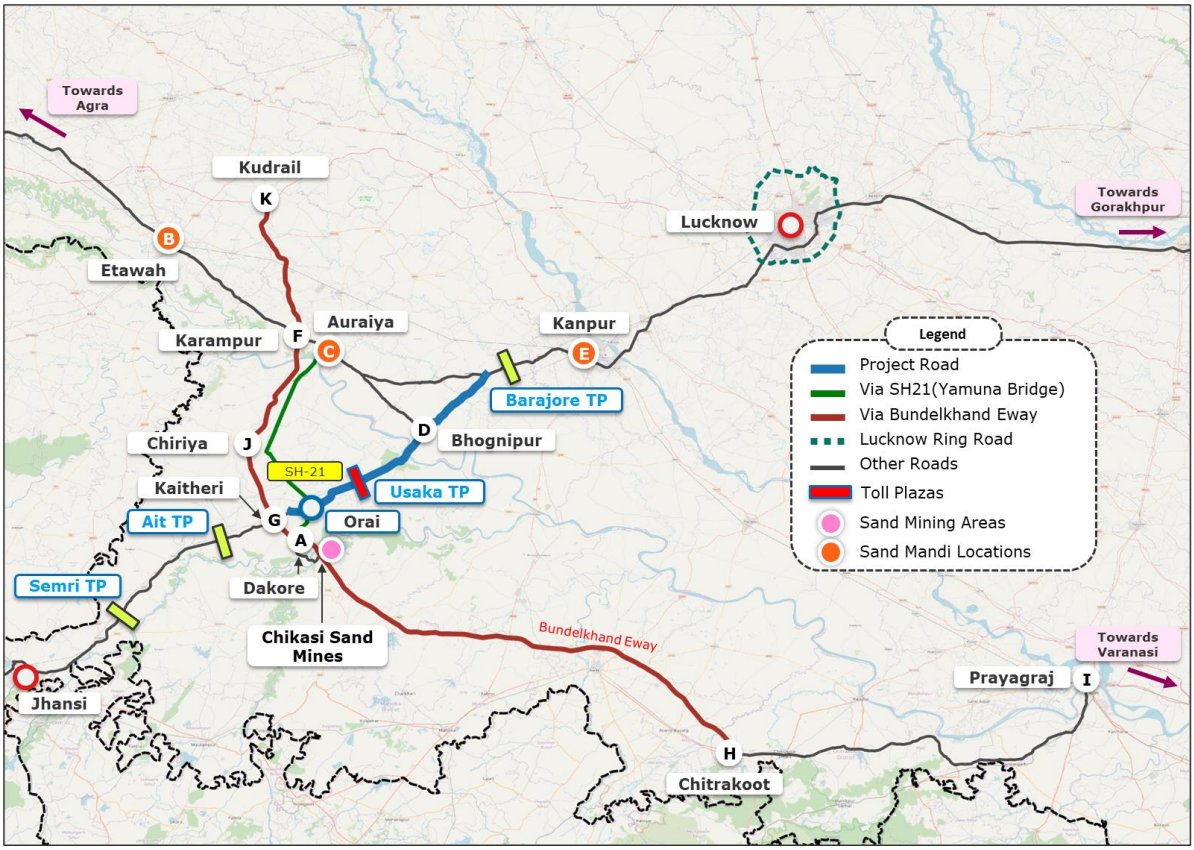


Figure 2-7: Bundelkhand Expressway Along with Project Road and Adjoining Network

Based on the analysis of the traffic, FY24 AADT for cars and LCVs have been estimated by applying 8-12 months factor on April-November 2023 average ETC traffic.

For other modes of 2A/3A and MAV, it is found appropriate that the base traffic from Aug to November is utilised for estimating the AADT for FY24 as these months present the actual trend of traffic after opening of Bundelkhand Eway. In view of this, 4-12 months factor has been applied on August-November 2023 average traffic of these modes.

The correction factors were derived from average ETC traffic for FY23 of the adjacent toll plazas of Ait, Semri and project road TP of Usaka.

The steps of derivation of FY24 AADT are presented in **Table 2-6**.

Sr. No.	Particulars	Car/Jeep/ Van	LCV	2 Axle	3 Axle	MAV	OSV	PCU
Daily Total Traffic without Cash and Exemptions								
A. April-Nov 2023 Average	Total Traffic without Cash and exemption	3,823	309					
B. Aug-Nov 2023 Average				1,211	628	4,706	4	
C. 8-12 months (April-Nov)	SCF	1.02	1.01					
D. 4-12 months (Aug-Nov)				1.05	1.09	1.10	1.09	
E. ETC AADT		3,888	312	1,205	625	4,702	4	31,021
Daily Cash and Exemptions from the Traffic Count Summary Report of PATH								
F	Daily Cash (Apr-Dec 2022 Avg)	72	4	2	1	1	0	
G	Daily Exemptions (Apr-Dec 2022 Avg)	430	7	5	2	4	0	
AADT FY24 Including cash and Exemptions								
I = E+F+G	**AADT**	4,389	322	1,211	628	4,706	4	31,589

Table 2-8: Estimation of FY24 AADT

2.5 Travel Characteristics

2.5.1 Survey Methodology

In order to understand the travel demand pattern in the region and tollable traffic streams, origin and destination (OD) surveys were carried out at the toll plaza location. The OD survey was carried out for 24 hours, by roadside interview method as described in IRC: 102-1988. Both passenger and commercial vehicles plying on the project road were stopped on a random sampling basis and interviewed.

The travel characteristics obtained by OD survey facilitate the identification of:

1. Local and through traffic on the project road.
2. Potential divertible traffic to/from project road to various alternative routes.

Trained enumerators under the supervision of transport planners collected the trip characteristics using survey forms designed for this purpose. The OD survey elicited characteristics like origin, destination, frequency, purpose of trip for passenger vehicles and commodity being transported for goods vehicles. The information pertaining to origin and destination of trips collected during roadside interviews was analysed to obtain the trip distribution based on a zoning system suitably designed for the present study.

2.5.2 Traffic Zoning System

To understand the spatial dimensions of the trip characteristics of the vehicles interviewed during the O-D survey, a detailed zoning system was developed giving due consideration to the following factors:

- The road network catering to the traffic on the project road and its generating points
- Important towns, villages, factories, and industrial centres around the project road area

- Administrative boundaries of districts and states.
- Configuration of the project road in the regional road network with respect to other roads

Two major types of areas were identified for analysis purpose: -

Immediate Influence Area (IIA): It includes the cities/towns/villages and districts along the project road and adjacent to it, which generate/attract trips to the project road. In this study, it consists of districts of Jalaun and Kanpur Dehat in the state of Uttar Pradesh.

Broad Influence Area (BIA): It includes the remaining districts of Madhya Pradesh and other neighbouring states such as Delhi, Bihar, West Bengal and remaining states of India.

Detailed zoning system is prepared for IIA, while more aggregate or broad zoning is developed for BIA. The zoning system adopted for data collection was based on 98 zones and is presented in **Appendix 2.1**.

2.5.3 Sample Size as per November 2022 surveys

The vehicles during the OD surveys were interviewed on a random sample basis. The individual volume count of all categories of vehicles along with the direction split were derived from the seven-day traffic volume video count at the toll plaza location. **Table 2-9** shows the AADT - FY23 and the sample size (both in absolute numbers and in percentage terms) captured during the exercise.

Modes	Car	M Bus	Bus	MLCV	LCV	2A	3A	MAV/OSV
Usaka TP								
Sample	1,402	24	189	468	318	253	441	2,088
AADT – FY23	3,260	32	482	726	272	631	628	4,910
Percentage (%)	43.0	74.2	39.2	64.4	116.9	40.1	70.2	42.5

Table 2-9: Sample Size Collected in OD

Based on the sample size of different categories of vehicles interviewed during the OD survey, direction-wise expansion factors were calculated based on FY23 AADT. The OD matrices for all vehicle categories were generated and analysis was done in terms of regional distribution, travel pattern, commodity distribution and trip purpose for cars.

2.5.4 Regional Distribution as per November 2022 surveys

Based on the OD matrices, the regional distribution of tollable vehicles at the toll plaza location has been calculated. **Table 2-10** gives the distribution indicating the attraction and generation zones for the traffic on the project road.

Region/Modes	Car/MLCV	LCV/MBus	Bus	2A	3A	MAV
Uttar Pradesh	94.9	88.0	96.3	85.0	76.8	73.0
Madhya Pradesh	2.0	5.5	2.3	6.0	6.8	6.4
West Bengal	0.1	0.3	0.0	0.3	1.0	2.7
Bihar	0.1	0.4	0.0	0.7	2.9	2.0
Gujarat	0.7	2.3	0.0	3.3	4.1	3.9
Maharashtra	0.9	0.4	0.7	3.0	4.2	5.1
Rajasthan	0.3	1.7	0.7	0.9	1.1	1.6
Southern Indian States	0.2	0.6	0.0	0.4	1.2	1.5
Rest of India	0.8	0.8	0.0	0.4	2.0	3.8
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 2-10: Regional Distribution of Tollable Traffic (in %) at Usaka TP

Passenger traffic:

- In case of Car/MLCV traffic, Uttar Pradesh contributes about 94.9 percent; state of Madhya Pradesh contributes about 2.0 percent.
- The Car/MLCV traffic is observed to be having Orai to Kanpur/Unnao as top OD pair. In case of cars, work and business trips account for about 86.9 percent at the toll plaza and social/shopping trips were observed to be around 5.6 percent whereas education trips account for another 2.6 percent.
- In case of Bus traffic, Uttar Pradesh contributes about 96.3 percent at toll plaza location.

Freight traffic:

- In case of LCV, Uttar Pradesh contributes about 88 percent, followed by Madhya Pradesh which contributes about 5.5 percent at toll plaza location.
- In case of 3A/MAVs, share of Uttar Pradesh state is about 73-77 percent, followed by Madhya Pradesh and Maharashtra which contribute about 6-7 percent each.
- The 3A/MAV traffic is observed to be having Jhansi to Kanpur/Unnao as top OD pair.

The mode wise top 20 OD pairs are given in **Appendix 2.2**. It is worth mentioning that the influencing states remain the same in the recent OD conducted in January,2024.

2.5.5 Travel Pattern as per November 2022 surveys

To understand the travel pattern of vehicles, the important groups of zones corresponding to the different streams of traffic plying on the project road are presented in **Figure 2-8**.

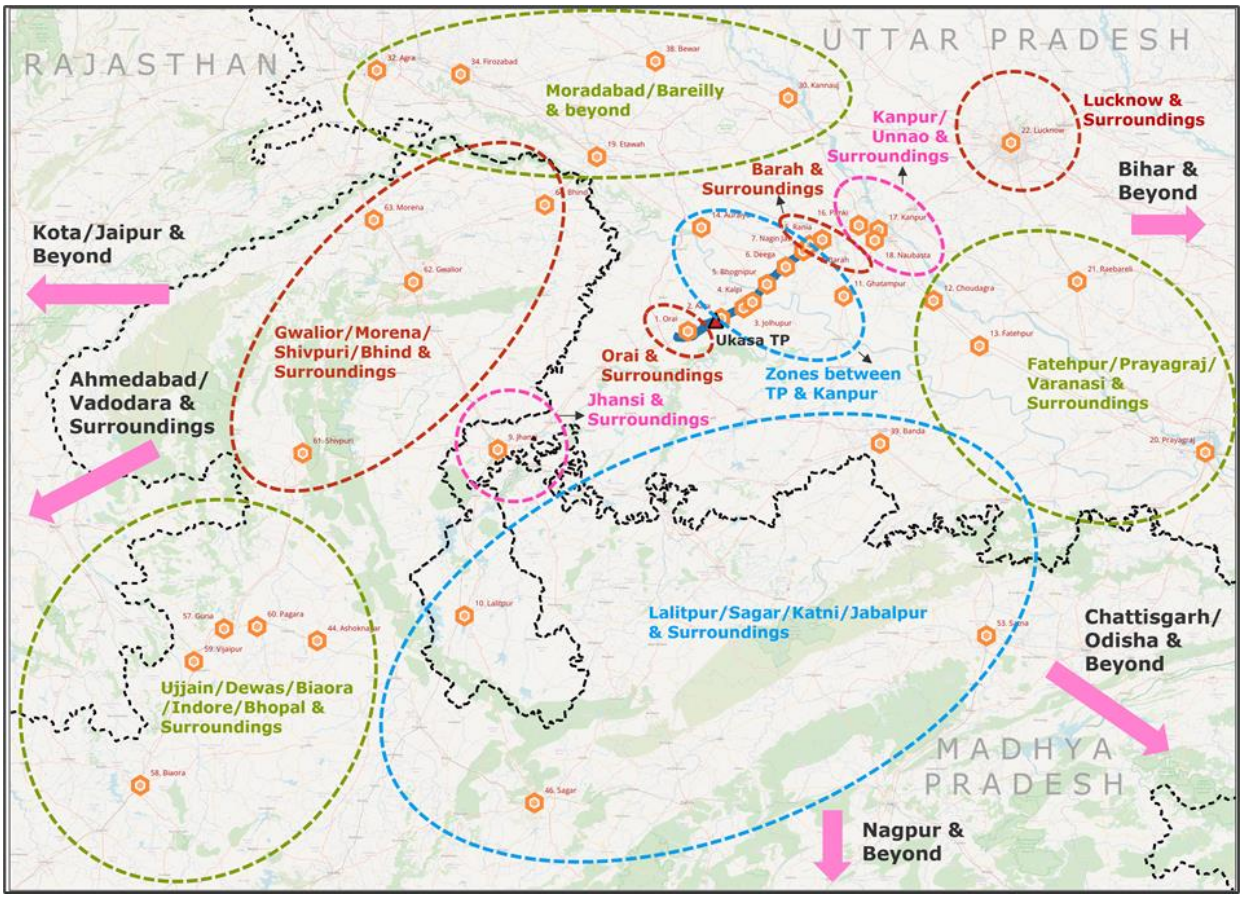


Figure 2-8: Streams of Traffic Plying on the Project Road

The list of the popular movements found at Usaka TP is presented in **Table 2-11**.

S. No	Traffic Streams	Cars	M Bus	BUS	MLCV	LCV	2A	3A	MAV
1	Orai & Surroundings-Kanpur & beyond	60.0	92.2	50.6	64.6	30.2	29.0	22.4	18.2
2	Jhansi & Surroundings-Kanpur & beyond	30.6	7.8	40.0	25.2	45.2	43.7	42.1	43.9
3	Ujjain/ Bhopal & Surroundings-Kanpur & beyond	3.8	0.0	6.7	7.0	12.6	12.0	13.7	13.0
4	Kota/Ahmedabad & -Kanpur & beyond	2.1	0.0	1.4	1.3	8.9	8.5	10.3	10.9
5	Nagpur & beyond -Kanpur & beyond	3.5	0.0	1.4	1.8	3.2	6.8	11.5	14.0
Total		**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 2-11: Traffic Streams on Usaka TP (in %)

- About 60.0 percent of the car traffic is from/to Orai & surroundings (stream 1) of which 52.0 percent of car traffic is to/from Kanpur/Unnao & surroundings, 6.7 percent is to/from Lucknow & beyond and 1.3 percent is to/from Fatehpur/Prayagraj/Bihar & beyond.
- Around 42.1 percent of 3A and about 43.9 percent of MAV are from/to Jhansi & surroundings (stream 2) of which 20.0 percent of 3A and 22.5 percent of MAV is to/from Kanpur/Unnao/Barah & surroundings and about 15 percent each of 3A & MAV is to/from Lucknow & beyond.

- About 11.5 percent of 3A and around 14 percent of MAV are from/to Nagpur & beyond to/from Kanpur & beyond (stream 5).
- About 50 percent of freight and around 90 percent of passenger traffic on the project road has interactions between Jhansi/Orai and Kanpur/Lucknow (stream 1 + stream 2).

Similar travel pattern was observed during an Origin and Destination survey conducted in Jan,2024 except for the streams which might have shifted to the route via Bundelkhand Expressway to travel to Agra/Etawah in the west and to Prayagraj/Varanasi in the east.

2.5.6 Lead Distribution as per November 2022 surveys

Based on the OD matrices, the lead distribution of tollable vehicles at the toll plaza location has been calculated. **Figure 2-9** presents the lead distribution for traffic on the project road.

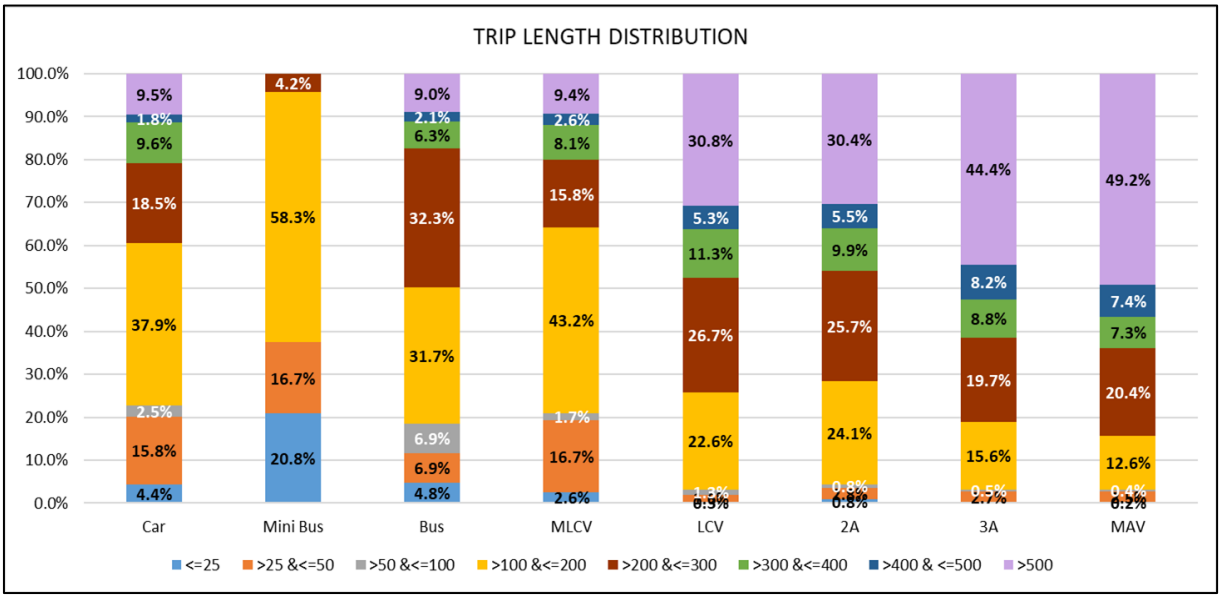


Figure 2-9: Lead Distribution Usaka TP

- The majority of car traffic (around 37.9 percent) has trip lead between 100 to 200 km at toll plaza location. These trips are observed mainly from/to Orai/Jhansi to/from Kanpur/Unnao/Lucknow/Kalpi/Daulatpur. In addition, short distance trips (>25 & <=50 km) of about 15.8 percent are found to be between Orai to Kalpi/ Daulatpur/Bhognipur/Pukhrayan.
- In case of MAV trucks, around 49.2 percent of vehicles have trip lead of greater than 500 km. These trips are found majorly between Orai/Jhansi and Kanpur/Unnao & beyond.

2.5.7 Commodity Distribution as per November 2022 surveys

Analysis was also carried out to understand the different commercial vehicles being used to transport different commodities. The commodity distribution for project corridor is presented in **Figure 2-10**.

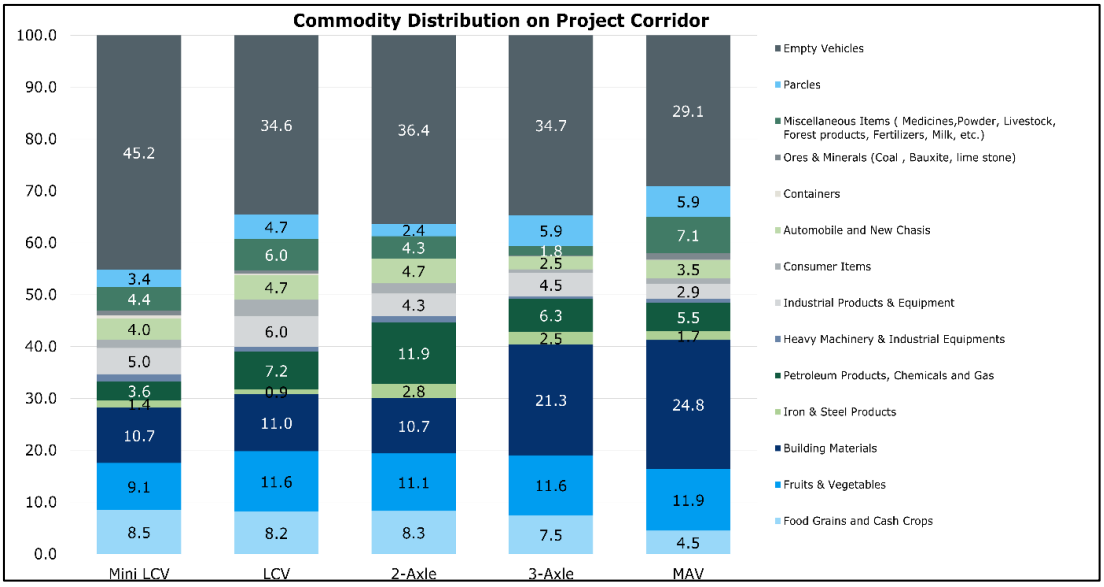


Figure 2-10: Commodity Distribution on Project Corridor

- About 11-12 percent of 3A/MAVs are found to be transporting fruits & vegetables
- About 21-25 percent of 3A/MAVs are transporting building materials along the entire project corridor.
- About 7-12 percent of LCV/2A are found to be transporting petroleum products, chemicals and gas along the entire project corridor.

Table 2-12 presents the direction wise commodity-wise share on the project road.

Jhansi-Kanpur						Kanpur-Jhansi				
MLCV	**LCV**	**2A**	**3A**	**MAV**	**Commodity**	**MLCV**	**LCV**	**2A**	**3A**	**MAV**
4.8	4.8	11.2	7.1	4.1	Food Grains and Cash Crops	13.0	11.8	5.8	7.9	4.9
11.9	16.3	21.6	20.9	23.0	Fruits & Vegetables	6.5	6.6	2.2	1.9	0.6
15.1	15.1	19.8	33.3	43.0	Building Materials and Cement	5.6	6.6	2.9	8.8	6.2
0.8	0.6	0.0	0.0	0.8	Iron & Steel Products	1.9	1.3	5.1	5.1	2.6
2.4	8.4	9.5	7.6	5.1	Petroleum Products, Chemicals and Gas	4.6	5.9	13.9	5.1	5.9
1.6	0.6	0.9	0.0	1.3	Heavy Machinery & Industrial Equipment's	0.9	1.3	1.5	0.9	0.1
4.8	10.2	5.2	5.3	3.2	Industrial Products	3.7	1.3	3.6	3.7	2.6
0.0	1.8	2.6	0.4	1.7	Consumer Items	2.8	4.6	1.5	0.9	0.5
4.0	9.0	3.4	3.1	3.7	Automobile and New Chassis	3.7	0.0	5.8	1.9	3.3
0.8	0.0	0.0	0.0	0.0	Containers	0.0	0.7	0.0	0.0	0.1
0.0	0.0	0.0	0.0	0.6	Ores & Minerals (Coal, Bauxite, limestone)	1.9	1.3	0.0	0.5	1.9
4.8	6.6	7.8	3.1	2.1	Miscellaneous Items	2.8	5.3	1.5	0.5	12.2
0.0	4.8	1.7	6.7	3.2	Parcels	7.4	4.6	2.9	5.1	8.6
49.2	21.7	16.4	12.4	8.2	Empty Vehicles	45.4	48.7	53.3	57.9	50.4
100.0	**100.0**	**100.0**	**100.0**	**100.0**	**Total**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 2-12: Direction wise Commodity Distribution on Project Road

- About 10.2 percent of LCV are transporting industrial products in the direction of Jhansi to Kanpur.

- About 8-10 percent of LCV/2A are transporting Petroleum/Chemical/Gas in the direction of Jhansi to Kanpur.
- Around 20-22 percent of 2A/3A are transporting fruits & vegetables moving in the direction of Jhansi to Kanpur.
- In case of MAVs, about 43.0 percent are found to be transporting building materials in the direction of Jhansi to Kanpur. The movement of building materials is mainly from the stone crushers/aggregate processing units located near Jhansi viz., Digara, Pratap Pura and Khailar and sand mining units located below Orai on the banks of Betwa river.
- Higher share of empty vehicles observed in the direction from Kanpur to Jhansi. This can be attributed to the fruits/vegetables and building material trucks returning empty back to their source points after unloading.
- Around 5-9 percent of 3A/MAV are transporting parcels in the direction of Kanpur to Jhansi.
- The recent OD conducted in January 2024 also shows the similar commodity distribution.

The distribution of building materials on the project is presented in **Table 2-13** and the major components are found to be sand and stone aggregates in the OD conducted in November 2022.

Jhansi-Kanpur						Kanpur-Jhansi				
MLCV	**LCV**	**2A**	**3A**	**MAV**	**Commodity**	**MLCV**	**LCV**	**2A**	**3A**	**MAV**
5.7	3.8	3.3	13.4	13.5	Sand	0.0	0.0	0.0	1.5	1.2
3.8	6.6	8.3	15.2	25.7	Stone Aggregates	0.0	0.0	0.0	2.9	0.8
5.7	4.7	8.3	4.8	3.8	Others Building Materials	0.0	6.6	2.9	4.4	4.1
15.1	**15.1**	**19.8**	**33.3**	**43.0**	**Total**	**5.6**	**6.6**	**2.9**	**8.8**	**6.2**

Table 2-13: Distribution of Building Materials on Project Road

- About 15-25 percent of 3A/MAV are transporting stone aggregates (Gitti) from Jhansi in the direction of Jhansi to Kanpur. There are 3 stone crushers and aggregates processing locations present near Jhansi viz., Khailar, Pratap Pura and Digara as presented in section 2.2.2 and **Figure 2-3**.
- About 13 percent each of 3A/MAV are transporting sand (Muram) extracted from Betwa river deposits located below Orai (Bandhuali, Kharka, Jhansi etc) in the direction of Jhansi to Kanpur.

3. TRAFFIC GROWTH RATE AND PROJECTIONS

3.1 General

The project road, currently under OMT, is proposed to be taken under InvIT round 3. The projections of traffic and revenue have been presented till 2044 in line with the concession period. The estimation of the traffic using the tolled highway and its future growth are important elements to assess the project's economics as these are generally the main/sole source of revenue for the project. This chapter details various aspects of the current traffic of the project road and its growth potential as assessed as part of this study.

3.2 Project Road Traffic

The traffic that is likely to use the project road was estimated on the basis of the traffic and travel characteristics gathered as part of the study. The traffic on the project road would normally consist of the following components:

- Normal Traffic
- Diverted Traffic
- Induced/Developmental Traffic

3.2.1 Normal Traffic

Normal traffic is the traffic which is already plying on the project road as assessed in section 2.4.4.

3.2.2 Diverted Traffic

Diverted traffic is generally dictated by the presence of an alternative route at a lower generalised cost, which is in-turn defined by the road configuration and its condition, the type of vehicle and its operating costs, the average riding speed, the route distance and any tolling that may apply on a specific route.

In context of broader network development, Bundelkhand expressway has been completed since last year and passes through the PIA region. Bundelkhand Expressway is a 296 km long 4 lane access-controlled expressway project by UPEIDA with a route alignment connecting Kudrail Village in Etawah District with Bharatkoop on NH-35 in Chitrakoot District. As stated above, the commercial operations on the expressway started on 28th July 2023 and some of the traffic which was using the Project Road section to reach Agra/Etawah/Auraiya, now has an option to use the route via Bundelkhand Eway and avoid the PR toll plazas. Also, some of the traffic which is destined to Prayagraj/Varanasi and beyond also has an option to use Bundelkhand Eway. That is why the base traffic for FY24 has been estimated based on the August to November 2023 traffic which exhibits the traffic trend post opening of Bundelkhand Eway. The alignment of the expressway in context of the project road is presented in **Figure 3-1**

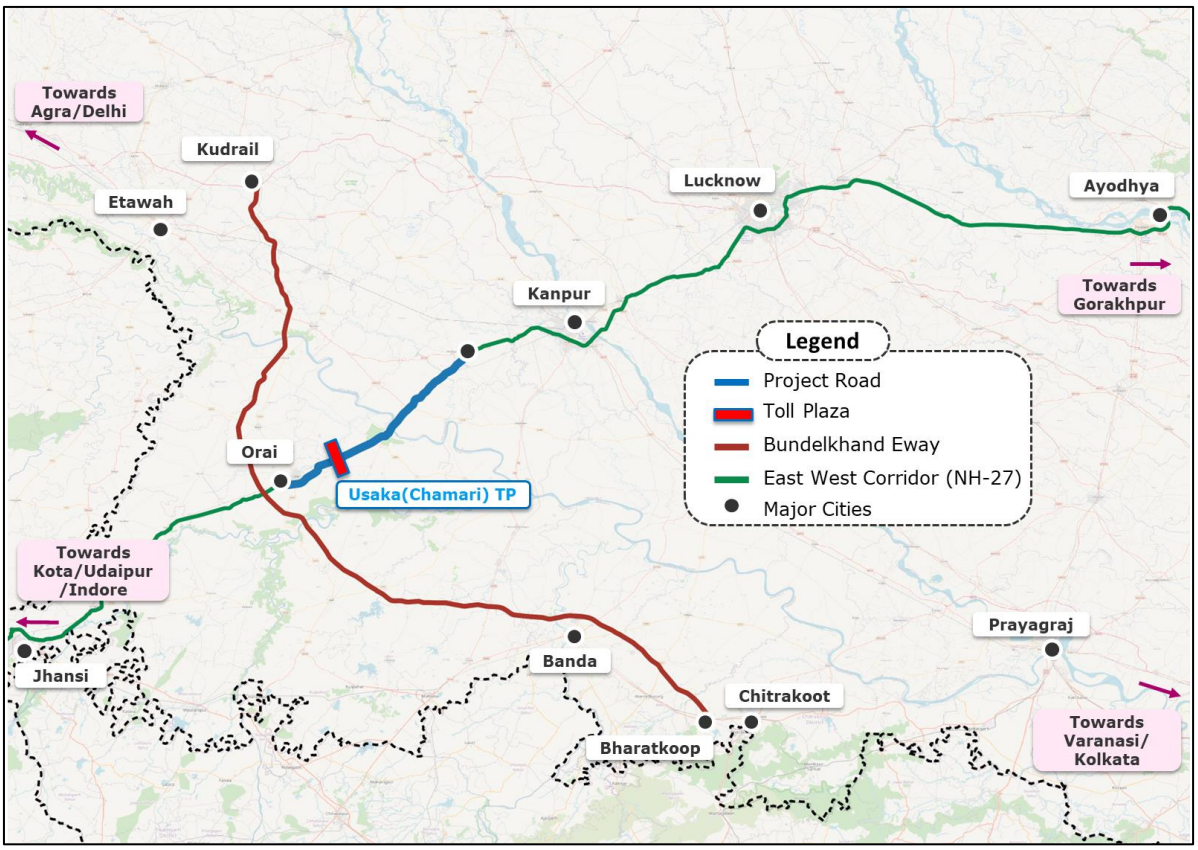


Figure 3-1: Alignment of Bundelkhand Expressway

The assessment of any likely traffic addition to/diversion away from the Project Road (PR) has been done using the cost ratio analysis as described below:

- Assessment of the potential divertible traffic sensitive to network improvements based on the observed travel pattern
- Calculation of road user cost of travelling on the project road and the alternative route. The road user cost includes vehicle operating cost (VOC), travel time cost (TTC) and toll cost (TC), if any. VOC comprises of the cost of fuel, spare parts, maintenance labour, tyre, engine oil, grease, fixed cost, depreciation and crew wages.
- The potential long- distance traffic for cars is negligible; therefore, analysis has not been done for passenger traffic. The diversion analysis has been done only for larger axle trucks as these vehicles travel long lead and are potential to shift to alternate route.

The road user cost is estimated based on vehicle operating cost equations presented in IRC SP-30,2019 which is based on updation of Road User Cost Study (RUCS) carried out by Central Road Research Institute in 2019 for Ministry of Road Transport and Highways. Using the likely traffic stream speeds and lane configuration, the vehicle operating, and travel time costs are estimated for each of the routes. Road user cost on the identified routes is calculated and diversion percentages are estimated using diversion curve method mainly for trucks. In this method, traffic likely to be diverted from/to the project

road, was estimated using Logit model, which computes expected diversion percentage based on the ratio of perceived cost on the existing and proposed facilities. The perceived cost is the financial vehicle operating cost and the time saving cost including toll charges (if any). According to the model, a vehicle will shift if the perceived cost on an alternative route is lower in comparison to existing route. The diversion equations for estimating diversion have been adopted from Indian National Expressway Network Report, MORTH (2009) as mentioned in IRC 108:2015. These equations are presented in **Table 3-1**.

Vehicle	Cost Ratio (CR) Interval	Equations
Truck	<= 0.750	% Div. = 100 - ((CR/0.75) * 5)
	0.750 <= CR <= 1.250	% Div. = 95 - ((CR-0.75)/0.5) * 90
	1.250 <= CR <= 2.0	% Div. = ((2-CR)/0.75) * 5

Source: IRC 108-2015

Table 3-1: Diversion Equations Used for Analysis

In context of the project road, two road network developments which may further impact the traffic on the project road are:

- Improvement of Sagar-Kanpur-Lucknow corridor under Bharatmala Pariyojana - applicable traffic stream is from/to Indore/Bhopal & surroundings to/from Kanpur & beyond.
- Completion of Chambal Expressway (CE) and Delhi-Mumbai Expressway (DME) - Analysis done for two traffic streams
    - Ahmedabad & surroundings – Kanpur & beyond
    - Mumbai & surroundings – Kanpur & beyond

The impact of both these network developments has been studied.

Alternate Route: Indore – Kanpur via Sagar

The route via Indore – Kanpur (A-I-J-K-L-M) is partially a part of Kandla – Lucknow economic corridor. The alignment of PR viz-a-viz identified alternate route is presented in **Figure 3-2**.

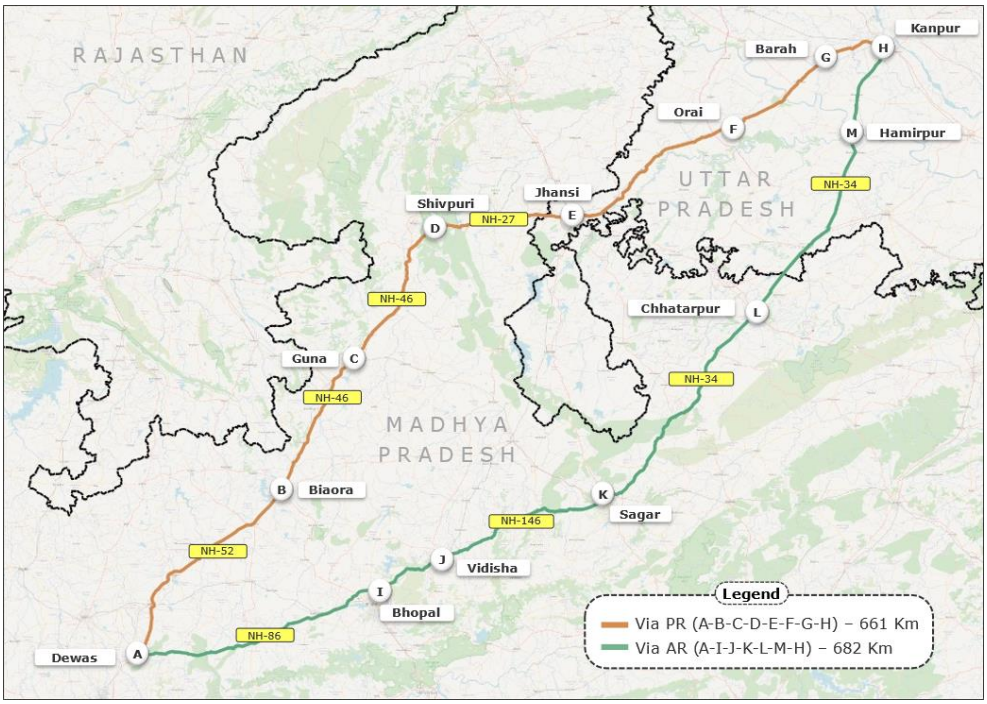


Figure 3-2: Project Road and Alternate Route (Indore – Kanpur via Sagar)

The route from Kanpur to Dewas via Sagar passes through NH-34/NH-146/NH-86 and is around 21 km longer than the route via PR/Jhansi. The alternate route is partially 2-lane (73%) and partially 4-lane (27%) configuration at present; two lane section is proposed to be upgraded to 4 lanes as part of Bharatmala Pariyojana.

Once the economic corridor gets upgraded from 2 lane to 4 lane configurations, there could be some redistribution of the potential stream of long-distance traffic between project road and alternate route. The applicable long-distance stream for this route is the traffic commuting to/from Indore/Bhopal from/to Kanpur & beyond. The cost ratios and diversion percentages have been estimated for the travel under existing and the future situations with upgradation envisaged under Kandla-Sagar corridor improvement.

The results of diversion analysis along with the potential divertible traffic, diversion percentages and diverted traffic are presented in **Table 3-2**.

Modes	2A	3A	MAV
Potential Traffic			
Indore-Kanpur Potential as % of AADT	4.6	5.8	8.1
Loss from PR based on Diversion Equations			
Cost Ratio (PR/AR) in Existing situation	0.93	0.94	0.93
Cost Ratio (PR/AR) in Future situation	1.00	1.00	1.00
Present PR Share (%)	62.3	61.3	63.0
Future PR Share (%)	49.9	50.0	49.6
Estimated Future PR Traffic (%)	3.7	4.7	6.4
Loss as % of AADT			
Diverted Traffic as % of AADT (%)	-0.9	-1.1	-1.7

Table 3-2: Diversion Analysis for Indore-Kanpur via Sagar Route

The Kandla – Lucknow economic corridor is expected to be completed in FY28. Therefore, the impact of this diversion has been considered under the base case from FY28 onwards

and phased over three years with 50% diversion in FY28, 75 percent in FY29 and 100% in FY30 onwards.

Alternate Route: Ahmedabad/Mumbai – Kanpur via DME + Chambal Expressway

Chambal Expressway is a proposed 6 lane access-controlled highway with a route alignment connecting Etawah (Uttar Pradesh) and Kota (Rajasthan) under Bharatmala Pariyojana. For this project, DPR preparation is currently under progress and the expressway is likely to be completed by FY29. On competition of Chambal Expressway, there could be some loss to PR for the traffic stream currently using the project road between Ahmedabad/Mumbai and Kanpur & beyond. This stream of traffic will have the option to use the alternate route with a combination of Delhi Mumbai Expressway (DME) and Chambal Expressway (CE).

Two streams of traffic which are likely to be impacted by completion of CE and DME are:

- Ahmedabad-Kanpur traffic- Route via DME+CE
- Mumbai-Kanpur traffic- Route via DME+CE

The alignment of PR viz-a-viz identified alternate route is presented in **Figure 3-3.**

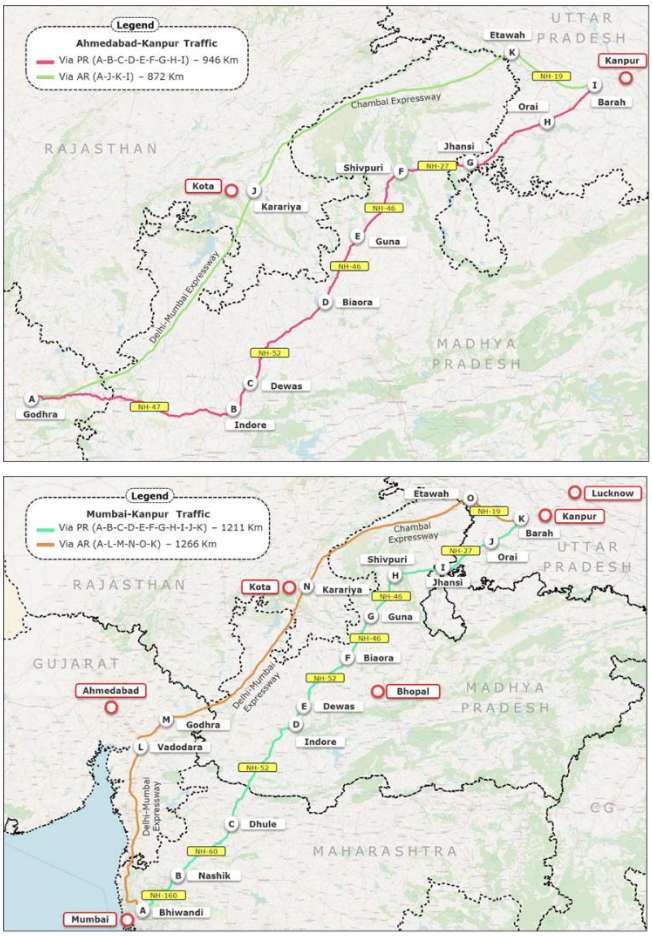


Figure 3-3: PR and Alternate route -Ahmedabad/Mumbai - Kanpur via DME and CE

The alternate route between Ahmedabad to Kanpur via DME and CE is 74 km shorter than the route via project road. In case of route between Mumbai to Kanpur via DME and CE is 54 km longer than the route via project road.

The results of diversion analysis along with the potential divertible traffic, diversion percentages and diverted traffic are presented in **Table 3-2**.

Modes	2A	3A	MAV
Potential Traffic as % of AADT			
Ahmedabad-Kanpur Traffic	6.7%	7.7%	7.5%
Mumbai-Kanpur Traffic	5.7%	8.1%	9.9%
Loss from PR based on Diversion Equations			
Cost Ratio (PR/AR) for Ahmedabad-Kanpur stream	1.17	1.18	1.16
Cost Ratio (PR/AR) for Mumbai-Kanpur stream	1.05	1.08	1.04
Future AR Share (%) for Ahmedabad-Kanpur stream	80.0	82.0	78.2
Future AR Share (%) for Mumbai-Kanpur stream	58.8	63.6	57.5
Loss from PR traffic for Ahmedabad-Kanpur stream (%)	5.3	6.4	5.9
Loss from PR traffic for Mumbai-Kanpur stream (%)	3.3	5.1	5.7
Loss as % of AADT			
A. Total Diverted as % of AADT (%)	-8.7	-11.5	-11.6
Adopted Loss as % of AADT			
B. Captive Traffic for PR (%)	33.3	33.3	33.3
C. Diverted to Expressway (%) = A*(1-B)	-5.8	-7.7	-7.7

Table 3-3: Diversion Analysis for Ahmedabad/Mumbai via DME & CE Route

The cost-ratio based analysis indicates loss of 8.7 percent for 2A, 11.5/11.6 percent for 3A/MAV. However, the alternate route consisting of the greenfield expressways of Chambal and DME may not be able to attract whole of this traffic. It is worth mentioning that the Atal Progressway (Chambal Expressway) passes through the Chambal region and historically, the region has been known for law-and-order issues. The freight vehicles using the route via project road may still prefer the national highway network due to cargo distribution points along the route, familiarity of the route and wayside amenities along the route via project road. In light of this, about 2/3rd of the total diverted traffic is envisaged to shift to the alternate route consisting of expressways. Thus, the project road may lose about 5.8 percent of 2A, 7.7 percent each of 3A/MAV once the alternate route is operational.

The impact of this diversion has been considered under the base case from FY29 onwards and phased over three years with 50 percent diversion in FY29, 75 percent in FY30 and 100 percent in FY31 onwards.

3.2.3 Induced/ Development Traffic

Developmental /new generated traffic is the one which would be generated, over and above normal growth, because of lowering of transport costs or new developments in the immediate influence area of the project road. In case of the project road, there is no development envisaged in the vicinity of the project road.

Bharatmala Pariyojana is the second largest highways construction project in the country since NHDP, under which almost 50,000 km or highway roads were targeted across the country. It will look to improve connectivity particularly on economic corridors, border areas and far-flung areas with an aim of quicker movement of cargo and boosting exports. The Phase-I includes economic corridors of around 9,000 km; inter-corridor and feeder routes of around 6,000 km; 5,000 km roads under the National Corridors Efficiency Program, border and international connectivity roads of around 2,000 km; coastal and port connectivity roads of around 2,000 km; expressways of around 800 km and 10,000 km of NHDP roads. The total length in phase 1 comes to around 34,800 km.

In the context of the project influence area, there are a few economic corridors and inter corridors listed in the vicinity of the project road. The economic corridors in the region include Delhi - Lucknow, Delhi - Kanpur, Sagar - Lucknow and Sagar - Varanasi. Additionally, the influence area has Lucknow - Raebareli - Allahabad inter corridor and three feeder routes namely, Sagar - Allahabad, Varanasi - Robertsganj and Varanasi - Ghazipur.

3.3 Methodology for Traffic Growth Rate Estimation

Traffic growth for both passenger and freight vehicles has been estimated using the econometric approach as described in IRC-108, 2015. For freight traffic, due consideration has been given to the total tonnage transported and the shift in types of vehicles used for moving goods.

The econometric model applied, relates traffic growth to changes in state (or district) domestic product via an elasticity factor. According to IRC guidelines, elasticity based econometric model for highway projects should be derived in the following form:

$Log_e(P) = A0 + A1\ Log_e\ (EI)$, where:

P - Traffic Volume

EI - Economic Indicator

A0 - Regression Constant

A1 - Regression Co-efficient (Elasticity Index)

In order to estimate traffic on the project road, the methodology described below has been followed:

- Identify the influence area - From the analysis of OD survey data, the project influencing states and districts, which are likely to impact the traffic growth on the project road, were identified.
- Review Past traffic Data – Based on toll data available for the project, a review of past traffic and tonnage growth is carried out.
- Analysis of economic growth of the Project Influencing Area (PIA) - For each PIA state, an economic profile describing past performance and future outlook was prepared. This also considers India's past economic performance and its future outlook.
- Estimation of traffic elasticity to income – in order to translate economic growth into traffic growth, an elasticity factor was estimated.
- Derivation of traffic growth rates – On the basis of the weighted (based on OD shares) PIA outlook and related traffic elasticity, traffic growth rates were estimated.

The methodology thus adopted incorporates, as basic data inputs, the perspective growth envisaged in the influence area and the changes in transport demand elasticities over a period of time. The traffic growth rates by vehicle type for the project road have been determined till FY44 in line with the concession period.

3.4 Identification of PIA States

The regional distribution observed on the project road shows that Uttar Pradesh is the main contributor of traffic on the project road in case of passenger and freight vehicles, however, states of Madhya Pradesh, West Bengal, Bihar, Gujarat, and Maharashtra also contribute to the project road freight traffic.

The mode wise normalized regional distribution at the toll plaza is presented in **Table 3-4**.

States/Mode	Cars	LCV	Bus/2A Truck	3A	MAV
Uttar Pradesh	100.0	90.9	91.0	80.2	78.4
Madhya Pradesh	0.0	5.7	4.5	7.1	6.8
West Bengal	0.0	0.3	0.2	1.1	2.9
Bihar	0.0	0.4	0.4	3.1	2.2
Gujarat	0.0	2.3	1.9	4.3	4.2
Maharashtra	0.0	0.4	2.0	4.3	5.5
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 3-4: Normalised Regional Distribution (%) for the PR As Per November 2022 OD

Car traffic is entirely contributed by the state of Uttar Pradesh for the project road.

In case of freight traffic, Uttar Pradesh contributes the highest share of 78-80 percent in 3A trucks & MAVs and about 91 percent share in LCVs & Bus/2A trucks each. Madhya Pradesh has a share of about 5-7 percent in each freight mode. The states of Maharashtra and Gujarat contribute about 4-5 percent each in 3A and MAVs traffic. Additionally, the

states of Bihar and West Bengal also contribute to 3A and MAV traffic with a share of about 1-3 percent each.

In view of the above regional distribution, Uttar Pradesh has been considered as the primary PIA state for passenger vehicle category. For freight vehicles, along with Uttar Pradesh the states of Madhya Pradesh, West Bengal, Bihar, Gujarat, and Maharashtra have also been considered as the PIA states.

3.5 Past Economic Growth of PIA

Growth of traffic on the project road depends on existing development and future growth prospects of the connecting regions. A number of economic indicators for the PIA states, as published by Central Statistical Organisation (2011-12 prices), have been studied to assess their past performance.

PIA State- Uttar Pradesh

Past economic performance of the state has been as follows:

- Uttar Pradesh's Gross State Domestic Product (GSDP) stood at Rs 13,046.8 billion in FY23 and has been growing at a compounded annual growth rate of 5.4 percent since FY12.
- The tertiary sector is the largest contributor to GSDP of Uttar Pradesh, about 46.6 percent. Secondary sector stood at 29.7 percent and allied activities sector at 23.8 percent of the GSDP in FY23.

The change of sectoral composition of GSDP over the years is presented in **Figure 3-4**.

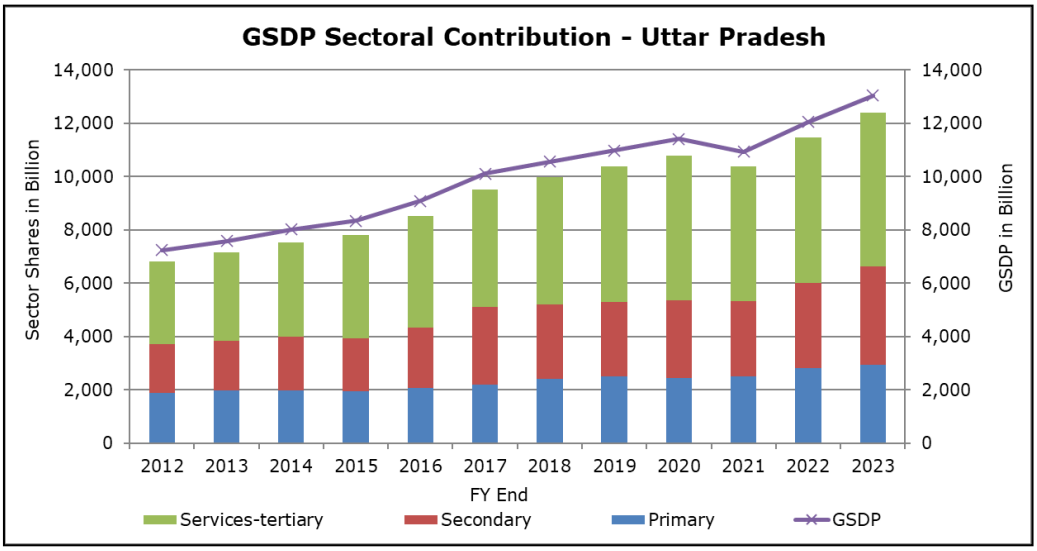


Figure 3-4: GSDP (in Rs billion) and its Sectoral Composition for Uttar Pradesh

The performance of the state economy and its different sectors has been studied using time trend analysis. The average annual growth rates as obtained using regression analysis are presented in **Table 3-5**.

Particulars	FY12 to FY23	FY15 to FY23
GSDP	5.4	4.9
Agriculture and Allied	4.1	4.8
Industry	6.3	6.0
Services	5.8	4.8
Construction	5.2	5.6
Per Capita Income	3.9	3.4

Table 3-5 : Average Annual Growth Rates (%) of State Income for Uttar Pradesh

Uttar Pradesh is a predominant exporter of telecom instruments, meat and edibles, apparel and clothing, footwear, iron and steel products, aluminium and aluminium products, handmade carpet (excl. silk), mechanical appliances, organic chemicals, etc.

Currently, the state has 14 operational Special Economic Zones (SEZs), 24 have been formally approved and 23 have been notified. These SEZs are dispersed over a manifold range of sectors including textiles, handicrafts, electronics hardware, non-conventional energy, and IT SEZs. The state has emerged as an IT hub and supports units of key IT players like Tech Mahindra, IBM, TCS, HCL, Adobe, etc. The state has proposed the development of 40 IT/ITeS parks, excluding IT SEZs, along with 2 biotech zones and a knowledge park. Furthermore, there are plans for the establishment of integrated agro/food processing zones in Hapur, situated around 54 km. from Delhi. The HCL Group is undertaking the development of a 100-acre IT City SEZ project in Lucknow, with an initial investment of around US$2.1 billion.

Also, to attract high investments and catalyze growth, the state has facilitated the investments in developing world-class road infrastructure providing connectivity between the national capital New Delhi to the state capital Lucknow and to the far eastern under-developed districts through fast, reliable, and access-controlled expressways. Several expressways such as the 165 km long 6-lane Yamuna Expressway connecting Greater Noida and Agra, the 302 km long 6-lane Agra-Lucknow Expressway, the 340 km long 6-lane Purvanchal Expressway connecting Lucknow to Ghazipur near Bihar border, the 296 km long Bundelkhand Expressway connecting the backward districts such as Chitrakoot and Banda to the National Capital via other expressways are already operational. Also, Gorakhpur Link Expressway, connecting Gorakhpur to Purvanchal Expressway and Ganga Expressway (US$ 1 billion investment), connecting Meerut district to Allahabad district, are under construction which will further enhance connectivity of different regions of the state.

According to Department for Promotion of Industry and Internal Trade (DPIIT), the state has enticed the Foreign Direct Investment (FDI) equity inflows worth US$ 1,301.4 million during the period October 2019 to March 2023.

Due to the availability of fertile soil and favourable climatic conditions, the state has a rich agricultural belt. Food grains such as wheat, rice, maize, millet, gram, pea, and lentils are produced in large quantities giving Uttar Pradesh the tag of the country's largest food grains producer. Uttar Pradesh is also the country's largest producer of

vegetables. The state has proposed the development of an integrated agro/food processing zone at Hapur.

The state is also the second largest producer of sugar in the country. Over 100 sugar mills operated in the state during the sugarcane crushing season of 2022-23. Most of the sugar mills are in the western Uttar Pradesh belt in districts of Meerut, Muzaffarnagar, Bijnor, Saharanpur, Moradabad, Rampur, Bareilly, etc. The prominent sugar mills operated by large players are Bajaj Hindustan Sugar Limited, Balarampur Chini Mills Limited, Dhampur Sugar Mills Limited, and Oudh Sugar Mills Limited. The state has also introduced National Dairy Plan (NDP) to boost the dairy industry of the state. It houses large number of units of key players in dairy products like Mother Dairy, Amul, Gyan, Paras, Namaste India, etc.

The per capita income of Uttar Pradesh is Rs. 55,591 in the year FY23. During FY12 to FY23, a growth of about 3.9 percent is seen in the state Uttar Pradesh. The growth in per capita income of Uttar Pradesh since FY12 is presented in **Figure 3-5**.

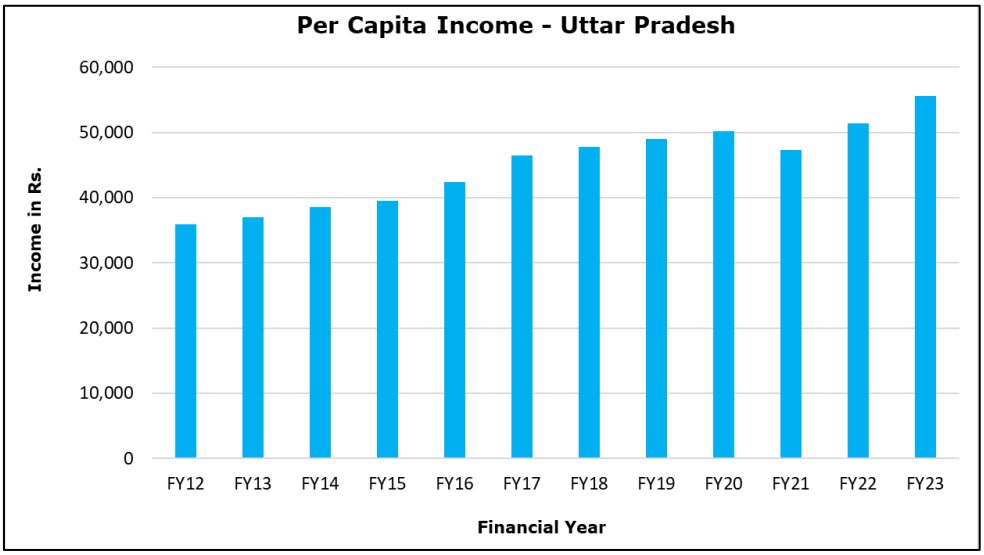


Figure 3-5: Per Capita Income of Uttar Pradesh from FY12 to FY23

Other PIA States

The other PIA states contributing to the traffic on the project road are Madhya Pradesh, West Bengal, Bihar, Gujarat, and Maharashtra. Economic indicators of PIA states are as follows.

- Madhya Pradesh's Gross State Domestic Product (GSDP) stood at Rs 6,431.2 billion in FY23 and has been growing at a compounded annual growth rate of 6.6 percent since FY12.
- Gross State Domestic Product (GSDP) of West Bengal stood at Rs 8,540.2 billion in FY23 and has been growing at a compounded annual growth rate of 4.5 percent since FY12.

- Bihar's Gross State Domestic Product (GSDP) stood at Rs 4,424.7 billion in FY23 and has been growing at a compounded annual growth rate of 5.5 percent since FY12.
- Gujarat's Gross State Domestic Product (GSDP) stood at Rs 13,722.0 billion in FY22 and has been growing at a compounded annual growth rate of 8.5 percent since FY12.
- Gross State Domestic Product (GSDP) of Maharashtra stood at Rs 20,279.7 billion in FY22 and has been growing at a compounded annual growth rate of 4.8 percent since FY12.
- The service sector is the largest contributor to GSDP for the PIA states in FY22/FY23 - 38.3 percent in Madhya Pradesh, 51.9 percent in West Bengal, 60.0 percent in Bihar, 57.1 percent in Maharashtra while in the state of Gujarat secondary sector accounts for highest contribution (about 48.5 percent) in GSDP.

The average annual growth rates as obtained using regression analysis for the period FY12 to the latest available year are presented in **Table 3-6**.

Particular/States	Uttar Pradesh	Madhya Pradesh	West Bengal	Bihar	Gujarat	Maharashtra
	FY12 to FY23				FY12 to FY22	
GSDP	5.4	6.6	4.5	5.5	8.5	4.8
Primary	4.1	6.4	2.5	3.1	5.2	3.6
Secondary	6.3	6.3	6.6	6.8	9.6	3.1
Tertiary	5.8	5.8	4.9	6.0	7.4	6.0
Construction	5.2	3.8	5.7	4.0	5.5	2.6
Per Capita Income	3.9	5.0	3.8	3.7	7.0	3.7

Table 3-6: Average Annual Growth Rates (%) of State Income for Other PIA States

The GSDP over the years for the PIA states is presented in **Figure 3-6**.

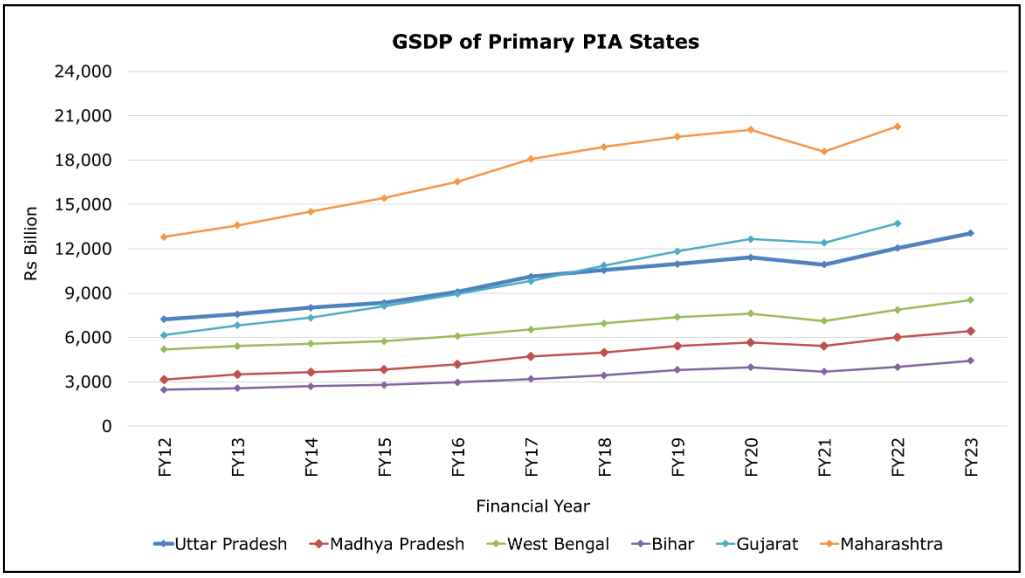


Figure 3-6: GSDP (in Rs billion) for other PIA States

3.6 India and PIA Outlook

3.6.1 India's Past Performance and Outlook for Future

India's growth trend during the recent years has been presented in **Figure 3-7**.

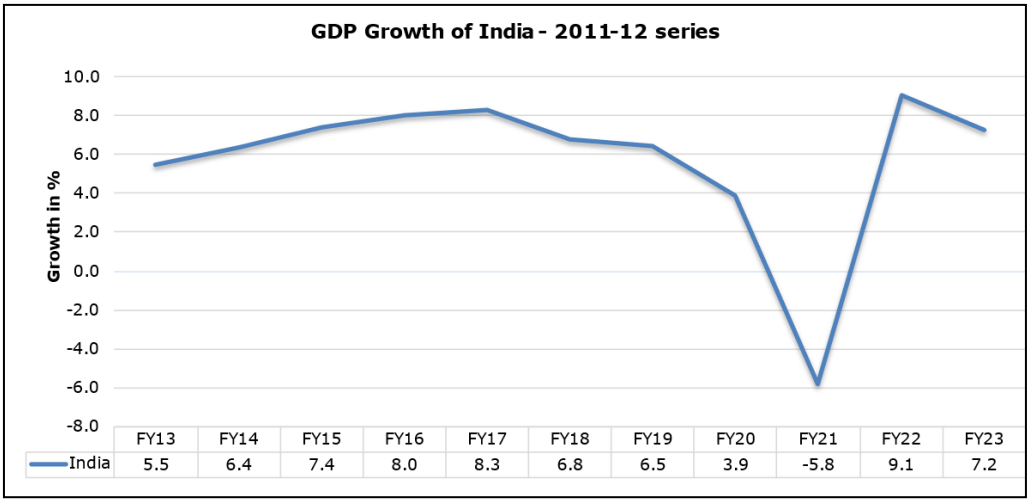


Figure 3-7: GDP Growth in India

Economic growth in India has been broadly on an accelerating path till FY18. It is likely to be the fastest growing major economy in the world in the medium-term. The growth in real GDP was 8.3 percent for FY17 and 6.8 percent in FY18, while the growth in FY19 was slightly lower at 6.5 percent. The long-term trend line growth of 7.2 percent has been achieved between FY12 to FY19. During FY20, growth has slowed down due to some structural issues and global headwinds resulting in an average GDP growth rate of 3.7 percent.

With the outbreak of COVID-19, global recession was witnessed across all the economies. The lockdown period announced by Indian government had an adverse impact on the economy. The resultant contraction for FY21 has been 5.8 percent.

As per the latest update by Central Statistical Organisation (CSO), GDP in FY22 has grown by 9.1 percent. India has grown at 7.2 percent in FY23. As per the latest forecast of RBI, the economy is likely to grow at 7.0 percent in FY24.

In light of the outlook being predicted by various agencies for the current years and likely revival thereafter spread over a couple of years, the year-on-year growth for Indian economy based on the forecast by Consensus Economics for FY25 and beyond as provided by the client is presented in **Figure 3-8**.

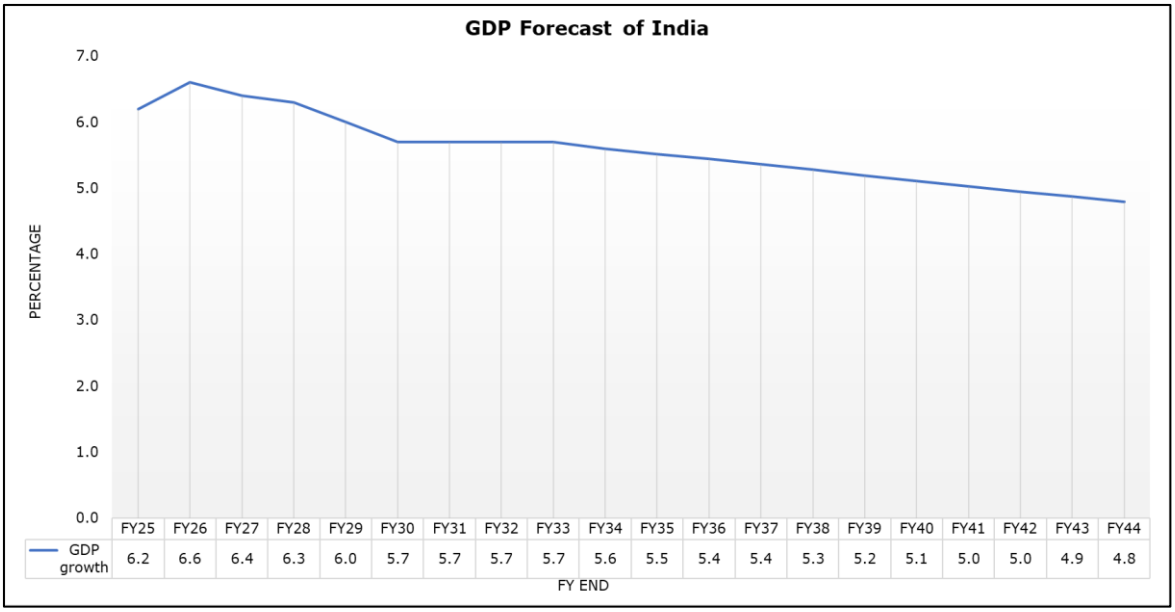


Figure 3-8: GDP Forecast of India

3.6.2 PIA States Outlook

A snapshot of the main economic indicators in the past for the PIA states is presented in **Table 3-7**.

Indicators	Uttar Pradesh	Madhya Pradesh	West Bengal	Bihar	Gujarat	Maharashtra
	FY23				FY22	
GSDP in Rs Billion (Till latest available FY)	13,046.8	6,431.2	8,540.2	4,424.7	13,722.0	20,279.7
GSDP growth (FY12 to FY22/FY23)	5.4%	6.6%	4.5%	5.5%	8.5%	4.8%
Per capita Income in Rs (FY22/FY23)	55,591	74,653	86,366	35,119	195,223	162,231
Sector Share (%) in FY22/FY23						
Agriculture and allied	23.8	36.3	19.2	20.0	16.5	16.5
Industry	29.7	25.4	29.0	20.0	48.5	26.4
Services	46.6	38.3	51.9	60.0	35.1	57.1

Table 3-7: Main Economic Indicators of PIA States

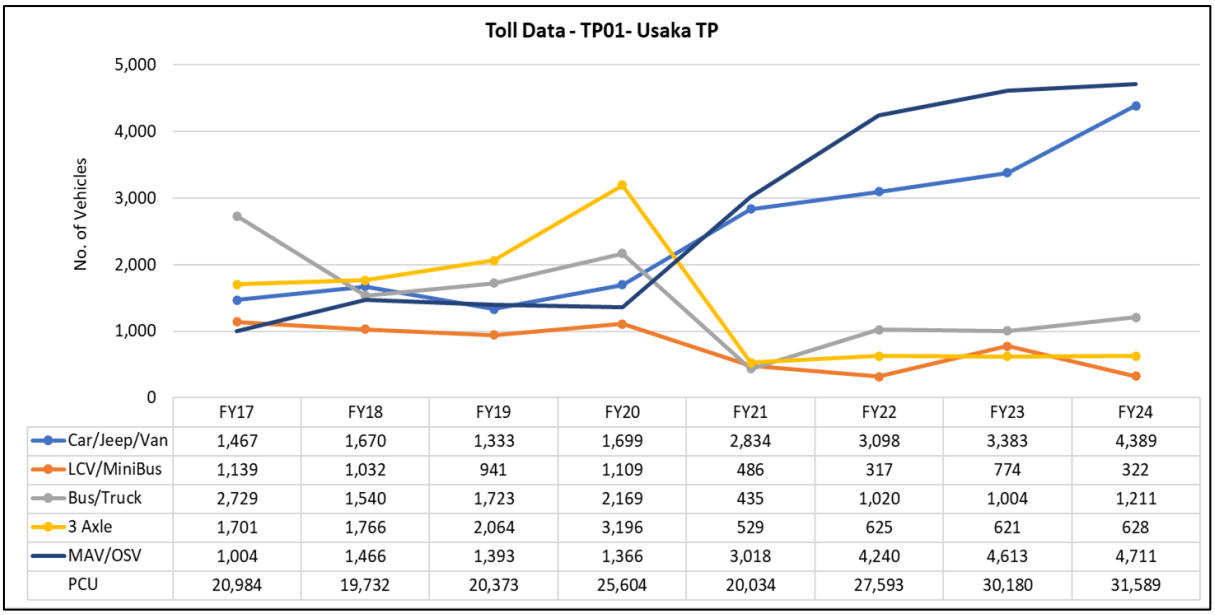
In order to arrive at the forecast of the PIA states, past performance of the State GDPs vis-a-vis India GDP has been studied and the multipliers have been derived for both short term and long term. The past and adopted multipliers for PIA states to Indian economy are presented in **Table 3-8**.

Period	India	Uttar Pradesh	Madhya Pradesh	West Bengal	Bihar	Gujarat	Maharashtra
Past growth (%)							
FY12 to FY20	7.0	6.3	7.7	5.2	6.4	9.6	6.1
FY15 to FY20	6.8	6.4	8.3	6.0	7.7	9.5	5.4
FY12 to FY23	5.6	5.4	6.6	4.5	5.5	8.5	4.8
FY15 to FY23	4.8	4.9	6.1	4.5	5.4	7.6	3.4
Past Multipliers vis-a-vis India							
FY12 to FY20		0.9	1.1	0.7	0.9	1.4	0.9
FY15 to FY20		0.9	1.2	0.9	1.1	1.4	0.8
FY12 to FY23		1.0	1.2	0.8	1.0	1.5	0.8
FY15 to FY23		1.0	1.3	0.9	1.1	1.6	0.7
Multipliers adopted for future							
States w.r.t. India		1.0	1.1	1.0	1.0	1.3	0.9

Table 3-8: Past and Future Multipliers of PIA States

3.7 Past Traffic Data on Project Road

Past traffic data is available from Schedule M from July 2016 to November 2023 for the toll plaza location. A comparison of the respective years of Schedule M data has been carried out with estimated AADT for FY24. Traffic data with respect to financial year and vehicular modes is presented in **Figure 3-9**.



	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24
Car/Jeep/Van	1,467	1,670	1,333	1,699	2,834	3,098	3,383	4,389
LCV/MiniBus	1,139	1,032	941	1,109	486	317	774	322
Bus/Truck	2,729	1,540	1,723	2,169	435	1,020	1,004	1,211
3 Axle	1,701	1,766	2,064	3,196	529	625	621	628
MAV/OSV	1,004	1,466	1,393	1,366	3,018	4,240	4,613	4,711
PCU	20,984	19,732	20,373	25,604	20,034	27,593	30,180	31,589

Figure 3-9: Past Toll Data of Usaka TP

The end point growth from the time series analysis of the traffic data is presented in **Table 3-9** for the project road toll plaza.

FY/Mode	CJV	LCV/MBus	Bus/Truck	3A/MAV	PCU
Trend Line Growth (%)					
FY17 vs FY24	18.5	-15.7	-12.3	9.9	7.0
FY20 vs FY24	23.1	-18.2	-3.2	7.3	8.7

Table 3-9: Past Traffic Trend Analysis

Car growth has been varying year on year at the toll plaza and has shown a double-digit growth of about 18-23 percent while comparing FY17 and FY20 with FY24. In case of 3A/MAV, a growth of about 7 percent is observed during FY20 to FY24.

3.8 Past and Future Transport Demand Elasticity

The econometric model applied for the project, relates traffic growth to changes in state domestic product via an elasticity factor according to IRC guidelines. The elasticity by vehicle types have been estimated based on the regression analysis of weighted income of PIA states with the actual traffic data.

A regression between GSDP (as independent variable) and registered vehicles (as dependant variable) of Uttar Pradesh was carried out. The registered vehicle elasticity in case of cars for the state of UP is 2.0 during FY12 to FY19. In case of all trucks combined, the registered vehicle elasticity for UP is 1.8 during the same period; however, an elasticity value of 1.6 has been observed for trucks while considering all the PIA states of the project road.

Vehicle registration data is also used as a proxy wherein operational toll data is not available. Vehicle registration data represents all vehicles registered in the state, but does not indicate actual number of vehicles plying on the road as it does not account for factors such vehicles taken off the road due to lack road worthiness, those registered in a state but mostly used elsewhere, etc. Consequently, the elasticity values based on vehicle registration may not be representative of the traffic growth trends on the project road.

The derived elasticities on the project road (from Schedule M data) and on other National Highways across India have also formed the basis for choosing the recommended elasticities on PR.

Cars

- The motorization rate for cars (per 1000 population) in India has gone up from 6.6 in 2001 to 25 in 2019. Although India's car fleet has been growing at 10 percent for nearly 25 years, its motorization rate is low compared to other countries of similar wealth and much lower than developed countries with motorization rate of around 450. The low motorization rate suggests that there is room for continued growth for many years to come. With the continual increase in motorization rate and improved road network usage of cars for inter-urban travel is showing a growing trend.
- The elasticities and the past growth levels for cars are a result of increasing income levels, increasing vehicle ownership and higher propensity to travel on highways in India due to network level developments and higher levels of service. These levels of growth are likely to continue in the near to medium term since car ownership levels are still very low and the road network is undergoing continual development.

- Since passenger travel pattern of the project road has the highest interaction of about 90 percent between the towns of Jhansi/Orai and Kanpur/Lucknow, the motorisation rate of the Uttar Pradesh has been studied. During FY19, there are 35 cars per 1,000 population of Uttar Pradesh exhibiting CAGR of 11.9 percent during FY11 to FY19.
- In the past car elasticity has been 2.7 during the FY21 to FY24 on the project road. Going into the future, car elasticity has been considered as 1.3 till FY30 and further tapered for the remaining concession period.

Bus/Truck

- Over the years in India, there has been a change in passenger's travel mode preferences with increasingly more people shifting from public transport systems towards personalised modes. This has resulted, in general, in elasticity of bus traffic/demand to GSDP lower than unity ranging between 0.3 to 0.8 across the operational National Highways.
- Bus/Truck elasticity has been recommended as 0.5 till FY40 and tapered to 0.4 till the end of the concession period for the Project Road.

LCV

- The switch between MLCV and LCV is being observed across other national highways wherein MLCVs have been gaining importance lately over LCV category. Since MLCVs have been gaining importance over LCVs, an elasticity value of 0.5 for LCV has been adopted till FY40 and further tapered for the remaining concession period.

3A/MAV Trucks

- With the limited data of Schedule M, the elasticity value for 3A and MAVs combined is 1.5 during FY20 to FY24.
- For 3A Trucks, elasticity has been recommended as 0.6 respectively till FY40 and tapered thereafter. As mentioned earlier, 3A trucks have started showing a low growth after reaching a low base, therefore a minimal positive elasticity has been adopted for the project road.
- In case of MAV trucks, an elasticity of 1.0 has been adopted till FY30, and is tapered for the subsequent years.
- For freight traffic, the higher elasticities for trucks (2A/3A/MAV) in the initial slab has been considered in light of the construction activities in the region with the development of Ganga Expressways Phase-1 and southern greenfield Bypass for Prayagraj etc. which may lead to the movement of additional construction material related trucks on project corridor. The developments of infrastructure in Ayodhya post construction of the main temple are also likely to keep the growth momentum for traffic on the project road.

It is likely that this growth would slow down over time as the market becomes more mature and saturated, therefore elasticity to GSDP can be expected to decline over time. With the anticipated growth momentum in the coming years, higher elasticity values have been considered in the initial slabs for Cars & MAV and further tapering has been done in the future slabs.

In India as a whole, the freight vehicle mix has been changing in the last decade favouring MAV to 2 Axle/ 3Axle vehicles for long-distance traffic. Considering the ongoing technical advancements in automobile industry, some of the standard 2 Axle/ 3 Axle trucks would gradually be replaced by MAVs. Within MAVs, 5-6 axle vehicles are gaining priority.

On an overall level, due consideration has been given to the tonnage shifts happening in the market with Mini LCV gaining importance for short distance movements over LCVs and MAVs being preferred over 2A/3A for long distance movements given the operational efficiencies achievable with larger vehicles. Some of the mature National Highways have started showing a minimal growth in 2A/3A and are being used for local movements.

While assigning elasticities to different modes, freight travel pattern and over all elasticity of cargo tonnage with respect to weighted GSDP has been an important consideration. The past elasticity values have been observed in the range of 1-1.3 for cars on various National Highways and around 0.5-0.9 for 3A/MAV combined. Individually, 3A trucks have shown a negative elasticity in some of the assets with MAVs showing a higher positive elasticity. In case of 3A trucks a minimal positive elasticity has been observed in some national highways after their base has hit the bottom.

The recommended elasticity values adopted for all vehicle types in line with the traffic growth being observed on the PR, trends and elasticity values on other National Highways and likely changes in freight traffic pattern are presented in **Table 3-10**.

Period/Modes	Cars	LCV	Bus/2A	3A	MAV
Up to 2030	1.3	0.5	0.5	0.6	1.0
2031 to 2040	1.2	0.5	0.5	0.6	0.9
Beyond 2040	1.1	0.4	0.4	0.5	0.8

Table 3-10: Recommended Elasticity for Project Road

With these individual assigned elasticities for 3A and MAVs, the weighted elasticity of 3A/MAV works out to be 0.8 during the tenure of concession period.

3.9 Projected Traffic Growth Rates

Based on the moderated perspective elasticity values and the projected growth rates of the income for PIA states, the future average annual compound traffic growth rates by vehicle type have been estimated for the project road by using the following relationship:

$T_{gr} = (GSDP_{gr}) \times E;$

where,

T_{gr} – Traffic growth rate for mode

$GSDP_{gr}$ – Growth rate of GSDP

E – Elasticity value for mode

Using the year-on-year mode wise weighted income for PIA and elasticity for different time periods, traffic growth rates have been estimated for each year till FY44. The estimated traffic growth rates for the project road along with the implied growth rates after considering the impact of diversions have been presented in **Table 3-11**.

FY/Modes	Cars	LCV	Bus/ 2A Truck	3A	MAV	Cars	LCV	Bus/ 2A Truck	3A	MAV
	Normal Growth Rates					Implied Growth Rates				
2025	8.1	3.1	3.1	3.8	6.2	8.1	3.1	3.1	3.8	6.2
2026	8.6	3.3	3.3	4.0	6.7	8.6	3.3	3.3	4.0	6.7
2027	8.3	3.2	3.2	3.9	6.4	8.3	3.2	3.2	3.9	6.4
2028	8.2	3.2	3.2	3.8	6.3	8.2	3.2	2.9	3.2	5.4
2029	7.8	3.0	3.0	3.6	6.0	7.8	3.0	1.2	-0.7	1.5
2030	7.4	2.9	2.9	3.5	5.7	7.4	2.9	1.9	1.1	3.1
2031	6.8	2.9	2.9	3.5	5.2	6.8	2.9	2.0	1.3	3.0
2032	6.8	2.9	2.9	3.5	5.2	6.8	2.9	2.9	3.5	5.2
2033	6.8	2.9	2.9	3.5	5.2	6.8	2.9	2.9	3.5	5.2
2034	6.7	2.8	2.8	3.4	5.1	6.7	2.8	2.8	3.4	5.1
2035	6.6	2.8	2.8	3.3	5.0	6.6	2.8	2.8	3.3	5.0
2036	6.5	2.7	2.7	3.3	4.9	6.5	2.7	2.7	3.3	4.9
2037	6.4	2.7	2.7	3.2	4.9	6.4	2.7	2.7	3.2	4.9
2038	6.3	2.7	2.7	3.2	4.8	6.3	2.7	2.7	3.2	4.8
2039	6.2	2.6	2.6	3.1	4.7	6.2	2.6	2.6	3.1	4.7
2040	6.1	2.6	2.6	3.1	4.6	6.1	2.6	2.6	3.1	4.6
2041	5.5	2.0	2.0	2.5	4.1	5.5	2.0	2.0	2.5	4.1
2042	5.4	2.0	2.0	2.5	4.0	5.4	2.0	2.0	2.5	4.0
2043	5.4	2.0	2.0	2.5	3.9	5.4	2.0	2.0	2.5	3.9
2044	5.3	1.9	1.9	2.4	3.9	5.3	1.9	1.9	2.4	3.9

Table 3-11: Projected Traffic Growth Rates for Project Road (%)

In derivation of above growth rates, the likely shift of buses to cars in case of passenger vehicles and the replacement/ tonnage shift of 2A/3A trucks to MAV for long distance in case of freight vehicles has been duly considered.

The above growth rates relate to the most likely Base Case. In addition, two sets of traffic growth rates under low and high cases have also been considered and impact on toll revenue evaluated for both these cases. Based on the risk analysis of key parameters like economic growth and elasticity of travel demand impacting traffic growth, two additional growth scenarios have been presented. Low growth scenario considers a 20 percent reduction in growth rates relating to about 10 percent decline each in elasticity and economic growth. The high growth scenario considers a 20 percent increase in growth rates signifying about 10 percent increase each in elasticity and economic parameters.

4. TOLL REVENUE PROJECTIONS

4.1 Tolling Strategy

The project road will continue to have an "Open System" of toll collection which enables the concessionaire to collect tolls from through traffic as well as from short distance one.

As mentioned earlier, there is one operational toll plaza on the project road, TP01-Usaka at km 1,519.880 with approximate section length of 62.8 km.

4.2 Schedule of User Fee

As per Schedule of User Fee for the project, the per km toll rates applicable from 2007-08 for normal tolling length, bypasses and permanent structures, the revision basis and concessions are provided.

The concessions to traffic have been given in the form of rates as below:

Local traffic

Car / Jeep / Vans - includes local users owning a vehicle registered for non-commercial purposes, residing within a distance of 20 km from the toll plaza and crossing the same for commuting purposes.

Commercial vehicles - includes local users owning a commercial vehicle (excluding vehicles under National Permit), registered with address on the Registration Certificate of a particular district and uses such vehicle for commuting on a section of National Highway, permanent bridge, tunnel or bypass, as the case may be, which is located within that district, shall be levied user fee on all toll plazas which are located within that district at the rate of fifty per cent of the prescribed rate of fee (single journey rate). No such concession shall be provided, if a service road or alternative road is available for use by such commercial vehicles. Thus, local commercial traffic has to pay only 50 percent of the normal ticket.

Daily Pass

When the vehicle has to cross the tolled section more than once in a day, the user shall have the option to pay one and half times (1.5 times) of the fee for a single entry; this pass shall be valid for 2 entries within 24 hours of purchase.

Monthly Pass

A user, who makes use of the project road frequently during a month, may opt to purchase a monthly pass upon payment of a charge equal to two-thirds of the fee payable for 50 single journeys; this pass can be used for a maximum 50 one-way journeys over the month of validity.

Thus, the different categories of toll tickets are as follows:

(i) Traffic paying normal toll rates (single trip)

(ii) Traffic paying return journey rates

(iii) Traffic paying monthly pass rates

(iv) Traffic paying local personal rates

(v) Traffic paying local commercial rates

4.3 Tolling Streams

The tolling stream distribution has been estimated from the ETC data of FY24 (Aug 2023 to November 2023) to which annualised Cash & Exemptions data available from April 2022 to December 2022 has been added. The resultant ticket distribution is presented in **Table 4-1**.

Type	Car	LCV	Bus/2A Trucks	3A Trucks	MAV	OSV
Single	36.4	72.9	62.3	83.7	47.0	100.0
Return	44.5	24.9	36.5	15.0	51.9	
Monthly	0.0	0.0	0.0	0.0	0.0	
Local personal	2.7					
Local commercial	0.4	0.0	0.7	0.9	1.0	
Exemptions and Violations	16.0	2.3	0.4	0.4	0.1	
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 4-1: Tolling Distribution

In case of cars, the normal toll paying traffic is likely to be about 36.4 percent at the toll plaza location. The car traffic for return journey is likely to be high which is around 44.5 percent due to the short lead of travel for cars on the project road. The exemptions for car traffic are 16.0 percent.

In case of MAVs, around 47.0 percent of traffic is opting for normal ticket due to their long lead of travel and around 51.9 percent of MAV falling under return journey category. As mentioned earlier, these trucks are making short distance trips from Jhansi/Orai to Kanpur/Lucknow and surroundings. The MAV traffic falling under local commercial category is 1.0 percent.

In case of LCV and Bus/2A trucks, the level of normal paying traffic is likely to be around 72.9 percent and 62.3 percent respectively.

Trip rate for local personal pass users for cars is 0.9 and for monthly pass it is considered as 1.67 across all the modes. For daily pass, trip rate of 2.0 has been considered for all the modes.

4.4 Toll Rates

This section presents details on the toll rates that are likely to be imposed on the users of the project road during the study period. The toll rates (Rs/km) for the base year 2007-08 for different vehicle categories as per toll fee rules are presented in **Table 4-2**.

Mode	Base rate per km (in Rs)
Car, Jeep, Van, LMV	0.65
LCV /M Bus	1.05
Bus/ 2 Axle Truck	2.20
3 Axle	2.40
MAV	3.45
Oversized	4.20

Table 4-2: Toll Rates in Rs/km for Different Vehicle Categories

The toll notification states that the 2007 toll rates shall be increased without compounding by three per cent each year with effect from the 1st day of April 2008 and such increased rate shall be deemed to be the base rate for the subsequent years.

In addition to this, the rate of fee for use of bypass forming part of a section of a National Highway constructed with a cost of Rs 10 crore or more, for the base year 2007, shall be one and a half times of the per km base rates specified above and the length of such bypass shall be excluded from the length of such section of National Highway. Also, the fee levied and collected hereunder for permanent bridge/ structures, as the case may be, having a length of 60m or more on the basis of the equivalent length for structure as specified shall be due and payable at the toll plaza.

The details of normal tolling lengths, bypass length (at 1.5 times) and equivalent structure lengths being charged at toll plaza as per the information in the Schedule M for the project are presented in **Table 4-3**.

Usaka (TP01) at km 1519.880	FY24 onwards
A. Normal	61.729
B. Bypass	0.000
C. Eq. structure	11.74
Total Road Length	62.903
Tolling Length = A+(B*1.5) + (C*10)	73.469

Table 4-3: Tolling Length (in km) for the Project Road

The applicable base rates shall be revised annually with effect from April 1 each year to reflect the increase in wholesale price index for the month of December of the immediate preceding year in which such revision is undertaken but such revision shall be restricted for 40 per cent of the increase in wholesale price index.

Actual WPI information for December 2023 of 151.6 under 2011-12 series converted into 1999-00 series (151.6*1.873*1.641=465.957) has been used.

WPI increase of 5.25 percent and 4.5 percent for December 2024 (applicable for FY26) and December 2025 (applicable for FY27) respectively has been considered to account for the low base in December 2023, the ongoing effect of El Niño and other geopolitical issues. The WPI growth forecast for remaining years beyond December 2025 has been kept unchanged at 3.5 percent.

The stream of toll rates to be charged at the toll plaza of the project road in cardinal years till FY44 is presented in **Table 4-4**. The toll fee has been rounded to nearest 5 Rupees as per toll fee rules.

FY	Car	LCV	Bus/ 2-axle Truck	3-axle Truck	MAV	O/size/ HME	Car Local
2024	105	170	355	390	560	680	330
2025	110	175	365	400	570	695	340
2030	135	215	455	495	710	865	420
2035	165	265	555	605	870	1,060	515
2040	200	325	675	740	1,060	1,290	630
2044	235	380	795	865	1,245	1,515	735

Table 4-4: Toll Rates at Toll Plaza (in Rs)

The users purchasing return journey tickets will pay 1.5 times the above toll rates; the traffic opting for monthly pass will pay 33.3 times (two-thirds of 50 single journeys) the normal traffic toll rates.

4.5 Toll Revenue Estimates

Total Revenue collected at the toll plaza location during FY23 is Rs 112.45 crore. The user fee remittance from 1st April 2022 is Rs 2,41,98,875 per week which amounts to Rs 125.83 crores for FY23. The latest assured remittance for FY24 is Rs 123.8 crore. The actual realised revenue for FY24 from April 2023 to November 2023 is Rs 77.4 crore. Month on month past toll revenue for the project road from ETC is presented in **Table 4-5**.

Month	Revenue (In Crores)
Nov-21	8.0
Dec-21	9.5
Jan-22	8.6
Feb-22	8.4
Mar-22	9.9
Apr-22	10.1
May-22	9.7
Jun-22	10.8
Jul-22	8.3
Aug-22	8.0
Sep-22	8.1
Oct-22	8.0
Nov-22	9.5
Dec-22	10.0
Jan-23	9.7
Feb-23	9.4
Mar-23	10.8
Apr-23	10.9
May-23	10.9
Jun-23	10.6
Jul-23	9.0
Aug-23	8.6
Sep-23	9.2
Oct-23	9.7
Nov-23	8.5
FY23	**112.4**
FY24 (Apr-Nov)	**77.4**

Table 4-5: Past Toll Revenue (in Crores)

Using the estimated base AADT for FY24 and the tolling segmentation, the revenue for FY24 is calculated as Rs 119.74 crore as against the assured remittance amount for FY24 of Rs 123.78 crore.

As per the site findings, WIM is not currently installed at the Usaka toll plaza lanes whereas a weigh bridge is present in both the directions. In case of adjacent toll plazas of Ait and Semri with similar PCU levels as of Usaka, overloading is being charged and the revenue from the overloaded vehicles as per Schedule-G is around Rs 1.9 crores for 8 months and is likely to be around Rs 2.8 crore for the year.

The travel pattern and commodity distribution with prominence of building materials (muram and Gitti) at Usaka toll plaza is similar to that of Ait and Semri toll plazas.

In view of this, 7- day axle load survey data (as part of technical due diligence) has been provided by the client which has been analysed to understand the extent of overloaded vehicles at Usaka toll plaza. The analysis shows similar overloading trends across the seven days. The findings of the overloading analysis are presented in **Table 4-6**.

S.No.	Vehicle Type	Within Permissible Limit	Within Tolerance up to 5%	>5%-<10%	>10%-<20%	>20%	Total
1	LCV	97.5%	0.0%	2.5%	0.0%	0.0%	100.0%
2	2A	96.2%	1.6%	1.2%	0.5%	0.5%	100.0%
3	3A	84.2%	5.9%	4.1%	3.5%	2.3%	100.0%
4	MAV	49.8%	3.6%	4.3%	7.8%	34.5%	100.0%

Table 4-6: Overloaded Vehicles on the PR

As observed from the axle load analysis, around 35 percent of the MAVs and 2 percent of 3A trucks are above 20 percent overloading limit at Usaka TP whereas 3 percent of 3A trucks and 8 percent of MAVs are in the 10 percent to 20 percent overloaded category.

The overloading vehicles are liable to pay the overloading penalty as per the provisions of the concession agreement. The concession agreement of the latest TOT project states that overloading penalty should be charged as per the NHAI overloading circular. As per the amended National Highways Fee (Determination of Rates and Collection) Rules, 2018, "the driver or owner or person in charge of a mechanical vehicle shall be liable to pay fee, for entering the overloaded vehicle on the National Highway, to the user fee collecting agency, equal to fees as presented in **Table 4-7**.

Percentage of excess load over Maximum Permissible Gross Vehicular Weight	Multiplying factor to base rate fees	Fees
0% to 20%	Two	[(Fees applicable for such category of mechanical vehicle under sub-rule (2) of rule 4) X (Multiplying factor)]
>20% to 40%	Four	
>40% to 60%	Six	
>60% to 80%	Eight	
>80% and above	Ten	

Table 4-7: User Fee for Overloaded Vehicles

However, as per the operational overloading practices at the toll plazas where overloading penalty is being charged, it is either the next higher category toll or two times the normal fee which is usually being collected.

Continuing with the practice of two times toll, since MAVs are heavily overloaded, with WIM in place at Usaka, the practice of charging them for one-time extra payment can be put in place. Even if 33 percent of these MAVs pay one time extra, it will result in a substantial gain in revenue, but it might not be practically possible to stop each vehicle and collect extra toll.

Although the quantum of overloaded vehicles is high but after factoring in the practical number of vehicles from whom overloading can be charged, under a more pragmatic scenario, it is assumed that around 25 percent of this 33 percent overloaded category is charged for one-time additional payment. This results in around 8.25 percent of MAV AADT of FY24 - paying one-time extra toll. With appointed date likely to be achieved in March 2024 and considering the time required for putting the systems in place for overloading revenue collection, this additional revenue from overloaded vehicles is considered from FY26. The estimated revenue from overloading in FY26 is Rs 96.3 million.

However, with strict overloading compliance in place in the future years, this overloading percentage of 33 percent (considered till FY26) is likely to decline over the years of concession - a decline of 1 percent every year has been considered starting from FY27 onwards.

NHAI has taken steps for the better compliance of the overloading norms due to which the practice of overloading is observed to be declining over the operational toll road assets on National Highways. In context of the project road also, stricter compliance of non-overloading norms on the project road could be achieved in next 3-4 years from now. The truckers would prefer to go for conversion of overloading tonnage into legible commercial traffic through addition of more trucks rather than paying the overloading penalty. In case the overloaded tonnage beyond the permissible limit (basis axle load analysis) is converted into additional vehicles, it may result in additional vehicles of around 2 percent in 3A trucks and 15 percent in MAV category as presented in **Table 4-8**.

Mode	Direction	Overloaded Vehicle Share	Average Overload (Tonnes)	AADT	Total Overloaded Vehicles	Total Overloaded Tonnage (Tonnes)	Permissible Payload (Tonnes)	Additional Vehicles Required	Additional Replacement Vehicles Required (Both Directions)	Additional Vehicles as % of AADT
3A	Orai-Kanpur	24%	3.4	314	75	252.6	28.5	9	12	1.90%
	Kanpur-Orai	9%	2.8	314	29	81.1	28.5	3		
MAV	Orai-Kanpur	79%	15.3	2,455	1,931	29,627.50	45	658	722	14.70%
	Kanpur-Orai	15%	7.8	2,455	364	2,858.10	45	64		

Table 4-8: Estimation of Additional Vehicles

However, to estimate the revenue under this scenario, 50 percent of the additional estimated vehicles from overloaded tonnage on project road have been considered. Since this could only be achieved over the next few years, the additional vehicles of around 1 percent of 3A and 7.5 percent of MAVs have been considered from FY27.

In light of the above, **Table 4-9** presents the estimation of revenue is done for the following cases:

- Case I- No overloading revenue- Business as Usual (BAU)
- Case II-Revenue from one-time extra payment from overloaded vehicles
- Case III-Overloading revenue from additional vehicles added from FY27

FY ending March	CASE I: Without overloading	Case II: One-time extra payment from overloaded MAVs	CASE III: Additional 3A and MAVs added from FY27
2024	1,197.4	1,197.4	1,197.4
2025	1,291.6	1,291.6	1,291.6
2026	1,444.5	1,540.8	1,444.5
2027	1,606.4	1,710.8	1,692.1
2028	1,765.0	1,876.2	1,859.3
2029	1,873.6	1,987.5	1,973.1
2030	2,009.6	2,127.3	2,116.1
2031	2,161.2	2,283.2	2,275.5
2032	2,367.9	2,496.9	2,493.2
2033	2,578.1	2,713.5	2,714.9
2034	2,814.4	2,957.1	2,964.0
2035	3,082.4	3,232.4	3,246.2
2036	3,365.4	3,522.7	3,544.5
2037	3,652.9	3,816.4	3,847.6
2038	3,988.4	4,158.8	4,201.0
2039	4,343.0	4,519.9	4,574.7
2040	4,735.9	4,919.1	4,988.5
2041	5,116.1	5,303.9	5,389.1
2042	5,532.9	5,724.8	5,828.5
2043	5,983.2	6,178.3	6,302.7
2044	6,481.7	6,680.1	6,828.2
PV12 FY24 to FY44	17,338	18,108	18,095
CAGR FY24 to FY44	8.8%	9.0%	9.1%
PV variation w.r.t. Case I (without overloading) in %		4.4%	4.4%
PV variation w.r.t. Case II (Base Case) in %			-0.07

Table 4-9: Revenue Estimates in Rs Million under three Cases

The projected revenue under Business-as-usual Case would result in a PV of about Rs 17,338 million over the life of concession. Case II with one-time extra payment from overloaded vehicles would generate 4.4 percent higher PV (Rs 18,108 million) than Business-as-usual Case (Case I) and 4.4 percent with overloading revenue from additional vehicles (Case III). The variation in PV for Case III with respect to Case II is -0.07 percent.

In view of the current practices of overloading being charged at one time extra payment, Case II (one-time extra payment from overloaded vehicles) has been considered as the Base Case.

4.6 Traffic Projections and Capacity Analysis on PR

Table 4-10 presents the projections of the mode-wise vehicles under Base Case after diversion till FY44.

FY End	CJV	LCV	Bus/2A	3A	MAV	OSV	Total PCU
2024	4,389	322	1,211	628	4,706	4	31,584
2025	4,743	332	1,249	652	5,000	4	33,461
2026	5,150	343	1,290	678	5,332	5	35,585
2027	5,578	354	1,332	704	5,676	5	37,782
2028	6,035	366	1,370	727	5,985	5	39,832
2029	6,506	377	1,387	722	6,074	5	40,752
2030	6,988	387	1,412	730	6,263	6	42,206
2031	7,466	399	1,441	739	6,450	6	43,656
2032	7,976	410	1,482	765	6,783	6	45,886
2033	8,522	422	1,524	791	7,134	7	48,235
2034	9,095	434	1,567	818	7,496	7	50,667
2035	9,697	446	1,611	846	7,872	7	53,190
2036	10,330	458	1,655	873	8,260	8	55,806
2037	10,995	471	1,699	902	8,661	8	58,517
2038	11,691	483	1,744	931	9,076	9	61,322
2039	12,419	496	1,790	960	9,503	9	64,217
2040	13,181	509	1,836	990	9,944	9	67,209
2041	13,910	519	1,873	1,015	10,347	10	69,956
2042	14,668	529	1,910	1,040	10,760	10	72,777
2043	15,453	540	1,948	1,066	11,182	10	75,670
2044	16,268	550	1,985	1,092	11,614	11	78,634
CAGR (%) (FY24 to FY44)	6.8%	2.7%	2.5%	2.8%	4.6%	5.1%	4.7%

Table 4-10: Projected Traffic Mode-Wise at PR

With the considered diversion impacts, the project road traffic is likely to cross 40,000 PCUs in FY29. DPR may be prepared during FY30 and FY31 and the construction period for six laning is likely to be in FY32 and FY33.

4.7 Toll Revenue Projections

The projections of revenue for the project road have been presented till FY44 in line with the study period. Toll revenue streams have been calculated assuming that:

- Toll would be collected for all 365 days in a year and for 366 days in a leap year
- Toll revenues have been presented from FY24 to FY44.
- Revenue from one-time extra toll from overloaded MAVs has been considered from April 2025 (FY26) under the Base Case.
- Toll rates will be 75% of the applicable toll rates during construction period for six laning (FY32 and FY33) but have not been considered in the analysis as NHAI InvIT will be compensated for the revenue loss.

For FY24, the revenue estimated as part of this study is Rs 119.74 crore as against the assured remittance amount is Rs 123.78 crore. The toll revenue by mode for the project road for the base case is presented in **Table 4-11**.

FY ending March	Car	LCV	Bus/2A Truck	3A Truck	MAV	O/size /HME	Total
2024	119.4	18.3	141.9	85.4	831.4	1.0	1,197.4
2025	131.8	19.4	149.6	90.7	899.0	1.1	1,291.6
2026	150.8	21.2	163.1	99.0	1,105.6	1.2	1,540.8
2027	171.6	22.5	175.1	107.8	1,232.5	1.3	1,710.8
2028	192.7	24.5	189.3	115.5	1,352.8	1.5	1,876.2
2029	216.8	26.3	198.5	119.4	1,424.8	1.6	1,987.5
2030	240.4	27.9	211.0	125.7	1,520.5	1.8	2,127.3
2031	268.0	30.0	223.1	132.5	1,627.6	2.0	2,283.2
2032	299.0	32.2	239.4	142.9	1,781.2	2.2	2,496.9
2033	327.7	34.5	255.6	154.2	1,939.1	2.4	2,713.5
2034	363.3	36.9	273.6	165.2	2,115.5	2.6	2,957.1
2035	408.2	39.4	293.6	178.1	2,310.3	2.9	3,232.4
2036	451.5	42.3	313.9	192.1	2,519.8	3.1	3,522.7
2037	495.6	44.9	335.2	205.6	2,731.7	3.4	3,816.4
2038	552.1	48.3	358.1	220.4	2,976.2	3.7	4,158.8
2039	610.1	51.3	382.5	237.3	3,234.6	4.0	4,519.9
2040	677.7	55.3	408.8	255.6	3,517.3	4.4	4,919.1
2041	743.3	58.1	433.8	272.1	3,791.8	4.8	5,303.9
2042	811.6	61.9	461.3	289.8	4,095.2	5.2	5,724.8
2043	894.6	65.7	489.5	309.8	4,413.0	5.6	6,178.3
2044	979.4	70.0	519.9	329.8	4,774.9	6.0	6,680.1

Table 4-11: Toll Revenue (in Rs million) for the Project Road by Mode

Around 85.4 percent of total revenue is likely to be generated from freight vehicles only. Majority of the revenue is expected to come from MAV/OSV with about 71.4 percent of the total revenue. Amongst other categories, cars represent a share of around 14.6 percent of total revenue followed by Bus/2A Trucks having a share of around 7.9 percent and 5.0 percent share is contributed by 3A Trucks. LCV is likely to generate about 1.1 percent of total revenue.

Vehicles paying normal tolls are around 55.7 percent of total toll revenue for the project road section and around 41.0 percent of the traffic may fall in return pass category. Overloaded vehicles contribute about 2.7 percent of the revenue, while the remaining 0.6 percent is generated from local concession passes.

4.8 Scenario Analysis

For toll road projects, revenue streams are generally based on the assessment of the traffic volume (base and future) crossing the toll plazas and the applicable toll imposed on the user of the road. There is an inherent element of uncertainty in any forecast and whilst is not possible to measure risk in a strictly statistical sense (as many of the risks are largely or partly unknown), in this section an attempt is made at quantifying the main risks that could have an impact on this forecast.

The econometric approach used to derive traffic growth, is based on the estimation of GSDP growth rates for the influence area economies and traffic demand elasticity by mode; the estimation of both variables contains a certain degree of uncertainty which can be represented in the scenario analysis. Scenario analysis has been done in the following subheadings for the base case:

High Case

The high case is based on a more optimistic economic outlook for future years and higher elasticity values as compared to the base case. Therefore, traffic growth rates of 20 percent higher than the base case for every year and for all the mode are considered.

Low Case

A growth rate of 20 percent lower than base case for all types of vehicles has been considered in the present analysis to reflect uncertainty with regard to economic performance of PIA states and lower elasticity values.

The result of base case and scenario is presented in **Table 4-12**. A comparison versus base case has been presented for the Present Value of the project (at 12 percent discount rate) and the compounded annual growth rate (CAGR) from FY24 to FY44.

FY Ending March	Base Case with one-time extra payment from overloaded MAVs	High Growth (+20%)	Low Growth (-20%)
2024	1,197.4	1,197.4	1,197.4
2025	1,291.6	1,305.8	1,277.4
2026	1,540.8	1,576.3	1,505.8
2027	1,710.8	1,770.4	1,652.7
2028	1,876.2	1,963.7	1,791.8
2029	1,987.5	2,103.1	1,877.3
2030	2,127.3	2,274.6	1,988.4
2031	2,283.2	2,465.0	2,113.5
2032	2,496.9	2,722.0	2,289.0
2033	2,713.5	2,986.8	2,463.5
2034	2,957.1	3,286.3	2,659.1
2035	3,232.4	3,626.6	2,879.0
2036	3,522.7	3,989.6	3,108.2
2037	3,816.4	4,362.3	3,336.3
2038	4,158.8	4,797.9	3,602.2
2039	4,519.9	5,262.0	3,879.7
2040	4,919.1	5,778.5	4,184.6
2041	5,303.9	6,280.3	4,476.3
2042	5,724.8	6,831.9	4,794.1
2043	6,178.3	7,430.8	5,134.0
2044	6,680.1	8,096.2	5,508.8
PV12 FY24 to FY44	18,108	19,893	16,529
PV12 vs base (FY24 to FY44)		9.9%	-8.7%
CAGR FY24 to FY44	9.0%	10.1%	8.0%

Table 4-12: Comparison of Annual Revenues Forecasts in Rs Million (Base) to Alternate Traffic Growth Assumptions

The project road revenues will have a CAGR of 9.0 percent for the period FY24 to FY44. The high growth scenario would generate about 9.9 percent higher PV than the base case while low growth scenario may result in 8.7 percent lower PV than the base case.

APPENDICES

APPENDIX 2.1
TRAFFIC ZONING SYSTEM

Traffic Study for Orai-Barah Section of NH-27 in the State of Uttar Pradesh

Traffic Zoning System

Zone	Place/Region	District/ State	State/Country/Region
1	Orai	Project Section	Uttar Pradesh
2	Aata		
3	Jolhupur		
4	Kalpi/Daulatpur		
5	Bhognipur/Pukhrayan/Biroha		
6	Deega/Marwar		
7	Nagin Jasi/Jainpur		
8	Barah		
9	Jhansi	Jhansi District	
10	Lalitpur/Babina	Jhansi District	
11	Ghatampur/Hamirpur	Hamirpur District	
12	Choudagra/Bindki/Bakewar/Azad Nagar	Fatehpur District	
13	Fatehpur	Fatehpur District	
14	Auraiya	Auraiya District	
15	Rania/Bhisar	Kanpur	
16	Panki/Armapur Estate		
17	Kanpur/Unnao		
18	Naubasta		
19	Etawah	Etawah District	
20	Prayagraj	Prayagraj	
21	Raebareli/Lalganj	Raebareli	
22	Lucknow City	Lucknow	
23	Faizabad/Gonda/Ayodhya	Faizabad	
24	Sultanpur	Sultanpur	
25	Varanasi	Varanasi	
26	Mirzapur	Mirzapur	
27	Jaunpur	Jaunpur	
28	Azamgarh	Azamgarh	
29	Gorakhpur	Gorakhpur	
30	Kannauj/Farrukhabad/Hardoi	Kannauj/Farrukhabad	
31	Sitapur/Lakhimpur	Sitapur	
32	Agra	Agra	
33	Mathura	Mathura	
34	Firozabad/Tundla/Shikohabad	Firozabad	
35	Aligarh/Etah	Aligarh	
36	Bareilly/Moradabad/Shahjahanpur	Bareilly	
37	Meerut/Muzaffarnagar/Khurja	Meerut	
38	Bewar/Maudaha/Muskara/Rath	Mainpuri	
39	Banda	Banda	
40	Ghazipur	Ghazipur	
41	Ballia	Azamgarh	
42	Noida/Ghaziabad	Noida/Ghazibad	
43	Rest of Uttar Pradesh	Rest of Uttar Pradesh	
44	Ashoknagar/Chanderi/Mungaoli	Ashoknagar District	Madhya Pradesh
45	Chhatarpur/Nowgong/Khajuraho	Chhatarpur District	
46	Sagar/Malthone	Sagar District	
47	Jabalpur	Jabalpur District	
48	Bhopal/Vidisha/Sanchi	Bhopal/Vidisha District	
49	Indore/Dewas/Pithampur	Indore/Ujjain District	
50	Hoshangabad/Itarsi	Narmadapuram District	
51	Chhindwara/Betul	Chhindwara/Betul District	
52	Khandwa/Khargone	Khandwa/Khargone District	
53	Satna/Rewa	Satna/Rewa district	
54	Ujjain	Ujjain district	
55	Ratlam	Ratlam district	
56	Barwani/Sendhwa	Barwani/Sendhwa district	
57	Guna	Guna district	
58	Biaora/Rajgarh	Rajgarh District	
59	Vijaipur/Ruthiyai	Guna district	
60	Pagara/Miana/Bhadaura/Maksundargarh	Guna district	
61	Shivpuri/Sheopur	Shivpuri/Sheopur district	
62	Gwalior	Gwalior district	
63	Morena	Morena district	
64	Bhind	Bhind district	
65	Rest of Madhya Pradesh	Rest of Madhya pradesh	
66	Patna	Patna	Bihar
67	Buxar/Arrah	Buxar	
68	Muzaffarpur/Darbhangha/Samastipur	Muzaffarpur/Samastipur	
69	Begusarai/Bhagalpur	Begusarai	
70	Gaya/Aurangabad/Sonnagar	Gaya/Aurangabad	
71	Rest of Bihar	Rest of Bihar	
72	Ranchi	Ranchi	Jharkhand
73	Jamshedpur	East Singhbhum	
74	Dhanbad/Bokaro/Gamoh	Dhanbad/Bokaro	
75	Asansol/Durgapur/Andal	Asansol/Burdwan	West Bengal
76	Kharagpur	Paschim Medinipur	
77	Kolkata	Kolkata	
78	Haldia Port	Kolkata	
79	Chattisgarh	Chattisgarh	Chattisgarh
80	Sambalpur/Jharsuguda	Sambalpur/Jharsuguda	Odisha
81	Bhubaneshwar/Cuttack/Puri	Khorda/Cuttack/Puri	
82	Faridabad/Gurgaon	Faridabad/Gurgaon	Haryana
83	Haldwani/Nainital	Nainital	Uttarkhand
84	Dehradun/Haridwar	Dehradun/Haridwar	
85	Nagpur/Amravati/Wardha/Akola	Nagpur/Amravati/Wardha/Akola	Gujarat
86	Mumbai/Pune/Nashik/Dhule/Jalgaon/Rest of Maharashtra/Goa	Maharashtra	Maharashtra
87	Rest of Gujarat	Rest of Gujarat	
88	Jaipur/Ajmer	Jaipur/Ajmer	Rajasthan
89	Chittorgarh/Udaipur/Kota	Chittorgarh/Udaipur/Kota	
90	Rest of Rajasthan	Rest of Rajasthan	
91	Delhi	Delhi	Delhi
92	Punjab/Himachal Pradesh/Jammu & Kashmir	Punjab	Punjab
93	Telangana	Telangana	Telangana
94	Andhra Pradesh	Andhra Pradesh	Andhra Pradesh
95	Karnataka	Karnataka	Karnataka
96	Tamil Nadu	Tamil Nadu	Tamil Nadu
97	Kerala	Kerala	Kerala
98	North Eastern States	North Eastern States	North Easter States

APPENDIX 2.2
MODE WISE TOP20 OD PAIRS

Traffic Study for Orai-Barah Section of NH-27 in the State of Uttar Pradesh

TOP 20 Origin Destination Pairs at Usaka TP

Car

S.No.	Origin	Destination	% of total
1	Orai	Kanpur/Unnao	29%
2	Jhansi	Kanpur/Unnao	17%
3	Orai	Kalpi/Daulatpur	12%
4	Jhansi	Lucknow City	7%
5	Orai	Lucknow City	6%
6	Orai	Aata	4%
7	Orai	Bhognipur/Pukhrayan/Biroha	4%
8	Orai	Ghatampur/Hamirpur	2%
9	Bhognipur/Pukhrayan/Biroha	Jhansi	2%
10	Orai	Jolhupur	1%
11	Kalpi/Daulatpur	Jhansi	1%
12	Jhansi	Ghatampur/Hamirpur	1%
13	Kanpur/Unnao	Mumbai/Pune/Nashik/Dhule/Jalgaon/Rest of Maharashtra/Goa	1%
14	Kanpur/Unnao	Rest of Gujarat	1%
15	Aata	Jhansi	1%
16	Jhansi	Prayagraj	1%
17	Orai	Sultanpur	0%
18	Jhansi	Gorakhpur	0%
19	Lucknow City	Mumbai/Pune/Nashik/Dhule/Jalgaon/Rest of Maharashtra/Goa	0%
20	Jhansi	Noida/Ghaziabad	0%
		Total	**91%**

Mini Bus

S.No.	Origin	Destination	% of total
1	Orai	Kanpur/Unnao	51%
2	Orai	Aata	24%
3	Orai	Bhognipur/Pukhrayan/Biroha	8%
4	Jhansi	Kanpur/Unnao	8%
5	Orai	Kalpi/Daulatpur	6%
6	Orai	Jolhupur	3%
		Total	**100%**

Bus

S.No.	Origin	Destination	% of total
1	Jhansi	Kanpur/Unnao	30%
2	Orai	Kanpur/Unnao	27%
3	Orai	Ghatampur/Hamirpur	7%
4	Jhansi	Lucknow City	5%
5	Orai	Aata	4%
6	Orai	Bhognipur/Pukhrayan/Biroha	3%
7	Orai	Kalpi/Daulatpur	3%
8	Orai	Lucknow City	3%
9	Jhansi	Ghatampur/Hamirpur	2%
10	Kanpur/Unnao	Chittorgarh/Udaipur/Kota	1%
11	Orai	Ghazipur	1%
12	Jhansi	Faizabad/Gonda/Ayodhya	1%
13	Orai	Jolhupur	1%
14	Lalitpur/Babina	Kanpur/Unnao	1%
15	Jolhupur	Jhansi	1%
16	Kalpi/Daulatpur	Bhopal/Vidisha/Sanchi	1%
17	Kalpi/Daulatpur	Indore/Dewas/Pithampur	1%
18	Bhognipur/Pukhrayan/Biroha	Indore/Dewas/Pithampur	1%
19	Ghatampur/Hamirpur	Indore/Dewas/Pithampur	1%
20	Kanpur/Unnao	Bhopal/Vidisha/Sanchi	1%
		Total	**93%**

MLCV

S.No.	Origin	Destination	% of total
1	Orai	Kanpur/Unnao	35%
2	Jhansi	Kanpur/Unnao	14%
3	Orai	Kalpi/Daulatpur	10%
4	Orai	Lucknow City	7%
5	Orai	Bhognipur/Pukhrayan/Biroha	6%
6	Jhansi	Lucknow City	5%
7	Orai	Aata	2%
8	Kalpi/Daulatpur	Jhansi	1%
9	Orai	Auraiya	1%
10	Jaunpur	Bhind	1%
11	Indore/Dewas/Pithampur	North Eastern States	1%
12	Jhansi	Gorakhpur	1%
13	Orai	Jolhupur	0%
14	Orai	Ghatampur/Hamirpur	0%
15	Orai	Prayagraj	0%
16	Orai	Noida/Ghaziabad	0%
17	Jhansi	Ghatampur/Hamirpur	0%
18	Jhansi	Auraiya	0%
19	Jhansi	Prayagraj	0%
20	Jhansi	Faizabad/Gonda/Ayodhya	0%
		Total	**88%**

Traffic Study for Orai-Barah Section of NH-27 in the State of Uttar Pradesh

TOP 20 Origin Destination Pairs at Usaka TP

LCV

S.No.	Origin	Destination	% of total
1	Jhansi	Kanpur/Unnao	24%
2	Orai	Kanpur/Unnao	17%
3	Jhansi	Lucknow City	9%
4	Orai	Lucknow City	4%
5	Jhansi	Gorakhpur	4%
6	Kanpur/Unnao	Rest of Gujarat	3%
7	Kanpur/Unnao	Indore/Dewas/Pithampur	2%
8	Orai	Gorakhpur	2%
9	Orai	Rania/Bhisar	1%
10	Kanpur/Unnao	Rest of Rajasthan	1%
11	Lucknow City	Indore/Dewas/Pithampur	1%
12	Jhansi	Faizabad/Gonda/Ayodhya	1%
13	Jhansi	Sitapur/Lakhimpur	1%
14	Lucknow City	Rest of Rajasthan	1%
15	Orai	Bhognipur/Pukhrayan/Biroha	1%
16	Bhognipur/Pukhrayan/Biroha	Jhansi	1%
17	Jhansi	Ghatampur/Hamirpur	1%
18	Nagin Jasi/Jainpur	Indore/Dewas/Pithampur	1%
19	Kanpur/Unnao	Rest of Madhya Pradesh	1%
20	Orai	Sitapur/Lakhimpur	1%
		Total	**79%**

2 Axle

S.No.	Origin	Destination	% of total
1	Jhansi	Kanpur/Unnao	26%
2	Orai	Kanpur/Unnao	20%
3	Jhansi	Lucknow City	6%
4	Kanpur/Unnao	Mumbai/Pune/Nashik/Dhule/Jalgaon/Rest of Maharashtra/Goa	5%
5	Kanpur/Unnao	Rest of Gujarat	3%
6	Lucknow City	Rest of Gujarat	2%
7	Jhansi	Gorakhpur	2%
8	Orai	Lucknow City	2%
9	Jhansi	Sitapur/Lakhimpur	2%
10	Orai	Bhognipur/Pukhrayan/Biroha	1%
11	Orai	Kalpi/Daulatpur	1%
12	Jhansi	Sultanpur	1%
13	Lucknow City	Indore/Dewas/Pithampur	1%
14	Kanpur/Unnao	Indore/Dewas/Pithampur	1%
15	Orai	Faizabad/Gonda/Ayodhya	1%
16	Lucknow City	Rest of Madhya Pradesh	1%
17	Gorakhpur	Chittorgarh/Udaipur/Kota	1%
18	Bhognipur/Pukhrayan/Biroha	Jhansi	1%
19	Jhansi	Prayagraj	1%
20	Jhansi	Jaunpur	1%
		Total	**81%**

3 Axle

S.No.	Origin	Destination	% of total
1	Jhansi	Kanpur/Unnao	18%
2	Orai	Kanpur/Unnao	11%
3	Jhansi	Gorakhpur	7%
4	Jhansi	Lucknow City	6%
5	Kanpur/Unnao	Mumbai/Pune/Nashik/Dhule/Jalgaon/Rest of Maharashtra/Goa	4%
6	Orai	Lucknow City	3%
7	Kanpur/Unnao	Indore/Dewas/Pithampur	2%
8	Jhansi	Faizabad/Gonda/Ayodhya	2%
9	Kanpur/Unnao	Rest of Gujarat	2%
10	Jhansi	Sultanpur	2%
11	Orai	Gorakhpur	2%
12	Lucknow City	Mumbai/Pune/Nashik/Dhule/Jalgaon/Rest of Maharashtra/Goa	2%
13	Lucknow City	Rest of Gujarat	2%
14	Orai	Kalpi/Daulatpur	2%
15	Jhansi	Patna	1%
16	Orai	Faizabad/Gonda/Ayodhya	1%
17	Jhansi	Kolkata	1%
18	Patna	Rest of Gujarat	1%
19	Lucknow City	Indore/Dewas/Pithampur	1%
20	Orai	Bhognipur/Pukhrayan/Biroha	1%
		Total	**71%**

MAV

S.No.	Origin	Destination	% of total
1	Jhansi	Kanpur/Unnao	19%
2	Orai	Kanpur/Unnao	8%
3	Jhansi	Gorakhpur	8%
4	Jhansi	Lucknow City	5%
5	Kanpur/Unnao	Mumbai/Pune/Nashik/Dhule/Jalgaon/Rest of Maharashtra/Goa	4%
6	Orai	Gorakhpur	2%
7	Jhansi	Faizabad/Gonda/Ayodhya	2%
8	Lucknow City	Mumbai/Pune/Nashik/Dhule/Jalgaon/Rest of Maharashtra/Goa	2%
9	Orai	Bhognipur/Pukhrayan/Biroha	2%
10	Kanpur/Unnao	Indore/Dewas/Pithampur	2%
11	Orai	Lucknow City	2%
12	Kolkata	Rest of Gujarat	2%
13	Bhognipur/Pukhrayan/Biroha	Jhansi	2%
14	Mumbai/Pune/Nashik/Dhule/Jalgaon/Rest of Maharashtra/Goa	North Eastern States	2%
15	Kanpur/Unnao	Rest of Gujarat	1%
16	Lucknow City	Indore/Dewas/Pithampur	1%
17	Indore/Dewas/Pithampur	North Eastern States	1%
18	Orai	Faizabad/Gonda/Ayodhya	1%
19	Jhansi	Kolkata	1%
20	Jhansi	North Eastern States	1%
		Total	**66%**

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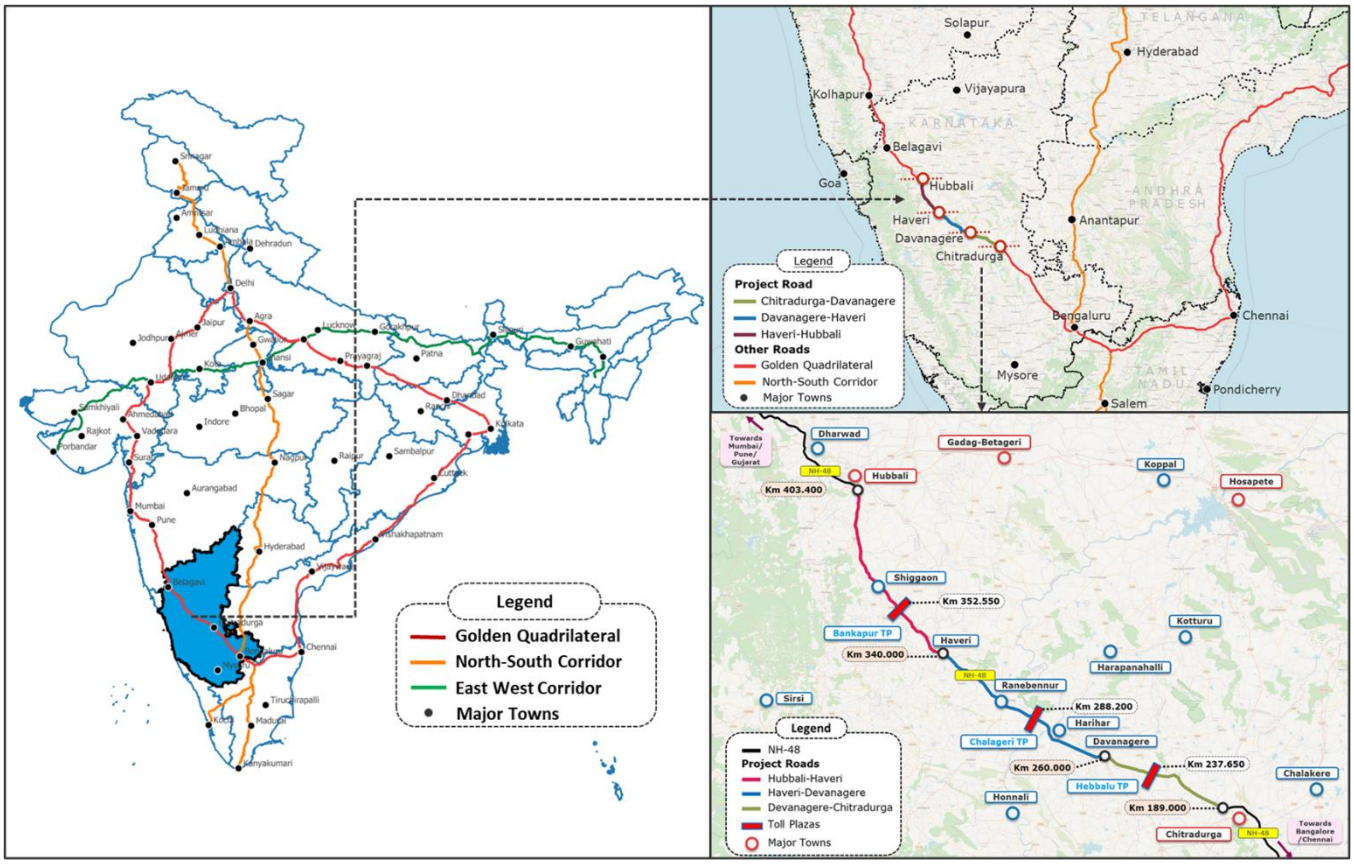
TRAFFIC STUDY FOR HUBBALI-HAVERI-CHITRADURGA SECTION OF NH-48 IN THE STATE OF KARNATAKA



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ABBREVIATIONS

%	Percentage
2A	2 Axle truck
3A	3 Axle truck
AADT	Annual Average Daily Traffic
ADT	Average Daily Traffic
AR	Alternate Route
BIA	Broad Influence Area
CAGR	Compounded Annual Growth Rate
FY	Financial Year
GDP	Gross Domestic Product
GSDP	Gross State Domestic Product
HPCL	Hindustan Petroleum Corporation Limited
IIA	Immediate Influence Area
IRC	Indian Road Congress
KIADB	Karnataka Industrial Areas Development Board
Km	Kilometre
LCV	Light Commercial Vehicle
M Bus	Minibus
MAV	Multi Axle Vehicle
MLCV	Mini LCV
NH	National Highway
NHAI	National Highway Authority of India
NHDP	National Highway Development Program
NHIIMPL	National Highways Infra Investment Managers Private Limited
NPV	Net Present Value
IOCL	Indian Oil Corporation Limited
OD	Origin-Destination survey
PCU	Passenger Car Unit
PIA	Project Influence Area
PR	Project Road
PS	Paved Shoulder
PV	Present Value
Rs/₹	Rupees
SEZ	Special Economic Zone
Sq.km	Square Kilometre
TP	Toll Plaza
WPI	Wholesale Price Index
YOY	Year on Year

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Appendix 2.3: Commodity Distribution at Toll Plaza Locations

EXECUTIVE SUMMARY

Project Overview

The project highway, NH-48 (Old NH-4), is part of the Golden Quadrilateral connecting many of the major industrial, agricultural and cultural centres of India. The total length of NH-48 (Old NH-4) is roughly 1,235 km starting from Chennai in the state of Tamil Nadu and ending at Mumbai in the state of Maharashtra. The highway acts as a primary conduit for transportation of freight as well as passenger traffic in these states as well as various other important states in India. NH-48 (Old NH-4) connects important cities and towns like Pune, Satara, Karad, Sangli, Kolhapur, Belgaum, Dharwad, Hubli, Bangalore etc.

The project road section consists of three continuous toll roads and the details of the three project road sections, lengths, chainage, toll plazas and tolling lanes at the toll plaza locations are presented in **Table 0-1**.

S No.	Project Section	Length (km)	Start km	End km	Toll Plaza	Tolling Lanes
1	Hubbali-Haveri	71.0	Km 340.00	Km 403.40	Bankapur (km 352.550)	7+7
2	Haveri-Davangere	72.0	Km 260.00	Km 340.00	Chalageri (km 288.200)	7+7
3	Davanagere-Chitradurga	62.0	Km 189.00	Km 260.00	Hebbalu (km 237.650)	7+7

Table 0-1: Details of Project Section

Figure 0-1 shows the context and alignment of project road with major places along the highway.

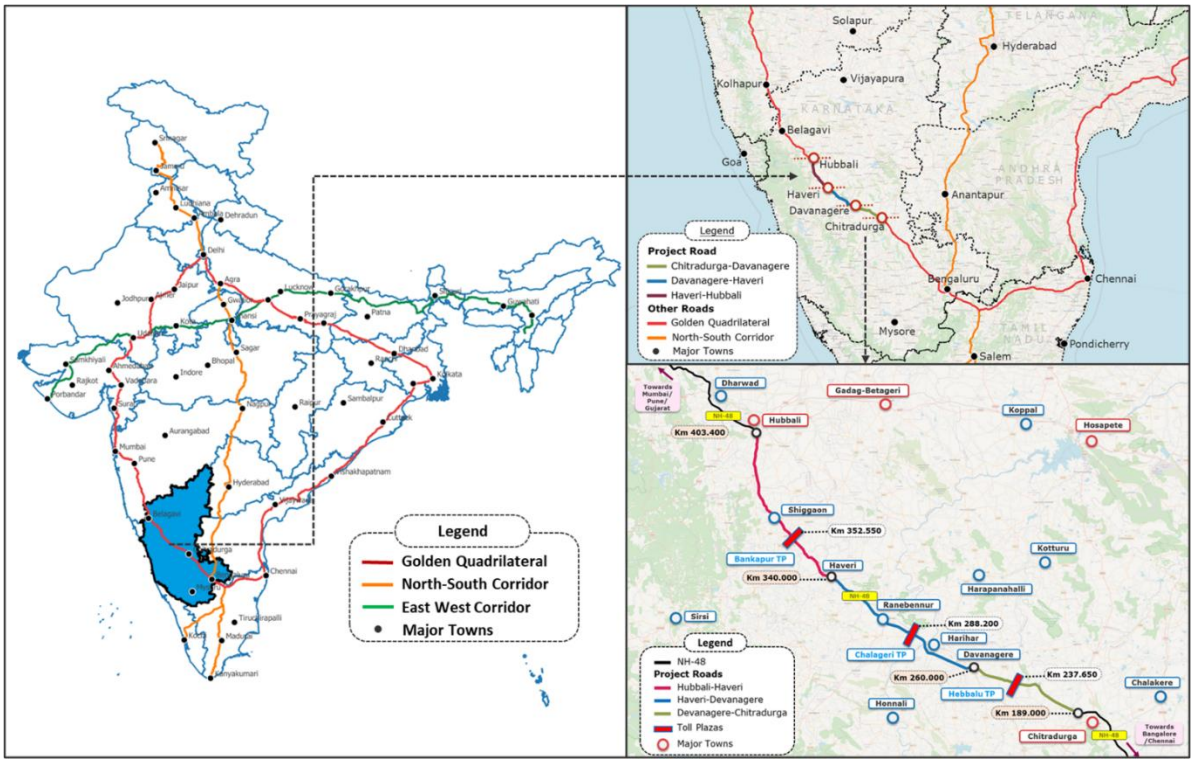


Figure 0-1: Alignment of Project Road and Location of Toll Plazas

Project Road Characteristics and Profile of Influencing Districts

The project road, in wider context, serves the long-distance traffic for the freight vehicles, which is majorly plying between Mumbai/ Pune/ Delhi Chitradurga/Bangalore/ Chennai/ Vellore. Apart from long distance traffic, it also serves the short distance traffic for both passenger and freight which is mainly generated between Hubbali/Dharwad/Haveri/Davanagere/Ranebennur/Chitradurga and nearby places.

The project road falls under the jurisdiction of four districts in the state of Karnataka.

Dharwad is one of the emerging districts in North Karnataka region and its economy relies broadly on agriculture with jowar, wheat, Bengal gram, tur dal, ground nut, onion, maize, sunflower and cotton as the major produce. Dharwad district is fast developing as the commercial and industrial hub in the state. These industrial areas have several small, medium and scale industries present some of which include agro equipment and agro food processing industries, polymers, engineering works, steel and wire works, engineering and automobiles manufacturing, chemical and fertilizers industries, textiles, paper products, printing, and other consumer products-based industries.

Haveri district is majorly dependent on agriculture for its economy with major produce being maize, paddy, jowar, hybrid cotton, groundnut, chilly, pulses etc. It is rich in spice cultivation and the major spice industry in the district has chilly powder mills and processing facilities. The district also has an industrial base having several large and medium industries having Agriculture and allied industries, sericulture, animal husbandry, textile and handloom industries as potential industrial sectors in the district.

Davanagere district economically is dependent on agriculture primarily with major agricultural crops including paddy, maize, red gram, green gram, black gram, groundnut, sunflower, sugarcane, cotton etc. Davanagere is known as the Manchester of Karnataka and has a dominant textile sector that is set to grow along with the food processing sector which provides the highest employment in the district. The district has large industrial units, small and medium scale industries. Other notable sectors include agro and allied activities, wood and wood-based furniture manufacturing industries, horticulture units of marigold dye processing and arecanut processing.

Chitradurga district has agriculture as the backbone of the district economy having major agricultural produce of paddy, ragi, jowar, maize, red gram, horse gram, green gram, black gram, bengal gram, tur, groundnut, sunflower, cotton, tobacco and betul nut. The district also has several small-scale industrial units in the district are engaged in agro and food processing activities and textile constitutes second highest number of large & medium scale industries in the district. The district is rich in mineral reserves of iron ore, manganese, limestone, dolomite, gray granite and building stone. Chitradurga is the 4th largest producer of wind energy in the country.

Annual Average Daily Traffic (AADT)

The AADT for FY24 has been derived from the average of ETC toll data of FY24 from April 2023 to November 2023. The cash (April – November 2023) and exemption traffic (average of October and November 2023) has been added to the ETC traffic. This 8-month traffic has been annualised by applying an 8-12 month factor from IHMCL for cars and for rest of the modes, factor has been adopted from the adjacent section of Belgaum Dharwad. The AADT for FY24 derived for all three toll plazas with 8 months to yearly factors is presented in **Table 0-2**.

Mode	Car	LCV	Bus/Truck	3A	MAV	OSV	PCUs
Bankapur (TP01)							
A. Apr 23 – Nov 23 (ETC Traffic +Cash)	6,472	1,430	2,710	940	1,619	6	26,879
B. Oct 23 – Nov 23 Average Exempt	639	11	8	1	0	0	
C. ADT (A+B)	7,111	1,441	2,718	940	1,620	6	27,563
D. SCF (8–12-month factor)	1.03	1.05	1.06	1.03	1.03	1.03	
E. AADT FY24 (C*D)	**7,304**	**1,509**	**2,873**	**966**	**1,663**	**6**	**28,596**
Chalageri (TP02)							
A. Apr 23 – Nov 23 (ETC Traffic +Cash)	6,387	1,379	2,586	910	1,605	5	26,188
B. Oct 23 – Nov 23 Average Exempt	357	3	2	1	1	0	
C. ADT (A+B)	6,744	1,382	2,587	911	1,605	5	26,559
D. SCF (8–12-month factor)	1.02	1.05	1.06	1.03	1.03	1.03	
E. AADT FY24 (C*D)	**6,898**	**1,447**	**27,35**	**935**	**1,649**	**5**	**27,522**
Hebbalu (TP03)							
A. Apr 23 – Nov 23 (ETC Traffic +Cash)	7,432	1,435	2,491	922	1,594	6	27,025
B. Oct 23 – Nov 23 Average Exempt	360	8	1	1	1	0	
C. ADT (A+B)	7,792	1,444	2,492	924	1,595	6	27,406
D. SCF (8–12-month factor)	1.01	1.05	1.06	1.03	1.03	1.03	
E. AADT FY24 (C*D)	**7,900**	**1,512**	**2,634**	**948**	**1,638**	**6**	**28,311**

Table 0-2: AADT for FY24

Travel Pattern

- Serves the long-distance traffic majorly plying between Mumbai/ Pune/ Delhi Chitradurga/Bangalore/ Chennai/ Vellore.
- The project road also serves the short distance traffic for both passenger and freight which is mainly generated between Hubbali/Dharwad/Haveri/Davanagere/Ranebennur/Chitradurga and nearby places.
- The passenger traffic on the road were found to be for the purpose of work and business at the toll plaza locations.

- The MAV traffic is observed to be having Bangalore-Mumbai as top OD pair at all three toll plazas.

Network Impacts

In context of the project road, two road network developments which may impact the traffic on the project road are:

1. Impact of Pune - Bangalore Expressway

The assessment for the route between Pune and Bangalore/Chennai has been done for the four traffic streams:

- Traffic plying between Mumbai/Pune/Nashik & surroundings and Bangalore & beyond
- Traffic from/to Mumbai/Pune/Nashik & surroundings to/from Chennai & beyond
- Traffic plying between Hubbali and surroundings and Bangalore & beyond
- Traffic from/to Hubbali and surroundings to/from Chennai & beyond

The total diverted traffic after the operation of Pune Bangalore Expressway at the three toll plazas is presented in **Table 0-3**.

Modes	Car	2A	3A	MAV
Bankapur (TP01)	5.4%	15.0%	34.2%	33.1%
Chalageri (TP02)	5.7%	15.7%	35.3%	33.4%
Hebbalu (TP03)	5.0%	16.3%	34.8%	33.6%

Table 0-3: Total Impact Due to Pune-Bangalore Expressway

The proposed expressway will be a greenfield alignment and considering the usual timelines for a long greenfield expressway project, the diversion impact is considered from FY31 onwards under Base Case. Owing to the gradual shift of traffic away from the project road, the traffic impacts have been assumed to take place in phases with about 50 percent in FY31, 75 percent in FY32 and 100 percent from FY33 onwards.

2. Impact of completion of 6 laning construction activities on National Highway 48 (Old NH-4- Route via PR)

The potential and divertible traffic (gain) due to completion of 6 laning construction activities on National Highway 48 (Old NH-4) is presented in **Table 0-4**.

Potential Traffic (Nagarhalla TP)	2A	3A	MAV	2A/3A/MAV	PCU
A. Earlier study of Solapur-Bijapur (July-22) – FY23	156	80	197	434	1,598
B. Traffic on Solapur-Bijapur -FY24 (5% growth on earlier study) – A*(1+5%)	164	84	207	456	1,678
C. AR potential at Nagarhalla TP (FY24)	284	124	539	947	3,650
D. SCF Jan	0.90	0.99	0.93	-	-
E. AADT (C*D)	257	123	504	883	3,406
F. Absolute Increase (E-B)	93	39	297	428	1,728
G. % Shift to PR	61.4%	61.9%	66.2%	-	-
H. Traffic Shift to PR (F*G)	57	24	196	277	1,126

Table 0-4: Potential and Divertible Traffic Due To Completion Of 6 Laning Construction Activities On NH-48 (Route via PR)

NH-48 may have a gain of about 57 2A trucks, 24 3A trucks and 196 MAV trucks resulting in a total PCU gain of 1,126. As the 6 laning is expected to be completed in FY25, the impact has been considered in phases with 50 percent in FY26 and 100 percent in FY27.

Traffic Growth rates

The estimated traffic growth rates for the project road based on the elasticity approach applicable across all the three toll plazas have been presented in **Table 0-5**.

FY/Modes	Car	LCV	Bus/2A	3A	MAV/OSV
Normal Growth Rates					
2025	7.3	2.7	3.5	2.0	6.6
2026	7.8	2.9	3.7	2.1	7.0
2027	7.5	2.8	3.6	2.0	6.8
2028	7.4	2.8	3.5	2.0	6.7
2029	7.1	2.6	3.4	1.9	6.4
2030	6.7	2.5	3.2	1.8	6.0
2031	6.7	2.5	3.2	1.8	5.4
2032	6.7	2.5	3.2	1.8	5.4
2033	6.7	2.5	3.2	1.8	5.4
2034	6.6	2.5	3.1	1.8	5.3
2035	6.5	2.4	3.1	1.8	5.3
2036	5.8	2.4	3.0	1.7	4.6
2037	5.7	2.4	3.0	1.7	4.5
2038	5.6	2.3	3.0	1.7	4.5
2039	5.5	2.3	2.9	1.7	4.4
2040	5.4	2.2	2.9	1.6	4.3
2041	5.3	2.2	2.8	1.6	4.3
2042	5.2	2.2	2.8	1.6	4.2
2043	5.2	2.1	2.7	1.6	4.1
2044	5.1	2.1	2.7	1.5	4.1

Table 0-5: Projected Traffic Growth Rates for Project Road (%)

Implied Traffic Growth rates

The implied traffic growth rates for the project road after considering the impact of diversions at all the three toll plazas have been presented in **Table 0-6**.

Implied Traffic Growth Rates															
FY/ Mode	TP01-Bankapur					TP02-Chalageri					TP03-Hebbalu				
	Car	LCV	Bus/ 2A	3A	MAV /OSV	Car	LCV	Bus/ 2A	3A	MAV/ OSV	Car	LCV	Bus/ 2A	3A	MAV/ OSV
2025	7.3	2.7	3.5	2.0	6.6	7.3	2.7	3.5	2.0	6.6	7.3	2.7	3.5	2.0	6.6
2026	7.8	2.9	4.7	3.4	13.3	7.8	2.9	4.8	3.4	13.4	7.8	2.9	4.8	3.4	13.4
2027	7.5	2.8	4.6	3.3	12.7	7.5	2.8	4.7	3.3	12.8	7.5	2.8	4.7	3.3	12.8
2028	7.4	2.8	3.5	2.0	6.7	7.4	2.8	3.5	2.0	6.7	7.4	2.8	3.5	2.0	6.7
2029	7.1	2.6	3.4	1.9	6.4	7.1	2.6	3.4	1.9	6.4	7.1	2.6	3.4	1.9	6.4
2030	6.7	2.5	3.2	1.8	6.0	6.7	2.5	3.2	1.8	6.0	6.7	2.5	3.2	1.8	6.0
2031	3.8	2.5	-4.5	-15.6	-12.0	3.7	2.5	-4.9	-16.1	-12.2	4.0	2.5	-5.2	-15.9	-12.3
2032	5.2	2.5	-1.0	-8.7	-5.0	5.1	2.5	-1.2	-9.1	-5.1	5.3	2.5	-1.4	-8.9	-5.2
2033	5.2	2.5	-1.2	-9.9	-6.2	5.1	2.5	-1.4	-10.4	-6.3	5.3	2.5	-1.6	-10.2	-6.4
2034	6.6	2.5	3.1	1.8	5.3	6.6	2.5	3.1	1.8	5.3	6.6	2.5	3.1	1.8	5.3
2035	6.5	2.4	3.1	1.8	5.3	6.5	2.4	3.1	1.8	5.3	6.5	2.4	3.1	1.8	5.3
2036	5.8	2.4	3.0	1.7	4.6	5.8	2.4	3.0	1.7	4.6	5.8	2.4	3.0	1.7	4.6
2037	5.7	2.4	3.0	1.7	4.5	5.7	2.4	3.0	1.7	4.5	5.7	2.4	3.0	1.7	4.5
2038	5.6	2.3	3.0	1.7	4.5	5.6	2.3	3.0	1.7	4.5	5.6	2.3	3.0	1.7	4.5
2039	5.5	2.3	2.9	1.7	4.4	5.5	2.3	2.9	1.7	4.4	5.5	2.3	2.9	1.7	4.4
2040	5.4	2.2	2.9	1.6	4.3	5.4	2.2	2.9	1.6	4.3	5.4	2.2	2.9	1.6	4.3
2041	5.3	2.2	2.8	1.6	4.3	5.3	2.2	2.8	1.6	4.3	5.3	2.2	2.8	1.6	4.3
2042	5.2	2.2	2.8	1.6	4.2	5.2	2.2	2.8	1.6	4.2	5.2	2.2	2.8	1.6	4.2
2043	5.2	2.1	2.7	1.6	4.1	5.2	2.1	2.7	1.6	4.1	5.2	2.1	2.7	1.6	4.1
2044	5.1	2.1	2.7	1.5	4.1	5.1	2.1	2.7	1.5	4.1	5.1	2.1	2.7	1.5	4.1

Table 0-6: Implied Traffic Growth Rates for Project Road After Diversion (%)

Traffic Projections

Mode-wise projected traffic for the three toll plazas of the project road under the base case after considering diversion impacts till FY44 is presented in **Table 0-7, Table 0-8 and Table 0-9**.

FY/Modes	Car	LCV	Bus/2A	3A	MAV	OSV	PCU
2024	7,304	1,509	2,873	966	1,663	6	28,595
2025	7,837	1,550	2,973	985	1,772	6	30,040
2026	8,445	1,595	3,113	1,018	2,008	7	32,300
2027	9,081	1,640	3,257	1,052	2,264	7	34,686
2028	9,754	1,685	3,372	1,073	2,415	8	36,517
2029	10,442	1,730	3,485	1,094	2,568	8	38,368
2030	11,143	1,773	3,597	1,113	2,723	9	40,227
2031	11,569	1,817	3,434	940	2,396	9	38,239
2032	12,174	1,863	3,400	858	2,275	10	38,027
2033	12,808	1,909	3,361	774	2,135	10	37,728
2034	13,652	1,956	3,466	787	2,249	11	39,515
2035	14,539	2,004	3,573	801	2,367	11	41,372
2036	15,376	2,052	3,682	815	2,476	12	43,143
2037	16,248	2,100	3,793	829	2,589	12	44,971
2038	17,157	2,149	3,905	843	2,705	13	46,855
2039	18,100	2,198	4,019	857	2,824	14	48,792
2040	19,079	2,247	4,134	871	2,946	14	50,786
2041	20,095	2,297	4,250	885	3,072	15	52,836
2042	21,148	2,347	4,368	899	3,201	15	54,943
2043	22,238	2,397	4,488	913	3,333	16	57,106
2044	23,366	2,447	4,608	927	3,468	17	59,324

Table 0-7: Projected Mode-wise Traffic at TP01

FY/Modes	Car	LCV	Bus/2A	3A	MAV	OSV	PCU
2024	6,898	1,447	2,735	935	1,649	5	27,522
2025	7,401	1,486	2,830	953	1,757	5	28,913
2026	7,976	1,529	2,965	986	1,992	6	31,114
2027	8,576	1,572	3,103	1,019	2,246	6	33,439
2028	9,212	1,616	3,213	1,039	2,396	6	35,206
2029	9,862	1,659	3,321	1,059	2,549	7	36,992
2030	10,523	1,700	3,427	1,079	2,703	7	38,787
2031	10,909	1,743	3,258	904	2,374	8	36,727
2032	11,469	1,786	3,219	822	2,252	8	36,442
2033	12,056	1,831	3,174	737	2,109	9	36,065
2034	12,850	1,876	3,273	750	2,222	9	37,774
2035	13,684	1,922	3,375	763	2,339	10	39,549
2036	14,472	1,967	3,478	777	2,447	10	41,242
2037	15,294	2,014	3,582	790	2,558	10	42,988
2038	16,149	2,060	3,688	803	2,673	11	44,789
2039	17,036	2,107	3,795	816	2,790	11	46,640
2040	17,958	2,155	3,904	830	2,911	12	48,545
2041	18,914	2,202	4,014	843	3,035	12	50,503
2042	19,905	2,250	4,126	856	3,163	13	52,516
2043	20,932	2,298	4,238	870	3,293	13	54,583
2044	21,993	2,347	4,352	883	3,427	14	56,702

Table 0-8: Projected Mode-wise Traffic at TP02

FY/Modes	Car	LCV	Bus/2A	3A	MAV	OSV	PCU
2024	7,900	1,512	2,634	948	1,638	6	28,312
2025	8,476	1,553	2,726	967	1,746	6	29,767
2026	9,134	1,598	2,857	1,000	1,979	7	32,040
2027	9,822	1,643	2,991	1,033	2,233	7	34,440
2028	10,550	1,689	3,097	1,054	2,382	8	36,289
2029	11,295	1,733	3,201	1,074	2,534	8	38,157
2030	12,052	1,776	3,303	1,093	2,687	9	40,036
2031	12,540	1,821	3,130	919	2,356	9	38,065
2032	13,210	1,867	3,087	838	2,233	10	37,876
2033	13,913	1,913	3,037	753	2,090	10	37,602
2034	14,830	1,960	3,132	766	2,201	11	39,420
2035	15,792	2,008	3,229	779	2,317	11	41,310
2036	16,702	2,056	3,328	793	2,424	12	43,110
2037	17,650	2,104	3,428	807	2,534	12	44,970
2038	18,637	2,153	3,529	820	2,648	13	46,888
2039	19,661	2,202	3,632	834	2,764	14	48,861
2040	20,724	2,251	3,736	847	2,884	14	50,893
2041	21,828	2,301	3,841	861	3,007	15	52,985
2042	22,972	2,351	3,948	874	3,133	15	55,135
2043	24,156	2,402	4,056	888	3,263	16	57,344
2044	25,381	2,452	4,165	902	3,395	17	59,611

Table 0-9: Projected Mode-wise Traffic at TP03

Projections of the total vehicles based on the most likely growth rates before and after considering diversion impacts is presented in **Table 0-10**.

FY	Total Traffic After Diversion			Total Traffic Before Diversion		
	TP01	TP02	TP03	TP01	TP02	TP03
2024	28,595	27,522	28,312	28,595	27,522	28,312
2025	30,040	28,913	29,767	30,040	28,913	29,767
2026	32,300	31,114	32,040	32,300	31,114	32,040
2027	34,686	33,439	34,440	34,686	33,439	34,440
2028	36,517	35,206	36,289	36,517	35,206	36,289
2029	38,368	36,992	38,157	38,368	36,992	38,157
2030	40,227	38,787	40,036	40,227	38,787	40,036
2031	38,239	36,727	38,065	42,115	40,606	41,946
2032	38,027	36,442	37,876	44,102	42,523	43,960
2033	37,728	36,065	37,602	46,196	44,541	46,082
2034	39,515	37,774	39,420	48,364	46,630	48,281
2035	41,372	39,549	41,310	50,613	48,798	50,564
2036	43,143	41,242	43,110	52,755	50,862	52,735
2037	44,971	42,988	44,970	54,963	52,990	54,976
2038	46,855	44,789	46,888	57,238	55,182	57,286
2039	48,792	46,640	48,861	59,576	57,434	59,660
2040	50,786	48,545	50,893	61,981	59,750	62,104
2041	52,836	50,503	52,985	64,452	62,131	64,618
2042	54,943	52,516	55,135	66,991	64,575	67,200
2043	57,106	54,583	57,344	69,595	67,084	69,851
2044	59,324	56,702	59,611	72,265	69,655	72,571
CAGR (FY24 to FY44)	3.7%	3.7%	3.8%	4.7%	4.8%	4.8%

Table 0-10: Projected Traffic (in PCUs)

Tolling Segmentation

The tolling stream distribution for the project road has been derived from the average of ETC toll data of FY24 from April 2023 to November 2023. The cash (April – November 2023) and exemption traffic (average of October and November 2023) has been added to the ETC traffic distribution and the resultant tolling segmentation is presented in **Table 0-11**.

Ticket Type/Modes	Car	LCV	Bus/ 2A Truck	3A Truck	MAV	OSV
TP01-Bankapur						
Single	51.9	80.7	58.9	85.8	93.5	100.0
Return	35.4	16.6	31.0	12.6	6.2	
Local personal	0.9					
Local commercial	2.7	2.0	9.8	1.6	0.3	
Exempt	9.0	0.8	0.3	0.1	0.0	
Total	100.0	100.0	100.0	100.0	100.0	100.0
TP02-Chalageri						
Single	58.4	81.8	60.6	87.4	93.2	100.0
Return	32.0	16.0	33.5	11.6	6.3	
Local personal	3.1					
Local commercial	1.2	2.0	5.9	0.9	0.4	
Exempt	5.3	0.2	0.1	0.1	0.0	
Total	100.0	100.0	100.0	100.0	100.0	100.0
TP03-Hebbalu						
Single	57.6	78.4	56.9	80.5	92.8	100.0
Return	34.9	17.5	34.9	10.3	6.6	
Local personal	2.3					
Local commercial	0.6	3.6	8.2	9.1	0.6	
Exempt	4.7	0.6	0.0	0.1	0.0	
Total	100.0	100.0	100.0	100.0	100.0	100.0

Table 0-11: Tolling Distribution

Tollable Length and Toll Rates

The details of normal tolling lengths, bypass length (at 1.5 times) and equivalent structure lengths being charged at Bankapur, Chalageri and Hebbalu are presented in **Table 0-12**.

Toll Plazas	TP01 – Bankapur		TP02 - Chalageri		TP03-Hebbalu
	TP1 at 75%	TP1 at 100%	TP2 at Chalageri-6 Lane	TP2 at Chalageri-4 Lane	
A. Normal length	62.339	62.339	42.799	4.943	44.714
B. Bypass length			28.227	2.242	27.698
C. Equivalent Structure length	5.380	5.38	7.120		2.680
D. Total tolling length=(A+1.5*B+C)	67.719	67.719	92.260	8.306	88.941

Table 0-12: Existing Tolling Lengths at PR

The Schedule M lengths have been considered from FY24 onwards for TP01 and TP03. However, for TP02, Schedule M lengths have been considered from January 2025 onwards. The details of tolling length as per Schedule M are presented in **Table 0-13**.

Toll Plazas	Schedule M		
	TP01-Bankapur	TP02-Chalageri	TP03-Hebbalu
A. Normal length	62.339	47.732	44.714
B. Bypass length		30.469	27.698
C. Equivalent Structure length	5.38	7.12	2.68
D. Total tolling length=(A+1.5*B+C)	67.719	100.556	88.941

Table 0-13: Tolling Distribution from Toll Data for present study (in %)

The stream of toll rates to be charged at the toll plaza of the project road in cardinal years till FY44 is presented in **Table 0-14**. The toll fee has been rounded to nearest 5 Rupees as per toll fee rules.

FY End	Car	LCV/ M Bus	Bus/2A Truck	3A	MAV	OSV	Car Local
TP01-Bankapur							
2024	95	155	330	360	515	625	330
2025	100	160	335	365	525	640	340
2030	125	200	420	455	655	795	420
2035	150	245	510	555	800	975	515
2040	185	300	625	680	980	1,190	630
2044	215	350	730	800	1,150	1,400	735
TP02-Chalageri							
2024	140	225	470	510	735	895	330
2025 Existing Length	140	230	480	525	755	915	340
2025 Schedule M Length	145	240	500	545	780	950	340
2030	185	295	620	675	975	1,185	420
2035	225	360	760	825	1,190	1,445	515
2040	275	440	925	1,010	1,455	1,770	630
2044	320	520	1,085	1,185	1,705	2,075	735
TP03-Hebbalu							
2024	125	205	430	470	675	820	330
2025	130	210	440	480	690	840	340
2030	160	260	550	600	860	1,045	420
2035	200	320	670	730	1,050	1,280	515
2040	240	390	820	895	1,285	1,565	630
2044	285	460	960	1,050	1,510	1,835	735

Table 0-14: Toll Rates at Toll Plaza (in Rs)

Project Road Revenue

The travel pattern and commodity distribution reveal the presence of building materials, iron and steel products and miscellaneous items in which there could be an ongoing practice of overloading on PR and is not being currently charged.

As observed from the seven-day axle load analysis, around 20 percent of the MAVs and 5.0 percent of 3A trucks are above 20 percent overloading limit at Bankapur TP whereas around 3 percent of 3A trucks and 10 percent of MAVs are in the above 20 percent overloading limit at both Chalageri and Hebbalu Toll Plazas.

Continuing with the practice of two times toll, since 3A and MAVs are heavily overloaded, with WIM installed at all the toll plazas, the practice of charging them for one-time extra payment can be put in place.

Although the quantum of overloaded vehicles is high but after factoring in the practical number of vehicles from whom overloading can be charged, under a more pragmatic scenario, it is assumed that around 25 percent of this >20% overloaded category of 3A and MAVs is charged for one-time additional payment. This results in around 1 percent of 3A AADT at all the three plazas and 5.2% of MAV AADT of FY24 at Bankapur, 2.4% percent each at Chalageri and Hebbalu TP paying one-time extra toll. With appointed date likely to be achieved in March 2024 and considering the time required for putting the systems in place for overloading revenue collection, this additional revenue from overloaded vehicles is considered from FY26. The estimated revenue from overloading in FY26 is Rs 53.7 million.

However, with strict overloading compliance in place in the future years, this overloading percentage of >20 percent category (considered till FY26) is likely to decline over the years of concession - a decline of 1 percent every year has been considered starting from FY27 onwards under base case.

The project road revenue under the base case including overloading and considering the impact of all the diversions is presented in **Table 0-15**.

FY End	TP1 - Bankapur	TP2 - Chalageri	TP3 - Hebbalu	Total
2024	1,017.8	1,429.6	1,322.9	3,770.3
2025	1,092.4	1,547.9	1,421.5	4,061.8
2026	1,262.5	1,817.1	1,627.3	4,706.9
2027	1,420.3	2,039.7	1,837.8	5,297.8
2028	1,560.1	2,244.5	2,019.5	5,824.1
2029	1,699.8	2,442.9	2,196.6	6,339.3
2030	1,852.9	2,668.3	2,397.0	6,918.2
2031	1,810.6	2,598.3	2,355.7	6,764.6
2032	1,864.0	2,676.2	2,423.2	6,963.4
2033	1,901.9	2,719.4	2,487.8	7,109.0
2034	2,065.1	2,967.4	2,699.2	7,731.7
2035	2,243.4	3,227.3	2,943.8	8,414.5
2036	2,436.6	3,512.3	3,198.0	9,146.9
2037	2,642.0	3,795.3	3,459.6	9,896.8
2038	2,856.9	4,113.8	3,757.1	10,727.8
2039	3,082.3	4,451.9	4,078.1	11,612.3
2040	3,353.7	4,828.3	4,412.1	12,594.0
2041	3,609.9	5,199.9	4,762.6	13,572.4
2042	3,904.3	5,624.9	5,155.3	14,684.6
2043	4,221.9	6,094.5	5,597.3	15,913.7
2044	4,555.9	6,579.1	6,058.1	17,193.0
PV12 FY24 to FY44				51,402.8
CAGR FY24 to FY44				7.9%

Table 0-15: Base Case Revenue in Rs Million

The project road revenues will have a CAGR of 7.9 percent for the period FY24 to FY44.

1. INTRODUCTION

1.1 General

National Highways Authority of India (NHAI) has setup NHAI InvIT to monetize its completed and operational National Highway projects with the objective of mobilizing additional resources through capital markets. Three continuous road sections with an aggregate length of 204 kilometers viz., Hubbali-Haveri, Haveri-Davanagere, Davanagere-Chitradurga of NH-48 (Old NH-4) in the state of Karnataka referred to as Project Road (PR), has been identified by National Highways Infra Investment Managers Private Limited (NHIIMPL) for transfer to InvIT in the third round.

The project highway, NH-48 (Old NH-4), is part of the Golden Quadrilateral connecting many of the major industrial, agricultural and cultural centres of India. The total length of NH-48 (Old NH-4) is roughly 1,235 km starting from Chennai in the state of Tamil Nadu and ending at Mumbai in the state of Maharashtra. The highway acts as a primary conduit for transportation of freight as well as passenger traffic in these states as well as various other important states in India. NH-48 (Old NH-4) connects important cities and towns like Pune, Satara, Karad, Sangli, Kolhapur, Belgaum, Dharwad, Hubli, Bangalore etc.

Figure 1-1 shows the alignment of NH-48 (Old NH-4) with major places along the highway.

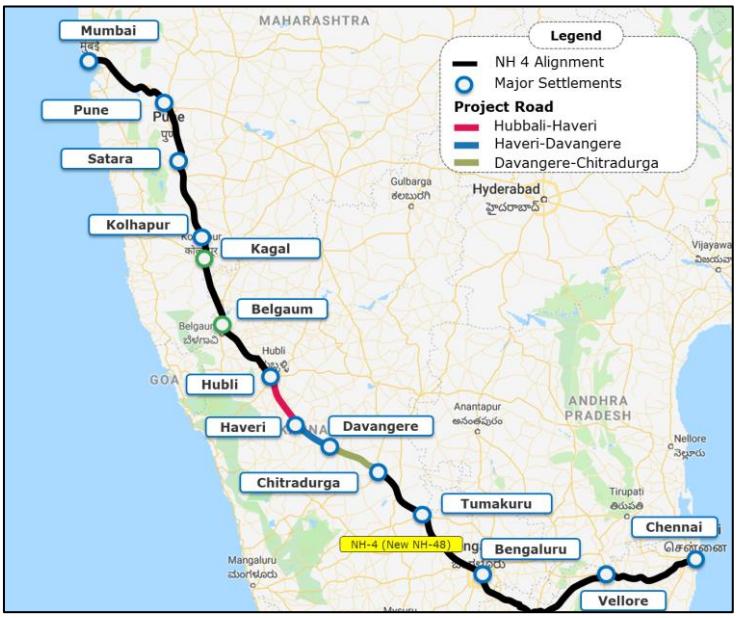


Figure 1-1: Alignment of NH-48 (Old Nh-4) with Major Places

National Highways Infra Investment Managers Private Limited, has appointed Ramboll India Private Ltd as the Traffic Consultant to carry out a study for assessing the present traffic levels, travel pattern and future traffic & revenue estimation till year FY44 duly considering the network characteristics, future economic perspective in the influence area of the project.

1.2 Scope of Services

The scope of the study includes the following:

- Undertake Traffic Survey on the highway section as per the following:
  - Seven days 24 hours Videography Traffic Counts at or near the existing toll plaza locations on the project road to derive the Average Daily Traffic (ADT)
  - One day Origin-Destination survey at or near the existing toll plaza locations to assess the existing travel pattern of vehicles plying on the project road – origin and destination.
- Estimation of the base year AADT FY24
- Analysis of OD data to cover:
  - Regional distribution of traffic and influence factors for different zones contributing traffic on the corridor
  - Identification of Project Influence Area from analysis of travel pattern - regional distribution of traffic,
  - Main traffic generators (industrial areas, towns, ports etc.)
  - Commodity composition- Goods type distribution
  - Top OD pairs by vehicle types
  - Travel frequency and trip purpose distribution
- Review of past traffic studies, traffic/toll data and other relevant reports as may be available to determine category wise volume of traffic for past years as well as for current year
- To identify competing route and analyse the network conditions, traffic characteristics & level of toll charged and the advantage/ disadvantage of the competing road and their impact on the project traffic
- Carry out a study of past economic performance of influence area
- Diversion analysis, wherever needed – cost ratio-based diversion analysis using spreadsheets to be carried out for respective potential OD pairs.
- Preparation of traffic projections till year FY44 in three scenarios – low, most likely and high
- Capacity analysis of the road or any other requirements for potential capacity augmentation
- Estimation of tollable traffic streams by toll category and estimation of toll revenue as per categories of traffic streams stipulated in the tolling schedule for the study period

- Review future road and transportation network developments in the area of influence of the project and identify those schemes that may impact positively or negatively traffic on the toll road
- Identify factors which may have a positive and / or negative impact on the traffic - all major developments like DFC, industrial corridors, economic corridors, ports, Bharatmala, Sagarmala
- Scenario Analysis of toll revenue – Critical parameters of diversion (if applicable) and three scenarios of traffic growth (most likely, low and high).

1.3 Report Structure

This report is divided into four chapters, including this introduction chapter. Chapter 2 details upon the project road characteristics and socio – economic profile of the districts in the project influence area including the estimation of AADT and travel characteristics in the Project Influence Area (PIA). Chapter 3 contains the details on the derivation of traffic growth rates used for traffic forecasting and presents traffic projections for the study period. Chapter 4 presents the details regarding tolling strategy, toll rates and the revenue projections for the duration of the concession.

2. TRAFFIC SURVEY AND ANALYSIS

2.1 General

In order to understand the traffic characteristics, the volume of traffic and travel pattern of vehicles plying on the project road were collected through primary surveys. This chapter presents the details of the project road characteristics, traffic surveys carried out, their analysis and the salient findings. The results of the analysis will be utilized in assessing the traffic growth and estimation of traffic and revenue forecast on the project road for the concession period.

2.2 Project Road Characteristics

The project road section consists of three continuous toll roads and the details of the three project road sections, lengths, chainage, toll plazas and tolling lanes at the toll plaza locations are presented in **Table 2-1**.

S No.	Project Section	Length (km)	Start km	End km	Toll Plaza	Tolling Lanes
1	Hubbali-Haveri	71.0	Km 340.00	Km 403.40	Bankapur (km 352.550)	7+7
2	Haveri-Davangere	72.0	Km 260.00	Km 340.00	Chalageri (km 288.200)	7+7
3	Davanagere-Chitradurga	62.0	Km 189.00	Km 260.00	Hebbalu (km 237.650)	7+7

Table 2-1: Details of Project Section

The project road falls under the jurisdiction of Dharwad, Haveri, Davanagere and Chitradurga districts passing through settlements of Hubbali, Varur, Shiggaon, Bankapura, Devagiri, Haveri, Motebennur, Ranebennur, Chalageri, Harihar, Davanagere, Anagodu and Chitradurga. There are three operational toll plazas on the project road, one near Bankapur, one near Chalageri, and another near Hebbalu.

The alignment of project road and toll plaza locations is shown in **Figure 2-1**.

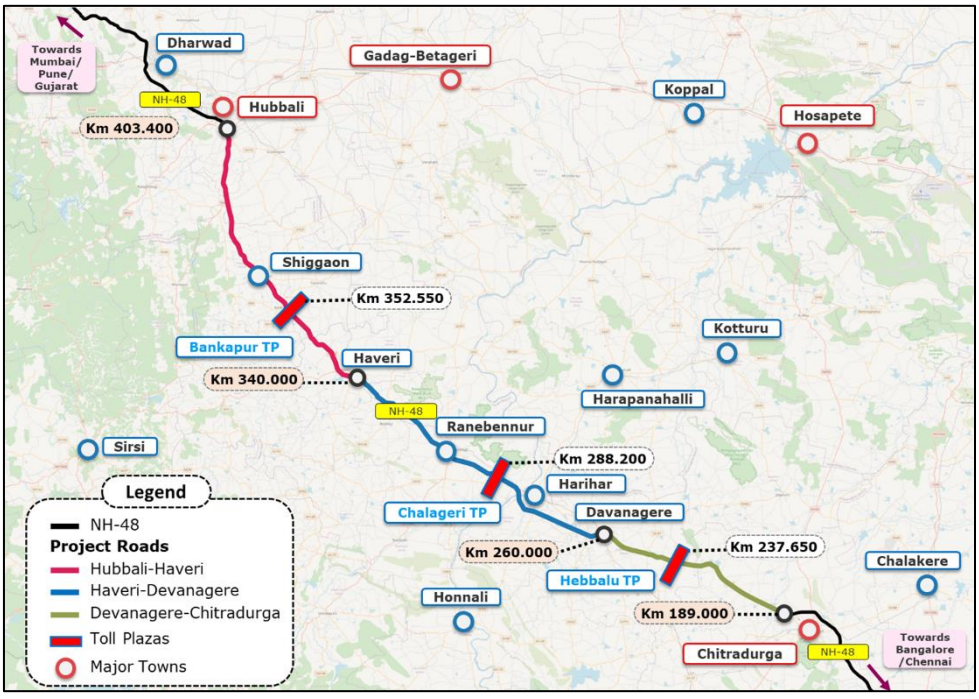


Figure 2-1: Project Road Sections and Location of Toll Plazas

The project road, in wider context, serves the long-distance traffic for the freight vehicles, which is majorly plying between Mumbai/ Pune/ Delhi Chitradurga/Bangalore/ Chennai/ Vellore. Apart from long distance traffic, it also serves the short distance traffic for both passenger and freight which is mainly generated between Hubbali/Dharwad/Haveri/Davanagere/Ranebennur/Chitradurga and nearby places.

2.2.1 Profile of Project Influence Area District

The project section falls under the jurisdiction of Dharwad, Haveri, Davanagere and Chitradurga districts in the state of Karnataka. A brief description of the profile of these four districts is presented below.

Dharwad District

Dharwad is one of the emerging districts and important business centre in North Karnataka region. Dharwad district covers an area of around 4,260 sq.km and is surrounded by Belgaum district on the north, Gadag district on the east, Haveri district in the south and Uttara Kannada district in the west. According to the 2011 census, Dharwad district has a population of 1.84 million and had a decadal growth rate of about 15.1 percent in 2001-2011.

Agriculture is the main occupation of the district with around 57 percent of its net area under cultivation. Major crops found in the district are jowar, wheat, Bengal gram, tur dal, ground nut, onion, maize, sunflower and cotton. Available natural resources in the district are building stone, clay, black cotton soil and jelly stone.

Dharwad district is fast developing as the commercial and industrial hub in the state with 25 large and medium scale industries and 18,203 small scale industries. The potential sectors in the district are agriculture & allied sectors (rice mills and food processing), forest-based sawmills, cotton and textile, mechanical and automobile and education. Dharwad district has major trade centre at Hubli. The major industrial areas in the district are Belur Industrial area with 1,479 acres, Belur SUC with 647 acres and KIADB Gamanagatty Industrial area with 450 acres, Tarihal Industrial Area, Rayapur Industrial Area near Dharwad and Gokul Industrial Area in Hubbali. The district also has Agricultural Science University and Indian Institute of Technology at Dharwad.

These industrial areas have several small, medium and scale industries present some of which include agro equipments and agro food processing industries, polymers, engineering works, steel and wire works, engineering and automobiles manufacturing, chemical and fertilizers industries, textiles, paper products, printing, and other consumer products-based industries. Notable industries present in the district include HPCL Bottling Plant, Gujarat NRE Coke Plant, TATA Hitachi Construction Machinery Plant, TATA Marcopolo Motors Limited Plant, IOCL Refinery and a Bharat Petroleum warehouse.

Haveri District

Haveri district is located exactly in the centre of Karnataka with an area of 4,823 Sq.km. The district is bounded by Dharwad district on the north, Gadag district in the northeast, Bellary district on the east, Davanagere district on the south, Shivamogga district in the southwest and Uttar Kannada district on the west and northwest. According to the 2011 census, Haveri district has a population of 1.6 million and had a decadal growth rate of about 11 percent in 2001-2011.

Agriculture is the main occupation of the district with around 75 percent of its net area under cultivation. Major food crops being produced are maize, paddy, jowar, hybrid cotton, groundnut, chilly, pulses. It is rich in spice cultivation and the major spice industry in the district has chili powder mills and processing facilities. The district comprises of world-famous chilly market at Byadagi and a major export hub for Byadagi chillies.

The district has 1 mega and 9 large and medium industries and around 10,000 small scale industries that is well supported by 5 industrial estates. Agriculture and allied industries, sericulture, animal husbandry, textile and handloom industries are the potential industrial sectors in the district. The natural resources available in the district are building stone, sand and jelly stones which are widely used for the local consumption.

Davanagere District

Davanagere district is located in the central part of Karnataka with an area of 5,924 sq.km. The district is bounded by Haveri and Vijayanagara district on the north, Chitradurga district on the east, Chikkamangaluru district on the south and Shivamogga district in the west. According to the 2011 census, Davanagere district has a population of 1.9 million and had a decadal growth rate of about 8.6 percent in 2001-2011.

Economically, the district is based on agriculture primarily. Major agricultural crops include paddy, maize, red gram, green gram, black gram, groundnut, sunflower, sugarcane, cotton etc.

Davanagere is known as the Manchester of Karnataka and has a dominant textile sector that is set to grow along with the food processing sector which provides the highest employment in the district. The district has large industrial units, small and medium scale industries. Textile constitutes approximately 13% of small-scale industrial units in the district, and a focused apparel park is in the pipeline to enhance this sector. Agro and allied activities along with textiles form the major industry in the district, followed by wood and wood-based furniture manufacturing industries. The district also has a good base for horticulture units of marigold dye processing and arecanut processing. There are two industrial areas viz., KIADB Karur Industrial area and Sri Ramnagar Industrial area present in the city of Davanagere which has several agro and food processing industries, rice mills, furniture and metal processing etc. Notable industries include

Shamanur Sugar's, Cargill, Amazon Distribution Center, National Seed Corporation Processing plant, Aradhya Agro etc.

Chitradurga District

Chitradurga district located in the heart of deccan plateau in Karnataka state, with an area of about 8,436 Sq.km. It is bounded by the districts of Tumkuru and Hassan on south, Chikkamangaluru on the west, Davanagere and Bellary on the north, and Anantapur district of Andhra Pradesh on the east. The district population as per Census 2011 is 1.6 million with a decadal growth rate of about 9.4 percent.

Economically, agriculture is the backbone of the district. Major agricultural crops include paddy, ragi, jowar, maize, red gram, horse gram, green gram, black gram, bengal gram, tur, groundnut, sunflower, cotton, tobacco and betul nut.

More than 20% of the small-scale industrial units in the district are engaged in agro and food processing activities and textile constitutes second highest number of large & medium scale industries in the district and around 12% of small-scale units in the district.

Major minerals available in Chitradurga are iron ore and manganese. Limestone, dolomite, gray granite and building stone are the minor minerals produced in the district. It is rich in mineral deposits, including gold prospecting at Halekal, Kotemardi and open cast copper mines at Ingaldhal. Tamarind seeds, ground nuts and decorating items are major exportable items from the district.

Chitradurga is the 4th largest producer of wind energy in the country with around 20,000 wind turbines set up. Textiles, handlooms, food processing are the major large and medium industries in the district. Due to large limestone reserves, cement industrial sector is also predominant.

The major industries present along the project corridor and in the vicinity are presented in **Figure 2-2**

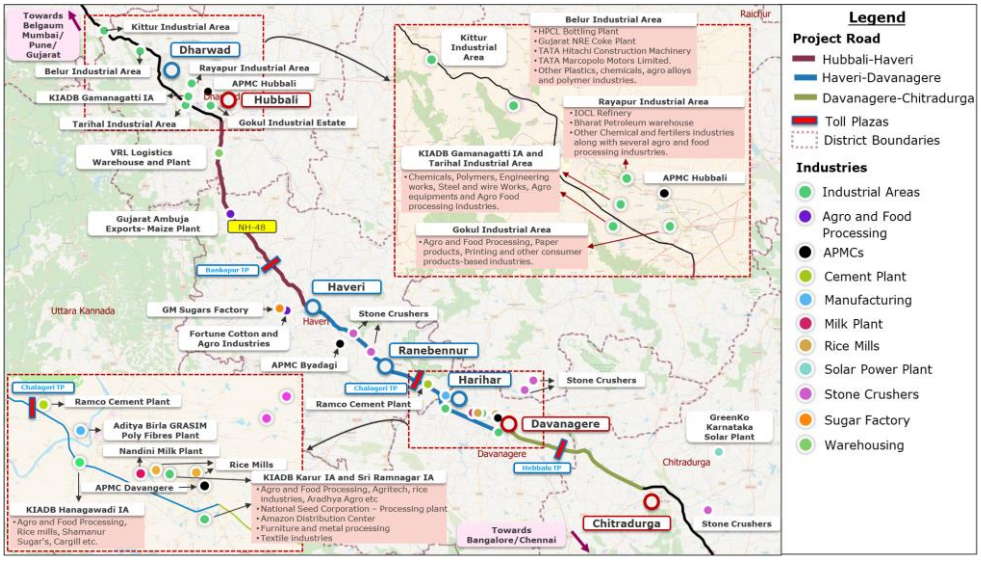


Figure 2-2: Major Industries Along And Around The Project Corridor

2.3 Traffic Surveys

In order to understand the characteristics and the volume of traffic using the project road, data on road network, traffic and travel pattern of vehicles plying on the project road were collected through primary traffic surveys.

As part of Phase I surveys in the month of October 2023 traffic volume video graphic survey for seven days and origin-destination (OD) survey as roadside interview for one day at toll plaza locations were conducted on the project road.

In addition to the above, a proposal for shifting of Bankapur (TP01) has been in place as the plaza is almost under the municipal limit of Bankapur town. The new proposed location is about 5.4 km south of the existing toll plaza location. Thus, another round of TVC surveys for three days (Phase II) in month of December 2023 was conducted at the existing location (km 352.550) and at the proposed location (km 347.180) of Bankapur Toll Plaza. The traffic observed at the proposed location is almost similar to the traffic levels at the existing toll plaza location, thus traffic from the existing TP location of Bankapur has been considered for further analysis. The ADT at the Phase II survey locations viz., Bankapur existing TP and proposed TP location has been presented in Section 2.7.

The schedule of the traffic surveys and locations on the project road are given in **Table 2-2**.

Location	Chainage	Duration	TVC	OD
Phase I Surveys				
Bankapur (TP01)	km 352.550	7 Days	10th October–16th October 2023	11th October 2023
Chalageri (TP02)	km 288.200		11th October –17th October 2023	12th October 2023
Hebbalu (TP03)	km 237.650			13th October 2023
Phase II Surveys				
Bankapur (TP01)	km 352.550	3 Days	11th December –13th December 2023	-
Proposed Bankapur TP	km 347.180			

Table 2-2: Traffic Survey Locations and Schedule

Trained enumerators were engaged for conducting traffic surveys under the supervision of experienced transport planner. The vehicle classification as generally used in the traffic surveys of NHAI studies along with their PCU values, as suggested in IRC: 64 – 1990, are presented in **Table 2-3**.

Vehicle Type	PCU Factor
Motorized Vehicles	
Car, Jeep, Van &Taxi	1.0
Two –Wheeler	0.5
Three-Wheeler (Auto-Rickshaw)	1.0
Mini-Bus/ School Bus	1.5
Govt. Bus/ Private Bus	3.0
Mini LCV/Max Pick Up	1.0
Light Commercial Vehicle (LCV)	1.5
2-Axle Truck	3.0
3-Axle Truck	3.0
Multi-Axle Vehicle (MAV 4-6 Axle)	4.5
HME	4.5
Agricultural Tractor	1.5
Agricultural Tractor with Trailer	4.5
Non – Motorised Vehicles	
Cycle	0.5
Cycle Rickshaw	2.0
Animal Drawn Cart	6.0

Table 2-3: Vehicle classification and PCU factors

2.4 Traffic Characteristics

The data collected from the traffic volume count survey was analysed in order to get the results with respect to existing traffic intensity, flow pattern, hourly variation and composition of traffic on the study road network. The various traffic characteristics have been analysed under the following heads:

- Average Daily Traffic (ADT)
- Daily variation, Hourly variation, and Traffic composition
- Annual Average Daily Traffic (AADT)

2.4.1 Average Daily Traffic (ADT): Phase I Surveys

The traffic volume data collected at the toll plaza locations during the seven days survey for Phase I has been analysed. The summary of ADT in terms of vehicles and PCUs is presented in **Table 2-4**.

Mode	Bankapur (TP01)	Chalageri (TP02)	Hebbalu (TP03)
Tollable vehicles			
Car/Jeep/Van/Taxi	5,611	6,092	6,693
Minibus	82	102	110
Standard Bus	971	994	1,047
Mini LCV	1,041	988	1,079
LCV	2,366	2,346	2,326
2 Axle	1,054	984	932
3 Axle	999	987	1,009
MAV (4-6 Axle)/OSV	1,595	1,620	1,587
Non Tollable vehicles			
Two-Wheeler	4,232	6,423	3,916
Auto Rickshaw	161	419	325
Agri. Tractors	110	97	110
Total Non-Motorised	28	11	3
Total Vehicles/PCUs			
Total Tollable Vehicles	**13,719**	**14,112**	**14,783**
Total Non Tollable Vehicles	**4,530**	**6,950**	**4,354**
Total Vehicles	**18,249**	**21,062**	**19,137**
Total PCU	**26,572**	**26,937**	**27,530**
Tollable PCU	**26,572**	**26,937**	**27,530**

Table 2-4: Average Daily Traffic at TP01, TP02 & TP03

- The observed total vehicles are around 18,249 vehicles at TP01, about 21,062 vehicles at TP02 and around 19,137 at TP03.
- Car traffic has a share of around 30.2 percent (5,611 vehicles) at TP01, about 29.0 percent (6,092 vehicles) at TP02 and around 34.9 percent (6,693 vehicles) at TP03 of total traffic.
- Total freight vehicles account for a share of 38.6 percent at TP01, 33.2 percent at TP02 and 36.6 percent at TP03. Within the freight traffic, MAV/OSV accounts for 8.8 percent (1,595 vehicles) at TP01, 7.6 percent (1,620 vehicles) at TP02 and 8.3 percent (1,587 vehicles) at TP03.
- The tollable traffic recorded at TP01 is 74.1 percent, about 67.1 percent at TP02 and 77.0 percent at TP03.
- Other motorised non-tollable vehicles (two-wheeler, auto rickshaw and tractor) account for about 25.9 percent at Bankapur toll plaza, about 32.9 percent at Chalageri toll plaza and 23.0 percent at Hebbalu toll plaza.

2.4.2 Daily Variation, Hourly Variation, and Traffic Composition

The day wise variation, hourly variation and the traffic composition at the toll plaza locations is presented in **Figure 2-3**.

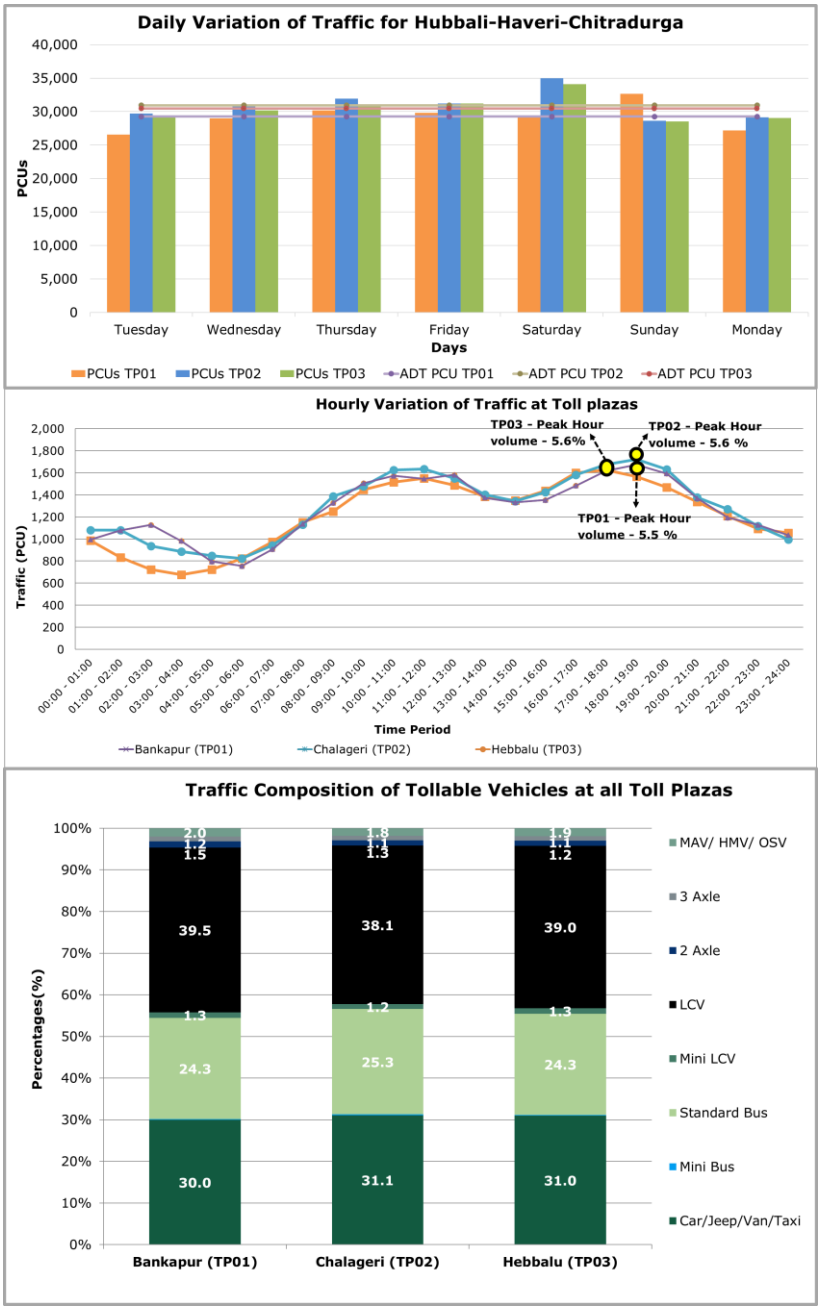


Figure 2-3: Daily & Hourly Variation and Traffic Composition

- It was observed that the traffic at the toll plazas is consistent with minor fluctuations during the days of volume count survey.
- The directional distribution at the toll plaza location is almost equal with Hubbali-Chitradurga having a directional distribution of 49.3 percent at TP01, 49.4 percent at TP02 and 49.0 percent at TP03.

2.4.3 Comparison of ETC with TVC

ETC vs TVC

The TVC survey was conducted from 10th October 2023 to 16th October 2023 at Bankapur (TP01) and from 11th October 2023 to 17th October 2023 at Chalageri (TP02) and Hebbalu (TP03). A comparison between TVC and ETC data for the days of the survey is presented in **Table 2-5**.

Day/Date	CJV	LCV	2A	3A	MAV/OSV	LCV/2A	Total	PCUs
Bankapur (TP01)								
TVC Average	6,652	2,448	2,025	953	1,595	4,473	13,672	26,433
ETC Average	5,804	1,412	2,786	1,001	1,648	4,198	12,652	26,702
TVC MINUS ETC Average	*848*	*1,036*	*-762*	*-48*	*-53*	*274*	*1,020*	*-268*
% Variation wrt ETC	14.6%	42.3%	-37.6%	-5.1%	-3.3%	6.1%	7.5%	-1.0%
Chalageri (TP02)								
TVC Average	7,079	2,448	1,978	935	1,620	4,426	14,060	26,779
ETC Average	5,867	1,392	2,711	976	1,657	4,104	12,603	26,474
TVC MINUS ETC Average	*1,303*	*1,020*	*-743*	*-47*	*-57*	*322*	*1,456*	*304*
% Variation wrt ETC	20.7%	43.1%	-37.1%	-4.4%	-2.3%	7.3%	10.4%	1.1%
Hebbalu (TP03)								
TVC Average	7,771	2,437	1,978	943	1,587	4,415	14,716	27,329
ETC Average	6,831	1,464	2,623	955	1,593	4,087	13,467	26,931
TVC MINUS ETC Average	*940*	*973*	*-645*	*-13*	*-8*	*328*	*1,249*	*399*
% Variation wrt ETC	13.8%	39.9%	*-32.6%*	-1.3%	-0.5%	7.4%	8.5%	1.5%

Table 2-5: Comparison Between TVC and ETC data

The main observations from the comparison are:

- The variation of TVC vs ETC data at all the toll plazas shows that TVC is higher than ETC transaction data. The difference between both the traffic can be attributed to the cash and exemptions traffic.
- The average variation of total traffic with respect to TVC is about 8-10 percent at TP02 & TP03 and about 7 percent at TP01.
- The variation in LCV/2A could be due to cross classification amongst these modes.

2.4.4 Annual Average Daily Traffic (AADT)

The traffic plying on any road generally varies over different periods of the year depending on the cycle of different socio-economic activities in the regions through which it passes. Therefore, in order to have a more realistic picture of the traffic on the project road, it is required to assess its seasonal variation to estimate the annual average daily traffic (AADT).

For the present study, the past toll traffic data (Schedule M) at toll plaza locations was collected from NHAI PIU at Dharwad for Bankapur (TP01) and from NHAI PIU at Chitradurga for Chalageri (TP02) and Hebbalu (TP03). The data received showed variations, inconsistent and incomplete data for the recent financial years along with missing local personal and local commercial trips data.

The ETC transaction data was made available from March 22 to November 23 for Bankapur (TP01), November 21 to November 23 for Chalageri (TP02) and December 21 to November 23 for Hebbalu (TP03). As this data gives only ETC traffic (paying) on the project section, thus this data is used to derive the base year ETC ADT for FY24.

The cash & exemptions data was made available by the client from April 23 to November 23 for all three toll plazas. However, the exemption data from April 23 to September 23

was found to be inconsistent. Therefore, FY24 ADT has been derived by adding average exemption traffic of 2 months (Oct 23 to Nov 23) to the estimated FY24 ETC AADT.

Estimation for FY24 AADT for passenger vehicles is done after annualising the behaviour of April 2023 to November 2023 traffic from ETC data. For this purpose, a ratio/factor of average of April-November to twelve-month average of IHMCL FY23 was adopted for all three toll plazas.

For freight vehicles, the past toll traffic data from adjacent section as available with the consultant have been used. Estimation for FY24 AADT for freight vehicles is done after annualising the behaviour of April 23 to November 23 traffic. For this purpose, a ratio/factor of average of April-November to twelve-month average derived from the average of factors from FY17-FY23 (except FY21 & FY22) of Belgaum-Dharwad toll plaza is used.

The AADT for FY24 derived for all three toll plazas with 8 months to yearly factors is presented in **Table 2-6**.

	Car	LCV	Bus/Truck	3A	MAV	OSV	PCUs
Bankapur (TP01)							
A. Apr 23 – Nov 23 (ETC Traffic +Cash)	6,472	1,430	2,710	940	1,619	6	26,879
B. Oct 23 – Nov 23 Average Exempt	639	11	8	1	0	0	
C. ADT (A+B)	7,111	1,441	2,718	940	1,620	6	27,563
D. SCF (8–12-month factor)	1.03	1.05	1.06	1.03	1.03	1.03	
E. AADT FY24 (C*D)	**7,304**	**1,509**	**2,873**	**966**	**1,663**	**6**	**28,596**
Chalageri (TP02)							
A. Apr 23 – Nov 23 (ETC Traffic +Cash)	6,387	1,379	2,586	910	1,605	5	26,188
B. Oct 23 – Nov 23 Average Exempt	357	3	2	1	1	0	
C. ADT (A+B)	6,744	1,382	2,587	911	1,605	5	26,559
D. SCF (8–12-month factor)	1.02	1.05	1.06	1.03	1.03	1.03	
E. AADT FY24 (C*D)	**6,898**	**1,447**	**2,735**	**935**	**1,649**	**5**	**27,522**
Hebbalu (TP03)							
A. Apr 23 – Nov 23 (ETC Traffic +Cash)	7,432	1,435	2,491	922	1,594	6	27,025
B. Oct 23 – Nov 23 Average Exempt	360	8	1	1	1	0	
C. ADT (A+B)	7,792	1,444	2,492	924	1,595	6	27,406
D. SCF (8–12-month factor)	1.01	1.05	1.06	1.03	1.03	1.03	
E. AADT FY24 (C*D)	**7,900**	**1,512**	**2,634**	**948**	**1,638**	**6**	**28,311**

Table 2-6: AADT for FY24

2.5 Travel Characteristics

2.5.1 Survey Methodology

In order to understand the travel demand pattern in the region and tollable traffic streams, origin and destination (OD) surveys were carried out at the toll plaza locations. The OD survey was carried out for 24 hours, by roadside interview method as described in IRC: 102-1988. Both passenger and commercial vehicles plying on the project road were stopped on a random sampling basis and interviewed.

The travel characteristics obtained by OD survey facilitate the identification of:

1. Local and through traffic on the project road.
2. Potential divertible traffic to/from project road to various alternative routes.

Trained enumerators under the supervision of transport planners collected the trip characteristics using survey forms designed for this purpose. The OD survey elicited characteristics like origin, destination, frequency, purpose of trip for passenger vehicles and commodity being transported for goods vehicles. The information pertaining to origin and destination of trips collected during roadside interviews was analysed to obtain the trip distribution based on a zoning system suitably designed for the present study.

2.5.2 Traffic Zoning System

To understand the spatial dimensions of the trip characteristics of the vehicles interviewed during the O-D survey, a detailed zoning system was developed giving due consideration to the following factors:

- The road network catering to the traffic on the project road and its generating points
- Important towns, villages, factories and industrial centres around the project road area
- Administrative boundaries of districts and states.
- Configuration of the project road in the regional road network with respect to other roads

Two major types of areas were identified for analysis purpose: -

Immediate Influence Area (IIA): It includes the cities/towns/villages and districts along the project road and adjacent to it, which generate/attract trips to the project road. In this study, it consists of districts of Dharwad, Haveri, Davanagere and Chitradurga in the state of Karnataka.

Broad Influence Area (BIA): It includes the remaining districts of Karnataka and Maharashtra and other neighbouring states such as Telangana, Tamil Nadu, Andhra Pradesh and remaining states of India.

Detailed zoning system is prepared for IIA, while more aggregate or broad zoning is developed for BIA. The list of zones adopted for data collection was based on 96 zones and is presented in **Appendix 2.1**.

The zoning system adopted for data collection is presented in **Figure 2-4**.

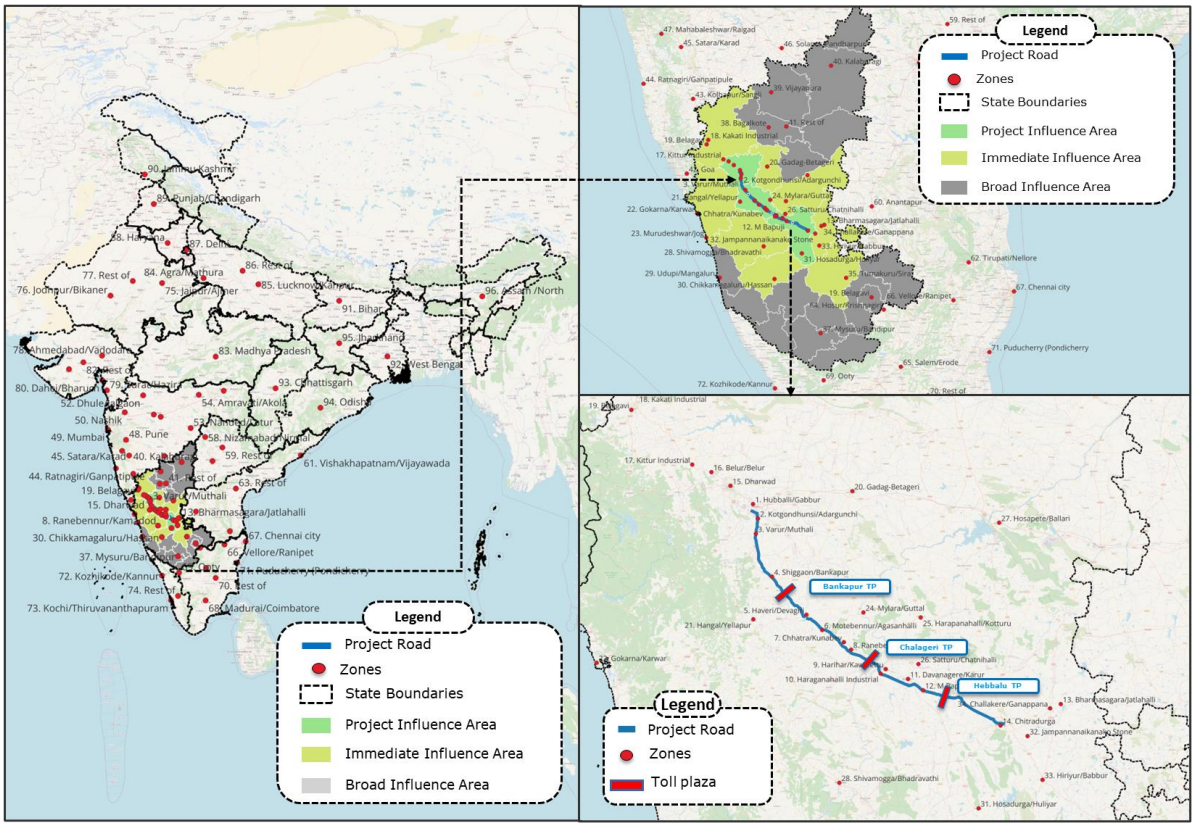


Figure 2-4: Zoning System Adopted for OD Surveys

The list of zones used for further analysis is presented in **Appendix 2.2**.

2.5.3 Sample Size

The toll traffic data does not provide the individual traffic volume count of all categories of vehicles. The seven-day traffic volume video count at the existing toll plazas was analysed to get the individual volume count of all categories of vehicles along with the direction split.

The vehicles during the OD surveys were interviewed on a random sample basis. **Table 2-7** shows the AADT and the sample size (both in absolute numbers and in percentage terms) captured during the exercise.

Modes	Car	Minibus	Bus	Mini - LCV	LCV	2Axle	3Axle	MAV	Total
Bankapur (TP01)									
Sample	2,755	90	612	648	1,372	846	819	850	7,992
AADT FY24	6,004	69	1,252	1,300	1,440	1,622	966	1,669	14,321
Percentage (%)	45.9	130.0	48.9	49.8	95.3	52.2	84.8	50.9	55.8
Chalageri (TP02)									
Sample	3,400	96	836	720	743	1,008	690	896	8,389
AADT FY24	5,718	72	1,228	1,180	1,375	1,507	935	1,654	13,669
Percentage (%)	59.5	133.4	68.1	61.0	54.0	66.9	73.8	54.2	61.4
Hebbalu (TP03)									
Sample	3,761	55	591	537	978	587	766	959	8,234
AADT FY24	6,779	92	1,335	1,121	1,419	1,300	948	1,643	14,638
Percentage (%)	55.5	59.5	44.3	47.9	68.9	45.2	80.8	58.4	56.3

Table 2-7: Sample Size Collected in OD Survey at TP01, TP02 & TP03

Based on the sample size of different categories of vehicles interviewed during the OD survey, direction-wise expansion factors were calculated based on FY24 AADT. The OD matrices for all vehicle categories were generated and analysis was done in terms of regional distribution, travel pattern and commodity distribution.

2.5.4 Regional Distribution

Based on the OD matrices, the regional distribution of tollable vehicles at the toll plaza locations has been calculated. **Table 2-8** gives the distribution indicating the attraction and generation zones for the traffic on the project road.

Region/Modes	Car	LCV	2A	3A	MAV
Bankapur (TP01)					
Karnataka	90.9	65.0	73.7	50.5	48.1
Maharashtra	4.8	20.7	14.8	27.1	26.8
Tamil Nadu	1.4	8.1	5.9	14.0	13.5
Gujarat	0.3	2.5	2.0	5.2	5.8
Goa	1.9	2.1	2.0	1.5	1.7
Kerala	0.2	0.5	0.5	0.4	2.2
Delhi/Haryana/Punjab	0.1	0.6	0.3	0.5	0.9
Rajasthan	0.1	0.1	0.4	0.2	0.5
Andhra Pradesh	0.2	0.1	0.2	0.0	0.0
Rest of India	0.1	0.5	0.3	0.6	0.4
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Chalageri (TP02)					
Karnataka	91.2	65.0	74.2	52.8	50.3
Maharashtra	5.4	21.1	15.5	27.1	28.2
Tamil Nadu	0.8	8.6	6.7	13.2	15.2
Gujarat	0.3	2.3	1.6	3.1	3.2
Goa	1.9	1.6	1.1	2.3	0.8
Kerala	0.2	0.1	0.3	0.7	1.1
Delhi/Haryana/Punjab	0.1	0.5	0.1	0.1	0.5
Rajasthan	0.0	0.3	0.3	0.3	0.6
Andhra Pradesh	0.1	0.1	0.0	0.0	0.0
Rest of India	0.0	0.5	0.2	0.4	0.2
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Hebbalu (TP03)					
Karnataka	92.1	70.9	76.3	54.6	50.0
Maharashtra	4.2	17.0	14.3	25.4	25.9
Tamil Nadu	1.4	8.2	5.3	12.9	15.7
Gujarat	0.2	1.2	1.0	1.9	3.9
Goa	1.6	1.5	1.2	2.4	2.0

Region/Modes	Car	LCV	2A	3A	MAV
Kerala	0.2	0.4	0.7	1.4	1.2
Delhi/Haryana/Punjab	0.1	0.1	0.1	0.1	0.5
Rajasthan	0.0	0.0	0.0	0.0	0.0
Andhra Pradesh	0.1	0.1	0.2	0.5	0.0
Rest of India	0.3	0.6	0.9	0.9	0.6
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Combined (Avg. TP01, TP02 & TP03)					
Karnataka	91.4	67.0	74.7	52.6	49.4
Maharashtra	4.7	19.6	14.9	26.6	27.0
Tamil Nadu	1.2	8.3	6.0	13.4	14.8
Gujarat	0.3	2.0	1.6	3.4	4.3
Goa	1.8	1.7	1.4	2.1	1.5
Kerala	0.2	0.3	0.5	0.8	1.5
Delhi/Haryana/Punjab	0.1	0.4	0.2	0.2	0.7
Rajasthan	0.0	0.1	0.2	0.2	0.4
Andhra Pradesh	0.1	0.1	0.1	0.2	0.0
Rest of India	0.1	0.5	0.5	0.6	0.4
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 2-8: Regional Distribution of Tollable Traffic (in %) On Project Road

Passenger traffic:

- Majority of the passenger traffic at all the toll plaza locations is from the state of Karnataka. Car traffic influenced by Karnataka state at the toll plaza location accounts for about 90.9 percent at TP01, 91.2 percent at TP02 and 92.1 percent at TP03 followed by Maharashtra accounting for 4-5 percent at all the three toll plazas.
- The car traffic is observed to be having Hubbali/Gabbur to Haveri/Devagiri as top OD pair at TP01, Hubbali/Gabbur to Bangalore and Devanagere/Karur to Chitradurga at TP03.

Freight Traffic

- In case of LCV, Karnataka contributes about 65 percent each at TP01 and TP02 & about 70.9 percent at TP03. Additionally, Maharashtra contributes about 17-20 percent at all the three toll plazas.
- About 73.7 percent of truck traffic at TP01, 74.2 percent at TP02, 76.3 percent at TP03 is contributed by the state of Karnataka, followed by Maharashtra accounting to about 14-15 percent at all the toll plazas.
- In case of 3A traffic, Karnataka accounts for a share of about 50.5 percent at TP01, 52.8 percent at TP02 and 54.6 percent at TP03. Maharashtra contributes to 25-27 percent followed by Tamil Nadu which accounts for about 13-14 percent at all the three toll plazas.
- In case of MAVs, share of Karnataka state at TP01 is 48.1 percent, at TP02 is 50.3 percent and at TP03 is about 50 percent, followed by Maharashtra which contributes about 26-28 percent at all three toll plazas.
- The MAV traffic is observed to be having Bangalore-Mumbai as top OD pair at all three toll plazas.

The mode wise top 20 OD pairs are given in **Appendix 2.2**.

2.5.5 Travel Pattern

To understand the travel pattern of vehicles, the important groups of zones corresponding to the different streams of traffic plying on the project road are presented in **Figure 2-5.**

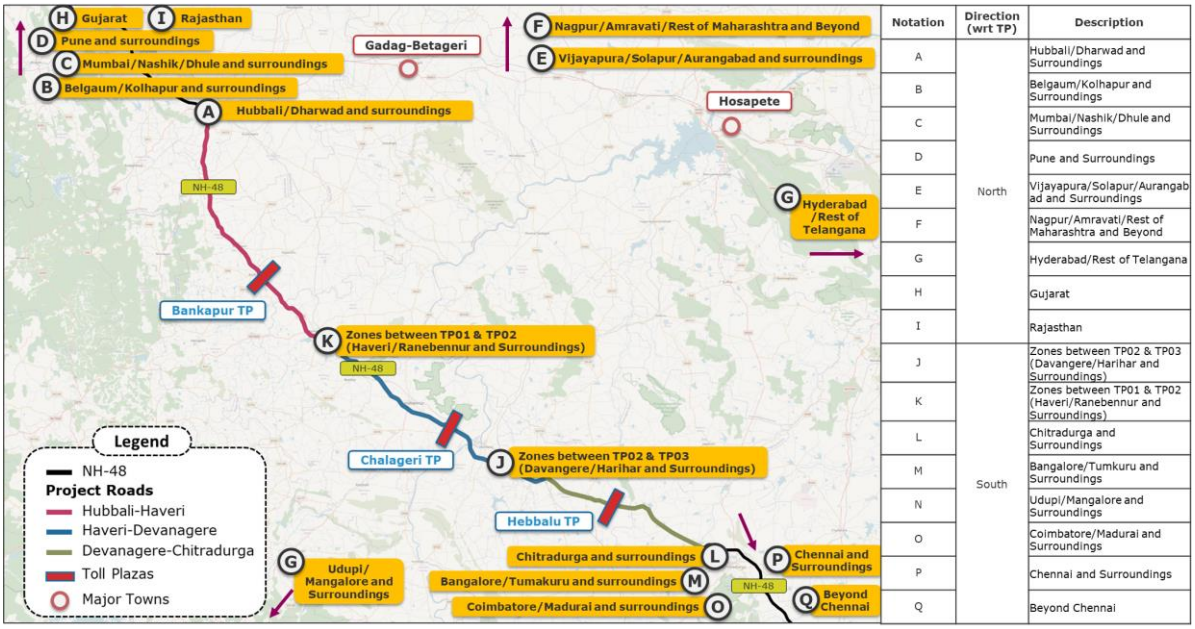


Figure 2-5: Streams of Traffic at the three TPs

The list of the popular movements found at the toll plaza locations is presented in **Table 2-9**, **Table 2-10** and **Table 2-11**.

Sr. No.	Notations	Traffic Streams	Car	LCV	2A	3A	MAV
1	A,B-L	Hubbali/Dharwad/Belgaum/Kolhapur and Surroundings-Chitradurga and Surroundings	3.7	1.2	1.2	0.4	0.5
2	A,B-L	Hubbali/Dharwad/Belgaum/Kolhapur and Surroundings-Bangalore/Tumakuru and Surroundings	22.8	24.9	27.5	19.3	17.5
3	A,B-N,O,P,Q	Hubbali/Dharwad/Belgaum/Kolhapur and Surroundings- Beyond Bangalore/Tumakuru	3.1	4.9	4.7	5.5	7.4
4	C,D-L	Mumbai/Pune/Nashik/Dhule and Surroundings-Chitradurga and Surroundings	0.1	0.1	0.2	0.1	0.3
5	C,D-M	Mumbai/Pune/Nashik/Dhule and Surroundings-Bangalore/Tumakuru and Surroundings	3.8	21.0	15.0	25.9	26.3
6	C,D-N,O,P,Q	Mumbai/Pune/Nashik/Dhule and Surrounding-Beyond Bangalore/Tumakuru	1.2	10.6	7.8	17.1	17.4
7	E-L,M,N,O,P,Q	Vijayapura/Solapur/Aurangabad and Surroundings-Chitradurga and beyond	0.9	1.1	1.5	1.5	1.3
8	F,G-L,M,N,O,P,Q	Nagpur/Hyderabad/Amravati and beyond-Chitradurga and beyond	0.8	2.5	1.6	3.1	3.0
9	H,I-L,M,N,O,P,Q	Gujarat/Rajasthan & Surroundings-Chitradurga and beyond	0.7	4.8	4.3	10.6	11.8
10	A,B,C,D,E,F,G,H,I-J	Hubbali/Dharwad/Belgaum and beyond-Zones between TP02 & TP03 (Davangere/Harihar and Surroundings)	17.6	10.7	10.8	8.4	8.1

Sr. No.	Notations	Traffic Streams	Car	LCV	2A	3A	MAV
11	A,B,C,D,E,F,G,H,I-K	Hubbali/Dharwad/Belgaum and beyond-Zones between TP01 & TP02 (Haveri/Ranebennur and Surroundings)	45.3	18.3	25.4	8.2	6.4
Total			100.0	100.0	100.0	100.0	100.0

Table 2-9: Traffic Streams at Bankapur (TP01) in %

Sr. No.	Notations	Traffic Streams	Car	LCV	2A	3A	MAV
1	A,B-L	Hubbali/Dharwad/Belgaum/Kolhapur and Surroundings-Chitradurga and Surroundings	4.4	1.3	1.3	0.6	0.2
2	A,B-L	Hubbali/Dharwad/Belgaum/Kolhapur and Surroundings-Bangalore/Tumakuru and Surroundings	20.6	23.6	23.1	18.4	19.1
3	A,B-N,O,P,Q	Hubbali/Dharwad/Belgaum/Kolhapur and Surroundings- Beyond Bangalore/Tumakuru	2.8	5.1	6.4	8.5	7.0
4	C,D-L	Mumbai/Pune/Nashik/Dhule and Surroundings-Chitradurga and Surroundings	0.1	0.8	0.2	0.2	0.5
5	C,D-M	Mumbai/Pune/Nashik/Dhule and Surroundings-Bangalore/Tumakuru and Surroundings	4.4	19.3	15.1	28.5	23.3
6	C,D-N,O,P,Q	Mumbai/Pune/Nashik/Dhule and Surrounding-Beyond Bangalore/Tumakuru	0.6	9.3	8.3	16.2	22.0
7	E-L,M,N,O,P,Q	Vijayapura/Solapur/Aurangabad and Surroundings-Chitradurga and beyond	1.5	1.3	1.5	0.2	1.1
8	F,G-L,M,N,O,P,Q	Nagpur/Hyderabad/Amravati and beyond-Chitradurga and beyond	2.3	7.2	2.4	4.3	5.1
9	H,I-L,M,N,O,P,Q	Gujarat/Rajasthan & Surroundings-Chitradurga and beyond	0.5	4.8	3.5	6.5	4.7
10	A,B,C,D,E,F,G,H,I-J	Hubbali/Dharwad/Belgaum and beyond-Zones between TP02 & TP03 (Davangere/Harihar and Surroundings)	19.3	12.7	14.1	7.6	8.9
11	K-L,M,N,O,P,Q	Zones between TP01 & TP02 (Haveri/Ranebennur and Surroundings)-Chitradurga and beyond	29.8	8.1	17.7	3.4	2.9
12	K-J	Zones between TP01 & TP02 (Haveri/Ranebennur and Surroundings)-Zones between TP02 & TP03 (Davangere/Harihar and Surroundings)	13.7	6.5	6.5	5.5	5.3
Total			100.0	100.0	100.0	100.0	100.0

Table 2-10: Traffic Streams at Chalageri (TP02) in %

Sr. No.	Notations	Traffic Streams	Car	LCV	2A	3A	MAV
1	A,B-L	Hubbali/Dharwad/Belgaum/Kolhapur and Surroundings-Chitradurga and Surroundings	3.7	4.5	1.6	3.0	1.9
2	A,B-L	Hubbali/Dharwad/Belgaum/Kolhapur and Surroundings-Bangalore/Tumakuru and Surroundings	18.3	23.3	26.0	19.0	18.9
3	A,B-N,O,P,Q	Hubbali/Dharwad/Belgaum/Kolhapur and Surroundings- Beyond Bangalore/Tumakuru	1.7	3.8	2.1	8.0	5.9
4	C,D-L	Mumbai/Pune/Nashik/Dhule and Surroundings-Chitradurga and Surroundings	0.7	1.0	0.9	0.8	1.5
5	C,D-M	Mumbai/Pune/Nashik/Dhule and Surroundings-Bangalore/Tumakuru and Surroundings	3.1	18.2	15.4	27.7	24.9

Sr. No.	Notations	Traffic Streams	Car	LCV	2A	3A	MAV
6	C,D-N,O,P,Q	Mumbai/Pune/Nashik/Dhule and Surrounding-Beyond Bangalore/Tumakuru	0.8	9.1	7.7	13.1	18.8
7	E-L,M,N,O,P,Q	Vijayapura/Solapur/Aurangabad and Surroundings-Chitradurga and beyond	1.7	2.7	2.1	2.7	3.5
8	F,G-L,M,N,O,P,Q	Nagpur/Hyderabad/Amravati and beyond-Chitradurga and beyond	2.0	3.5	4.1	6.2	4.7
9	H,I-L,M,N,O,P,Q	Gujarat/Rajasthan & Surroundings-Chitradurga and beyond	0.5	2.7	2.7	4.1	8.1
10	J-L,M,N,O,P,Q	Zones between TP02 & TP03 (Davangere/Harihar and Surroundings)-Chitradurga and beyond	55.3	24.9	32.2	12.7	10.1
11	K-L,M,N,O,P,Q	Zones between TP01 & TP02 (Haveri/Ranebennur and Surroundings)-Chitradurga and beyond	12.2	6.3	5.3	2.7	1.6
Total			100.0	100.0	100.0	100.0	100.0

Table 2-11: Traffic Streams at Hebbalu (TP03) in %

Passenger Traffic:

- The car traffic originating from/to Hubbali/Dharwad/Belgaum/Kolhapur and surroundings to/from Bangalore/Tumakuru and surroundings (stream 2) is about 22.8 percent at TP01, 20.6 percent at TP02 and about 18.3 percent at TP03.This stream of traffic is through traffic crossing all the toll plazas of the project road. It may be noted that majority of car trips were found to be for the purpose of work and business at the toll plaza locations.
- In case of car traffic, about 17-19 percent at TP01 and TP02 were found to be travelling between Hubbali/Dharwad/Belgaum and beyond to zones between TP02 & TP03 (Davangere/Harihar and surroundings). This stream of traffic crosses TP01 & TP02 of the project road (stream 10).
- Also, at TP02 and TP03, about 12-14 percent of car traffic were found to be travelling from/to zones between TP01 & TP02 (Haveri/Ranebennur and surroundings) to/from Chitradurga and beyond. This stream of traffic crosses TP02 & TP03 of the project road (stream 11).

Freight Traffic:

- In case of LCV, about 23 percent each at TP01, TP02 and TP03 were found to be travelling between Hubbali/Dharwad/Belgaum/Kolhapur and surroundings and Bangalore/Tumakuru and surroundings (stream 2).
- Around 27.5 percent at TP01, 23.1 percent at TP02 and 26.0 percent at TP03 of Bus/Truck were found to be travelling between Hubbali/Dharwad/Belgaum/Kolhapur and surroundings and Bangalore/Tumakuru and surroundings (stream 2).
- Significant share of freight traffic was observed to flow between Mumbai/Pune/Nashik/Dhule and surroundings and Bangalore/Tumakuru and

surroundings. About 25-29 percent of 3A and 23-26 percent of MAVs ply along this route (stream 5).

- In case of MAV, about 17.4 percent at TP01, 22.0 percent at TP02 and around 18.8 percent at TP03 were found to be travelling between Mumbai/Pune/Nashik/Dhule and surrounding and Beyond Bangalore/Tumakuru (stream 6).

It is worth mentioning that the traffic likely to be impacted by construction of Pune-Bangalore Expressway is part of traffic from/to Mumbai/Pune & beyond to/from Bangalore & beyond (stream 4 & stream 5).

2.5.6 Summarised Corridor Travel Pattern

In order to simplify the travel pattern at PR section, the streams given above are divided into 2 major streams:

- Through Traffic – Long Distance trips crossing all three Toll Plazas
- Crossing Traffic – Trips originating/destined within the project corridor and crossing any or more than one toll plazas.

The summarised travel pattern on the project corridor is presented in **Table 2-12.**

Crossing Traffic	Car	LCV	2A	3A	MAV
Bankapur (TP01) – As % of AADT					
Through	37.1%	70.9%	63.9%	83.4%	85.5%
TP01&TP02	17.6%	10.7%	10.8%	8.4%	8.1%
TP01	45.3%	18.3%	25.4%	8.2%	6.4%
Total	100.0%	100.0%	100.0%	100.0%	100.0%
Chalageri (TP02) – As % of AADT					
Through	37.2%	72.7%	61.7%	83.4%	82.9%
TP01&TP02	19.3%	12.7%	14.1%	7.6%	8.9%
TP02	29.8%	8.1%	17.7%	3.4%	2.9%
TP02&TP03	13.7%	6.5%	6.5%	5.5%	5.3%
Total	100.0%	100.0%	100.0%	100.0%	100.0%
Hebbalu (TP03) – As % of AADT					
Through	32.5%	68.8%	62.5%	84.6%	88.3%
TP03	55.3%	24.9%	32.2%	12.7%	10.1%
TP02&TP03	12.2%	6.3%	5.3%	2.7%	1.6%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Table 2-12: Summarised Travel Pattern on the Project Corridor

Around 32-37 percent of Car, 63-72 percent of LCV/2A, 83-84 percent of 3A and 83-88 percent MAV traffic at all the toll plaza locations is through traffic which is crossing all the three toll plaza locations. The local traffic crossing TP03 at Hebbalu (TP03) is about 24.9 percent of LCV, 32.2 percent of 2A and 10-12 percent of 3A/MAV which might be due to the interaction of Chitradurga/Tumakuru/Bangalore areas with the industrial units present at Davanagere/Harihar/Mahajenahalli.

2.5.7 Commodity Distribution

Analysis was also carried out to understand the different commercial vehicles being used to transport different commodities. The plaza wise commodity distribution is presented in **Appendix 2.3**.

The commodity distribution for project corridor is presented in **Figure 2-6**.

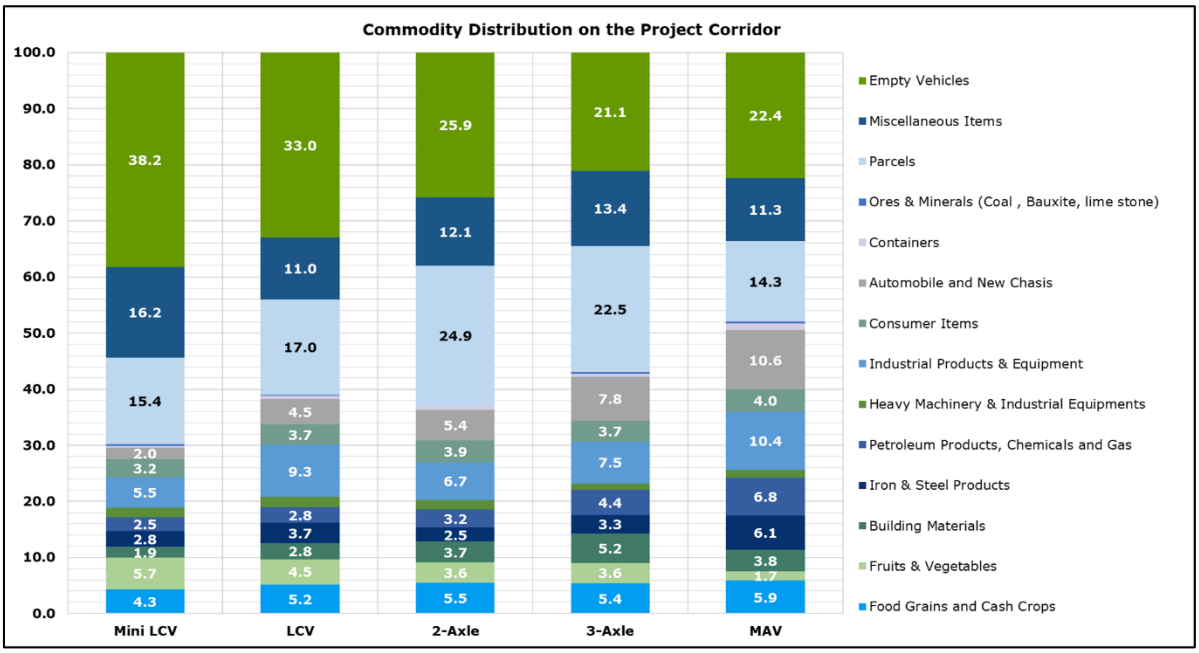


Figure 2-6: Commodity Distribution for Project Corridor

- Major commodities being transported across all three toll plazas are industrial products & equipment, automobile and new chassis, parcels, miscellaneous items etc.
- About 8-12 percent of LCV, 7-8 percent of 3A and around 9-12 percent of MAV were found to be transporting industrial products and equipments across all the three toll plazas. This can be attributed due to the presence of large industrial areas and industrial parks near Hubbali/Dharwad viz., Belur, Kittur, Rayapur industrial areas etc along with other industrial areas present near Harihar on the project road. It may be noted that there are many small and medium industrial clusters present along the project road and also, along the entire NH-4 till Bangalore. LCV and 2A trucks mainly serve the short distance industrial demand along the project corridor and thus after dropping return empty to their source.
- Around 10.8 percent of MAV at TP01, 9.6 percent at TP02 and about 11.3 percent at TP03 are found to be carrying Automobile and new Chassis. This can be attributed due to the presence of large automobile manufacturing plants present at Pune, Bangalore and Chennai and their high demand in these metropolitan cities.
- Significant volume of parcels carrying ecommerce goods and couriers were being transported by all the modes of freight vehicles (around 16-18 percent of LCV, 24-26 percent of 2A, 21-24 percent of 3A and 13-16 percent MAVs). These parcels are

significantly high due to the influence of major metropolitan cities like Mumbai, Bangalore, Pune, and Chennai.

- Miscellaneous items like furniture, FMCGs, and other consumer items are mainly transported almost across by all the freight modes at all the toll plaza locations to serve the needs and demands of the metropolitan cities as well as the small and medium scale settlements and cities along the project road and along entire NH-4.

2.6 Alternate Route Characteristics

A detailed road network assessment along with visual site reconnaissance was conducted on the project road to identify alternate routes which could be used by vehicles to bypass the toll plaza.

Short distance alternate routes

Two short distance existing roads each at Bankapur (TP01) and Chalageri (TP02) were found to be acting as alternate routes using which traffic can bypass the toll plazas. The identified routes are:

1. Bankapur (TP01)

- AR1 (B-O-C), which is around 3.6 km long and is 2.7 km longer than the PR.
- AR2 (A-E-D), which is around 12.8 km long and is 7.1 km longer than the PR

Both the above-mentioned routes have single/intermediate lane configuration and pass through village settlements. The short distance routes present at Bankapur (TP01) are presented in **Figure 2-7**.

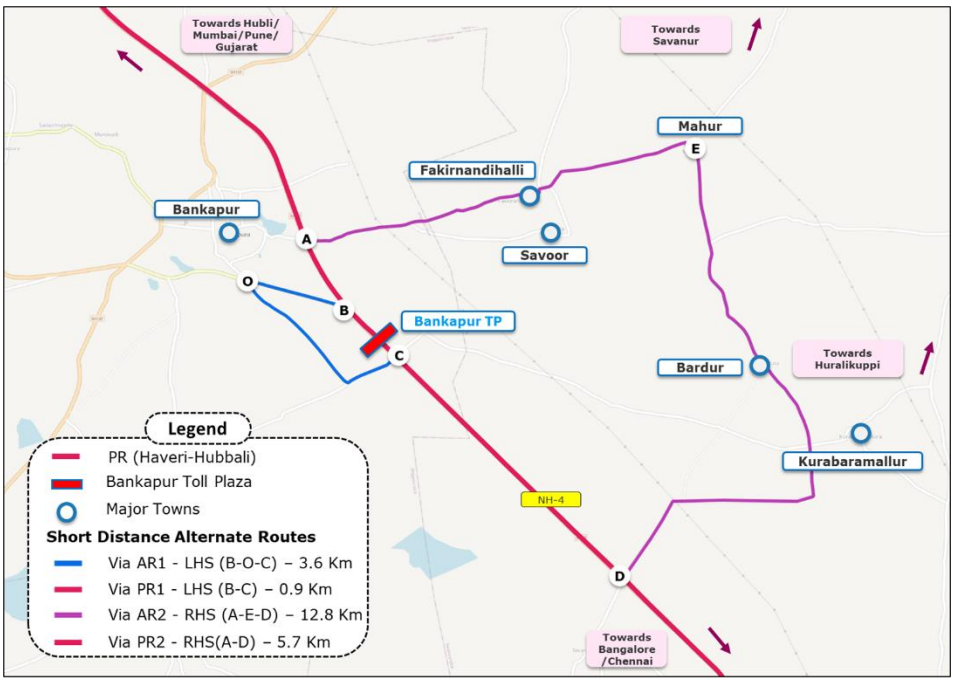


Figure 2-7: Short Distance Alternate Routes at Bankapur (TP01)

Assessment of bypassing traffic through alternate route on LHS viz., AR1 (B-O-C) of Bankapur (TP01) has been made through a one day Turning Movement Count (TMC) and

for the other alternate route on RHS viz. AR2 (A-E-D) of Bankapur (TP01) has been made through a one-day Registration Plate Survey/ Traffic Volume count.

The details of the surveys conducted are presented in **Table 2-13**.

Toll Plaza (Route)	Location	Survey Typology	Duration	Phase of Surveys	Date
Turning Movement Count					
TP01 (B-O-C)	O	TMC	1 Day	Phase I	14th Oct – 15th Oct 2023
Registration Plate Survey & Classified Traffic Volume Count					
TP01 (A-E-D)	A D	TVC & RP	1 Day	Phase I	14th Oct – 15th Oct 2023

Table 2-13: Surveys Conducted on Short Distance Alternate Routes of Bankapur (TP01)

Turning Movement Count Analysis Results for B-O-C

The one-day traffic observed at survey point O on AR1 (B-O-C) of TP01 is presented in **Table 2-14.**

Mode	Chitradurga – Hubbali (C-O-B)	Hubbali – Chitradurga (B-O-C)	Both Direction
Tollable vehicles			
Car/Jeep/Van/Taxi	77	72	149
Minibus	1	0	1
Standard Bus	0	0	0
Mini LCV	53	69	122
LCV	4	1	5
2 Axle	9	4	13
3 Axle	0	0	0
MAV (4-6 Axle)/OSV	2	2	4
Non Tollable vehicles			
Two-Wheeler	563	592	1,155
Auto Rickshaw	18	18	36
Agri. Tractors	4	5	9
Total Non-Motorised	14	14	28
Total Vehicles/PCUs			
Total Tollable Vehicles	146	148	294
Total Non Tollable Vehicles	599	629	1,228
Total Vehicles	745	777	1,522
Total PCU	506	518	1,024
Tollable PCU	174	164	337

Table 2-14: Daily Traffic at AR1 (B-O-C) of TP01

- Around 300 PCUs are found to be using the alternate route in order to avoid the toll at Bankapur TP. This could be the local traffic which is aware of this route.

Registration Plate Survey Analysis for A-E-D

To understand the traffic bypassing the toll plaza location, one day registration plate survey was carried out on route on RHS of Bankapur (TP01) viz., Location A & Location D along with Traffic Volume Count Survey at both RP locations.

The traffic observed at survey points viz., A & D on AR2 (TP01) along with registration plate matching analysis is presented in **Table 2-15**.

Modes/Directions	Car	MBus	Bus	MLCV	LCV	2A	3A	MAV	
Registration Plate Matching at Bankapur (TP01) on AR2 (A-E-D)									
Volume at Location A (Both Direction)	53	1	0	20	1	0	0	1	81
Volume at Location D (Both Direction)	455	14	19	93	16	15	23	3	778
Crossing both locations: 10-Digit RP Matching	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Crossing both locations: 4-Digit RP Matching	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**

Table 2-15: Registration Plate Survey Matching Exercise Results on Route AR2 (A-E-D) of Bankapur (TP01)

From the 10-digit Registration Plate matching exercise at Bankapur (TP01), it was found that no vehicles are using the alternate road to avoid the toll plaza. 4-digit Registration Plate matching exercise was also done which yielded in 1 car bypassing the toll plaza location.

2. Chalageri (TP02)

- AR1 (A-O-D), which is around 5.5 km long and is 3.2 km longer than the PR
- AR2 (B-E-C), which is around 3.2 km long and is 1.0 km longer than the PR

Both the routes have single/intermediate lane configuration and pass through village settlements. The short distance routes present at Chalageri (TP02) are presented in **Figure 2-8**.

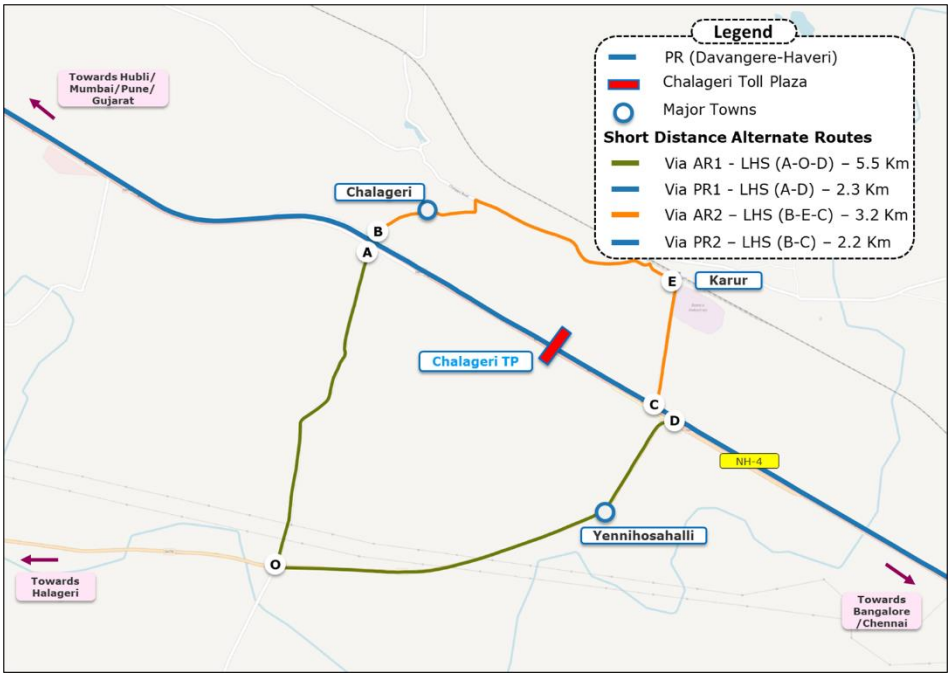


Figure 2-8: Short Distance Alternate Routes at Chalageri (TP02)

Assessment of bypassing traffic through alternate route on LHS viz., AR1 (A-O-D) of Chalageri (TP02) has been made through a one day Turning Movement Count (TMC) and for the other alternate route on RHS viz. AR2 (B-E-C) of Chalageri (TP02) has been made through a one-day Registration Plate Survey/ Traffic Volume count under Phase I.

In addition, Turning Movement Count (TMC) for three days at the AR1 (A-O-D) of Chalageri (TP02) was conducted as a part of Phase II surveys to analyse the potential traffic which may be bypassing the Chalageri TP.

The details of the surveys conducted are presented in **Table 2-16**.

Toll Plaza (Route)	Location	Survey Typology	Duration	Phase of Surveys	Date
Turning Movement Count					
TP02 (A-O-D)	O	TMC	1 Day	Phase I	14th Oct – 15th Oct 2023
			3 Days	Phase II	14th Dec – 16th Dec 2023
Registration Plate Survey & Classified Traffic Volume Count					
TP02 (B-E-C)	B	TVC & RP	1 Day	Phase I	14th Oct – 15th Oct 2023
	C				

Table 2-16: Surveys Conducted on Short Distance Alternate Routes of Chalageri (TP02)

Turning Movement Count Analysis Results on A-O-D

The one-day and three-day traffic observed at survey point O on AR1 (A-O-D) of TP02 is presented in **Table 2-17**.

Direction	Car	LCV	Bus/2A	3A	MAV	PCU
One Day TMC						
14th October 2023 (Saturday)						
A2-A3 (A-O-D)	100	38	17	3	2	226
A3-A2 (D-O-A)	245	75	12	20	12	508
Total	345	113	29	23	14	734
Three Day TMC						
3 Days Average						
A2-A3 (A-O-D)	258	73	23	48	10	627
A3-A2 (D-O-A)	284	107	26	60	23	805
Total	542	180	50	108	33	1,435

Table 2-17: Daily Traffic at AR1 (A-O-D) of Chalageri (TP02)

- Around 700 PCUs are found to be using this alternate route to avoid the toll at Chalageri (TP02) under Phase 1 survey whereas 1,400 PCUs were observed during Phase II surveys.
- This could be the local traffic which is using this alternate route from/to Chalageri town to/from small settlements/ institutions along this route.

Registration Plate Survey Analysis on B-E-C

To understand the traffic bypassing the toll plaza location, one day registration plate survey was carried out on route on RHS of Chalageri (TP02) viz., Location B & Location C along with Traffic Volume Count Survey at both RP locations.

The traffic observed at survey points viz., B & C on AR2 (TP02) along with registration plate matching analysis is presented in **Table 2-18**.

Modes/Directions	Car	MBus	Bus	MLCV	LCV	2A	3A	MAV	PCUs
Registration Plate Matching at Chalageri (TP02) on AR2 (B-E-C)									
Volume at Location B (Both Direction)	457	15	4	210	15	13	2	4	892
Volume at Location C (Both Direction)	510	9	0	291	41	17	19	8	1,166
Crossing both locations: 10-Digit RP Matching	**36**	**0**	**0**	**18**	**1**	**0**	**0**	**0**	**56**
Crossing both locations: 4-Digit RP Matching	**47**	**0**	**0**	**23**	**1**	**0**	**0**	**0**	**72**

Table 2-18: Registration Plate Survey Matching Exercise Results on route AR2 (B-E-C) of Chalageri (TP02)

From the 10-digit Registration Plate matching exercise at Chalageri (TP02), it was found that around 36 car and around 18 vehicles of MLCV might be using the alternate road to avoid paying toll at Chalageri TP. About 47 vehicles in car and around 23 vehicles in MLCV were found to be bypassing the toll plaza location as per 4-digit registration plate matching exercise.

As mentioned above, this could be the local traffic bypassing toll plaza with a work purpose in Chalageri/ Karur town.

2.7 Proposal for Shifting of Bankapur (TP01)

As mentioned in Section 2.3, a proposal for shifting of Bankapur (TP01) has been in place as the plaza is almost under the municipal limit of Bankapur town. The new proposed location is about 5.4 km south of the existing toll plaza location. The new proposed location for the plaza along with the existing plaza location is presented in **Figure 2-9**.

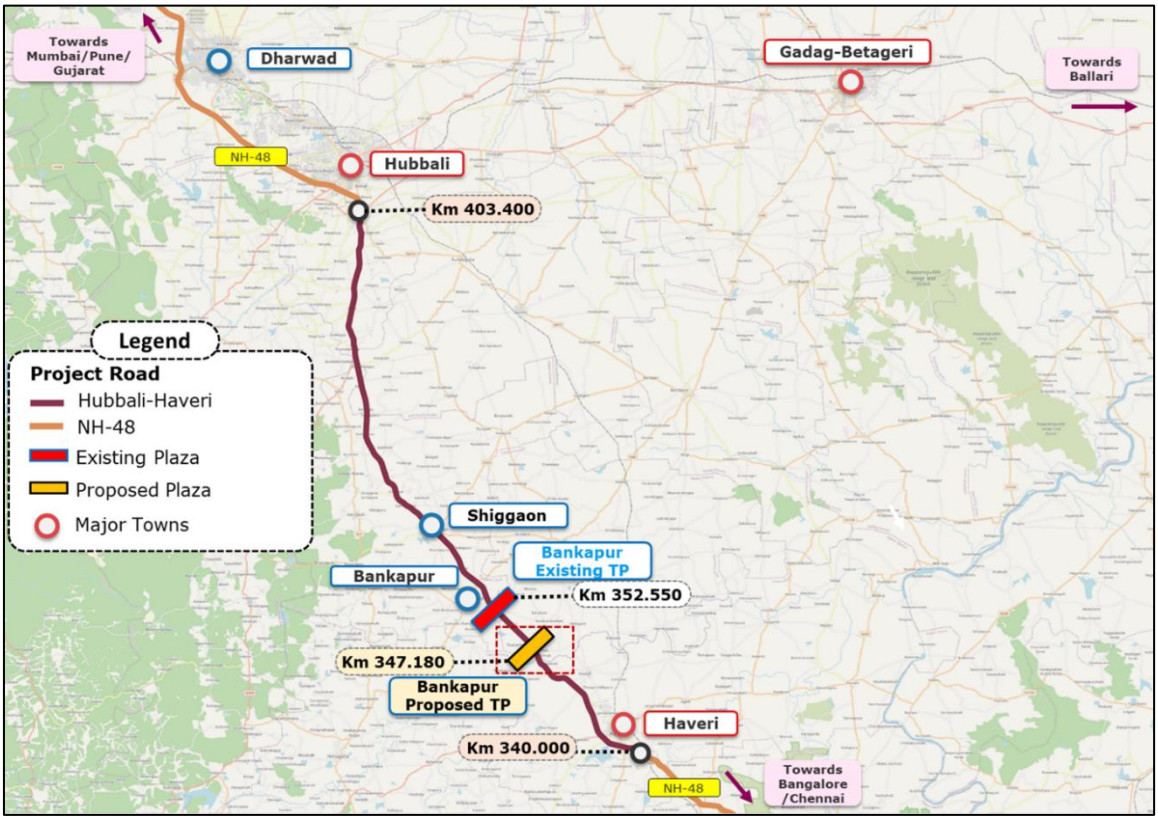


Figure 2-9: Proposed and Existing location of Bankapur (TP01)

It is to be noted that, there are short distance alternate routes on either side of the proposed toll plaza location, but as the plaza is not in place, the potential quantum of traffic which will be able to bypass the location cannot be estimated.

To understand the volume of traffic at the new proposed location, 3 days traffic volume video graphic survey (part of Phase II Surveys) was conducted at the proposed location as well as the existing toll plaza location.

Average Daily Traffic (ADT): Phase II Surveys

The traffic volume data collected at the existing & proposed location toll plaza location of Bankapur during the three days survey for Phase II has been analysed. The summary of ADT in terms of vehicles and PCUs is presented in **Table 2-4**.

Mode	Bankapur TP	Proposed Bankapur TP
Tollable vehicles		
Car/Jeep/Van/Taxi	5,618	6,253
Minibus	142	158
Standard Bus	1,019	1,039
Mini LCV	989	1,224
LCV	2,090	2,045
2 Axle	962	1,198
3 Axle	949	953
MAV (4-6 Axle)/OSV	1,409	1,385
Non Tollable vehicles		
Two-Wheeler	4,549	4,309
Auto Rickshaw	185	222
Agri. Tractors	172	151
Total Non-Motorised	25	7
Total Vehicles/PCUs		
Total Tollable Vehicles	**13,178**	**14,255**
Total Non Tollable Vehicles	**4,930**	**4,690**
Total Vehicles	**18,108**	**18,945**
Total PCU	**28,326**	**29,586**
Tollable PCU	**25,086**	**26,584**

Table 2-19: Average Daily Traffic at Existing & Proposed location of Bankapur TP

- Traffic at the proposed location is around 1,500 PCUs (6 percent) higher than the existing toll plaza location.
- About 635 car vehicles, 235 MLCVs and 236 2A trucks were observed to be higher at the proposed toll plaza location. It is to be noted that the traffic from/to Tevaramellihalli, Naregal, Sangur, Haveri and beyond to/from Savanur/Bardur and beyond travels via the route presented in **Figure 2-10**.

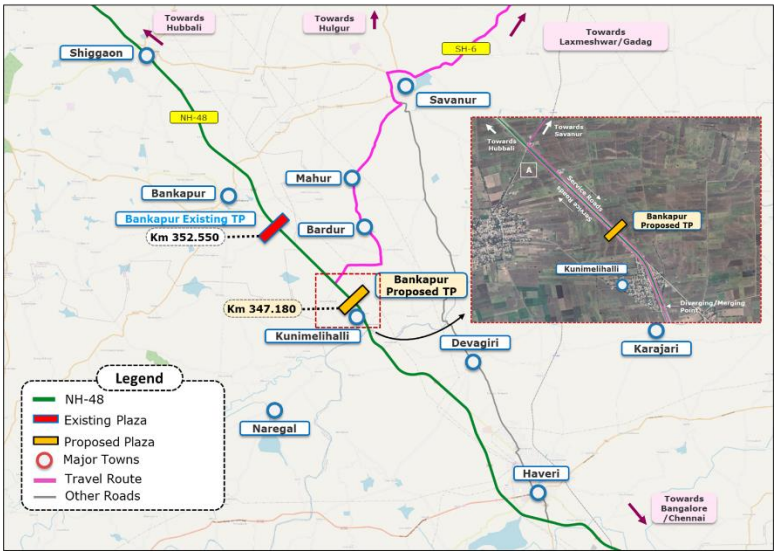


Figure 2-10: Potential traffic route at Bankapur TP proposed location

In addition, this road beyond Savanur connects to Laxmeshwar/Gadag which is a district headquarter and the traffic from these towns might be using this road.

- As mentioned before, the proposed location of Bankapur TP also has one circumventing route each on both RHS and LHS through which this local traffic can avoid paying toll at the new plaza location.
- Based on the above analysis, the AADT at proposed toll plaza location is assumed to be same as of the existing toll plaza location.

3. TRAFFIC GROWTH RATE AND PROJECTIONS

3.1 General

The project road is a part of the NHAI InvIT Round 3 portfolio and the projections of traffic and revenue have been presented till FY44. The estimation of the traffic using the tolled highway and its future growth are important elements to assess the project's economics as these are generally the main/sole source of revenue for the project This chapter details various aspects of the current traffic of the project road and its growth potential as assessed by Ramboll.

3.2 Project Road Traffic

The traffic that is likely to use the project road was estimated on the basis of the traffic and travel characteristics gathered as part of the study. The traffic on the project road would normally consist of the following components:

- Normal Traffic
- Diverted Traffic
- Induced/Developmental Traffic

3.2.1 Normal Traffic

Normal traffic is the traffic which is already plying on the project road as assessed in section 2.4.4.

3.2.2 Diverted Traffic

Diverted traffic is generally dictated by the presence of an alternative route at a lower generalised cost, which is in-turn defined by the road configuration and its condition, the type of vehicle and its operating costs, the average riding speed, the route distance, and any tolling that may apply on a specific route. A detailed road network assessment along with site reconnaissance survey was conducted on the project road and vicinity to identify alternate routes.

Diverted traffic is generally dictated by the presence of an alternative route at a lower generalised cost, which is in-turn defined by the road configuration and its condition, the type of vehicle and its operating costs, the average riding speed, the route distance, and any tolling that may apply on a specific route.

The assessment of any likely traffic diversion from/to the Project Road (PR) has been done using the cost-ratio analysis as described below:

- Assessment of the potential divertible traffic sensitive to network improvements based on the observed travel pattern.
- Calculation of road user cost of travelling on the project road and the alternative route. The road user cost includes vehicle operating cost (VOC), travel time cost

(TTC) and toll cost (TC), if any. VOC comprises of the cost of fuel, spare parts, maintenance labour, tyre, engine oil, grease, fixed cost, depreciation and crew wages.

- The toll rates for expressway have been considered as 1.5 times the normal NHAI per km toll rates (accounting for 1.25 times for normal length of expressway and increase for the likely equivalent structure length).

The road user cost is estimated based on vehicle operating cost equations presented in IRC SP-30,2019 which is based on updation of Road User Cost Study (RUCS) carried out by Central Road Research Institute in 2019 for Ministry of Road Transport and Highways. Using the likely traffic stream speeds and lane configuration, the vehicle operating, and travel time costs are estimated for each of the routes. Road user cost on the identified routes is calculated and diversion percentages are estimated using diversion curve method mainly for trucks. In this method, traffic likely to be diverted from/to the project road, was estimated using Logit model, which computes expected diversion percentage based on the ratio of perceived cost on the existing and proposed facilities. The perceived cost is the financial vehicle operating cost and the time saving cost including toll charges (if any). According to the model, a vehicle will shift if the perceived cost on an alternative route is lower in comparison to existing route. The diversion equations for estimating diversion have been adopted from Indian National Expressway Network Report, MORTH (2009) as mentioned in IRC 108:2015. These equations are presented in **Table 3-1**.

Vehicle	Cost Ratio (CR) Interval	Equations
Truck	<= 0.750	% Div. = 100 - ((CR/0.75) * 5)
	0.750 <= CR <= 1.250	% Div. = 95 - ((CR-0.75)/0.5) * 90
	1.250 <= CR <= 2.0	% Div. = ((2-CR)/0.75) * 5

Source: IRC 108-2015

Table 3-1: Diversion Equations Used for Analysis

There are two major development that could impact the project road traffic, and these have been studied in detail:

1. Pune - Bangalore Expressway
2. Impact of Completion of 6 laning construction activities on National Highway 48 (Old NH-4-Route via PR)

Impact of Pune – Bangalore Expressway

Pune – Bangalore Expressway is a proposed 8 lane access-controlled highway connecting Pune, Maharashtra and Bengaluru, Karnataka via Satara, Sangli, Belagavi (Belgaum), Dharwad, Hubli, Devanagere and Tumakuru with a length of 698 km. The new expressway will provide an alternative route to the traffic between Pune and Bangalore. The expressway is proposed to counter the issue of submergence of the existing NH-48 (Old NH-4) during monsoon and hence remove the issue of traffic bottlenecks in those

areas. As per latest information available on public domain, DPR preparation is in initial stages and the details about interchanges and connecting spurs are not yet available.

The traffic from Mumbai/Pune/Nashik can get on to the expressway at Pune and the traffic from Hubbali/Belgaum/Kolhapur/Satara can travel from Huballi to Banikoppa via NH-67 and take the Expressway to reach Bangalore/Chennai and beyond. Therefore, further analysis has been done for the routes starting from Pune and Hubbali separately.

A. <u>Route Choice between Pune-Bangalore/Chennai and Beyond</u>

The assessment for the route between Pune and Bangalore/Chennai has been done for the two traffic streams:

- Traffic plying between Mumbai/Pune/Nashik & surroundings and Bangalore & beyond
- Traffic from/to Mumbai/Pune/Nashik & surroundings to/from Chennai & beyond

The route via project road and the tentative alignment of the Pune- Bangalore expressway is presented in **Figure 3-1**.

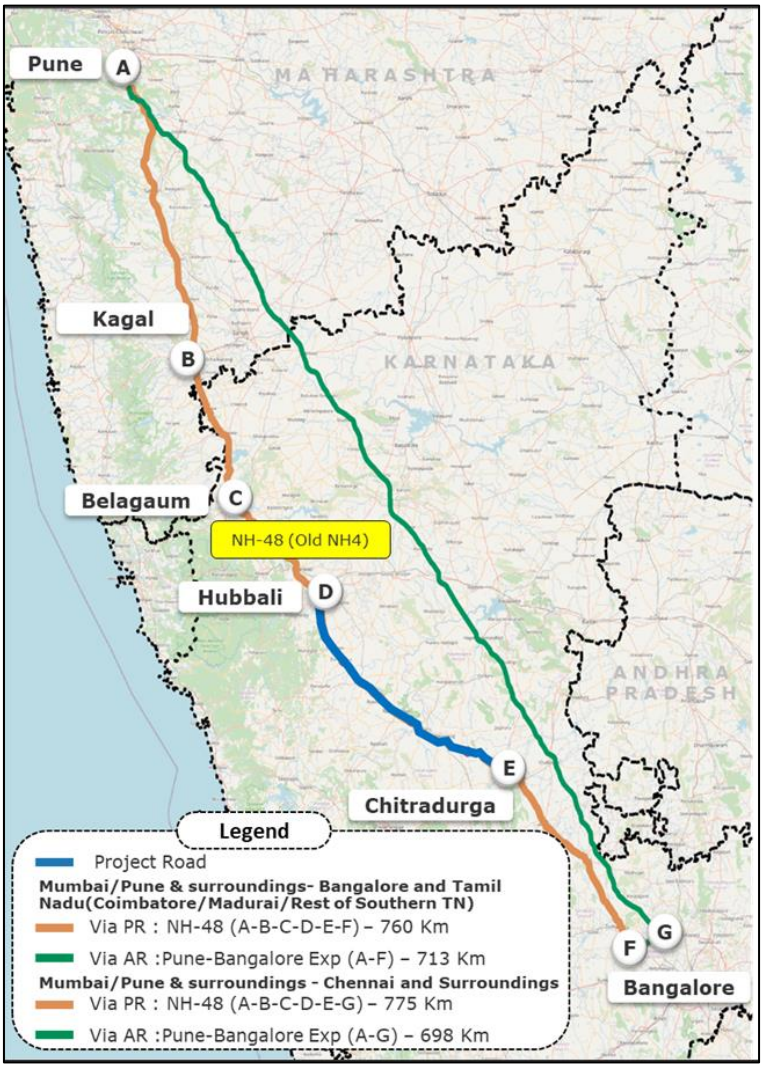


Figure 3-1: Project Road and Tentative Pune - Bangalore Alignment

The route via Pune-Bangalore Expressway is about 713 km as against route 760 km via the project road for the Bangalore bound traffic. Thus, the route via Expressway is about 47 km shorter than the route via PR.

The traffic destined towards Chennai will travel 698 km via expressway and the route via project road will have a total distance of 775 km. The expressway will be around 76 km shorter than the route via project road.

This expressway once completed may attract some of the freight vehicles which are currently using the project road.

The potential divertible traffic is the traffic plying between Mumbai/Pune/Nashik & surroundings to Bangalore/ Chennai and beyond which has been estimated from the OD survey conducted during the present study.

The results of diversion analysis for the traffic from/to Mumbai/Pune/Nashik & surroundings to/from Bangalore / Chennai along with the potential divertible traffic, diversion percentages and diverted traffic is presented in **Table 3-2**.

Modes	Car	2A	3A	MAV
A. Mumbai/Pune & surroundings - Bangalore and Tamil Nadu (Coimbatore/Madurai/Rest of Southern TN)				
Potential Traffic				
Bankapur (TP01)	186	393	269	495
Chalageri (TP02)	180	374	280	433
Hebbalu (TP03)	170	332	280	447
Average	179	366	276	458
Average Potential As % of AADT				
Bankapur (TP01)	2.4%	12.7%	28.6%	27.6%
Chalageri (TP02)	2.6%	13.4%	29.5%	27.8%
Hebbalu (TP03)	2.3%	13.9%	29.1%	28.0%
B. Mumbai/Pune & surroundings - Chennai and Surroundings				
Potential Traffic				
Bankapur (TP01)	19	148	140	206
Chalageri (TP02)	9	176	127	291
Hebbalu (TP03)	39	146	87	251
Average	22	156	118	250
Potential As % of AADT				
Bankapur (TP01)	0.3%	5.4%	12.2%	15.0%
Chalageri (TP02)	0.3%	5.7%	12.6%	15.1%
Hebbalu (TP03)	0.3%	5.9%	12.5%	15.2%
Diversion % based on Cost Ratio				
A: % diversion (AR Share)	51.0	67.6	71.3	66.0
B: % diversion (AR Share)	55.3	75.3	79.0	73.5
Diverted Traffic				
A. Mumbai/Pune & surroundings - Bangalore and Tamil Nadu (Coimbatore/Madurai/Rest of Southern TN)				
Bankapur (TP01)	1.2%	8.6%	20.4%	18.2%
Chalageri (TP02)	1.3%	9.1%	21.1%	18.3%
Hebbalu (TP03)	1.2%	9.4%	20.8%	18.5%
B. Mumbai/Pune & surroundings - Chennai and Surroundings				
Bankapur (TP01)	0.2%	4.1%	9.7%	11.0%
Chalageri (TP02)	0.2%	4.3%	10.0%	11.1%
Hebbalu (TP03)	0.2%	4.5%	9.8%	11.2%

Table 3-2: Potential Divertible Traffic to the Pune-Bangalore Expressway

The proposed expressway may take away around 8-20 percent of the freight traffic from all three toll plazas for the Bangalore bound traffic whereas, around 4-11 percent of freight traffic may divert towards Chennai and surroundings.

B. Route Choice between Hubbali/Belgaum/Kolhapur/Satara -Bangalore/Chennai and Beyond

In addition to the above traffic streams, the assessment for the route between Hubbali and Bangalore/Chennai has been done for the two traffic streams:

- Traffic plying between Hubbali and surroundings and Bangalore & beyond
- Traffic from/to Hubbali and surroundings to/from Chennai & beyond

The tentative alignment of the alternate route along with the route via Project Road is presented in **Figure 3-1**.

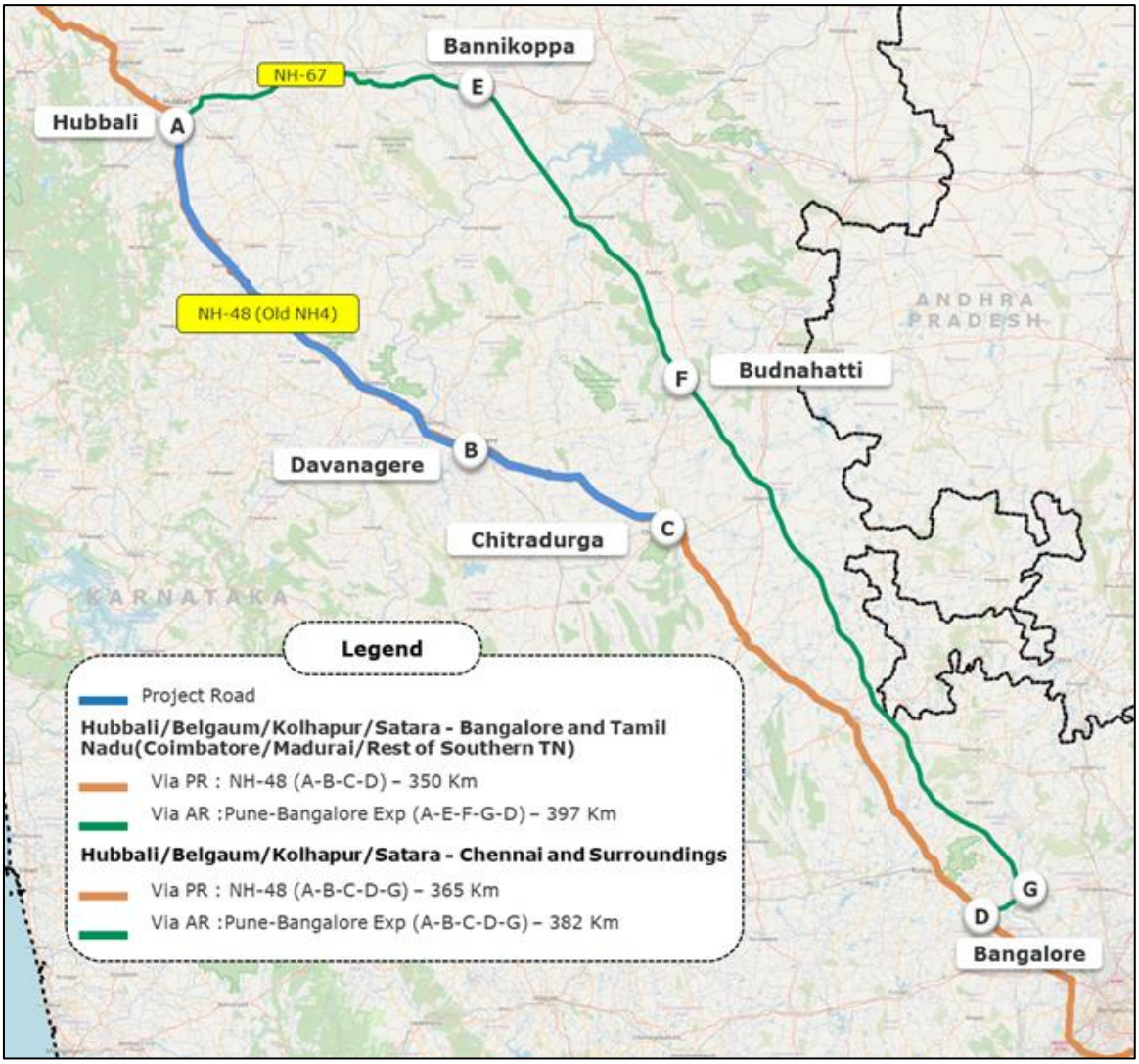


Figure 3-2: Project Road and Tentative Hubbali - Bangalore Alignment

The route via Expressway is about 47 km longer than the route via PR for the Bangalore bound traffic whereas it is only 17 km longer for the Chennai bound traffic.

The potential divertible traffic has been estimated from the OD survey conducted during the present study.

The results of diversion analysis along with the potential divertible traffic, diversion percentages and diverted traffic is presented in **Table 3-3**.

Modes	Car	2A	3A	MAV
A. Hubbali and surroundings - Bangalore and Tamil Nadu (Coimbatore/Madurai/Rest of Southern TN)				
Potential				
Bankapur (TP01)	1,025	215	113	173
Chalageri (TP02)	901	177	107	211
Hebbalu (TP03)	852	198	108	189
Average	926	197	109	191
Average Potential As % of AADT				
Bankapur (TP01)	12.7%	6.8%	11.3%	11.5%
Chalageri (TP02)	13.4%	7.2%	11.7%	11.6%
Hebbalu (TP03)	11.7%	7.5%	11.5%	11.7%
B. Hubbali and surroundings - Chennai and Surroundings				
Potential				
Bankapur (TP01)	53	38	22	48
Chalageri (TP02)	37	45	32	63
Hebbalu (TP03)	32	28	37	30
Average	41	37	30	47
Potential As % of AADT				
Bankapur (TP01)	0.6%	1.3%	3.1%	2.8%
Chalageri (TP02)	0.6%	1.4%	3.2%	2.8%
Hebbalu (TP03)	0.5%	1.4%	3.2%	2.9%
Diversion % based on Cost Ratio				
A: % diversion (AR Share)	29.7	25.8	25.9	25.1
B: % diversion (AR Share)	36.6	37.9	37.6	37.0
Diverted Traffic				
A. Hubbali and surroundings- Bangalore and Tamil Nadu (Coimbatore/Madurai/Rest of Southern TN)				
Bankapur (TP01)	3.8%	1.8%	2.9%	2.9%
Chalageri (TP02)	4.0%	1.9%	3.0%	2.9%
Hebbalu (TP03)	3.5%	1.9%	3.0%	2.9%
B. Hubbali and surroundings- Chennai and Surroundings				
Bankapur (TP01)	0.2%	0.5%	1.2%	1.0%
Chalageri (TP02)	0.2%	0.5%	1.2%	1.1%
Hebbalu (TP03)	0.2%	0.5%	1.2%	1.1%

Table 3-3: Potential Divertible traffic to the Pune-Bangalore Expressway via Hubbali

The proposed expressway may divert around 2-4 percent of traffic from all three toll plazas for Bangalore bound traffic whereas, around 1 percent of traffic may divert towards Chennai and surroundings.

C. Total Diverted Traffic to Pune Bangalore Expressway

The total diverted traffic after the operation of Pune Bangalore Expressway at the three toll plazas is presented in **Table 3-4**.

Modes	Car	2A	3A	MAV
TP01				
Bankapur (TP01)	5.4%	15.0%	34.2%	33.1%
Chalageri (TP02)	5.7%	15.7%	35.3%	33.4%
Hebbalu (TP03)	5.0%	16.3%	34.8%	33.6%

Table 3-4: Total Diverted Traffic to Pune Bangalore Expressway – FY24

The proposed expressway will be a greenfield alignment and considering the usual timelines for a long greenfield expressway project, the diversion impact is considered from FY31 onwards under Base Case. Owing to the gradual shift of traffic away from the project road, the traffic impacts have been assumed to take place in phases with about 50 percent in FY31, 75 percent in FY32 and 100 percent from FY33 onwards.

Impact of Completion of 6 laning construction activities on National Highway 48 (Old NH-4 – Route via PR)

The long-distance traffic stream commuting between Pune & beyond and Bengaluru & beyond has two routes to follow one via NH-48 (Project Road) and other one via NH-65/NH-52/NH-50. The alignment of NH-48 vs route via NH-65/NH-52/NH-50 is presented in **Figure 3-3**.

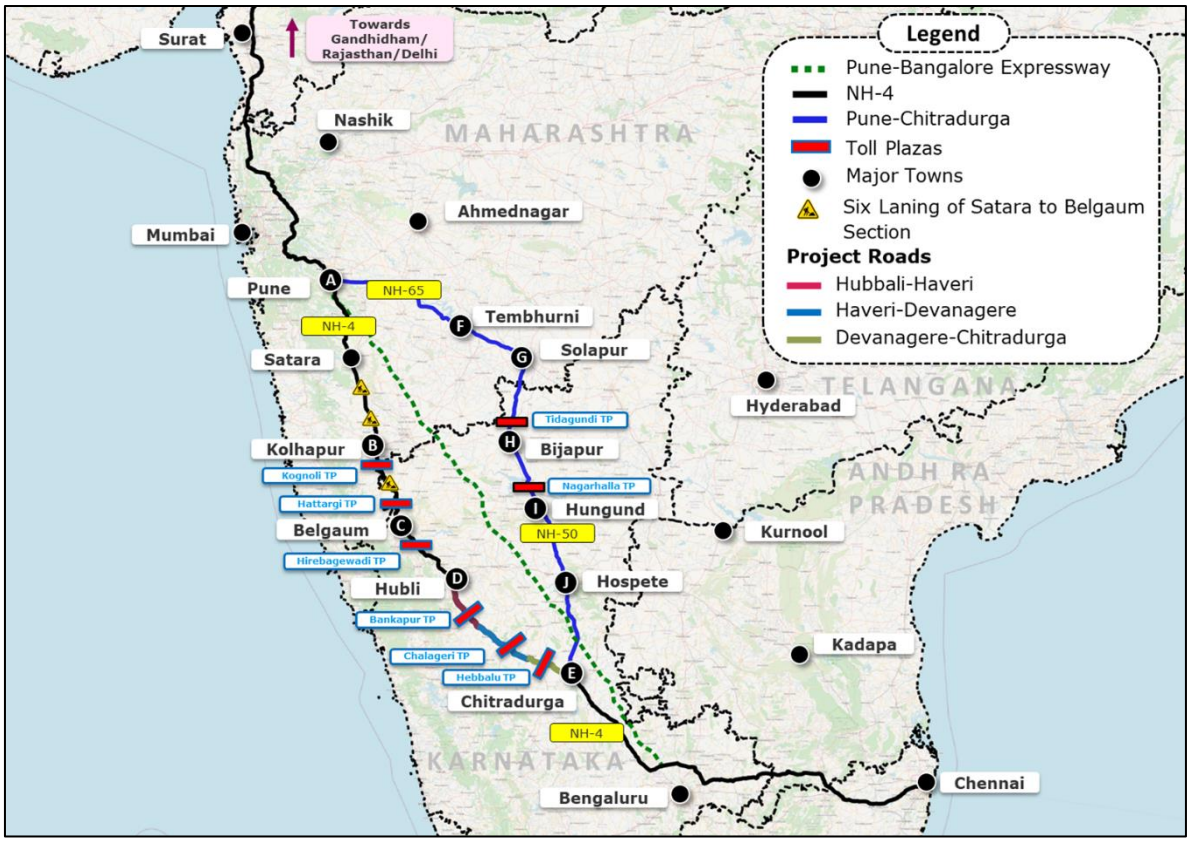


Figure 3-3: Route Alignment of NH-48 and route via Solapur-Bijapur-Hospete (NH65/NH52/NH50)

The route via project road i.e., NH-48 (A-B-C-D-E) starts from Pune passing through Belgaum, Dharwad, Hubli and ending at Chitradurga. This whole section of NH-4 is a part of Golden Quadrilateral (GQ) and announced for six-laning with higher level of service. The sections of this route between Satara to Belgaum have been tendered for six-laning and construction works of 6 laning of NH-48 are ongoing. Along with this, construction work for widening of two lane Hubli-Dharwad Bypass to six lane facility is already on. Thus, the traffic from/to Pune and beyond to/from Bangalore/Chitradurga and beyond might be using the alternate route via Solapur-Bijapur-Hungund-Hospete.

As against this, route via Solapur-Bijapur-Hungund-Hospete (A-F-G-H-I-J-E) is a combination of NH65/NH52/NH50 which starts from Pune and passes through Solapur, Bijapur, Hungund, Hospete and ends at Chitradurga. The sections of this route (NH65/NH52/NH50) are already of 4-lane configuration and tolled (Pune-Solapur, Solapur-Bijapur, Bijapur-Hungund, Hungund-Hospete and Hospete-Chitradurga).

Characteristics of Alternate Route via Solapur-Bijapur-Hungund-Hospete

The traffic travelling on NH-65 (Pune-Solapur section) is able to bypass the toll plazas between Tembhurni-Solapur-Bijapur if it travels via Tembhurni-Pandharpur-Mangalwedha-Umadi-Arakeri and meet directly at Bijapur. The route and its alignment compared to the route via Solapur is presented in **Figure 3-4.**

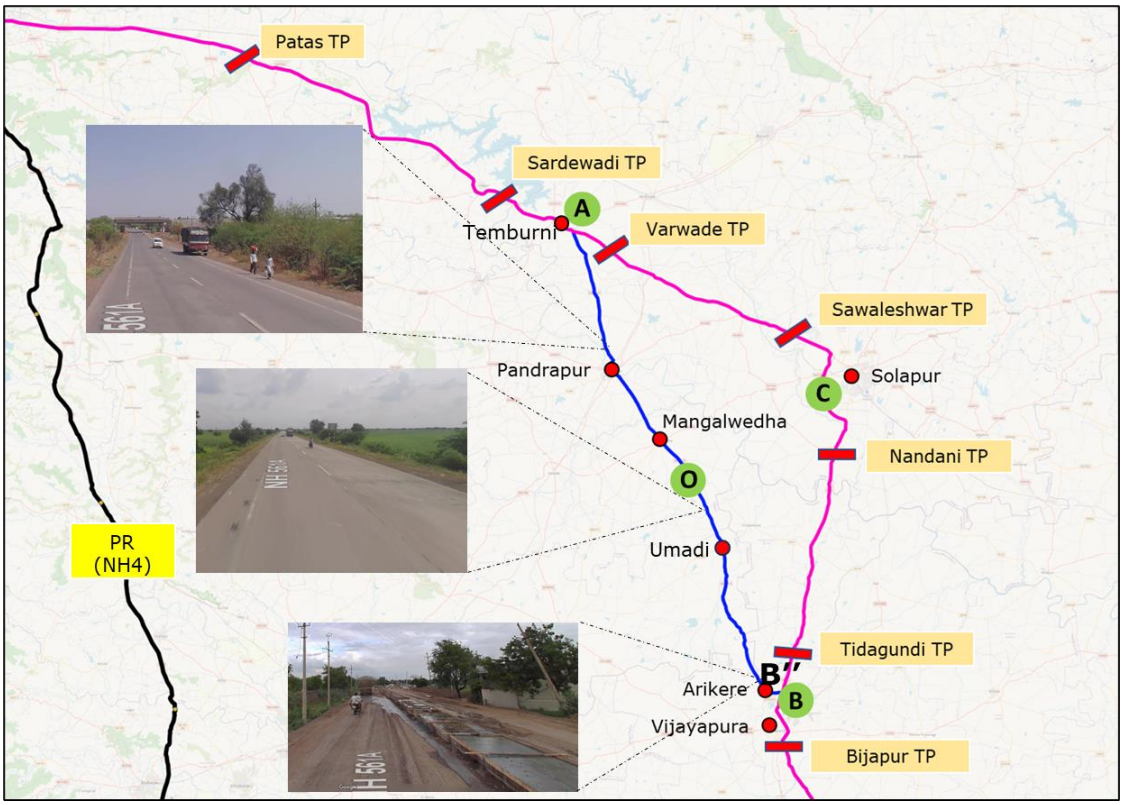


Figure 3-4: Characteristics of Alternate Route via Tembhurni-Solapur-Bijapur vs Tembhurni-Pandharpur-Mangalwedha-Umadi-Bijapur

The section from Tembhurni-Solapur-Bijapur (A-C-B) is a complete 4 lane section with a length of 172 km. As against this, the route between Tembhurni-Pandharpur-Mangalwedha-Umadi-Arikeri-Bijapur(A-O-B''-B) has a length of 146 km and has a 2 lane + PS configuration except for a very small section between 1 km north of Arikere (B'') to Bijapur (B) which are already under construction. Thus, this route via Pandharpur-Mangalwedha is around 26 km shorter and has no toll plazas which results in a saving of toll at 4 toll plazas of Varvade and Sawaleshwar TPs of Pune-Solapur Package II section and Nandani and Tidagundi TPs of Solapur-Bijapur section. Vehicular underpasses are present at both Tembhurni (A) and at Bijapur (B) providing a smooth flow of the traffic plying on this route.

To assess this loss of long-distance traffic, 24-hour Origin Destination surveys at Tidagundi TP of Solapur-Bijapur section and Nagarhalla TP of Bijapur-Hungund section were conducted on 12th January 2024. Along with this, interviews with truckers were conducted to assess their route choices post completion of six laning of NH-48.

The analysis of the travel pattern at both the toll plazas indicates that the traffic on Tidagundi TP does not capture the traffic which is bypassing Tembhurni-Solapur-Bijapur toll plazas and using the alternate road via Pandharpur. To get the total divertible traffic on this route the results from the OD conducted at Nagarhalla TP have been considered for further analysis.

The alternate route viz., NH65/NH52/NH50 has its own captive traffic movement between Gujarat/Rajasthan & surroundings and Chitradurga/ Bengaluru and beyond. With the upgradation of the remaining sections on NH-48, this stream of traffic between Gujarat/Rajasthan to Chitradurga/Bangalore and beyond is not likely to shift to NH-48 post completion of 6 laning.

However, the traffic from/to Pune/Nashik/Mumbai and surroundings to/from Bengaluru/Chitradurga and beyond is the potential traffic which is likely plying on this route via NH65/NH52/NH50 due to the 6 laning construction activities ongoing on NH-48. The potential traffic using the route via Solapur-Bijapur-Hungund-Hospete at Nagarhalla TP is presented in **Table 3-5**.

Sr. No.	Potential Traffic (Nagarhalla TP)	2A	3A	MAV	2A/3A/MAV
1	Pune & Surroundings-Bengaluru/Chitradurga & Beyond	171	69	291	531
2	Nashik & Surroundings-Bengaluru/Chitradurga & Beyond	16	14	54	84
3	Mumbai & Surroundings-Bengaluru/Chitradurga & Beyond	97	41	194	332
TOTAL		284	124	539	947

Table 3-5: Potential Traffic plying on the route at Nagarhalla TP

Once the 6 laning on NH-48 is complete, the traffic using this alternate route via Nagarhalla TP might shift back to NH-48 and thus result in a gain of traffic on PR. An assessment of this gain has been done considering the difference of potential traffic obtained from this current OD at Nagarhalla TP and an earlier study of Solapur Bijapur section viz., Tidagundi TP. The diversion percentages basis the cost ratio analysis have been applied on the balance traffic. The impact of the shift is presented in **Table 3-6**.

Potential Traffic (Nagarhalla TP)	2A	3A	MAV	2A/3A/MAV	PCU
A. Earlier study of Solapur-Bijapur (July-22) – FY23	156	80	197	434	1,598
B. Traffic on Solapur-Bijapur -FY24 (5% growth on earlier study) – A*(1+5%)	164	84	207	456	1,678
C. AR potential at Nagarhalla TP (FY24)	284	124	539	947	3,650
D. SCF Jan (basis FY23 Nagarhalla IHMCL traffic)	0.90	0.99	0.93	-	-
E. AADT (C*D)	257	123	504	883	3,406
F. Absolute Increase (E-B)	93	39	297	428	1,728
G. % Shift to PR	61.4%	61.9%	66.2%	-	-
H. Traffic Shift to PR (F*G)	57	24	196	277	1,126

Table 3-6: Divertible Traffic to Project Road

The cost-ratio based analysis indicates gain of 57 2A trucks, 24 3A trucks and 196 MAV trucks resulting in a total PCU gain of 1,126. As the 6 laning is expected to be completed by March 2025, the impact has been considered in phases with 50 percent in FY26 and 100 percent in FY27.

3.2.3 Induced/ Development Traffic

Developmental /new generated traffic is the one which would be generated, over and above normal growth, because of lowering of transport costs or new developments in the immediate influence area of the project road. In case of the project road, there is no development envisaged in the vicinity of the project road.

Bharatmala Pariyojana is the second largest highways construction project in the country since NHDP, under which almost 50,000 km or highway roads were targeted across the country. It will look to improve connectivity particularly on economic corridors, border areas and far-flung areas with an aim of quicker movement of cargo and boosting exports.

It will connect 550 district headquarters to minimum 4-lane highway by raising the number of corridors to 50 (from current 6) and move 80 percent freight traffic (currently 40 percent) to national highways by connecting 24 logistics parks and 7 north east multimodal waterway ports.

The Phase-I includes economic corridors of around 9,000 km; inter-corridor and feeder routes of around 6,000 km; 5,000 km roads under the National Corridors Efficiency Program, border and international connectivity roads of around 2,000 km; coastal and port connectivity roads of around 2,000 km; expressways of around 800 km and 10,000 km of NHDP roads. The total length in phase 1 comes to around 34,800 km.

In the context of the project influence area, there are a few economic corridors and inter corridors listed in the Maharashtra and Karnataka plan. The economic corridors are planned from Pune-Vijayawada, Mumbai-Kolkata and Solapur-Bellary-Gooty and are likely to improve connectivity with an aim to provide quicker movement of cargo.

The project road is a connecting link between large cities/ industrial hubs of Pune and Mumbai on the north and Bengaluru and Chennai on the south. As the project road is

part of the golden quadrilateral highway network and caters to the long-distance traffic movement, it is likely to remain an important highway for the north-south movement and may see sustained growth in the future.

3.2.4 Methodology for Traffic Growth Rate Estimation

Traffic growth for both passenger and freight vehicles has been estimated using the econometric approach as described in IRC-108, 2015. For freight traffic, due consideration has been given to the total tonnage transported and the shift in types of vehicles used for moving goods.

The econometric model applied, relates traffic growth to changes in state (or district) domestic product via an elasticity factor. According to IRC guidelines, elasticity based econometric model for highway projects should be derived in the following form:

$Log_e(P) = A0 + A1\ Log_e\ (EI)$, where:

P - Traffic Volume
EI - Economic Indicator
A0 - Regression Constant
A1 - Regression Co-efficient (Elasticity Index)

In order to estimate traffic on the project road, the methodology described below has been followed:

- Identify the influence area - From the analysis of OD survey data, the project influencing states and districts, which are likely to impact the traffic growth on the project road, were identified.
- Review Past traffic Data – Based on toll data available for the project, a review of past traffic and tonnage growth is carried out.
- Analysis of economic growth of the Project Influencing Area (PIA) - For each PIA state, an economic profile describing past performance and future outlook was prepared. This also considers India's past economic performance and its future outlook.
- Estimation of traffic elasticity to income – in order to translate economic growth into traffic growth, an elasticity factor was estimated.
- Derivation of traffic growth rates – On the basis of the weighted (based on OD shares) PIA outlook and related traffic elasticity, traffic growth rates were estimated.

The methodology thus adopted incorporates, as basic data inputs, the perspective growth envisaged in the influence area and the changes in transport demand elasticities over a period of time. The traffic growth rates by vehicle type for the project road have been determined till FY44.

3.3 Identification of PIA States

The regional distribution shows that Karnataka and Maharashtra are the main contributors of traffic on the project road in case of passenger vehicles. In case of freight traffic, states of Tamil Nadu and Gujarat also contribute to the project road traffic in addition to the states of Karnataka and Maharashtra.

The states of Karnataka and Maharashtra have been considered as PIA states for passenger vehicles and in addition to these two PIA states, Tamil Nadu and Gujarat have also been considered as the PIA states for freight traffic. The mode wise normalized regional distribution shares are presented in **Figure 3-5**.

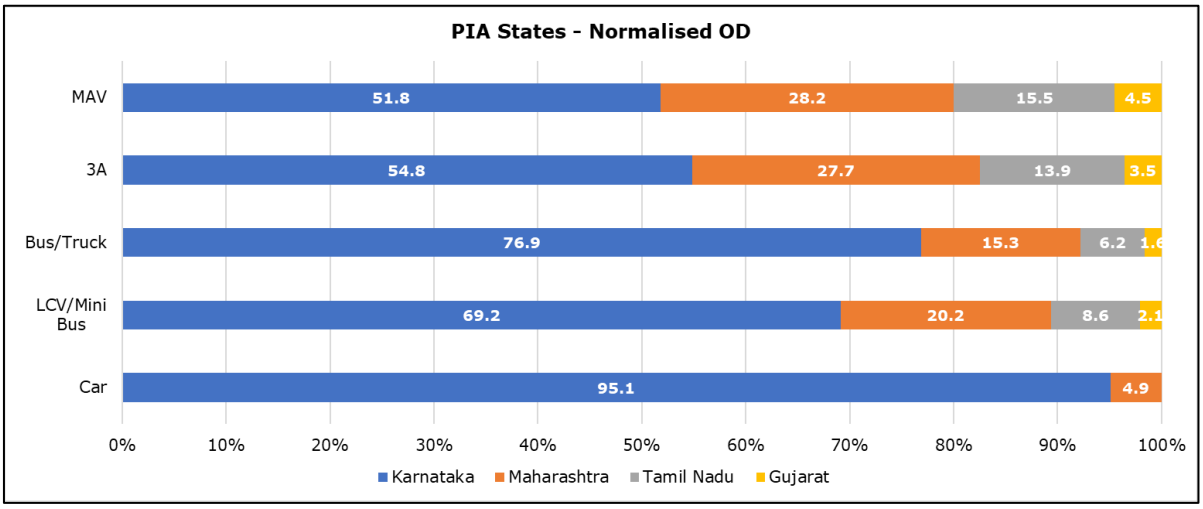


Figure 3-5: Normalised Regional Distribution (%) for the Project Road

In case of Cars, Karnataka accounts for the majority share of about 95.1 percent while, Maharashtra contributes around 4.9 percent.

In the LCV/Minibus category, Karnataka holds a substantial 69.2 percent share, followed by Maharashtra with a share of 20.2 percent, while Tamil Nadu shows an 8.6 percent share. Gujarat holds a smaller share of 2.1 percent in this category.

Karnataka and Maharashtra emerge as the primary contributors in the Bus/Truck category, with Karnataka having a share of 76.9 percent and Maharashtra having 15.3 percent share. Tamil Nadu and Gujarat exhibit a share of about 2-6 percent.

In case of large freight vehicles (3A/MAVs), Karnataka contributes the highest percentage, accounting for approximately 52-55 percent each on the project road, followed by Maharashtra with a share of around 28 percent in both 3A and MAV however, Gujarat and Tamil Nadu exhibit a share of 3-15 percent respectively.

3.4 Past Economic Growth of PIA

Growth of traffic on the project road depends on existing development and future growth prospects of the connecting regions. A number of economic indicators for the PIA states, as published by Central Statistical Organisation (2011/12 prices), have been studied to assess their past performance.

PIA State- Karnataka

Past economic performance of the state has been as follows:

- Karnataka's Gross State Domestic Product (GSDP) stood at Rs 13,263.2 billion in FY23 and has been growing at a compounded annual growth rate of 7.5 percent since FY12. The state has shown a growth of 11 percent in FY22 which could be due to the low base in FY21.
- The tertiary sector is the largest contributor to GSDP (63.9 percent), secondary sector at 23.5 percent and agriculture allied activities sector at 12.6 percent of the GSDP in FY23.

The change of sectoral composition of GSDP over the years is presented in **Figure 3-6**.

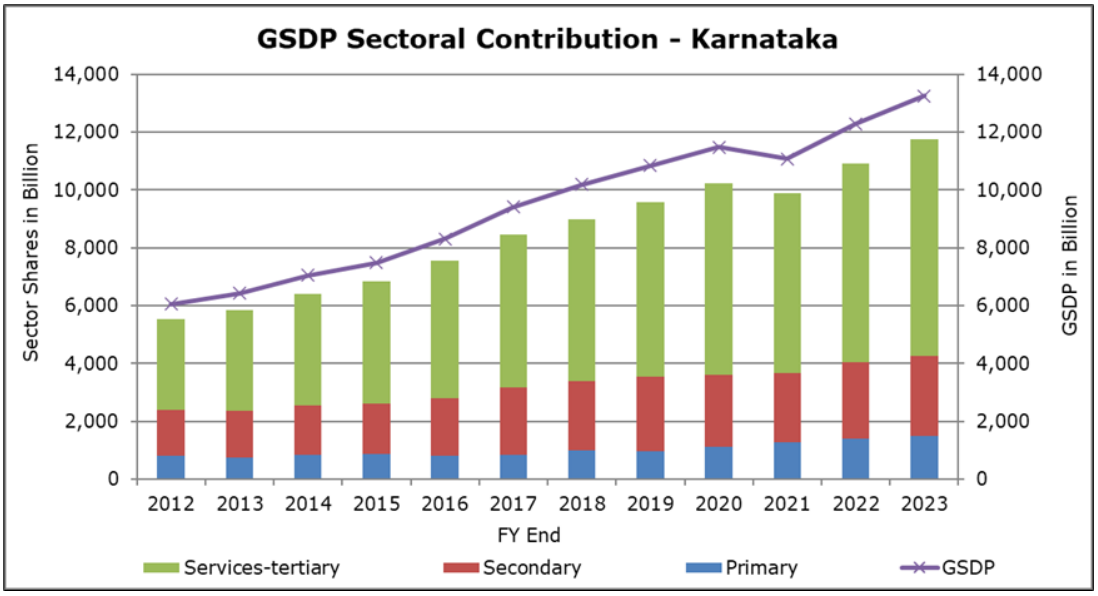


Figure 3-6: GSDP (in Rs billion) and its Sectoral Composition for Karnataka

The performance of the state economy and its different sectors has been studied using time trend analysis. The average annual growth rates as obtained using regression analysis are presented in **Table 3-7**.

Particulars	FY12 to FY23	FY15 to FY23
GSDP	7.5	6.7
Agriculture and Allied	6.2	8.2
Industry	5.5	4.7
Services	8.0	6.7
Construction	2.4	2.1
Per Capita Income	6.6	5.9

Table 3-7: Average Annual Growth Rates (%) of State Income for Karnataka

Karnataka is a predominant exporter of petroleum products, iron and steel and cotton accessories.

Currently, the state has 34 operational Special Economic Zones (SEZs). Moreover, 61 have been formally approved and 50 have been notified. These SEZs are dispersed over

a manifold range of sectors including textiles, biotechnology, aerospace industry, electronics hardware, multi-product, pharma, IT SEZs, etc.

According to Department for Promotion of Industry and Internal Trade (DPIIT), the state has enticed the Foreign Direct Investment (FDI) equity inflows worth US$ 44.46 billion between October 2019 to March 2023.

In order to attract high investments and catalyse growth, the state is highlighting the need to facilitate port logistics and road infrastructure development.

The development work of Pavinakurve and Karwar ports has also been initiated by the state. In September 2022, the New Coastal Zone Management Plan for Karnataka has been approved.

The state houses 47 IT related SEZs and has emerged as an IT hub with 5,500 IT companies in the state which provides employment to approximately 550,000 IT professionals. The state also houses engineering and aerospace industry units belonging to eminent global and national players like BEML (Bharat Earth Movers Limited), HMT (Hindustan Machine Tools Limited) and Saint-Gobain India, Volvo, Delphi, Boeing, Hindustan Aeronautics Limited (HAL), etc.

In July 2022, the Karnataka Industries Department approved 61 industrial projects worth Rs. 3,830 crore (US$ 4.66 billion), which are expected to generate over 19,500 jobs. In May 2022, the Karnataka government signed an MoU with Israel based ISMC Analog Fab Private Limited to set up a semiconductor fabrication plant in the state with an investment of Rs. 22,900 crore (US$ 2.95 billion).

The per capita income of Karnataka is Rs 1,96,448 in the year FY23. During FY12 to FY23, a growth of about 6.6 percent is seen in the state's per capita income. The growth in per capita income of Karnataka since FY12 is presented in **Figure 3-7**.

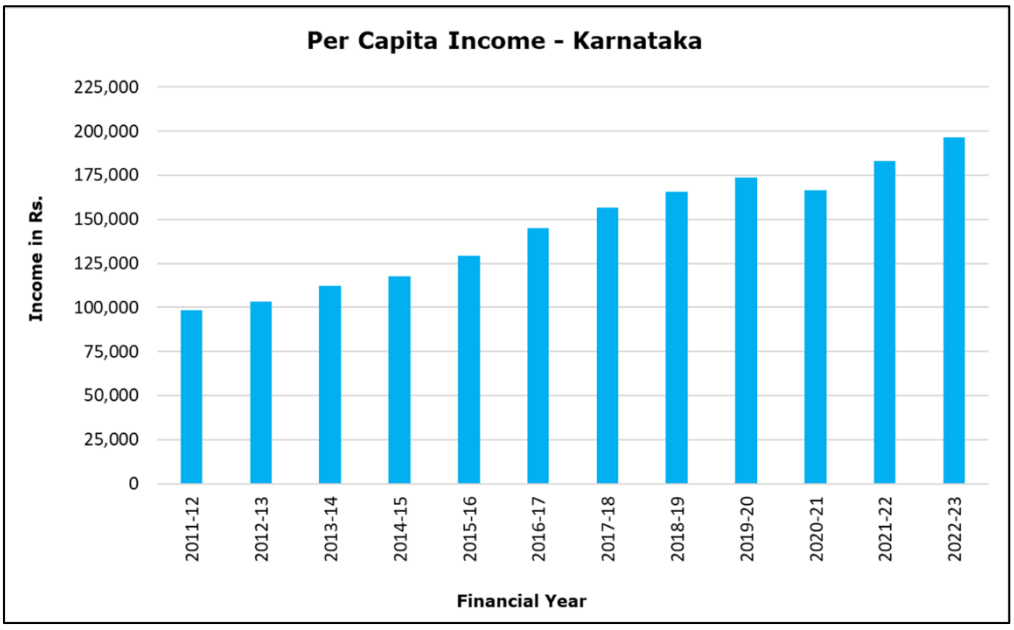


Figure 3-7: Per Capita Income of Karnataka FY12 to FY23

Other PIA States

The other PIA states contributing to the traffic on the project road are Maharashtra, Tamil Nadu, and Gujarat.

- Maharashtra's Gross State Domestic Product (GSDP) stood at Rs 20,279.7 billion in FY22 and has been growing at a compounded annual growth rate of 4.8 percent since FY12.
- Gross State Domestic Product (GSDP) of Tamil Nadu stood at Rs 14,533.2 billion in FY23 and has been growing at a compounded annual growth rate of 6.1 percent since FY12.
- Gujarat's Gross State Domestic Product (GSDP) stood at Rs 13,722.0 billion in FY22 and has been growing at a compounded annual growth rate of 8.5 percent since FY12.
- The secondary sector is the largest contributor to GSDP (48.5 percent) in the PIA state of Gujarat, whereas the services sector is the largest contributor to GSDP of in the remaining PIA states, 57.1 percent in Maharashtra and 50.9 percent in Tamil Nadu.

The average annual growth rates as obtained using regression analysis for the period FY12 to FY22/FY23 are presented in **Table 3-8**.

State/ Particulars	Maharashtra	Tamil Nadu	Gujarat
	FY12 to FY22	FY12 to FY23	FY12 to FY22
GSDP	4.8	6.1	8.5
Primary	3.6	5.5	5.2
Secondary	3.1	6.2	9.6
Tertiary	6.0	5.6	7.4
Construction	2.6	4.6	5.5
Per Capita Income	3.7	5.6	7.0

Table 3-8: Average Annual Growth Rates (%) of State Income for Other PIA States

The GSDP over the years for the PIA states of the project road are presented in **Figure 3-8**.

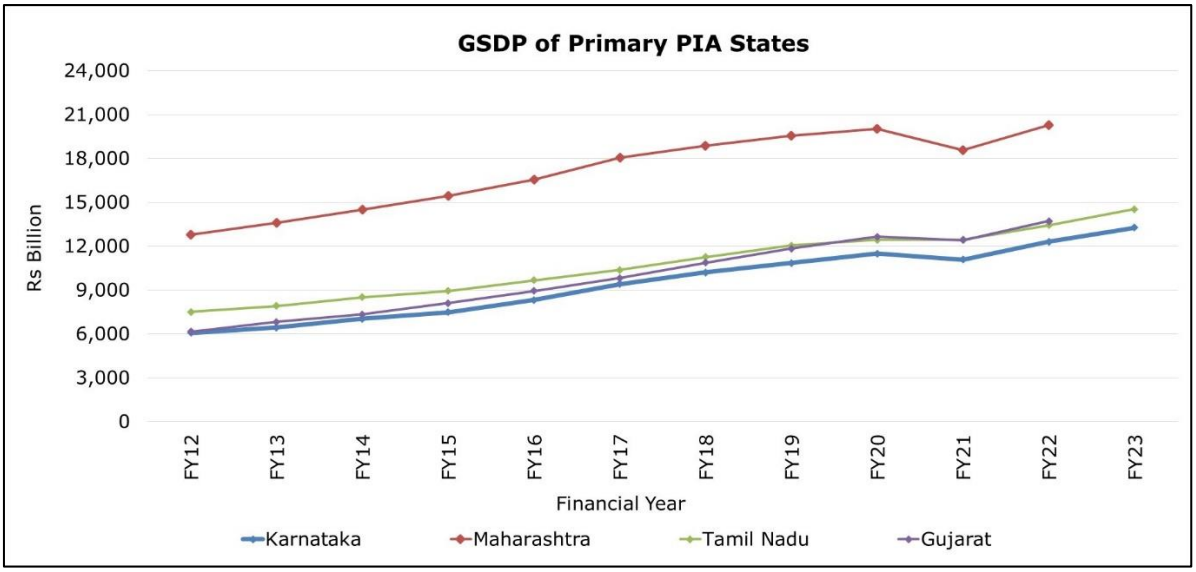
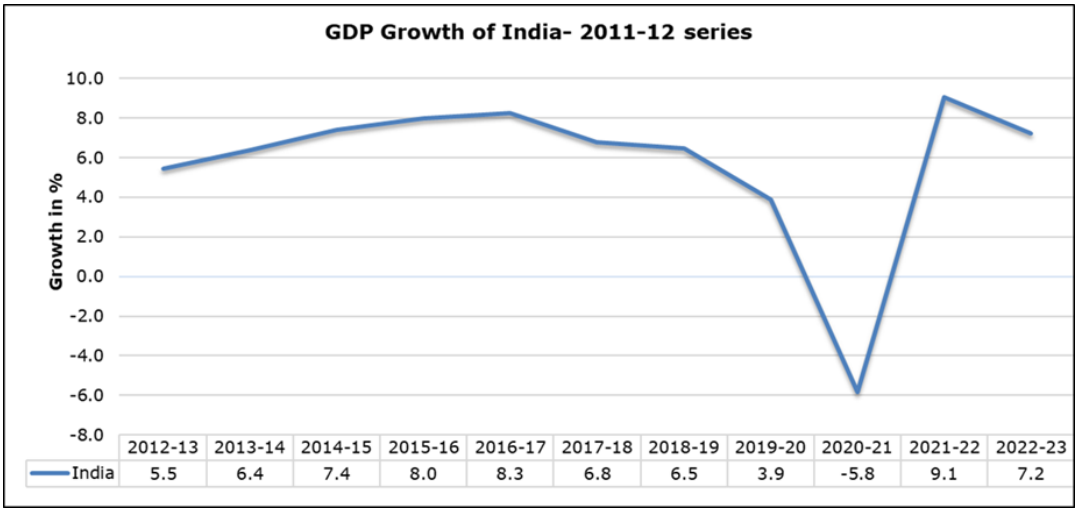


Figure 3-8: GSDP (in Rs billion) for PIA States

3.5 India and PIA Outlook

3.5.1 India's past performance and outlook for future

India's growth trend during the recent years has been presented in **Figure 3-9**.



	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
India	5.5	6.4	7.4	8.0	8.3	6.8	6.5	3.9	-5.8	9.1	7.2

Figure 3-9: GDP Growth in India

Economic growth in India has been broadly on an accelerating path till FY18. It is likely to be the fastest growing major economy in the world in the medium-term. The growth in real GDP was 8.3 percent for FY17 and 6.8 percent in FY18, while the growth in FY19 was slightly lower at 6.5 percent. The long-term trend line growth of 7.2 percent has been achieved between FY12 to FY19. During FY20, growth has slowed down due to some structural issues and global headwinds resulting in an average GDP growth rate of 3.7 percent.

With the outbreak of COVID-19, global recession was witnessed across all the economies. The lockdown period announced by Indian government had an adverse impact on the economy. The resultant contraction for FY21 has been 5.8 percent.

As per the latest update by Central Statistical Organisation (CSO), GDP in FY22 has grown by 9.1 percent. India has grown at 7.2 percent in FY23. As per the latest forecast of RBI, the economy is likely to grow at 7.0 percent in FY24.

The year-on-year growth for Indian economy as provided by the client based on the forecast by Consensus Economics from FY25 and beyond is presented in **Figure 3-10**.

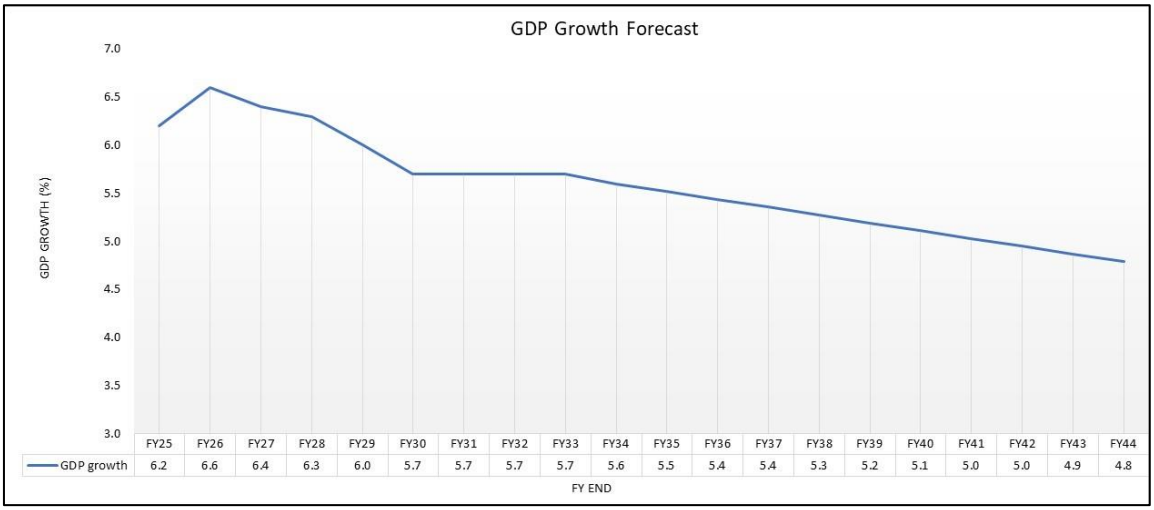


Figure 3-10: GDP Forecast of India

3.5.2 PIA States Outlook

A snapshot of the main economic indicators in the past and the growth adopted for future for the PIA states is presented in **Table 3-9**.

Indicators/ States	Karnataka (FY12 to FY23)	Maharashtra (FY12 to FY22)	Tamil Nadu (FY12 to FY23)	Gujarat (FY12 to FY22)
GSDP in Rs Billion (till latest available FY)	13,263.2	20,279.7	14,533.2	13,722.0
GSDP growth (FY12 to last available FY)	7.5%	4.8%	6.1%	8.5%
Per capita Income in Rs (till latest available FY)	196,448	162,231	189,321	195,223
Sector Share (%) in FY22/FY23				
Agriculture and allied	12.6	16.5	11.7	16.5
Industry	23.5	26.4	37.4	48.5
Services	63.9	57.1	50.9	35.1

Table 3-9: Main Economic Indicators of PIA States

In order to arrive at the forecast of the PIA states, past performance of the State GDPs vis-a-vis India GDP has been studied and the multipliers have been derived for both short term and long term. The past and adopted multipliers for PIA states to Indian economy are presented in **Table 3-10**.

Period	India	Karnataka	Maharashtra	Tamil Nadu	Gujarat
Past growth %					
FY12 to FY20	7.0	8.9	6.1	6.9	9.6
FY15 to FY20	6.8	9.0	5.4	7.1	9.5
FY12 to FY23	5.6	7.5	4.6	6.1	8.4
FY15 to FY23	4.8	6.7	3.5	5.8	7.6
Past Multipliers vis-a-vis India					
FY12 to FY20		1.3	0.9	1.0	1.4
FY15 to FY20		1.3	0.8	1.0	1.4
FY12 to FY23		1.3	0.8	1.1	1.5
FY15 to FY23		1.4	0.7	1.2	1.6
Multipliers adopted for future					
States w.r.t. India		1.2	0.9	1.0	1.3

Table 3-10: Past Multipliers and Future Outlook of PIA States

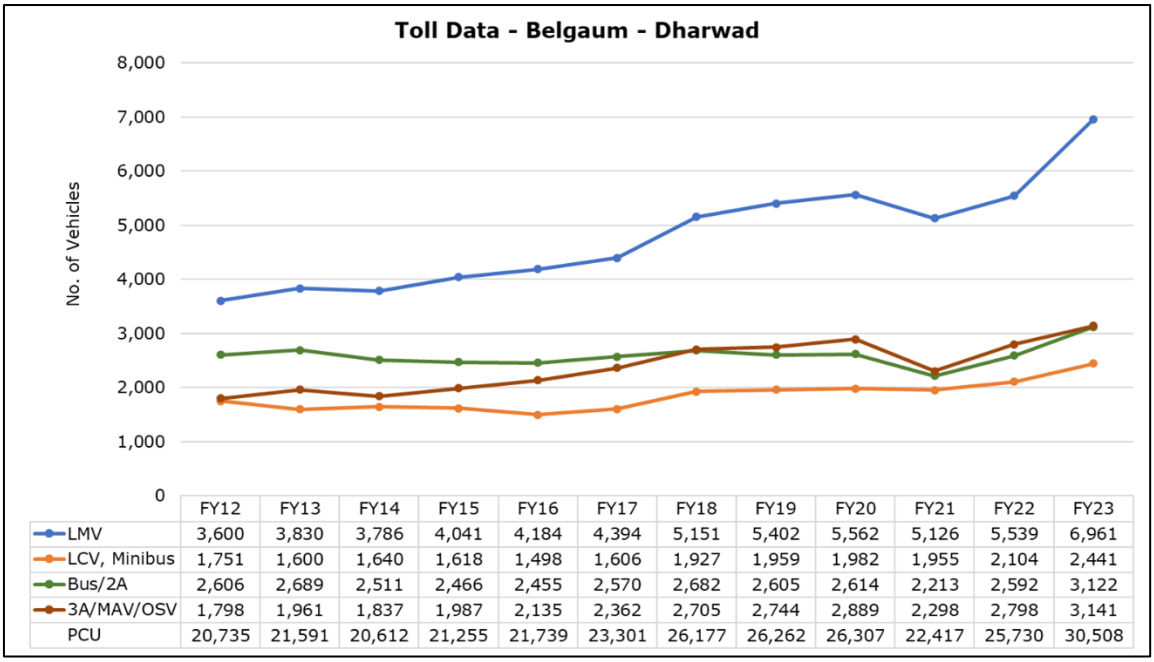
Based on the normalised OD shares of the toll plaza and the outlooks adopted for PIA states, the mode-wise future weighted income is presented in **Table 3-11**.

Period/Modes	Car/MLCV	LCV/M Bus	Bus/Truck	3A	MAV
2025	7.3	6.8	7.0	6.6	6.6
2026	7.8	7.2	7.4	7.0	7.0
2027	7.5	7.0	7.2	6.8	6.8
2028	7.4	6.9	7.1	6.7	6.7
2029	7.1	6.6	6.7	6.4	6.4
2030	6.7	6.3	6.4	6.1	6.0
2031	6.7	6.3	6.4	6.1	6.0
2032	6.7	6.3	6.4	6.1	6.0
2033	6.7	6.3	6.4	6.1	6.0
2034	6.6	6.1	6.3	6.0	5.9
2035	6.5	6.1	6.2	5.9	5.9
2036	6.4	6.0	6.1	5.8	5.8
2037	6.3	5.9	6.0	5.7	5.7
2038	6.2	5.8	5.9	5.6	5.6
2039	6.1	5.7	5.8	5.5	5.5
2040	6.0	5.6	5.7	5.4	5.4
2041	5.9	5.5	5.6	5.3	5.3
2042	5.8	5.4	5.5	5.3	5.2
2043	5.7	5.3	5.5	5.2	5.2
2044	5.6	5.3	5.4	5.1	5.1

Table 3-11: Future Mode-wise Weighted Income of PIA States

3.6 Review of Past Traffic Data at Adjacent Section of Belgaum-Dharwad (BD)

The toll traffic data for the adjacent section of Belgaum-Dharwad is available with the consultants from the date of operation till FY23 from a past study. The past traffic trend derived from the toll data is presented in **Figure 3-11**.



	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23
LMV	3,600	3,830	3,786	4,041	4,184	4,394	5,151	5,402	5,562	5,126	5,539	6,961
LCV, Minibus	1,751	1,600	1,640	1,618	1,498	1,606	1,927	1,959	1,982	1,955	2,104	2,441
Bus/2A	2,606	2,689	2,511	2,466	2,455	2,570	2,682	2,605	2,614	2,213	2,592	3,122
3A/MAV/OSV	1,798	1,961	1,837	1,987	2,135	2,362	2,705	2,744	2,889	2,298	2,798	3,141
PCU	20,735	21,591	20,612	21,255	21,739	23,301	26,177	26,262	26,307	22,417	25,730	30,508

Figure 3-11: Past Traffic Data of Belgaum-Dharwad (BD)

A time series analysis of the past traffic data of Belgaum Dharwad Toll Plaza is presented in **Table 3-12**.

FY/Mode	LMV	LCV/M Bus	Bus/Truck	3A/MAV/OSV	PCU
Trendline Growth in %					
FY12 vs FY23	5.5	3.3	0.5	4.9	2.9
FY15 vs FY20	7.5	5.9	1.5	8.2	5.1
FY20 vs FY23	7.8	7.2	7.2	4.6	6.0
FY16 vs FY19	9.7	10.4	2.2	9.3	7.1
FY17 vs FY20	7.8	6.7	0.2	6.4	3.7

Table 3-12: Past Toll Data Traffic Comparison

The comparison of past toll data from the toll plaza for car traffic shows a trend line growth of 5.5 percent for the period FY12 to FY23 and the recent years of FY20 to FY23 show a growth of 7.8 percent. LCV/M Bus category has shown a trend line growth of 5.9 percent during FY15 to FY20, however in recent years 7.2 percent growth is observed between FY20 to FY23.

Bus/Truck category has shown minimal growth in most of the comparison years. The trendline analysis between FY20 and FY23 has been around 7.2 percent in Bus/2A trucks category.

3A/MAV/OSVs have shown a long-term decadal growth of about 4.9 percent between FY12 and FY23 whereas the pre-COVID years of FY15 to FY20 show a growth of around 8.2 percent.

Also, an overall growth of about 5.1 percent PCUs have been observed in FY15 to FY20 whereas, about 6.0 percent growth is observed during FY20 to FY23 comparison.

3.7 Past and Future Transport Demand Elasticity

The econometric model applied for the project, relates traffic growth to changes in state domestic product via an elasticity factor according to IRC guidelines.

The best measure of deriving traffic elasticity to income is time series data of traffic on the road. The past traffic data for the adjacent section of Belgaum-Dharwad section is available since the year of operation of the toll plaza. The YOY mode wise traffic elasticity has been derived using rate of growth in the traffic vis a vis the rate of growth in income. The elasticity estimates for different time periods have been done using regression analysis with mode wise traffic as dependent variable and weighted income as independent variable. The point to point and trend line actual elasticity between weighted income (GSDP) and traffic is presented in **Table 3-13**.

FY/Mode	LMV	LCV/M Bus	Bus/Truck	3A/MAV/OSV
Trend Line Elasticity				
FY12 vs FY23	0.8	0.5	0.1	0.8
FY15 vs FY20	0.9	0.7	0.2	1.1
FY20 vs FY23	1.6	1.3	1.8	1.7
FY16 vs FY19	1.1	1.3	0.3	1.3
FY17 vs FY20	1.3	1.2	0.1	1.2

Table 3-13: Actual Past Traffic Elasticity at Adjacent Section of Belgaum-Dharwad

CJV

- The motorization rate for cars (per 1000 population) in India has gone up from 6.6 in 2001 to 25 in 2019. Although India's car fleet has been growing at 10 percent for nearly 25 years, its motorization rate is low compared to other countries of similar wealth and much lower than developed countries with motorization rate of around 450. The low motorization rate suggests that there is room for continued growth for many years to come. With the continual increase in motorization rate and improved road network usage of cars for inter-urban travel is showing a growing trend.
- A regression between GSDP (as independent variable) and registered vehicles (as dependent variable) of PIA state was carried out for the state of Karnataka which showed an elasticity of 1.1 during the period between FY13 and FY19.
- The past elasticity of 1.3-1.6 is observed for the period FY17 to FY20 and between FY20 and FY23 at the adjacent section of Belgaum-Dharwad.
- It is likely that this growth would slow down over time as the market becomes more mature and saturated, therefore elasticity to GSDP can be expected to decline over time. With the anticipated growth momentum in the coming years, for the project road an elasticity value of 1.0 have been considered for the slab up to FY35 and further tapering to 0.9 has been done over different slabs in the remaining concession period.

LCV/Minibus

- Predominance of Mini LCV in the LCV category for short haul traffic is being witnessed across many national highways. The LCV segments are also witnessing a smart uptick in demand in the goods carrier segment, where the 2T mini-truck and 2-3.5T pickups dominate with 90 percent share of the total LCV goods segment.
- For project road, an elasticity of 0.4 has been adopted till the end of concession.

Bus/Truck

- Over the years in India there has been a change in passenger's travel mode preferences with increasingly more people shifting from public transport systems towards personalised modes. This has resulted, in general, in elasticity of bus traffic/demand to GSDP lower than unity.
- Past trend line elasticity in Bus/Truck category has been around 0.1 between FY12 and FY23 and 0.3 between FY16 and FY19, whereas the recent years show a higher elasticity at the adjacent section. For the project road, an elasticity of Bus/Truck traffic to GSDP of 0.5 has been adopted throughout the concession period.

Trucks

- In India as a whole, the freight vehicle mix has been changing in the last decade favouring MAV to 2A/3A vehicles for long-distance traffic, given the operational efficiencies achievable with larger vehicles. Considering the ongoing technical advancements in automobile industry, some of the standard 2A/3A trucks would gradually be replaced by MAVs. Mature National Highways with tolling in operation for few years, have already witnessed the shift in 2A/3A trucks to MAV for long distance movement and the limited number of 2A trucks are being used for local movements.
- In case of adjacent section, 3A/MAV category has shown an elasticity varying between 0.8 to 1.7 across various years. The trend line elasticity of 1.2 is observed in FY17 to FY20 comparison. During the period between FY12 and FY23, an elasticity of 0.8 has been observed on the Belgaum-Dharwad section.
- For the project road, 0.3 has been considered for 3A trucks till the end of concession period and an elasticity of 1.0 has been considered for MAVs till FY30 resulting in a combined elasticity of 0.7 for 3A/MAV till FY30.
- It has been assumed that transport demand elasticity, for both freight and passenger traffic, would gradually decline over time, despite growth in per capita income, as regions becomes more mature, self-sufficient and with alternative mode of transport available to users. Due consideration has been given to the tonnage shifts happening in the market with Mini LCV gaining importance for short distance movements over

LCVs and MAVs being preferred over 2A/3A for long distance movements due to better operational efficiencies.

While assigning elasticities to different modes, freight travel pattern and over all elasticity of cargo tonnage with respect to weighted GSDP has been an important consideration. The recommended elasticity values adopted for all vehicle types in line with the traffic growth being observed on other national highways and changes in freight traffic pattern observed on the project road are presented in **Table 3-14**.

Period/ Modes	Car	LCV/M Bus	Bus/Truck	3A	MAV
Up to 2030	1.0	0.4	0.5	0.3	1.0
2031-2035	1.0	0.4	0.5	0.3	0.9
Beyond 2035	0.9	0.4	0.5	0.3	0.8

Table 3-14: Recommended Elasticity for Project Road

3.8 Projected Traffic Growth Rates

The estimated traffic growth rates for the project road, based on the perspective elasticity values and the projected growth rates of the income for PIA states, the future average annual compound traffic growth rates by vehicle type have been estimated for the project road by using the following relationship:

Tgr = (GSDPgr) x E; where,

Tgr – Traffic growth rate for mode

GSDPgr – Growth rate of GSDP

E – Elasticity value for mode

Using the year-on-year mode wise weighted income for PIA and elasticity for different time periods, traffic growth rates have been estimated for each year till FY44. The estimated traffic growth rates for the project road have been presented in **Table 3-15**.

FY/Modes	Car	LCV	Bus/2A	3A	MAV/OSV
TP01, TP02 & TP03					
2025	7.3	2.7	3.5	2.0	6.6
2026	7.8	2.9	3.7	2.1	7.0
2027	7.5	2.8	3.6	2.0	6.8
2028	7.4	2.8	3.5	2.0	6.7
2029	7.1	2.6	3.4	1.9	6.4
2030	6.7	2.5	3.2	1.8	6.0
2031	6.7	2.5	3.2	1.8	5.4
2032	6.7	2.5	3.2	1.8	5.4
2033	6.7	2.5	3.2	1.8	5.4
2034	6.6	2.5	3.1	1.8	5.3
2035	6.5	2.4	3.1	1.8	5.3
2036	5.8	2.4	3.0	1.7	4.6
2037	5.7	2.4	3.0	1.7	4.5
2038	5.6	2.3	3.0	1.7	4.5
2039	5.5	2.3	2.9	1.7	4.4
2040	5.4	2.2	2.9	1.6	4.3
2041	5.3	2.2	2.8	1.6	4.3
2042	5.2	2.2	2.8	1.6	4.2
2043	5.2	2.1	2.7	1.6	4.1
2044	5.1	2.1	2.7	1.5	4.1

Table 3-15: Projected Traffic Growth Rates for Project Road (%)

In derivation of above growth rates, the likely shift of buses to cars in case of passenger vehicles and the replacement/tonnage shift of 2A/3A trucks to MAV for long distance in case of freight vehicles has been duly considered.

The above growth rates relate to the most likely Base Case. In addition, two sets of traffic growth rates under low and high cases have also been considered and impact on toll revenue evaluated for both these cases. Based on the risk analysis of key parameters like economic growth and elasticity of travel demand impacting traffic growth, two additional growth scenarios have been presented. Low growth scenario considers a 20 percent reduction in growth rates relating to about 10 percent decline each in elasticity and economic growth. The High growth scenario considers a 20 percent increase in growth rates signifying about 10 percent increase each in elasticity and economic parameters.

The implied traffic growth rates under the base case after considering the impact of completion of 6 laning of NH-48 and diversion to Pune-Bangalore Expressway under the base case have been presented in **Table 3-16**.

Implied Traffic Growth Rates															
FY/ Mode	TP01-Bankapur					TP02-Chalageri					TP03-Hebbalu				
	Car	LCV	Bus/ 2A	3A	MAV /OSV	Car	LCV	Bus/ 2A	3A	MAV/ OSV	Car	LCV	Bus/ 2A	3A	MAV/ OSV
2025	7.3	2.7	3.5	2.0	6.6	7.3	2.7	3.5	2.0	6.6	7.3	2.7	3.5	2.0	6.6
2026	7.8	2.9	4.7	3.4	13.3	7.8	2.9	4.8	3.4	13.4	7.8	2.9	4.8	3.4	13.4
2027	7.5	2.8	4.6	3.3	12.7	7.5	2.8	4.7	3.3	12.8	7.5	2.8	4.7	3.3	12.8
2028	7.4	2.8	3.5	2.0	6.7	7.4	2.8	3.5	2.0	6.7	7.4	2.8	3.5	2.0	6.7
2029	7.1	2.6	3.4	1.9	6.4	7.1	2.6	3.4	1.9	6.4	7.1	2.6	3.4	1.9	6.4
2030	6.7	2.5	3.2	1.8	6.0	6.7	2.5	3.2	1.8	6.0	6.7	2.5	3.2	1.8	6.0
2031	3.8	2.5	-4.5	-15.6	-12.0	3.7	2.5	-4.9	-16.1	-12.2	4.0	2.5	-5.2	-15.9	-12.3
2032	5.2	2.5	-1.0	-8.7	-5.0	5.1	2.5	-1.2	-9.1	-5.1	5.3	2.5	-1.4	-8.9	-5.2
2033	5.2	2.5	-1.2	-9.9	-6.2	5.1	2.5	-1.4	-10.4	-6.3	5.3	2.5	-1.6	-10.2	-6.4
2034	6.6	2.5	3.1	1.8	5.3	6.6	2.5	3.1	1.8	5.3	6.6	2.5	3.1	1.8	5.3
2035	6.5	2.4	3.1	1.8	5.3	6.5	2.4	3.1	1.8	5.3	6.5	2.4	3.1	1.8	5.3
2036	5.8	2.4	3.0	1.7	4.6	5.8	2.4	3.0	1.7	4.6	5.8	2.4	3.0	1.7	4.6
2037	5.7	2.4	3.0	1.7	4.5	5.7	2.4	3.0	1.7	4.5	5.7	2.4	3.0	1.7	4.5
2038	5.6	2.3	3.0	1.7	4.5	5.6	2.3	3.0	1.7	4.5	5.6	2.3	3.0	1.7	4.5
2039	5.5	2.3	2.9	1.7	4.4	5.5	2.3	2.9	1.7	4.4	5.5	2.3	2.9	1.7	4.4
2040	5.4	2.2	2.9	1.6	4.3	5.4	2.2	2.9	1.6	4.3	5.4	2.2	2.9	1.6	4.3
2041	5.3	2.2	2.8	1.6	4.3	5.3	2.2	2.8	1.6	4.3	5.3	2.2	2.8	1.6	4.3
2042	5.2	2.2	2.8	1.6	4.2	5.2	2.2	2.8	1.6	4.2	5.2	2.2	2.8	1.6	4.2
2043	5.2	2.1	2.7	1.6	4.1	5.2	2.1	2.7	1.6	4.1	5.2	2.1	2.7	1.6	4.1
2044	5.1	2.1	2.7	1.5	4.1	5.1	2.1	2.7	1.5	4.1	5.1	2.1	2.7	1.5	4.1

Table 3-16: Implied Traffic Growth Rates for Project Road After Diversion (%)

3.9 Projections Mode-wise Traffic

Mode-wise projected traffic for the three toll plazas of the project road under the base case after considering diversion impacts till FY44 is presented in **Table 3-17**, **Table 3-18** and **Table 3-19**.

FY/Modes	Car	LCV	Bus/2A	3A	MAV	OSV	PCU
2024	7,304	1,509	2,873	966	1,663	6	28,595
2025	7,837	1,550	2,973	985	1,772	6	30,040
2026	8,445	1,595	3,113	1,018	2,008	7	32,300
2027	9,081	1,640	3,257	1,052	2,264	7	34,686
2028	9,754	1,685	3,372	1,073	2,415	8	36,517
2029	10,442	1,730	3,485	1,094	2,568	8	38,368
2030	11,143	1,773	3,597	1,113	2,723	9	40,227
2031	11,569	1,817	3,434	940	2,396	9	38,239
2032	12,174	1,863	3,400	858	2,275	10	38,027
2033	12,808	1,909	3,361	774	2,135	10	37,728
2034	13,652	1,956	3,466	787	2,249	11	39,515
2035	14,539	2,004	3,573	801	2,367	11	41,372
2036	15,376	2,052	3,682	815	2,476	12	43,143
2037	16,248	2,100	3,793	829	2,589	12	44,971
2038	17,157	2,149	3,905	843	2,705	13	46,855
2039	18,100	2,198	4,019	857	2,824	14	48,792
2040	19,079	2,247	4,134	871	2,946	14	50,786
2041	20,095	2,297	4,250	885	3,072	15	52,836
2042	21,148	2,347	4,368	899	3,201	15	54,943
2043	22,238	2,397	4,488	913	3,333	16	57,106
2044	23,366	2,447	4,608	927	3,468	17	59,324

Table 3-17: Projected Mode-wise Traffic at TP01

FY/Modes	Car	LCV	Bus/2A	3A	MAV	OSV	PCU
2024	6,898	1,447	2,735	935	1,649	5	27,522
2025	7,401	1,486	2,830	953	1,757	5	28,913
2026	7,976	1,529	2,965	986	1,992	6	31,114
2027	8,576	1,572	3,103	1,019	2,246	6	33,439
2028	9,212	1,616	3,213	1,039	2,396	6	35,206
2029	9,862	1,659	3,321	1,059	2,549	7	36,992
2030	10,523	1,700	3,427	1,079	2,703	7	38,787
2031	10,909	1,743	3,258	904	2,374	8	36,727
2032	11,469	1,786	3,219	822	2,252	8	36,442
2033	12,056	1,831	3,174	737	2,109	9	36,065
2034	12,850	1,876	3,273	750	2,222	9	37,774
2035	13,684	1,922	3,375	763	2,339	10	39,549
2036	14,472	1,967	3,478	777	2,447	10	41,242
2037	15,294	2,014	3,582	790	2,558	10	42,988
2038	16,149	2,060	3,688	803	2,673	11	44,789
2039	17,036	2,107	3,795	816	2,790	11	46,640
2040	17,958	2,155	3,904	830	2,911	12	48,545
2041	18,914	2,202	4,014	843	3,035	12	50,503
2042	19,905	2,250	4,126	856	3,163	13	52,516
2043	20,932	2,298	4,238	870	3,293	13	54,583
2044	21,993	2,347	4,352	883	3,427	14	56,702

Table 3-18: Projected Mode-wise Traffic at TP02

FY/Modes	Car	LCV	Bus/2A	3A	MAV	OSV	PCU
2024	7,900	1,512	2,634	948	1,638	6	28,312
2025	8,476	1,553	2,726	967	1,746	6	29,767
2026	9,134	1,598	2,857	1,000	1,979	7	32,040
2027	9,822	1,643	2,991	1,033	2,233	7	34,440
2028	10,550	1,689	3,097	1,054	2,382	8	36,289
2029	11,295	1,733	3,201	1,074	2,534	8	38,157
2030	12,052	1,776	3,303	1,093	2,687	9	40,036
2031	12,540	1,821	3,130	919	2,356	9	38,065
2032	13,210	1,867	3,087	838	2,233	10	37,876
2033	13,913	1,913	3,037	753	2,090	10	37,602
2034	14,830	1,960	3,132	766	2,201	11	39,420
2035	15,792	2,008	3,229	779	2,317	11	41,310
2036	16,702	2,056	3,328	793	2,424	12	43,110
2037	17,650	2,104	3,428	807	2,534	12	44,970
2038	18,637	2,153	3,529	820	2,648	13	46,888
2039	19,661	2,202	3,632	834	2,764	14	48,861
2040	20,724	2,251	3,736	847	2,884	14	50,893
2041	21,828	2,301	3,841	861	3,007	15	52,985
2042	22,972	2,351	3,948	874	3,133	15	55,135
2043	24,156	2,402	4,056	888	3,263	16	57,344
2044	25,381	2,452	4,165	902	3,395	17	59,611

Table 3-19: Projected Mode-wise Traffic at TP03

3.10 Traffic Projections and Capacity Analysis

Table 3-20 presents the projections of the total vehicles based on the most likely growth rates till FY44 as assessed in this study.

FY	Total Traffic After Diversion			Total Traffic Before Diversion		
	TP01	TP02	TP03	TP01	TP02	TP03
2024	28,595	27,522	28,312	28,595	27,522	28,312
2025	30,040	28,913	29,767	30,040	28,913	29,767
2026	32,300	31,114	32,040	32,300	31,114	32,040
2027	34,686	33,439	34,440	34,686	33,439	34,440
2028	36,517	35,206	36,289	36,517	35,206	36,289
2029	38,368	36,992	38,157	38,368	36,992	38,157
2030	40,227	38,787	40,036	40,227	38,787	40,036
2031	38,239	36,727	38,065	42,115	40,606	41,946
2032	38,027	36,442	37,876	44,102	42,523	43,960
2033	37,728	36,065	37,602	46,196	44,541	46,082
2034	39,515	37,774	39,420	48,364	46,630	48,281
2035	41,372	39,549	41,310	50,613	48,798	50,564
2036	43,143	41,242	43,110	52,755	50,862	52,735
2037	44,971	42,988	44,970	54,963	52,990	54,976
2038	46,855	44,789	46,888	57,238	55,182	57,286
2039	48,792	46,640	48,861	59,576	57,434	59,660
2040	50,786	48,545	50,893	61,981	59,750	62,104
2041	52,836	50,503	52,985	64,452	62,131	64,618
2042	54,943	52,516	55,135	66,991	64,575	67,200
2043	57,106	54,583	57,344	69,595	67,084	69,851
2044	59,324	56,702	59,611	72,265	69,655	72,571
CAGR (FY24 to FY44)	3.7%	3.7%	3.8%	4.7%	4.8%	4.8%

Table 3-20: Projected Traffic on the Project Road

The projected traffic for the project road is not reaching the designed capacity of 1,20,000 PCUs till FY44.

4. TOLL REVENUE PROJECTIONS

4.1 Tolling Strategy

The project road has an "Open System" of toll collection which enables the concessionaire to collect tolls from through traffic as well as from short distance one.

As mentioned earlier, there are three operational toll plazas on the project road - TP01-Bankapur, TP02- Chalageri and TP03- Hebbalu with an effective tolling length of 67.719 km, 92.260 km (six lane) & 8.306 km (four lane), and 88.941 km respectively being charged at present. As per the information available with us, the four-lane section of TP02 is likely to be six laned by December 2024, hence from January 2025, it has been considered to be six laned.

4.2 Schedule of User Fee

As per Schedule of User Fee for the project, the per km toll rates applicable from 2007-08 for normal tolling length and permanent structures, the revision basis and concessions are provided.

The concessions to traffic have been given in the form of rates as below:

Local traffic

Car / Jeep / Vans - includes local users owning a vehicle registered for non-commercial purposes, residing within a distance of 20 km from the toll plaza and crossing the same for commuting purposes.

Commercial vehicles - includes local users owning a commercial vehicle (excluding vehicles under National Permit), registered with address on the Registration Certificate of a particular district and uses such vehicle for commuting on a section of National Highway, permanent bridge, tunnel or bypass, as the case may be, which is located within that district, shall be levied user fee on all toll plazas which are located within that district at the rate of fifty per cent of the prescribed rate of fee (single journey rate). No such concession shall be provided, if a service road or alternative road is available for use by such commercial vehicles. Thus, local commercial traffic has to pay only 50 percent of the normal ticket.

Daily Pass

When the vehicle has to cross the tolled section more than once in a day, the user shall have the option to pay one and half times (1.5 times) of the fee for a single entry; this pass shall be valid for 2 entries within 24 hours of purchase.

Thus, the different categories of toll tickets are as follows:

(i) Traffic paying normal toll rates (single trip)
(ii) Traffic paying return journey rates
(iii) Traffic paying local personal rates

(iv) Traffic paying local commercial rates

4.3 Tolling Streams

The tolling stream distribution for the project road has been derived from the average of ETC toll data of FY24 from April 2023 to November 2023. The cash (April – November 2023) and exemption traffic (average of October and November 2023) has been added to the ETC traffic distribution and the resultant tolling segmentation is presented in **Table 4-1**.

Ticket Type/Modes	Car	LCV	Bus/ 2A Truck	3A Truck	MAV	OSV
TP01-Bankapur						
Single	51.9	80.7	58.9	85.8	93.5	100.0
Return	35.4	16.6	31.0	12.6	6.2	
Local personal	0.9					
Local commercial	2.7	2.0	9.8	1.6	0.3	
Exempt	9.0	0.8	0.3	0.1	0.0	
Total	100.0	100.0	100.0	100.0	100.0	100.0
TP02-Chalageri						
Single	58.4	81.8	60.6	87.4	93.2	100.0
Return	32.0	16.0	33.5	11.6	6.3	
Local personal	3.1					
Local commercial	1.2	2.0	5.9	0.9	0.4	
Exempt	5.3	0.2	0.1	0.1	0.0	
Total	100.0	100.0	100.0	100.0	100.0	100.0
TP03-Hebbalu						
Single	57.6	78.4	56.9	80.5	92.8	100.0
Return	34.9	17.5	34.9	10.3	6.6	
Local personal	2.3					
Local commercial	0.6	3.6	8.2	9.1	0.6	
Exempt	4.7	0.6	0.0	0.1	0.0	
Total	100.0	100.0	100.0	100.0	100.0	100.0

Table 4-1: Tolling Distribution from Toll Data for present study (in %)

In case of cars, TP02 shows around 58.4 percent falling in normal toll paying traffic, while TP03 exhibits a share of about 57.6 percent followed by TP01 with about 51.9 percent. In case of return ticket TP01 displaying the highest share of around 35.4 percent, followed by TP03 with around 34.9 percent. Local personal traffic is varying between 1-3 percent across the three toll plazas.

In case of LCVs, all three toll plazas display a consistent share for single tickets varying between 78-82 percent, with minor fluctuations among other ticket types.

Across three toll plazas, Bus/2A Trucks exhibit around 57-60 percent share each for single tickets and around 31-35 percent for return tickets.

In case of 3A trucks, the share of normal toll paying traffic is around 80-87 percent and share of return traffic is around 10-13 percent across the three toll plazas. In case of MAVs, TP01, TP02, and TP03 have a share of around 93 percent each for single tickets, and for return tickets each toll plaza has a share of around 6 percent.

Trip rate for local pass users is considered as 1.0, for daily pass, trip rate of 2.0 has been considered for all the modes.

4.4 Toll Rates

This section presents details on the toll rates that are likely to be imposed on the users of the project road during the study period. The toll rates (Rs/km) for the base year 2007-08 for different vehicle categories as per toll fee rules are presented in **Table 4-2**.

Mode	Base rate per km (in Rs)
Car, Jeep, Van, LMV	0.65
LCV /M Bus	1.05
Bus/ 2 Axle Truck	2.20
3 Axle	2.40
MAV	3.45
Oversized	4.20
Local Passenger	150

Table 4-2: Toll Rates in Rs/km for Different Vehicle Categories

The toll notification states that the 2007 toll rates shall be increased without compounding by three per cent each year with effect from the 1st day of April 2008 and such increased rate shall be deemed to be the base rate for the subsequent years.

In addition to this, the rate of fee for use of bypass forming part of a section of a National Highway constructed with a cost of Rs 10 crore or more, for the base year 2007, shall be one and a half times of the per km base rates specified above and the length of such bypass shall be excluded from the length of such section of National Highway.

In addition to this, the fee levied and collected hereunder for permanent bridge/ structures, as the case may be, having a length of 60 m or more on the basis of the equivalent length for structure as specified shall be due and payable at the toll plaza.

In case of the project road, the details of normal tolling lengths, bypass length (at 1.5 times) and equivalent structure lengths being charged at Bankapur, Chalageri and Hebbalu are presented in **Table 4-3**.

Toll Plazas	TP01 – Bankapur		TP02 - Chalageri		TP03-Hebbalu
	TP1 at 75%	TP1 at 100%	TP2 at Chalageri-6 Lane	TP2 at Chalageri-4 Lane	
A. Normal length	62.339	62.339	42.799	4.943	44.714
B. Bypass length			28.227	2.242	27.698
C. Equivalent Structure length	5.380	5.380	7.120		2.680
D. Total tolling length=(A+1.5*B+C)	67.719	67.719	92.260	8.306	88.941

Table 4-3: Existing Tolling Lengths at PR

In case of Chalageri TP, 100 percent work for six laning has been completed for 71.026 km tolling length. However, for balance length of 7.12 km, two structures at two villages viz, Motebennur and Chattra are yet to be completed. Therefore, 75 percent of the applicable toll rates is being charged at present. The construction is likely to be completed

by December 2024 as per information received from NHAI. The revenue is being considered from January 2025 in the toll revenue model for 100 percent of tolling length.

The Schedule M lengths have been considered from FY24 onwards for TP01 and TP03. However, for TP02, Schedule M lengths have been considered from January 2025 onwards. The details of tolling length as per Schedule M are presented in **Table 4-4**.

Toll Plazas	Schedule M		
	TP01 Bankapur	TP02-Chalageri	TP03-Hebbalu
A. Normal length	62.339	47.732	44.714
B. Bypass length		30.469	27.698
C. Equivalent Structure length	5.38	7.12	2.68
D. Total tolling length=(A+1.5*B+C)	67.719	100.556	88.941

Table 4-4: Tolling Lengths as per Schedule M at PR

The applicable base rates shall be revised annually with effect from April 1 each year to reflect the increase in wholesale price index for the month of December of the immediate preceding year in which such revision is undertaken but such revision shall be restricted for 40 per cent of the increase in wholesale price index.

Actual WPI information for December 2023 of 151.6 under 2011-12 series converted into 1999-00 series (151.6*1.873*1.641=465.96) has been used.

The WPI increase of 5.25 percent and 4.5 percent for December 2024 (applicable for FY26) and December 2025 (applicable for FY27) respectively has been considered to account for the low base in December 2023, the ongoing effect of El Niño and other geopolitical issues. The WPI growth forecast for remaining years beyond December 2025 has been kept unchanged at 3.5 percent.

The stream of toll rates to be charged at the toll plaza of the project road in cardinal years till FY44 is presented in **Table 4-5**. The toll fee has been rounded to nearest 5 Rupees as per toll fee rules.

FY End	Car	LCV/ M Bus	Bus/2A Truck	3A	MAV	OSV	Car Local
TP01-Bankapur							
2024	95	155	330	360	515	625	330
2025	100	160	335	365	525	640	340
2030	125	200	420	455	655	795	420
2035	150	245	510	555	800	975	515
2040	185	300	625	680	980	1,190	630
2044	215	350	730	800	1,150	1,400	735
TP02-Chalageri							
2024	140	225	470	510	735	895	330
2025 Existing Length	140	230	480	525	755	915	340
2025 Schedule M Length	145	240	500	545	780	950	340
2030	185	295	620	675	975	1,185	420
2035	225	360	760	825	1,190	1,445	515
2040	275	440	925	1,010	1,455	1,770	630
2044	320	520	1,085	1,185	1,705	2,075	735
TP03-Hebbalu							
2024	125	205	430	470	675	820	330
2025	130	210	440	480	690	840	340
2030	160	260	550	600	860	1,045	420
2035	200	320	670	730	1,050	1,280	515
2040	240	390	820	895	1,285	1,565	630
2044	285	460	960	1,050	1,510	1,835	735

Table 4-5: Toll Rates at Toll Plaza (in Rs)

The users purchasing return journey tickets will pay 1.5 times the above toll rates. All passes have been rounded to the nearest 5 Rupees as per fee rules.

4.5 Toll Revenue Estimates

The total combined assured remittance amount for FY24 for the three toll plazas is Rs. 377.4 Crores, the details of which are presented in **Table 4-6**.

Toll Plaza	Period	Remittance (in Million)	Equivalent Remittance for FY24 Per Year in Million
Bankapur (km 352.550)	12/01/2023 to 12/01/2024	538.4	992.9*
Chalageri (km 288.200)	05/05/2023 to 05/05/2024	1,465.3	1,465.3
Hebbalu (km 237.650)	29/03/2023 to 29/03/2024	1,316.1	1,316.1
Total Revenue			3,774.3

*After 4th Nov 2023

Table 4-6: Assured Remittance for the Toll Plazas

As per the site findings, WIM is currently installed in all the lanes at the Bankapur TP; at Chalageri, WIM is present in two lanes on each side of L.H.S and R.H.S whereas Hebballu toll plaza does not have WIM in place.

The travel pattern and commodity distribution reveal the presence of building materials, iron and steel products and miscellaneous items in which there could be an ongoing practice of overloading on PR and is not being currently charged.

In view of this, 7- day axle load survey data (as part of technical due diligence) has been provided by the client which has been analysed to understand the extent of overloaded vehicles at the three toll plazas of PR. The analysis shows similar overloading trends across the seven days. The findings of the overloading analysis are presented in **Table 4-7**.

Mode	Within Permissible Limit	Within Tolerance up to 5%	>5%-<10%	>10%-<20%	>20%	Total
TP01-Bankapur TP						
LCV	100.0%	0.0%	0.0%	0.0%	0.00%	100%
2A	95.0%	2.8%	1.3%	0.9%	0.00%	100%
3A	62.8%	14.1%	8.0%	10.1%	5.0%	100%
MAV	41.0%	8.4%	9.0%	20.9%	20.7%	100%
TP02-Chalageri TP						
LCV	100.0%	0.0%	0.0%	0.0%	0.00%	100%
2A	96.9%	2.1%	0.9%	0.1%	0.07%	100%
3A	57.8%	19.5%	7.4%	12.3%	3.0%	100%
MAV	42.6%	13.3%	13.2%	21.1%	9.7%	100%
TP03-Hebbalu TP						
LCV	100.0%	0.0%	0.0%	0.0%	0.00%	100%
2A	97.7%	1.7%	0.6%	0.0%	0.00%	100%
3A	59.5%	20.0%	7.1%	9.9%	3.5%	100%
MAV	51.1%	11.8%	10.2%	16.9%	10.0%	100%

Table 4-7: Overloaded Vehicles in Percentage on the PR

As observed from the axle load analysis, around 20 percent of the MAVs and 5.0 percent of 3A trucks are above 20 percent overloading limit at Bankapur TP whereas around 3 percent of 3A trucks and 10 percent of MAVs are in the above 20 percent overloading limit at both Chalageri and Hebbalu Toll Plazas.

The overloading vehicles are liable to pay the overloading penalty as per the provisions of the concession agreement. The concession agreement of the latest TOT project states that overloading penalty should be charged as per the NHAI overloading circular. As per the amended National Highways Fee (Determination of Rates and Collection) Rules, 2018, "the driver or owner or person in charge of a mechanical vehicle shall be liable to pay fee, for entering the overloaded vehicle on the National Highway, to the user fee collecting agency, equal to fees as presented in **Table 4-8**.

Percentage of excess load over Maximum Permissible Gross Vehicular Weight	Multiplying factor to base rate fees	Fees
0% to 20%	Two	[(Fees applicable for such category of mechanical vehicle under sub-rule (2) of rule 4) X (Multiplying factor)]
>20% to 40%	Four	
>40% to 60%	Six	
>60% to 80%	Eight	
>80% and above	Ten	

Table 4-8: User Fee for Overloaded Vehicles

However, as per the operational overloading practices at the toll plazas where overloading penalty is being charged, it is either the next higher category toll or two times the normal fee which is usually being collected.

Continuing with the practice of two times toll, since 3A and MAVs are heavily overloaded, with fully functional WIMs at all the toll plazas, the practice of charging them for one-time extra payment can be put in place. Even if > 20% category of 3A and MAVs pay one time extra, it will result in a substantial gain in revenue, but it might not be practically possible to stop each vehicle and collect extra toll.

Although the quantum of overloaded vehicles is high but after factoring in the practical number of vehicles from whom overloading can be charged, under a more pragmatic scenario, it is assumed that around 25 percent of this >20% overloaded category is charged for one-time additional payment. This results in around 1 percent of 3A AADT at all the three plazas and 5.2% of MAV AADT of FY24 at Bankapur, 2.4% percent each at Chalageri and Hebbalu TP paying one-time extra toll. With appointed date likely to be achieved in March 2024 and considering the time required for putting the systems in place for overloading revenue collection, this additional revenue from overloaded vehicles is considered from FY26. The estimated revenue from overloading in FY26 is Rs 53.7 million.

However, with strict overloading compliance in place in the future years, this overloading percentage of >20 percent category (considered till FY26) is likely to decline over the years of concession - a decline of 1 percent every year has been considered starting from FY27 onwards under Base case.

The projections of revenue under the present study for the project road have been presented till FY44.

- Toll revenue streams have been calculated assuming that toll would be collected for all 365 days in a year and for 366 days in a leap year.
- The estimated revenue for FY24 for Bankapur TP with 100% 6 laning toll rate from 4th Nov 2023 is Rs. 751.3 million (based on existing tolling length); however, the toll revenue considering the 100% length as per Schedule M for the full year is Rs. 1,017.8 million.
- Revenue from one-time extra toll from overloaded MAVs has been considered from April 2025 (FY26) under the Base Case

The toll revenue for all three toll plazas at the project road including overloading revenue and considering the impacts of all diversions for the base case is presented in **Table 4-9**.

FY End	TP1 - Bankapur	TP2 - Chalageri	TP3 - Hebbalu	Total
2024	1,017.8	1,429.6	1,322.9	3,770.3
2025	1,092.4	1,547.9	1,421.5	4,061.8
2026	1,262.5	1,817.1	1,627.3	4,706.9
2027	1,420.3	2,039.7	1,837.8	5,297.8
2028	1,560.1	2,244.5	2,019.5	5,824.1
2029	1,699.8	2,442.9	2,196.6	6,339.3
2030	1,852.9	2,668.3	2,397.0	6,918.2
2031	1,810.6	2,598.3	2,355.7	6,764.6
2032	1,864.0	2,676.2	2,423.2	6,963.4
2033	1,901.9	2,719.4	2,487.8	7,109.0
2034	2,065.1	2,967.4	2,699.2	7,731.7
2035	2,243.4	3,227.3	2,943.8	8,414.5
2036	2,436.6	3,512.3	3,198.0	9,146.9
2037	2,642.0	3,795.3	3,459.6	9,896.8
2038	2,856.9	4,113.8	3,757.1	10,727.8
2039	3,082.3	4,451.9	4,078.1	11,612.3
2040	3,353.7	4,828.3	4,412.1	12,594.0
2041	3,609.9	5,199.9	4,762.6	13,572.4
2042	3,904.3	5,624.9	5,155.3	14,684.6
2043	4,221.9	6,094.5	5,597.3	15,913.7
2044	4,555.9	6,579.1	6,058.1	17,193.0

Table 4-9: Base Case Revenue in Rs Million

Across all three toll plazas of the project road, cars represent around 28-32 percent share of total revenue, while amongst the freight vehicle category, MAVs also represent share of around 31-32 percent of total revenue, followed by 2A trucks with a share of 23-25 percent, LCVs, and 2A trucks, each with a share of around 7 percent.

Vehicles paying normal tolls are around 78-80 percent of total toll revenues for the project road sections, and around 18-20 percent of the traffic may opt for the daily pass category while, remaining 1-2 percent may fall under the local concession category for the three toll plazas of the project road.

4.6 Scenario Analysis

For toll road projects, revenue streams are generally based on the assessment of the traffic volume (base and future) crossing the toll plazas and the applicable toll imposed on the user of the road. There is an inherent element of uncertainty in any forecast and whilst is not possible to measure risk in a strictly statistical sense (as many of the risks are largely or partly unknown), in this section an attempt is made at quantifying the main risks that could have an impact on this forecast.

The econometric approach used to derive traffic growth, is based on the estimation of GSDP growth rates for the influence area economies and traffic demand elasticity by mode; the estimation of both variables contains a certain degree of uncertainty which can be represented in the scenario analysis. Scenario analysis has been done in the following subheadings for the base case:

High Case

The high case is based on a more optimistic economic outlook for future years and higher elasticity values as compared to the base case. Therefore, traffic growth rates of 20 percent higher than the base case for every year and for all the modes are considered.

Low Case

A growth rate of 20 percent lower than base case for all types of vehicles has been considered in the present analysis to reflect uncertainty with regard to economic performance of PIA states and lower elasticity values.

Scenario Results

A comparison of scenarios versus base case has been presented for the Present Value (PV) of the project (at 12 per cent discount rate) and the compounded annual growth rate (CAGR) from FY24 to end of concession period (FY44).

The results of Base Case and two traffic growth scenarios are presented in **Table 4-10**.

Financial Year (FY) ending March	Toll Revenue in Rs Million		
	Base	High Growth (+20%)	Low Growth (-20%)
2024	3,770.3	3,770.3	3,770.3
2025	4,061.8	4,100.3	4,023.2
2026	4,706.9	4,798.6	4,616.3
2027	5,297.8	5,451.1	5,148.0
2028	5,824.1	6,053.8	5,602.0
2029	6,339.3	6,654.4	6,037.9
2030	6,918.2	7,331.3	6,527.3
2031	6,764.6	7,235.6	6,323.4
2032	6,963.4	7,518.8	6,448.6
2033	7,109.0	7,749.8	6,521.1
2034	7,731.7	8,508.0	7,026.8
2035	8,414.5	9,347.2	7,576.4
2036	9,146.9	10,247.8	8,166.6
2037	9,896.8	11,183.6	8,761.5
2038	10,727.8	12,225.6	9,418.3
2039	11,612.3	13,344.9	10,111.1
2040	12,594.0	14,593.0	10,877.1
2041	13,572.4	15,856.0	11,628.0
2042	14,684.6	17,295.7	12,480.5
2043	15,913.7	18,898.7	13,415.9
2044	17,193.0	20,579.9	14,382.6
PV12 FY24 till FY44	51,402.8	55,718.4	47,566.9
PV12 till FY44 vs base		8.4%	-7.5%
CAGR FY24 to FY44	7.9%	8.9%	6.9%

Table 4-10: Comparison of Annual Revenue Forecasts Under Different Scenarios

The low growth scenario has a negative impact on revenue PV of about 7.5 percent versus base case (till FY44), whilst the optimistic growth scenario would generate about 8.4 percent higher PV than the base case.

APPENDICES

APPENDIX 2.1
TRAFFIC ZONING SYSTEM

Traffic Study for Hubbali-Haveri-Chitradurga Section of NH-48 (Old NH-4) in the State of Karnataka
Traffic Zoning System

Zone	Place/Region	District/ State	State
1	**Hubbali**/Gabbur	Hubbali-Haveri	Karnataka
2	Kotgondhunsi/Adargunchi/Sherewad/Kundgol		
3	Varur/Muthali/Tadas/Timmapur		
4	Shiggaon/Bankapur		
5	**Haveri**/Devagiri		
6	Motebennur/Agasanhalli/Byadagi	Haveri-Devanagere	
7	Chhatra/Kunabev		
8	Ranebennur/Kamadod/Chalageri		
9	Harihar/Kawalettu/Kodiyal		
10	Haraganahalli Industrial Area/Mahajenahalli		
11	**Devanagere**/Karur		
12	M Bapuji Badavaner/Anagodu/Hebbalu	Devanagere-Chitradurga	
13	Bharmasagara/Jatlahalli		
14	**Chitradurga**		
15	**Dharwad**	Dharwad District	
16	Belur/Belur Industrial Area		
17	Kittur Industrial Area	Belagavi District	
18	Kakati Industrial Area		
19	**Belagavi**		
20	**Gadag**-Betageri/Laxmeshwar	Gadag District	
21	Hangal/Yellapur/Sirsi/Dhamra Reservoir	Uttar Kannada District	
22	Gokarna/Karwar		
23	Murudeshwar/Jog/Siddapur/Shikaripur		
24	Mylara/Guttal/Holalu	Haveri District	
25	Harapanahalli/Kotturu/Ittigi	Vijayanagara District	
26	Satturu/Chatnihalli/Harpanahalli Stone Crushers		
27	Hosapete/Ballari/Koppal	Vijayanagara/Ballari/Koppal District	
28	Shivamogga/Bhadravathi	Shivamogga District	
29	Udupi/Mangaluru	Udupi/Dakshin Kannada District	
30	Chikkamagaluru/Hassan/Madikeri	Chikkamagaluru/Hassan District	
31	Hosadurga/Huliyar/Tiptur	Chitradurga District	
32	Jampannanaikanako Stone Crushers		
33	Hiruyur/Babbur		
34	Challakere/Ganappana Hatty		
35	Tumakuru/Sira	Tumakuru District	
36	**Bangalore City**	Bangalore District	
37	**Mysuru/Bandipur**	Mysuru District	
38	Bagalkot	Bagalkot District	
39	**Vijaypura (Bijapur)**	Vijayapura District	
40	Kalaburagi	Kalaburagi District	
41	Rest of Karnataka	Rest of Karnataka	
42	Goa	Goa	Goa
43	Kolhapur/Sangli	Kolhapur/Sangli	Maharashtra
44	Ratnagiri/Ganpatipule	Ratnagiri/Ganpatipule	
45	Satara/Karad	Satara/Karad	
46	Solapur/Pandharpur	Solapur/Pandharpur	
47	Mahabaleshwar/Raigad	Mahabaleshwar/Raigad	
48	**Pune**	Pune	
49	**Mumbai**	Mumbai	
50	**Nashik**	Nashik	
51	Aurangabad/Jalna/Ahmednagar	Aurangabad/Jalna/Ahmednagar	
52	Dhule/Jalgaon	Dhule/Jalgaon	
53	Nanded/Latur	Nanded/Latur	
54	Amravati/Akola/Yavatmal	Amravati/Akola/Yavatmal	
55	Nagpur/Gondia/Bhandara	Nagpur/Gondia/Bhandara	
56	Rest of Maharashtra	Rest of Maharashtra	
57	**Hyderabad city**	Hyderabad city	Telangana
58	Nizamabad/Nirmal/Adilabad/Warangal	Nizamabad/Nirmal/Adilabad/Warangal	
59	Rest of Telangana	Rest of Telangana	
60	Anantapur	Anantapur	Andhra Pradesh
61	Vishakhapatnam/Vijayawada	Vishakhapatnam/Vijayawada	
62	Tirupati/Nellore/Kadapa	Tirupati/Nellore/Kadapa	
63	Rest of Andhra Pradesh	Rest of Andhra Pradesh	
64	Hosur/Krishnagiri	Hosur/Krishnagiri	Tamil Nadu
65	Salem/Erode	Salem/Erode	
66	Vellore/Ranipet	Vellore/Ranipet	
67	**Chennai city**	Chennai city	
68	Madurai/Coimbatore/Tiruppur	Madurai/Coimbatore/Tiruppur	
69	Ooty	Ooty	
70	Rest of Tamil Nadu	Rest of Tamil Nadu	
71	Puducherry (Pondicherry)	Puducherry (Pondicherry)	Puducherry (Pondicherry)
72	Kozhikode/Kannur	Kozhikode/Kannur	Kerala
73	**Kochi/Thiruvananthapuram**	Kochi/Thiruvananthapuram	
74	Rest of Kerala	Rest of Kerala	
75	**Jaipur/Ajmer/Kota**	Jaipur/Ajmer/Kota	Rajasthan
76	Jodhpur/Bikaner/Udaipur	Jodhpur/Bikaner/Udaipur	
77	Rest of Rajasthan	Rest of Rajasthan	
78	**Ahmedabad/Vadodara**	Ahmedabad/Vadodara	Gujarat
79	Surat/Hazira	Surat/Hazira	
80	Dahej/Bharuch	Dahej/Bharuch	
81	Rajkot/Morbi/Gandhidham	Rajkot/Morbi/Gandhidham	
82	Rest of Gujarat	Rest of Gujarat	
83	**Madhya Pradesh**	Madhya Pradesh	Madhya Pradesh
84	Agra/Mathura	Agra/Mathura	Uttar Pradesh
85	**Lucknow/Kanpur**	Lucknow/Kanpur	
86	Rest of Uttar Pradesh	Rest of Uttar Pradesh	
87	**Delhi**	Delhi	Delhi
88	Haryana	Haryana	Haryana
89	Punjab/Chandigarh	Punjab/Chandigarh	Punjab/Chandigarh
90	Jammu Kashmir & Ladakh/Himachal Pradesh/Uttarakhand	Jammu Kashmir & Ladakh/Himachal Pradesh/Uttarakhand	Jammu Kashmir & Ladakh/Himachal Pradesh/Uttarakhand
91	Bihar	Bihar	Bihar
92	West Bengal	West Bengal	West Bengal
93	Chhattisgarh	Chhattisgarh	Chhattisgarh
94	Odisha	Odisha	Odisha
95	Jharkhand	Jharkhand	Jharkhand
96	Assam /North eastern states	Assam /North eastern states	Assam /North eastern states

Confidential

APPENDIX 2.2
TOP 20 OD PAIRS

Traffic Study for Hubbali-Haveri-Chitradurga Section of NH-48 (Old NH-4) in the state of Karnataka - Bankapur (TP01)

TOP 20 Origin Destination Pairs

Car

S.No.	Origin	Destination	% of total
1	Hubbali/Gabbur	Haveri/Devagiri	16%
2	Hubbali/Gabbur	Bangalore City	10%
3	Shiggaon/Bankapur	Haveri/Devagiri	10%
4	Hubbali/Gabbur	Devanagere/Karur	8%
5	Hubbali/Gabbur	Ranebennur/Kamadod/Chalageri	6%
6	Belagavi	Bangalore City	4%
7	Hubbali/Gabbur	Chitradurga	3%
8	Haveri/Devagiri	Dharwad	2%
9	Dharwad	Bangalore City	2%
10	Haveri/Devagiri	Belagavi	2%
11	Bangalore City	Goa	2%
12	Devanagere/Karur	Belagavi	2%
13	Hubbali/Gabbur	Harihar/Kawalettu/Kodiyal	2%
14	Shiggaon/Bankapur	Ranebennur/Kamadod/Chalageri	2%
15	Bangalore City	Pune	2%
16	Shiggaon/Bankapur	Devanagere/Karur	1%
17	Devanagere/Karur	Dharwad	1%
18	Shiggaon/Bankapur	Bangalore City	1%
19	Bangalore City	Mumbai	1%
20	Ranebennur/Kamadod/Chalageri	Dharwad	1%
		Total	**79%**

MiniBus

S.No.	Origin	Destination	% of total
1	Hubbali/Gabbur	Haveri/Devagiri	18%
2	Hubbali/Gabbur	Bangalore City	8%
3	Shiggaon/Bankapur	Haveri/Devagiri	7%
4	Haveri/Devagiri	Belagavi	6%
5	Bangalore City	Goa	4%
6	Hubbali/Gabbur	Ranebennur/Kamadod/Chalageri	3%
7	Hubbali/Gabbur	Devanagere/Karur	3%
8	Haveri/Devagiri	Gadag-Betageri/Laxmeshwar	3%
9	Hubbali/Gabbur	Harihar/Kawalettu/Kodiyal	2%
10	Bangalore City	Pune	2%
11	Shiggaon/Bankapur	Ranebennur/Kamadod/Chalageri	2%
12	Shiggaon/Bankapur	Devanagere/Karur	2%
13	Devanagere/Karur	Belagavi	2%
14	Ranebennur/Kamadod/Chalageri	Belagavi	2%
15	Belagavi	Bangalore City	2%
16	Hubbali/Gabbur	Chitradurga	1%
17	Shiggaon/Bankapur	Shivamogga/Bhadravathi	1%
18	Haveri/Devagiri	Vijaypura (Bijapur)	1%
19	Haveri/Devagiri	Goa	1%
20	Haveri/Devagiri	Ahmedabad/Vadodara	1%
		Total	**74%**

Bus

S.No.	Origin	Destination	% of total
1	Hubbali/Gabbur	Bangalore City	19%
2	Hubbali/Gabbur	Haveri/Devagiri	17%
3	Hubbali/Gabbur	Devanagere/Karur	8%
4	Belagavi	Bangalore City	7%
5	Haveri/Devagiri	Gadag-Betageri/Laxmeshwar	6%
6	Hubbali/Gabbur	Ranebennur/Kamadod/Chalageri	5%
7	Bangalore City	Pune	4%
8	Bangalore City	Goa	2%
9	Shiggaon/Bankapur	Haveri/Devagiri	2%
10	Gadag-Betageri/Laxmeshwar	Bangalore City	2%
11	Bangalore City	Mumbai	2%
12	Hubbali/Gabbur	Shivamogga/Bhadravathi	2%
13	Dharwad	Bangalore City	2%
14	Bangalore City	Kolhapur/Sangli	1%
15	Bangalore City	Vijaypura (Bijapur)	1%
16	Haveri/Devagiri	Belagavi	1%
17	Hubbali/Gabbur	Mysuru/Bandipur	1%
18	Devanagere/Karur	Belagavi	1%
19	Devanagere/Karur	Kolhapur/Sangli	1%
20	Ranebennur/Kamadod/Chalageri	Belagavi	1%
		Total	**85%**

Mini LCV

S.No.	Origin	Destination	% of total
1	Hubbali/Gabbur	Haveri/Devagiri	16%
2	Shiggaon/Bankapur	Haveri/Devagiri	15%
3	Hubbali/Gabbur	Bangalore City	8%
4	Hubbali/Gabbur	Devanagere/Karur	6%
5	Hubbali/Gabbur	Ranebennur/Kamadod/Chalageri	5%
6	Bangalore City	Pune	4%
7	Bangalore City	Mumbai	2%
8	Bangalore City	Goa	2%
9	Haveri/Devagiri	Dharwad	2%
10	Hubbali/Gabbur	Chitradurga	2%
11	Hubbali/Gabbur	Tumakuru/Sira	1%
12	Haveri/Devagiri	Belagavi	1%
13	Haveri/Devagiri	Mumbai	1%
14	Mumbai	Chennai city	1%
15	Shiggaon/Bankapur	Devanagere/Karur	1%
16	Dharwad	Bangalore City	1%
17	Devanagere/Karur	Belagavi	1%
18	Hubbali/Gabbur	Mysuru/Bandipur	1%
19	Devanagere/Karur	Pune	1%
20	Devanagere/Karur	Mumbai	1%
		Total	**73%**

Traffic Study for Hubbali-Haveri-Chitradurga Section of NH-48 (Old NH-4) in the state of Karnataka - Bankapur (TP01)			
TOP 20 Origin Destination Pairs			
LCV			
S.No.	**Origin**	**Destination**	**% of total**
1	Hubbali/Gabbur	Bangalore City	11%
2	Bangalore City	Mumbai	11%
3	Bangalore City	Pune	9%
4	Shiggaon/Bankapur	Haveri/Devagiri	8%
5	Hubbali/Gabbur	Devanagere/Karur	4%
6	Mumbai	Chennai city	4%
7	Hubbali/Gabbur	Haveri/Devagiri	3%
8	Pune	Chennai city	3%
9	Belagavi	Bangalore City	3%
10	Bangalore City	Goa	3%
11	Bangalore City	Kolhapur/Sangli	2%
12	Bangalore City	Rest of Gujarat	2%
13	Dharwad	Bangalore City	2%
14	Hubbali/Gabbur	Ranebennur/Kamadod/Chalageri	2%
15	Hubbali/Gabbur	Mysuru/Bandipur	1%
16	Devanagere/Karur	Pune	1%
17	Bangalore City	Ahmedabad/Vadodara	1%
18	Hubbali/Gabbur	Tumakuru/Sira	1%
19	Mumbai	Rest of Tamil Nadu	1%
20	Devanagere/Karur	Mumbai	1%
		Total	**72%**
2 Axle			
S.No.	**Origin**	**Destination**	**% of total**
1	Hubbali/Gabbur	Haveri/Devagiri	12%
2	Bangalore City	Mumbai	11%
3	Hubbali/Gabbur	Bangalore City	9%
4	Bangalore City	Pune	8%
5	Mumbai	Chennai city	4%
6	Hubbali/Gabbur	Devanagere/Karur	3%
7	Belagavi	Bangalore City	2%
8	Bangalore City	Rest of Gujarat	2%
9	Pune	Rest of Tamil Nadu	2%
10	Pune	Chennai city	2%
11	Bangalore City	Goa	2%
12	Bangalore City	Kolhapur/Sangli	2%
13	Mumbai	Madurai/Coimbatore/Tiruppur	1%
14	Hubbali/Gabbur	Ranebennur/Kamadod/Chalageri	1%
15	Mumbai	Rest of Tamil Nadu	1%
16	Devanagere/Karur	Pune	1%
17	Bangalore City	Ahmedabad/Vadodara	1%
18	Hubbali/Gabbur	Mysuru/Bandipur	1%
19	Shiggaon/Bankapur	Haveri/Devagiri	1%
20	Mysuru/Bandipur	Mumbai	1%
		Total	**69%**
3 Axle			
S.No.	**Origin**	**Destination**	**% of total**
1	Bangalore City	Mumbai	14%
2	Bangalore City	Pune	9%
3	Hubbali/Gabbur	Bangalore City	7%
4	Mumbai	Chennai city	7%
5	Bangalore City	Rest of Gujarat	3%
6	Mumbai	Rest of Tamil Nadu	3%
7	Pune	Chennai city	3%
8	Belagavi	Bangalore City	3%
9	Hubbali/Gabbur	Devanagere/Karur	2%
10	Hubbali/Gabbur	Haveri/Devagiri	2%
11	Bangalore City	Kolhapur/Sangli	2%
12	Bangalore City	Goa	2%
13	Dharwad	Bangalore City	2%
14	Bangalore City	Rest of Maharashtra	1%
15	Pune	Rest of Tamil Nadu	1%
16	Mysuru/Bandipur	Mumbai	1%
17	Mumbai	Madurai/Coimbatore/Tiruppur	1%
18	Bangalore City	Ahmedabad/Vadodara	1%
19	Shiggaon/Bankapur	Haveri/Devagiri	1%
20	Chennai city	Ahmedabad/Vadodara	1%
		Total	**67%**
MAV			
S.No.	**Origin**	**Destination**	**% of total**
1	Bangalore City	Mumbai	12%
2	Bangalore City	Pune	11%
3	Mumbai	Chennai city	6%
4	Hubbali/Gabbur	Bangalore City	5%
5	Bangalore City	Rest of Gujarat	4%
6	Mumbai	Rest of Tamil Nadu	3%
7	Bangalore City	Goa	2%
8	Bangalore City	Kolhapur/Sangli	2%
9	Pune	Chennai city	2%
10	Hubbali/Gabbur	Haveri/Devagiri	2%
11	Pune	Rest of Tamil Nadu	2%
12	Mumbai	Madurai/Coimbatore/Tiruppur	2%
13	Belagavi	Bangalore City	2%
14	Dharwad	Bangalore City	2%
15	Kochi/Thiruvananthapuram	Rest of Gujarat	2%
16	Mysuru/Bandipur	Mumbai	1%
17	Chennai city	Rest of Gujarat	1%
18	Hubbali/Gabbur	Ranebennur/Kamadod/Chalageri	1%
19	Hubbali/Gabbur	Mysuru/Bandipur	1%
20	Bangalore City	Delhi	1%
		Total	**63%**

Traffic Study for Hubbali-Haveri-Chitradurga Section of NH-48 (Old NH-4) in the state of Karnataka - Chalageri (TP02)

TOP 20 Origin Destination Pairs

Car

S.No.	Origin	Destination	% of total
1	Hubbali/Gabbur	Bangalore City	9%
2	Ranebennur/Kamadod/Chalageri	Devanagere/Karur	9%
3	Hubbali/Gabbur	Devanagere/Karur	8%
4	Haveri/Devagiri	Devanagere/Karur	7%
5	Ranebennur/Kamadod/Chalageri	Harihar/Kawalettu/Kodiyal	6%
6	Haveri/Devagiri	Harihar/Kawalettu/Kodiyal	5%
7	Haveri/Devagiri	Bangalore City	4%
8	Hubbali/Gabbur	Chitradurga	4%
9	Ranebennur/Kamadod/Chalageri	Bangalore City	3%
10	Belagavi	Bangalore City	3%
11	Hubbali/Gabbur	Harihar/Kawalettu/Kodiyal	2%
12	Bangalore City	Goa	2%
13	Dharwad	Bangalore City	2%
14	Bangalore City	Pune	1%
15	Bangalore City	Rest of Maharashtra	1%
16	Bangalore City	Mumbai	1%
17	Haveri/Devagiri	Chitradurga	1%
18	Hangal/Yellapur/Sirsi/Dhamra Reservoir	Bangalore City	1%
19	Haveri/Devagiri	Shivamogga/Bhadravathi	1%
20	Harihar/Kawalettu/Kodiyal	Belagavi	1%
		Total	**73%**

MiniBus

S.No.	Origin	Destination	% of total
1	Hubbali/Gabbur	Bangalore City	11%
2	Ranebennur/Kamadod/Chalageri	Harihar/Kawalettu/Kodiyal	7%
3	Ranebennur/Kamadod/Chalageri	Devanagere/Karur	6%
4	Ranebennur/Kamadod/Chalageri	Bangalore City	5%
5	Haveri/Devagiri	Harihar/Kawalettu/Kodiyal	5%
6	Hubbali/Gabbur	Devanagere/Karur	4%
7	Devanagere/Karur	Belagavi	4%
8	Haveri/Devagiri	Devanagere/Karur	4%
9	Devanagere/Karur	Kolhapur/Sangli	4%
10	Dharwad	Bangalore City	3%
11	Haveri/Devagiri	Bangalore City	3%
12	Satturu/Chatnihalli/Harpanahalli Stone Crushers	Mumbai	3%
13	Tumakuru/Sira	Vijaypura (Bijapur)	3%
14	Harihar/Kawalettu/Kodiyal	Belagavi	2%
15	Bangalore City	Pune	2%
16	Ranebennur/Kamadod/Chalageri	Chitradurga	2%
17	Belagavi	Bangalore City	2%
18	Hubbali/Gabbur	Shivamogga/Bhadravathi	1%
19	Hubbali/Gabbur	Tumakuru/Sira	1%
20	Devanagere/Karur	Bagalkot	1%
		Total	**73%**

Bus

S.No.	Origin	Destination	% of total
1	Ranebennur/Kamadod/Chalageri	Devanagere/Karur	20%
2	Hubbali/Gabbur	Bangalore City	18%
3	Hubbali/Gabbur	Devanagere/Karur	8%
4	Belagavi	Bangalore City	4%
5	Haveri/Devagiri	Devanagere/Karur	3%
6	Ranebennur/Kamadod/Chalageri	Harihar/Kawalettu/Kodiyal	3%
7	Bangalore City	Pune	2%
8	Ranebennur/Kamadod/Chalageri	Bangalore City	2%
9	Bangalore City	Mumbai	2%
10	Hubbali/Gabbur	Harihar/Kawalettu/Kodiyal	2%
11	Haveri/Devagiri	Bangalore City	2%
12	Devanagere/Karur	Vijaypura (Bijapur)	2%
13	Hubbali/Gabbur	Shivamogga/Bhadravathi	1%
14	Devanagere/Karur	Belagavi	1%
15	Gadag-Betageri/Laxmeshwar	Bangalore City	1%
16	Bangalore City	Vijaypura (Bijapur)	1%
17	Devanagere/Karur	Mumbai	1%
18	Bangalore City	Bagalkot	1%
19	Hubbali/Gabbur	Chitradurga	1%
20	Hubbali/Gabbur	M Bapuji Badavaner/Anagodu/Hebbalu	1%
		Total	**77%**

Mini LCV

S.No.	Origin	Destination	% of total
1	Ranebennur/Kamadod/Chalageri	Devanagere/Karur	11%
2	Haveri/Devagiri	Devanagere/Karur	10%
3	Hubbali/Gabbur	Devanagere/Karur	8%
4	Hubbali/Gabbur	Bangalore City	7%
5	Bangalore City	Pune	5%
6	Ranebennur/Kamadod/Chalageri	Harihar/Kawalettu/Kodiyal	4%
7	Bangalore City	Mumbai	4%
8	Haveri/Devagiri	Harihar/Kawalettu/Kodiyal	4%
9	Haveri/Devagiri	Bangalore City	4%
10	Dharwad	Bangalore City	2%
11	Hubbali/Gabbur	Chitradurga	2%
12	Ranebennur/Kamadod/Chalageri	Bangalore City	2%
13	Bangalore City	Kolhapur/Sangli	2%
14	Bangalore City	Rest of Maharashtra	2%
15	Hubbali/Gabbur	Harihar/Kawalettu/Kodiyal	2%
16	Devanagere/Karur	Pune	1%
17	Ranebennur/Kamadod/Chalageri	Tumakuru/Sira	1%
18	Ranebennur/Kamadod/Chalageri	Mysuru/Bandipur	1%
19	Mysuru/Bandipur	Mumbai	1%
20	Haveri/Devagiri	Shivamogga/Bhadravathi	1%
		Total	**76%**

Traffic Study for Hubbali-Haveri-Chitradurga Section of NH-48 (Old NH-4) in the state of Karnataka - Chalageri (TP02)			
TOP 20 Origin Destination Pairs			
LCV			
S.No.	**Origin**	**Destination**	**% of total**
1	Hubbali/Gabbur	Bangalore City	12%
2	Bangalore City	Mumbai	11%
3	Bangalore City	Pune	7%
4	Mumbai	Chennai city	4%
5	Hubbali/Gabbur	Devanagere/Karur	4%
6	Haveri/Devagiri	Devanagere/Karur	3%
7	Belagavi	Bangalore City	3%
8	Bangalore City	Rest of Maharashtra	3%
9	Haveri/Devagiri	Bangalore City	3%
10	Bangalore City	Kolhapur/Sangli	2%
11	Ranebennur/Kamadod/Chalageri	Devanagere/Karur	2%
12	Dharwad	Bangalore City	2%
13	Bangalore City	Rest of Gujarat	2%
14	Bangalore City	Goa	2%
15	Pune	Chennai city	2%
16	Ranebennur/Kamadod/Chalageri	Bangalore City	1%
17	Mumbai	Rest of Tamil Nadu	1%
18	Hubbali/Gabbur	Rest of Tamil Nadu	1%
19	Rest of Maharashtra	Rest of Tamil Nadu	1%
20	Pune	Rest of Tamil Nadu	1%
		Total	**66%**
2 Axle			
S.No.	**Origin**	**Destination**	**% of total**
1	Bangalore City	Mumbai	13%
2	Bangalore City	Pune	9%
3	Haveri/Devagiri	Devanagere/Karur	9%
4	Hubbali/Gabbur	Bangalore City	8%
5	Mumbai	Chennai city	5%
6	Belagavi	Bangalore City	3%
7	Mumbai	Rest of Tamil Nadu	3%
8	Pune	Chennai city	3%
9	Hubbali/Gabbur	Devanagere/Karur	2%
10	Bangalore City	Rest of Maharashtra	2%
11	Bangalore City	Rest of Gujarat	2%
12	Ranebennur/Kamadod/Chalageri	Bangalore City	2%
13	Bangalore City	Goa	2%
14	Bangalore City	Kolhapur/Sangli	2%
15	Hubbali/Gabbur	Chitradurga	1%
16	Devanagere/Karur	Belagavi	1%
17	Haveri/Devagiri	Bangalore City	1%
18	Bangalore City	Ahmedabad/Vadodara	1%
19	Pune	Rest of Tamil Nadu	1%
20	Hubbali/Gabbur	Rest of Tamil Nadu	1%
		Total	**71%**
3 Axle			
S.No.	**Origin**	**Destination**	**% of total**
1	Bangalore City	Mumbai	16%
2	Hubbali/Gabbur	Bangalore City	9%
3	Bangalore City	Pune	8%
4	Mumbai	Rest of Tamil Nadu	6%
5	Belagavi	Bangalore City	3%
6	Mumbai	Chennai city	3%
7	Bangalore City	Rest of Maharashtra	3%
8	Pune	Chennai city	3%
9	Mysuru/Bandipur	Mumbai	3%
10	Pune	Rest of Tamil Nadu	2%
11	Hubbali/Gabbur	Devanagere/Karur	2%
12	Bangalore City	Ahmedabad/Vadodara	2%
13	Bangalore City	Goa	2%
14	Haveri/Devagiri	Bangalore City	2%
15	Hubbali/Gabbur	Rest of Tamil Nadu	2%
16	Bangalore City	Kolhapur/Sangli	1%
17	Hubbali/Gabbur	Chennai city	1%
18	Ranebennur/Kamadod/Chalageri	Devanagere/Karur	1%
19	Ranebennur/Kamadod/Chalageri	Bangalore City	1%
20	Haveri/Devagiri	Devanagere/Karur	1%
		Total	**70%**
MAV			
S.No.	**Origin**	**Destination**	**% of total**
1	Bangalore City	Mumbai	11%
2	Hubbali/Gabbur	Bangalore City	9%
3	Bangalore City	Pune	9%
4	Mumbai	Chennai city	7%
5	Bangalore City	Kolhapur/Sangli	5%
6	Mumbai	Rest of Tamil Nadu	4%
7	Pune	Chennai city	3%
8	Devanagere/Karur	Rest of Gujarat	3%
9	Pune	Rest of Tamil Nadu	3%
10	Hubbali/Gabbur	Devanagere/Karur	2%
11	Bangalore City	Rest of Maharashtra	2%
12	Hubbali/Gabbur	Rest of Tamil Nadu	2%
13	Ranebennur/Kamadod/Chalageri	Bangalore City	2%
14	Devanagere/Karur	Dharwad	2%
15	Haveri/Devagiri	Bangalore City	2%
16	Mumbai	Madurai/Coimbatore/Tiruppur	1%
17	Dharwad	Bangalore City	1%
18	Mysuru/Bandipur	Pune	1%
19	Hubbali/Gabbur	Harihar/Kawalettu/Kodiyal	1%
20	Haveri/Devagiri	Devanagere/Karur	1%
		Total	**71%**

Traffic Study for Hubbali-Haveri-Chitradurga Section of NH-48 (Old NH-4) in the state of Karnataka - Hebbalu (TP03)

TOP 20 Origin Destination Pairs

Car

S.No.	Origin	Destination	% of total
1	Devanagere/Karur	Chitradurga	19%
2	Devanagere/Karur	Bangalore City	17%
3	Hubbali/Gabbur	Bangalore City	6%
4	Harihar/Kawalettu/Kodiyal	Chitradurga	5%
5	Harihar/Kawalettu/Kodiyal	Bangalore City	4%
6	Haveri/Devagiri	Bangalore City	4%
7	Devanagere/Karur	Bharmasagara/Jatlahalli	3%
8	Devanagere/Karur	Mysuru/Bandipur	3%
9	Bangalore City	Goa	2%
10	Hubbali/Gabbur	Chitradurga	2%
11	Devanagere/Karur	Tumakuru/Sira	2%
12	Hubbali/Gabbur	Tumakuru/Sira	2%
13	Ranebennur/Kamadod/Chalageri	Chitradurga	2%
14	Belagavi	Bangalore City	2%
15	Haveri/Devagiri	Shivamogga/Bhadravathi	2%
16	Ranebennur/Kamadod/Chalageri	Bangalore City	2%
17	Harihar/Kawalettu/Kodiyal	Tumakuru/Sira	1%
18	Bangalore City	Rest of Maharashtra	1%
19	Bangalore City	Kolhapur/Sangli	1%
20	Haveri/Devagiri	Chitradurga	1%
		Total	**79%**

MiniBus

S.No.	Origin	Destination	% of total
1	Devanagere/Karur	Chitradurga	15%
2	Devanagere/Karur	Bangalore City	10%
3	Hubbali/Gabbur	Bangalore City	8%
4	Devanagere/Karur	Tumakuru/Sira	8%
5	Hubbali/Gabbur	Chitradurga	5%
6	Hangal/Yellapur/Sirsi/Dhamra Reservoir	Bangalore City	4%
7	Devanagere/Karur	Bharmasagara/Jatlahalli	4%
8	Devanagere/Karur	Udupi/Mangaluru	4%
9	Chitradurga	Goa	3%
10	Hangal/Yellapur/Sirsi/Dhamra Reservoir	Tumakuru/Sira	3%
11	Hubbali/Gabbur	Tumakuru/Sira	3%
12	Haveri/Devagiri	Chitradurga	3%
13	Ranebennur/Kamadod/Chalageri	Bangalore City	3%
14	Ranebennur/Kamadod/Chalageri	Madurai/Coimbatore/Tiruppur	3%
15	Devanagere/Karur	Mysuru/Bandipur	3%
16	Bangalore City	Mumbai	3%
17	Bangalore City	Rest of Maharashtra	3%
18	Bangalore City	Rest of Telangana	3%
19	Haveri/Devagiri	Tumakuru/Sira	1%
20	Ranebennur/Kamadod/Chalageri	Tumakuru/Sira	1%
		Total	**88%**

Bus

S.No.	Origin	Destination	% of total
1	Devanagere/Karur	Bangalore City	22%
2	Devanagere/Karur	Chitradurga	22%
3	Hubbali/Gabbur	Bangalore City	15%
4	Harihar/Kawalettu/Kodiyal	Bangalore City	5%
5	Belagavi	Bangalore City	4%
6	Bangalore City	Pune	4%
7	Ranebennur/Kamadod/Chalageri	Chitradurga	3%
8	Bangalore City	Mumbai	3%
9	Ranebennur/Kamadod/Chalageri	Bangalore City	2%
10	Bangalore City	Goa	2%
11	Gadag-Betageri/Laxmeshwar	Bangalore City	2%
12	Devanagere/Karur	Tumakuru/Sira	1%
13	Harihar/Kawalettu/Kodiyal	Chitradurga	1%
14	Bangalore City	Kolhapur/Sangli	1%
15	Bangalore City	Jaipur/Ajmer/Kota	1%
16	Bangalore City	Vijaypura (Bijapur)	1%
17	Shiggaon/Bankapur	Bangalore City	1%
18	Haveri/Devagiri	Bangalore City	1%
19	Bangalore City	Rest of Maharashtra	1%
20	Hubbali/Gabbur	Tumakuru/Sira	1%
		Total	**91%**

Mini LCV

S.No.	Origin	Destination	% of total
1	Devanagere/Karur	Chitradurga	31%
2	Hubbali/Gabbur	Bangalore City	10%
3	Devanagere/Karur	Bangalore City	9%
4	Bangalore City	Pune	3%
5	Devanagere/Karur	Bharmasagara/Jatlahalli	3%
6	Bangalore City	Mumbai	3%
7	Harihar/Kawalettu/Kodiyal	Bangalore City	2%
8	Devanagere/Karur	Tumakuru/Sira	2%
9	Belagavi	Bangalore City	2%
10	Harihar/Kawalettu/Kodiyal	Chitradurga	2%
11	Haveri/Devagiri	Bangalore City	2%
12	Haveri/Devagiri	Chitradurga	1%
13	Ranebennur/Kamadod/Chalageri	Chitradurga	1%
14	Ranebennur/Kamadod/Chalageri	Bangalore City	1%
15	Hubbali/Gabbur	Tumakuru/Sira	1%
16	Hubbali/Gabbur	Chitradurga	1%
17	Devanagere/Karur	Chennai city	1%
18	Harihar/Kawalettu/Kodiyal	Tumakuru/Sira	1%
19	Chitradurga	Vijaypura (Bijapur)	1%
20	Bangalore City	Goa	1%
		Total	**79%**

Traffic Study for Hubbali-Haveri-Chitradurga Section of NH-48 (Old NH-4) in the state of Karnataka - Hebbalu (TP03)

TOP 20 Origin Destination Pairs

LCV

S.No.	Origin	Destination	% of total
1	Hubbali/Gabbur	Bangalore City	11%
2	Bangalore City	Mumbai	10%
3	Devanagere/Karur	Bangalore City	8%
4	Bangalore City	Pune	8%
5	Devanagere/Karur	Chitradurga	7%
6	Belagavi	Bangalore City	4%
7	Mumbai	Chennai city	3%
8	Pune	Chennai city	3%
9	Hubbali/Gabbur	Chitradurga	3%
10	Devanagere/Karur	Tumakuru/Sira	2%
11	Bangalore City	Goa	2%
12	Haveri/Devagiri	Bangalore City	2%
13	Harihar/Kawalettu/Kodiyal	Chitradurga	2%
14	Bangalore City	Rest of Maharashtra	2%
15	Hubbali/Gabbur	Tumakuru/Sira	2%
16	Harihar/Kawalettu/Kodiyal	Bangalore City	1%
17	Dharwad	Bangalore City	1%
18	Bangalore City	Kolhapur/Sangli	1%
19	Ranebennur/Kamadod/Chalageri	Bangalore City	1%
20	Hubbali/Gabbur	Chennai city	1%
		Total	**72%**

2 Axle

S.No.	Origin	Destination	% of total
1	Bangalore City	Mumbai	12%
2	Hubbali/Gabbur	Bangalore City	11%
3	Bangalore City	Pune	9%
4	Mumbai	Chennai city	6%
5	Belagavi	Tumakuru/Sira	5%
6	Pune	Chennai city	4%
7	Bangalore City	Rest of Maharashtra	3%
8	Devanagere/Karur	Chitradurga	3%
9	Belagavi	Bangalore City	2%
10	Devanagere/Karur	Bangalore City	2%
11	Bangalore City	Goa	2%
12	Bangalore City	Rest of Gujarat	2%
13	Dharwad	Bangalore City	1%
14	Harihar/Kawalettu/Kodiyal	Bangalore City	1%
15	Ranebennur/Kamadod/Chalageri	Bangalore City	1%
16	Haveri/Devagiri	Bangalore City	1%
17	Bangalore City	Kolhapur/Sangli	1%
18	Bangalore City	Vijaypura (Bijapur)	1%
19	Hubbali/Gabbur	Chitradurga	1%
20	Pune	Hosur/Krishnagiri	1%
		Total	**72%**

3 Axle

S.No.	Origin	Destination	% of total
1	Bangalore City	Mumbai	16%
2	Bangalore City	Pune	10%
3	Hubbali/Gabbur	Bangalore City	8%
4	Devanagere/Karur	Chitradurga	5%
5	Mumbai	Chennai city	4%
6	Belagavi	Bangalore City	3%
7	Bangalore City	Rest of Maharashtra	3%
8	Mumbai	Rest of Tamil Nadu	2%
9	Bangalore City	Goa	2%
10	Hubbali/Gabbur	Chennai city	2%
11	Harihar/Kawalettu/Kodiyal	Bangalore City	2%
12	Pune	Chennai city	2%
13	Devanagere/Karur	Bangalore City	2%
14	Hubbali/Gabbur	Chitradurga	1%
15	Mumbai	Madurai/Coimbatore/Tiruppur	1%
16	Hubbali/Gabbur	Tumakuru/Sira	1%
17	Pune	Rest of Tamil Nadu	1%
18	Devanagere/Karur	Chennai city	1%
19	Bangalore City	Ahmedabad/Vadodara	1%
20	Mumbai	Hosur/Krishnagiri	1%
		Total	**68%**

MAV

S.No.	Origin	Destination	% of total
1	Bangalore City	Mumbai	13%
2	Bangalore City	Pune	10%
3	Hubbali/Gabbur	Bangalore City	9%
4	Mumbai	Chennai city	6%
5	Pune	Chennai city	4%
6	Harihar/Kawalettu/Kodiyal	Tumakuru/Sira	4%
7	Mumbai	Rest of Tamil Nadu	4%
8	Belagavi	Bangalore City	4%
9	Bangalore City	Rest of Gujarat	3%
10	Bangalore City	Rest of Maharashtra	2%
11	Bangalore City	Goa	2%
12	Devanagere/Karur	Chitradurga	2%
13	Hubbali/Gabbur	Tumakuru/Sira	1%
14	Pune	Rest of Tamil Nadu	1%
15	Chennai city	Rest of Gujarat	1%
16	Bangalore City	Kolhapur/Sangli	1%
17	Hubbali/Gabbur	Chitradurga	1%
18	Hubbali/Gabbur	Chennai city	1%
19	Goa	Chennai city	1%
20	Chitradurga	Mumbai	1%
		Total	**73%**

APPENDIX 2.3
COMMODITY DISTRIBUTION AT TOLL PLAZA LOCATIONS

Traffic Study for Hubbali-Haveri-Chitradurga Section of NH-48 (Old NH-4) in the State of Karnataka
Commodity Distribution on Toll Plaza Locations

Sr. No.	Commodity Type	MLCV	LCV	2 Axle	3 Axle	MAV
	Bankapur (TP01)					
1	Food Grains and Cash Crops	7.3	2.9	3.6	2.7	3.5
2	Fruits & Vegetables	4.1	1.9	1.2	0.9	3.0
3	Building Materials	9.8	11.4	23.8	23.9	15.9
4	Iron & Steel Products	0.8	1.0	0.6	2.4	2.8
5	Petroleum Products, Chemicals and Gas	0.8	5.7	11.9	14.7	5.6
6	Heavy Machinery & Industrial Equipment	1.6	1.0	0.0	0.0	0.6
7	Industrial Products & Equipment	0.0	2.9	1.8	3.5	3.8
8	Consumer Items	4.1	4.8	2.4	1.8	3.3
9	Automobile and New Chassis	5.7	2.9	1.2	1.5	1.6
10	Containers	0.8	1.0	0.0	0.6	0.5
11	Ores & Minerals (Coal, Bauxite, limestone)	0.8	3.8	0.0	0.6	2.6
12	Miscellaneous Items (Medicines, Powder, Livestock, Forest products, Fertilizers, Milk, etc.)	3.3	0.0	0.6	0.9	1.1
13	Parcels	7.3	16.2	7.7	11.8	8.8
14	Sand/Stone chips	0.0	1.0	1.8	0.6	1.9
15	Cement/Fly ash	6.5	7.6	8.9	5.9	17.5
16	Empty Vehicles	47.2	36.2	34.5	28.3	27.6
	Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Sr. No.	Commodity Type	MLCV	LCV	2 Axle	3 Axle	MAV
	Chalageri (TP02)					
1	Food Grains and Cash Crops	8.4	1.4	2.7	5.9	10.1
2	Fruits & Vegetables	7.3	3.4	3.2	1.4	2.6
3	Building Materials	3.4	8.1	26.9	9.5	10.3
4	Iron & Steel Products	1.7	2.0	0.0	0.9	0.8
5	Petroleum Products, Chemicals and Gas	0.6	16.9	13.4	22.7	4.8
6	Heavy Machinery & Industrial Equipment	0.6	0.0	0.0	0.0	0.1
7	Industrial Products & Equipment	0.0	1.4	0.5	0.5	0.3
8	Consumer Items	3.9	3.4	1.1	1.4	1.3
9	Automobile and New Chassis	1.7	2.0	1.1	0.0	1.3
10	Containers	4.5	3.4	1.6	3.6	3.1
11	Ores & Minerals (Coal, Bauxite, limestone)	0.0	0.7	0.5	0.0	1.4
12	Miscellaneous Items (Medicines, Powder, Livestock, Forest products, Fertilizers, Milk, etc.)	2.2	1.4	0.5	0.0	0.3
13	Parcels	15.6	12.8	4.8	16.4	4.6
14	Sand/Stone chips	1.1	0.0	0.5	0.5	2.5
15	Cement/Fly ash	3.4	7.4	5.9	5.9	21.6
16	Empty Vehicles	45.8	35.8	37.1	31.4	34.9
	Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Sr. No.	Commodity Type	MLCV	LCV	2 Axle	3 Axle	MAV
	Hebbalu (TP03)					
1	Food Grains and Cash Crops	3.9	4.5	4.2	7.5	5.8
2	Fruits & Vegetables	3.2	3.8	2.8	3.3	2.6
3	Building Materials	4.5	1.5	3.5	2.5	7.6
4	Iron & Steel Products	1.3	0.8	0.7	2.1	1.3
5	Petroleum Products, Chemicals and Gas	2.6	9.0	22.2	17.8	6.6
6	Heavy Machinery & Industrial Equipment	0.0	0.8	0.0	0.0	0.0
7	Industrial Products & Equipment	1.3	1.5	1.4	2.1	2.0
8	Consumer Items	3.2	7.5	0.0	0.8	0.5
9	Automobile and New Chassis	1.3	3.8	0.7	1.2	2.1
10	Containers	0.0	0.0	0.0	0.0	0.0
11	Ores & Minerals (Coal, Bauxite, limestone)	0.0	1.5	1.4	0.8	2.9
12	Miscellaneous Items (Medicines, Powder, Livestock, Forest products, Fertilizers, Milk, etc.)	5.2	5.3	0.7	2.9	2.1
13	Parcels	3.2	9.8	5.6	7.5	4.4
14	Sand/Stone chips	1.9	0.0	1.4	0.4	7.4
15	Cement/Fly ash	10.4	6.8	20.8	10.8	29.0
16	Empty Vehicles	57.8	43.6	34.7	40.2	25.8
	Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

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Report
May 2023

Project Drone III: Traffic and Revenue due diligence – Aburoad Swaroopganj (Undavariya) and Palanpur Aburoad (Khemana)

National Highways Infra Projects Private Limited
Our ref: 24265605

steer

Report
May 2023

Project Drone III: Traffic and Revenue due diligence – Aburoad Swaroopganj (Undavariya) and Palanpur Aburoad (Khemana)

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Traffic Consultant developed the relationships in the models used to produce the forecasts for the projects based on data available through March 2023. Since March 2020, the outbreak of the virus known as COVID- 19 has spread throughout the world and has been defined by the World Health Organization as a "pandemic". The COVID-19 outbreak had a material impact on global economic and political affairs including having a significant impact on all the transportation industries, including toll road traffic, where in particular vehicle volumes fell in response to quarantine and self-care measures that governments imposed as a response to the different waves of infection rates in different parts of the country.

As of the date of distribution of this Report, the COVID-19 outbreak is continuing to have a material and uncertain impact on economic and political affairs in some jurisdictions, which may have a significant impact on the transportation sector including the actual usage of tolled highways. In such jurisdictions, these factors may introduce additional uncertainty into forward looking outputs included in our Report. Further, there are a wide range of views by authoritative sources concerning future travel patterns post-COVID, which adds uncertainty to forecasting in this regard.

As a result, no assurance can be provided by Traffic Consultant that the scenarios and assumptions Traffic Consultant has identified will prove to be accurate. Given the uncertainty inherent in this unprecedented pandemic, Traffic Consultant advises that all readers of the Reports consider the Reports in the context of their own assessment of the impact of COVID-19 on travel patterns post-COVID.

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Glossary Items

Acronym	Meaning
2A	2-Axle
3A	3-Axle
AADC	Annual Average Daily Collection
AADT	Annual Average Daily Traffic
ADT	Average Daily Traffic
AS	Aburoad Swaroopganj
BCF	Base Correction Factor
CAGR	Compound Annual Growth Rate
CJV	Cars / Jeeps / Vans
CPI	Consumer Price Index
Cr	Crore
COD	Commercial Operations Date
DPR	Detailed Project Report
DME	Delhi Mumbai Expressway
EDFC	Eastern Dedicated Freight corridor
ETC	Electronic Toll Collection
FY	Financial Year
GDP	Gross Domestic Product
GJC	Generalised Journey Cost
GSDP	Gross State Domestic Product
HCM	Heavy Commercial Vehicles
IAOI	Immediate Area of Influence
IHMCL	Indian Highways Management Company Limited
INR	Indian Rupee
LCV	Light Commercial Vehicles
LoS	Level of Service
MADT	Monthly Average Daily Traffic
MAV	Multi Axle Vehicle
MLCV	Mini LCV
NH	National Highway
NHAI	National Highways Authority of India

Acronym	Meaning
NHIPPL	National Highways Infra Projects Private Limited
NPV	Net Present Value
OD	Origin Destination
OSV	Over Sized Vehicle
PA	Palanpur Aburoad
PCI	Per Capita Income
PCU	Passenger Car Unit
RoS	Rest of State
SH	State Highway
T&R	Traffic and Revenue
TMS	Traffic Management System
TP	Toll Plaza
TVC	Traffic Volume Count
VOC	Vehicle Operating Costs
VOT	Value of Time
WADT	Weekly Average Daily Traffic
WDFC	Western Dedicated Freight corridor
WPI	Wholesale Price Index
YTD	Year to Date

Executive Summary for Abu Road- Swaroopganj, Palanpur-Abu Road ('Assets')

Project overview

The Assets are located on NH 27 in the states of Rajasthan and Gujarat and has one toll plaza each in the respective states namely Undavariya and Khemana. Both the toll plazas lie on the continuous section of NH 27 as shown in the map below and are located at:

- Undavariya (KM 670.750): Four-laned Asset starts near Swaroopganj on the NH 27 and ends near Abu Road.
- Khemana (KM 602.750): Four-laned Asset starts south of Abu Road and ends just south of Chitrasani village.

Figure: Asset context

Source: Steer cartography using OpenStreetMap data

Salient growth features and traffic generators

Undavariya (Rajasthan), Khemana (Gujarat) Toll Plazas lie on NH 27 which is the second longest highway in India. This section is one of the key connectors between Gujarat, Rajasthan and Eastern India and catering to East-West movement.

The Assets cater to the demands generated by the states connected through the National Highway. NH 27 runs over 3,507 kms completing the East-West movement and connects some

of the major states and industrial centres of Western states of Gujarat, Rajasthan with Eastern states of West Bengal, Assam, UP etc. The traffic profile is largely goods vehicles undertaking long distance movements and CJV traffic between Rajasthan & Gujarat.

The key industries in this region include dairy, textile, diamond polishing, and marble processing. Palanpur is a major hub for dairy production, having one of the largest dairies in the State – Banas Dairy. Mehsana is a town located south of Palanpur and is also known for its dairy production and related processing services.

Udaipur in the east and Jodhpur in the north of the asset, are popular tourist destinations in the state of Rajasthan. Tourism constitutes most of the state's tertiary sector and Rajasthan is one of the key tourist destinations in India which has attracted more than 50 million domestic tourists in 2019.

CJV movements on these Assets are predominantly local and of a short distance between Palanpur, Swaroopganj, Deesa and other small towns. MAV traffic on the other hand is long-distance in nature, connecting Rajasthan, Punjab, Delhi, and Haryana in the north to industrial cities in Gujarat. The toll plazas also cater port-bound traffic including Gandhidham industrial cluster while connecting the regional centres, i.e., Bhilwara, Jodhpur, etc., with the port towns Kandla and Mudra in the Kutch region. There is also an amount of traffic carrying powder and other inputs to ceramic-based industry located in the Morbi area in Gujarat.

Traffic volume and composite of vehicles

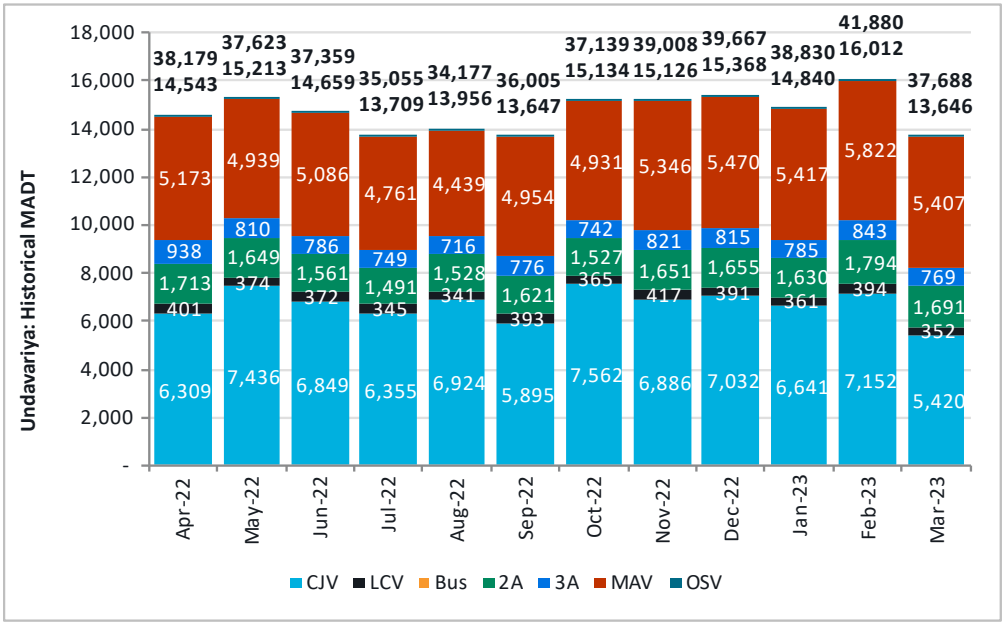
Historical traffic data

As discussed already, the toll plaza data is available from 1st Apr 2021 till 27th Mar 2023 for Undavariya TP and from 1st Apr 2021 till 31st Mar 2023 for Khemana TP.

It was found that for Undavariya, the violations abruptly got zero from an average of 1800 and exemptions reduced to half to about 850 from Aug-22 onwards. Whereas, for Khemana, we didn't observe such drastic change in violations/ exemptions data. It is understood from the client and toll plaza management that this was a result of improved reporting from Aug 2022, after the toll plazas were taken over by NHIPPL and the run-through traffic which was incorrectly recorded was removed from the traffic data reporting. Based on discussions with the client in order to make the old traffic data (i.e., before Aug-22) consistent with the data reported from Aug-22 onwards, the adjustment in the exemptions/ violations and passes traffic from Apr-22 to Jul-22 based on the exemptions/ violations and passes traffic observed from Aug-2022 onwards for CJV and LCV categories were made. For the remaining categories, we have relied on toll plaza data for all ticket type traffic.

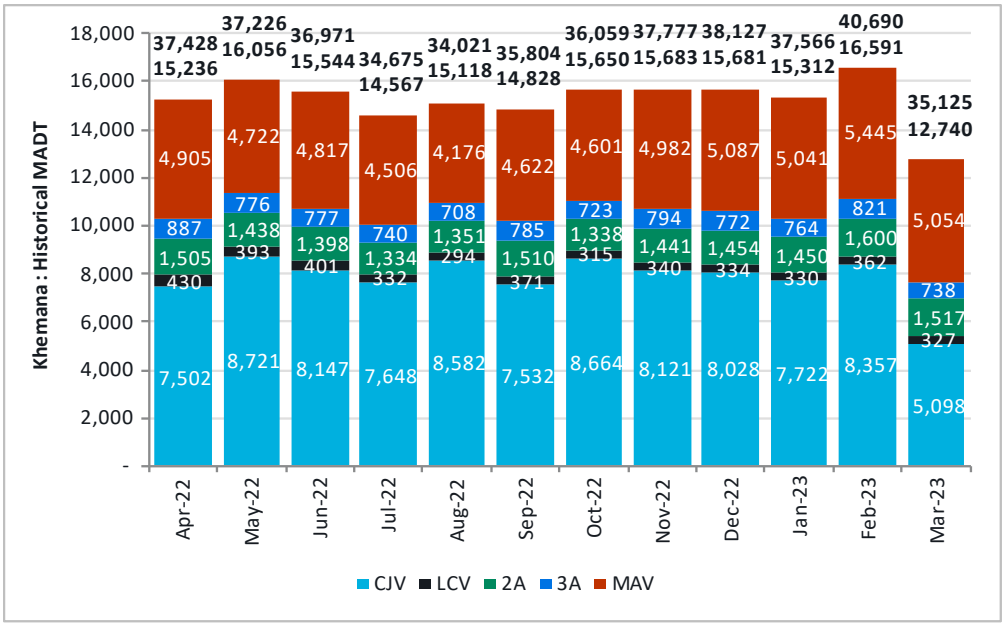
The Assets trend at 35,000 PCU levels in FY23 with robust CJV and MAV performance. Undavariya toll plaza observed an average of ~14.700 AADT and Khemana ~15,300 AADT in FY23. The Asset has shown a flattish growth, recording a PCU growth (excluding CJV and LCV) of ~2.5% and ~1.1% at Undavariya and Khemana respectively in FY23 with respect to FY22N. On an average, the daily revenue collection at Undavariya and Khemana are ~INR 18 lakhs and ~INR 26 lakhs respectively.

Figure: PCU and Adjusted MADT for FY23 - AS: Undavariya



Source: Steer analysis of client toll plaza data

Figure: PCU and Adjusted MADT for FY23 – PA: Khemana



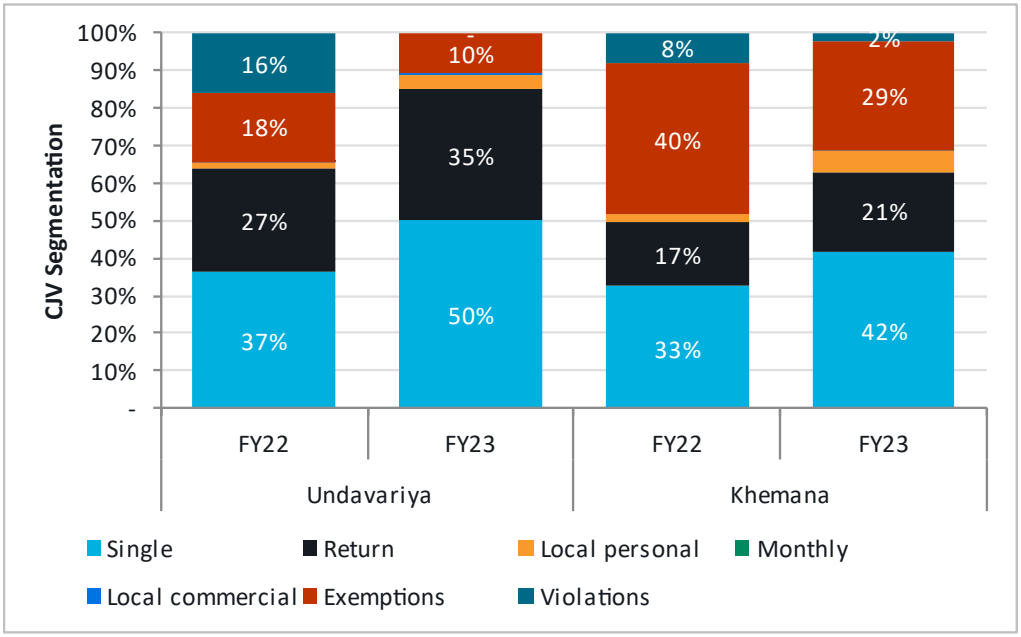
Source: Steer analysis of client toll plaza data

Toll segmentation

On the Assets, CJVs are observed to have ~40-45% exemptions/violations in FY22-23 YTD. There has been a significant improvement in exemptions/violation from FY22 to FY23 which is due to plazas taken over by NHIPPL in Aug 2022.

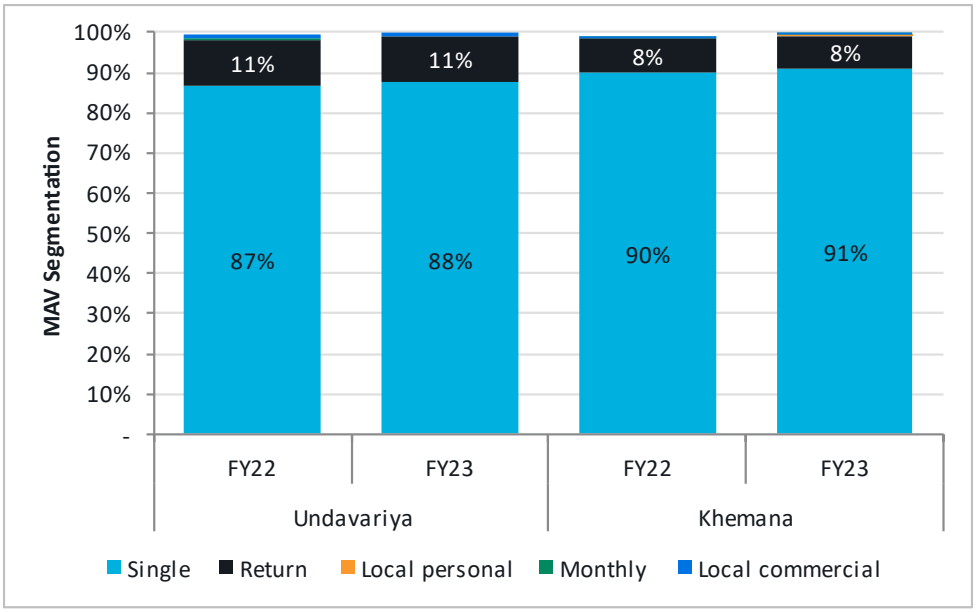
85%-90% of the commercial vehicles (3A/ MAV) plying on the Asset are observed to buy single tickets as the Asset caters to long-distance movements. Return trips are primarily attributed to the short distance trips in the vicinity of the Asset.

Figure: Segmentation CJV



Source: Steer analysis

Figure: Segmentation MAV



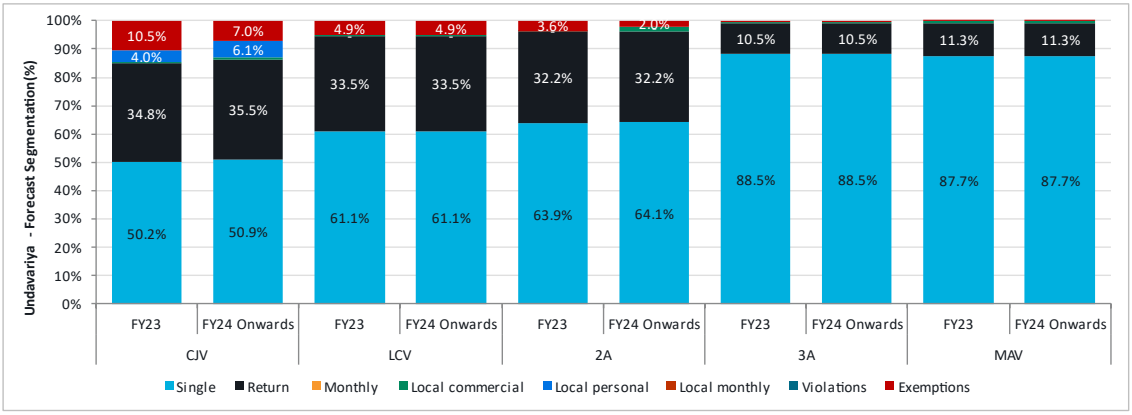
Source: Steer analysis

However, as the above-mentioned segmentation doesn't correctly reflect the share of non-toll paying traffic, i.e., violations and exemptions. The same has been assessed based on the difference between TMS and TVC dataset in the final adopted segmentation.

The final forecast segmentation is shown in the charts below. The changes in forecast toll segmentation observed on toll plaza is due to our understanding that once the Assets are taken over by the Client, the overall reporting practises will improve as the toll plaza will be operated by a reputed toll operator and may result in a decrease in total exemptions. Increasing compliance due to better operational efficiency in the next year will see the

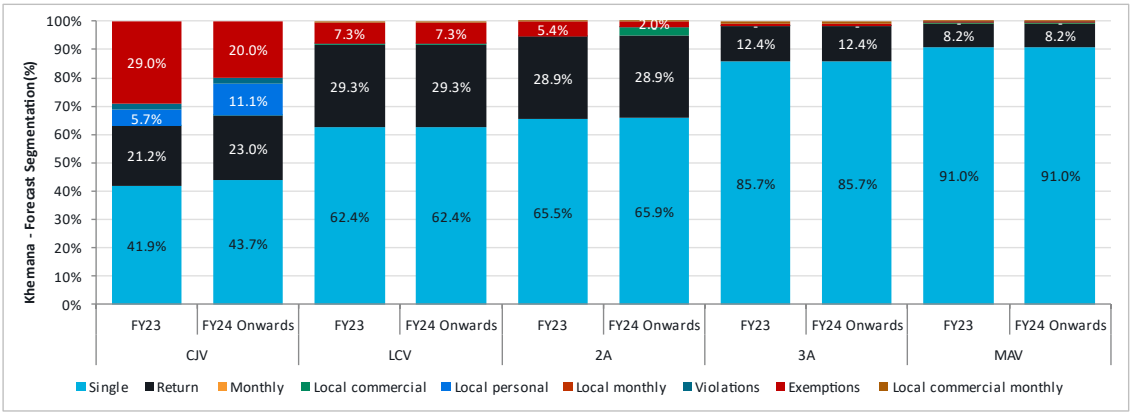
number of exemptions decrease further, with a subsequent increase in the Local passes, as well as the Single and Return ticket categories.

Figure: Toll segmentation (%) at AS: Undavariya



Source: Steer analysis

Figure: Toll segmentation (%) at PA: Khemana



Source: Steer analysis

Traffic forecast

The increase of traffic on any existing road alignment depends on how fast the background travel demand (background growth) will grow; and on how successfully the project road is in attracting that traffic (traffic capture). Background travel demand is driven by the prevalent socio-economic conditions in the region, which include:

- Changes in factors such as population, employment, and income distribution
- Economic growth (GSDP, and GDP).
- Growth of local industries near the Asset.

The model uses India GDP and GSDP of Rajasthan & Gujarat as the two macro-economic inputs which operate as growth drivers on our base year forecasts.

The network developments near the Assets' alignment which Steer believes would affect traffic on the Asset during the concession period are Amritsar Jamnagar Expressway, completion of Wester Dedicated Freight Corridor (WDFC), Two laning of Udaipur-Sirohi-Tharad road sections; Six Laning & LoS Improvement and 3A/MAV recovery (at Khemana TP).

Steer has developed traffic and revenue forecasts for the Assets by taking into consideration all inputs discussed above – base year estimates, macro-economic assumptions, growth drivers, elasticities, and forecast ticket segmentation. The table below provides the final (background plus impacts) traffic growth on the Assets.

Table: Final (background plus impacts) AADT forecast – AS: Undavariya

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	5,933	6,754	9,313	12,547	16,451	19,073
Mini LCV	785	838	987	1,147	1,315	1,418
LCV	386	412	477	555	637	686
Bus	665	711	837	972	1,115	1,202
2A	1,005	1,034	1,112	1,228	1,334	1,396
3A	796	797	873	1,004	1,118	1,187
MAV	5,137	5,311	6,756	8,901	11,299	12,912
OSV	7	7	10	12	16	18
AADT	**14,714**	**15,865**	**20,365**	**26,366**	**33,284**	**37,890**
PCUs	**37,841**	**39,769**	**49,928**	**64,248**	**80,337**	**91,054**

Table: Final (background plus impacts) AADT CAGR (%) – AS: Undavariya

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	6.7%	6.6%	6.1%	5.6%	5.1%	6.0%
Mini LCV	3.3%	3.3%	3.0%	2.8%	2.5%	3.0%
LCV	3.3%	2.9%	3.1%	2.8%	2.5%	2.9%
Bus	3.3%	3.3%	3.0%	2.8%	2.5%	3.0%
2A	1.4%	1.5%	2.0%	1.7%	1.5%	1.7%
3A	0.1%	1.9%	2.8%	2.2%	2.0%	2.0%
MAV	1.7%	4.9%	5.7%	4.9%	4.5%	4.7%
OSV	5.4%	5.6%	5.3%	4.9%	4.5%	5.2%
AADT	**3.8%**	**5.1%**	**5.3%**	**4.8%**	**4.4%**	**4.8%**
PCU's	**2.5%**	**4.7%**	**5.2%**	**4.6%**	**4.3%**	**4.5%**

Source: Steer analysis

Table: Final (background plus impacts) AADT forecast – PA: Khemana

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	7,438	8,467	11,675	15,775	20,684	23,980
Mini LCV	656	701	825	959	1,100	1,185
LCV	372	398	460	538	618	666
Bus	511	546	643	747	857	923
2A	998	1,013	1,086	1,203	1,307	1,367
3A	776	783	858	979	1,090	1,158
MAV	4,803	4,989	6,334	8,282	10,513	12,013

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
OSV	6	7	9	11	14	17
AADT	**15,561**	**16,904**	**21,890**	**28,495**	**36,182**	**41,309**
PCUs	**37,152**	**39,273**	**49,492**	**63,648**	**79,844**	**90,642**

Table: Final (background plus impacts) AADT CAGR (%) – PA: Khemana

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	6.7%	6.6%	6.2%	5.6%	5.1%	6.0%
Mini LCV	3.3%	3.3%	3.0%	2.8%	2.5%	3.0%
LCV	3.3%	2.9%	3.2%	2.8%	2.5%	2.9%
Bus	3.3%	3.3%	3.0%	2.8%	2.5%	3.0%
2A	0.7%	1.4%	2.1%	1.7%	1.5%	1.6%
3A	0.4%	1.8%	2.7%	2.2%	2.0%	2.0%
MAV	1.9%	4.9%	5.5%	4.9%	4.5%	4.7%
OSV	5.4%	5.6%	5.3%	4.9%	4.5%	5.2%
AADT	**4.2%**	**5.3%**	**5.4%**	**4.9%**	**4.5%**	**5.0%**
PCU's	**2.8%**	**4.7%**	**5.2%**	**4.6%**	**4.3%**	**4.6%**

Source: Steer analysis

Tollable Length and Toll Rates

In terms of tollable length, Undavariya currently (FY24) comprises 32.59 km whereas at Khemana the tolling length is 50.92 km. In India, toll rates are as per notification by the Ministry of Road Transport and Highways in the National Gazette. The present toll rates are determined with reference to the published base toll rates and are adjusted annually at the beginning of each fiscal year equal to 40% of the movement in the wholesale price index in December of the preceding year plus a fixed 3%.

According to the NHAI's toll notification for FY24, i.e., April 1, 2023, onwards, the toll rates at the Undavariya and Khemana toll plazas for Assets are as follows:

Table: FY24 toll rates – AS: Undavariya

Vehicle Type	Single	Return	Monthly
CJV	45	70	1555
LCV	75	115	2510
Bus/Truck	160	235	5260
3A	170	260	5735
MAV/ HCM/EME	245	370	8245
OSV	300	450	10040

Table: FY24 toll rates – PA: Khemana

Vehicle Type	Single	Return	Monthly
CJV	75	110	2425
LCV	120	175	3920
Bus/Truck	245	370	8215

3A	270	405	8960
MAV/ HCM/EME	385	580	12885
OSV	470	705	15685

1 Introduction

The assignment

1.1 National Highways Infra Projects Private Limited (**'NHIPPL'** or the '**Client'**) has commissioned Steer Davies Gleave India Private Limited (hereafter called '**Steer**') for an Annual Review traffic assessment study for the following two project roads ('**Assets**' or '**Asset**'). The Assets include a toll plaza each:

- Abu Road – Swaroopganj section of NH27 from KM 646.00 to KM 677.00 (Undavariya Toll Plaza); and
- Palanpur – Abu Road section of NH 27 from KM 601.00 to KM 646.00 (Khemana Toll Plaza)

1.2 The National Highways Authority of India (**'NHAI'**) has set up an Infrastructure Investment Trust ('**InvIT**') namely National Highways Infra Trust and is acting as its Sponsor to the said InvIT. The National Highway Infrastructure Investment Managers Private Limited (NHIIMPL) has been incorporated and appointed as the Investment Manager for the proposed InvIT by NHAI and NHIPPL is the entity under NHIIMPL, which is responsible for the operation and maintenance of these Assets.

1.3 Further, as part of this study, we have also covered a high-level comparison with the estimates provided in the earlier review study performed in FY21 (Dec-20) by Steer, which was used as an input to the first round of NHAI InvIT.

Table 1.1: Description of Assets

Asset ID	Asset: AS	Asset: PA
Asset Name	Abu Road - Swaroopganj	Palanpur - Abu Road
State	Rajasthan	Gujarat
NH	NH27	NH27
Length (km)	31 km	45 km
Chainage	km 646.00 to km 677.00	Km 601.00 to Km 646.00
Nos. of toll plaza	1	1
Toll plaza locations	Undavariya (km 670.75)	Khemana (km 602.75)
Taken over by NHIPPL	Aug 2022	Aug 2022
Tollable length (km)	32.59 km	50.92 km

Source: Toll notifications provided by the Client

Scope of work

1.4 Our scope of work for carrying out a T&R due diligence exercise covered:

- Review of available data, and concession agreements.
- Primary traffic survey and analysis as per the schedule presented in the table below:

  - 7-days video based classified traffic volume count (TVC).
  - 24 hours origin-destination (OD) survey and commodity analysis
- Assembly of the toll plaza level base data from PIU, where available, and review of the recent growth trends.
- Identify appropriate benchmarks for historical performance, seasonality, ticket type segmentation for the assets.
- Estimate the base traffic and revenue position utilising the above information.
- Establishing traffic growth estimates based on key economic growth drivers such as GDP, GSDP, commodity, etc. and estimating underlying growth elasticities based on these growth drivers.
- Assessing impacts from exogenous factors, including network change impacts.
- Developing traffic forecasts by vehicle class and segmentation categories; and
- Toll revenue estimation for entire concession period.

Primary Data collection undertaken by Steer

1.5 The below table presents the primary surveys which were undertaken by Steer for the purposes of this study.

Table 1.2: Data collection schedule

Survey	AS – Undavariya	PA – Khemana	Near Chitrasani at the intersection with SH54
TVC survey (7 x 24 hours)	27th Feb to 5th Mar 2023	27th Feb to 5th Mar 2023	(3 x 24 hours): 3rd Mar-23 to 5th Mar-23
OD survey (1 x 24 hours)	28th Feb 2023	2nd Mar 2023	-

Source: Steer

Our approach

1.6 The approach employed by Steer in the preparation of the traffic and revenue forecasts was developed to take advantage of the existing knowledge of the Assets and of the available data. It follows normal practices well established in addressing the issue of forecasting on-going traffic growth on a brownfield project. The key difference in this exercise as compared to a typical secondary market transaction, where the vendor provides detailed information on the historical performance of their assets, is that the historical traffic and revenue information provided by the client is very limited (and had reporting variations) and therefore less reliable than what could be expected. Therefore, significant efforts had to be put into developing a credible base year position and growth expectations through benchmarking with other asset in close vicinity of the asset under consideration.

1.7 The analysis focused on two sets of issues:

- understanding and verifying the traffic which is, at present, using the Asset; and
- identifying how and why that traffic will change in the future.

1.8 Regarding the former (i.e., current traffic on the asset), independent primary data collection was commissioned as part of this study and then compared against the available traffic data from various sources (as discussed in the table below).

1.9 To arrive at the base position, we have utilised information from various sources – including the toll plaza data shared by NHAI and client, Steer independent primary surveys to validate

the network understanding and ensure quality in the data collection process, and our context knowledge, to assess a reasonable demand on the corridor for the base year which formed the basis of future year forecasts.

1.10 Further base year revenue validation exercise has been undertaken to ensure both base traffic and segmentation assumptions are robust.

1.11 This approach is be-spoke for such projects where long time series consistent historical data is not available. Therefore, significant efforts had to be put into developing a credible base year position and growth expectations.

1.12 The estimation of future traffic demand on the Assets are driven by:

- Growth of 'background' traffic: this depends to a certain extent on the on-going socio-economic and demographic development of the area served by the Asset; and
- Change in the local and international industry: which drives heavy goods traffic on the Asset; and
- Change in the competitive position of the Asset: this reflects changes in highway capacity of competing roads and the relative changes in service levels (time, congestion, price, etc.) for the Asset, and their competitors.

1.13 The information related to the concession agreements, toll notifications, toll calculations and designed capacity was also provided. We have analysed traffic data from multiple independent sources to understand the current traffic on the Asset. The list of data sources available and discussed in later chapters in detail are presented below:

Table 1.3: List of data sources available

Data sources	Provided by	Undavariya TP	Khemana TP
Monthly toll plaza data sourced by Client	Client	Monthly level traffic and revenue starting 1st Apr 2021 up to 27th Mar 2023.	Monthly level traffic and revenue starting 1st Apr 2021 up to 31st Mar 2023.
TMS Daily Data	Client	TMS Daily data from 28th Feb 2023 to 7th Mar 2023.	TMS Daily data from 28th Feb 2023 to 7th Mar 2023.
Toll Notifications	Publicly sourced from NHAI website	Historical and latest toll notification detailing toll computations.	Historical and latest toll notification detailing toll computations.
Steer TVC counts	Steer	Commissioned by Steer, 7 days TVC counts from 27th Feb -5th Mar 2023	Commissioned by Steer, 7 days TVC counts from 27th Feb -5th Mar 2023
Origin-Destination (OD) survey	Steer	Commissioned by Steer, 24 hours on 28th Feb 2023	Commissioned by Steer, 24 hours on 2nd Mar 2023

Source: Steer's review of data points

Evolution of Covid19 pandemic in India in FY21 and FY22

1.14 On 24th March 2020, the Central government announced a nationwide 21-day lockdown which was extended for another three weeks until May 3rd. Further extensions until May 17th and again until May 31 featured relaxations in 'green' and 'orange' zones. Starting 8th June 2020, 'Unlock' phases began. States have also taken their own measures, with Central guidelines being the minimum expected restrictions from States. The tolling across all national highways in India was stopped between 25th March 2020 and 20th April 2020. These lockdowns resulted in significant disruptions to traffic, with a reduction of both commuting trips to work (as people were required to work from home or stay at home) and leisure trips (due to the closure of various entertainment venues, places of worship, tourist destinations, etc.). Goods movements, while still impacted, continued to a lesser extent due to a need to supply essential goods such as food, etc.

1.15 The traffic volumes since then gradually started recovering on most Assets in India, with varying extent. By Q3 of FY21 traffic levels were already at par FY20 AADT numbers and even higher in some cases. The traffic trends observed on most of the India toll roads during Q4FY21, showed sustained traffic levels as were witnessed in Q3FY21, which reflected sustained demand revival in the Indian economy. These traffic levels reflected the longer-term trends of a strong economic recovery, in segments like auto manufacturing, road construction, energy consumption /production etc., are more stable and are driving the growth over and above FY20 levels and are expected to continue as more segments of the economy, like hospitality, tourism, etc., recover fully from the pandemic.

1.16 This second wave of Covid19 was accompanied by various local and state level night curfews and lockdowns starting from April until end of June. The second wave of Covid19, although had a higher infection rate, the movement of traffic and goods was not impacted by the same magnitude as the first wave when whole country went under strict lockdown for two quarters. This can be attributed to the fact that almost all the restrictions were localised or at state level. Moreover, there was no restriction on movement of goods vehicles and other services. As the industries and agricultural activities continued to operate, the truck traffic did not fall as steeply as it did in Q1 FY21. The second half of the year from October'21 showed sustained traffic levels due to the resumption in Economic activities and easing of restrictions.

1.17 Post which, there was a third wave of Covid19 in Jan-Feb'22. It lived for a short period and hence, the impact on traffic was observed only for these two period at some of the toll plazas in India. Since, then there hasn't been any material impact of Covid19 on traffic.

1.18 Therefore, FY23 is considered as normal year and has been considered for base estimation (without any Covid19 specific adjustments) for FY23 which is explained in detail in Chapter 5.

Contents of this Report

1.19 The report has been divided into 6 chapters, including:

- Chapter 2 describes the key features of the Assets.
- Chapter 3 provides a historic traffic and revenue overview of the Assets, and presents all the survey data collection, and analysis.
- Chapter 4 discusses the socio-economic context in the corridors containing the Assets.
- Chapter 5 presents our base year traffic estimates and forecasting assumptions.
- Chapter 6 summarises our key forecasting assumptions, assessment of network impacts, and presents our traffic and revenue forecasts for the Assets.

2 The Asset

Introduction

2.1 This chapter provides a description of the Asset, based on primary data (from site visits), our understanding of the region and network surrounding the Assets. We cover the strategic network context, followed by key economic activities and network developments around the Assets.

2.2 The figure below shows the location of the Assets in relation to the country.

Figure 2-1: Asset locations

Source: Steer cartography using OpenStreetMap data

Asset context

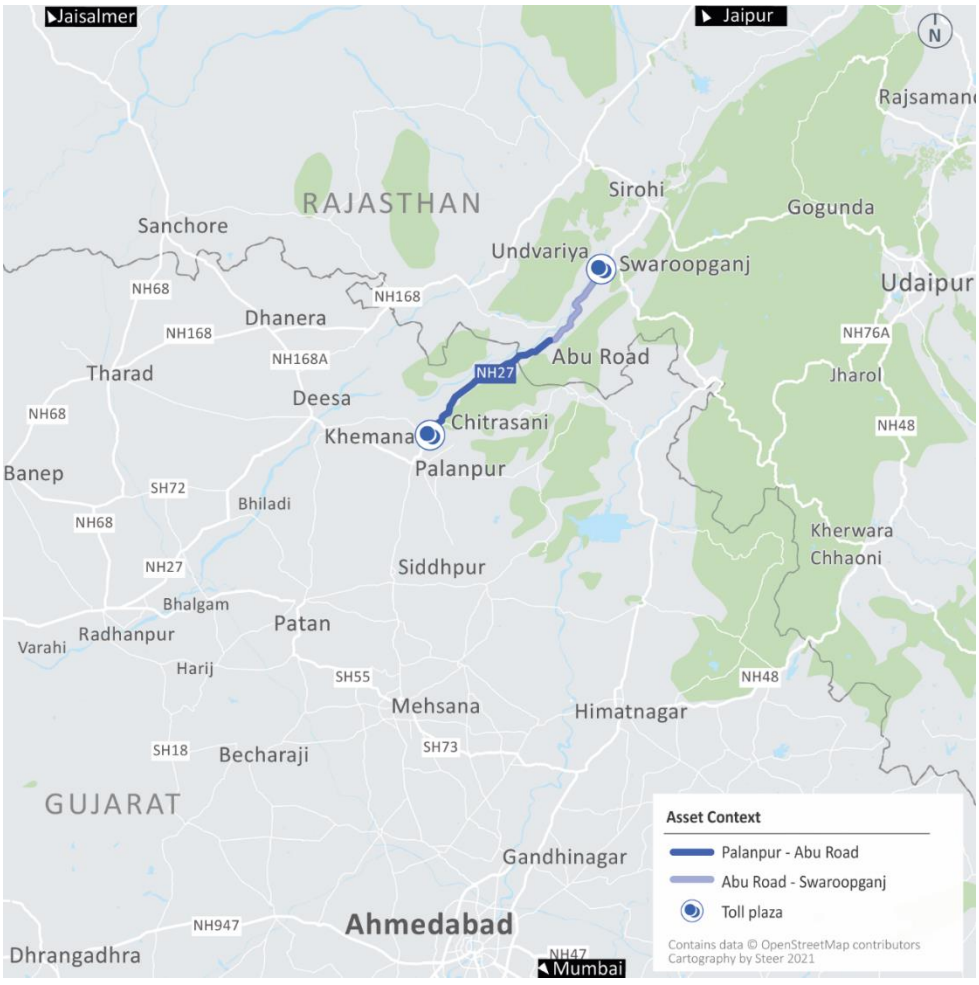
Context

2.3 As shown in the figure above, the Assets are located in Rajasthan and Gujarat, and it has two toll plazas – Undavariya and Khemana respectively.

2.4 Undavariya and Khemana lie on the continuous sections of the same road, as can be seen in Figure 2-2 figure presented below:

- Undavariya toll plaza: Four-laned Asset starts near Swaroopganj on the NH 27 and ends near Abu Road. The location of toll plaza is at Km 670.750.
- Khemana toll plaza: Four-laned Asset starts south of Abu Road and ends just south of Chitrasani village. The location of toll plaza is at Km 602.750.

Figure 2-2: Location of Asset and toll plaza



Source: Steer cartography using OpenStreetMap data

2.5 These toll plazas lie on the NH27 which forms one of the key connectors between western Gujarat in the south and Rajasthan and other northern and eastern Indian states. NH27, the second-longest highway in India, caters to the north-west movement between Haryana, Punjab, Delhi, and the different business centres of Gujarat, and east-west movement between Silchar and Porbandar, connecting major centres of economic activity such as Guwahati, Silguri, Lucknow and Udaipur.

2.6 The figures below show a typical cross-section of the Assets and its toll plazas as captured during site visits.

Figure 2-3: Toll Plaza, cross section and SH54 Micro diversion

2.7 There are 4 lanes on each side of the toll plaza with a separate lane for OSVs which are destined to major industries. The Assets are maintained in a good condition with proper lane markings and road signages, pavement distress is visible in some patches, like alligator cracking and rutting.

2.8 At Undavaria, passenger car movements which were present on the Asset are local traffic between the urban settlements along the Asset like Aburoad, Palanpur, Swaroop ganj and Pindwara etc. Medium distance traffic between southern Rajasthan (Jodhpur, Udaipur etc.) to various regions of Gujarat (which includes Ahmedabad, Mehsana, Vadodara etc.).

2.9 Major commodities which were seen on the Asset comprises of Marble blocks, coal, Cement, Dairy, Oil, Ceramic raw material and Gas for regional consumption and containers. Freight movements are observed between the settlements like Chittorgarh, Beawer, Jodhpur, Mehsana, Becharaji, Morbi ceramic cluster and Gandhidham industrial area. Some share of the traffic present on the Asset is generated by the two major ports Kandla and Mundra.

2.10 The long-distance movement for MAVs is observed to Haryana, Punjab, NCR. For the same, the traffic either takes a combination of NH62 - NH58- NH52 or NH-58 – NH-48.

Network context

2.11 The Asset location in the regional context is shown in map below:

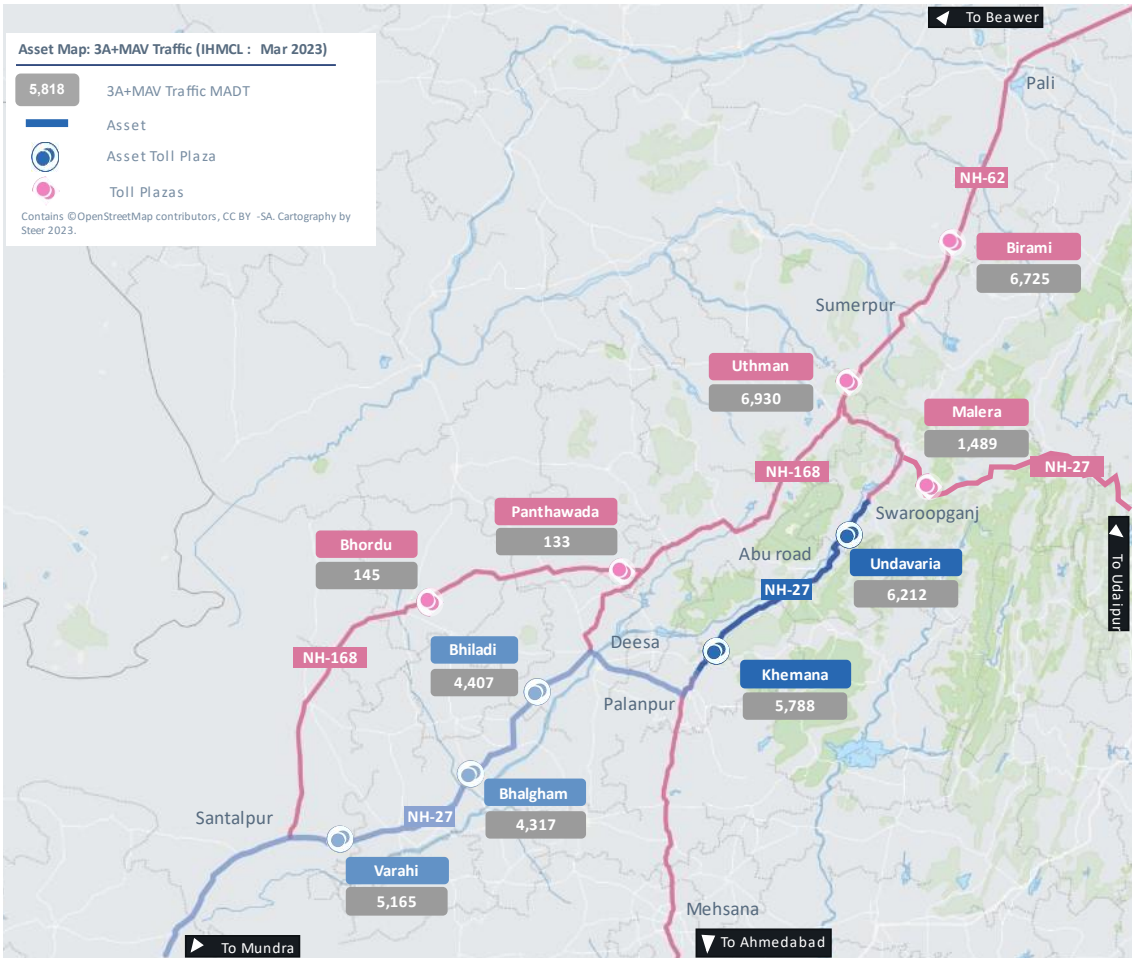
Figure 2-4: Asset location in the regional network context

2.12 Being located on the long-distance NH 27, the Assets cater to the following three markets:

- **Short-distance traffic** between local towns and cities (Palanpur, Aburoad) in and around the Asset
- **Medium-distance traffic** between origins and destinations in western and southern Rajasthan (Udaipur, Kota, Chittorgarh, Bhilwara, Jodhpur) in the north, and regions of Gujarat (including Ahmedabad).
- **Long-distance traffic** between northern Indian states and industrial regions, ports and cities of Gujarat, Maharashtra, and South India.

2.13 The Asset supports large volumes of good traffic movement, and the network around the Assets is quite dense with several industrial and consumptions activities going on. In order to get a sense of 3A+MAV volumes appearing on various toll plazas in the region, we have utilised the ETC traffic data (for Mar-23) as reported by IHMCL. The Asset location in the context of traffic volumes on surrounding assets is shown in map below.

Figure 2-5: Traffic volumes as per IHMCL ETC data for Mar-23



Source: Steer cartography

2.14 NH-62 connects Abohar in Punjab to Pindwara in Rajasthan. It offers connectivity to traffic originating from northern India (Punjab, NCR, Haryana, Uttarakhand), Rajasthan to the Gujarat region. Most of the traffic meant for central/ eastern Gujarat and western Maharashtra, diverts to our Asset on NH27 at Sirohi from NH62. Whereas some portion of traffic directed for western Gujarat continues on NH 168 and the remaining uses NH27 (with some move to Deesa and do not appear on Khemana TP).

2.15 NH168 is a recently operationalized 2-lane road, where the 3A/ MAV volume ranges between 130-160, which earlier used to reflect on the Asset. There is some more traffic shift expected to happen over next 1-2 years, before the traffic pattern stabilizes. This diversion is further discussed in the next sections.

Concession and tolling details

2.16 As discussed in chapter 1, the tolling length as per the latest technical schedules available from NHAI refer to a tolling length change. The concession and tolling details are provided in the table below.

Table 2.1: Summary of concession

Asset ID	Asset: AS	Asset: PA
Asset name	Abu Road - Swaroopganj	Palanpur Abu Road
State	Rajasthan	Gujarat
NH	NH27	NH27
Length (km)	31 km	45 m
Chainage	km 646.00 to km 677.00	km 601.00 to km 646.00
Nos. of toll plaza	1	1
Toll Plaza locations	Undavariya (km 670.75)	Khemana (km 602.75)
Taken over by NHIPPL	Aug 2022	Aug 2022
Tollable length (km)	32.59 km	50.92 km

Source: Information provided in NHAI technical schedules

2.17 The Assets have been handed over full control to the client and they have started operating the toll plaza from Aug-22 onwards. However, it is understood that the tolling systems and other infrastructure components have still not been completely replaced.

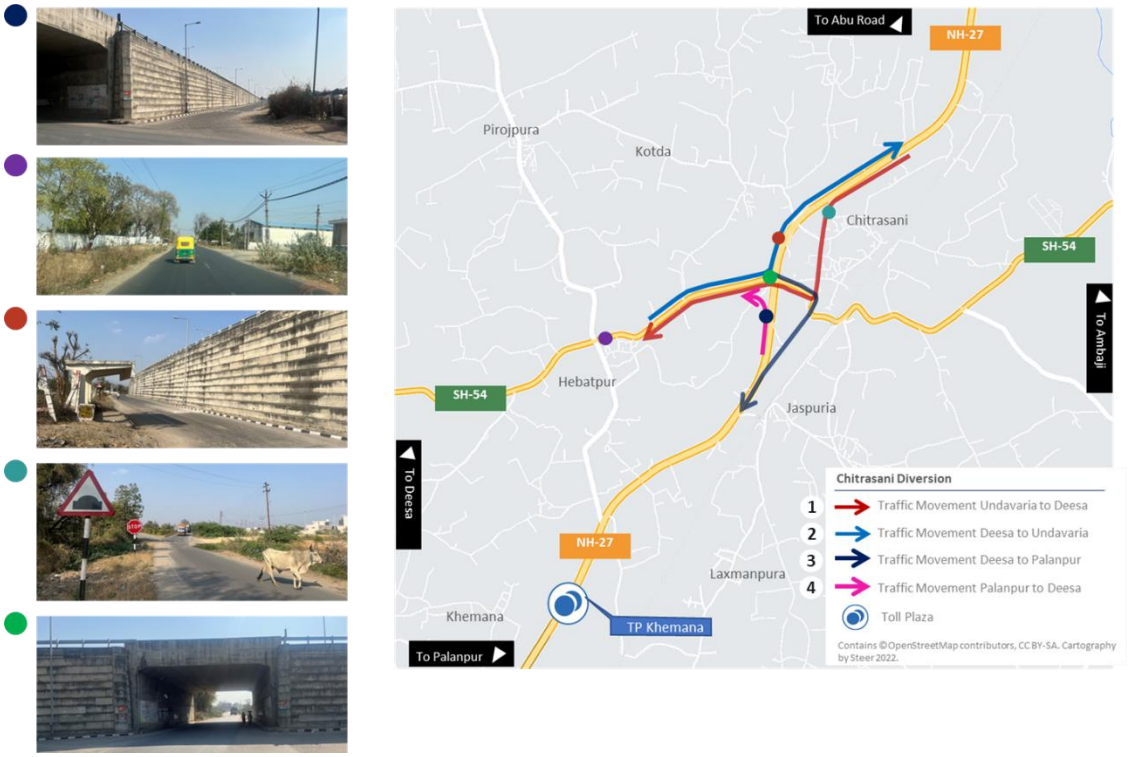
Local diversions

2.18 The RTO circle near Palanpur, which lies about 6km south of Khemana toll plaza, is under construction (understood to begin around Apr-May 2022). This construction activity has caused congestion, mainly driven by the CJV vehicles. Due to which, it has been observed that some of the long-haul traffic plying on NH27 and/ or destined to/ from central and western Gujarat including ports, Morbi, among others has started using the diversion to avoid Khemana TP, which is near Chitrasani that leads to the SH54.

2.19 Historically, the difference of 3A and MAVs volumes between Undavariya and Khemana was 250-300 vehicles, which has been observed to stabilize around 400 now. The same has been validated through TVC and OD through trips analysis. The area around this intersection near Chitrasani is also rich in warehousing activities, due to which some of the commercial traffic coming from Undavariya uses this diversion and does not appear at Khemana TP.

2.20 There are four potential movements possible at this intersection as explained below:

Figure 2-6: Pictorial representation of micro diversion



Source: Steer site visit pictures and cartography

- Movement 1: From Undavariya to Deesa – traffic takes a left turn to an arterial road instead of continuing on NH27, after a small detour passes under the NH27 flyover, and gets onto SH54 towards Deesa.
- Movement 2: From Deesa to Undavariya – traffic simply takes a left turn at the intersection to get onto NH27.
- Movement 3: From Deesa to Palanpur – traffic goes straight under the NH27 flyover, and takes a right turn and after a little detour gets onto NH27 towards Palanpur/ Khemana TP.
- Movement 4: From Palanpur to Deesa – traffic simply takes a left turn at the intersection.

2.21 SH54 provides a direct link to the traffic which is destined to Deesa and further towards the ports. It is a state highway 7m undivided road of good quality, however it is highly constrained at the two ends of the road where it meets Asset again. Near Chitrasani, in order to access SH54 from the project road, the trucks need to take the Movement 1 (as explained above). As they continue on SH54, they move along the back boundary wall of Deesa Airport, pass under the Asset flyover at Deesa, and continue on congested service road for about 2 kms before they meet the project road again. This is not a convenient road for the trucks as compared to a seamless movement offered by the Asset.

2.22 Therefore, we believe that once the construction is over by end of FY24, the diverted traffic will appear on the Asset (Khemana TP). The recovery impact is discussed in Chapter 6.

Toll plazas and toll rates

2.23 As discussed earlier in section, both the Assets have one toll plaza each. The toll plaza on the Asset has 4+4 lane configuration on each side with a separate lane for OSVs.

2.24 The road users having valid FASTag installed on their respective vehicles approach the ETC lanes where the installed RFID readers detect the tag and deduct toll charges equalling single trip or for Local/monthly pass/discounts wherever applicable. In case, the RFID reader is not able to detect the FASTag, handheld devices are used to read the vehicle's tag. Further, in cases where FASTag is blacklisted or not working, the user can only buy single cash ticket and are charged twice the single trip fare. The users crossing toll plaza twice within 24 hours automatically get return discount.

2.25 Like the other National Highway plazas, the Assets have Single, Return, Local Commercial, Local Personal, Monthly and Local Monthly tickets. Single toll rates and categories on each of the toll plaza are presented in the table below.

Table 2.2: Toll rates on the Asset (INR), applicable for FY23

Type of Vehicle	Undavariya			Khemana		
	Single	Return	Monthly	Single	Return	Monthly
CJV	45	65	1480	70	105	2310
LCV	70	105	2390	110	170	3730
Bus/Truck	150	225	5005	235	350	7820
3A	165	245	5460	255	385	8530
MAV	235	355	7850	370	550	12265
OSV	285	430	9555	450	670	14930

Source: NHAI - User fee Rate w.e.f. 01.04.2022

Table 2.3: Toll rates on the Asset (INR), applicable for FY24

Type of Vehicle	Undavariya			Khemana		
	Single	Return	Monthly	Single	Return	Monthly
CJV	45	70	1555	75	110	2425
LCV	75	115	2510	120	175	3920
Bus/Truck	160	235	5260	245	370	8215
3A	170	260	5735	270	405	8960
MAV	245	370	8245	385	580	12885
OSV	300	450	10040	470	705	15685

Source: Steer Computation

2.26 The following table shows the change in tolling length as per the schedules provided by the Client. There is no change in tollable length on the Assets.

Table 2.4: Tolling lengths for the Asset

Toll Plaza	FY23	FY24 onwards
Undavariya	32.59 Km	No change - 32.59 Km

Toll Plaza	FY23	FY24 onwards
Khemana	50.92 Km	No change - 50.92 Km

Source: NHAI – User fee rate and Schedule-M

Key economic activities

Industrial Influence

2.27 Based on our understanding of the region, the key industries are dairy, textile, diamond polishing, and marble processing. Palanpur is a major hub for dairy production, having one of the largest dairies in the State – Banas Dairy. Mehsana is a town located south of Palanpur and is also known for its dairy production and related processing services.

2.28 CJV movements on these Assets are predominantly local and of a short distance between Palanpur, Swaroopganj, Deesa and other small towns. MAV traffic on the other hand is long-distance in nature, connecting Rajasthan, Punjab, Delhi, and Haryana in the north to industrial cities like Morbi, Jamnagar and Gandhidham, and ports like Kandla and Mundra in Gujarat.

2.29 The toll plazas also cater port-bound traffic including Gandhidham industrial cluster while connecting the regional centres, i.e., Bhilwara, Jodhpur, etc., with the port towns Kandla and Mudra in the Kutch region. There is also an amount of traffic carrying powder and other inputs to ceramic-based industry located in the Morbi area in Gujarat.

Network developments

Western Dedicated Freight Corridor

2.30 The Government of India has plans to develop two Dedicated Freight Rail Corridors: The Western Dedicated Freight Corridor (WDFC) linking Dadri, east of Delhi, to Mumbai and the Eastern Dedicated Freight Corridor (EDFC) linking Ludhiana to Dhankuni in West Bengal.

2.31 We estimate that on completion of WDFC, the relevant goods carried via roads will shift to rail, causing a reduction in traffic volume on the corridor. As per the DFC website, base commodities which are expected to be carried on WDFC include containers, POL, fertilizers, iron & steel and cement, groceries, agricultural products such as food grains, among other bulk commodities and travelling more than 750Kms to Rail from Road. Additional commodities such as manufacturing, chemicals, courier/parcel, and other ecommerce related commodities will also have an alternate to shift to the DFC. However, these commodities may take a longer duration to shift since related first mile and last mile connectivity infrastructure needs to be developed for seamless loading/unloading process. The Rewari to Palanpur section of the DFC commissioned in April 2021 and first RO-RO service from Palanpur was flagged off in August 2021. Whereas, the Dadri-Rewari section was commissioned in Mar-23. The impact of WDFC on Palanpur Aburoad will be immediate and negative.

Udaipur Sirohi Tharad Corridor

2.32 The Assets are part of the long-distance corridor network connecting Rajasthan and the northern Indian states with the western Gujarat region, particularly industries and ports in the Kutch and Morbi region. Southbound trips from Delhi and the northern states plying via Jaipur enter Gujarat through Udaipur and Pindwara. This traffic market however has two options to reach Radhanpur – via the Asset and via Pindwara-Sirohi-Tharad.

2.33 Road sections on the Pindwara-Sirohi-Tharad corridor was upgraded from single lane to two-lane configuration under NH168 upgrade. While the Pindwara-Sirohi section being without a toll plaza does not entail tolls (though part of the tolled BPP toll road Asset), the Sirohi-Tharad section is tolled.

2.34 The traffic pattern (i.e., the total diversion from the Asset) has not established yet on account of this development which took place in the last year. Therefore, there will be some negative impact over the next few years on the Assets.

Amritsar Jamnagar Expressway

2.35 A 1256 km long Amritsar – Jamnagar Expressway is being developed by the NHAI. Of which, 915 km is being developed as a Greenfield section and the remaining 341 km as a brownfield upgrade. The existing distance between Amritsar and Jamnagar using the Asset is 1520 kms which will get reduced to 1256 kms after the expressway becomes operational.

2.36 The work on six lanes, 917 km (greenfield) long Amritsar-Bhatinda-Jamnagar (Trans-Rajasthan) corridor is going at a fast pace. The work for the entire length is awarded and the 594 km stretch has been constructed till October 2022. The Rajasthan section of length 440 km will be completed and opened to traffic soon. As per the public sources, it is expected to be completed by FY25.

2.37 The proposed expressway between Amritsar and Jamnagar will establish a new competing route as long-distance corridor for traffic moving between Amritsar/Punjab/ Northern Rajasthan and Jamnagar/Coastal Gujarat. This will have a negative impact on the Assets.

3 Traffic and revenue description

Introduction

3.1 This Chapter outlines the historical and current traffic and revenues on the Assets and how these are used to establish the current/base year demand (in terms of AADTs), which forms the basis of our forecasts. We then use our independent traffic volume counts (TVC) to validate the AADTs and estimate shares of toll violations and unreported exemptions.

3.2 For traffic and revenue due diligence exercise the data provided by the toll plaza is typically the primary source of establishing a road asset's base position, in terms of vehicle level AADT and PCU levels, as well as historical performance, in terms of growth trends by vehicle type. However due to the unique nature of the assets under consideration in this assignment, being operated under different Operate Manage and Transfer (OMT) contracts, basically independent contractors, the toll plaza based historical data available was affected by reporting variations. Therefore, it was important to validate the toll plaza data against other independent data sources. In the case of the Assets, the client started operating the toll plazas from Aug'22 onwards.

3.3 An independent traffic count is often a good way to validate the toll plaza information which has been used in combination with data shared by the Client team. A fresh set forecasting approach was also developed using this independent data and benchmarks available from other studies. These data sources, described in detail below, were helpful in establishing the base position as well as the historical trends that could be relied upon for developing a robust set of forecasts.

Historical traffic and revenue analysis from various sources

3.4 This section below presents the sources from which the historical traffic and revenue of the Assets have been analysed. For this study, the toll plaza traffic data was made available by the Client.

3.5 The following section outlines the current and historical traffic and revenue datasets available on the Assets, as well as our analysis of primary traffic count data, collected as a part of this project. In addition to the data available through secondary sources we have conducted our own independent Traffic Volume Counts (TVC) counts to validate the AADT and estimate shares of vehicle classes, where data are not available or aggregated.

Historical traffic

Data sets available from the earlier study

3.6 During the earlier study undertaken by Steer in Dec-2020 (FY21), the Client had provided the following data sets to us.

- IHMCL data (Jul-15 to Nov-20 for Undavariya and Dec-15 to Feb-19 for Khemana)
- Schedule M (Apr-19 to Dec-20 for Undavariya, Jun-19 to Nov-20 for Khemana)

- DPR (7 Day classified counts), OD data (Feb-18 and Nov-20, 1 Day OD data)
- Traffic data from surrounding Assets (Apr-19 to Jan-21)
- ETC Data (Apr-19 to Dec-20 for Undavariya, Jun-19 to Nov-20 for Khemana)

3.7 Each of the data points analysed pointed towards a sustained traffic growth on the Asset under consideration historically. Payment through ETC mode was observed to be increasing consistently on the Asset, with levels reaching up to 90% for heavy vehicles. These proportions were much lower for the passenger vehicles.

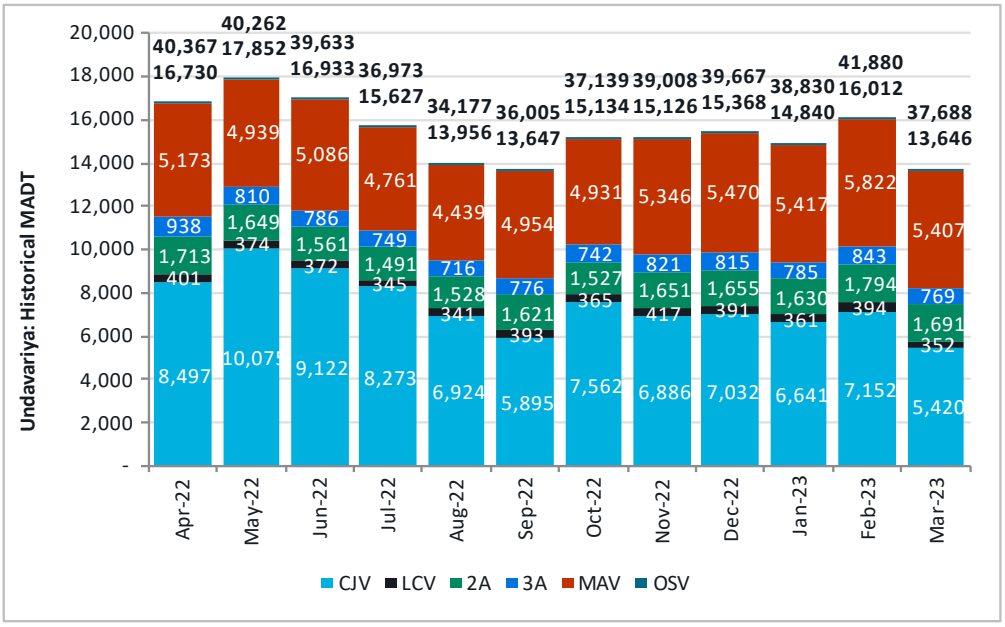
3.8 In the absence of traffic data from the toll plaza/ TMS, the above-mentioned data sets were triangulated by undertaking like to like comparison between different data sets, benchmarking with surrounding assets to determine the suitable PCU level, historic growth, seasonality, and the toll segmentation.

3.9 However, for the purpose of this study we have been provided 24 months toll plaza data by the Client, which is the primary source of establishing a road asset's base position, in terms of vehicle level AADT and PCU levels, as well as historical performance in terms of growth trends by vehicle type. Therefore, for the purposes of historical analysis and FY23 base AADT estimation we have utilised only this data source (along with steer primary survey).

Toll plaza data (ETC + Cash + Violations/ Exemptions) as shared by Client

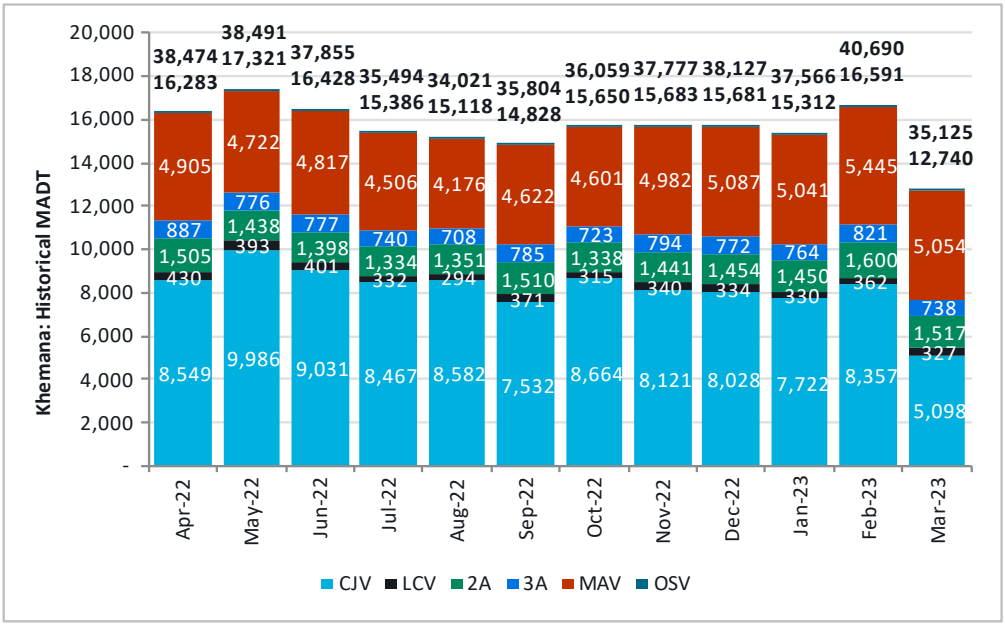
3.10 As discussed already, the toll plaza data is available from 1st Apr 2021 till 27th Mar 2023 for Undavariya TP and from 1st Apr 2021 till 31st Mar 2023 for Khemana TP. The corresponding revenue for the stated period was also provided by the Client. Figure below shows the MADT reported for the Assets.

Figure 3-1 Historical MADT at Undavariya Toll Plaza



Source: Steer Analysis of Client Data

Figure 3-2 Historical MADT at Khemana Toll Plaza



Source: Steer Analysis of Client Data

3.11 It was found that for Undavariya, the violations abruptly got zero from an average of 1800 and exemptions reduced to half to about 850 from Aug-22 onwards. Whereas, for Khemana, we didn't observe such drastic change in violations/ exemptions data. It is understood from the client and toll plaza management that this was a result of improved reporting from Aug 2022, after the toll plazas were taken over by NHIPPL and the run-through traffic which was incorrectly recorded was removed from the traffic data reporting. Based on discussions with the client in order to make the old traffic data (i.e., before Aug-22) consistent with the data reported from Aug-22 onwards, the following adjustments were made to traffic between Apr'22 – July'22.

3.12 An adjustment in the exemptions/ violations and passes traffic from Apr-22 to Jul-22 based on the exemptions/ violations and passes traffic observed from Aug-2022 onwards for CJV and LCV categories has been made. For the remaining categories, we have relied on toll plaza data for all ticket type traffic. Following which, the adjustment towards violation/ exemptions has been made based on difference between TVC and TMS. Please note that the traffic numbers presented for FY22 are the unadjusted numbers.

3.13 The following table explains the quarterly recorded MADT (adjusted for exemptions/ violations as explained above for fY23) by vehicle class, at the Asset's toll plaza over the period of 24 months from Apr-21 to Mar-23 (as provided by the client).

Table 3.1: Reported AADT at AS: Undavariya

Vehicle Category	FY22	FY22 N	FY23 YTD	Q1 FY23	Q2 FY23	Q3 FY23	Q4 FY23	FY 23 vs FY22	FY23 vs FY22N
CJV	7,524	7,821	6,718	6,865	6,391	7,160	6,405		
LCV	372	375	375	382	360	391	369		
Bus/ 2A	1,423	1,439	1,624	1,641	1,546	1,611	1,705	14.1%	12.9%
3A	887	906	796	845	747	793	799	(10.3%)	(12.2%)

Vehicle Category	FY22	FY22 N	FY23 YTD	Q1 FY23	Q2 FY23	Q3 FY23	Q4 FY23	FY 23 vs FY22	FY23 vs FY22N
MAV	4,810	5,026	5,137	5,066	4,718	5,249	5,549	6.8%	2.2%
OSV	5	5	7	6	8	6	5	27.3%	34.2%
Total	**15,021**	**15,573**	**14,656**	**14,805**	**13,771**	**15,209**	**14,833**		
Total PCUs	**36,680**	**38,060**	**37,684**	**37,721**	**35,079**	**38,605**	**39,466**		

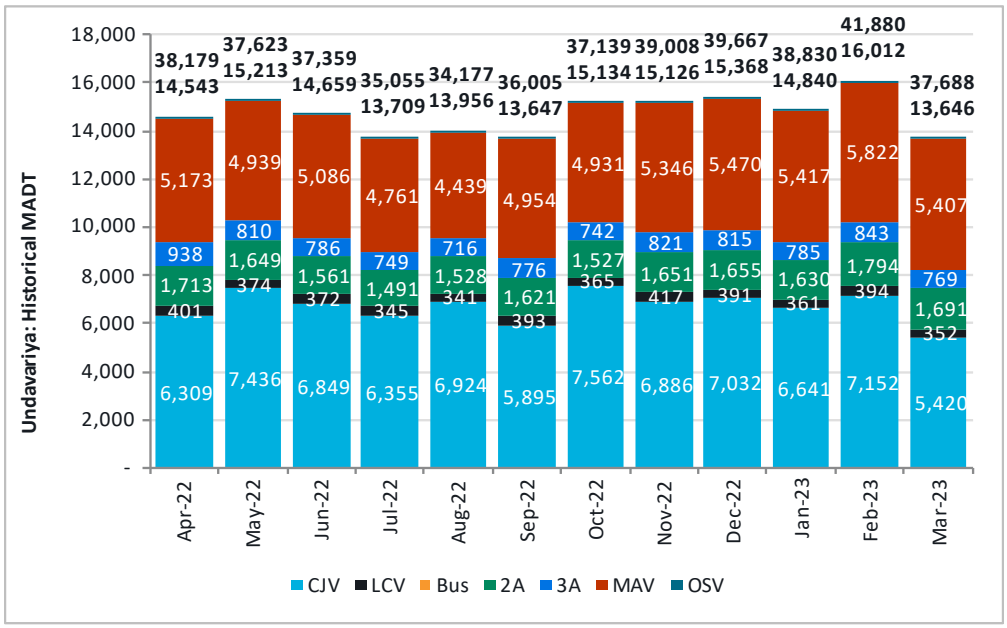
Source: Steer analysis of client data from 1st Apr-21 to 27th Mar-23

Table 3.2: Reported AADT at PA: Khemana

Vehicle Category	FY22	FY22 N	FY23 YTD	Q1 FY23	Q2 FY23	Q3 FY23	Q4 FY23	FY 23 vs FY22	FY23 vs FY22N
CJV	8,132	8,586	8,094	8,123	7,921	8,271	7,059		
LCV	392	405	354	408	332	330	340		
Bus/ 2A	1,276	1,281	1,436	1,447	1,398	1,411	1,522	12.6%	12.1%
3A	864	864	776	813	744	763	774	(10.2%)	(10.2%)
MAV	4,576	4,779	4,803	4,814	4,435	4,890	5,180	5.0%	0.5%
OSV	5	5	6	6	7	6	5	22.8%	26.8%
Total	**15,244**	**15,921**	**15,471**	**15,612**	**14,837**	**15,671**	**14,881**		
Total PCUs	**35,751**	**37,158**	**36,906**	**37,208**	**34,834**	**37,321**	**37,794**		

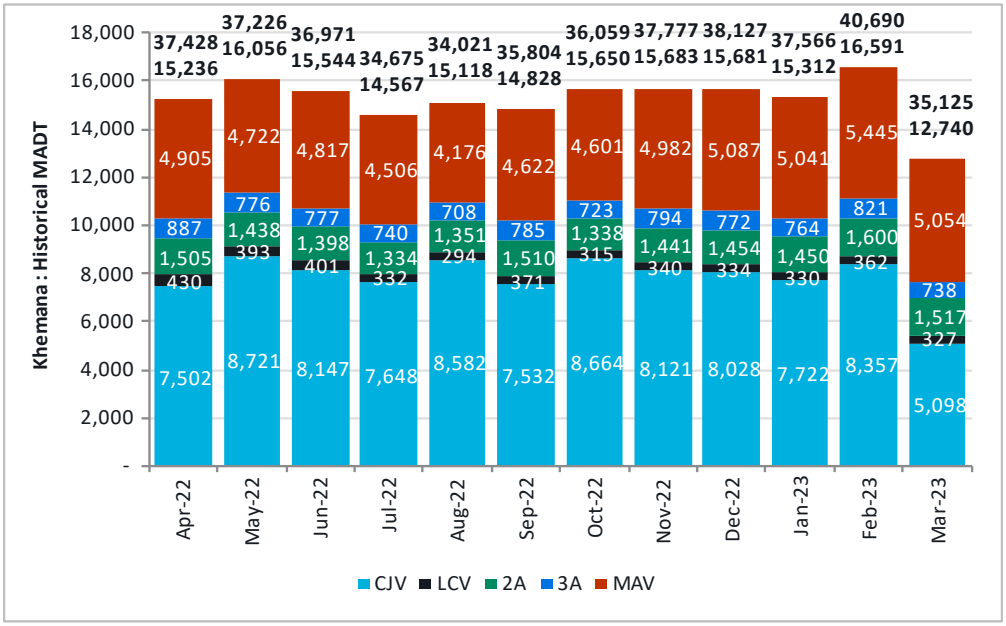
Source: Steer analysis of client data from 1st Apr-21 to 31st Mar-23

Figure 3-3 Adjusted MADT at Undavariya Toll Plaza



Source: Steer Analysis of Client Data

Figure 3-4 Adjusted MADT at Khemana Toll Plaza



Source: Steer Analysis of Client Data

3.14 Further, as stated above, the reporting of exemptions/ violations has improved post the taken over of toll plazas by NHIPPL in Aug-22. As a result, the FY23 data is adjusted traffic data, whereas the FY22 data still includes higher number of exemptions/ violations in CJV and LCV categories. Accordingly, for CJV and LCV, the growth rate between FY22N and FY23YTD cannot be interpreted correctly and do not reflect the actual volumes.

3.15 The Asset trends at over 35,000 PCU levels in FY23 with robust CJV and MAVs performance. ETC proportion of reported traffic exceeds 95% in the recent months of FY23.

3.16 The Asset has shown a flattish growth, recording a PCU growth (excluding CJV and LCV) of ~2.5% and ~1.1% at Undavariya and Khemana respectively in FY23 with respect to FY22N. It showed a slowdown from Q1 to Q2 but grew at a higher rate in subsequent quarters.

3.17 As per the reported data, it can be observed that the Asset witnesses a strong contribution of both passenger and goods vehicles. In FY23, the Asset observed ~14,700 and ~15,300 vehicles at Undavariya and Khemana respectively, dominated by CJV/ MAVs. For Undavariya, the share of heavy commercial vehicles (3A/MAV) collectively is ~41% which is comparable to CJV share, i.e., ~46% in FY23. Whereas, for Khemana, the share of trucks (3A/MAV) collectively is ~36%, which is significantly lower than the CJV share, i.e., ~52% in FY23. This is because the Khemana TP lies close to Palanpur, due to which it observes higher local/ urban CJV traffic.

3.18 Passenger movements (Car + Bus) at both Undavariya, Khemana TPs have a mix of short distance trips such as Patan, Palanpur, etc. and medium distance trips to the respective capital cities Jaipur (East Rajasthan) & Ahmedabad (North Rajasthan). Palanpur and Patan are known for architectural shrines and Palanpur is additionally known for the original home of the Indian diamond merchants.

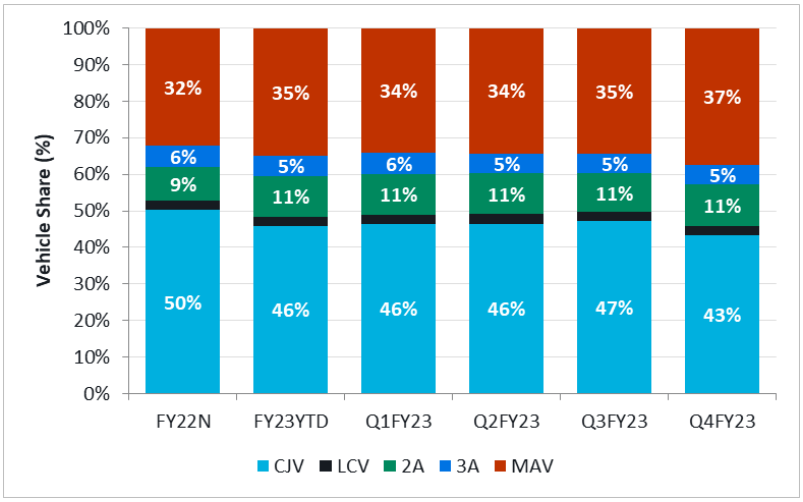
3.19 It is observed that historically, the difference between 3A and MAVs at Undavariya and Khemana TP was 250-300 vehicles, which has been observed to stabilize around ~400 vehicles now in Q4 of FY23. In FY23, the Undavariya plaza saw ~5930 3A/MAVs crossing each day and the Khemana plaza saw ~5580 3A/MAVs vehicles.

3.20 Apart from CJVs and 3A/MAVs, Bus/2As also contribute significantly to the total traffic share. In FY23, ~1625 Bus/2As plied on the Undavariya TP and ~1435 Bus/2As on Khemana TP. Buses and 2As are reported together on the toll plaza. However, it was observed in the TVC counts that 2As dominate the traffic in the Bus/2A category as the proportion of 2A was observed to be 1.5-2 times the Buses in the TVC data.

3.21 Among the trucks, both the Assets observed a slowdown in 3A vehicles and a much higher growth in 2A vehicles. Further, the MAVs at Khemana didn't observe similar growth as at Undavariya due to some traffic diversion near Chitrasani on account of congestion caused by the construction activity happening near Palampur, about 6 km south of Khemana TP.

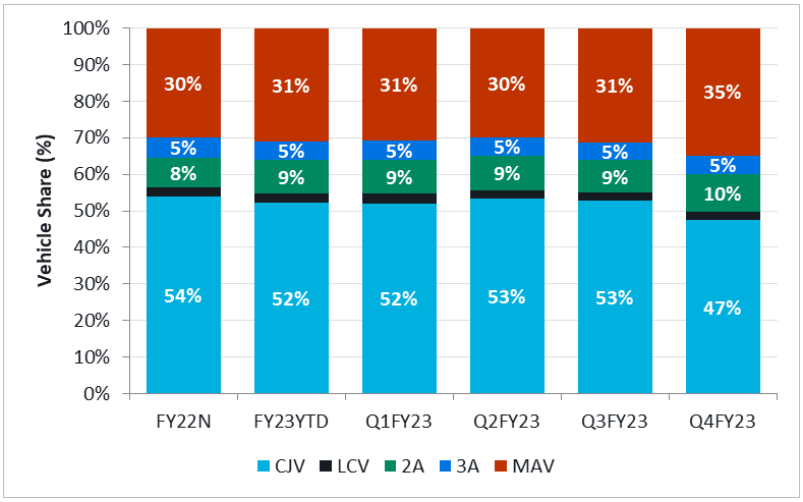
3.22 The figures below show the category-wise share of traffic at the toll plazas for FY22 N and FY23 YTD. It can be seen that CJVs make up the highest proportion of vehicle share with an average 46% and 52% of total vehicles at Undavariya and Khemana respectively. As the data for FY22 is unadjusted of exemptions/ violations, it includes a higher number of non-toll paying traffic for CJV and LCV, Therefore, the correct interpretation on change in proportion between FY22 and FY23 cannot be made.

Figure 3-5 Vehicle share at AS: Undavariya



Source: Steer analysis of client data from 1st Apr-21 to 27th Mar-23

Figure 3-6: Vehicle share at PA: Khemana



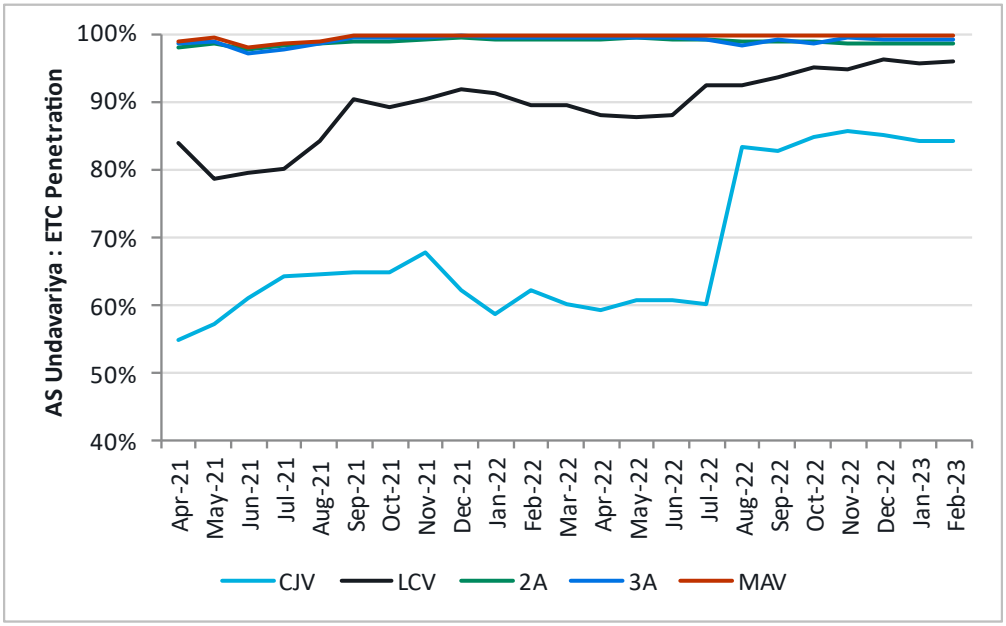
Source: Steer analysis of client data from 1st Apr-21 to 31st Mar-23

3.23 Although, CJVs have the highest proportion in total traffic, it is MAVs, which derive the highest proportion of revenue of ~66% of total revenue in FY23 at each of the toll plazas.

3.24 We have verified the traffic volumes by conducting our own independent TVC counts. The difference between TVC counts and the TMS and is being treated as unreported 'exemptions/violations' (non-paying traffic) in our forecasts explained in detail in TVC comparison section.

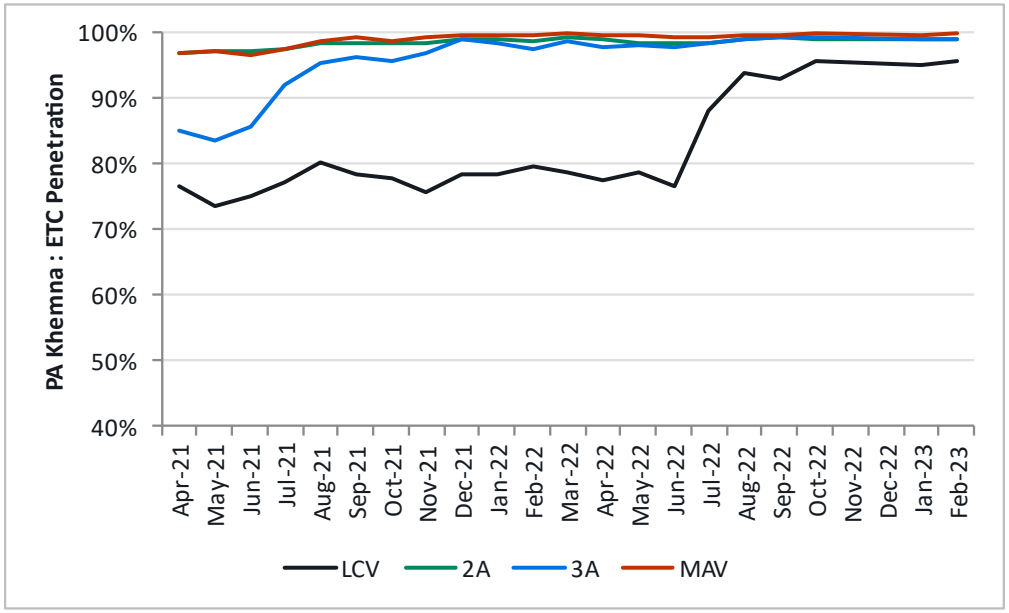
3.25 To understand the proportion of traffic that has moved to payment via FASTag/ETC, %age transactions have been calculated by comparing the share of traffic using FASTag for payment with the total traffic. It should be noted that toll plaza traffic data provided by the Client had details of both, users paying via FASTag as well as users paying via cash.

Figure 3-7 Undavariya: ETC Penetration



Source: Steer Analysis of Client Data

Figure 3-8 Khemana: ETC Penetration



Source: Steer Analysis of Client Data

3.26 As observed in the chart above, from Aug-22 onwards more than 97% of the 2A/3A/MAV traffic pay tolls via FASTag, whereas there has been a considerable increase in the proportion of LCV paying FASTag. This is majorly because of the improved reporting for exemptions/ violations after the toll plazas were taken over by the client in Aug-22. Generally, a valid FASTag on a vehicle facilitates smooth movement through tolls and hence, becomes time-efficient in case of long-distance travel. Such benefits of FASTag leads to higher penetration levels as being observed on the Assets.

3.27 Similarly, for CJVs, there's a significant improvement in ETC penetration. There's still a scope of improvement as the proportion of non-toll paying traffic (exemptions/ violations) is significant at both the toll plazas.

Historical revenue

3.28 Revenue details were available split by vehicle category and ticket in the toll plaza data dataset. The dataset reported revenue on a daily level split by payment via FASTag and via cash. The revenue details from the datasets are shown in the charts below.

3.29 The difference between ETC and cash payment is primarily the penalty revenue for users who pay via cash for buying tickets in addition to the single ticket. As observed in the traffic data, more than 99% of revenue generated on the Asset is collected via ETC/FASTag.

Table 3.3: Undavariya: annual revenue (INR Cr)

Vehicle	PA: Undavariya		
	FY22	FY23 (YTD)	Growth rate
CJV	6.31	8.24	30.6%
LCV	0.73	0.84	15.1%
Bus/2A	6.36	7.97	25.3%
3A	4.66	4.57	(1.9%)
MAV	36.18	42.14	16.5%

Vehicle	PA: Undavariya		
OSV	0.05	0.07	40.0%
Total	**54.28**	**63.82**	17.6%

Source: Steer analysis of client data till 27th Mar'23

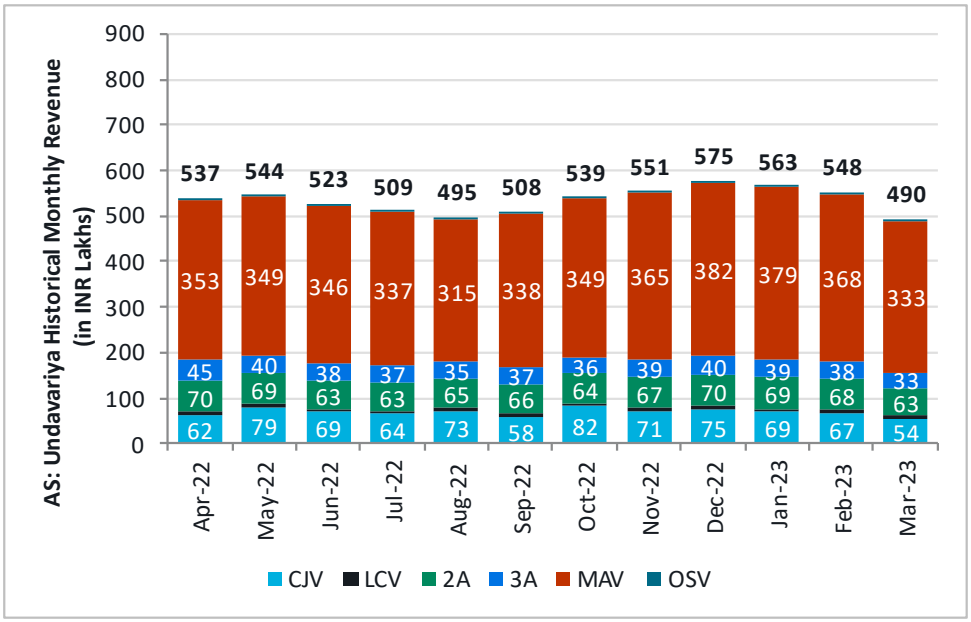
Table 3.4: Khemana: annual revenue (INR Cr)

Vehicle	PA: Khemana		
	FY22	**FY23**	**Growth rate**
CJV	8.75	11.48	31.2%
LCV	1.12	1.21	7.9%
Bus/2A	9.12	11.31	24.0%
3A	6.76	6.88	1.8%
MAV	53.95	63.42	17.6%
OSV	0.07	0.10	36.2%
Total	**79.77**	**94.40**	18.3%

Source: Steer analysis of client data till 31st Mar'23

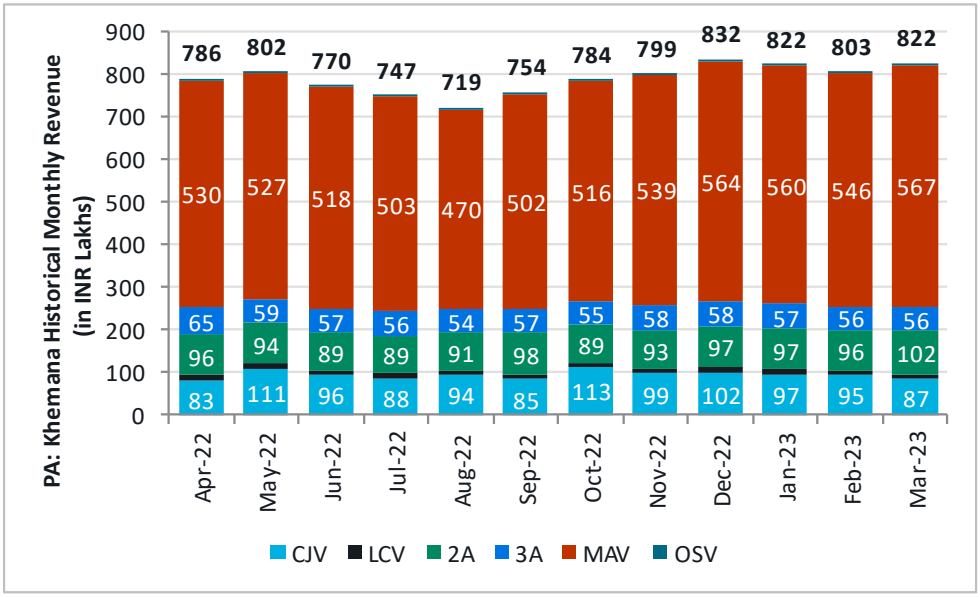
3.30 The Asset collected INR 158.2 Cr in FY23 YTD, an increase of ~18% from total collection of INR 134.0 Cr in FY22. The revenue collection is dominated by the share of 3A/MAVs, driven by the high traffic volumes and the high toll rates of the category. 3A/MAVs contributed ~74% to the total revenue share in FY23 YTD. This was followed by ~12% each contribution by Bus/2As and CJVs. The average monthly collection is presented below:

Figure 3-9: AS: Undavariya Monthly revenue reported in toll plaza data (INR Lakhs)



Source: Steer analysis of client data

Figure 3-10 PA: Khemana Monthly revenue reported in toll plaza data (INR Lakhs)



Source: Steer analysis of client data

3.31 In FY23 YTD, the average monthly collection on the Undavariya Toll Plaza was ~INR 5.3 Cr and at Khemana ~INR 7.9 Cr. The average daily collection for the Undavariya and Khemana was ~INR 18 lakhs and 26 lakhs respectively.

Toll segmentation

3.32 Toll frequency or segmentation is typically the share of each ticket category recorded for a particular vehicle type. Each vehicle category has different segmentation. As a part of historical analysis, we calculate the toll frequency for each vehicle category from the monthly data shared by the client. The most common ticket categories observed on a typical national highway concession are: Single, Return, Monthly, Local and Exempt.

3.33 Understanding the toll frequency gives insights into the nature of traffic. CJVs (Cars) generally have higher shares of return passes or monthly passes as the CJV users on Indian national highways tend to make shorter distance and more frequent trips. However heavy trucks mostly have single tickets since they travel long distance. This varies from asset to asset or even toll plaza to toll plaza. The asset catering to short distance local traffic generally observes high share of return or other local monthly passes while the asset catering to strategic long-distance traffic generally observes high share of single ticket traffic.

FASTag implementation

3.34 Generally, over the period the shares of single/return/monthly tickets tend to stabilise within 2-3 years from start of an asset operation. This is related to the stability of trip patterns are not expected to change significantly in absence of any major external events. During the last two years, two key events impacted the traffic patterns throughout the country: Covid19 and FASTag implementation.

3.35 With the FASTag implementation in Dec'19, it was ensured that only FASTag users benefited from discounted tickets such as return/monthly and cash users were only allowed to buy single tickets, thus leading to a drastic increase in single ticket users between January 2020 till Feb- 2021. The removal of discounts for cash users and significant push by NHAI and toll plaza

operators to promote use of FASTag has resulted in significant increase in %age transactions via FASTag. This in turn has resulted in ticket type use patterns have begun to return to their previous segmentation levels as observed prior to the FASTag implementation.

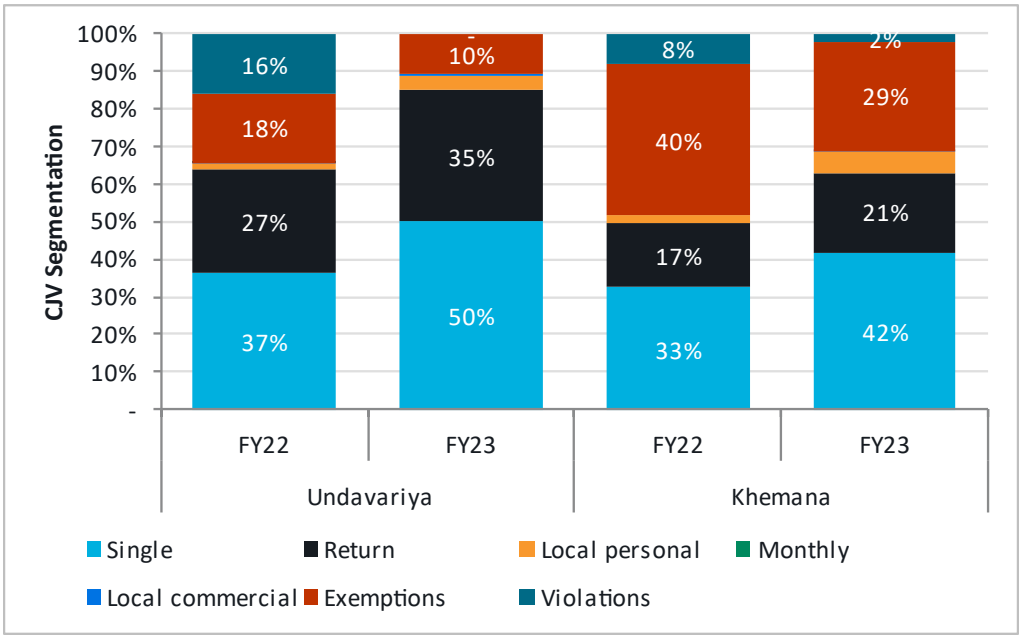
3.36 The following are the types of tickets are assumed to be sold at the plazas of both the Assets as per the concession agreement.

Table 3.5: Typical ticket types sold at NHAI plazas

Category	Description
Single	Allows the vehicle to cross the toll plaza once
Return	Daily pass for crossing the toll plaza multiple times within 24 hours. Charged 1.5 times the single toll
Monthly	Monthly pass
Local Personal	Discounted monthly pass only for private cars of residents within 20km radius of toll plaza
Local Commercial	50% discount on single trips for commercial vehicles registered in the local district
Exemptions	Officially exempted vehicles like ambulance, police cars, key political personnel etc.

3.37 The observed ticket segmentation on the Assets is presented in the chart below.

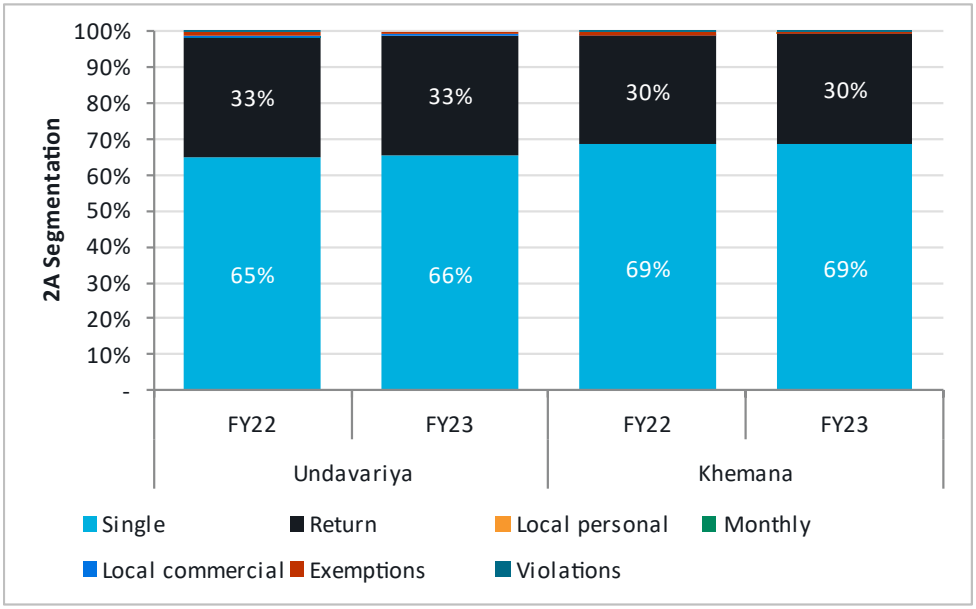
Figure 3-11 Ticket segmentation (%) – CJV



Source: Steer analysis of client data

3.38 CJVs are observed to have ~40-45% exemptions/violations in FY22-23 YTD. There has been a significant decrease in exemptions/violation from FY22 to FY23 which is due to plazas taken over by NHIPPL in Aug 2022. We have verified the levels of exemptions by comparing the independent TVC counts with the reported traffic. This has resulted in revised segmentation which is described in Chapter 6. Apart from this, CJVs are found to have considerable proportion of Return tickets, which is due to strong local influence on the Assets.

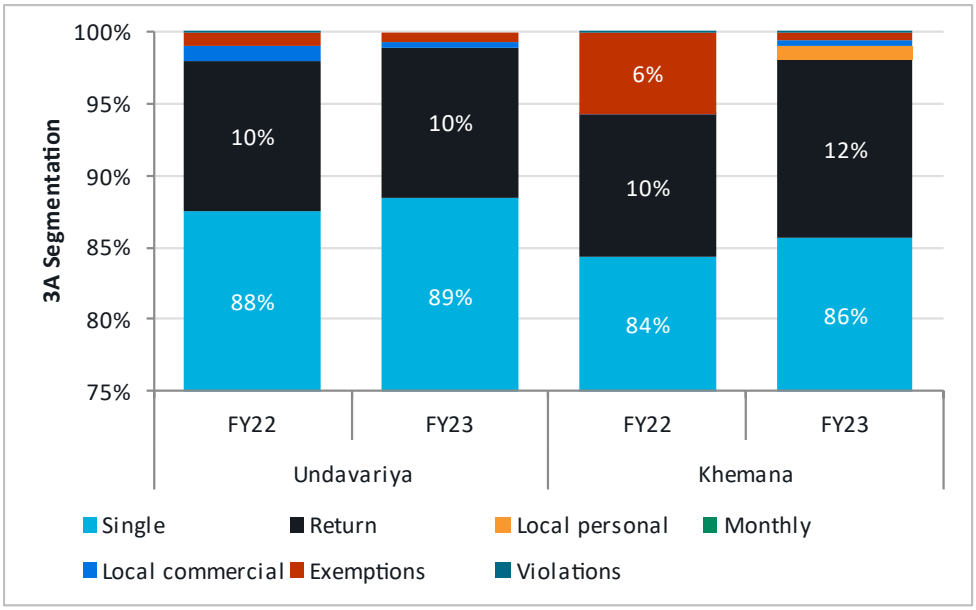
Figure 3-12 Ticket segmentation (%) – 2A



Source: Steer analysis of client data

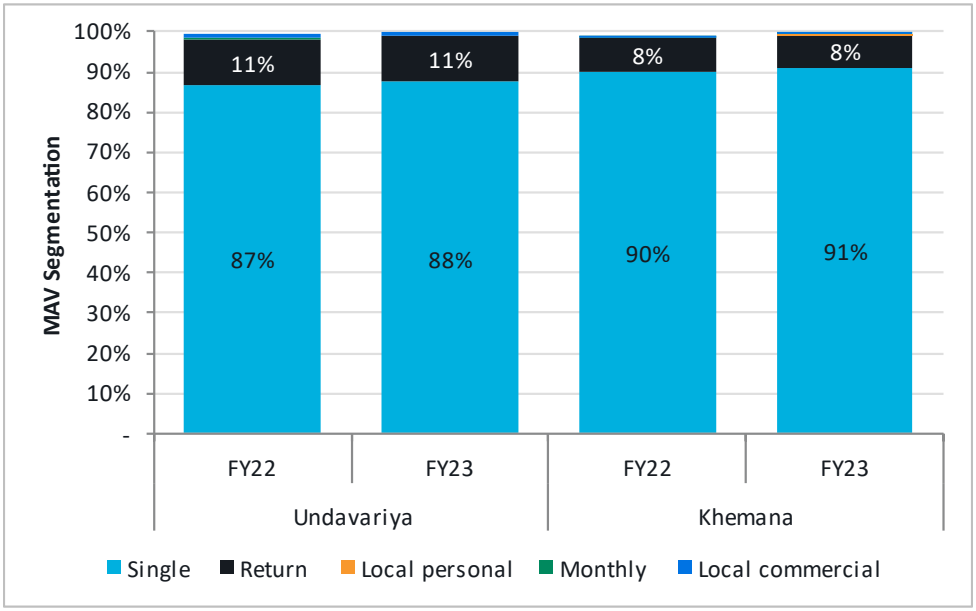
3.39 2As report high proportion of return trips. This is further validated by relatively higher proportion of under 250 km trips (23%-25% of the vehicles) as compared to 3A/ MAVs as observed in our OD data.

Figure 3-13 Ticket segmentation (%) – 3A



Source: Steer analysis of client data

Figure 3-14 Ticket segmentation (%) – MAV



Source: Steer analysis of client data

3.40 More than 85% of the heavy commercial vehicles (3A/ MAV) plying on the Assets are observed to buy single tickets as the Assets caters to long-distance movements. Return trips are primarily attributed to the short distance trips in the vicinity of the Assets.

3.41 In the case of Khemana toll plaza, it is observed that the some of the commercial vehicles (LCV, 2A, 3A, and MAV) from the vicinity of toll plaza use a small portion of the Asset and were not paying any toll fees. The toll plaza has started recovering some fee from these vehicles through an informal arrangement of a monthly pass of INR 1000 for LCVs and INR 1500 for 2A, 3A and MAV. This is getting recorded under the ticket type 'Local Personal' by the toll plaza operator. This is discussed in Chapter-5.

Conclusions – historical traffic and revenue analysis

3.42 The chapter outlined the current and historical traffic and revenue datasets available on the Assets, as well as our analysis of primary traffic count data, collected as a part of this project. Historical data records were obtained from several sources (PIU, ETC, etc.) and a review of all the sources was done to estimate the robust traffic and revenue numbers.

3.43 Multiple data sources including traffic data provided by the Client have been analysed and presented in detail in this chapter.

3.44 The analysis of these data sets confirms that the Assets carry high volumes of goods traffic which connect large urban centres and industrial clusters located in various parts of the country and facilitates long-distance movement between the western and northern/ southern parts of India.

3.45 Both traffic and revenue information are available for the toll plaza for a relatively short period, i.e., 2 years. The traffic data was available as reported in toll plaza datasets, which is available on Asset from 1st Apr-21 to 27th Mar-23 for Undavariya and 1st Apr-21 to 31st Mar-23 for Khemana.

3.46 The Asset trends at ~37,000 PCU levels for each toll plaza in FY23 with Khemana leading in CJVs and Undavariya with MAVs in comparison to each other. Commercial volumes are similar across both the plazas as they cater to medium to long-distance through movement. The traffic is dominated by CJVs and MAVs. On an average, the daily revenue collection on the Asset (collectively for Undavariya and Khemana) is ~INR 43.5 lakhs.

Survey data analysis

3.47 As mentioned earlier, to validate and inform various inputs used in our forecasting, we undertook primary data collection on the Assets, comprising the surveys listed below. OD survey data was collected on behalf of the Client, TVC surveys were commissioned by Steer with a third party. OD data collection typically involves manual data entry by enumerators based on oral surveys with road users crossing toll plazas, which Steer also commissioned with a third party. TVC data collection involves video-graphic capture of traffic passing crossing the toll plazas, followed by manual counting.

3.48 It should be noted that, in our experience, traffic on national highways shows variation across the week due to the economic activities surrounding each road. To derive a representative TVC count considering daily variation, three-day to seven-day traffic counts are generally recommended, and hence, in order to fully understand the impact of this weekly fluctuation on the Assets, we collected seven-day counts at each toll plaza.

3.49 Steer commissioned the following primary data collection at the Assets:

- 7-day 24-hour Traffic Volume Count (TVC) at toll plazas
- 3-day 24-hour Traffic Volume Count (TVC) at a strategic point between the toll plazas
- 24-hour Origin-Destination (OD) survey at toll plazas

3.50 This chapter presents the analysis of the primary data collected and its use thereof.

Key findings of the TVC data analysis

WADT estimates

3.51 As mentioned earlier, camera based Total Vehicle Counts (TVC) forms a key part of our primary data collection exercise. Using the TVC data and taking a simple average of the seven-day TVC counts, we obtained the Weekly Average Daily Traffic (WADT) for each toll plaza. The WADT excludes non-tollable vehicle such as tractors, two-wheelers, bullock-carts, etc., but includes officially exempt vehicles such as police cars, ambulances, emergency response vehicle, government vehicle and other vehicle types officially allowed as ‘exempted’ under the concession agreement.

3.52 During the site visits, our team makes sure that the cameras are located at a location where complete tollable traffic is captured. Additionally, emphasis is laid on positioning camera at such a location that the traffic from local leakages or bypass is also captured, if any.

3.53 In order to check the reliance of the TVC data, several checks are applied before using it in our analysis. Directional counts are verified by matching the sum of both the directions with the total counts. Our TVC data is directly used for validating our base year AADT and benchmarked with respect to traffic volumes on the sections in close vicinity of the Asset (discussed in Chapter 6).

3.54 The table below present the 7-day average (WADT) of independent counts undertaken by Steer.

Table 3.6: WADT at Assets arrived using TVC

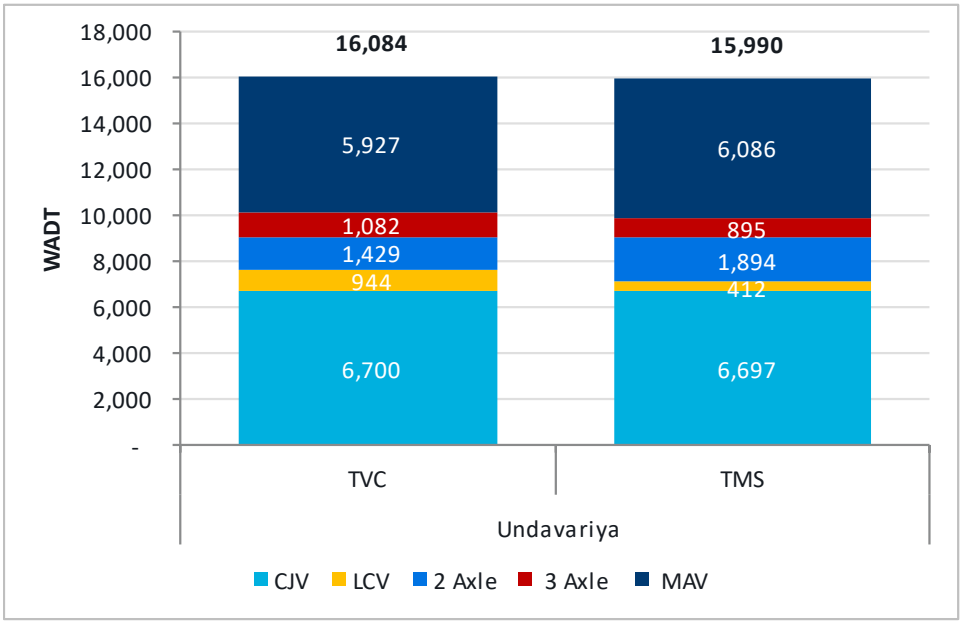
Vehicle Category	AS: Undavariya	PA: Khemana
CJV	6,700	7,900
LCV	944	863
2 Axle	1,429	1,344
3 Axle	1,082	1,002
MAV	5,927	5,504
OSV	2	2
Total	**16,084**	**16,615**

Source: Steer analysis of TVC data

TVC (Traffic Volume Count) analysis

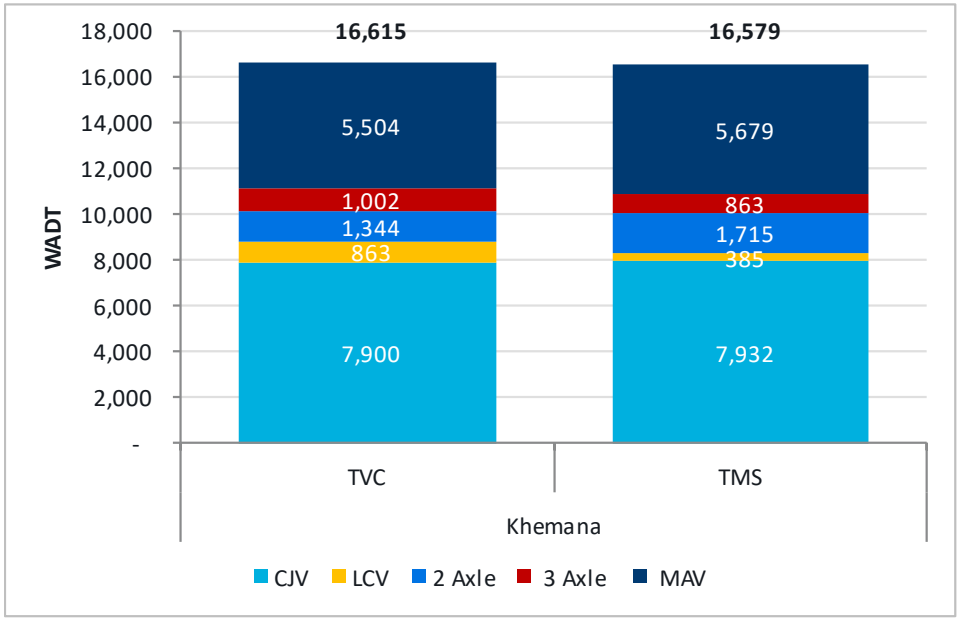
3.55 The figure below compares the vehicle wise traffic as recorded by TVC and TMS datasets on Undavariya and Khemana toll plazas.

Figure 3-15 Undavariya: Vehicle TVC comparison



Source: Steer Analysis

Figure 3-16 Khemana: Vehicle TVC comparison

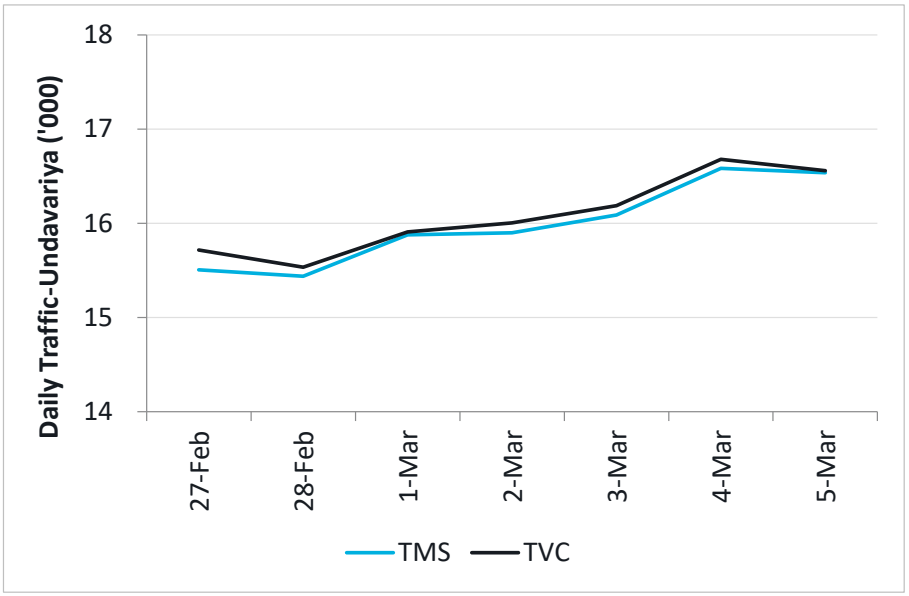


Source: Steer Analysis

3.56 The TVC counts conducted in the month of Mar'23. The total average traffic recorded was 16,084 ADT and 16,615 ADT for Undavariya and Khemana respectively. Moreover, the Assets were dominated by the traffic shares of MAVs followed by CJVs at both the toll plazas.

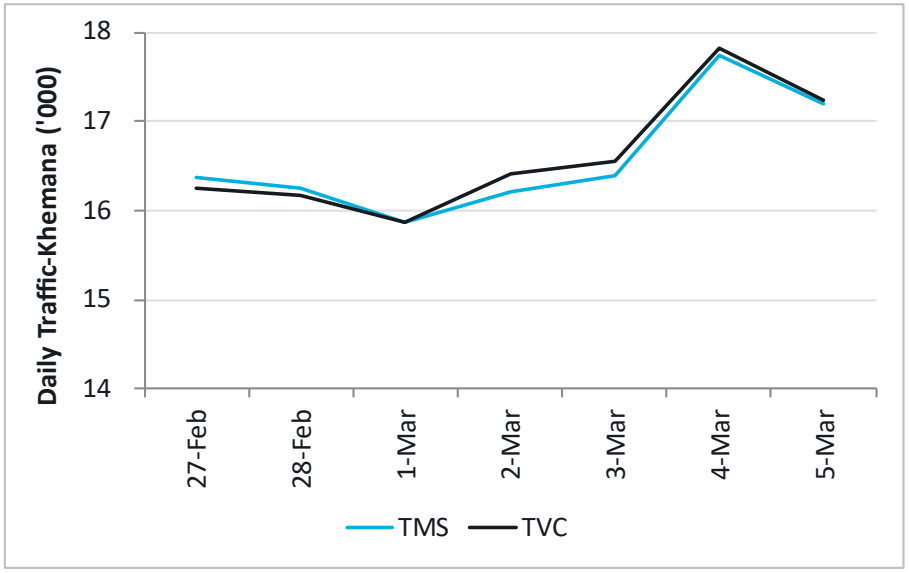
3.57 The following figure shows the daily traffic observed in our TVC-TMS (ETC only) counts for the toll plaza.

Figure 3-17 Undavariya – Daily Traffic Counts



Source: Steer Analysis

Figure 3-18 Khemana – Daily Traffic Counts



Source: Steer Analysis

3.58 TVC and TMS traffic data on the Asset follows similar trend on all days, the difference in the two sources may be due to some vehicles which pay in cash or are not paying (exemptions + violations) at the toll plaza.

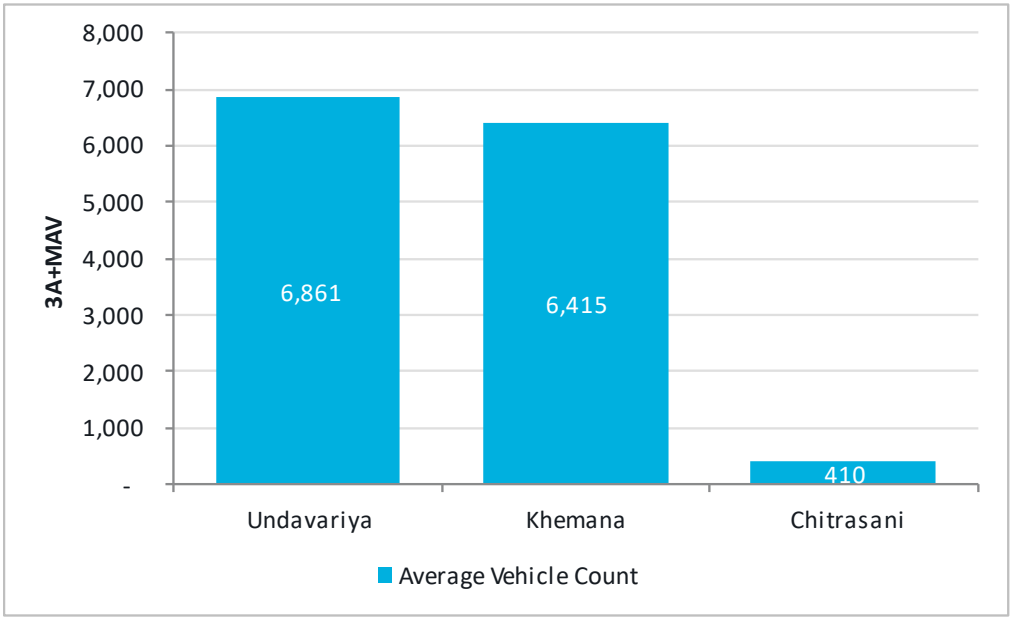
3.59 On an overall level, Steer independent TVC has reported higher traffic volumes than the TMS data. The difference is primarily observed in CJV's, 2As, and LCVs.

3.60 TVC counts report lesser for 2As, but higher LCVs as compared to TMS counts. This could be due to the error in categorization of LCVs and 2As post FASTag implementation. On the whole, TVC reports higher LCV+Bus+2A traffic which can be attributed to the fact that a share of this traffic crosses the plaza without paying and hence isn't getting recorded. CJV, 3A+MAV traffic levels are similar in both the counts.

3.61 Further, it was observed that there's diversion near Chitrasani which intersects with SH54, as discussed in Chapter 2 earlier. Therefore, we had under 3-day TVC surveys at that location to understand the quantum of 3A/ MAV ADT diverting at this interchange and compare it with delta of 3A/ MAV between Undavariya and Khemana TP.

3.62 Provided below is the chart, showing the average vehicle count (7-day average for Undavariya, Khemana and 3-day average for Chitrasani) at three TVC locations. It can be observed that the 3A/ MAV volumes observed at Chitrasani (Undavariya to Deesa and Deesa to Undavariya), almost matches with the 3A/ MAV delta observed between Undavariya and Khemana.

Figure 3-19: Average vehicle count for the Assets



Source: Steer analysis of TVC

Outputs from TVC analysis

3.63 We have further analysed the TVC and TMS data at vehicular category level to ascertain the following outputs:

- **Base Correction:** As observed in the TVC-TMS analysis, the volume of traffic in LCV and 2A categories saw a difference in the counts. While estimating the base, the delta is being incorporated as 'base correction factor'. The base correction factor is the % delta between TVC and toll plaza data (ETC+Cash+Violations) counts for each vehicle category. The delta is added on the base traffic of FY23 to account for the unreported traffic is crossing the plaza without paying. The percentage of delta for CJVs/3A/MAVs is not being incorporated as the negligible delta can be attributed to the reconciliation of traffic numbers with the data received from the bank**.**
  This adjustment was necessary to understand the capacity at which the Assets are operating.

Table 3.7: Base Correction Factors

Vehicle Category	AS: Undavariya	PA: Khemana
LCV	2.9%	5.1%
2A	2.9%	5.1%

Source: Steer analysis of TVC/TMS data

- **Exemption adjustment:** The additional traffic being added to the base of our forecasts, as mentioned in the previous paragraph, is being treated as 'non-paying' traffic as the traffic isn't getting reported in the TMS counts as provided by the Client. Hence, in the ticket segmentation, the additional traffic in the corrected base traffic is assumed to be unreported 'exemptions'.

- **Traffic splits:** TVC WADT of each plaza was considered to derive the traffic splits for Bus/ 2A and CJV/ Mini LCV, the split is not present in the data shared by the Client. It is summarized in the table below:

Table 3.8: Traffic splits from TVC analysis

Vehicle Category	AS: Undavariya	PA: Khemana
CJV	88.3%	91.9%
Mini LCV	11.7%	8.1%

Source: Steer analysis of TVC/TMS data

Table 3.9 Traffic splits from TVC analysis

Vehicle Category	AS: Undavariya	PA: Khemana
Bus	39.8%	33.9%
2A	60.2%	66.1%

Source: Steer analysis of TVC/TMS data

Key findings of origin-destination analysis

3.73 OD surveys were conducted on the toll plaza locations across the Assets, through interviews for 24 hours at the toll location, typically starting at 8 AM and finishing at same time on the following day. The interviews began on 2nd Mar-23 and 28th Feb-23 on the Asset's toll plaza. Each toll lane had an interviewer filling OD records with supervisor monitoring them to minimise errors in data collected. This was accompanied by Steer staff visiting the toll plaza to ensure the data is being collected to quality and standards required to understand the traffic patterns on the Asset.

3.74 Data collected was segregated into vehicle types, origin area, origin zone, destination area, destination zones, commodity being carried, total load, and frequency of travel. The zones were further segmented into Internal, Rest of State, and External zones. The zones were also used to calculate the trip distances of the traffic plying on the Asset.

3.75 Before using the data for final analysis, the data is first cleaned, and numerous checks are applied. Some of these checks include verifying that the zones are physically apart as well as these zones are located within a reasonable distance and boundary. Reliability checks are also used which confirms that the sample rates are 25% for passenger and 50% for goods. Sanity checks includes verifying the sanctity of direction wise origin and destination as well as establishing that the share of empty vehicles is in line with the site visit observations (not more than 50% in any case). The final check includes matching the OD numbers with the TVC counts of the particular day and substantiating that the OD numbers aren't greater than the TVC counts.

3.76 Origin-destination (OD) analysis enables the understanding of the nature of traffic movement on the Asset. We have analysed the regional drivers of demand based on the following analysis:

- Zonal influence
- Commodity distribution
- Top OD pairs
- Trip length distribution

3.77 While zonal analysis and the list of top OD pairs help to understand 'where' people and goods travel, commodity distribution sheds light on 'what' goods get transported on this asset. Trip length distribution shows 'how far' vehicles and people travel, and goods get transported. This set of analysis is used to estimate key drivers of traffic and aid in making informed forecasting assumptions related to traffic demand elasticities, growth drivers and exogenous impacts.

Sample rates

3.78 Sample rates help understand the reliability of OD data. They are calculated by dividing OD samples by the TVC count observed on the same date for each vehicle category at the toll plaza. The table below presents the sample rates for key vehicle type aggregations at the toll plaza. We believe that the sample rates of the OD data are reasonable for the analysis required.

Table 3.10: Sample rates for OD data

Vehicle type	Undavariya	Khemana
CJV	10.2%	25.6%
Bus + 2 Axle	34.6%	39.9%
3 Axle + MAV	75%	53..6%

Source: Steer analysis of OD data

3.79 CJV users are traditionally difficult to interview primarily because their waiting times have reduced significantly due to FASTag implementation, and they are also reluctant to answer questions due to Covid19 related concerns.

Zone categories

3.80 To facilitate better interpretation of key regional drivers of traffic as determined by their OD zones, and influenced by various towns, cities, states, and regions in the vicinity of the Asset, we have aggregated zonal data as described in the table below.

Table 3.11: Zone aggregations for zonal influence analysis

Aggregate Zone	Description
Local	Local zones are those that fall on or very close to the Asset.
IAOI	IAOI zones are the locations which generate traffic and lie within approximately 75-150 km distance from the Asset.
Rest of Rajasthan	Rest of the cities/Districts in the state that Asset lies in Rajasthan (other than Local/IAOI)
Rest of Gujarat	Rest of the cities/Districts in the state that Asset lies in Gujarat (other than Local/IAOI)
Punjab	Punjab
Haryana	Haryana
NCT Delhi	NCT Delhi
Maharashtra	Maharashtra
Madhya Pradesh	Madhya Pradesh
Uttar Pradesh	Uttar Pradesh
East India	Bihar, West Bengal, Odisha, Jharkhand

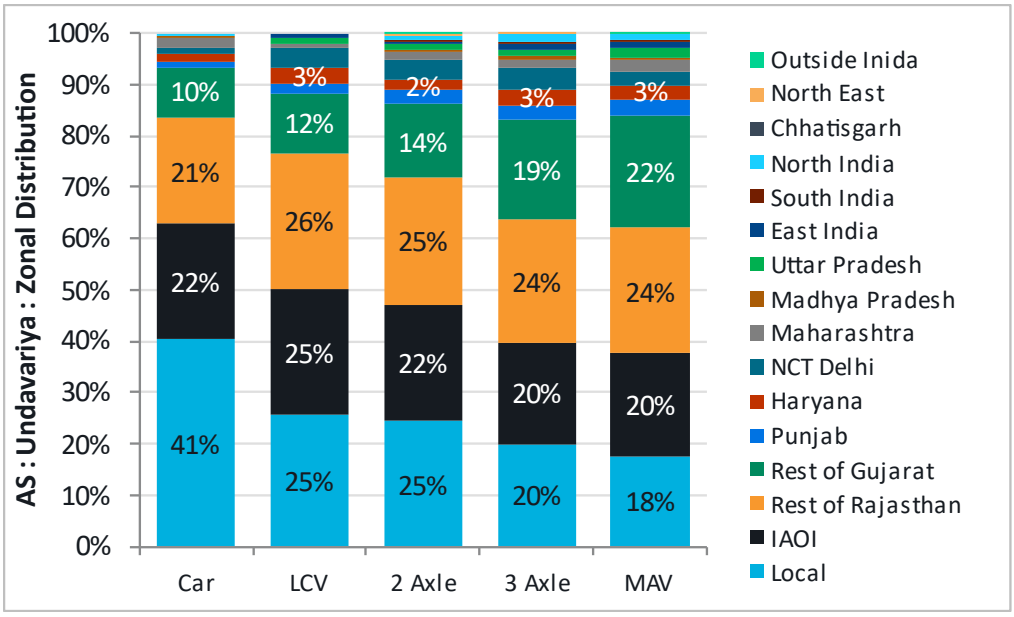
South India	Tamil Nadu, Telangana, Andhra Pradesh
North India	Himachal Pradesh, Uttarakhand, Jammu and Kashmir, Ladakh
Chhattisgarh	Chhattisgarh
Northeast	Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, Sikkim
Outside India	Nepal, Bangladesh, Bhutan

Source: Steer analysis

Zonal influence

3.81 The zonal influence is the contribution of the zone or the zonal aggregation to trips by a vehicle type. This section presents the zonal influence[1] at the toll plaza for the Asset, based on zonal aggregation listed in the previous sub-section. it should be noted that zonal influence is analysed on trip ends and not trips. Asset wise zonal influence is presented as follows.

Figure 3-20: Zonal distribution: Undavariya plaza



Source: Steer analysis of OD data

3.82 According to the zonal analysis, ~80% of 3A/MAV trips on both the plazas have one of the trip ends in local, IAOI, or rest of Gujarat/Rajasthan zones. As the Asset is located on the Gujarat – Rajasthan border, the states have a significant share in the total zonal distribution. As observed on site as well as from the results of the survey data analysis, the trips have one end in Rajasthan and the other in Gujarat. Majority of these trips cater to the consumption demands of the states where the goods are transported from warehouses/industrial centres of one state to the consumption centres of the other state. This nature of trips is also validated by the trip length analysis where the average trips distance of 3A/MAVs is less than

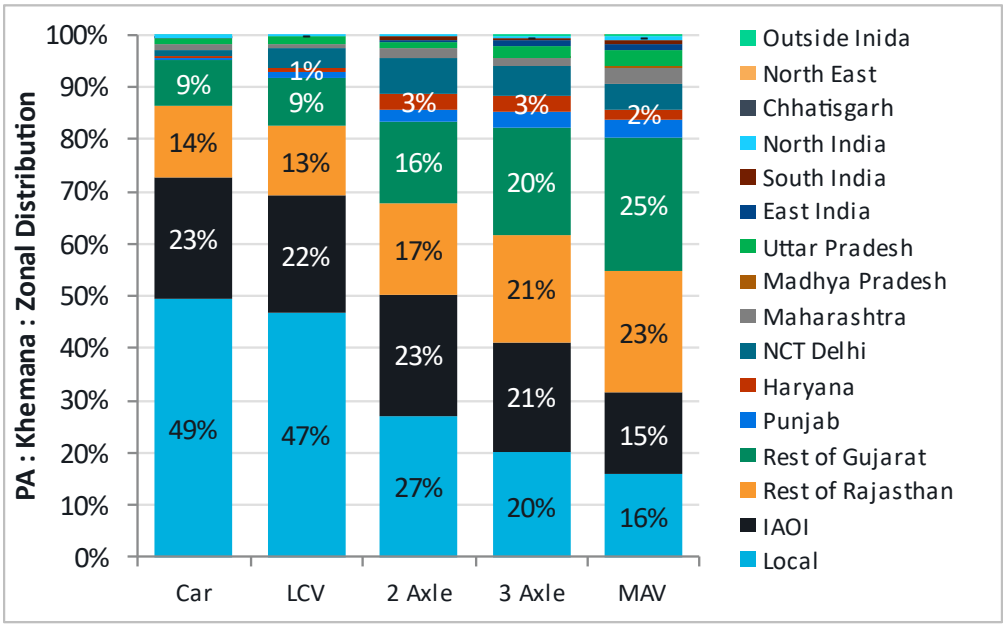
[1] For example, if out of 100 trips at a toll plaza on an Asset, 10 trips are between Hyderabad and Delhi and 90 trips are between Hyderabad and Chennai, then zonal influence of Hyderabad would be 50% since one end of all trips are at Hyderabad. Likewise, zonal influence of Delhi and Chennai would be 5% and 45%, respectively.

700-800 kms. Further, the presence of industries in Morbi, Palanpur, Jaipur, Ahmedabad, Surat Jodhpur facilitates the movement of goods between these two states.

3.83 Undavariya observes a higher share of local+IAOI movement due to the truck plying between western Gujarat and Rajasthan/northern India. This share of traffic can enter/exit the Asset at Chitrasani and only crosses Undavariya plaza.

3.84 The Asset also caters to medium/long distance trips which ply between the industrial centers/warehouses of Gujarat, Haryana, Punjab, Delhi NCR. Traffic from Rajasthan uses the Asset to reach Gujarat, Maharashtra, and south India.

Figure 3-21: Zonal distribution: Khemana plaza



Source: Steer analysis of OD data

3.85 Since the medium/long distance traffic is through in nature, similar results are observed for Khemana toll plaza as well.

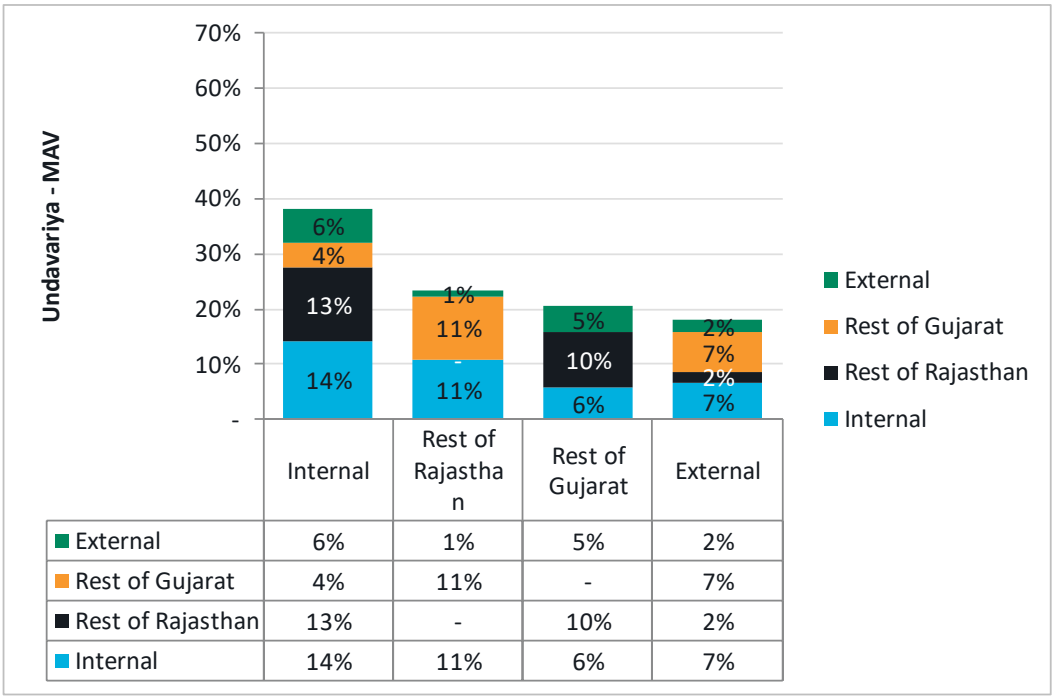
Internal External analysis

3.86 Internal-External analysis helps in identifying the trips which have both an origin and destination on or near the Asset i.e., local/IAOI zones (Internal-Internal or I-I), any one end on the Asset (Internal-External or I-E), or neither end on the Asset i.e., through trips (External-External or E-E). Rest of State here represents areas within the state which are neither local nor IAOI. 'Internal' zones are those that were analysed as 'local' and 'IAOI' in the zonal influence analysis, i.e., lying on the Asset, while 'External' zones are areas lying outside the state.

3.87 As observed in the zonal analysis, the IE analysis also witnesses significant share of trips having one end in internal zones, Rajasthan or Gujarat. The share of internal trips is higher at Undavariya plaza due to trucks plying between western Gujarat and Rajasthan/northern India. As mentioned before, this share can enter/exit the asset at Chitrasani and will only appear at Undavariya plaza. Due to the same reason, the share of 'rest of Gujarat' and 'external' trips is lower at Undavariya than Khemana.

3.88 The share of external-external trips is low at both the plazas. This validates the fact the through movement (between states other than Gujarat and Rajasthan) isn't taking place on the Asset. The average trips length of 700-800 km for 3A/MAVs denotes the medium-distance nature of traffic on the Asset.

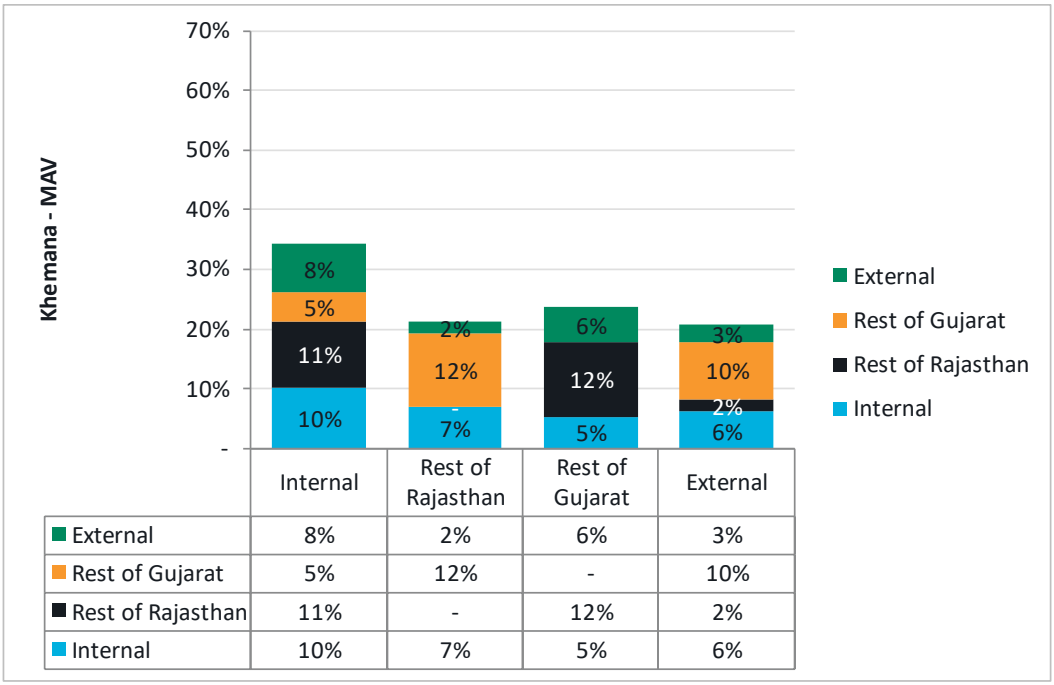
Figure 3-22: Zonal influence: Undavariya



	Internal	Rest of Rajastha n	Rest of Gujarat	External
External	6%	1%	5%	2%
Rest of Gujarat	4%	11%	-	7%
Rest of Rajasthan	13%	-	10%	2%
Internal	14%	11%	6%	7%

Source: Steer analysis of OD data

Figure 3-23: Zonal influence: Khemana



	Internal	Rest of Rajasthan	Rest of Gujarat	External
External	8%	2%	6%	3%
Rest of Gujarat	5%	12%	-	10%
Rest of Rajasthan	11%	-	12%	2%
Internal	10%	7%	5%	6%

Source: Steer analysis of OD data

Commodity distribution

3.89 We have grouped various commodities into aggregate categories for ease of interpretation, as shown in the table below. The charts in the following sub-section present information in terms of aggregate commodity categories.

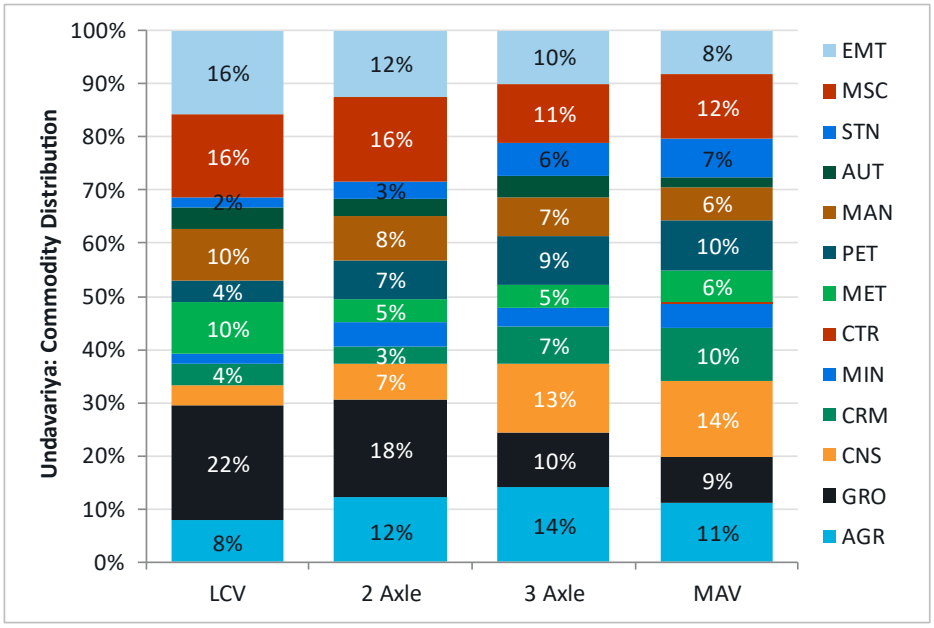
Table 3.12: Aggregate commodity categories

Commodity Category	Category Code
Agriculture Products / Cash crops (Wheat, Rice, Sugarcane, Maize, Castor Oil, Spices like Dhania, Jeera, etc.)	AGR
Perishable Items (Fruits, Vegetables, Dairy, Eggs, Fish, Meat, Milk)	PER
Groceries / Food items (Soap, Salt, Sugar, Pulses, Biscuits, Bread, Cold drinks, Beer etc.)	GRO
Cattle Food / Livestock (sheep, goat, cow, etc. animals)	LIV
Building Material / Construction (Aggregate Stones, Lime, Brick etc.)	CNS
Cement	CMT
Ceramic & Sanitary Items (Finished Products like Tiles, Wash Basins etc. mainly from Morbi and Kutchh)	CSI
Ceramic Raw Material (Powder form of clay, silica sand, feldspar, gypsum, limestone, wollastonite and dolomite from Rajasthan)	CRM
Sand/Clay	SND
Stone (Kota stone, Marble, Granite, etc.)	STN
Mining Minerals (Other than ceramic clay from Rajasthan, coal etc.)	MIN
Coal	COL
Container (Loaded)	CTL
Container (Empty)	CTE
Steel / Metal (Iron, steel etc.)	STL
Petroleum and associated products (Oil, LPG, CNG, Petrol, Diesel, Bitumen etc.)	PET
Fertilizers	FER
Chemicals (Liquid & Chemical Powder, Chemical Powder from Refineries)	CHM
Electrical/Manufacturing items (Electronic items, Medicine, Wine, Plastics, Cloth, Paper etc.)	MAN
Automobiles (Finished products, Auto parts, Car/bike manufacturing)	AUT
Textile & Leather Products (Yarn, Clothes, Garments etc.)	TXT
Basic / Fabricated Metals (steel or iron pipes)	MET
Machinery / Spare parts	MAC
Raw Wood, Cork & Wood Products, Furniture	WUD
Empty	EMT
Passengers	PAS
Rubber	RUB
Scrap / Hazardous waste - used tyres etc.	SCR

Commodity Category	Category Code
Parcel and Courier including Delhivery, Amzon, Flipkart etc	PAR
Miscellaneous (Household items, any other commodities different then mentioned in list etc.)	MSC
Salt	SLT
Edible Oil	EOL
DFM	DFM

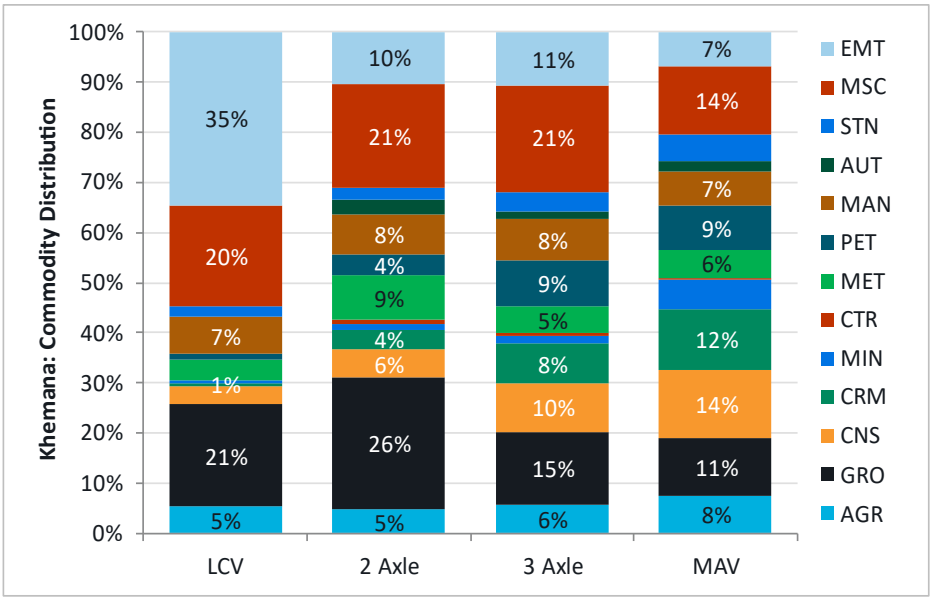
Source: Steer Analysis

Figure 3-24: Commodity distribution: Undavariya



Source: Steer OD analysis

Figure 3-25: Commodity distribution: Khemana



Source: Steer OD analysis

3.90 The key commodities observed on the assets include – Groceries (including DFM), Construction material, Ceramic, Miscellaneous, Agriculture, and Petroleum products. The commodity distribution is largely similar for both the toll plazas for goods vehicles (2A+3A+MAV).

3.91 Construction goods represent 10-14% of 3A/MAV traffic on the Asset. These goods comprise of soil, clinkers, bricks being transported from Pali, Jodhpur, Jaipur, and Abu Road. The miscellaneous goods comprise of parcels, couriers, and household items. These goods represent 12-14% of the goods transported on the Asset and are being transported from the warehouses of Delhi, Jaipur, Punjab, Surat, Ahmedabad to different consumption centres. Similarly, trucks carrying groceries make up around 10-15% of the 3A/MAV traffic and are being transported to consumption centres throughout the country.

3.92 The trucks carrying agri-related goods are majorly observed to carry rice, lentils, and onion from farmlands of Rajasthan and Gujarat. Manufacturing goods are sourced from industrial centres of Gujarat and Rajasthan whereas metal related goods are primarily iron and related products from Bhilwara, Jaipur, and Jaisalmer.

3.93 Direction wise commodity splits are given below:

Table 3.13: Directional commodity distribution: Undavariya

Sirohi to Palanpur					Palanpur to Sirohi			
LCV	**2 Axle**	**3 Axle**	**MAV**		**LCV**	**2 Axle**	**3 Axle**	MAV
3%	17%	21%	16%	*Agriculture*	15%	7%	6%	6%
26%	13%	9%	6%	*Groceries*	15%	24%	12%	11%
3%	10%	16%	19%	*Construction*	5%	3%	9%	9%
-	4%	5%	11%	*Ceramic*	10%	2%	9%	9%
-	2%	0%	1%	*Minerals*	5%	7%	7%	9%
-	-	-	0%	*Container*	-	-	-	0%

Sirohi to Palanpur					Palanpur to Sirohi			
6%	2%	3%	4%	*Metals (Stee/Iron etc.)*	15%	7%	7%	8%
-	4%	6%	4%	*Petroleum, Chemicals, Fertilizers*	10%	10%	13%	15%
13%	6%	8%	6%	*Manufacturing*	5%	11%	7%	6%
6%	3%	4%	1%	*Automobiles*	-	3%	4%	2%
-	6%	5%	8%	*Stone*	5%	1%	8%	7%
19%	15%	8%	10%	*Miscellaneous*	10%	17%	15%	14%
23%	17%	16%	13%	*Empty*	5%	7%	3%	3%

Source: Steer Analysis of OD data

Table 3.14: Directional commodity distribution: Khemana

Sirohi to Palanpur					Palanpur to Sirohi			
LCV	**2 Axle**	**3 Axle**	**MAV**		**LCV**	**2 Axle**	**3 Axle**	MAV
8%	7%	7%	7%	*Agriculture*	1%	4%	5%	8%
19%	20%	12%	11%	*Groceries*	24%	30%	17%	12%
6%	10%	15%	20%	*Construction*	-	3%	3%	7%
1%	6%	10%	12%	*Ceramic*	-	3%	6%	12%
1%	3%	0%	3%	*Minerals*	-	-	3%	8%
-	3%	-	0%	*Container*	-	-	1%	0%
6%	15%	6%	6%	*Metals (Stee/Iron etc.)*	1%	5%	4%	6%
2%	3%	11%	8%	*Petroleum, Chemicals, Fertilizers*	-	5%	8%	10%
6%	2%	4%	2%	*Manufacturing*	10%	11%	13%	12%
-	2%	1%	1%	*Automobiles*	-	4%	1%	3%
3%	4%	6%	9%	*Stone*	-	1%	2%	2%
25%	20%	17%	12%	*Miscellaneous*	11%	21%	27%	15%
24%	6%	11%	8%	*Empty*	53%	13%	10%	5%

Source: Steer Analysis of OD data

Trip length analysis

3.94 Trip-length distribution provides the distance-based profile of various vehicle categories. This aids in validating assumptions around the share of macro-economic drivers, inputs from zonal influence and toll segmentation. For ease of interpretation, we have categorised distances into 4 groups – local and short distance (0-250km), medium-distance (250-500 km), medium/long-distance (500-1000 km) and very-long-distance (+1,000 km). The trip distances were derived as driving distances from Google Distance Matrix Tool based on zonal coordinates for OD pairs.[2]

[2] Google Distance API is a tool that is available on a chargeable basis from Google Maps Platform. Link: **https://developers.google.com/maps/documentation/distance-matrix/start**. Travel distance and time information for driving/transit under various congestion scenarios can be extracted through this tool by using macro-enabled Excel, R, etc.

3.95 The following table states the average trip lengths of traffic plying on the Assets across the toll plazas.

Table 3.15: Average trip lengths (Kms)

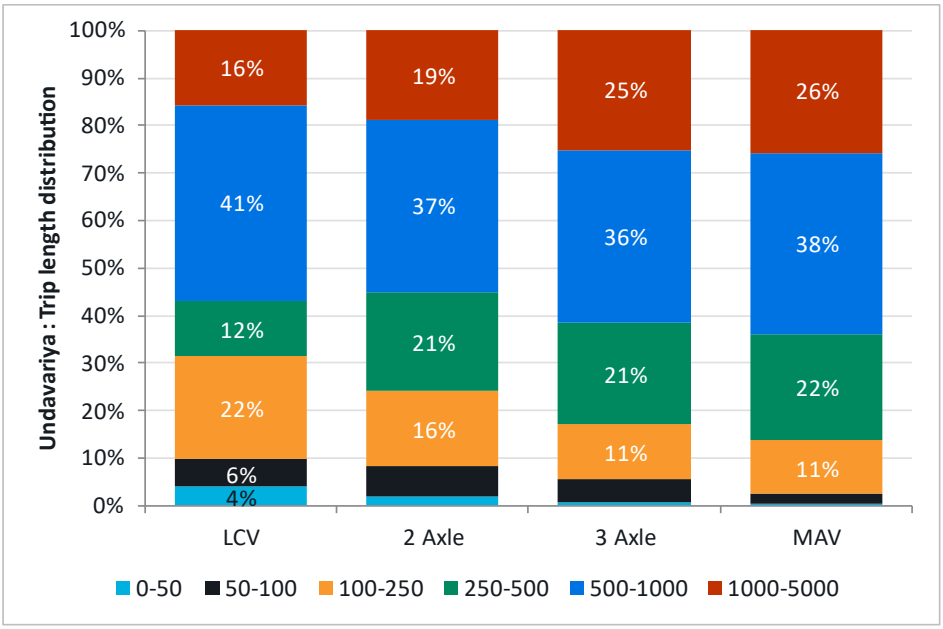
	CJV	LCV	2 Axle	3 Axle	MAV
Undavariya	414	708	618	717	731
Khemana	335	523	612	716	802

Source: Steer analysis of OD data

3.96 As discussed in the above sections, the Assets cater to trucks primarily traversing movements between Rajasthan and Gujarat. The same is validated by the average trip lengths observed in the table above where 2A/3A/MAV trucks are travelling medium distance trips with average trip distance being ~800 km.

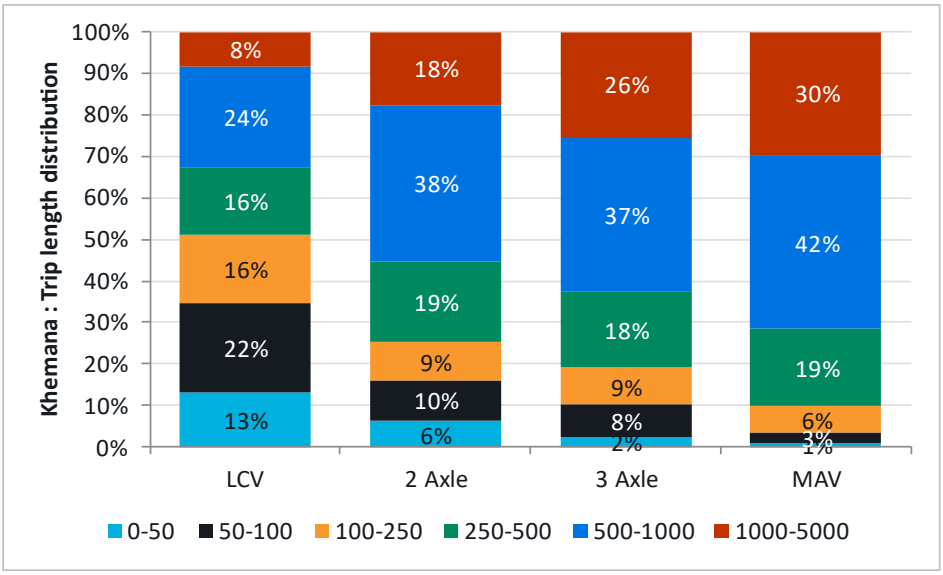
3.97 The trip length proportions for each vehicle type for each of the toll plaza is discussed below.

Figure 3-26: Trip length distribution, Undavariya



Source: Steer analysis of OD data

Figure 3-27: Trip length distribution, Khemana



Source: Steer analysis of OD data

3.98 As understood from the zonal distribution and commodities' distribution, the Asset caters to medium-distance movements due to presence of trips ends in vicinity. Accordingly, 70-75% 3A/MAV trips traverse less than 1000 km distances. This share increases for LCVs and 2As.

3.99 Majority of truck trips traverse distances between 500-1000 km as seen in the charts above. These trips are generally between centres of Gujarat (Ahmedabad, Morbi, Gandhi Dham, Surat) and centres of Rajasthan (Udaipur, Bhilwara, Jaipur, Bikaner).

Conclusions – primary surveys

3.100 Key takeaways from the data analysis obtained from primary and secondary sources are:

- The nature of traffic on the Asset was validated by the zonal distribution of the OD analysis as for MAVs, ~80% of 3A/MAV trips on both the plazas have one of the trip ends in local, IAOI, or rest of Gujarat/Rajasthan zones. As the Asset is located on the Gujarat – Rajasthan border, the states have a significant share in the total zonal distribution. In line with these observations, the trip length analysis saw that 3As covered ~720 kms per trip for both the toll plazas. For MAVs, they covered ~730 and ~800 km per trip for Undavariya and Khemana respectively.
- The key commodities observed on the asset include – Groceries (including DFM), Construction material, Ceramic, Miscellaneous, Agriculture, and Petroleum products. The commodity distribution is largely similar for both the toll plazas for goods vehicles (2A+3A+MAV). Construction goods represent 10-14% of 3A/MAV traffic on the Asset. These goods comprise of soil, clinkers, bricks being transported from Pali, Jodhpur, Jaipur, and Abu Road.
- Steer TVC counts when compared to the TMS data on the overlapping dates observed a difference in the traffic volumes for LCVs and 2As.
- To account for the delta, we found in the TVC-TMS analysis, the observed unreported vehicle traffic has been added as 'Exemptions' during the calculation of our base position. This is necessary to identify the true traffic currently moving on the toll plazas.
- The delta in 3A/ MAV volumes between Undavariya and Khemana was found to be in range with the 3A/ MAV volumes observed at a diversion near Chitrasani.

4 Socio Economic Context

Introduction

4.1 The growth of traffic on existing (brownfield) roads depends on, firstly, how quickly the background travel demand grows (background growth); and secondly, how successful the Assets are in attracting that traffic (traffic capture). Background travel demand is driven by the socio-economic conditions of the region where the Assets are located and conditions at a national level. These include:

- Changes in macro-economic factors such as population, economic growth (regional and national) and industrial production; and
- Other local factors such as strategic port growth, and growth of industries in the vicinity of the Assets.

4.2 The change in the competitive position of the Assets (and thus of the traffic capture it will achieve) derives from the level of service and associated cost on the Assets in comparison to competing roads; and whether any new competing road facilities are available.

4.3 In this chapter, we assess the socio-economic indicators relevant to traffic growth on the Assets. The relevant growth drivers where reliable information was available have been selected for establishing growth trends in the traffic forecasts.

Population growth

National Level

4.4 The total population in India has grown at a Compound Annual Growth Rate (CAGR) of 1.5% since 2000, and have been showing decreasing trends over the years, as presented in the table below. The World Bank forecasts this growth to decrease to 0.6% CAGR by the 2030-45 period.

Table 4.1: CAGR of population in India

Years	CAGR		
	Total Population (m)	Rural Population (m)	Urban Population (m)
1970 - 1985	2.3%	1.9%	3.8%
1985 - 2000	2.0%	1.7%	2.9%
2000 - 2015	1.5%	1.0%	2.6%
2015 – 2030*	1.0%	0.3%	2.3%
2030 – 2045*	0.6%	-0.3%	1.9%

Source: World Bank Data on Health Nutrition and Population Statistics, *forecast population growth

4.5 The Assets lie in the state of Gujarat/ Rajasthan. Gujarat represents 5% of India's population, with total state population of 60 million (2011 census). The rate of growth of the urban population in Gujarat has been consistently higher than that of the total population, indicating

a trend towards urban agglomeration. Rajasthan represents 5.7% of India's population, with the total state population of 68 million (2011 Census). The rate of growth of the urban population in Rajasthan has been consistently higher than that of the total population, indicating a trend towards urban agglomeration. The proportion of urban population in Rajasthan has increased from 23% to 25% between 2001 and 2011. However, overall, the proportion of rural population in Rajasthan is higher than the country average.

Table 4.2: Population Growth in India (2001 – 2011)

State	2001 Population (m)			2011 Population (m)			CAGR (2001 – 2011)		
	Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban
Rajasthan	56.5	43.3	13.2	68.5	51.5	17	2%	1.8%	2.6%
Gujarat	50	31	19	60	34	26	1.8%	0.9%	3.2%
India	1,028.7	742.6	286.1	1,210.9	833.7	377.1	1.6%	1.2%	2.8%

Source: Census 2011 Data

4.6 However, due to complexities in urbanisation trends, and the dynamic nature of local population migration (which are very difficult to forecast), we do not use population growth as a proxy for understanding future travel demand growth on the Assets. It has been included in this section to provide the overall context of the region in which the Assets are located.

Economic Indicators

GDP and GSDP Growth

4.7 The Indian economy has grown at a CAGR of 6.6% during FY12-20, aided by a strong growth in the services/tertiary sector. The economic growth of Rajasthan (GSDP)[3] has been weaker than the country overall. Rajasthan approximately contributes 5% to the India's GDP. In terms of per capita income, Rajasthan has lower per capita income than the country overall while the GSDP of Gujarat is higher than the country.

Rajasthan

4.8 Rajasthan, the largest (area-wise) state in India, is located in the north-western part of the country. The state has a large pool of semi-skilled and unskilled labour and has primarily agricultural economy.

4.9 In terms of sectoral contribution to the state GDP, tertiary sector (45%) has the highest share followed by primary (34%) and secondary (21%), with the shares remaining stable during the last five years.

4.10 The tourism and transport sector constitute a majority of the state's tertiary sector. Rajasthan is considered a favoured tourist destination in India, with key tourist attractions being Jaipur, Jodhpur, Jaisalmer, Bharatpur and Udaipur. In 2019, the state attracted over 50 million domestic tourist arrivals in the country whereas, in terms of foreign tourist arrivals it holds sixth position with over 1.6 million tourist visiting state every year.

4.11 In terms of secondary sector, the state has key industrial areas in Kishangarh (marble); Manesar (automobile), Pali and Jodhpur (textiles), Chittorgarh - Neemuch (cement), and Kota

[3] GSDP is the Gross State Domestic Product i.e., the GDP equivalent for a particular state, it is the final value of goods and services produced by a particular state

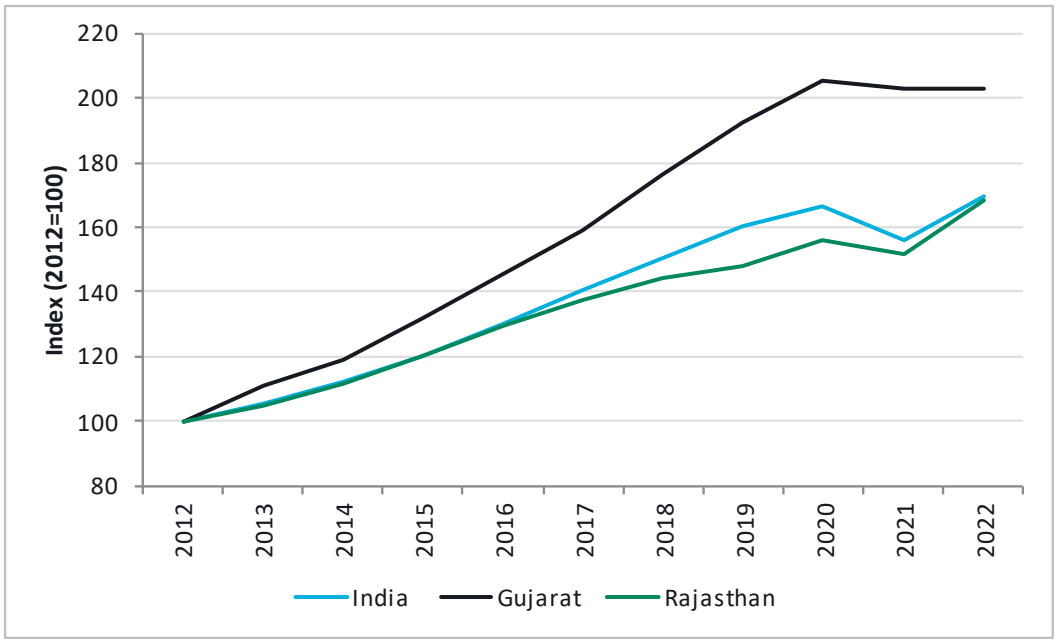
(stone). Rajasthan is also the second-largest mineral producing state and the sole producer of lead and zinc in India. The state has one of the largest limestone reserves, making it a hub for cement industries.

Gujarat

4.12 Gujarat is located on the west coast of India and has the longest coastline of approximately 1600 kms in the country and is one of the fastest growing states in India.

4.13 Gujarat is also home to many industrial sectors such as Petrochemicals, Cement, Gems & Jewellery, Pharmaceuticals and Textiles.

Table 4.3: GDP/GSDP index (2012=100)



Source: Central Statistical Organisation (CSO)

4.14 The official historical GDP and GSDP data for India are released by the Central Statistical Organisation (CSO). The GDP forecasts for India are available from various reliable sources such as Oxford and Consensus, but the state level GSDP forecasts are not published. However, using the long-term historical trends between GDP and GSDP, we have developed factors which are used to forecast GSDPs for each state.

4.15 Therefore, in our view, GDP is the best source to be used as a growth driver for long term forecasts of traffic.

Summary

4.16 For any indicator to be used as a growth driver to forecast traffic, a reliable source of historical and forecast available for that indicator is the key requirement. Of the key socioeconomic indicators discussed above GDP seems to be the only growth driver for which reliable data is available both in terms of historical and forecast data, therefore, to forecast traffic we would be using GDP/GSDP as our key growth drivers.

Indicator	Remarks
GDP/GSDP	Available annually ***National level reliable historical and forecast available***

Indicator	Remarks
Population/Urbanisation	Revised every 10 years, last available 2011. Population estimates are not available annually, making it difficult to run regressions. Also, the very dynamic nature of local population migration (which are very difficult to forecast with accuracy), we do not use population growth as a proxy for understanding future travel demand growth on the Assets. *Forecast available but historical data is a constraint*

Source: Steer analysis

5 Base Traffic, revenue validation, and forecasting assumptions

5.1 In this chapter, we present our approach to arrive at the base year position and assumptions for baseline (or background) traffic growth for each vehicle category on the Assets.

5.2 The two most important inputs that go into traffic and revenue forecasts are:

- The base position – both in terms of traffic and revenue levels currently being generated by an asset; and
- The future growth trends – which can be correlated to the various growth drivers and used to develop an informed view of the forecasts.

5.3 The following sections discuss our approach to arrive at each of these inputs for both the Assets.

FY23 Base year AADT estimates

FY23 base traffic (without correction)

5.4 The base year is the year on which long-term background forecast growth rates are applied to derive year-wise average annual daily traffic (AADT) estimates for forecast years. This is therefore an important aspect of our forecasting approach as baseline traffic and ultimately revenue forecasts for future years are built on top of the base year traffic estimate. We have used FY23 as the base year for AADT estimates for the forecast years.

5.5 As described previously in Chapter 3, to establish the base year (FY23) traffic position, we utilised information from various sources – including from the Client and our context knowledge, to assess a reasonable demand on the corridor for the base year FY23 which formed the basis of future year forecasts.

5.6 FY23 has not been affected by any unexpected event(s) and can be considered as a normal year for the purposes of base year estimation. We have arrived at our Base year traffic using the actual data for the period of 1st Apr'22 – 27th Mar'23 for Undavariya and for the period of 1st Apr'22 – 31st Mar'23 for Khemana. 27 days data for Mar'23 was prorated to arrive at full month MADT. The average traffic of actual traffic of FY23 is the base traffic (without correction) of our forecasts. The split between CJVs and Mini LCVS as well as Buses and 2As for the base year traffic has been referred to from the TVC survey analysis results. It should be noted that Mini LCVs are reported with CJVs, and buses are reported with 2As in the TMS systems.

5.7 Base correction factors are then applied on FY23 base (without correction) to incorporate the unreported share of traffic. The corrected FY23 is the base of traffic forecasts.

5.8 The table provided below provides a comparison between the FY23 base year and FY22 normalized (FY22 N). FY22 N represent the normalised AADT levels for FY22.

Table 5.1: FY23 base traffic comparison with FY22 N

	Undavariya			Khemana		
	FY22 N	**FY23**	**FY23 vs FY22 N**	**FY22 N**	**FY23**	**FY23 vs FY22 N**
CJV	7,821	6,718		8,586	8,094	
LCV	375	375		405	354	
Bus/2A	1,439	1,624	12.9%	1,281	1,436	12.1%
3A	906	796	(12.2%)	864	776	(10.2%)
MAV	5,026	5,137	2.2%	4,779	4,803	0.5%
OSV	5	7	34.2%	5	6	26.8%
Total	**15,573**	**14,656**		**15,921**	**15,471**	(2.8%)
PCU	**38,060**	**37,684**		**37,158**	**36,906**	(0.7%)

Source: Steer analysis

5.9 As discussed in initial chapters, the second wave of Covid19 infections peaked in the country during April and May 2021. Therefore, the traffic volumes on the Assets were impacted during Q1FY22. In Q2FY22, the traffic gradually returned to normal as the impact of second wave weaned away, including an element of residual (pent up) demand (from Q1 FY22) impacting traffic on the Assets. The period starting Oct'21 up until Mar'22 is devoid of any significant event, except Jan'22 when the third wave of Covid19 affected traffic volumes. However, the impact was short lived and had limited impact on the goods volumes of the Assets. We believe that the traffic levels observed during the Oct'21 to Mar'22 period when seasonally adjusted, were representative of normalised traffic on the Assets and not a result of temporary shifts or impacts. Therefore, H2 FY22 period is assumed to be a 'normal' period. FY22 N is derived using the weighted average of SCF adjusted MADTs from Oct'21 to Mar'22 (H2) based on number of days in respective months.

5.10 Strong growth is observed for Bus/2As and reasonable growth for MAVs thus validating the assumptions for FY23 base year traffic. Similar to trends observed on the Assets, a decrease in 3As has been observed in other parts of the country as well with subsequent increase in 2As. The traffic for CJVs and LCVs is lower/flat in FY23 as compared to FY22N. A high number of exemptions were being reported for these categories in FY22 which didn't represent the true on-ground situation of traffic. As the Client took over the operations of the Assets in Aug-22, reporting systems were made better leading to correct identification and reporting of true exemptions. Better reporting practices led to a decrease in the total reported traffic, especially for CJVs and LCVs.

Base correction for FY23

5.11 To arrive at the true base traffic position, we have used a base correction factor to adjust the traffic volumes for CJVs, LCVs and 2As. The percentage of this correction has been calculated by comparing the toll plaza traffic volumes with TVC data as explained earlier in the report. As the base AADT of our forecasts is derived using the TMS data, it is imperative to validate the robustness of the reported traffic volumes with independent counts.

5.12 The difference between reported TMS data and the traffic in Steer independent TVC counts is added as part of the base to account for the vehicles which are crossing the plaza as 'unreported' traffic. The traffic observed in the independent counts conducted by Steer report ~0.6% and ~0.2% higher than the traffic reported in TMS in the same week for Undavariya and Khemana plazas respectively. This difference is largely driven by LCV/Bus/2A categories. The TMS data is for the same dates as the TVC and an average of 7 days.

5.13 To correctly account for true traffic levels, we have added the difference between Steer TVC and TMS counts (as a % of TMS) on the FY23 base traffic (without correction) position. We believe that this share of additional and unreported traffic does not pay at the plaza and hence, we treat this share as 'Exemptions' in our forecasts, allowing us to estimate the correct capacity of operations at both the toll plazas. Significant differences are observed for LCV+Bus+2A category. These categories are compared at a combined level due to classification issues between these categories.

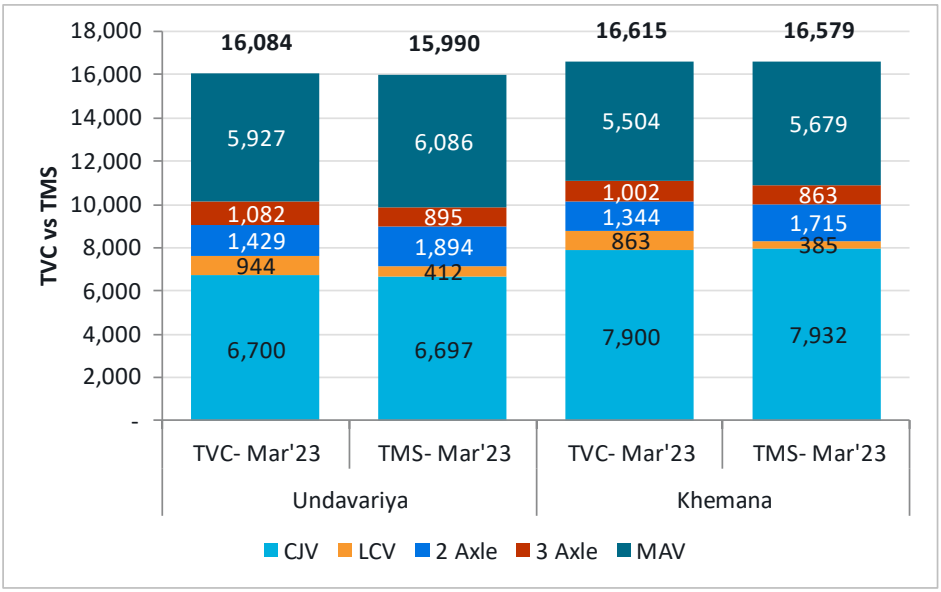
5.14 The table below illustrates the adjustment for the delta, and how it is factored into our base position:

Table 5.2: Base correction factor adjustment

	Undavariya			Khemana		
	FY23	**Base Correction Factor**	**FY23 Base**	**FY23**	**Base Correction Factor**	**FY23 Base**
CJV	5,933		5,933	7,438		7,438
Mini LCV	785		785	656		656
LCV	375	2.9%	386	354	5.1%	372
Bus	647	2.9%	665	487	5.1%	511
2A	977	2.9%	1,005	950	5.1%	998
3A	796		796	776		776
MAV	5,137		5,137	4,803		4,803
OSV	7		7	6		6
Total	**14,656**		**14,714**	**15,471**		**15,561**

Source: Steer analysis

Figure 5-1: TVC vs TMS comparison



Source: Steer analysis

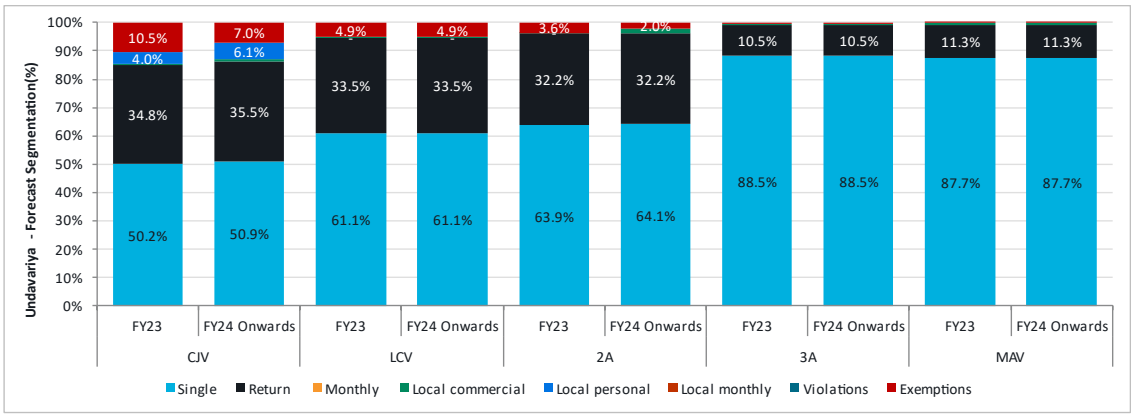
Revenue Estimates

5.15 To estimate the base revenue for the toll plaza, we used the estimated FY23 AADT, established as part of the analysis above, as the assumptions for base FY23 traffic. We then used the segmentation assumptions, discussed in chapter 3, as a starting point to arrive at the base year revenue. This is further discussed in the section below.

Toll Segmentation

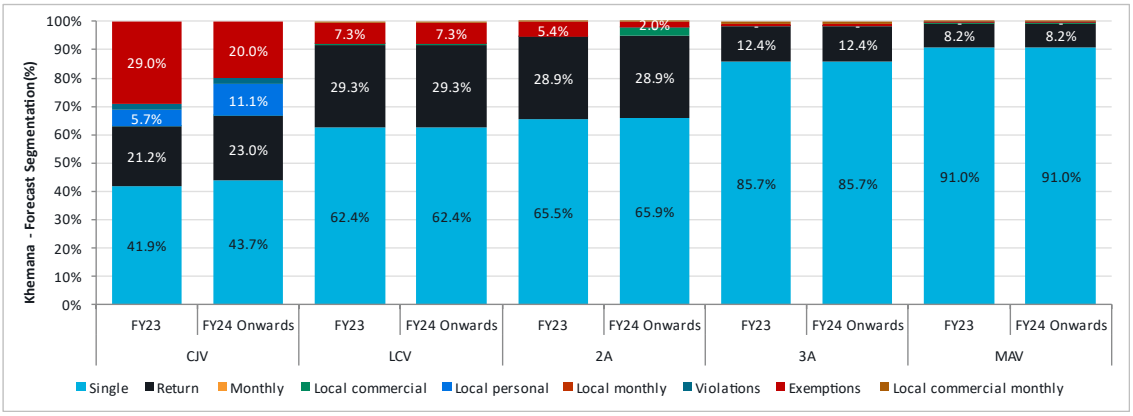
5.16 As discussed in chapter 3, segmentation trends have largely been stabilising over the last few months, with FASTag now being in a compulsory implementation since Feb'21 and more than 95% of transactions are via FASTag, it can be assumed that travel patterns have stabilised. Therefore, we believe the that average of the segmentation in actual traffic data for FY23 is representative of the travel patterns on the Assets. This is presented below:

Figure 5-2: Toll segmentation (%) at AS: Undavariya



Source: Steer analysis

Figure 5-3: Toll segmentation (%) at PA: Khemana



Source: Steer analysis

5.17 The changes in forecast toll segmentation observed on all three toll plazas is due to our understanding that once the Assets are taken over by the Client, the overall reporting practises will improve as the toll plaza will be operated by a reputed toll operator and may result in a decrease in total exemptions. Increasing compliance due to better operational efficiency in the next year will see the number of exemptions decrease further, with a subsequent increase in the Local passes, as well as the Single and Return ticket categories.

5.18 As discussed in Chapter 3, in the case of Khemana toll plaza, it is observed that the some of the commercial vehicles (LCV, 2A, 3A, and MAV) from the vicinity of toll plaza use a small portion of the Asset and were not paying any toll fees. The toll plaza has started recovering some fee from these vehicles through an informal arrangement of a monthly pass of INR 1000 for LCVs and INR 1500 for 2A, 3A and MAV. This is getting recorded under the ticket type 'Local Personal' by the toll plaza operator. Due to the unique nature of this ticket, we have defined it as 'Local Commercial Monthly' and applied the same annual revision mechanism as for the other ticket types.

Revenue reconciliation – validation of forecast segmentation

5.19 As part of validating the data provided by the Client, as well as our assumptions around toll calculations and forecast segmentation, we have reconciled the actual reported revenue on a monthly level for the Assets. To reconcile we have used our FY23 segmentation as mentioned in the previous section, MADT of the month and compared it with the reported revenue for FY23.

5.20 The Steer revenue calculations have been built up from monthly raw traffic data files, containing monthly data and ticket type information; and the toll notifications – all shared by the Client. The comparison, as shown in the table below, depicts the difference between modelled revenue and the reported revenue is within 0.1-0.3% for the Assets, this gives us the confidence on the assumptions around segmentation and trip factors used for estimating forecasting revenue.

5.21 The table below shows the delta between our modelled revenue and the actual revenue reported in the toll plaza data.

Table 5.3: Revenue Reconciliation

Toll plaza	Modelled	Reported	Delta

Undavariya	64.63	64.53	0.2%
Khemana	94.78	94.40	0.4%

Source: Steer analysis. 'Reported' is adjusted reported data for revenues till 31st Mar-23 (based on pro-rated revenues for 4 days, i.e., 28th – 31st Mar-23) for Undavariya. For Khemana, reported revenues are available for the entire FY23.

Base year (FY23) Comparison

Traffic comparison

5.22 The table presented below is the comparison of FY23 corrected base traffic as assumed in the previous study in Dec'20 (1st round of InVIT) and the FY23 base traffic as assumed in the present study.

Table 5.4: Base Year Traffic Comparison

	Undavariya			Khemana		
	Current study	**Previous study**	**Delta**	**Current study**	**Previous study**	**Delta**
CJV	6,718	6,830	(1.6%)	8,094	7,584	6.7%
LCV	386	521	(25.9%)	372	409	(8.9%)
Buses	665	525	26.7%	511	388	31.7%
2A	1,005	737	36.3%	998	796	25.4%
3A	796	972	(18.1%)	776	1,031	(24.7%)
MAV	5,137	5,221	(1.6%)	4,803	4,503	6.7%
OSV	7	-		6		
Total	**14,714**	**14,807**	**(0.6%)**	**15,561**	**14,711**	**5.8%**
PCU	**37,841**	**37,810**	**0.1%**	**37,152**	**35,108**	**5.8%**

Source: Steer Analysis, Previous Study was carried in July'22.

5.23 CJVs have outperformed as compared to the forecasted traffic at Khemana plaza. This can be attributed to the increased local influence of nearby urban centres (such as Palanpur) on the CJV traffic at the plaza. The CJV traffic has remained in line with the forecasted assumptions at Undavariya plaza. Lower than expected performance is observed for LCVs on the Assets. However, a subsequent healthy performance is being observed for 2As. Throughout the country, a drop in 3As is being observed with increase in either 2As or MAVs at most of the toll plazas. The same is being witnessed at the Assets also, with the increase being observed in 2As at Undavariya, and in 2As and MAVs at Khemana.

5.24 At an overall PCU level, the Undavariya performance has been in line with the forecasts, whereas, for Khemana, it has outperformed the traffic estimates by ~5.8%.

6 Traffic and revenue forecasts

Introduction

6.1 Following the discussion on establishment of base year and assumed forecast background growth rates in the previous chapter, this chapter first deals with the forecasting assumptions around potential impacts on traffic growth on the Assets. Later, it also presents the assumed toll segmentation, trip factors and evolution of toll rates for the forecast period which are used to estimate the forecast revenue based on the forecast traffic. In the final section, the chapter summarises the traffic growth rates for the forecast years. The following table lists key final outputs that have presented in chapter 5, along with chapter references for the inputs.

Table 6.1: Key intermediate and final outputs in the forecast

Forecast	Final outputs	Intermediate outputs	Inputs	Chapter covering Inputs
Traffic	Base year AADT	AADT	Historical and year-to-date AADT	Chapter 3, 5
	Background traffic growth	Background forecast elasticity	Background historical elasticities with respect to growth drivers	Chapter 3,4
		Forecasts for growth drivers	Historical performance of growth drivers along with Macro assumptions (GDP and GSDP)	Chapter 6
	Impact growth rates and staging	Impacts	Asset vs alternate route costs for ongoing/upcoming network and other developments	Chapters 6
Revenue	Annual/daily revenue forecasts	Forecast toll segmentation: Trip frequencies and trip factors	Historical trip frequencies	Chapter 3
			Historical trip factors	Chapter 6
		Future toll rates	Toll charge estimation	Chapter 6

Source: Steer

6.2 All traffic is presented as AADT by vehicle category at each plaza, for financial years (April-March). All revenue is presented in Rupees (nominal terms). We have presented summary forecasts until FY50 in this chapter. Appendix A presents detailed forecasts until FY50.

Analysis of Potential Impacts

Summary of alternate routes and impact assessments

6.3 This section below details the impacts which we believe would affect traffic on the Assets during the concession period. As discussed earlier in Chapter 2, to assess the impacts on the Assets, whether positive or negative, we have studied developments (alternate roads, feeder roads and alternate modes) in the surrounding road network.

6.4 The following table lists the impacts considered on the Assets.

Table 6.2: Summary of Impacts

S. No.	Development	Probability/ Scale of Impact	Year of completion	Toll Plazas affected	Impact (+/-)
1	Amritsar-Jamnagar Expressway	Medium/ Medium	FY26 onwards	Undavariya Khemana	-ve
2	Two-laning upgrade of Udaipur-Sirohi-Tharad road sections	High/ Medium	Ongoing impact – adjusted to account in for actual impact already observed	Undavariya Khemana	-ve
3	Completion of Western Dedicated Freight Corridor (WDFC)	High/ High	FY24 onwards	Undavariya Khemana	-ve
4	3A/MAV Recovery	High/ Medium	FY25 onwards	Khemana	+ve
5	Six Laning & LOS improvement	High/ Low	FY34 onwards	Undavariya Khemana	+ve

Source: Steer analysis

6.5 For potential road-to-road diversions due to network improvements, we have used generalised journey cost (GJC) analysis to understand potential impacts on the Assets. The GJC costs combine distance (fuel), time and toll costs on the two routes in question and model the diversions using a logit/gravity model between the route choices to estimate potential diverted traffic. The in-scope (divertible) traffic on which the analysis is carried out is estimated from benchmark origin-destination (OD) survey data from neighbouring toll roads on the corridor network and based on our experience across the region.

6.6 For intermodal competition, we have followed a customised approach as explained further in the section for WDFC.

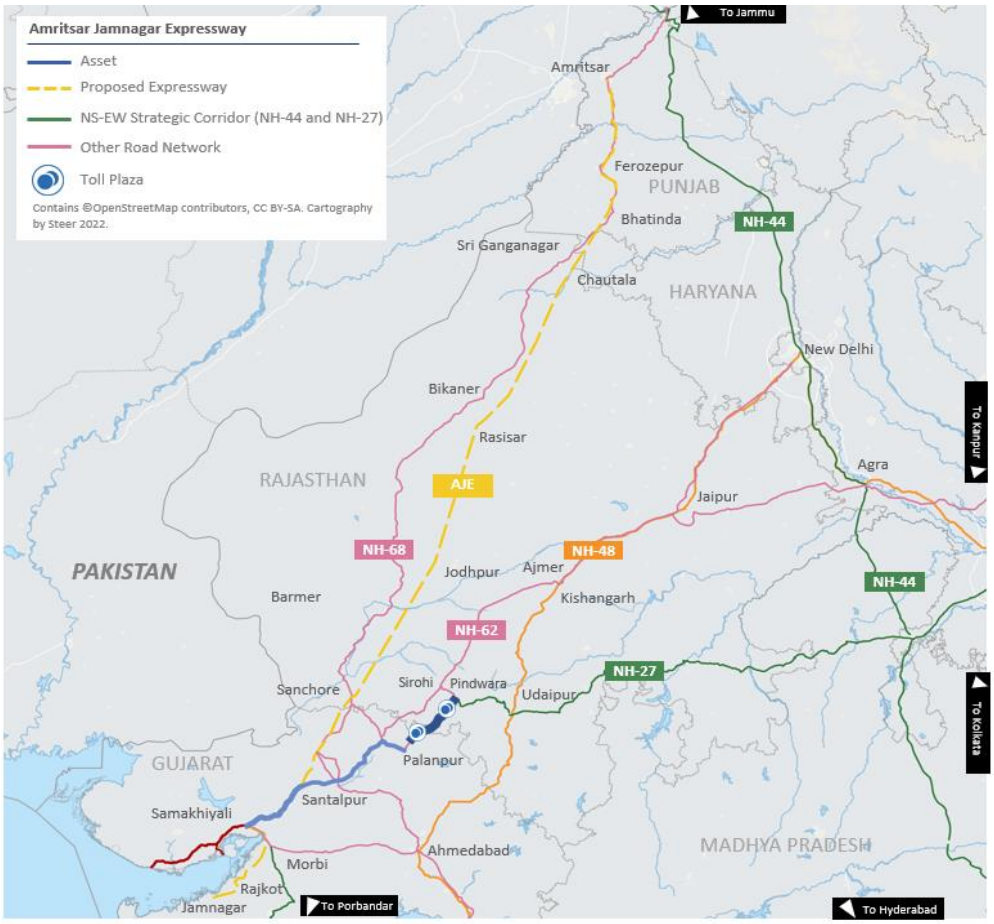
6.7 The subsections below include a narrative of each of the improvements, as listed in the table above, and impacts associated from each of these on the corresponding Assets.

Amritsar Jamnagar Expressway

6.8 A 1256 km long Amritsar – Jamnagar Expressway is being developed by National Highways Authority of India (NHAI). 915 km of total length is being developed as a Greenfield and the rest 341 km will be a brownfield upgrade.

6.9 The work on six lanes, 917 km (greenfield) long Amritsar-Bhatinda-Jamnagar (Trans-Rajasthan) corridor is going at a fast pace. The work for the entire length is awarded and the 594 km stretch has been constructed till October 2022. The Rajasthan section of length 440 km will be completed and opened to traffic soon.

Figure 6-1: Asset route shown against Amritsar Jamnagar Expressway



Source: Steer analysis and cartography

6.10 The proposed expressway between Amritsar and Jamnagar will establish new competing route as long-distance corridor for traffic moving between Amritsar/Punjab/ Northern Rajasthan and Jamnagar/Coastal Gujarat moving and the same will be the in-scope traffic moving on the Assets. The staged impact for this has been assumed starting FY26.

6.11 The existing distance between Amritsar and Jamnagar using Assets is 1520 kms which will get reduced to 1256 kms after the expressway becomes operational. This expressway was announced after the Steer study in FY21 (Dec-20) and therefore, it wasn't considered in the earlier study.

Table 6.3: Estimated impact due to completion of Amritsar Jamnagar Expressway

TP	2A	3A	MAV
Undavariya	(2.5%)	(2.9%)	(2.9%)
Khemana	(2.8%)	(3.0%)	(3.1%)

Source: Steer Analysis

Network development on Udaipur-Sirohi-Tharad corridor network

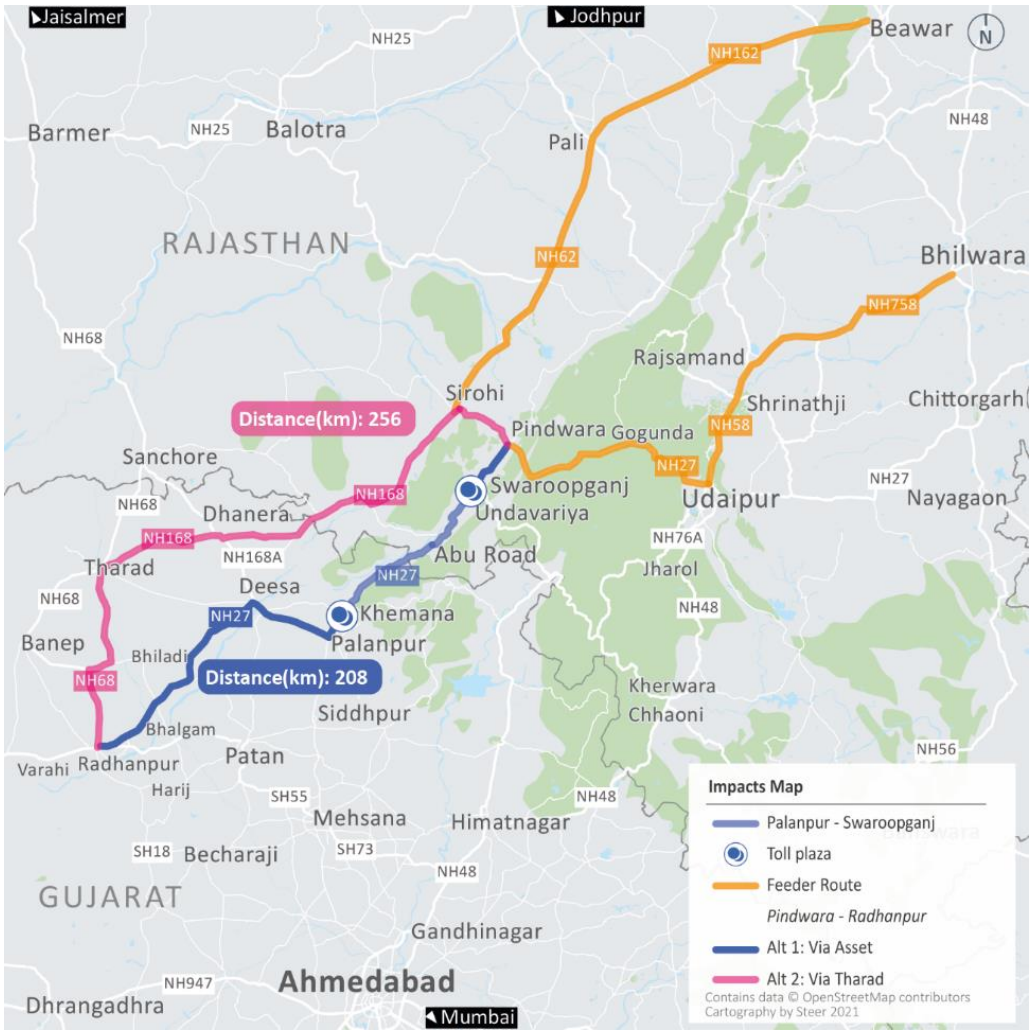
6.12 The Assets are a part of the long-distance corridor network connecting Rajasthan and the northern Indian states with the western Gujarat region, particularly industries and ports in the Kutch and Morbi region. Southbound trips from Delhi and the northern states plying via Jaipur enter Gujarat through Udaipur and Pindwara. This traffic market however has two options to reach Radhanpur – via the Assets and via Pindwara-Sirohi-Tharad.

6.13 Road sections on the Pindwara-Sirohi-Tharad corridor was upgraded from single lane to two-lane configuration under NH168 upgrade. While the Pindwara-Sirohi section being without a toll plaza does not entail tolls (though part of the tolled BPP toll road asset), the Sirohi-Tharad section is tolled.

6.14 The traffic pattern (i.e., the total diversion from the Asset) has not established yet on account of this development which took place in last year. We found that about 50% of the impact estimated in our earlier study in Dec-20, can be witnessed on the Asset (based on the 3A/ MAV PCU volumes at Panthawada and Bhordu toll plazas[4]), whereas the remaining is expected to take place over the next few years on the Assets. Accordingly, we have considered the adjusted impacts over FY24 and FY25 on the Assets. The map below shows the road network surrounding the Assets.

[4] Source: IHMCL (Feb-23)

Figure 6-2: Asset route shown against Udaipur-Sirohi-Tharad Corridor



Source: Steer analysis and cartography

Table 6.4: Estimated impacts due to Udaipur-Sirohi-Tharad upgrade

TP	3A	MAV
Undavariya	(1.9%)	(3.6%)
Khemana	(1.8%)	(4.2%)

Source: Steer analysis

Completion of Western Dedicated Freight Corridor (WDFC)

6.15 The Western Dedicated Freight Corridor (WDFC) is a 1506-km long dedicated freight rail line that connects Delhi (along with the wider Delhi NCR region) with Mumbai's JNPT port. This is expected to cater to north-south long-distance logistics, causing road-rail diversion especially of heavy vehicles that carry export-import (EXIM) goods and/or bulk commodities.

6.16 The Rewari to Palanpur section of the DFC commissioned in April 2021 and first RO-RO service from Palanpur was flagged off in August 2021. Whereas, the Dadri-Rewari section was commissioned in Mar-23. Essentially, Palanpur-Marwar and Rewari sections are already

operational, and the remaining sections will be operational by FY 24. Accordingly, the impact of WDFC on Palanpur Aburoad will be immediate (50% in FY24 and 100% in FY25) and negative.

6.17 To estimate the loss of trucks on the Assets due to WDFC, we identified the in-scope traffic which was estimated using the following parameters:

- Commercial vehicles that carry the following commodities:
  - POL, Coal, Containers that are bulk in nature.
- Vehicles that commute between regions north of the Assets, which are located along the alignment of the WDFC like Delhi, Haryana and travelling long-distance covering more than 750 km.

6.18 These commodities on the Assets 1 and 2 form up to 15% of the total 3A/MAV traffic. We have assumed up-to one-third of the in-scope traffic to shift towards DFC. Below tables presents our assumptions for the same.

Table 6.5: Estimated impacts due to completion of WDFC

TP	2A	3A	MAV
Undavariya	(1.1%)	(2.6%)	(3.3%)
Khemana	(2.5%)	(2.6%)	(4.2%)

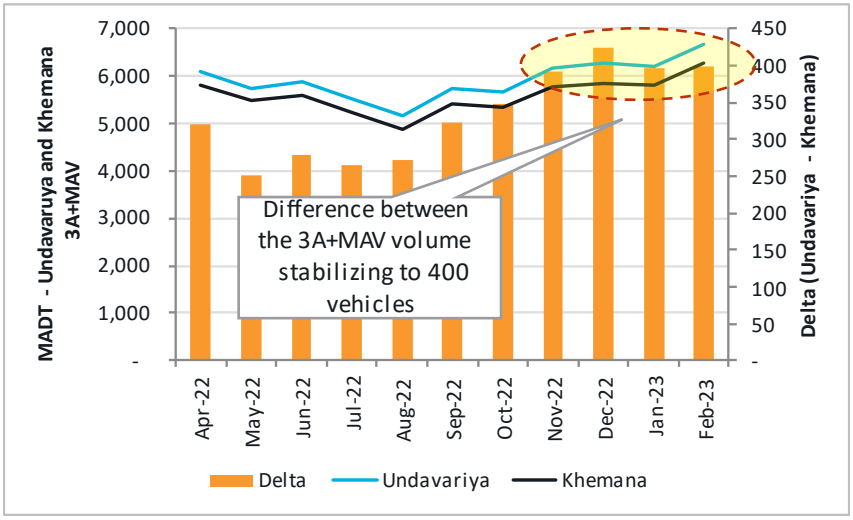
Source: Steer analysis

3A/ MAV recovery at Khemana toll plaza

6.19 As discussed earlier, the RTO circle near Palanpur, which lies about 6km south of Khemana toll plaza, is under construction (understood to begin around Apr-May 2022). This construction activity has caused congestion, mainly driven by the CJV vehicles. Due to which, it has been observed that some of the long-haul traffic plying on NH27 and/ or destined to/ from central and western Gujarat including ports, Morbi, among others has started using the diversion to avoid Khemana TP, which is near Chitrasani that leads to the SH54.

6.20 Historically, the difference of 3A and MAVs volumes between Undavariya and Khemana was 250-300 vehicles, which has been observed to stabilize around 400 now. The same has been validated through TVC and OD through trips analysis. The area around this intersection near Chitrasani is also rich in warehousing activities, due to which some of the commercial traffic coming from Undavariya uses this diversion and does not appear at Khemana TP.

Figure 6-3: Historical delta of 3A, MAV volumes between Undavariya and Khemana

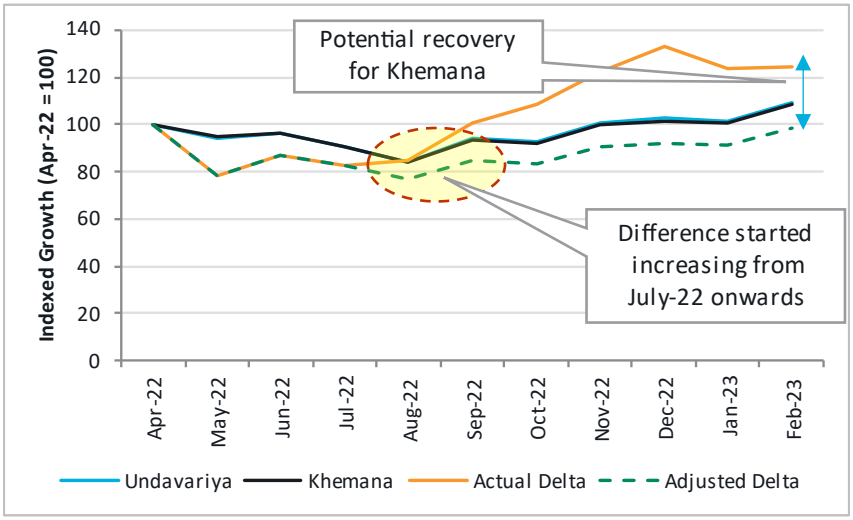


Source: Steer analysis

6.21 SH54 provides a direct link to the traffic which is destined to Deesa and further towards the ports. It is a state highway 7m undivided road of good quality, however it is highly constrained at the two ends of the road where it meets Asset again. Near Chitrasani, in order to access SH54 from the project road, the trucks need to take the movement 1 (as explained above). As they continue on SH54, they move along the back boundary wall of Deesa Airport, pass under the Asset flyover at Deesa, and continue on congested service road for about 2 kms before they meet the project road again. This is not a convenient road for the trucks as compared to a seamless movement offered by the Asset.

6.22 Therefore, we believe that once the construction is over by end of FY24, the diverted traffic will appear on the Asset (Khemana TP).

Figure 6-4: 3A, MAV expected recovery at Khemana



Source: Steer analysis

6.23 Based on the historical data and inputs from primary surveys, ~100 trucks (3A+MAV) are expected to recover at Khemana toll plaza once the construction of RTO circle is completed.

Assuming 2 years of construction period, we are applying a positive impact in FY25 (5% - 3A, 95% - MAV).

6.24 Accordingly, the positive impact at Khemana toll plaza is considered as follows:

Table 6.6: Estimated impact due to completion of RTO circle construction

TP	3A	MAV
Khemana	0.6%	1.9%

Source: Steer analysis

LOS improvement

6.25 The Assets are likely to undergo 6-laning once the design capacity is breached. In our analysis, we have assumed that the Assets will begin construction activities for 6-laning once the traffic exceeds 40,000 PCUs for four consecutive years. For DPR preparation it would take another two years which will be followed by the construction activity, which expected to last another two years.

6.26 Therefore, we have estimated that the first two years of construction would cause a negative impact on the local traffic due to reduced speeds on the Asset and increased time, while on completion of 6-laning the improved LOS will induce more traffic on the Asset.

6.27 A comparison of generalised journey costs (GJC) provides how different elements of cost and time affect traffic. This comparison was done for both light and heavy vehicles. Lower GJCs correspond to higher induced traffic. Based on Steer's studies and research in India, we have found that for every 1% reduction in the GJCs, the traffic increases by a factor of 0.3. We then applied the difference of GJCs to the elasticity of 0.3 to get net influence on the traffic.

6.28 The improvement in travel costs or GJC is translated into the impact on that share of OD movements using a linear inverse relationship. Therefore, the GJC influence is applied on the corresponding shares of traffic, which were extracted from OD data. In this case, we have adopted the OD data provided by the client.

6.29 The table below shows the extent of the LOS impact and the expected timelines of the impact on each of the Assets.

Table 6.7: LOS improvement (impact)

TP	CJV	LCV	2A	3A	MAV
Undavariya	0.2%	0.2%	0.8%	2.2%	1.8%
Khemana	0.5%	0.8%	1.2%	1.6%	1.1%

Source: Steer analysis

Forecasts for Growth Drivers

6.30 In this section, we have described our assumptions in relation to forecasts of the key macro-economic drivers of traffic growth. India's GDP and the relevant state GSDPs are the primary macroeconomic variables that have been used to drive our traffic growth forecasts.

Macro assumptions: GDP, GSDP and WPI

National GDP

6.31 For the past 2 decades, the Indian economy has grown at an average of about 7% annually. Between 2014-2018, India was the fastest growing major economy globally. In the year 2019-20, there was a trend of economic downturn observed in the country, nevertheless, with government initiatives such as Make in India, and Production-Linked Incentive (PLI) scheme, the national economy was expected to improve.

6.32 The Input assumptions on GDP, GSDP and WPI are presented below. GDP is sourced from Consensus forecasts.

6.33 In the long term, we believe that as other smaller state economies of India catch up with the national economic growth, the gap between growth rates of larger state economies, such as Gujarat, Maharashtra and Karnataka, and the national GDP growth rate will start reducing.

Table 6.8: GDP, GSDP, WPI growth forecast assumptions

FY	GDP	GSDP Gujarat	GSDP Rajasthan	WPI
FY24	5.8%	7.4%	5.7%	5.02%*
FY25	6.2%	7.6%	6.1%	3.5%
FY26	6.5%	7.7%	6.4%	3.5%
FY27	6.5%	7.5%	6.4%	3.5%
FY28	6.3%	7.2%	6.2%	3.5%
FY29	5.9%	6.6%	5.8%	3.5%
FY30	5.9%	6.5%	5.8%	3.5%
FY31	5.9%	6.5%	5.8%	3.5%
FY32	5.9%	6.5%	5.8%	3.5%
FY33	5.9%	6.4%	5.9%	3.5%
FY34	5.8%	6.3%	5.8%	3.5%
FY35	5.7%	6.2%	5.7%	3.5%
FY36	5.6%	6.0%	5.6%	3.5%
FY37	5.5%	5.9%	5.5%	3.5%
FY38	5.4%	5.7%	5.4%	3.5%
FY39	5.3%	5.6%	5.3%	3.5%
FY40	5.2%	5.2%	5.2%	3.5%
FY41	5.1%	5.1%	5.1%	3.5%
FY42	5.1%	5.1%	5.1%	3.5%
FY43	5.0%	5.0%	5.0%	3.5%

Source: Projections of GDP from Consensus, *RBI Estimates, https://www.rbi.org.in/Scripts/PublicationsView.aspx?id=20931, WPI future input is provided by client

6.34 WPI for FY24 is sourced from the Dec'22 release of RBI estimates. According to the concession agreement, the RBI release of December is to be referred to vehicle incorporating WPI in the

toll rate revision. We have assumed 3.5% WPI growth each year FY25 onwards based on the inputs provided by the Client.

Elasticity and growth drivers

6.35 In this section, we present our approach, and assumptions around estimation of elasticities and forecast assumptions of macro parameters for each vehicle category on the Assets.

6.36 Traffic growth is commonly related to a variety of macro-economic and industry- or commodity-specific factors (hereafter referred to as 'traffic growth drivers'). These growth drivers are typically identified from the results of the OD data analysis and the site visits that help us appreciate the nature of traffic movement – 'what' travels 'where' and 'why'.

6.37 On asset where long time series historical data is available, to understand the historical traffic trends in relation to these growth drivers, we typically carry out regression analysis, to determine the historical relationship between traffic belonging to each major vehicle category and its macroeconomic growth driver at the toll plaza. The dynamics of traffic demand is the dependent variable while the dynamics of one or more identified growth drivers are the independent or explanatory variables. This is the primary approach to determine the elasticity relationships. However, for Assets under consideration where only limited historical data is available, we have adopted a benchmark approach to finalise our elasticity estimates.

6.38 While working on several asset across the country where historical data is available, it has been observed that typically, growth of passenger and light commercial vehicles like cars, buses and LCVs which have relatively shorter trip lengths (<200-250 km) is more closely linked to the local economic growth drivers where the Asset is located. These categories are generally driven by the demand of local production/consumption centres and are in most cases captive to the asset. Local factors coupled with tourism driven demand is often seen as the key driver for consumption of goods and services in the areas. Therefore, we typically link the growth rate of these vehicle categories with GSDP growth rates of the state where the asset is located as that is closest proxy of the local economic activity in the region.

6.39 Whereas heavy vehicle traffic like 3A trucks (sometimes 2A trucks as well) and MAVs tend to have a much longer average trip lengths (>350-500 km) and serve multiple economic activity centres located along an Asset as well beyond the Asset across multiple states of the country. For these vehicle categories we therefore assume these vehicle categories to grow in line with the national GDP.

6.40 This is because most light goods vehicles tend to travel shorter distances within the state, whereas a significant proportion of heavy vehicles carry commodities for long - distances across the country and have much longer trip lengths. These commodities also tend to be part of industry ecosystems whose demand-supply relationships are scattered across the country and therefore relate more with GDP growth. Therefore, using the OD data trip lengths of various vehicle types and the commodity carried by these goods vehicles form the basis for estimating the elasticity relationships.

6.41 The forecast elasticities are assumed to remain constant over the concession period as the logistics sector in still in early stages of development in India (95% of trucks still owned by operators owning less than 5 trucks). Car ownership levels are still around 22 per 1000 people, and it is likely to take a few years before the market reaches maturity. These trends are based on a long-term understanding of historical relationships and an overall outlook on the growth of the region and the country.

6.42 The table below detail out the reasoning for selection of respective growth driver(s) and elasticity adopted for each vehicle category for the Assets.

Table 6.9 Assumed Elasticities for the Assets

Vehicle Category	Adopted elasticity	Growth Driver	Comments
CJV	1.0	GSDP – 50% Gujarat, 50% - Rajasthan	Car traffic is local in nature and feeding key cities of Palanpur, Aburoad, Patan, among others. Volumes are low, but there is development in cities of Palanpur, Radhanpur, Deesa. Towns such as Patan are also growing. Both toll plazas are expected to grow with a higher 1 elasticity to GSDP due to its proximity to Palanpur, Udaipur, and Mount Abu.
Buses	0.5	GSDP – 50% Gujarat, 50% - Rajasthan	Buses are primarily a mix of public and private inter-city buses. Buses currently are serving local intercity demand. As these cities grow, the buses are also expected to grow to serve the increasing demand however only at a muted rate.
MLCV/LCV	0.5	GSDP – 50% Gujarat, 50% - Rajasthan	LCV have been observed to carry a mix of commodities, mostly catering to local demand. As these cities grow, we expect the consumption of these to also increase. 2A are very low in volume on the corridor and mostly local. With the allowance of more tonnage under the axle load revisions, this category has witnessed growth over the last couple of years. Therefore, an elasticity of 0.3 is considered reasonable for this category.
2A	0.3	GSDP – 50% Gujarat, 50% - Rajasthan	
3A	0.4	GDP	3A and MAVs are making long distance movements catering to the nearby industries. Further they feed into Morbi which generate and consume different finished goods and raw materials respectively. City of Gandhidham is a big intermediate industrial hub, further IOCL has a large Oil facility in the Kandla Cluster. The Assets also feed into the markets of Mehsana and Ahmedabad. All these industries are expected to continue to contribute to the growth of the Assets. Hence, we expect a healthy MAV elasticity of 0.9 on the corridor. This is also benchmarked to the feeder asset in the North which has shown similar historical trends for heavy vehicles.
MAV	0.9	GDP	

Revenue forecasting assumptions

6.43 To forecast the revenues for a forecast year, the traffic forecast for each vehicle type is converted into tickets sold, which is then multiplied with the corresponding toll rate. While toll segmentation provides the breakup of trips paying each ticket type, trip factors provide the conversion factor to convert from traffic (trips) to tickets sold. This section discusses assumptions related to toll segmentation, trip factors and toll rates for the forecast period.

Trip factors

6.44 As discussed in Chapter 3, a user can by different type of tickets to pay toll depending on the vehicle type. Apart from the single trips, trips such as return, monthly, local commercial, local personal, are discounted tickets that are offered to the users. The revenue realised from these

discounted trips is lower than a single trip fare. Therefore, in order to calculate the revenue for the trips made on discounted tickets (or passes) a trip factor is applied to calculate revenue realised from that particular pass sold.

6.45 The following trip factors are assumed for both the Assets.

Table 6.10: Trip factors for the forecast years

Ticket category	CJV	LCV	Bus	2A	3A	MAV	OSV
Single	1	1	1	1	1	1	1
Return	2	2	2	2	2	2	2
Monthly	45	45	45	45	45	45	45
Local Commercial	1	1	1	1	1	1	1
Local Personal	30						
Local Commercial Monthly		50	50	50	50	50	50

Source: Steer analysis. Local Commercial Monthly applicable only for Khemana TP

Toll Evolution

6.46 Based on the concession agreement and the gazetted toll notification, we see that base toll rates increase every year on 1st April based on WPI-linked inflation (December print of previous FY) to provide us unrounded toll rates. These are rounded up to the nearest five to estimate the rounded toll rates charged to the road user. We have used actual toll rates of FY23 toll notifications to validate the modelling of toll evolution. These toll lengths are presented in the table below:

Table 6.11: Tolling lengths for toll evolution –

Toll Plaza	FY23	FY24 onwards
Undavariya	32.59 Km	No change - 32.59 Km
Khemana	50.92 Km	No change - 50.92 Km

Source:

Traffic and Revenue forecasts

6.47 The PCU factors considered are given in the table below. These are derived from IRC: 16-1990 code. The splits for the same have been derived from the TVC counts that we have undertaken.

Table 6.12 PCU Factors

Vehicle Category	PCU Factor
CJV	1.0
LCV	1.5
Bus	3.0
2A	3.0
3A	3.0
MAV	4.5
OSV	4.5

Source:

6.48 Based on the traffic and revenue-related forecast assumptions discussed above, we have modelled the traffic and revenue forecasts for the forecast period for the Assets. The table below presents the traffic and revenue forecast growth rates and CAGRs on this Assets. Further, Appendix D presents the AADT and revenues for the forecast period.

Traffic and revenue forecasts

AS - Undavariya

Table 6.13: Traffic forecast, AS Undavariya

Undavariya	FY23	FY25	FY30	FY35	FY40	FY43
CJV	5,933	6,754	9,313	12,547	16,451	19,073
Mini LCV	785	838	987	1,147	1,315	1,418
LCV	386	412	477	555	637	686
Bus	665	711	837	972	1,115	1,202
2 Axle	1,005	1,034	1,112	1,228	1,334	1,396
3 Axle	796	797	873	1,004	1,118	1,187
MAV	5,137	5,311	6,756	8,901	11,299	12,912
OSV	7	7	10	12	16	18
Total	**14,714**	**15,865**	**20,365**	**26,366**	**33,284**	**37,890**
PCU	**37,841**	**39,769**	**49,928**	**64,248**	**80,337**	**91,054**

Source: Steer analysis

Table 6.14: Final (background plus impacts) traffic growth rates (%), AS Undavariya

Undavariya	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	6.7%	6.6%	6.1%	5.6%	5.1%	6.0%
Mini LCV	3.3%	3.3%	3.0%	2.8%	2.5%	3.0%
LCV	3.3%	2.9%	3.1%	2.8%	2.5%	2.9%
Bus	3.3%	3.3%	3.0%	2.8%	2.5%	3.0%
2 Axle	1.4%	1.5%	2.0%	1.7%	1.5%	1.7%
3 Axle	0.1%	1.9%	2.8%	2.2%	2.0%	2.0%
MAV	1.7%	4.9%	5.7%	4.9%	4.5%	4.7%
OSV	5.4%	5.6%	5.3%	4.9%	4.5%	5.2%
Total	**3.8%**	**5.1%**	**5.3%**	**4.8%**	**4.4%**	**4.8%**
PCU	**2.5%**	**4.7%**	**5.2%**	**4.6%**	**4.3%**	**4.5%**

Source: Steer analysis

Table 6.15: Revenue (INR Crore), AS Undavariya

Undavariya	FY23	FY25	FY30	FY35	FY40	FY43
CJV	7.46	9.76	16.16	26.99	42.93	55.16

Mini LCV	0.99	1.21	1.71	2.47	3.43	4.10
LCV	0.85	1.04	1.44	2.02	2.91	3.48
Bus	3.21	3.76	5.39	7.68	10.80	13.15
2A	4.85	5.53	7.23	9.80	13.05	15.43
3A	4.62	5.05	6.77	9.54	13.02	15.47
MAV	42.58	48.62	75.06	120.85	187.71	241.22
OSV	0.07	0.08	0.13	0.21	0.32	0.41
Total	**64.63**	**75.07**	**113.88**	**179.56**	**274.16**	**348.43**

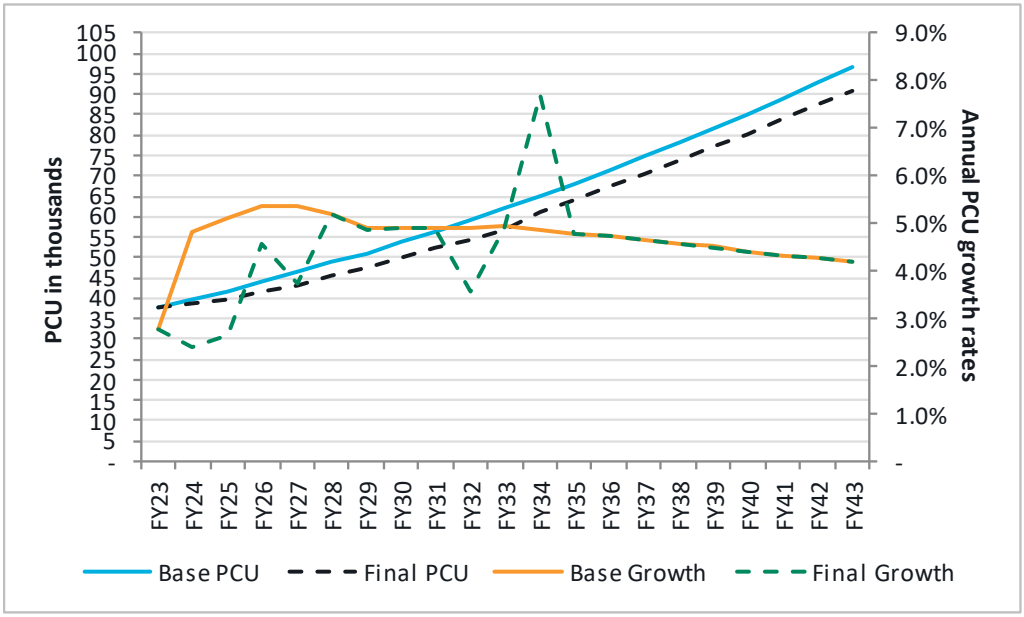
Source: Steer analysis

Table 6.16 Revenue growth rates (%), AS Undavariya

Undavariya	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	14.4%	10.6%	10.8%	9.7%	8.7%	10.5%
Mini LCV	10.8%	7.2%	7.6%	6.8%	6.1%	7.4%
LCV	10.5%	6.6%	7.1%	7.6%	6.2%	7.3%
Bus	8.2%	7.4%	7.4%	7.0%	6.8%	7.3%
2 Axle	6.7%	5.5%	6.3%	5.9%	5.7%	6.0%
3 Axle	4.6%	6.0%	7.1%	6.4%	5.9%	6.2%
MAV	6.9%	9.1%	10.0%	9.2%	8.7%	9.1%
OSV	10.8%	9.9%	9.6%	9.3%	8.5%	9.5%
Total	7.8%	8.7%	9.5%	8.8%	8.3%	8.8%

6.49 The growth rates and PCU projections are presented in the chart below. The overall PCU traffic is estimated to grow at a CAGR of 4.5% from FY23 to FY43, where the CJV would grow by 6.0% and MAV by 4.7%.

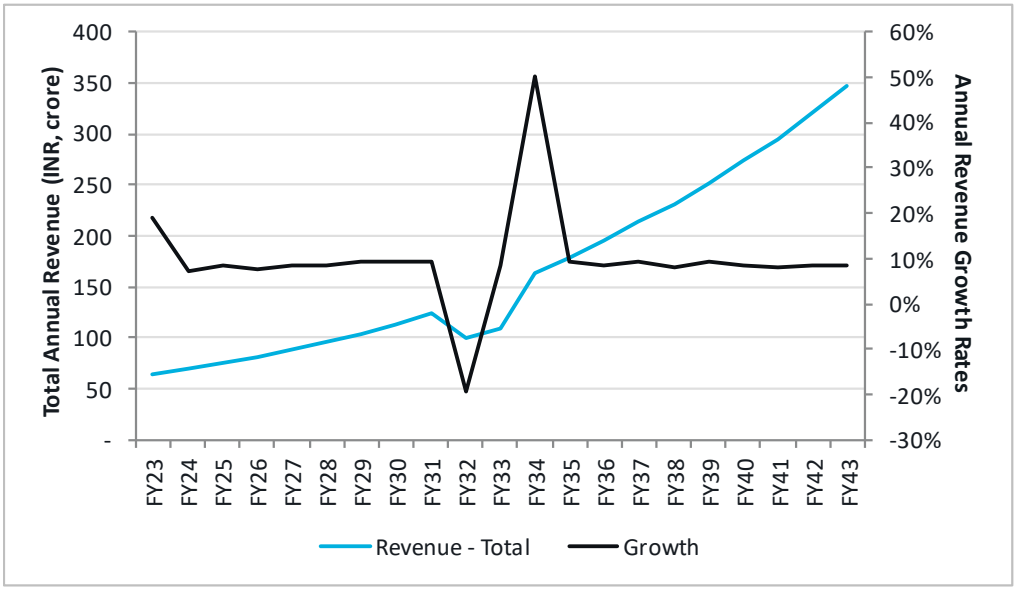
Figure 6-5: PCU growth rates (Base and Final) - AS: Undavariya



Source: Steer analysis

6.50 Annual revenue and associated growth rates are presented in the chart below. The overall revenue is estimated to grow at a CAGR of 8.8% from FY23 to FY43, where ~73% of the revenues are contributed by 3A and MAVs.

Figure 6-6: Revenue Estimates (INR Crore) and growth rates - AS: Undavariya



Source: Steer analysis

PA - Khemana

Table 6.17: Traffic forecast, PA Khemana

Khemana	FY23	FY25	FY30	FY35	FY40	FY43
CJV	7,438	8,467	11,675	15,775	20,684	23,980

Khemana	FY23	FY25	FY30	FY35	FY40	FY43
Mini LCV	656	701	825	959	1,100	1,185
LCV	372	398	460	538	618	666
Bus	511	546	643	747	857	923
2 Axle	998	1,013	1,086	1,203	1,307	1,367
3 Axle	776	783	858	979	1,090	1,158
MAV	4,803	4,989	6,334	8,282	10,513	12,013
OSV	6	7	9	11	14	17
Total	**15,561**	**16,904**	**21,890**	**28,495**	**36,182**	**41,309**
PCU	**37,152**	**39,273**	**49,492**	**63,648**	**79,844**	**90,642**

Source: Steer analysis

Table 6.18: Traffic growth rates (%), PA Khemana

Khemana	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	6.7%	6.6%	6.2%	5.6%	5.1%	6.0%
Mini LCV	3.3%	3.3%	3.0%	2.8%	2.5%	3.0%
LCV	3.3%	2.9%	3.2%	2.8%	2.5%	2.9%
Bus	3.3%	3.3%	3.0%	2.8%	2.5%	3.0%
2 Axle	0.7%	1.4%	2.1%	1.7%	1.5%	1.6%
3 Axle	0.4%	1.8%	2.7%	2.2%	2.0%	2.0%
MAV	1.9%	4.9%	5.5%	4.9%	4.5%	4.7%
OSV	5.4%	5.6%	5.3%	4.9%	4.5%	5.2%
Total	**4.2%**	**5.3%**	**5.4%**	**4.9%**	**4.5%**	**5.0%**
PCU	**2.8%**	**4.7%**	**5.2%**	**4.6%**	**4.3%**	**4.6%**

Source: Steer analysis

Table 6.19: Revenue (INR crore), PA Khemana

Khemana	FY23	FY25	FY30	FY35	FY40	FY43
CJV	11.14	14.61	25.21	41.28	66.35	85.23
Mini LCV	0.98	1.21	1.78	2.51	3.53	4.21
LCV	1.28	1.53	2.13	3.07	4.30	5.24
Bus	3.82	4.44	6.44	9.15	12.86	15.59
2 Axle	7.45	8.42	11.11	15.05	20.04	23.57
3 Axle	6.89	7.63	10.29	14.30	19.40	23.16
MAV	63.11	71.77	111.37	176.61	275.33	354.27
OSV	0.10	0.12	0.19	0.30	0.46	0.60
Total	**94.78**	**109.73**	**168.53**	**262.28**	**402.28**	**511.87**

Source: Steer analysis

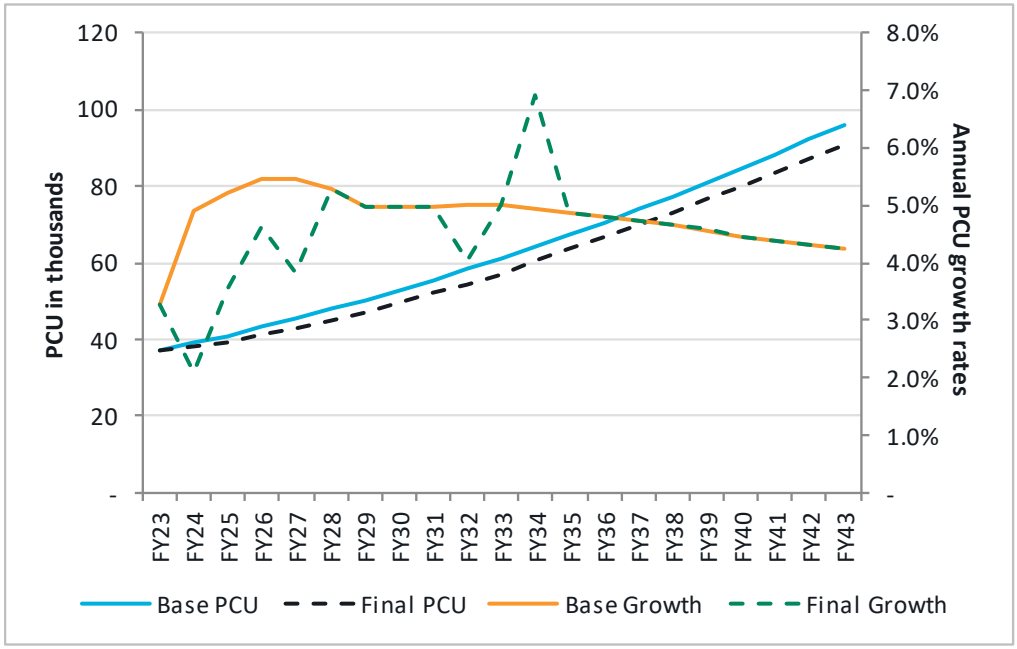
Table 6.20 Revenue growth rates (%), PA Khemana

Khemana	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	14.5%	11.5%	10.4%	10.0%	8.7%	10.7%
Mini LCV	10.9%	8.1%	7.1%	7.1%	6.1%	7.5%
LCV	9.5%	6.8%	7.6%	7.0%	6.8%	7.3%
Bus	7.8%	7.7%	7.3%	7.0%	6.6%	7.3%
2 Axle	6.3%	5.7%	6.3%	5.9%	5.6%	5.9%
3 Axle	5.2%	6.2%	6.8%	6.3%	6.1%	6.2%
MAV	6.6%	9.2%	9.7%	9.3%	8.8%	9.0%
OSV	10.0%	10.0%	9.6%	9.2%	8.7%	9.5%
Total	**7.6%**	**9.0%**	**9.2%**	**8.9%**	**8.4%**	**8.8%**

Source: Steer analysis

6.51 The growth rates and PCU projections are presented in the chart below. The overall PCU traffic is estimated to grow at a CAGR of 4.6% from FY23 to FY43, where the CJV would grow by 6.0% and MAV by 4.7%.

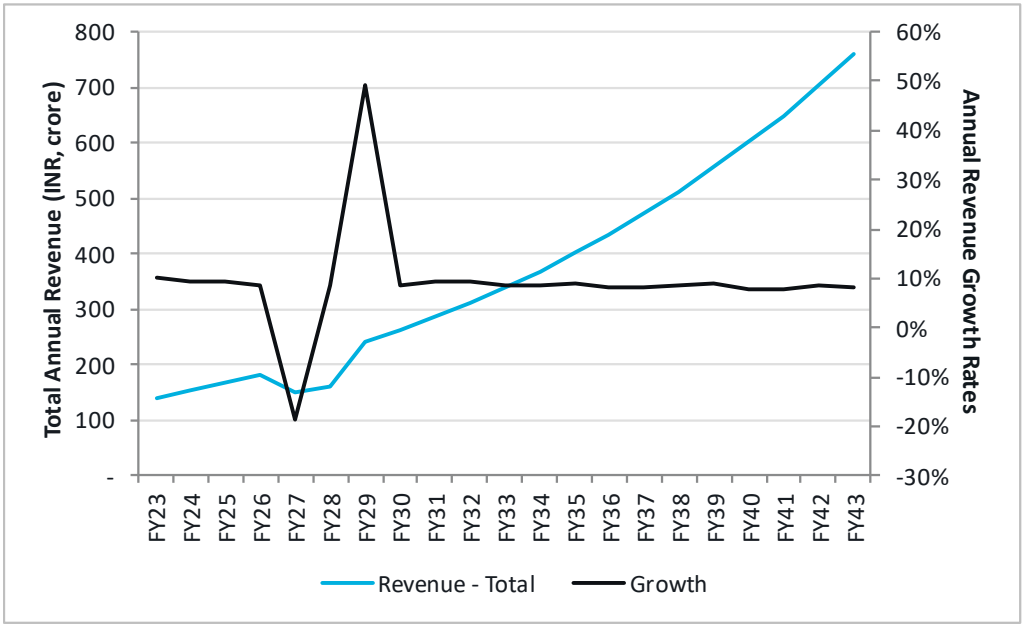
Figure 6-7: PCU growth rates (Base and Final) - PA: Khemana



Source: Steer analysis

6.52 Annual revenue and associated growth rates are presented in the chart below. The overall revenue is estimated to grow at a CAGR of 8.8% from FY23 to FY43, where ~74% of the revenues are contributed by 3A and MAVs.

Figure 6-8: Revenue Estimates (INR Crore) and growth rates - PA: Khemana



Source: Steer analysis

Comparison with earlier study

Traffic forecasts

6.53 Presented below is the comparison of revised traffic forecasts vis-à-vis the earlier forecasts (from the study conducted in Dec-20)

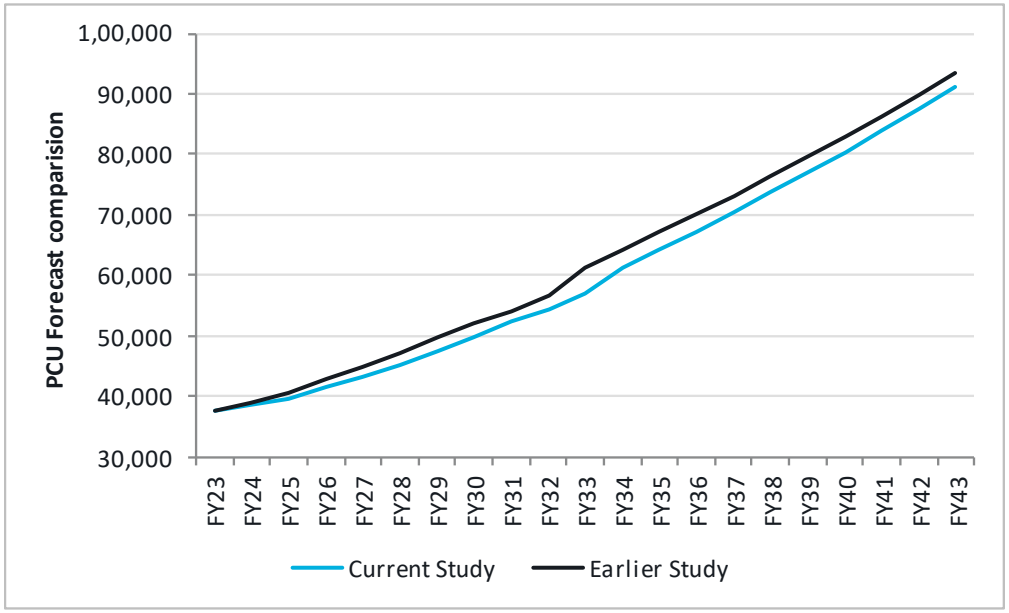
AS: Undavariya

Table 6.21: Traffic forecasts comparison – AS: Undavariya

Vehicle Type	Current study		Earlier study	
	AADT (FY43)	Growth Rate (FY23-FY43)	AADT (FY43)	Growth Rate (FY23-FY43)
CJV	19,073	6.0%	22,531	6.5%
Mini LCV	1,418	3.0%	694	3.0%
LCV	686	2.9%	941	3.0%
Bus	1,202	3.0%	925	2.9%
2A	1,396	1.7%	1,043	1.7%
3A	1,187	2.0%	1,436	2.0%
MAV	12,912	4.7%	13,021	4.7%
Total	37,890	4.8%	40,591	5.2%
Total (PCUs)	91,054	4.5%	93,443	4.6%

Source: Steer analysis

Figure 6-9: PCU Forecast Comparison – AS: Undavariya



Source: Steer Analysis

6.54 The total PCU growth rate is marginally lower as per the current study due to a combination of new impact (Amritsar Jamnagar Expressway) and revision in GDP estimates.

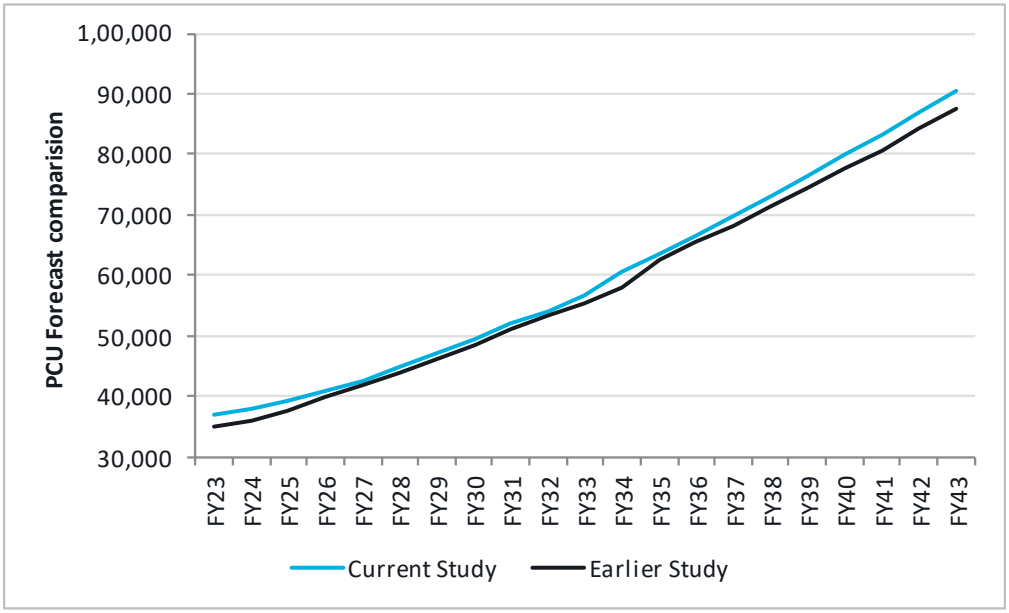
PA: Khemana

Table 6.22: Traffic forecasts comparison – PA: Khemana

Vehicle Type	Current study		Earlier study	
	AADT (FY43)	**Growth Rate (FY23-FY43)**	**AADT (FY43)**	**Growth Rate (FY23-FY43)**
CJV	23,980	6.0%	25,509	6.5%
Mini LCV	1,185	3.0%	517	3.0%
LCV	666	2.9%	738	3.0%
Bus	923	3.0%	684	2.9%
2A	1,367	1.6%	1,126	1.7%
3A	1,158	2.0%	1,525	2.0%
MAV	12,013	4.7%	11,194	4.7%
Total	41,309	5.0%	41,293	5.3%
Total (PCUs)	90,642	4.6%	87,509	4.7%

Source: Steer analysis

Figure 6-10 PCU Forecast Comparison – PA: Khemana



Source: Steer Analysis

6.55 The total PCU growth rate is marginally lower as per the current study due to a combination of new impact (Amritsar Jamnagar Expressway) and revision in GDP estimates. However, the eventual PCU number is higher due to an upward revision in base traffic.

Scenario Analysis

6.56 We have developed our base case scenario considering a balanced view on the risks associated with input assumptions around GDP growth and traffic growth elasticities. There is always a risk that the outturn values of these inputs will vary as compared to the assumptions taken due to exogenous impacts, e.g. GDP growth could be influenced both positively and negatively by the impact of monsoons, export-import balances, political changes etc.

6.57 Similarly, traffic growth elasticities could be influenced by increased efficiencies achieved by technology, large shifts in commodity prices globally, changes in local manufacturing practices. However, at this stage we consider that the base case represents a central case scenario given the risks of variation of input assumptions.

6.58 To account for the possible variations in the growth drivers, we are also presenting the forecasts for an Upside (optimistic) and a Downside (pessimistic) scenario.

6.59 These scenarios are defined by the following variations from the base assumptions:

Table 6.23 Summary of upside and downside scenario assumptions— AS Undavariya

Input	Base	Steer scenarios	
		Upside	Downside
Macro assumptions			
GDP/GSDP	As provided in report	+1% every year	-1% every year
Elasticities	As provided in report	+ 10%	- 10%
Impacts			
Amritsar-Jamnagar Expressway	As provided in earlier section of the report	2A: (2.5%) 3A: (2.9%)	2A: (4.1%) 3A: (4.8%)

Input	Base	Steer scenarios	
		Upside	Downside
		MAV: (2.9%)	MAV: (4.9%)
Two-laning upgrade of Udaipur-Sirohi-Tharad road sections	As provided in earlier section of the report	3A: (1.4%) MAV: (2.7%)	3A: (2.4%) MAV: (4.5%)
Completion of Western Dedicated Freight Corridor (WDFC)	As provided in earlier section of the report	2A: (0.8%) 3A: (2.0%) MAV: (2.5%)	2A: (1.4%) 3A: (3.3%) MAV: (4.1%)
Six Laning & LOS improvement	As provided in earlier section of the report	2A:1.0% 3A: 2.7% MAV: 2.2%	2A:0.6% 3A: 1.6% MAV: 1.3%

Source: Steer Analysis

Table 6.24 Summary of upside and downside scenario assumptions—PA Khemana

Input	Base	Steer scenarios	
		Upside	Downside
Macro assumptions			
GDP/GSDP	As provided in report	+1% every year	-1% every year
Elasticities	As provided in report	+ 10%	- 10%
Impacts			
Amritsar-Jamnagar Expressway	As provided in earlier section of the report	2A: (2.1%) 3A: (2.2%) MAV: (2.3%)	2A: (3.5%) 3A: (3.7%) MAV: (3.9%)
Two-laning upgrade of Udaipur-Sirohi-Tharad road sections	As provided in earlier section of the report	3A: (1.3%) MAV: (3.1%)	3A: (2.2%) MAV: (5.2%)
Completion of Western Dedicated Freight Corridor (WDFC)	As provided in earlier section of the report	2A: (1.8%) 3A: (2.0%) MAV: (3.2%)	2A: (3.1%) 3A: (3.3%) MAV: (5.3%)
3A/MAV recovery	As provided in earlier section of the report	3A: 0.8% MAV: 2.3%	3A: 0.5% MAV: 1.4%
Six Laning & LOS improvement	As provided in earlier section of the report	2A:1.5% 3A: 1.9% MAV: 1.3%	2A:0.9% 3A: 1.2% MAV: 0.8%

Source: Steer Analysis

6.60 The traffic forecast and growth, and revenue incorporating the upside and downside assumptions are presented in the following sections.

Traffic forecasts

Upside Case

Table 6.25 Final Traffic Forecasts: Upside Case - AS: Undavariya

Undavariya	FY23	FY25	FY30	FY35	FY40	FY43
CJV	5,933	6,980	10,448	15,256	21,623	26,236

Undavariya	FY23	FY25	FY30	FY35	FY40	FY43
Mini LCV	785	853	1,048	1,268	1,515	1,671
LCV	386	419	507	615	735	811
Bus	665	723	888	1,075	1,284	1,416
2 Axle	1,005	1,048	1,157	1,313	1,461	1,550
3 Axle	796	817	926	1,106	1,272	1,376
MAV	5,137	5,568	7,623	10,834	14,750	17,564
OSV	7	7	11	15	20	24
Total	**14,714**	**16,416**	**22,607**	**31,482**	**42,659**	**50,648**
PCU	**37,841**	**41,316**	**55,519**	**76,749**	**1,02,754**	**1,21,294**

Source: Steer Analysis

Table 6.26 Traffic Growth Rates (%): Upside case - AS: Undavariya

Undavariya	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	8.5%	8.4%	7.9%	7.2%	6.7%	7.7%
Mini LCV	4.2%	4.2%	3.9%	3.6%	3.3%	3.8%
LCV	4.2%	3.9%	4.0%	3.6%	3.3%	3.8%
Bus	4.2%	4.2%	3.9%	3.6%	3.3%	3.8%
2 Axle	2.1%	2.0%	2.6%	2.2%	2.0%	2.2%
3 Axle	1.3%	2.5%	3.6%	2.8%	2.7%	2.8%
MAV	4.1%	6.5%	7.3%	6.4%	6.0%	6.3%
OSV	6.9%	7.1%	6.8%	6.4%	6.0%	6.7%
Total	**5.6%**	**6.6%**	**6.8%**	**6.3%**	**5.9%**	**6.4%**
PCU	**4.5%**	**6.1%**	**6.7%**	**6.0%**	**5.7%**	**6.0%**

Source: Steer Analysis

Table 6.27 Revenue (INR Crore): Upside case - AS: Undavariya

Undavariya	FY23	FY25	FY30	FY35	FY40	FY43
CJV	7.46	10.09	18.13	32.82	56.43	75.88
Mini LCV	0.99	1.23	1.82	2.73	3.95	4.83
LCV	0.85	1.06	1.53	2.24	3.36	4.12
Bus	3.21	3.83	5.72	8.49	12.43	15.50
2A	4.85	5.60	7.52	10.47	14.29	17.13
3A	4.62	5.18	7.18	10.51	14.82	17.94
MAV	42.58	50.98	84.68	147.10	245.04	328.13
OSV	0.07	0.08	0.14	0.24	0.41	0.54

Undavariya	FY23	FY25	FY30	FY35	FY40	FY43
Total	**64.63**	**78.05**	**126.72**	**214.62**	**350.72**	**464.09**

Source: Steer Analysis

Table 6.28 Revenue Growth Rates (%): Upside Case - AS: Undavariya

Undavariya	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	16.3%	12.4%	12.6%	11.4%	10.4%	12.3%
Mini LCV	11.8%	8.1%	8.5%	7.7%	6.9%	8.3%
LCV	11.4%	7.6%	8.0%	8.4%	7.0%	8.2%
Bus	9.2%	8.3%	8.2%	7.9%	7.6%	8.2%
2 Axle	7.5%	6.1%	6.8%	6.4%	6.2%	6.5%
3 Axle	5.9%	6.7%	7.9%	7.1%	6.6%	7.0%
MAV	9.4%	10.7%	11.7%	10.7%	10.2%	10.7%
OSV	12.4%	11.5%	11.1%	10.8%	10.0%	11.1%
Total	**9.9%**	**10.2%**	**11.1%**	**10.3%**	**9.8%**	**10.4%**

Source: Steer Analysis

Table 6.29 Final Traffic Forecasts: Upside Case - PA: Khemana

Khemana	FY23	FY25	FY30	FY35	FY40	FY43
CJV	7,438	8,750	13,098	19,195	27,207	33,011
Mini LCV	656	713	876	1,060	1,266	1,397
LCV	372	405	490	600	716	790
Bus	511	556	682	826	987	1,088
2 Axle	998	1,030	1,141	1,301	1,448	1,536
3 Axle	776	804	918	1,087	1,250	1,352
MAV	4,803	5,274	7,268	10,232	13,931	16,588
OSV	6	7	10	14	18	22
Total	**15,561**	**17,538**	**24,484**	**34,315**	**46,822**	**55,784**
PCU	**37,152**	**41,003**	**55,686**	**76,903**	**1,03,369**	**1,22,268**

Source: Steer Analysis

Table 6.30 Traffic Growth Rates (%): Upside case - PA: Khemana

Khemana	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	8.5%	8.4%	7.9%	7.2%	6.7%	7.7%
Mini LCV	4.2%	4.2%	3.9%	3.6%	3.3%	3.8%
LCV	4.2%	3.9%	4.1%	3.6%	3.3%	3.8%
Bus	4.2%	4.2%	3.9%	3.6%	3.3%	3.8%
2 Axle	1.6%	2.1%	2.6%	2.2%	2.0%	2.2%

Khemana	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
3 Axle	1.8%	2.7%	3.4%	2.8%	2.7%	2.8%
MAV	4.8%	6.6%	7.1%	6.4%	6.0%	6.4%
OSV	6.9%	7.1%	6.8%	6.4%	6.0%	6.7%
Total	**6.2%**	**6.9%**	**7.0%**	**6.4%**	**6.0%**	**6.6%**
PCU	**5.1%**	**6.3%**	**6.7%**	**6.1%**	**5.8%**	**6.1%**

Source: Steer Analysis

Table 6.31 Revenue (INR Crore): Upside case - PA: Khemana

Khemana	FY23	FY25	FY30	FY35	FY40	FY43
CJV	11.14	15.10	28.28	50.23	87.27	117.32
Mini LCV	0.98	1.23	1.89	2.77	4.06	4.96
LCV	1.28	1.56	2.27	3.42	4.98	6.22
Bus	3.82	4.52	6.84	10.12	14.81	18.37
2A	7.45	8.56	11.68	16.27	22.20	26.49
3A	6.89	7.83	11.01	15.88	22.24	27.05
MAV	63.11	75.87	127.80	218.21	364.85	489.19
OSV	0.10	0.12	0.21	0.36	0.59	0.79
Total	**94.78**	**114.79**	**189.99**	**317.27**	**521.01**	**690.39**

Source: Steer Analysis

Table 6.32 Revenue Growth Rates (%): Upside Case - PA: Khemana

Khemana	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	16.4%	13.4%	12.2%	11.7%	10.4%	12.5%
Mini LCV	11.8%	9.0%	8.0%	7.9%	6.9%	8.4%
LCV	10.5%	7.9%	8.5%	7.8%	7.6%	8.2%
Bus	8.8%	8.6%	8.2%	7.9%	7.5%	8.2%
2 Axle	7.2%	6.4%	6.9%	6.4%	6.1%	6.5%
3 Axle	6.6%	7.1%	7.6%	7.0%	6.7%	7.1%
MAV	9.6%	11.0%	11.3%	10.8%	10.3%	10.8%
OSV	11.6%	11.6%	11.2%	10.7%	10.2%	11.1%
Total	**10.1%**	**10.6%**	**10.8%**	**10.4%**	**9.8%**	**10.4%**

Source: Steer Analysis

Downside Case

Table 6.33 Final Traffic Forecasts: Downside Case - AS: Undavariya

Undavariya	FY23	FY25	FY30	FY35	FY40	FY43
CJV	5,933	6,557	8,397	10,524	12,872	14,333
Mini LCV	785	826	936	1,048	1,160	1,225
LCV	386	406	448	502	556	587
Bus	665	700	793	888	983	1,038
2 Axle	1,005	1,021	1,056	1,138	1,209	1,249
3 Axle	796	778	810	900	974	1,017
MAV	5,137	5,080	5,917	7,282	8,686	9,570
OSV	7	7	9	11	13	14
Total	**14,714**	**15,375**	**18,366**	**22,293**	**26,454**	**29,033**
PCU	**37,841**	**38,382**	**44,647**	**53,921**	**63,509**	**69,478**

Source: Steer Analysis

Table 6.34 Traffic Growth Rates (%): Downside case - AS: Undavariya

Undavariya	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	5.1%	5.1%	4.6%	4.1%	3.6%	4.5%
Mini LCV	2.6%	2.5%	2.3%	2.1%	1.8%	2.2%
LCV	2.6%	2.0%	2.3%	2.1%	1.8%	2.1%
Bus	2.6%	2.5%	2.3%	2.1%	1.8%	2.2%
2 Axle	0.8%	0.7%	1.5%	1.2%	1.1%	1.1%
3 Axle	(1.1%)	0.8%	2.1%	1.6%	1.5%	1.2%
MAV	(0.6%)	3.1%	4.2%	3.6%	3.3%	3.2%
OSV	4.0%	4.2%	3.9%	3.6%	3.3%	3.8%
Total	**2.2%**	**3.6%**	**4.0%**	**3.5%**	**3.2%**	**3.5%**
PCU	**0.7%**	**3.1%**	**3.8%**	**3.3%**	**3.0%**	**3.1%**

Source: Steer Analysis

Table 6.35 Revenue (INR Crore): Downside case - AS: Undavariya

Undavariya	FY23	FY25	FY30	FY35	FY40	FY43
CJV	7.46	9.48	14.57	22.64	33.59	41.46
Mini LCV	0.99	1.19	1.62	2.25	3.03	3.54
LCV	0.85	1.03	1.35	1.83	2.54	2.98
Bus	3.21	3.71	5.11	7.02	9.52	11.36
2A	4.85	5.46	6.86	9.08	11.83	13.81
3A	4.62	4.94	6.28	8.55	11.35	13.26

MAV	42.58	46.51	65.73	98.87	144.30	178.78
OSV	0.07	0.08	0.12	0.18	0.26	0.32
Total	**64.63**	**72.39**	**101.65**	**150.42**	**216.41**	**265.52**

Source: Steer Analysis

Table 6.36 Revenue Growth Rates (%): Downside Case - AS : Undavariya

Undavariya	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	12.7%	9.0%	9.2%	8.2%	7.3%	9.0%
Mini LCV	10.0%	6.3%	6.8%	6.1%	5.4%	6.6%
LCV	9.6%	5.6%	6.3%	6.8%	5.5%	6.5%
Bus	7.4%	6.6%	6.6%	6.3%	6.1%	6.5%
2 Axle	6.1%	4.7%	5.8%	5.4%	5.3%	5.4%
3 Axle	3.3%	4.9%	6.4%	5.8%	5.3%	5.4%
MAV	4.5%	7.2%	8.5%	7.9%	7.4%	7.4%
OSV	9.3%	8.5%	8.2%	7.9%	7.2%	8.2%
Total	**5.8%**	**7.0%**	**8.2%**	**7.5%**	**7.1%**	**7.3%**

Source: Steer Analysis

Table 6.37 Final Traffic Forecasts: Downside Case - PA: Khemana

Khemana	FY23	FY25	FY30	FY35	FY40	FY43
CJV	7,438	8,220	10,527	13,223	16,173	18,008
Mini LCV	656	690	782	876	970	1,024
LCV	372	392	434	489	541	571
Bus	511	538	610	683	756	798
2 Axle	998	997	1,037	1,120	1,191	1,231
3 Axle	776	764	805	889	962	1,005
MAV	4,803	4,728	5,568	6,812	8,124	8,951
OSV	6	7	8	10	12	13
Total	**15,561**	**16,335**	**19,771**	**24,101**	**28,729**	**31,601**
PCU	**37,152**	**37,699**	**44,406**	**53,605**	**63,294**	**69,327**

Source: Steer Analysis

Table 6.38 Traffic Growth Rates (%): Downside case - PA: Khemana

Khemana	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	5.1%	5.1%	4.7%	4.1%	3.6%	4.5%
Mini LCV	2.6%	2.5%	2.3%	2.1%	1.8%	2.2%
LCV	2.6%	2.1%	2.4%	2.1%	1.8%	2.2%
Bus	2.6%	2.5%	2.3%	2.1%	1.8%	2.2%

Khemana	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
2 Axle	(0.0%)	0.8%	1.6%	1.2%	1.1%	1.1%
3 Axle	(0.8%)	1.1%	2.0%	1.6%	1.5%	1.3%
MAV	(0.8%)	3.3%	4.1%	3.6%	3.3%	3.2%
OSV	4.0%	4.2%	3.9%	3.6%	3.3%	3.8%
Total	**2.5%**	**3.9%**	**4.0%**	**3.6%**	**3.2%**	**3.6%**
PCU	**0.7%**	**3.3%**	**3.8%**	**3.4%**	**3.1%**	**3.2%**

Source: Steer Analysis

Table 6.39 Revenue (INR Crore): Downside case - PA: Khemana

Khemana	FY23	FY25	FY30	FY35	FY40	FY43
CJV	11.14	14.18	22.73	34.60	51.88	64.00
Mini LCV	0.98	1.19	1.69	2.29	3.11	3.64
LCV	1.28	1.51	2.01	2.79	3.77	4.50
Bus	3.82	4.38	6.11	8.36	11.34	13.47
2A	7.45	8.29	10.61	14.01	18.26	21.22
3A	6.89	7.44	9.66	12.99	17.13	20.11
MAV	63.11	68.01	97.90	145.26	212.78	263.97
OSV	0.10	0.11	0.17	0.26	0.37	0.46
Total	**94.78**	**105.11**	**150.88**	**220.57**	**318.65**	**391.36**

Source: Steer Analysis

Table 6.40 Revenue Growth Rates (%) : Downside Case - PA: Khemana

Khemana	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	12.8%	9.9%	8.8%	8.4%	7.2%	9.1%
Mini LCV	10.1%	7.2%	6.3%	6.3%	5.4%	6.8%
LCV	8.7%	5.9%	6.7%	6.2%	6.1%	6.5%
Bus	7.0%	6.9%	6.5%	6.3%	5.9%	6.5%
2 Axle	5.4%	5.1%	5.7%	5.4%	5.1%	5.4%
3 Axle	3.9%	5.4%	6.1%	5.7%	5.5%	5.5%
MAV	3.8%	7.6%	8.2%	7.9%	7.4%	7.4%
OSV	8.6%	8.5%	8.2%	7.8%	7.4%	8.1%
Total	**5.3%**	**7.5%**	**7.9%**	**7.6%**	**7.1%**	**7.3%**

Source: Steer Analysis

Summary

6.61 The analysis presented in this report and the methodology followed adopted presents a custom approach compared to a standard traffic and revenue forecasting approach. We have

utilised information from various sources, backed by our knowledge of toll roads in the regional setting of the study Assets, in order to triangulate a robust base T&R position before presenting our views on other key topics, such as base year AADT and revenue, growth forecasts, and traffic segmentation.

6.62 Overall, we believe, we have tabled a robust set of forecast numbers underpinned by a rigorous base T&R position, background growth, exogenous impacts coupled with our unparallel market knowledge of the toll road industry in India.

6.63 The Assets covered in the study present a balanced mix of movements between local and national significance, and we expect these to grow in tandem with the national economy. Its strategic location on NH27, enables it to cater to both medium and long-range trips. Assets carry high volumes of goods traffic which connect large urban centres and industrial clusters located in various parts of the country and facilitates long-distance movement between the western and northern/ southern parts of India.

6.64 Western DFC and Amritsar Jamnagar Expressway are the key risks that have been identified, which will impact the traffic on the Assets. As discussed in this chapter, a phased approach is taken to access the impact of DME, with 50% of estimated traffic loss in the first year of operation (FY24) and the complete impact in the subsequent year is considered for WDFC. There is some uncertainty around the exact timeline of the Amritsar Jamnagar Expressway, and it's 100% impact is considered in FY28. In addition to this, some more traffic is expected to get diverted from the Assets over FY24 and FY25 due to the upgradation of Sirohi Tharad corridor. Khemana is likely to observe some recovery in 3A/ Mav traffic, once the construction of RTO circle is completed near Palanpur.

6.65 Overall, we see a positive outlook for the region and the Assets, given that they serve major urban centres of Delhi NCR, Faridabad, Palwal, Agra, Mathura, Vrindavan while also catering to long distance movement to/from Mumbai, Gujarat, Chennai, Bangalore, Hyderabad etc. The underlying growth drivers of the corridor are strong and are expected to deliver long term sustained growth.

Appendices

A Data collection exercise

A.1 Below you can find the Zone list used for OD Analysis for both Assets:

OD analysis

Zone list

Table A.1: Zone list used for OD analysis

Zone No	Zone name	Description/ State
1	Swaroopganj	Rajasthan
2	Undawariya	Rajasthan
3	Mawal	Rajasthan
4	Iqbalgadh	Rajasthan
5	Banas	Rajasthan
6	Sarotra	Gujarat
7	Awal	Gujarat
8	Abu Road	Rajasthan
9	Pindwara	Rajasthan
10	Sirohi	Rajasthan
11	Udaipur	Rajasthan
12	Jalore	Rajasthan
13	Barmer	Rajasthan
14	Pali	Rajasthan
15	Rajsamand	Rajasthan
16	Chittorgarh	Rajasthan
17	Bhilwara	Rajasthan
18	Partapgarh	Rajasthan
19	Dungarpur	Rajasthan
20	Banswara	Rajasthan
21	Jodhpur	Rajasthan
22	Jaisalmer	Rajasthan
23	Ajmer, Beawar	Rajasthan
24	Jaipur	Rajasthan
25	Bundi, Kota, Jhalawar, Baran	Rajasthan
26	Sawai Madhopur, Karauli, Dholpur, Bharatpur, Tonk	Rajasthan
27	Nagaur	Rajasthan
28	Sikar, Jhunjhunun,	Rajasthan
29	Hanumangarh, Sri Ganganagar, Churu	Rajasthan
30	Bikaner	Rajasthan
31	Alwar	Rajasthan
32	Chitrasani	Gujarat
33	Khemana	Gujarat
34	Palanpur	Gujarat
35	Chandisar	Gujarat

Zone No	Zone name	Description/ State
36	Deesa	Gujarat
37	Adesar	Gujarat
38	Mudetha	Gujarat
39	Diyodar	Gujarat
40	Shihori	Gujarat
41	Thara	Gujarat
42	Bhalgam	Gujarat
43	Radhanpur	Gujarat
44	Varahi	Gujarat
45	Samkhiali	Gujarat
46	Gandhidham	Gujarat
47	Patan	Gujarat
48	Siddhpur	Gujarat
49	Kuchavada, Jerda, Dhanera	Gujarat
50	Sanchore	Gujarat
51	Tharad	Gujarat
52	Viramgam	Gujarat
53	Bhuj	Gujarat
54	Mundra port	Gujarat
55	Mandvi	Gujarat
56	Kandla Port	Gujarat
57	Lakhpat	Gujarat
58	Malia	Gujarat
59	Morbi	Gujarat
60	Halvad	Gujarat
61	Navlakhi	Gujarat
62	Wankaner	Gujarat
63	Dharangadhra	Gujarat
64	Rajkot	Gujarat
65	Jamnagar	Gujarat
66	Dharol	Gujarat
67	Devbhoomi Dwarka	Gujarat
68	Porbandar	Gujarat
69	Surendranagar	Gujarat
70	Bhavnagar	Gujarat
71	Amreli	Gujarat
72	Junagadh	Gujarat
73	Gir Somnath	Gujarat
74	Botad	Gujarat
75	Ahmedabad	Gujarat
76	Gandhinagar	Gujarat
77	Mehsana	Gujarat
78	Himatnagar	Gujarat
79	Banaskantha	Gujarat
80	Sabarkantha	Gujarat
81	Aravali	Gujarat
82	Mahisagar	Gujarat
83	Godhra	Gujarat
84	Dahod	Gujarat

Zone No	Zone name	Description/ State
85	Chota Udaipur	Gujarat
86	Vadodara	Gujarat
87	Kheda	Gujarat
88	Anand	Gujarat
89	Bharuch	Gujarat
90	Narmada	Gujarat
91	Surat	Gujarat
92	Tapi	Gujarat
93	Navasari	Gujarat
94	Dang	Gujarat
95	Valsad, Daman	Gujarat
96	Rapar	Gujarat
97	Palasava	Gujarat
98	Lakadia	Gujarat
99	Akhol	Gujarat
100	Suigam	Gujarat
101	Unjha	Gujarat
102	Pipavav	Gujarat
103	Thangadh	Gujarat
104	Nakhatrana	Gujarat
105	Panandhro	Gujarat
106	Rest of Kutch	Gujarat
107	Delhi, Gurgaon, Noida, Ghaziabad, Faridabad Palwal City	Delhi
108	Sirsa, Fatehabad , Hisar, Bhiwani, Jind Faridabad	Haryana
109	Kaithal, Kurukshetra, Ambala, Yamuna Nagar, Karnal, Sonipat Indore	Haryana
110	Dadri, Mahendragarh, Rewari, Jhajjar, Rohtak, Mewat, Palwal Ratlam	Haryana
111	Fazilka, Sri Mukhsar Sahib, Faridkot, Tarn Taran, Amritsar, Gurdaspur, Pathankot North Madhya Pradesh	Punjab
112	Hoshiarpur, Kapurthala, Jalandhar, Moga, Mansa, Sangrur, Barnala, Malerkotla, Ludhiana Central Madhya Pradesh	Punjab
113	Patiala, Mohali, Chandigarh Shahid Bagat Singh Nagar, Rupnagar, Fatehgarh Sahib East Madhya Pradesh	Punjab
114	Saharanpur, Shamli, Muzzafarnagar, Meerut, Baghpath, Bulandshahr, Amroha, Moradabad, Aligarh West Madhya Pradesh	Uttar Pradesh
115	Sambhal, Rampur, Hathras, Agra, Firozabad, Mainpuri, Farukhabad, Shahjahanpur, Barelli, Budaun, Kasganj, Lakhimpur kheri, Hardoi, Kannauj, Etawah, Auraiya, Jalaun,	Uttar Pradesh

Zone No	Zone name	Description/ State
	Akbarpur, Jhansi, Lalitpur, Banda, Fatepur, Raebareili, Unnao, Sitapur Bahraich, Shravasti East Rajasthan	
116	Lucknow, Barabanki, Gonda, Balrampur, Siddharathnagar, Maharajganj, Basti, Faizabad, Sultanpurm Amethi, Pratapgarh, Prayagraj, Mirzapur, Ghazipur, Varanasi, Balia, Deoria, Gorakhnagar. South Rajasthan	Uttar Pradesh
117	Bihar	Bihar
118	Chhattisgarh	Chhattisgarh
119	Odisha	Odisha
120	West Bengal	West Bengal
121	Jharkhand	Jharkhand
122	Madhya Pradesh	Madhya Pradesh
123	Himachal Pradesh, Uttarakhand	Himachal Pradesh
124	Jammu and Kashmir, Ladakh	Jammu and Kashmir, Ladakh
125	Mumbai, Thane, Navi Mumbai	Maharashtra
126	Raigad, Ratnagiri, Sindhudhurg	Coastal Maharashtra
127	Pune, Satara, Solapur, Sangli, Kolhapur	Maharashtra
128	Nandurbar, Dhule, Jalgaon, Ahmadnagar, Aurangabad, jalna, Beed, Parbhani, Hingoli, Nanded, Latur, Usmanabad	Central Maharashtra
129	Buldhana, Akola, Amaravati, Washim, Yavatmal, Wardha, Nagpur, Chandrapur, Bhandara, Gondia, Gadchiroli	Eastern Maharashtra
130	Goa, Karnataka, kerala	Western South India
131	Tamilnadu	Tamil Nadu
132	Telangana	Telangana
133	Andhra Pradesh	Andhra Pradesh
134	Assam, Meghalaya, Nagaland, Arunachal Pradesh, Sikkim, Manipur, Mizoram,Tripura	North east India
135	Nepal	Nepal
136	Bhutan	Bhutan
137	Bangladesh	Bangladesh

Source: Steer representation

Top OD pairs

A.2 Further to the OD analysis presented in Chapter 3, this appendix presents the OD maps for 3A+MAVs along with top 10 OD pairs at each toll plaza.

Table A.2: AS: Undavariya - 3A/MAV top 10 OD pair shares

	OD Pair	Share

1	Abu Road - Odisha	2.46%
2	Abu Road - Bundi, Kota, Jhalawar, Baran	2.38%
3	Abu Road - Sambhal, Rampur, Hathras, Agra, Firozabad, Mainpuri, Farukhabad, Shahjahanpur, Barelli, Budaun, Kasganj, Lakhimpur kheri, Hardoi, Kannauj, Etawah, Auraiya, Jalaun, Akbarpur, Jhansi, Lalitpur, Banda, Fatepur, Raebareili, Unnao, Sitapur Bahraich, Shravasti	2.00%
4	Abu Road - Sawai Madhopur, Karauli, Dholpur, Bharatpur, Tonk	1.56%
5	Abu Road - Partapgarh	1.46%
6	Abu Road - Jaipur	1.36%
7	Abu Road - Madhya Pradesh	1.36%
8	Sambhal, Rampur, Hathras, Agra, Firozabad, Mainpuri, Farukhabad, Shahjahanpur, Barelli, Budaun, Kasganj, Lakhimpur kheri, Hardoi, Kannauj, Etawah, Auraiya, Jalaun, Akbarpur, Jhansi, Lalitpur, Banda, Fatepur, Raebareili, Unnao, Sitapur Bahraich, Shravasti - Madhya Pradesh	1.34%
9	Abu Road - Sikar, Jhunjhunun,	1.31%
10	Abu Road - Sirohi	1.29%

Source: Steer analysis

Table A.3: PA: Khemana - 3A/MAV top 10 OD pair shares

	OD Pair	Share
1	Ahmedabad - Delhi, Gurgaon, Noida, Ghaziabad, Faridabad	1.78%
2	Jodhpur - Ahmedabad	1.70%
3	Jaipur - Ahmedabad	1.70%
4	Jodhpur - Palanpur	1.38%
5	Jaipur - Palanpur	1.25%
6	Palanpur - Delhi, Gurgaon, Noida, Ghaziabad, Faridabad	1.20%
7	Jaipur - Surat	1.17%
8	Abu Road - Palanpur	1.14%
9	Mehsana - Delhi, Gurgaon, Noida, Ghaziabad, Faridabad	1.12%
10	Jaipur - Morbi	1.04%

7 days TVC count

A.3 The TVC counts recorded at each toll plaza can be seen below. These counts form an important part of TVC-toll plaza data analysis which contributes significantly to our base estimation exercise:

Table A.4: AS: Undavariya: Daily TVC

Date	CJV	Mini LCV	LCV	Bus	2 Axle	3 Axle	MAV	OSV	Total
27-02-2023	6,228	731	860	568	732	1,006	5,588	4	15,717
28-02-2023	5,548	774	934	575	791	1,118	5,794	1	15,535
01-03-2023	5,227	795	981	540	929	1,077	6,358	1	15,908
02-03-2023	4,995	834	1,114	563	957	1,056	6,481	3	16,003
03-03-2023	5,634	780	933	556	787	1,292	6,203	3	16,188
04-03-2023	6,505	815	937	610	974	1,013	5,823	1	16,678
05-03-2023	7,284	752	846	574	850	1,013	5,239	1	16,559

Source: Steer analysis

Table A.5: PA: Khemana: Daily TVC

Date	CJV	Mini LCV	LCV	Bus	2 Axle	3 Axle	MAV	OSV	Total
27-02-2023	7,391	637	836	434	832	958	5,161	3	16,252
28-02-2023	6,755	683	878	477	861	962	5,543	1	16,160
01-03-2023	6,379	645	874	444	842	1,006	5,674	1	15,865
02-03-2023	6,331	651	914	412	1,108	1,038	5,956	3	16,413
03-03-2023	6,957	661	892	440	937	1,092	5,579	2	16,560
04-03-2023	8,210	658	909	495	807	1,070	5,668	1	17,818
05-03-2023	8,794	549	737	486	833	890	4,947	1	17,237

Source: Steer analysis

Table A.6: Chitrasani: Daily TVC

Date	CJV	Mini LCV	LCV	Bus	2 Axle	3 Axle	MAV	OSV	Total
03-03-2023	888	112	4	219	54	95	343	-	1,715
04-03-2023	1,012	108	7	218	71	80	372	-	1,868
05-03-2023	1,108	85	2	165	55	74	266	-	1,755

Source: Steer analysis

B Traffic and revenue forecasts

B.1 Further to the summary of forecasts presented in Chapter 6, this appendix presents detailed forecasts.

Traffic forecasts: Undavariya

Table B.1: AS Undavariya: Forecasts for final (background + impacts) AADT

Vehicle Category	FY23	FY24	FY25	FY26	FY27	FY28
CJV	5,933	6,321	6,754	7,232	7,737	8,256
Mini LCV	785	811	838	868	898	929
LCV	386	399	412	424	434	448
Bus	665	687	711	736	762	787
2A	1,005	1,019	1,034	1,047	1,051	1,072
3A	796	796	797	809	813	834
MAV	5,137	5,218	5,311	5,564	5,765	6,092
OSV	7	7	7	8	8	9
Total	**14,714**	**15,257**	**15,865**	**16,687**	**17,468**	**18,426**
PCU	**37,841**	**38,746**	**39,769**	**41,583**	**43,143**	**45,388**

Vehicle Category	FY29	FY30	FY31	FY32	FY33	FY34
CJV	8,769	9,313	9,889	10,479	11,124	11,845
Mini LCV	957	987	1,018	1,049	1,081	1,114
LCV	462	477	491	505	521	539
Bus	811	837	862	889	916	944
2A	1,092	1,112	1,133	1,152	1,173	1,207
3A	853	873	894	894	915	981
MAV	6,415	6,756	7,115	7,359	7,750	8,466
OSV	9	10	10	11	11	12
Total	**19,370**	**20,365**	**21,413**	**22,338**	**23,491**	**25,107**
PCU	**47,601**	**49,928**	**52,374**	**54,254**	**56,924**	**61,312**

Vehicle Category	FY35	FY36	FY37	FY38	FY39	FY40
CJV	12,547	13,277	14,034	14,819	15,632	16,451
Mini LCV	1,147	1,180	1,214	1,248	1,282	1,315
LCV	555	571	587	604	620	637
Bus	972	1,000	1,029	1,058	1,086	1,115
2A	1,228	1,250	1,271	1,292	1,314	1,334
3A	1,004	1,026	1,049	1,072	1,095	1,118

Vehicle Category	FY35	FY36	FY37	FY38	FY39	FY40
MAV	8,901	9,351	9,816	10,296	10,790	11,299
OSV	12	13	14	14	15	16
Total	**26,366**	**27,668**	**29,014**	**30,402**	**31,833**	**33,284**
PCU	**64,248**	**67,280**	**70,408**	**73,632**	**76,950**	**80,337**

Vehicle Category	FY41	FY42	FY43	FY44	FY45	FY46
CJV	17,298	18,172	19,073	20,001	20,955	21,935
Mini LCV	1,349	1,383	1,418	1,452	1,487	1,522
LCV	653	669	686	703	719	736
Bus	1,144	1,173	1,202	1,231	1,260	1,290
2A	1,355	1,375	1,396	1,416	1,436	1,457
3A	1,141	1,164	1,187	1,210	1,233	1,256
MAV	11,822	12,360	12,912	13,477	14,056	14,647
OSV	16	17	18	19	19	20
Total	**34,777**	**36,313**	**37,890**	**39,508**	**41,165**	**42,862**
PCU	**83,817**	**87,391**	**91,054**	**94,807**	**98,647**	**1,02,570**

Vehicle Category	FY47	FY48	FY49	FY50
CJV	22,940	23,969	25,023	26,099
Mini LCV	1,556	1,591	1,626	1,661
LCV	753	770	787	804
Bus	1,319	1,349	1,378	1,408
2A	1,477	1,496	1,516	1,536
3A	1,279	1,302	1,325	1,348
MAV	15,251	15,867	16,495	17,133
OSV	21	22	23	24
Total	**44,596**	**46,367**	**48,173**	**50,012**
PCU	**1,06,576**	**1,10,659**	**1,14,817**	**1,19,046**

Source: Steer analysis

Revenue forecasts: Undavariya

Table D.2 AS Undavariya: Revenue Forecasts (in INR Cr)

Vehicle Category	FY23	FY24	FY25	FY26	FY27	FY28
CJV	7.46	8.36	9.76	10.46	12.17	13.03
Mini LCV	0.99	1.07	1.21	1.26	1.41	1.47
LCV	0.85	0.95	1.04	1.08	1.17	1.28
Bus	3.21	3.53	3.76	4.03	4.39	4.71
2A	4.85	5.28	5.53	5.79	6.12	6.48

3A	4.62	4.79	5.05	5.28	5.58	5.90
MAV	42.58	45.22	48.62	52.95	56.90	62.44
OSV	0.07	0.07	0.08	0.09	0.10	0.11
Total	**64.63**	**69.28**	**75.07**	**80.93**	**87.85**	**95.42**

Vehicle Category	FY29	FY30	FY31	FY32	FY33	FY34
CJV	14.11	16.16	17.49	14.84	16.09	23.98
Mini LCV	1.54	1.71	1.80	1.49	1.56	2.25
LCV	1.33	1.44	1.55	1.26	1.37	1.95
Bus	5.08	5.39	5.83	4.72	5.01	7.15
2A	6.91	7.23	7.74	6.18	6.48	9.24
3A	6.32	6.77	7.25	5.68	6.12	8.98
MAV	68.93	75.06	82.76	66.37	72.44	110.42
OSV	0.12	0.13	0.14	0.12	0.13	0.19
Total	**104.33**	**113.88**	**124.56**	**100.66**	**109.21**	**164.16**

Vehicle Category	FY35	FY36	FY37	FY38	FY39	FY40
CJV	26.99	29.10	32.46	34.78	38.69	42.93
Mini LCV	2.47	2.59	2.81	2.93	3.17	3.43
LCV	2.02	2.19	2.33	2.50	2.72	2.91
Bus	7.68	8.25	8.79	9.38	10.14	10.80
2A	9.80	10.41	10.97	11.57	12.38	13.05
3A	9.54	10.16	10.72	11.34	12.15	13.02
MAV	120.85	132.21	145.22	157.81	172.99	187.71
OSV	0.21	0.23	0.25	0.27	0.29	0.32
Total	**179.56**	**195.12**	**213.54**	**230.58**	**252.54**	**274.16**

Vehicle Category	FY41	FY42	FY43	FY44	FY45	FY46
CJV	45.61	50.24	55.16	60.56	66.65	72.57
Mini LCV	3.56	3.82	4.10	4.40	4.73	5.03
LCV	3.09	3.28	3.48	3.76	3.98	4.20
Bus	11.58	12.28	13.15	14.08	14.82	15.81
2A	13.85	14.55	15.43	16.36	17.07	18.04
3A	13.67	14.56	15.47	16.45	17.38	18.38
MAV	204.20	222.20	241.22	264.30	284.97	309.79
OSV	0.35	0.38	0.41	0.45	0.48	0.53
Total	**295.90**	**321.33**	**348.43**	**380.37**	**410.09**	**444.34**

Vehicle Category	FY47	FY48	FY49	FY50
CJV	76.71	84.22	90.91	101.43
Mini LCV	5.20	5.59	5.91	6.46
LCV	4.52	4.85	5.10	5.44
Bus	16.95	18.05	19.08	20.39
2A	19.16	20.22	21.19	22.47
3A	19.60	20.70	21.94	23.27
MAV	335.91	364.55	392.57	425.68
OSV	0.57	0.62	0.67	0.72
Total	478.61	518.80	557.37	605.86

Source: Steer Analysis

Traffic forecasts: Khemana

Table D.3 PA Khemana: Forecasts for final (background + impacts) AADT

Vehicle Category	FY23	FY24	FY25	FY26	FY27	FY28
CJV	7,438	7,924	8,467	9,066	9,699	10,350
Mini LCV	656	678	701	726	751	776
LCV	372	385	398	409	418	432
Bus	511	528	546	566	585	605
2A	998	1,005	1,013	1,024	1,026	1,047
3A	776	777	783	795	799	819
MAV	4,803	4,842	4,989	5,223	5,405	5,711
OSV	6	6	7	7	8	8
Total	**15,561**	**16,144**	**16,904**	**17,816**	**18,691**	**19,748**
PCU	**37,152**	**37,927**	**39,273**	**41,095**	**42,663**	**44,922**

Vehicle Category	FY29	FY30	FY31	FY32	FY33	FY34
CJV	10,994	11,675	12,398	13,102	13,908	14,892
Mini LCV	800	825	851	877	904	931
LCV	446	460	474	485	500	523
Bus	624	643	663	683	704	726
2A	1,066	1,086	1,106	1,113	1,134	1,182
3A	838	858	878	884	905	957
MAV	6,014	6,334	6,670	6,948	7,317	7,877
OSV	8	9	9	10	10	11
Total	**20,791**	**21,890**	**23,049**	**24,103**	**25,383**	**27,099**
PCU	**47,149**	**49,492**	**51,958**	**54,061**	**56,766**	**60,697**

Vehicle Category	FY35	FY36	FY37	FY38	FY39	FY40

CJV	15,775	16,693	17,645	18,632	19,654	20,684
Mini LCV	959	987	1,015	1,043	1,072	1,100
LCV	538	554	570	586	602	618
Bus	747	769	791	813	835	857
2A	1,203	1,224	1,245	1,266	1,287	1,307
3A	979	1,001	1,023	1,045	1,068	1,090
MAV	8,282	8,700	9,133	9,579	10,039	10,513
OSV	11	12	13	13	14	14
Total	**28,495**	**29,940**	**31,434**	**32,978**	**34,570**	**36,182**
PCU	**63,648**	**66,698**	**69,846**	**73,092**	**76,435**	**79,844**

Vehicle Category	FY41	FY42	FY43	FY44	FY45	FY46
CJV	21,748	22,847	23,980	25,147	26,347	27,579
Mini LCV	1,128	1,156	1,185	1,214	1,243	1,272
LCV	634	650	666	682	698	714
Bus	879	901	923	946	969	991
2A	1,327	1,347	1,367	1,387	1,407	1,427
3A	1,113	1,135	1,158	1,180	1,203	1,225
MAV	11,000	11,500	12,013	12,539	13,077	13,628
OSV	15	16	17	17	18	19
Total	**37,843**	**39,553**	**41,309**	**43,112**	**44,961**	**46,855**
PCU	**83,349**	**86,949**	**90,642**	**94,427**	**98,301**	**1,02,261**

Vehicle Category	FY47	FY48	FY49	FY50
CJV	28,842	30,137	31,461	32,814
Mini LCV	1,301	1,330	1,360	1,389
LCV	731	747	764	780
Bus	1,014	1,037	1,059	1,082
2A	1,447	1,466	1,485	1,505
3A	1,248	1,270	1,292	1,315
MAV	14,190	14,763	15,347	15,941
OSV	20	20	21	22
Total	**48,792**	**50,770**	**52,789**	**54,847**
PCU	**1,06,306**	**1,10,431**	**1,14,633**	**1,18,909**

Source: Steer analysis

Revenue forecasts: Khemana

Table D.4 PA Khemana: Revenue Forecasts (in INR Cr)

Vehicle Category	FY23	FY24	FY25	FY26	FY27	FY28

CJV	11.14	13.53	14.61	16.57	17.95	20.28
Mini LCV	0.98	1.16	1.21	1.33	1.39	1.52
LCV	1.28	1.42	1.53	1.63	1.74	1.88
Bus	3.82	4.14	4.44	4.78	5.22	5.60
2A	7.45	8.05	8.42	8.85	9.34	9.90
3A	6.89	7.31	7.63	8.02	8.47	9.00
MAV	63.11	66.44	71.77	77.94	83.56	92.56
OSV	0.10	0.11	0.12	0.13	0.14	0.16
Total	**94.78**	**102.15**	**109.73**	**119.25**	**127.82**	**140.89**

Vehicle Category	FY29	FY30	FY31	FY32	FY33	FY34
CJV	22.61	25.21	27.06	22.66	25.12	37.43
Mini LCV	1.65	1.78	1.86	1.52	1.63	2.34
LCV	1.99	2.13	2.28	1.87	2.00	2.84
Bus	5.98	6.44	6.87	5.57	5.95	8.55
2A	10.43	11.11	11.71	9.28	9.78	14.23
3A	9.62	10.29	10.85	8.63	9.13	13.48
MAV	101.48	111.37	122.02	99.02	107.92	162.32
OSV	0.17	0.19	0.21	0.17	0.19	0.27
Total	**153.93**	**168.53**	**182.86**	**148.72**	**161.73**	**241.46**

Vehicle Category	FY35	FY36	FY37	FY38	FY39	FY40
CJV	41.28	45.54	50.20	54.95	60.42	66.35
Mini LCV	2.51	2.69	2.89	3.08	3.29	3.53
LCV	3.07	3.26	3.52	3.72	4.01	4.30
Bus	9.15	9.82	10.46	11.25	11.97	12.86
2A	15.05	15.97	16.83	17.89	18.84	20.04
3A	14.30	15.20	16.19	17.27	18.21	19.40
MAV	176.61	193.77	212.51	231.44	251.51	275.33
OSV	0.30	0.33	0.36	0.39	0.43	0.46
Total	**262.28**	**286.58**	**312.95**	**339.98**	**368.67**	**402.28**

Vehicle Category	FY41	FY42	FY43	FY44	FY45	FY46
CJV	71.84	78.33	85.23	94.80	102.36	110.62
Mini LCV	3.73	3.96	4.21	4.58	4.83	5.10
LCV	4.59	4.91	5.24	5.59	5.93	6.29
Bus	13.72	14.64	15.59	16.61	17.72	18.79
2A	21.15	22.35	23.57	24.89	26.30	27.64

3A	20.70	21.91	23.16	24.70	26.15	27.70
MAV	299.03	324.88	354.27	386.38	418.18	452.79
OSV	0.51	0.55	0.60	0.65	0.71	0.77
Total	**435.26**	**471.53**	**511.87**	**558.19**	**602.18**	**649.69**

Vehicle Category	FY47	FY48	FY49	FY50
CJV	121.61	131.24	143.78	154.13
Mini LCV	5.49	5.79	6.21	6.52
LCV	6.68	7.18	7.56	8.07
Bus	20.02	21.37	22.76	24.12
2A	29.17	30.87	32.59	34.26
3A	29.49	31.24	33.03	34.97
MAV	491.51	533.80	575.34	623.02
OSV	0.83	0.90	0.97	1.05
Total	**704.80**	**762.39**	**822.24**	**886.16**

Source: Steer Analysis

C Vehicle Classification Chart

Table C.1: Vehicle Types

Vehicle Type	Description
2-Wheeler	
Auto-Rickshaw	
Car/Jeep/Van	
Taxi- shared/private	
Buses (govt/Pvt)	
Minibus	

Vehicle Type	Description
Mini LCV	
LCV 4 Tyre	
LCV 6 Tyre	
2 Axle Truck	
3 Axle Truck	
4 Axle Truck (MAV)	
5 Axle Truck (MAV)	

Vehicle Type	Description
6 Axle Truck (MAV)	
Oversized Vehicle/ Earth moving equipment (OSV)	

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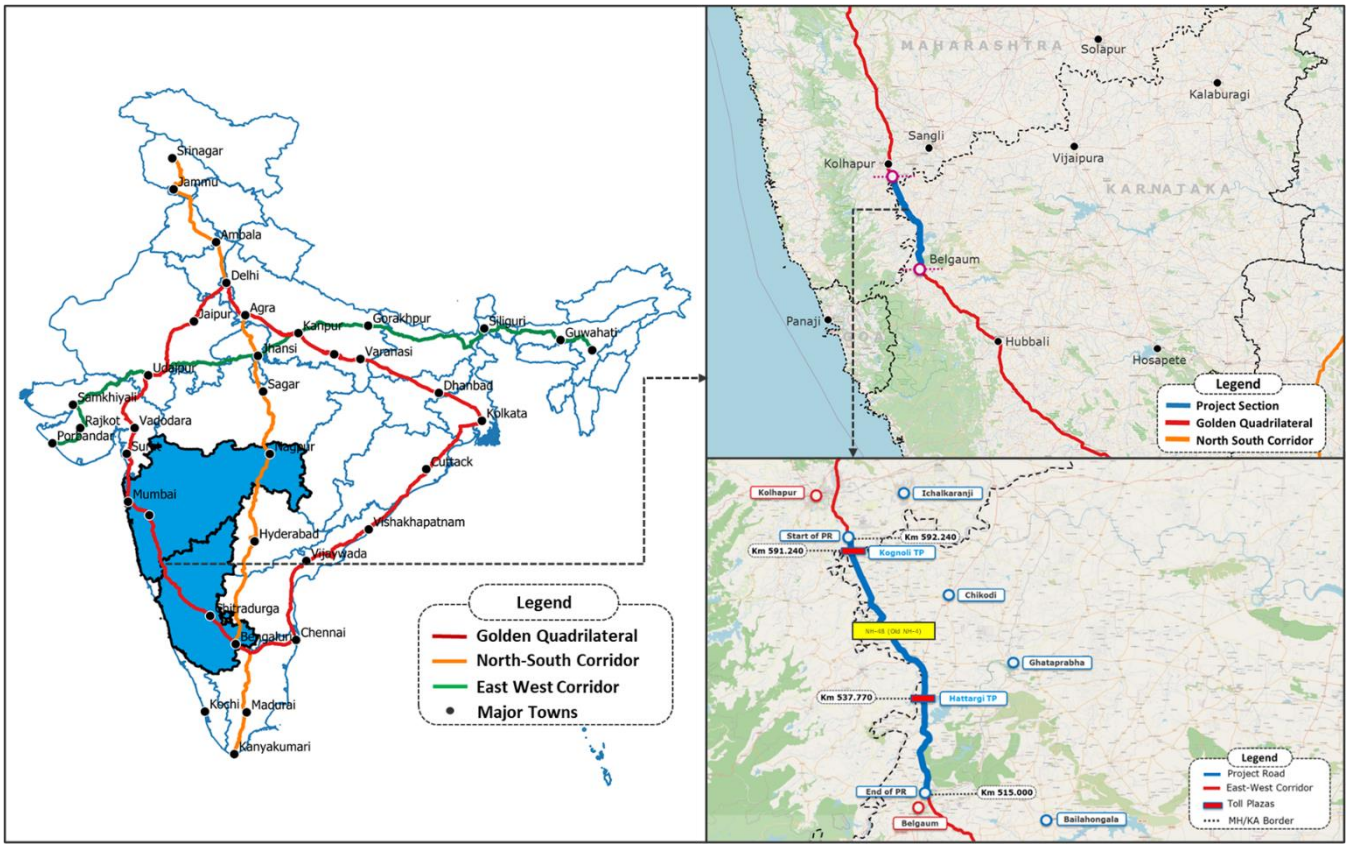

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ABBREVIATIONS

%	Percentage
2A	2 Axle truck
3A	3 Axle truck
AADT	Annual Average Daily Traffic
ADT	Average Daily Traffic
AR	Alternate Route
BIA	Broad Influence Area
CAGR	Compounded Annual Growth Rate
FY	Financial Year
GDP	Gross Domestic Product
GSDP	Gross State Domestic Product
IIA	Immediate Influence Area
IRC	Indian Road Congress
Km	Kilometre
LCV	Light Commercial Vehicle
M Bus	Minibus
MAV	Multi Axle Vehicle
MLCV	Mini LCV
NH	National Highway
NHAI	National Highway Authority of India
NHDP	National Highway Development Program
NHIPPL	National Highways Infra Projects Private Limited
NPV	Net Present Value
OD	Origin-Destination survey
PCU	Passenger Car Unit
PIA	Project Influence Area
PR	Project Road
PV	Present Value
Rs/₹	Rupees
SEZ	Special Economic Zone
Sq.km	Square Kilometre
TP	Toll Plaza
WPI	Wholesale Price Index
YOY	Year on Year

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Appendix 2.1 Past Traffic

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EXECUTIVE SUMMARY

Project Overview

The project highway, NH-48 (Old NH-4), is part of the Golden Quadrilateral connecting many of the major industrial, agricultural, and cultural centres of India. The total length of NH-48 (Old NH-4) is roughly 1,235 km starting from Chennai in the state of Tamil Nadu and ending at Mumbai in the state of Maharashtra. NH-48 (Old NH-4) acts as a primary conduit for transportation of freight as well as passenger traffic in these states as well as various other important states in India. NH-48 (Old NH-4) connects important cities and towns like Pune, Satara, Karad, Sangli, Kolhapur, Belgaum, Dharwad, Hubli, Bangalore etc.

The project road section, Kagal-Belgaum, a part of the NH-48 (Old NH-4) in the state of Maharashtra/Karnataka, starts at km 592.240 of NH-48 (Old NH-4) near Kagal and ends at km 515.000 of NH-48 (Old NH-4) near Belgaum with a length of about 77.24 km. There are two operational toll plazas on the project road, one near Kognoli (km 591.240) and other near Hattargi (km 537.770). Both Kognoli and Hattargi toll plaza have 12 tolling lanes (6 in each direction).

Figure 0-1 shows the context and alignment of project road with major places along the highway.

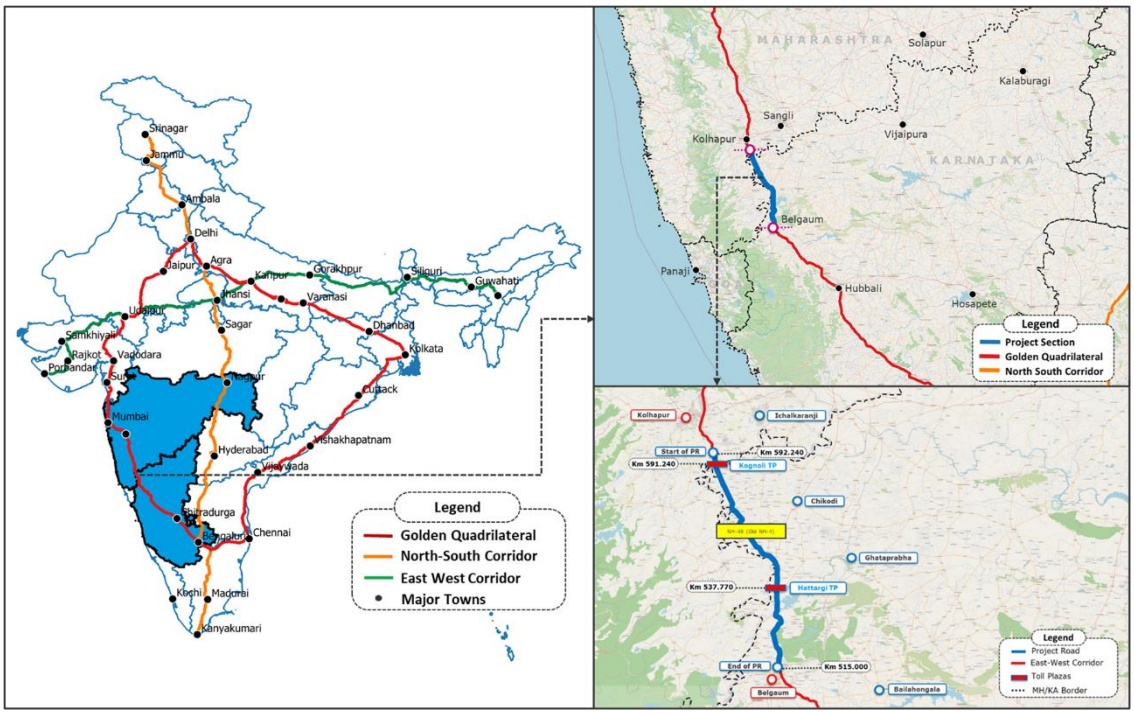


Figure 0-1: Project Road and Location of Toll Plazas

Project Road Characteristics and Profile of Influencing Districts

The project road, in wider context, serves the long-distance traffic for the freight vehicles, which is majorly plying between Mumbai/ Pune/ Delhi and Goa/ Bangalore/ Chennai/ Vellore. Apart from long distance traffic, it also serves the short distance traffic for both

passenger and freight which is mainly generated between Kolhapur/Sangli/ Goa/Belgaum/ Khanapur/Hubbali/Dharwad and nearby places.

The project road section is located in the districts of Kolhapur and Belagavi (Belgaum).

Kolhapur district is situated in the southern side of the Maharashtra state with an area of 7,692 sq.km. It is one of the industrialised districts in Maharashtra. Due to the presence of abundant water and fertile soil, the district is prominent in cultivation of sugarcane, paddy, banana, soyabean and several vegetables. It is the major producer of jaggery and sugar. The district also houses many dairy and poultry farms. It is one of the prime centres of the textile industry, cotton mills and arts and handicrafts industry. The district also has the highest number of sugar refineries in the country and is also known as the sugar bowl of India. The district has emerged to be one of the highest per capita income districts in India.

Belagavi district is situated in northwest of Karnataka State with an area of 13,433 sq. km, sharing borders with Goa and Maharashtra states. The district with different agro climatic conditions and soil types has vast agricultural potential. Major crops grown in the district are paddy, maize, jowar, oil seeds, cotton, onion, tomato and sugarcane. Belgaum has 16 industrial estates, 6 industrial areas and 1 SEZ. District is important centre for manufacturing of valves, pumps, and its accessories, heavy machine tools and high-pressure oil hydraulics. It has 58 export-oriented units and 22 sugar industries in different parts of district. Rich deposits of natural resources like bauxite, uranium, silica sand, aluminium, laterite, limestone, dolomite, quartzite and china clay are also found in the district.

Historical Traffic Volume and Vehicle Composition

The past toll traffic data for all the toll plazas was made available by the client from January 2021 to March 2023 is presented in **Figure 0-2**.

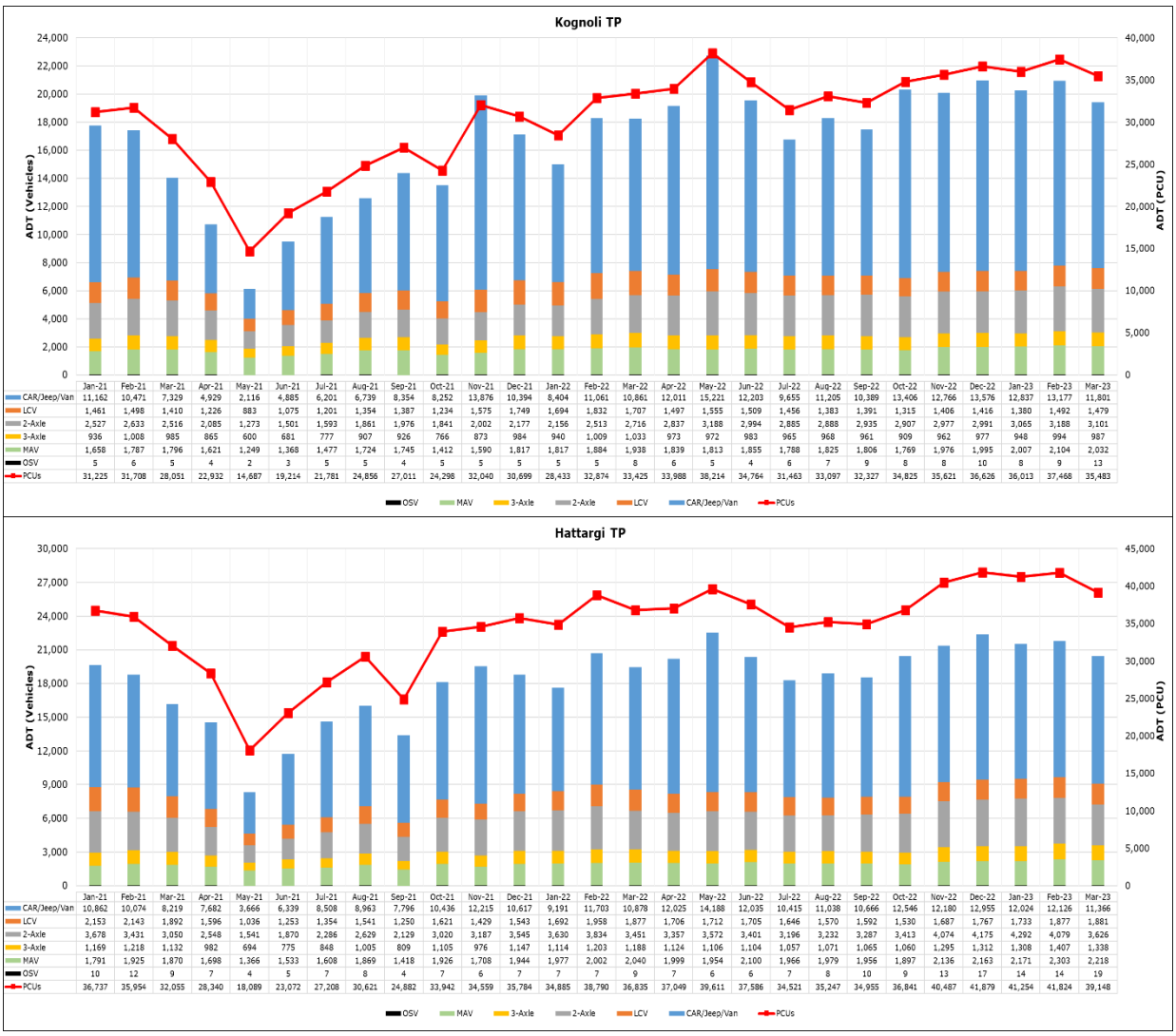


Figure 0-2: Month on Month Traffic Data for TP01 and TP02

AADT for FY23

The past toll traffic data for both the toll plazas was made available by the client from Jan 2021-March 2023.

For the period from April 2022 to June 2022, the corresponding monthly data for reusage of local pass and exemptions for cars were either not recorded or there were inconsistencies. Therefore, for reusage of local pass and exemptions, the average between August 2022 to March 2023 has been considered for the months of April 2022 to June 2022 for both the toll plazas to arrive at the monthly ADT for these months. For the period from April 2022 to June 2022, high numbers were recorded for cars in cash-violation category which are not considered for the AADT estimation for FY23.

It is to be noted that six laning of Kagal-Belgaum section has started from November 2022, therefore a significant number of construction vehicles (LCV/2A/3A/MAV) are observed at Hattargi toll plaza which are under the category of exempt and have not been considered for FY23 AADT estimation. Hence, the average exemption numbers from April 2022 to October 2022 is considered for the remaining months of FY23 (from November 2022 onwards) for Hattargi Toll Plaza.

The 12-month average traffic from April 2022 to March 2023 has been taken as the AADT for FY23 at both the toll plaza locations which are presented in **Table 0-1**.

Location/ Mode	Car/Jeep/ Van/Taxi	LCV	2A	3A	MAV	OSV	PCUs
TP01- Kognoli Toll Plaza							
AADT (Average April 2022 – March 2023)	12,354	1,440	2,996	966	1,901	8	34,991
TP02- Hattargi Toll Plaza							
ADT (Average April 2022 – March 2023)	11,964	1,701	3,642	1,187	2,070	11	38,367
AADT (without construction vehicles)	11,964	1,675	3,635	1,136	2,068	11	38,145

Table 0-1: AADT for FY23

Travel Pattern

- The car traffic originating from Kagal/Kolhapur/Sangli & surroundings to Belgaum & surroundings is about 16-20 percent at TP01 & TP02.
- Around 28 percent of LCV each at TP01 & TP02 were found to be plying between Mumbai/Pune & surroundings and Bangalore & beyond.
- In case of 2A, about 33-36 percent at both the toll plazas were found to be traveling between Mumbai/Pune & surroundings and Bangalore & beyond.
- In case of MAV, around 17-19 percent at both the toll plazas were found to be plying from/to Gujarat/Rajasthan & beyond to/ from Bangalore & beyond.
- The MAV traffic originating from/to Mumbai/Pune & surroundings to/from Bangalore & beyond is about 37 percent each at TP01 & TP02.

Network Impacts

Pune – Bangalore Expressway is a proposed 8 lane access-controlled highway connecting Pune, Maharashtra and Bengaluru, Karnataka via Satara, Sangli, Belgavi (Belgaum), Dharwad, Hubli, Devanagere and Tumakuru with a length of 700 km as against the existing distance via NH-48 (Old NH-4) of around 836 km.

The potential divertible traffic is the traffic plying between Pune and beyond to Bangalore and beyond which has been estimated from the OD survey. Since the expressway is likely to be shorter by 136 km, the project road may have a loss of 100 percent of the potential divertible traffic. The estimated loss of project road traffic due to the proposed expressway is presented in **Table 3-2**.

Toll Plaza	Car	2A	3A	MAV
TP01	2.92%	27.78%	37.69%	38.68%
TP02	3.02%	21.50%	32.07%	35.52%

Table 0-2: Potential Divertible Traffic to the Expressway

The proposed expressway will be a greenfield alignment and considering the usual timelines for a long greenfield expressway project, the diversion impact is considered from FY30 onwards with about 50 percent in FY30, 75 percent in FY31 and 100 percent from FY32 onwards.

Traffic Growth Rates

The estimated traffic growth rates for the project road based on the elasticity approach have been presented in **Table 0-3**.

FY/Modes	Car/MLCV	M Bus/ LCV	Bus	2A	3A	MAV
TP01 & TP02						
2024	6.5	2.4	3.0	1.8	2.4	5.5
2025	6.8	2.5	3.1	1.9	2.6	5.8
2026	6.6	2.7	3.3	2.0	2.7	5.5
2027	6.6	2.7	3.3	2.0	2.7	5.5
2028	6.4	2.6	3.2	2.0	2.6	5.3
2029	6.0	2.4	3.0	1.8	2.5	5.0
2030	6.0	2.4	3.0	1.8	2.5	5.0
2031	6.0	2.4	3.0	1.8	2.5	4.4
2032	6.0	2.4	3.0	1.8	2.5	4.4
2033	6.0	2.4	3.0	1.8	2.5	4.4
2034	5.9	2.4	3.0	1.8	2.4	4.3
2035	5.8	2.3	2.9	1.8	2.4	4.2
2036	5.1	2.3	2.9	1.7	2.3	4.2
2037	5.0	2.3	2.8	1.7	2.3	4.1
2038	5.0	2.2	2.8	1.7	2.3	4.0
2039	4.9	2.2	2.7	1.6	2.2	3.9
2040	4.8	2.1	2.7	1.6	2.2	3.9
2041	4.7	2.1	2.6	1.6	2.1	3.8
2042	4.7	2.1	2.6	1.6	2.1	3.8
2043	4.6	2.1	2.6	1.6	2.1	3.7
2044	4.5	2.0	2.5	1.5	2.1	3.6
2045	4.4	2.0	2.5	1.5	2.0	3.6
2046	4.3	1.9	2.4	1.5	2.0	3.5
2047	4.2	1.9	2.3	1.4	1.9	3.4
2048	4.1	1.9	2.3	1.4	1.9	3.3
2049	4.0	1.8	2.2	1.4	1.8	3.3
2050	3.9	1.8	2.2	1.3	1.8	3.2
2051	3.7	1.6	2.0	1.2	1.7	3.0
2052	3.7	1.6	2.0	1.2	1.7	3.0

Table 0-3: Projected Traffic Growth Rates for Project Road (%)

The car traffic on the project road has exhibited high growth rates of 54 percent at TP01 and 32 percent at TP02. This could be due to some pent-up demand increase post Covid-19. In view of this, zero growth rate for car traffic have been considered till FY25. The estimated growth rates for car traffic based on elasticity approach have been considered from FY26 onwards. However, for all other modes growth rates based on elasticity approach have been considered for the entire duration of concession period.

The implied traffic growth rates for freight vehicles of 2A/3A and MAV after considering the impact of diversion to Pune-Bangalore Expressway in FY30 to FY32 under the base case have been presented in **Table 0-4**.

FY/Modes	TP01			TP02		
	2A	3A	MAV	2A	3A	MAV
2030	-12.3	-16.8	-15.3	-9.1	-14.0	-13.6
2031	-6.4	-9.4	-8.1	-4.3	-7.3	-6.9
2032	-7.1	-11.0	-9.8	-4.7	-8.3	-8.3

Table 0-4: Implied Traffic Growth Rates for Project Road After Diversion to Pune-Bangalore Expressway (%)

Projected Mode-wise Traffic

Mode-wise projected traffic for the two toll plazas of the project road under the base case after considering diversion impacts till FY52 is presented in **Table 0-5** and **Table 0-6**.

FY END	Car	LCV	Bus	2-axle Truck	3-axle Truck	MAV	OSV	PCU
2023	12,354	1,440	1,314	1,682	966	1,901	8	34,991
2024	12,354	1,474	1,353	1,712	989	2,006	8	35,796
2025	12,354	1,511	1,395	1,745	1,015	2,123	9	36,680
2026	13,172	1,552	1,441	1,780	1,042	2,240	9	38,415
2027	14,044	1,593	1,489	1,816	1,071	2,364	10	40,245
2028	14,945	1,635	1,537	1,852	1,099	2,490	10	42,115
2029	15,843	1,674	1,584	1,886	1,126	2,615	11	43,959
2030	16,550	1,715	1,631	1,653	937	2,215	12	41,807
2031	17,415	1,757	1,680	1,548	848	2,035	12	41,492
2032	18,324	1,800	1,731	1,438	755	1,835	13	41,109
2033	19,425	1,843	1,783	1,464	774	1,915	13	42,932
2034	20,572	1,887	1,836	1,491	793	1,998	14	44,813
2035	21,767	1,932	1,889	1,517	812	2,082	14	46,754
2036	22,884	1,976	1,944	1,544	831	2,169	15	48,629
2037	24,038	2,021	1,998	1,570	850	2,258	15	50,552
2038	25,228	2,066	2,053	1,596	869	2,348	16	52,522
2039	26,454	2,111	2,109	1,623	888	2,441	17	54,538
2040	27,715	2,156	2,165	1,649	908	2,535	17	56,599
2041	29,010	2,201	2,221	1,675	927	2,631	18	58,703
2042	30,367	2,248	2,279	1,702	947	2,731	19	60,893
2043	31,759	2,294	2,337	1,728	967	2,832	19	63,128
2044	33,185	2,340	2,396	1,754	987	2,935	20	65,405
2045	34,645	2,386	2,455	1,781	1,006	3,040	21	67,723
2046	36,138	2,433	2,513	1,807	1,026	3,146	22	70,080
2047	37,662	2,479	2,573	1,832	1,046	3,254	22	72,474
2048	39,216	2,525	2,632	1,858	1,066	3,362	23	74,903
2049	40,797	2,570	2,691	1,883	1,085	3,472	24	77,364
2050	42,406	2,616	2,750	1,909	1,105	3,583	25	79,854
2051	43,961	2,659	2,806	1,932	1,123	3,690	25	82,252
2052	45,573	2,703	2,863	1,956	1,142	3,799	26	84,727
AADT CAGR%								
FY23 - FY25	0.0%	2.5%	3.0%	1.8%	2.5%	5.7%	5.7%	2.4%
FY25 - FY30	6.0%	2.6%	3.2%	-1.1%	-1.6%	0.9%	5.3%	2.7%
FY30 - FY35	5.6%	2.4%	3.0%	-1.7%	-2.8%	-1.2%	4.3%	2.3%
FY35 - FY40	5.0%	2.2%	2.8%	1.7%	2.3%	4.0%	4.0%	3.9%
FY40 - FY45	4.6%	2.1%	2.5%	1.5%	2.1%	3.7%	3.7%	3.7%
FY45 - FY50	4.1%	1.9%	2.3%	1.4%	1.9%	3.3%	3.3%	3.4%
FY50 - FY52	3.7%	1.6%	2.0%	1.2%	1.7%	3.0%	3.0%	3.0%
FY23 - FY52	4.6%	2.2%	2.7%	0.5%	0.6%	2.4%	4.2%	3.1%

Table 0-5: Projected Mode-wise Traffic at TP01

FY END	Car	LCV	Bus	2-axle Truck	3-axle Truck	MAV	OSV	PCU
2023	11,964	1,675	1,462	2,173	1,136	2,068	11	38,145
2024	11,964	1,715	1,505	2,212	1,164	2,183	12	39,054
2025	11,964	1,758	1,552	2,254	1,193	2,310	12	40,049
2026	12,756	1,805	1,604	2,300	1,226	2,437	13	41,877
2027	13,601	1,853	1,657	2,346	1,259	2,572	14	43,802
2028	14,473	1,902	1,710	2,392	1,293	2,709	14	45,767
2029	15,343	1,948	1,762	2,436	1,324	2,845	15	47,702
2030	16,020	1,995	1,815	2,214	1,140	2,457	16	45,645
2031	16,852	2,044	1,870	2,119	1,056	2,288	17	45,421
2032	17,727	2,093	1,926	2,019	968	2,099	17	45,130
2033	18,792	2,144	1,984	2,056	992	2,191	18	47,046
2034	19,902	2,195	2,043	2,093	1,016	2,285	19	49,021
2035	21,058	2,247	2,102	2,131	1,040	2,382	20	51,056
2036	22,139	2,299	2,162	2,168	1,065	2,481	20	53,029
2037	23,255	2,351	2,223	2,205	1,089	2,583	21	55,050
2038	24,406	2,403	2,284	2,242	1,114	2,686	22	57,119
2039	25,592	2,455	2,346	2,279	1,139	2,792	23	59,234
2040	26,812	2,508	2,409	2,315	1,164	2,900	24	61,394
2041	28,066	2,561	2,471	2,352	1,188	3,010	25	63,598
2042	29,378	2,614	2,536	2,389	1,214	3,124	26	65,889
2043	30,724	2,668	2,601	2,427	1,239	3,240	27	68,225
2044	32,104	2,722	2,666	2,464	1,265	3,358	28	70,604
2045	33,517	2,776	2,731	2,500	1,290	3,477	29	73,023
2046	34,961	2,830	2,797	2,537	1,316	3,599	30	75,481
2047	36,436	2,883	2,862	2,573	1,341	3,722	31	77,976
2048	37,939	2,937	2,928	2,609	1,366	3,846	32	80,504
2049	39,469	2,990	2,994	2,645	1,391	3,972	33	83,065
2050	41,025	3,043	3,060	2,680	1,417	4,099	34	85,654
2051	42,529	3,093	3,122	2,713	1,440	4,221	35	88,145
2052	44,088	3,144	3,186	2,747	1,464	4,346	36	90,715
AADT CAGR%								
FY23 - FY25	0.0%	2.5%	3.0%	1.8%	2.5%	5.7%	5.7%	2.5%
FY25 - FY30	6.0%	2.6%	3.2%	-0.4%	-0.9%	1.2%	5.3%	2.7%
FY30 - FY35	5.6%	2.4%	3.0%	-0.8%	-1.8%	-0.6%	4.3%	2.3%
FY35 - FY40	5.0%	2.2%	2.8%	1.7%	2.3%	4.0%	4.0%	3.8%
FY40 - FY45	4.6%	2.1%	2.5%	1.5%	2.1%	3.7%	3.7%	3.5%
FY45 - FY50	4.1%	1.9%	2.3%	1.4%	1.9%	3.3%	3.3%	3.2%
FY50 - FY52	3.7%	1.6%	2.0%	1.2%	1.7%	3.0%	3.0%	2.9%
FY23 - FY52	4.6%	2.2%	2.7%	0.8%	0.9%	2.6%	4.2%	3.0%

Table 0-6: Projected Mode-wise Traffic at TP02

Projected Traffic in PCUs

Total traffic in PCUs at the project road under the base case after considering diversion impacts is presented in **Table 0-7**.

FY end	TP01-Kognoli	TP02- Hattargi	Average
2023	34,991	38,145	36,568
2024	35,796	39,054	37,425
2025	36,680	40,049	38,365
2026	38,415	41,877	40,146
2027	40,245	43,802	42,024
2028	42,115	45,767	43,941
2029	43,959	47,702	45,831
2030	41,807	45,645	43,726
2031	41,492	45,421	43,456
2032	41,109	45,130	43,120
2033	42,932	47,046	44,989
2034	44,813	49,021	46,917
2035	46,754	51,056	48,905
2036	48,629	53,029	50,829
2037	50,552	55,050	52,801
2038	52,522	57,119	54,820
2039	54,538	59,234	56,886
2040	56,599	61,394	58,996
2041	58,703	63,598	61,151
2042	60,893	65,889	63,391
2043	63,128	68,225	65,676
2044	65,405	70,604	68,004
2045	67,723	73,023	70,373
2046	70,080	75,481	72,780
2047	72,474	77,976	75,225
2048	74,903	80,504	77,704
2049	77,364	83,065	80,214
2050	79,854	85,654	82,754
2051	82,252	88,145	85,199
2052	84,727	90,715	87,721
CAGR (%) (FY24 to FY51)	3.1	3.1	3.1

Table 0-7: Projected Traffic at PR in PCUs (after diversion)

Tolling Segmentation

The tolling stream distribution under the present study has been derived from the toll data taking an average of FY23 and the same is presented in **Table 0-8**.

Type	Car	LCV	Bus/2ATruck	3ATruck	4-6 A Truck	OSV
TP01 - Kognoli						
Single	47.6	74.1	63.4	87.1	90.9	96.8
Return	42.4	21.6	32.6	12.3	8.7	2.6
Monthly	0.0	0.0	0.0	0.0	0.0	0.0
Local personal	5.5	0.0	0.0	0.0	0.0	0.0
Local commercial	0.0	0.0	3.3	0.0	0.0	0.1
Exempt	4.4	4.3	0.7	0.6	0.3	0.5
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
TP02 - Hattargi						
Single	40.6	71.6	56.2	81.0	87.8	79.6
Return	53.1	24.0	34.6	18.4	11.9	2.7
Monthly	0.0	0.0	0.2	0.0	0.0	0.0
Local personal	1.5	0.0	0.0	0.0	0.0	0.0
Local commercial	0.2	0.8	8.6	0.2	0.1	0.0
Exempt	4.7	3.6	0.4	0.4	0.3	17.7
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 0-8: Tolling Distribution

Tollable Length and Toll Rates

The normal tolling lengths, bypass length (at 1.5 times) and equivalent structure lengths being charged at toll plazas along with the length which will be charged post augmentation to six lane configurations are presented in **Table 0-9**.

Toll Plazas	TP01	TP02
Existing Tolling Length till FY24	60.73	23.74
Tolling Length post six laning from FY25	79.39	41.83

Table 0-9: Tolling Lengths (in km) for Kagal-Belgaum

The construction for six laning for the project road has started from November in FY23 and is likely to continue till the end of FY25 during which the toll rates will be 75 percent of the applicable toll rates of FY23 and will be constant till the end of construction period. The stream of toll rates to be charged at two toll plazas of the project road till FY52 is presented in **Table 0-10**. The toll fee has been rounded to nearest 5 Rupees as per toll fee rules.

FY End	Car	LCV/ M Bus	Bus/ 2A Truck	3-axle Truck	MAV	O/size/HME	Car Local
TP01 - Kognoli							
2023* (Since Nov 2022)	60	100	210	230	330	400	315
2025*	60	100	210	230	330	400	315
2026	100	165	345	375	540	655	360
2027	125	205	430	470	670	820	375
2028	135	215	450	495	710	865	390
2030	145	235	490	535	770	935	420
2035	175	285	600	655	940	1,145	515
2040	215	350	730	800	1,145	1,395	630
2045	265	425	895	975	1,400	1,705	770
2050	325	520	1,095	1,190	1,715	2,085	940
2052	350	565	1,185	1,290	1,855	2,260	1,015
TP02 - Hattargi							
2023* (Since Nov 2022)	25	40	80	90	130	155	315
2025*	25	40	80	90	130	155	315
2026	55	85	180	195	285	345	360
2027	65	110	225	245	355	430	375
2028	70	115	240	260	375	455	390
2030	75	125	260	280	405	495	420
2035	95	150	315	345	495	600	515
2040	115	185	385	420	605	735	630
2045	140	225	470	515	740	900	770
2050	170	275	575	630	905	1,100	940
2052	185	300	625	680	980	1,190	1,015

**Toll rates at 75% during six laning since November 2022*

Table 0-10: Toll Rates at Toll Plazas (in Rs)

Project Road Revenue

The project road revenue under the base case scenario is presented in **Table 0-11**.

FY Ending March	Base Case
2023	1,324.3
2024	1,141.4
2025	1,170.1
2026	2,207.5
2027	2,877.5
2028	3,190.4
2029	3,460.0
2030	3,376.0
2031	3,465.1
2032	3,558.2
2033	3,848.8
2034	4,170.6
2035	4,516.0
2036	4,893.8
2037	5,267.8
2038	5,703.8
2039	6,153.6
2040	6,642.6
2041	7,159.3
2042	7,717.7
2043	8,316.7
2044	8,974.9
2045	9,628.1
2046	10,336.6
2047	11,111.0
2048	11,983.1
2049	12,842.4
2050	13,798.6
2051	14,739.4
2052*	11,245.4
PV12 FY23 till 15th Dec in FY52	30,809.2
CAGR FY24 to FY51	9.9%

** Till 15th Dec FY52*

Table 0-11: Base Case Revenue

The project road will have a CAGR of 9.9 percent for the period between FY24 to FY51.

1. INTRODUCTION

1.1 General

National Highways Authority of India (NHAI) has setup NHAI InvIT to monetize its completed and operational national highways projects with the objective of mobilizing additional resources through capital markets. In this context, National Highways Infra Projects Private Limited (NHIPPL) is acting as SPV for the projects under NHAI InvIT. Under Round1 (R1), NHAI InvIT has added a portfolio of five operating toll roads with an aggregate length of 390 kilometers located across the states of Gujarat, Karnataka, Rajasthan and Telangana.

The section viz., Kagal-Belgaum of NH-48 (Old NH-4) in the state of Maharashtra and Karnataka referred to as Project Road (PR) hereinafter, is part of the R1 portfolio of InvIT.

The project highway, NH-48 (Old NH-4), is part of the Golden Quadrilateral connecting many of the major industrial, agricultural, and cultural centres of India. The total length of NH-48 (Old NH-4) is roughly 1,235 km starting from Chennai in the state of Tamil Nadu and ending at Mumbai in the state of Maharashtra. NH-48 (Old NH-4) acts as a primary conduit for transportation of freight as well as passenger traffic in these states as well as various other important states in India. NH-48 (Old NH-4) connects important cities and towns like Pune, Satara, Karad, Sangli, Kolhapur, Belgaum, Dharwad, Hubli, Bangalore etc. **Figure 1-1** shows the alignment of NH-48 (Old NH-4) with major places along the highway.

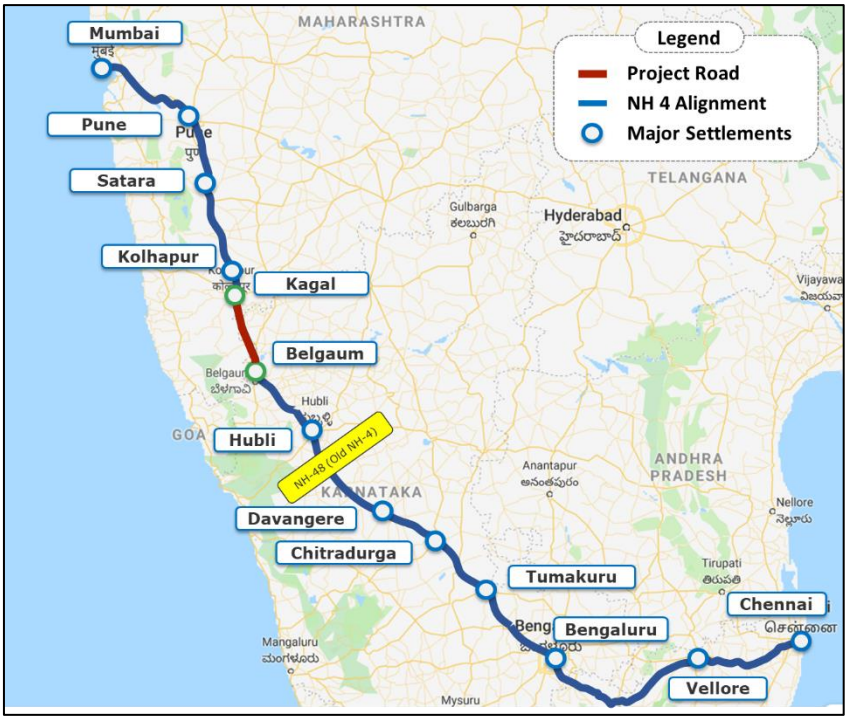


Figure 1-1: Alignment of NH-48 (Old NH-4) with Major Places

National Highways Infra Projects Private Limited, has appointed Ramboll India Private Ltd as the Traffic Consultant to carry out a study for assessing the present traffic levels,

travel pattern and future traffic & revenue estimation till year FY52 duly considering the network characteristics, future economic perspective in the influence area of the project.

1.2 Scope of Services

The scope of the study includes the following:

- Undertake Traffic Survey on the highway section as per the following:
  - Seven days 24 hours Videography Traffic Counts at or near the existing toll plaza locations on the project road to derive the Average Daily Traffic (ADT)
  - One day Origin-Destination survey at or near the existing toll plaza locations to assess the existing travel pattern of vehicles plying on the project road – origin and destination
- Estimation of the base year AADT using seasonality factors for conversion of ADT to AADT
- Analysis of OD data to cover:
  - Regional distribution of traffic and influence factors for different zones contributing traffic on the corridor
  - Identification of Project Influence Area from analysis of travel pattern - regional distribution of traffic,
  - Main traffic generators (industrial areas, towns, ports etc.)
  - Commodity composition- Goods type distribution
  - Top OD pairs by vehicle types
  - Travel frequency and trip purpose distribution
- Review of past traffic studies, traffic/toll data and other relevant reports as may be available to determine category wise volume of traffic for past years as well as for current year
- To identify competing route and analyse the network conditions, traffic characteristics & level of toll charged and the advantage/ disadvantage of the competing road and their impact on the project traffic
- Carry out a study of past economic performance of influence area
- Diversion analysis, wherever needed – cost ratio-based diversion analysis using spreadsheets to be carried out for respective potential OD pairs.
- Preparation of traffic projections till year FY52 in three scenarios – low, most likely and high
- Capacity analysis of the road or any other requirements for potential capacity augmentation

- Estimation of tollable traffic streams by toll category and estimation of toll revenue as per categories of traffic streams stipulated in the tolling schedule for the study period
- Review future road and transportation network developments in the area of influence of the project and identify those schemes that may impact positively or negatively traffic on the toll road
- Identify factors which may have a positive and / or negative impact on the traffic - all major developments like DFC, industrial corridors, economic corridors, ports, Bharatmala, Sagarmala.
- Scenario Analysis of toll revenue – Critical parameters of diversion (if applicable) and three scenarios of traffic growth (most likely, low and high).

1.3 Report Structure

This report is divided into four chapters, including this introduction chapter. Chapter 2 details upon the project road characteristics and socio – economic profile of the districts in the project influence area including the estimation of AADT and travel characteristics in the Project Influence Area (PIA). Chapter 3 contains the details on the derivation of traffic growth rates used for traffic forecasting and presents traffic projections for the study period. Chapter 4 presents the details regarding tolling strategy, toll rates and the revenue projections for the duration of the concession.

2. TRAFFIC SURVEY AND ANALYSIS

2.1 General

In order to understand the traffic characteristics, the volume of traffic and travel pattern of vehicles plying on the project road were collected through primary surveys. This chapter presents the details of the project road characteristics, traffic surveys carried out, their analysis and the salient findings. The results of the analysis will be utilized in assessing the traffic growth and estimation of traffic and revenue forecast on the project road for the concession period.

2.2 Project Road Characteristics

The project road section, Kagal-Belgaum, a part of the NH-48 (Old NH-4) in the state of Maharashtra/Karnataka, starts at km 592.240 of NH-48 (Old NH-4) near Kagal and ends at km 515.000 of NH-48 (Old NH-4) near Belgaum with a length of about 77.24 km. The project road falls under the jurisdiction of Kolhapur district of Maharashtra and Belagavi district of Karnataka passing through settlements of Kagal, Kognoli, Nippani, Sankeshwar, Hattargi and Belgaum. There are two operational toll plazas on the project road, one near Kognoli (km 591.240) and other near Hattargi (km 537.770). Both Kognoli and Hattargi toll plazas have 12 tolling lanes (6 in each direction).

The alignment of project road and toll plaza locations is shown in **Figure 2-1**.

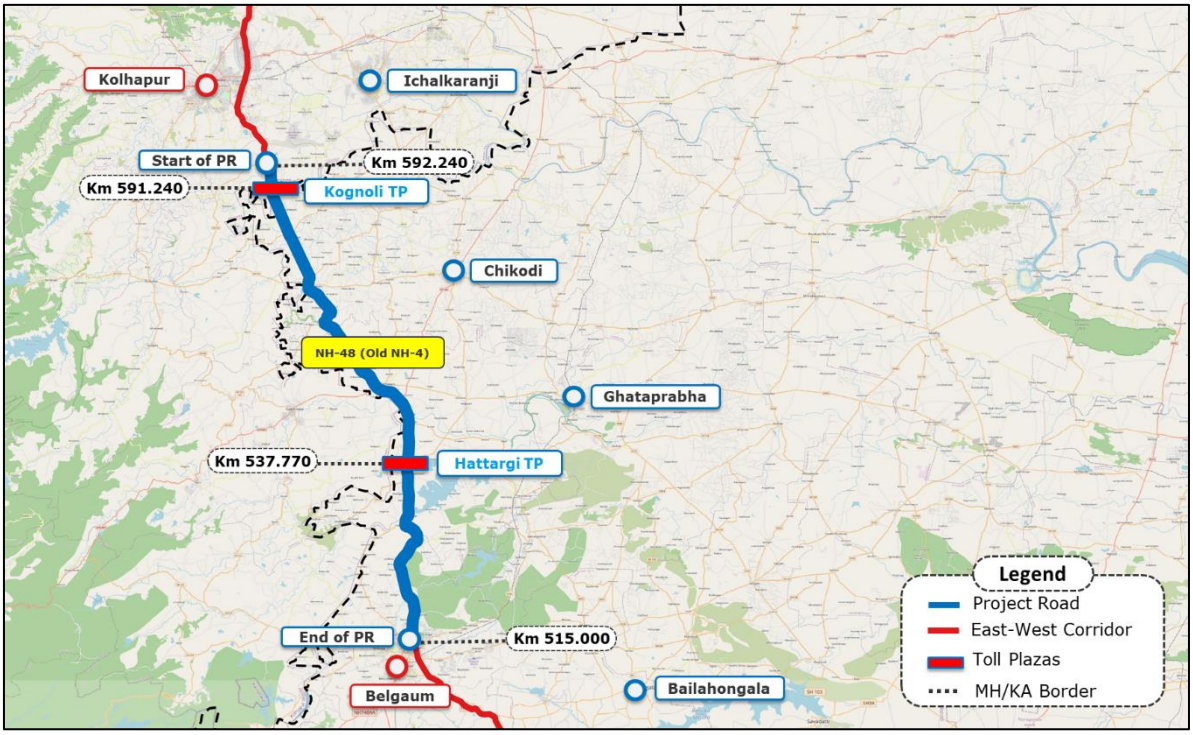


Figure 2-1: Project Road and Location of Toll Plazas

The project road, in wider context, serves the long-distance traffic for the freight vehicles, which is majorly plying between Mumbai/ Pune/ Delhi and Goa/ Bangalore/ Chennai/ Vellore. Apart from long distance traffic, it also serves the short distance traffic for both

passenger and freight which is mainly generated between Kolhapur/Sangli/ Goa/Belgaum/ Khanapur/Hubbali/Dharwad and nearby places.

2.2.1 Profile of Project Influence Area District

Kolhapur District

Kolhapur district is situated in the southern side of the Maharashtra state with an area of 7,692 sq.km. It is bounded by Sindhudurg district in the west, Sangli district in the north, Bijapur district of Karnataka in the east and Belgaum district of Karnataka in the south. The administrative headquarters of the district is at Kolhapur. Kolhapur is known as `Dakshin Kashi' or Kashi of the South because of its spiritual history and its Mahalaxmi shrine. According to 2011 census, the district has a population of 3.87 million with decadal growth of about 10.01 percent.

It is one of the industrialised districts in Maharashtra. Due to the presence of abundant water and fertile soil, the district is prominent in cultivation of sugarcane, paddy, banana, soyabean and several vegetables. It is the major producer of jaggery and sugar. The district also houses many dairy and poultry farms. It is one of the prime centres of the textile industry, cotton mills and arts and handicrafts industry. The district also has the highest number of sugar refineries in the country and is also known as the sugar bowl of India. The district has emerged to be one of the highest per capita income districts in India.

Belagavi (Belgaum) District

Belagavi district is situated in northwest of Karnataka State with an area of 13,433 sq. km, sharing borders with Goa and Maharashtra states. Belagavi district is surrounded by Dharwad and Uttara Kannada districts on the south, Bagalkot and Bijapur districts in the east, and Kolhapur district of Maharashtra state in the north. The administrative headquarters of the district is at Belgaum. According to 2011 census, the district has a population of 4.78 million with decadal growth of about 13.41 percent.

The district with different agro climatic conditions and soil types has vast agricultural potential. Major crops grown in the district are paddy, maize, jowar, oil seeds, cotton, onion, tomato and sugarcane. Belgaum has 16 industrial estates, 6 industrial areas and 1 SEZ. District is important centre for manufacturing of valves, pumps, and its accessories, heavy machine tools and high-pressure oil hydraulics. It has 58 export-oriented units and 22 sugar industries in different parts of district. Rich deposits of natural resources like bauxite, uranium, silica sand, aluminium, laterite, limestone, dolomite, quartzite and china clay are also found in the district.

2.3 Traffic Surveys

In order to understand the characteristics and the volume of traffic using the project road, data on road network, traffic and travel pattern of vehicles plying on the project road were collected through primary traffic surveys. Traffic volume video graphic survey

for seven days and origin-destination (OD) survey as roadside interview for one day at toll plaza locations were conducted on the project road. The schedule of the traffic surveys and locations on the project road are given in **Table 2-1**.

Location	Chainage	Duration	Date(s)
Classified Traffic Volume Counts			
TP01 – Kognoli Toll Plaza	km 591.240	7 Days	01st March–07th March 2023
TP02 – Hattargi Toll Plaza	km 537.770		
Origin and Destination Survey			
TP01 – Kognoli Toll Plaza	km 591.240	1 Day	02nd March 2023
TP02 – Hattargi Toll Plaza	km 537.770		

Table 2-1: Traffic Survey Locations and Schedule

Trained enumerators were engaged for conducting traffic surveys under the supervision of experienced transport planner. The vehicle classification as generally used in the traffic surveys of NHAI studies along with their PCU values, as suggested in IRC: 64 – 1990, are presented in **Table 2-2**.

Vehicle Type	PCU Factor
Motorized Vehicles	
Car, Jeep, Van &Taxi	1.0
Two –Wheeler	0.5
Three-Wheeler (Auto-Rickshaw)	1.0
Mini-Bus/ School Bus	1.5
Govt. Bus/ Private Bus	3.0
Mini LCV/Max Pick Up	1.0
Light Commercial Vehicle (LCV)	1.5
2-Axle Truck	3.0
3-Axle Truck	3.0
Multi-Axle Vehicle (MAV 4-6 Axle)	4.5
HME	4.5
Agricultural Tractor	1.5
Agricultural Tractor with Trailer	4.5
Non – Motorised Vehicles	
Cycle	0.5
Cycle Rickshaw	2.0
Animal Drawn Cart	6.0

Table 2-2: Vehicle classification and PCU factors

2.4 Traffic Characteristics

The data collected from the traffic volume count survey was analysed in order to get the results with respect to existing traffic intensity, flow pattern, hourly variation and composition of traffic on the study road network. The various traffic characteristics have been analysed under the following heads:

- Average Daily Traffic (ADT)
- Daily variation, Hourly variation and Traffic composition
- Annual Average Daily Traffic (AADT)

2.4.1 Average Daily Traffic (ADT)

The traffic volume data collected at the toll plaza locations during the seven days survey has been analysed. The summary of ADT in terms of vehicles and PCUs is presented in **Table 2-3**.

Mode	TP01- Kognoli Toll Plaza	TP02- Hattargi Toll Plaza
Tollable vehicles		
Car/Jeep/Van/Taxi	9,829	8,432
Minibus	102	127
Standard Bus	955	1,029
Mini LCV	1,193	1,685
LCV	2,537	2,909
2 Axle	1,222	1,528
3 Axle	924	1,256
MAV (4-6 Axle)	2,045	2,236
HMV/ MAV (=>7 Axle)	13	15
Non Tollable vehicles		
Two-Wheeler	15,578	7,618
Auto Rickshaw	145	101
Agri. Tractors	228	188
Total Non-Motorised	52	22
Total Vehicles/PCUs		
Total Tollable Vehicles	**18,820**	**19,217**
Total Non Tollable Vehicles	**16,002**	**7,930**
Total Vehicles	**34,822**	**27,146**
Total PCU	**42,464**	**40,953**
Tollable PCU	**33,543**	**36,239**

Table 2-3: Average Daily Traffic at TP01 & TP02

- The observed total vehicles are around 34,822 and 27,146 at TP01 and TP02 respectively.
- Car traffic has a share of around 28.2 percent (9,829 vehicles) and 31.1 percent (8,432 vehicles) at TP01 and TP02 respectively.
- Total freight vehicles account for a share of 23.4 percent at TP01 and 36.2 percent at TP02. Within the freight traffic, MAV accounts for 5.9 percent (2,058 vehicles) and 8.3 percent (2,251 vehicles) at TP01 and TP02 respectively.
- The tollable traffic recorded at TP01 and TP02 are 54.0 percent and 70.8 percent respectively.
- Other motorised non-tollable vehicles (two-wheeler, auto rickshaw and tractor) account for about 46.0 percent at Kognoli toll plaza and 29.2 percent at Hattargi toll plaza.

2.4.2 Daily Variation, Hourly Variation, and Traffic Composition

The day wise variation, hourly variation and the traffic composition at the toll plaza locations is presented in **Figure 2-2**.

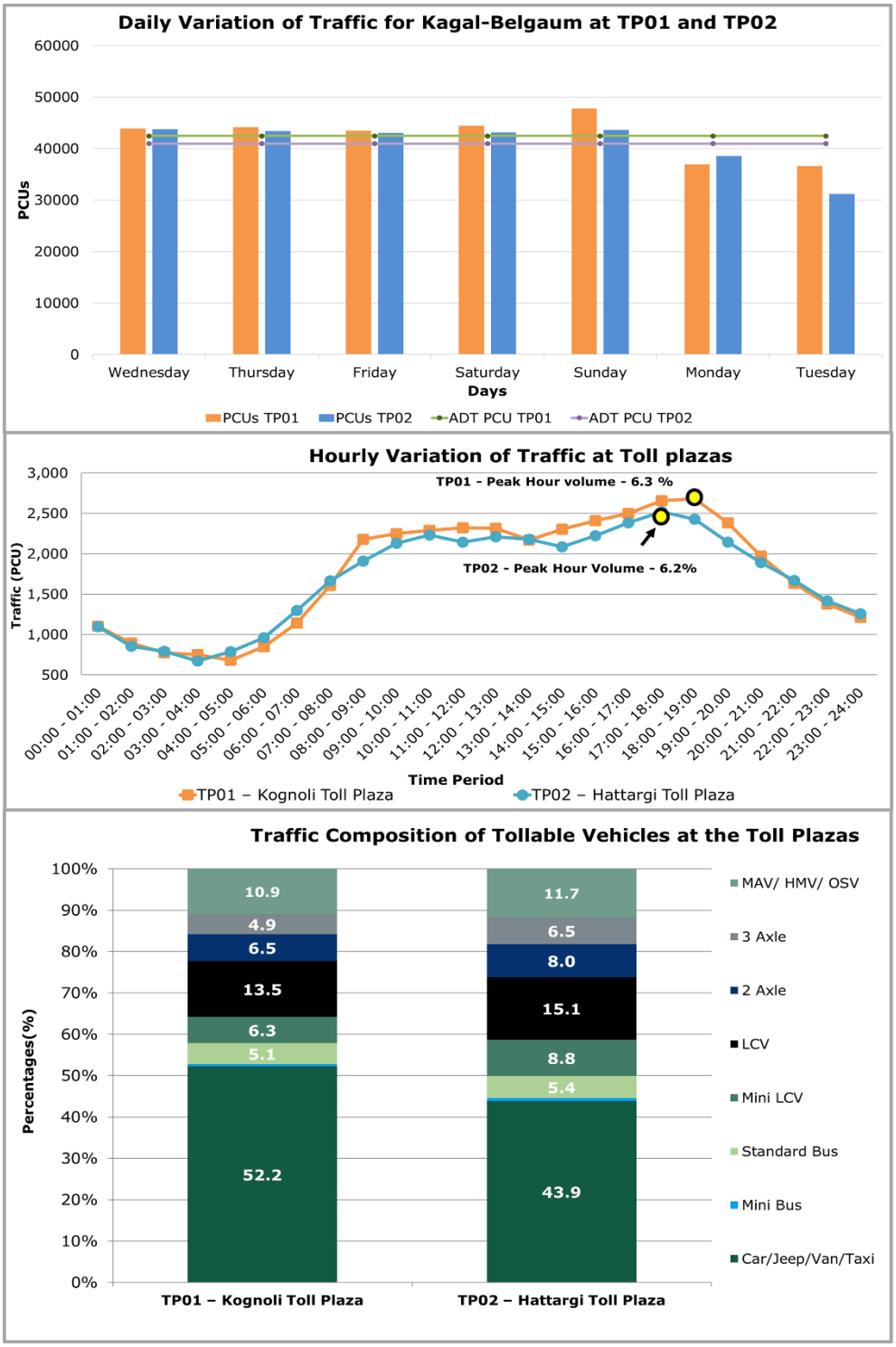


Figure 2-2: Daily Variation, Hourly Variation and Traffic Composition at TP01 & TP02

- It was observed that the traffic at the toll plazas is consistent with minor fluctuations during the days of Holi festival i.e., Monday & Tuesday.
- The directional distribution at the toll plaza location is almost equal with Kagal-Belgaum having a directional distribution of 50.3 percent at TP01 and 51.2 percent at TP02.
- The peak hour at both the toll plazas was observed to be in the evening with TP01 having peak hour as 18:00-19:00 and TP02 to be observed between 17:00-18:00.

- In case of passenger traffic, car traffic has a share of about 52.2 percent at TP01 and 43.9 percent at TP02.
- In case of freight traffic, MAV traffic has a share of about 10.9 percent at TP01 and 11.7 percent at TP02.

2.4.3 Comparison of Toll Data with TVC

Toll Data vs TVC

The TVC survey was conducted from 1st March 2023 to 7th March 2023. A comparison between TVC and Toll Data for the days of the survey is presented in **Table 2-4**.

Day/Date	CJV	LCV	2-Axle	3-Axle	MAV/ OSV	LCV/ 2A	Total	PCUs
TP01- Kognoli Toll Plaza								
TVC								
Wednesday, March 1, 2023	10,676	2,942	2,324	1,053	2,089	5,266	19,084	34,621
Thursday, March 2, 2023	10,545	2,895	2,368	1,014	2,171	5,263	18,993	34,803
Friday, March 3, 2023	11,014	2,882	2,260	937	2,186	5,142	19,279	34,765
Saturday, March 4, 2023	12,775	2,650	2,204	969	2,045	4,854	20,643	35,472
Sunday, March 5, 2023	13,478	2,939	2,345	991	2,316	5,284	22,069	38,317
Monday, March 6, 2023	9,522	1,953	1,893	774	1,836	3,846	15,978	28,715
Tuesday, March 7, 2023	9,145	2,211	1,843	730	1,762	4,054	15,691	28,110
Average	11,022	2,639	2,177	924	2,058	4,816	18,820	33,543
Toll Data								
Wednesday, March 1, 2023	11,142	1,723	3,437	1,089	2,192	5,160	19,583	37,169
Thursday, March 2, 2023	11,007	1,725	3,382	1,077	2,220	5,107	19,411	36,962
Friday, March 3, 2023	11,568	1,580	3,270	1,001	2,229	4,850	19,648	36,782
Saturday, March 4, 2023	13,424	1,503	3,160	1,031	2,048	4,663	21,166	37,468
Sunday, March 5, 2023	14,146	1,639	3,386	1,063	2,336	5,025	22,570	40,464
Monday, March 6, 2023	9,880	1,038	2,625	838	1,848	3,663	16,229	30,142
Tuesday, March 7, 2023	9,673	1,198	2,655	761	1,802	3,853	16,089	29,827
Average	11,549	1,487	3,131	980	2,096	4,617	19,242	35,545
Toll Data MINUS TVC								
Wednesday, March 1, 2023	*466*	*-1,219*	*1,113*	*36*	*103*	*-106*	*499*	*2,548*
Thursday, March 2, 2023	*462*	*-1,170*	*1,014*	*63*	*49*	*-156*	*418*	*2,159*
Friday, March 3, 2023	*554*	*-1,302*	*1,010*	*64*	*43*	*-292*	*369*	*2,017*
Saturday, March 4, 2023	*649*	*-1,147*	*956*	*62*	*3*	*-191*	*523*	*1,996*
Sunday, March 5, 2023	*668*	*-1,300*	*1,041*	*72*	*20*	*-259*	*501*	*2,147*
Monday, March 6, 2023	*358*	*-915*	*732*	*64*	*12*	*-183*	*251*	*1,428*
Tuesday, March 7, 2023	*528*	*-1,013*	*812*	*31*	*40*	*-201*	*398*	*1,718*
Average	526	-1,152	954	56	39	-198	423	2,002
TP02- Hattargi Toll Plaza								
TVC								
Wednesday, March 1, 2023	10,631	3,454	2,768	1,402	2,317	6,222	20,572	38,749
Thursday, March 2, 2023	10,237	3,339	2,723	1,378	2,446	6,062	20,123	38,556
Friday, March 3, 2023	10,246	3,311	2,680	1,331	2,397	5,991	19,965	38,032
Saturday, March 4, 2023	11,422	3,102	2,674	1,307	2,296	5,776	20,801	38,350
Sunday, March 5, 2023	11,450	3,325	2,628	1,352	2,412	5,953	21,167	39,232
Monday, March 6, 2023	9,928	2,390	2,422	1,220	2,030	4,812	17,990	33,574

Day/Date	CJV	LCV	2-Axle	3-Axle	MAV/ OSV	LCV/ 2A	Total	PCUs
Tuesday, March 7, 2023	6,905	2,328	2,003	804	1,858	4,331	13,898	27,179
Average	10,117	3,036	2,557	1,256	2,251	5,592	19,217	36,239
Toll Data								
Wednesday, March 1, 2023	11,173	2,082	4,033	1,451	2,401	6,115	21,140	41,553
Thursday, March 2, 2023	10,784	2,120	3,862	1,420	2,466	5,982	20,652	40,907
Friday, March 3, 2023	10,881	1,987	3,803	1,374	2,425	5,790	20,470	40,305
Saturday, March 4, 2023	11,968	1,852	3,702	1,370	2,299	5,554	21,191	40,308
Sunday, March 5, 2023	12,264	2,027	3,774	1,445	2,469	5,801	21,979	42,072
Monday, March 6, 2023	10,315	1,447	3,239	1,316	2,048	4,686	18,365	35,367
Tuesday, March 7, 2023	7,190	1,355	2,915	852	1,852	4,270	14,164	28,858
Average	10,654	1,839	3,618	1,318	2,280	5,457	19,709	38,481
Toll Data MINUS TVC								
Wednesday, March 1, 2023	*542*	*-1,372*	*1,265*	*49*	*84*	*-107*	*568*	*2,804*
Thursday, March 2, 2023	*547*	*-1,219*	*1,139*	*42*	*20*	*-80*	*529*	*2,352*
Friday, March 3, 2023	*635*	*-1,324*	*1,123*	*43*	*28*	*-201*	*505*	*2,273*
Saturday, March 4, 2023	*546*	*-1,250*	*1,028*	*63*	*3*	*-222*	*390*	*1,958*
Sunday, March 5, 2023	*814*	*-1,298*	*1,146*	*93*	*57*	*-152*	*812*	*2,841*
Monday, March 6, 2023	*387*	*-943*	*817*	*96*	*18*	*-126*	*375*	*1,793*
Tuesday, March 7, 2023	*285*	*-973*	*912*	*48*	*-6*	*-61*	*266*	*1,679*
Average	*537*	*-1,197*	*1,061*	*62*	*29*	*-136*	*492*	*2,243*

Table 2-4: Comparison Between TVC and Toll Data

The main observations from the comparison are:

- TVC data is higher than toll data in car for all the survey days at both the toll plazas.
- The variation in LCV/2A could be due to cross classification amongst these modes.
- The variation in total traffic is about 2-3 percent on an average per day at the two toll plaza locations.

2.4.4 Annual Average Daily Traffic (AADT)

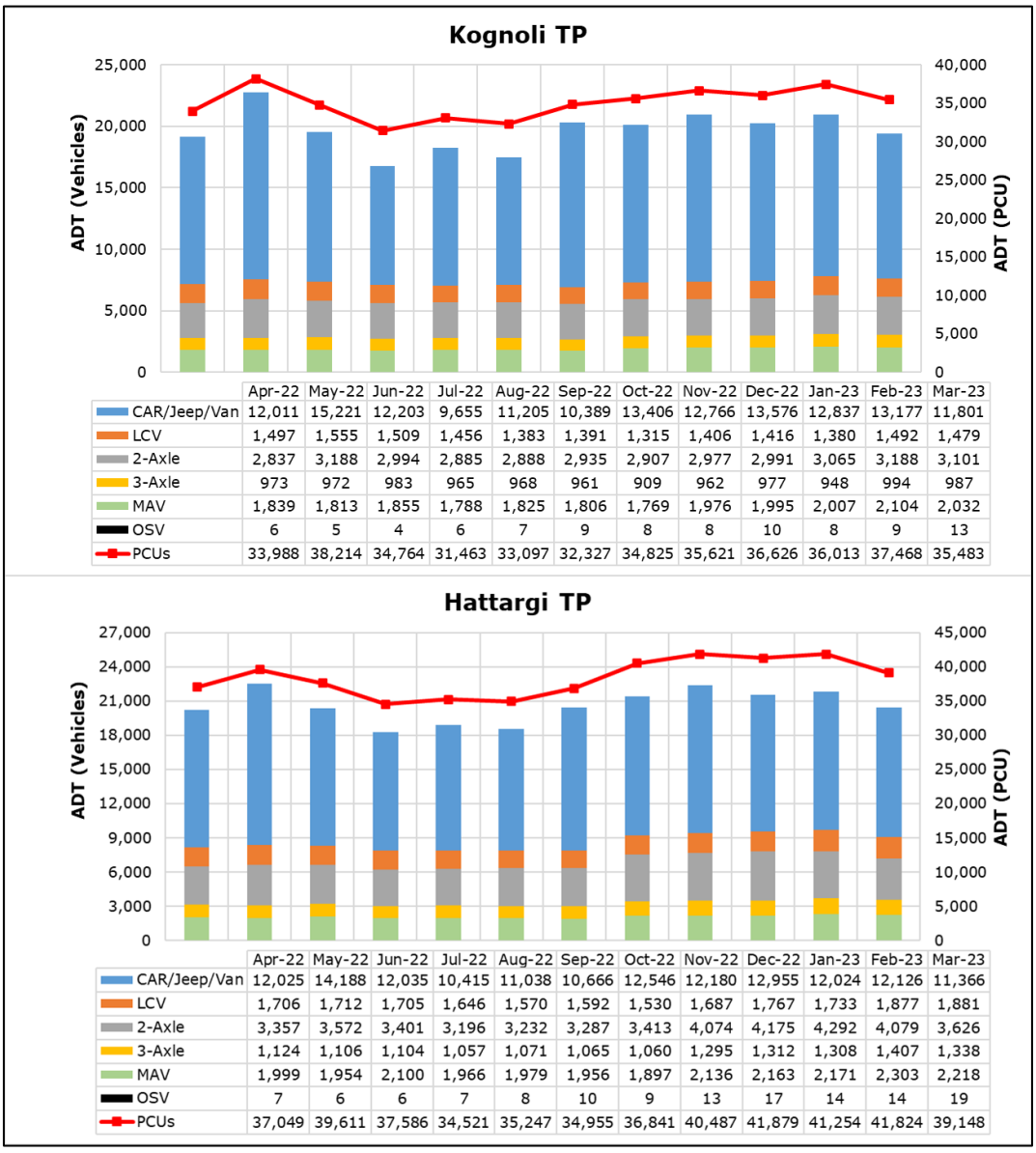
The traffic plying on any road generally varies over different periods of the year depending on the cycle of different socio-economic activities in the regions through which it passes. Therefore, in order to have a more realistic picture of the traffic on the project road, it is required to assess its seasonal variation to estimate the annual average daily traffic (AADT).

The past toll traffic data for both the toll plazas was made available by the client from Jan 2021-March 2023 as presented in **Appendix 2.1**.

For the period from April 2022 to June 2022, the corresponding monthly data for reusage of local pass and exemptions for cars were either not recorded or there were inconsistencies. Therefore, for reusage of local pass and exemptions, the average between August 2022 to March 2023 has been considered for the months of April 2022 to June 2022 for both the toll plazas to arrive at the monthly ADT for these months. For

the period from April 2022 to June 2022, high numbers were recorded for cars in cash-violation category which are not considered for the AADT estimation for FY23.

The month-on-month mode wise traffic for this period April 22 to March 23 for both the toll plazas is presented in **Figure 2-3**.



	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23
CAR/Jeep/Van	12,011	15,221	12,203	9,655	11,205	10,389	13,406	12,766	13,576	12,837	13,177	11,801
LCV	1,497	1,555	1,509	1,456	1,383	1,391	1,315	1,406	1,416	1,380	1,492	1,479
2-Axle	2,837	3,188	2,994	2,885	2,888	2,935	2,907	2,977	2,991	3,065	3,188	3,101
3-Axle	973	972	983	965	968	961	909	962	977	948	994	987
MAV	1,839	1,813	1,855	1,788	1,825	1,806	1,769	1,976	1,995	2,007	2,104	2,032
OSV	6	5	4	6	7	9	8	8	10	8	9	13
PCUs	33,988	38,214	34,764	31,463	33,097	32,327	34,825	35,621	36,626	36,013	37,468	35,483

	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23
CAR/Jeep/Van	12,025	14,188	12,035	10,415	11,038	10,666	12,546	12,180	12,955	12,024	12,126	11,366
LCV	1,706	1,712	1,705	1,646	1,570	1,592	1,530	1,687	1,767	1,733	1,877	1,881
2-Axle	3,357	3,572	3,401	3,196	3,232	3,287	3,413	4,074	4,175	4,292	4,079	3,626
3-Axle	1,124	1,106	1,104	1,057	1,071	1,065	1,060	1,295	1,312	1,308	1,407	1,338
MAV	1,999	1,954	2,100	1,966	1,979	1,956	1,897	2,136	2,163	2,171	2,303	2,218
OSV	7	6	6	7	8	10	9	13	17	14	14	19
PCUs	37,049	39,611	37,586	34,521	35,247	34,955	36,841	40,487	41,879	41,254	41,824	39,148

Figure 2-3: Month on Month Traffic Data for TP01 and TP02

It is to be noted that six laning of Kagal-Belgaum section has started from November 2022, therefore a significant number of construction vehicles (LCV/2A/3A/MAV) are observed at Hattargi toll plaza which are under the category of exempt and have not been considered for FY23 AADT estimation. Hence, the average exemption numbers from April 2022 to October 2022 is considered for the remaining months of FY23 (from November 2022 onwards) for Hattargi Toll Plaza.

The resultant mode wise AADT estimated for the project road for FY23 at both the toll plaza locations is presented in **Table 2-5**.

Location/ Mode	Car/Jeep/ Van/Taxi	LCV	2A	3A	MAV	OSV	PCUs
TP01- Kognoli Toll Plaza							
AADT (Average April 2022 – March 2023)	12,354	1,440	2,996	966	1,901	8	34,991
TP02- Hattargi Toll Plaza							
ADT (Average April 2022 – March 2023)	11,964	1,701	3,642	1,187	2,070	11	38,367
AADT (without construction vehicles)	11,964	1,675	3,635	1,136	2,068	11	38,145

Table 2-5: AADT for FY23

2.5 Travel Characteristics

2.5.1 Survey Methodology

In order to understand the travel demand pattern in the region and tollable traffic streams, origin and destination (OD) surveys were carried out at the toll plaza locations. The OD survey was carried out for 24 hours, by roadside interview method as described in IRC: 102-1988. Both passenger and commercial vehicles plying on the project road were stopped on a random sampling basis and interviewed.

The travel characteristics obtained by OD survey facilitate the identification of:

1. Local and through traffic on the project road.
2. Potential divertible traffic to/from project road to various alternative routes.

Trained enumerators under the supervision of transport planners collected the trip characteristics using survey forms designed for this purpose. The OD survey elicited characteristics like origin, destination, frequency, purpose of trip for passenger vehicles and commodity being transported for goods vehicles. The information pertaining to origin and destination of trips collected during roadside interviews was analysed to obtain the trip distribution based on a zoning system suitably designed for the present study.

2.5.2 Traffic Zoning System

To understand the spatial dimensions of the trip characteristics of the vehicles interviewed during the O-D survey, a detailed zoning system was developed giving due consideration to the following factors:

- The road network catering to the traffic on the project road and its generating points
- Important towns, villages, factories and industrial centres around the project road area
- Administrative boundaries of districts and states.
- Configuration of the project road in the regional road network with respect to other roads

Two major types of areas were identified for analysis purpose: -

Immediate Influence Area (IIA): It includes the cities/towns/villages and districts along the project road and adjacent to it, which generate/attract trips to the project road. In this study, it consists of districts of Kolhapur and Belagavi in the state of Maharashtra and Karnataka.

Broad Influence Area (BIA): It includes the remaining districts of Karnataka and Maharashtra and other neighbouring states such as Telangana, Tamil Nadu, and remaining states of India.

Detailed zoning system is prepared for IIA, while more aggregate or broad zoning is developed for BIA. The zoning system adopted for data collection was based on 95 zones and is presented in **Appendix 2.2**.

2.5.3 Sample Size

The toll traffic data does not provide the individual traffic volume count of all categories of vehicles. The seven-day traffic volume video count at the existing toll plazas was analysed to get the individual volume count of all categories of vehicles along with the direction split.

The vehicles during the OD surveys were interviewed on a random sample basis. **Table 2-6** shows the AADT and the sample size (both in absolute numbers and in percentage terms) captured during the exercise.

Modes	Car	M Bus	Bus	MLCV	LCV	2A	3A	MAV/ OSV	Total
TP01- Kognoli Toll Plaza									
Sample	4,686	59	349	473	690	840	535	730	8,362
AADT	11,017	56	1,314	1,337	1,384	1,682	966	1,909	19,665
Percentage (%)	42.5	105.8	26.6	35.4	49.8	49.9	55.4	38.2	42.5
TP02- Hattargi Toll Plaza									
Sample	4,446	71	469	764	777	966	566	676	8,735
AADT	9,971	70	1,462	1,993	1,605	2,173	1,136	2,078	20,489
Percentage (%)	44.6	101.3	32.1	38.3	48.4	44.5	49.8	32.5	42.6

Table 2-6: Sample Size Collected in OD Survey at TP01 & TP02

Based on the sample size of different categories of vehicles interviewed during the OD survey, direction-wise expansion factors were calculated based on FY23 AADT. The OD matrices for all vehicle categories were generated and analysis was done in terms of regional distribution, travel pattern and commodity distribution.

2.5.4 Regional Distribution

Based on the OD matrices, the regional distribution of tollable vehicles at the toll plaza locations has been calculated. **Table 2-7** gives the distribution indicating the attraction and generation zones for the traffic on the project road.

Region/Modes	Car	M Bus	Bus	MLCV	LCV	2A	3A	MAV
TP01- Kognoli Toll Plaza								
Maharashtra	86.9	87.2	88.8	90.1	73.1	72.9	63.5	53.7
Karnataka	7.8	6.9	8.0	8.2	16.6	16.8	20.2	21.6
Tamil Nadu	0.5	1.0	0.7	0.0	5.3	3.6	7.4	9.3
Kerala	0.3	2.0	0.5	0.0	1.4	1.6	1.8	3.0
Goa	3.8	3.0	0.9	1.7	1.7	2.3	0.8	0.7
Gujarat	0.3	0.0	0.4	0.0	1.6	2.2	4.7	9.2
Rajasthan	0.1	0.0	0.0	0.0	0.2	0.1	0.3	1.0
Rest of India	0.4	0.0	0.7	0.0	0.2	0.5	1.4	1.5
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
TP02- Hattargi Toll Plaza								
Maharashtra	73.2	76.2	73.4	79.0	66.6	63.0	57.9	48.5
Karnataka	22.2	15.1	25.7	19.8	26.7	28.2	30.1	24.0
Tamil Nadu	0.4	2.0	0.1	0.4	2.7	3.6	5.4	10.9
Kerala	0.1	1.3	0.2	0.0	1.2	2.2	1.8	3.2
Goa	3.3	0.7	0.1	0.8	1.3	0.6	0.2	0.6
Gujarat	0.4	0.7	0.3	0.0	1.1	1.7	4.1	8.5
Rajasthan	0.1	0.0	0.0	0.0	0.0	0.2	0.1	1.5
Rest of India	0.3	4.0	0.1	0.0	0.4	0.5	0.4	2.7
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Combined (Avg. TP01 & TP02)								
Madhya Pradesh	80.3	81.1	80.7	83.5	69.6	67.3	60.5	51.0
Maharashtra	14.6	11.5	17.3	15.1	22.0	23.3	25.5	22.9
Delhi	0.5	1.6	0.4	0.3	3.9	3.6	6.3	10.1
Uttar Pradesh	0.2	1.6	0.3	0.0	1.3	1.9	1.8	3.1
Haryana	3.5	1.7	0.5	1.2	1.5	1.4	0.5	0.7
Rajasthan	0.4	0.4	0.4	0.0	1.3	1.9	4.4	8.8
Karnataka	0.1	0.0	0.0	0.0	0.1	0.2	0.2	1.3
Rest of India	0.3	2.2	0.4	0.0	0.3	0.5	0.9	2.1
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 2-7: Regional Distribution of Tollable Traffic (in %) On Project Road

Passenger traffic:

- Car traffic at both the toll plaza locations is majorly from Maharashtra (86.9 percent at TP01 and 73.2 percent at TP02) followed by Karnataka (7.8 percent at TP01 and 22.2 percent at TP02).
- In case of Bus traffic, Maharashtra contributes about 88.8 percent and 73.4 percent at TP01 and TP02 respectively.

Freight Traffic

- Around 90.1 percent of MLCV at TP01 and 79.0 percent of MLCV at TP02 is from Maharashtra followed by Karnataka accounting for around 8.2 percent at TP01 and 19.8 at TP02 respectively.
- In case of MAVs, Maharashtra accounts for about 53.7 percent at TP01 and about 48.5 percent at TP02. Also, Karnataka contributes around 21.6 percent at TP01 and

24.0 percent at TP02, followed by Tamil Nadu accounting to about 9.3 percent and 10.9 percent at TP01 and TP02 respectively.

- The MAV traffic is observed to be having Mumbai-Bengaluru as top OD pair at both the toll plazas.

The mode wise top 20 OD pairs are given in **Appendix 2.3**.

2.5.5 Travel Pattern

In order to assess the travel pattern of vehicles, the important streams of traffic plying on the project road are estimated. The list of the popular movements found at the toll plaza locations is presented in **Table 2-8**.

Sr. No.	Traffic Streams	Car	Minibus	Bus	MLCV	LCV	2A	3A	MAV
TP01- Kognoli Toll Plaza									
1	Kagal/Kolhapur/Sangli & surroundings-Belgaum & surroundings	16.0	22.6	27.2	19.6	10.6	7.9	7.3	6.0
2	Kagal/Kolhapur/Sangli & surroundings-Hubli/Dharward & surroundings	1.0	0.0	1.3	4.1	1.4	1.2	0.4	0.7
3	Kagal/Kolhapur/Sangli & surroundings-Goa & surroundings	5.0	0.0	0.3	2.5	1.3	1.5	0.4	0.5
4	Kagal/Kolhapur/Sangli & surroundings-Bangalore & surroundings	1.5	2.0	2.6	3.5	4.3	4.6	5.4	5.9
5	Kagal/Kolhapur/Sangli & surroundings-Beyond Bangalore	0.7	0.0	0.9	0.0	2.0	2.3	1.5	1.0
6	Mumbai/Pune/Nasik & surroundings-Belgaum & surroundings	6.9	16.8	10.2	8.5	17.0	24.0	15.4	10.1
7	Mumbai/Pune/Nasik & surroundings-Hubli/Dharward & surroundings	0.7	0.0	0.0	0.9	3.3	1.3	2.8	2.6
8	Mumbai/Pune/Nasik & surroundings-Goa & surroundings	2.0	5.9	1.1	0.6	1.5	1.8	0.9	0.5
9	Mumbai/Pune& surroundings-Bangalore & beyond	4.0	11.8	8.1	4.3	28.8	26.9	35.8	37.1
10	Gujarat/Rajasthan & beyond-Belgaum & surroundings	0.6	0.0	1.2	0.0	1.7	1.3	3.2	3.7
11	Gujarat/Rajasthan & beyond-Hubli/Dharward & surroundings	0.0	0.0	0.0	0.0	0.2	0.3	0.4	0.6
12	Gujarat/Rajasthan & beyond-Goa & surroundings	0.5	0.0	0.3	0.0	0.0	0.0	0.2	0.4
13	Gujarat/Rajasthan & beyond-Bangalore & beyond	0.4	0.0	0.3	0.0	1.4	2.0	6.9	17.2
14	Nagpur/Hyderabad & Surroundings-Belgaum & beyond	1.0	0.0	3.9	2.1	3.8	5.3	4.8	2.2
15	Kagal/Kolhapur/Sangli & beyond-Zones between TP01 & TP02	59.7	40.9	42.5	53.7	22.5	19.6	14.6	11.4
Total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
TP02- Hattargi Toll Plaza									
1	Kagal/Kolhapur/Sangli & surroundings-Belgaum & surroundings	19.5	10.1	25.0	14.2	12.8	6.5	6.9	6.0
2	Kagal/Kolhapur/Sangli & surroundings-Hubli/Dharward & surroundings	1.4	2.7	2.2	1.9	2.6	2.7	2.0	0.9
3	Kagal/Kolhapur/Sangli & surroundings-Goa & surroundings	4.2	0.0	0.0	0.2	0.3	0.2	0.0	0.1
4	Kagal/Kolhapur/Sangli & surroundings-Bangalore & surroundings	2.1	0.0	3.0	2.2	4.4	5.1	3.9	3.3
5	Kagal/Kolhapur/Sangli & surroundings-Beyond Bangalore	0.4	1.3	0.2	0.0	1.9	2.5	2.3	2.4
6	Mumbai/Pune/Nasik & surroundings-Belgaum & surroundings	6.8	5.7	9.6	8.5	11.8	22.5	12.9	10.2

Sr. No.	Traffic Streams	Car	Minibus	Bus	MLCV	LCV	2A	3A	MAV
7	Mumbai/Pune/Nasik & surroundings-Hubli/Dharward & surroundings	1.3	2.7	3.0	3.0	3.9	3.4	3.9	3.2
8	Mumbai/Pune/Nasik & surroundings-Goa & surroundings	1.3	0.0	0.0	0.1	1.3	0.8	0.2	0.7
9	Mumbai/Pune& surroundings-Bangalore & beyond	2.9	4.0	2.9	1.0	28.5	22.2	33.6	36.9
10	Gujarat/Rajasthan & beyond-Belgaum & surroundings	0.3	1.3	0.4	0.0	1.3	0.8	2.4	4.0
11	Gujarat/Rajasthan & beyond-Hubli/Dharward & surroundings	0.2	2.7	0.0	0.0	0.1	0.3	0.5	0.5
12	Gujarat/Rajasthan & beyond-Goa & surroundings	0.1	0.0	0.0	0.0	0.4	0.3	0.0	0.4
13	Gujarat/Rajasthan & beyond-Bangalore & beyond	0.9	5.3	0.4	0.0	0.3	2.9	5.9	19.9
14	Nagpur/Hyderabad & Surroundings-Belgaum & beyond	1.9	0.0	10.1	0.1	0.4	0.9	0.4	0.6
15	Zones between TP01 & TP02-Belgaum & beyond	56.8	64.2	43.1	68.6	29.8	28.9	25.2	10.9
Total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 2-8: Traffic Streams (%) at TP01 & TP02

Passenger Traffic:

- The car traffic originating from Kagal/Kolhapur/Sangli & surroundings to Belgaum & surroundings is about 16-20 percent (about 1800 vehicles) at TP01 & TP02 (stream 1). It may be noted that majority of car trips were found to be for the purpose of work and business which accounts for about 82-84 percent, followed by social/shopping trips accounting for about 5-7 percent at both the toll plazas.
- About 25-28 percent of Bus traffic at TP01 & TP02 were found to be travelling from/to Kagal/Kolhapur/Sangli & surroundings to/from Belgaum & surroundings (stream 1).
- The local car and bus traffic at TP01 is about 42-60 percent travelling between Kagal/Kolhapur/Sangli & beyond to zones between TP01 & TP02 (stream 15).
- The local car and bus traffic at TP02 is about 43-57 percent travelling between Zones between TP01 & TP02 to Belgaum & beyond (stream 15).

Freight Traffic:

- Around 28 percent (about 400 vehicles) of LCV each at TP01 & TP02 were found to be plying between Mumbai/Pune & surroundings and Bangalore & beyond (stream 9).
- In case of 2A, about 33-36 percent (about 450 vehicles) at both the toll plazas were found to be traveling between Mumbai/Pune & surroundings and Bangalore & beyond (stream 9).
- In case of MAV, around 17-19 percent (about 350 vehicles) at both the toll plazas were found to be plying from/to Gujarat/Rajasthan & beyond to/ from Bangalore & beyond (stream 13).
- The MAV traffic originating from/to Mumbai/Pune & surroundings to/from Bangalore & beyond is about 37 percent (about 700 vehicles) each at TP01 & TP02 (stream 9).

2.5.6 Commodity Distribution

Analysis was also carried out to understand the different commercial vehicles being used to transport different commodities. The commodity distribution for project corridor is presented in **Figure 2-4**.

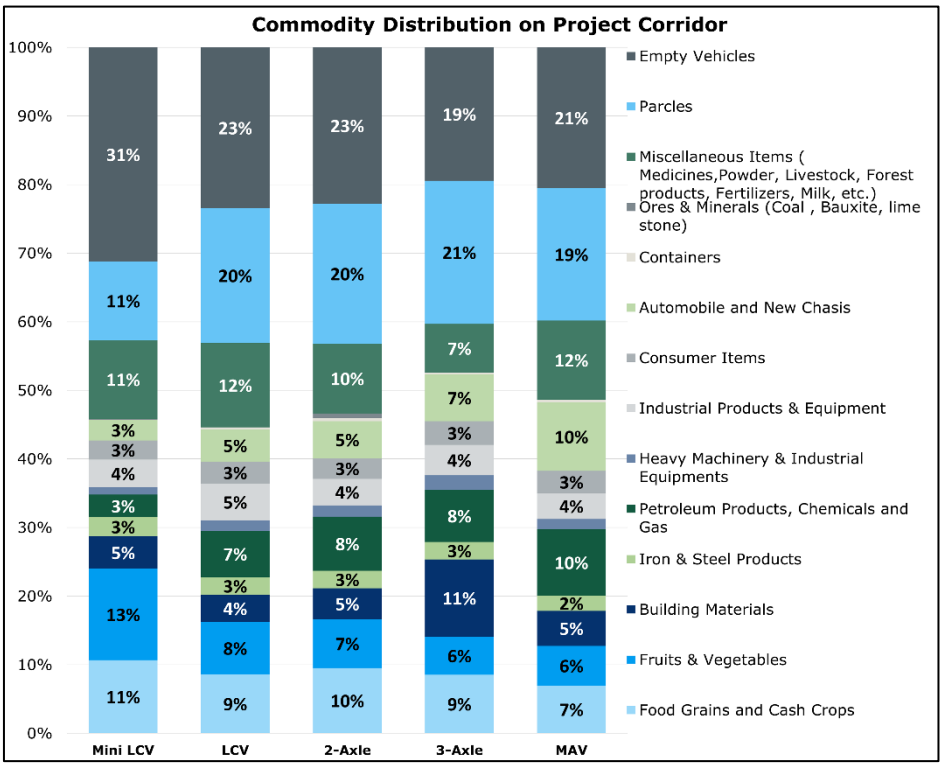


Figure 2-4: Commodity Distribution for Project Corridor

- Major commodities being transported across both the toll plazas are fruits and vegetables, food grains, consumer items, industrial products and equipment's, petroleum/gas products, parcels etc.
- About 8 percent of 3A and 10 percent of MAV are found to be transporting petroleum products and chemicals along the entire project corridor.
- Also, around 19-21 percent of 3A/MAV are found to be transporting parcels along the entire project corridor.
- Around 11-20 percent of MLCVs and LCVs are transporting miscellaneous items along the entire project corridor.

Table 2-9 presents the commodity-wise share of the total commercial traffic at each of the toll plaza on the project road.

Commodity Type	MLCV	LCV	2 Axle	3 Axle	MAV
TP01-Kognoli Toll Plaza					
Food Grains and Cash Crops	10.0	9.1	10.0	8.4	7.8
Fruits & Vegetables	9.4	4.6	6.7	4.3	5.1
Building Materials	3.6	3.3	4.3	4.3	5.3
Iron & Steel Products	4.2	3.6	3.8	3.6	2.7
Petroleum Products, Chemicals and Gas	6.3	5.8	7.1	7.3	7.5
Heavy Machinery & Industrial Equipment	0.0	0.3	0.7	0.2	0.4
Industrial Products & Equipment	3.9	6.1	3.1	4.5	2.7
Consumer Items	5.1	4.5	3.8	3.9	4.8
Automobile and New Chassis	5.1	4.6	4.0	4.7	6.2
Containers	0.0	0.3	0.2	0.0	0.4
Ores & Minerals (Coal, Bauxite, limestone)	0.0	0.0	0.0	0.0	0.0
Miscellaneous Items (Medicines, Powder, Livestock, Forest products, Fertilizers, Milk, etc.)	14.5	12.5	8.6	11.4	10.3
Parcels	12.4	22.6	22.6	26.4	21.5
Empty Vehicles	25.4	22.6	25.0	21.1	25.2
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
TP02-Hattargi Toll Plaza					
Food Grains and Cash Crops	11.2	8.1	9.1	8.7	6.1
Fruits & Vegetables	16.4	10.3	7.5	6.7	6.5
Building Materials	5.6	4.5	4.8	17.8	4.9
Iron & Steel Products	1.6	1.7	1.4	1.6	1.6
Petroleum Products, Chemicals and Gas	0.9	7.6	8.5	8.0	12.0
Heavy Machinery & Industrial Equipment	1.9	2.6	2.5	3.9	2.7
Industrial Products & Equipment	4.2	4.8	4.6	4.4	4.9
Consumer Items	0.9	2.1	2.3	3.0	1.6
Automobile and New Chassis	1.4	4.8	6.6	8.8	14.1
Containers	0.0	0.3	0.6	0.5	0.4
Ores & Minerals (Coal, Bauxite, limestone)	0.2	0.0	1.2	0.0	0.0
Miscellaneous Items (Medicines, Powder, Livestock, Forest products, Fertilizers, Milk, etc.)	9.1	12.2	11.6	3.0	12.9
Parcels	10.7	17.0	18.4	15.7	16.9
Empty Vehicles	35.7	24.2	20.9	17.8	15.5
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 2-9: Commodity Distribution on Project Road

- About 9-17 percent of MLCV at TP01 and TP02, were found to be transporting fruits and vegetables.
- Around 9-10 percent of 2A and 8-9 percent of 3A trucks at TP01 and TP02 were found to be transporting food grains and cash crops.

- Around 7-8 percent of 3A trucks and 7-12 percent of MAVs and at TP01 and TP02 were found to be carrying petroleum/gas products and chemicals. The higher share of petroleum/gas products can be attributed to the presence of IOCL LPG bottling plant at Kanagala present along the project corridor as well as HPCL and BPCL bottling plants present at Belur industrial area near Dharwad.
- Around 12 percent each of LCV at TP01 and TP02 were found to be transporting miscellaneous items (majorly milk). It may be noted that the major commodity observed was milk tankers which was transported from KMF (Karnataka Milk Federation) unit at Belgaum as well as Gokul milk processing unit present at Gokul Shirgaon MIDC near Kolhapur. These tankers return empty after dropping off milk to the distribution centres.
- About 17-22 percent of MAVs & 15-27 percent of 3A trucks across both the toll plazas were found be to be laden with parcels carrying ecommerce goods and couriers. These parcels are significantly high due to the influence of major metropolitan cities like Mumbai, Bangalore, Pune and Chennai.

3. TRAFFIC GROWTH RATE AND PROJECTIONS

3.1 General

The project road is a part of the NHAI InvIT portfolio and the projections of traffic and revenue have been presented till FY52. The estimation of the traffic using the tolled highway and its future growth are important elements to assess the project's economics as these are generally the main/sole source of revenue for the project This chapter details various aspects of the current traffic of the project road and its growth potential as assessed by Ramboll.

3.2 Project Road Traffic

The traffic that is likely to use the project road was estimated on the basis of the traffic and travel characteristics gathered as part of the study. The traffic on the project road would normally consist of the following components:

- Normal Traffic
- Diverted Traffic
- Induced/Developmental Traffic

3.2.1 Normal Traffic

Normal traffic is the traffic which is already plying on the project road as assessed in section 2.4.4.

3.2.2 Diverted Traffic

Diverted traffic is generally dictated by the presence of an alternative route at a lower generalised cost, which is in-turn defined by the road configuration and its condition, the type of vehicle and its operating costs, the average riding speed, the route distance and any tolling that may apply on a specific route. A detailed road network assessment along with site reconnaissance survey was conducted on the project road and vicinity to identify alternate routes. In case of the project road, the tolling has been at place since 2014, the travel pattern is well established. No alternate route has been found from/to where the traffic may divert.

Diverted traffic is generally dictated by the presence of an alternative route at a lower generalised cost, which is in-turn defined by the road configuration and its condition, the type of vehicle and its operating costs, the average riding speed, the route distance and any tolling that may apply on a specific route.

The assessment of any likely traffic addition to/diversion away from the Project Road (PR) has been done using the cost ratio analysis as described below:

- Assessment of the potential divertible traffic sensitive to network improvements based on the observed travel pattern

- Calculation of road user cost of travelling on the project road and the alternative route. The road user cost includes vehicle operating cost (VOC), travel time cost (TTC) and toll cost (TC), if any. VOC comprises of the cost of fuel, spare parts, maintenance labour, tyre, engine oil, grease, fixed cost, depreciation and crew wages.
- The toll rates for Pune-Bangalore expressway are considered as 1.5 times the normal NHAI per km toll rates (accounting for 1.25 times for normal length of expressway and increase for the likely equivalent structure length).
- Analysis has been done only for larger axle trucks as these vehicles travel long lead and are potential to shift to Pune-Bangalore expressway.

The road user cost is estimated based on vehicle operating cost equations presented in IRC SP-30,2019 which is based on updation of Road User Cost Study (RUCS) carried out by Central Road Research Institute in 2019 for Ministry of Road Transport and Highways. Using the likely traffic stream speeds and lane configuration, the vehicle operating, and travel time costs are estimated for each of the routes. Road user cost on the identified routes is calculated and diversion percentages are estimated using diversion curve method mainly for trucks. In this method, traffic likely to be diverted from/to the project road, was estimated using Logit model, which computes expected diversion percentage based on the ratio of perceived cost on the existing and proposed facilities. The perceived cost is the financial vehicle operating cost and the time saving cost including toll charges (if any). According to the model, a vehicle will shift if the perceived cost on an alternative route is lower in comparison to existing route. The diversion equations for estimating diversion have been adopted from Indian National Expressway Network Report, MORTH (2009) as mentioned in IRC 108:2015. These equations are presented in **Table 3-1**.

Vehicle	Cost Ratio (CR) Interval	Equations
Truck	<= 0.750	% Div. = 100 - ((CR/0.75) * 5)
	0.750 <= CR <= 1.250	% Div. = 95 - ((CR-0.75)/0.5) * 90
	1.250 <= CR <= 2.0	% Div. = ((2-CR)/0.75) * 5

Source: IRC 108-2015

Table 3-1: Diversion Equations Used for Analysis

However, there is one major development i.e., Pune - Bangalore Expressway that could impact the project road traffic.

Impact of Pune – Bangalore Expressway

Pune – Bangalore Expressway is a proposed 8 lane access-controlled highway connecting Pune, Maharashtra and Bengaluru, Karnataka via Satara, Sangli, Belgavi (Belgaum), Dharwad, Hubli, Devanagere and Tumakuru with a length of 700 km as against the existing distance via NH-48 (Old NH-4) of around 836 km. The new expressway will provide an alternative route to the traffic between Pune and Bangalore. The expressway is proposed to counter the issue of submergence of the existing NH-48 (Old NH-4) during

monsoon and hence remove the issue of traffic bottlenecks in those areas. Presently, DPR for the project is being prepared and the exact alignment details are not yet known. The project roads and the tentative alignment of the expressway is presented in **Figure 3-1**.

Figure 3-1: Project Road and Tentative Pune - Bangalore Alignment

In the absence of the same, the potential divertible traffic is the traffic plying between Pune and beyond to Bangalore and beyond which has been estimated from the OD survey conducted during the present study. Since the expressway is likely to be shorter by 136 km, the project road may lose 100 percent of the potential divertible traffic. The estimated loss of project road traffic due to the proposed expressway is presented in **Table 3-2**.

Toll Plaza	Car	2A	3A	MAV
TP01	2.92%	27.78%	37.69%	38.68%
TP02	3.02%	21.50%	32.07%	35.52%

Table 3-2: Potential Divertible traffic to the Expressway

The proposed expressway may take away about 28-39 percent of the freight traffic from TP01 and about 22-36 percent from TP02. The proposed expressway will be a greenfield alignment and considering the usual timelines for a long greenfield expressway project, the diversion impact is considered from FY30 onwards. Owing to the gradual shift of traffic away from the project road, the traffic impacts have been assumed to take place in phases with about 50 percent in FY30, 75 percent in FY31 and 100 percent from FY32 onwards.

3.2.3 Induced/ Development Traffic

Developmental /new generated traffic is the one which would be generated, over and above normal growth, because of lowering of transport costs or new developments in the immediate influence area of the project road. In case of the project road, there is no development envisaged in the vicinity of the project road.

Bharatmala Pariyojana is the second largest highways construction project in the country since NHDP, under which almost 50,000 km or highway roads were targeted across the country. It will look to improve connectivity particularly on economic corridors, border areas and far-flung areas with an aim of quicker movement of cargo and boosting exports.

It will connect 550 district headquarters to minimum 4-lane highway by raising the number of corridors to 50 (from current 6) and move 80 percent freight traffic (currently 40 percent) to national highways by connecting 24 logistics parks and 7 north east multimodal waterway ports.

The Phase-I includes economic corridors of around 9,000 km; inter-corridor and feeder routes of around 6,000 km; 5,000 km roads under the National Corridors Efficiency Program, border and international connectivity roads of around 2,000 km; coastal and port connectivity roads of around 2,000 km; expressways of around 800 km and 10,000 km of NHDP roads. The total length in phase 1 comes to around 34,800 km.

In the context of the project influence area, there are a few economic corridors and inter corridors listed in the Maharashtra and Karnataka plan. The economic corridors are planned from Pune-Vijayawada, Mumbai-Kolkata and Solapur-Bellary-Gooty and are likely to improve connectivity with an aim to provide quicker movement of cargo.

The project road is a connecting link between large cities/ industrial hubs of Pune and Mumbai on the north and Bengaluru and Chennai on the south. As the project road is part of the golden quadrilateral highway network and caters to the long-distance traffic movement, it is likely to remain an important highway for the north-south movement and may see sustained growth in the future.

3.3 Methodology for Traffic Growth Rate Estimation

Traffic growth for both passenger and freight vehicles has been estimated using the econometric approach as described in IRC-108, 2015. For freight traffic, due consideration has been given to the total tonnage transported and the shift in types of vehicles used for moving goods.

The econometric model applied, relates traffic growth to changes in state (or district) domestic product via an elasticity factor. According to IRC guidelines, elasticity based econometric model for highway projects should be derived in the following form:

$Log_e(P) = A0 + A1\ Log_e\ (EI)$, where:

P - Traffic Volume

EI - Economic Indicator

A0 - Regression Constant

A1 - Regression Co-efficient (Elasticity Index)

In order to estimate traffic on the project road, the methodology described below has been followed:

- Identify the influence area - From the analysis of OD survey data, the project influencing states and districts, which are likely to impact the traffic growth on the project road, were identified.
- Review Past traffic Data – Based on toll data available for the project, a review of past traffic and tonnage growth is carried out.
- Analysis of economic growth of the Project Influencing Area (PIA) - For each PIA state, an economic profile describing past performance and future outlook was prepared. This also considers India's past economic performance and its future outlook.
- Estimation of traffic elasticity to income – in order to translate economic growth into traffic growth, an elasticity factor was estimated.
- Derivation of traffic growth rates – On the basis of the weighted (based on OD shares) PIA outlook and related traffic elasticity, traffic growth rates were estimated.

The methodology thus adopted incorporates, as basic data inputs, the perspective growth envisaged in the influence area and the changes in transport demand elasticities over a period of time. The traffic growth rates by vehicle type for the project road have been determined till FY52.

3.4 Identification of PIA States

The regional distribution observed on the project road shows that Maharashtra and Karnataka are the main contributors of traffic on the project road in case of passenger vehicles. In case of freight traffic, states of Tamil Nadu, Kerala and Gujarat also

contribute to the project road traffic in addition to the states of Maharashtra and Karnataka.

The states of Maharashtra and Karnataka have, therefore, been considered as the PIA states for passenger traffic and in addition to these two PIA states, Tamil Nadu, Kerala and Gujarat have been considered as PIA states for freight traffic. The mode wise normalized regional distribution shares are presented in **Figure 3-2**.

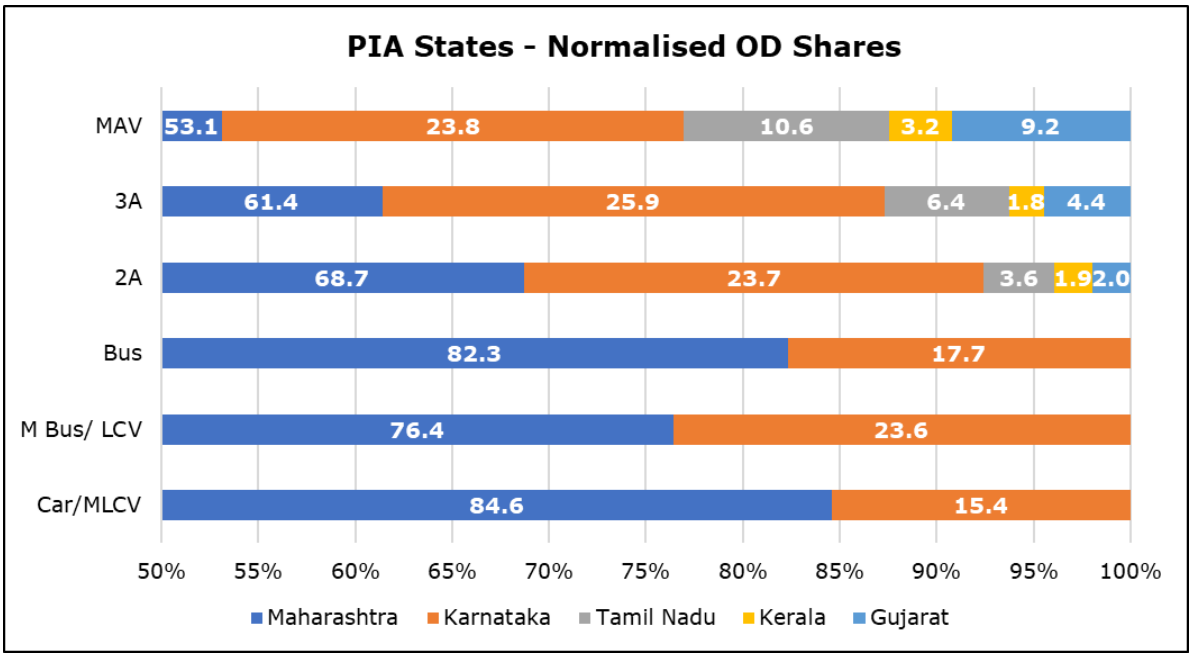


Figure 3-2: Normalised Regional Distribution (%) for the PR

The state of Maharashtra is the predominant contributor on the project road in all vehicular modes with more than 50 percent traffic.

Maharashtra has a share of 84.6 percent in cars and 82.3 percent in buses and the state of Karnataka contributes around 15.4 percent in cars and 17.7 percent in buses.

In case of freight vehicles, Maharashtra contributes the highest around 53-69 percent in 2A & 3A Trucks and MAVs signifying the long-distance traffic on the project road and for Minibus/LCVs, Maharashtra has a share of 76.4 percent.

Karnataka has a share of around 24-26 percent followed by 3-10 percent from Tamil Nadu in higher category of trucks. Also, Karnataka contributes about 23.6 percent in Minibus/LCVs. Around 9.2 percent of MAVs and 2-4 percent of 2A and 3A trucks are being contributed by the state of Gujarat. The state of Kerala contributes around 2-3 percent in 2A, 3A and MAV trucks.

3.5 Past Economic Growth of PIA

Growth of traffic on the project road depends on existing development and future growth prospects of the connecting regions. A number of economic indicators for the PIA states, as published by Central Statistical Organisation (2011-12 prices), have been studied to assess their past performance.

Maharashtra

- Maharashtra's Gross State Domestic Product (GSDP) stood at Rs 20,439.8 billion in 2019-20 and has been growing at a compounded annual growth rate of 6.3 per cent since 2011-12. The GSDP estimates for the year FY21 is Rs 18,893.1 billion.
- The state's growth had been between 6-7 per cent since 2012-16 and picked up to 9.2 percent in 2016-17. It has shown a growth of around 4.5 percent in FY19 and 3.6 percent in FY20.
- The services sector is the largest contributor to GSDP (57.6 percent), agriculture allied activities sector at 13.9 percent, secondary sector at 28.5 per cent of the GSDP in 2019-20.

The change of sectoral composition of GSDP over the years is presented in **Figure 3-3**.

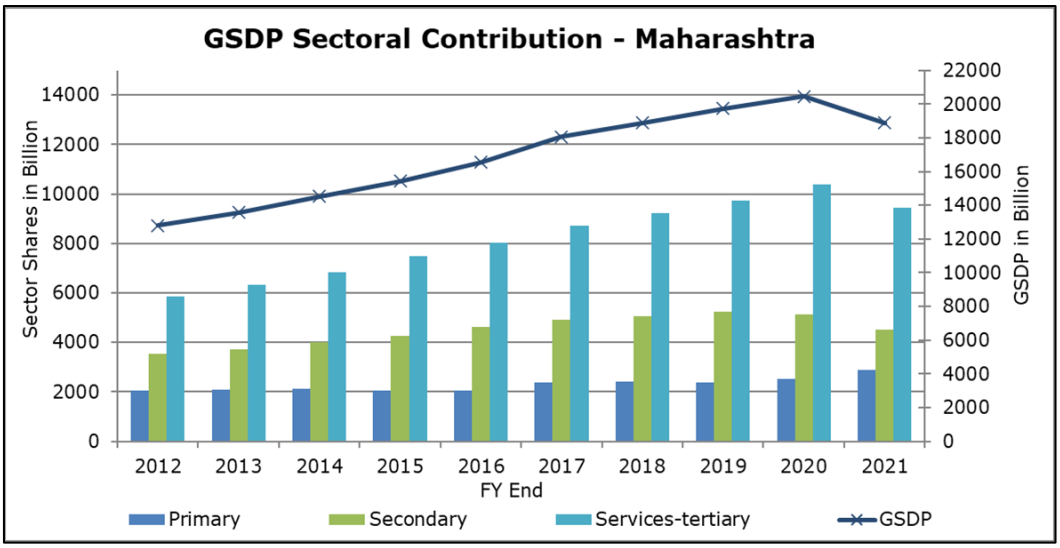


Figure 3-3: GSDP (in Rs billion) and its Sectoral Composition for Maharashtra

The performance of the state economy and its different sectors has been studied using time trend analysis. The average annual growth rates as obtained using regression analysis are presented in **Table 3-3**.

Particulars	2011-12 to 2019-20	2014-15 to 2019-20
GSDP	6.3	5.8
Primary	2.7	4.4
Secondary	5.4	4.0
Tertiary	7.5	6.8
Construction	3.1	2.4
Per Capita Income	5.2	4.8

Table 3-3 : Average Annual Growth Rates (%) of State Income for Maharashtra

Maharashtra is a predominant exporter of pearls, precious and semi-precious stones, gold, drug formulations and biologicals, ships, motor vehicles, cars, boats and structures and iron and steel.

Currently, the state has 37 operating Special Economic Zones (SEZs). Also, 12 SEZs with valid in-principle approvals, 51 more have been formally approved and 45 have been notified. These SEZs are dispersed over a manifold range of sectors including textiles &

apparel, food processing, footwear & leather products, multi-product, pharma, IT SEZs, etc.

According to by Department for Promotion of Industry and Internal Trade (DPIIT), the state has enticed the Foreign Direct Investment (FDI) equity inflows worth US$ 177.75 billion during the period FY01 to FY23 (until June 2022).

The dedicated freight corridor, the Delhi-Mumbai Industrial Corridor (DMIC), passes through and finally terminates in the state. Aurangabad Industrial City (AURIC), (10,000 acre), a Greenfield smart Industrial City located in one of the prominent project influence areas of the corridor, in the state, is expected to develop to facilitate investments in an aim to provide conducive business environment.

Also, in order to attract high investments and catalyze growth, the state has facilitated the investments in developing world-class road infrastructure. Mumbai -Pune Expressway is a 94.5 km expressway that has been constructed to connect the financial hub and state capital Mumbai with Pune thereby facilitating the seamless connectivity across the two influential cities.

Maharashtra is the most industrialised state in India and has maintained the leading position in the industrial sector in the country. The state is a pioneer in small scale industries and boasts of the largest number of special export promotion zones. Maharashtra has emerged as a key hub for IT and ITeS, electronics and captive business outsourcing industries. Maharashtra's infrastructure sector has grown significantly over the last decade, with a substantial rise in the number of industrial clusters and Public Private Partnership (PPP) projects.

The per capita income of Maharashtra is Rs 1,66,422 in the year 2019-20 and has been growing at 5.2 percent during 2011-12 to 2019-20. The growth in per capita income is presented in **Figure 3-4**.

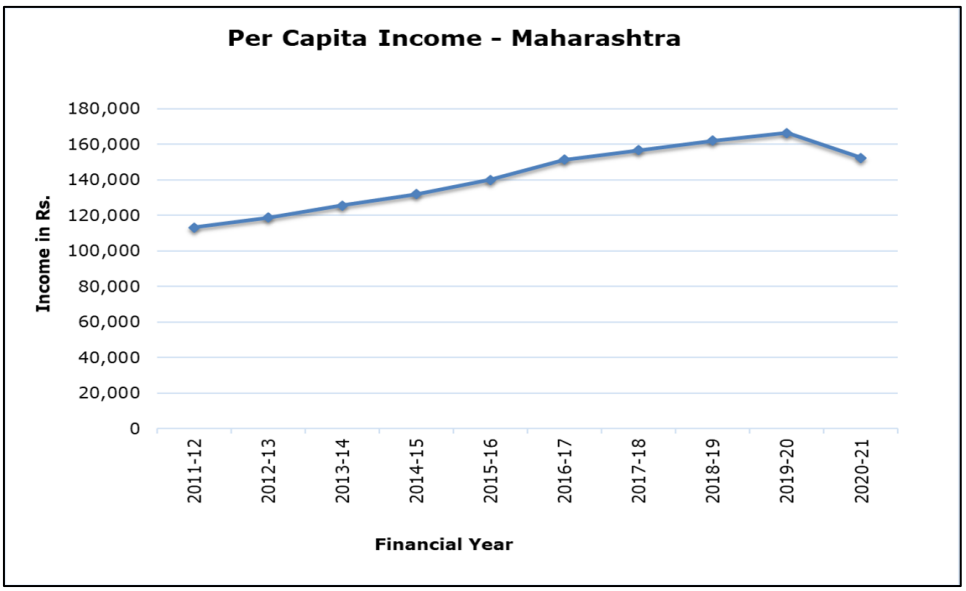


Figure 3-4: Per Capita Income of Maharashtra

Other PIA States

The other PIA states contributing to the traffic on the project road are Karnataka, Tamil Nadu, Kerala, and Gujarat.

- Karnataka's Gross State Domestic Product (GSDP) stood at Rs 11,498.3 billion in FY20 and has been growing at a compounded annual growth rate of 8.8 percent since FY12. The GSDP estimates for the year FY22 is Rs 12,522.3 billion. The state has shown a 9.5 percent growth in FY22 which could be due to the low base in FY21.
- Gross State Domestic Product (GSDP) of Tamil Nadu stood at Rs 12,438.3 billion in 2019-20 and has been growing at a compounded annual growth rate of 6.9 percent since 2011-12. The GSDP estimates for the year FY22 is Rs 13,451.1 billion. The growth in the recent year of FY22 is 8.0 percent.
- The State of Kerala's Gross State Domestic Product (GSDP) stood at Rs 5,665.2 billion in FY20 and has been growing at a compounded annual growth rate of 6.0 percent since FY12. The GSDP estimates for the year FY22 is Rs 5,509.2 billion. The growth in the recent year of FY22 is 7.1 percent.
- Gross State Domestic Product (GSDP) of Gujarat stood at Rs 12,652.8 billion in 2019-20 and has been growing at a compounded annual growth rate of 9.6 percent since 2011-12.
- The secondary sector is the largest contributor to GSDP (46.3 percent) in the PIA state of Gujarat and the services sector is the largest contributor to GSDP of in the remaining PIA states, 65.1 percent in Karnataka, 51.6 percent in Tamil Nadu and 65.3 percent in Kerala.

The average annual growth rates as obtained using regression analysis for the period FY12 to FY20 are presented in **Table 3-4**.

Particular/States	Karnataka	Tamil Nadu	Kerala	Gujarat
2011-12 to 2019-20				
GSDP	8.8	6.9	6.0	9.6
Primary	3.1	5.5	-2.0	6.5
Secondary	7.1	6.9	5.2	10.9
Tertiary	9.9	6.5	6.4	8.6
Construction	3.1	4.5	3.3	3.7
Per Capita Income	7.8	6.2	5.5	8.2

Table 3-4: Average Annual Growth Rates (%) of State Income for Other PIA States

The GSDP over the years for the PIA states of Maharashtra, Karnataka, Tamil Nadu, Kerala and Gujarat are presented in **Figure 3-5**.

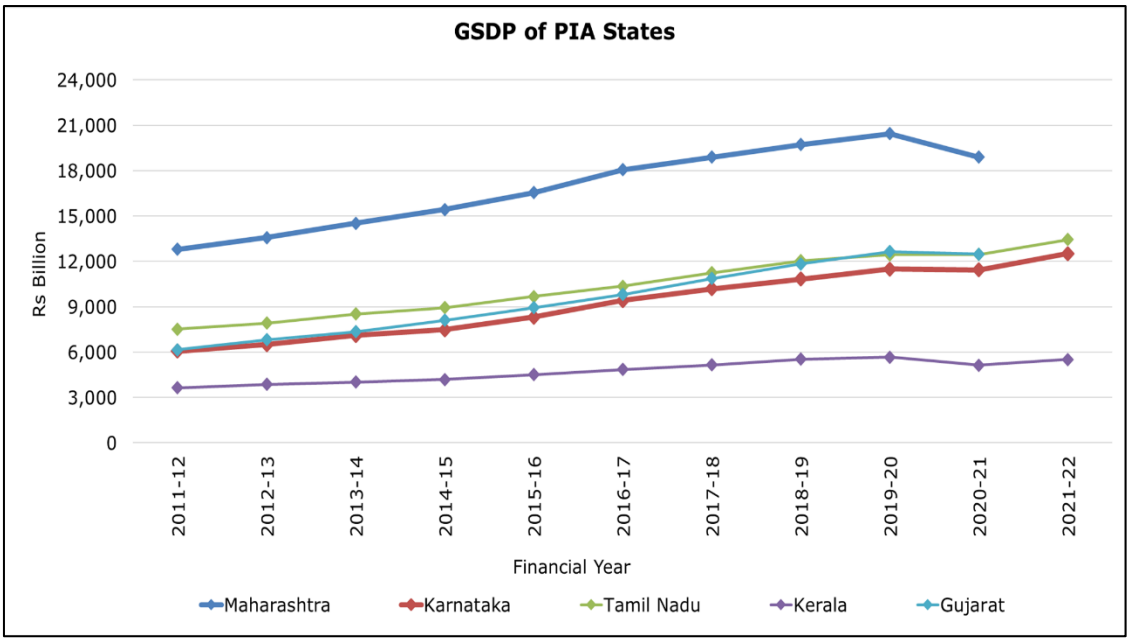


Figure 3-5: GSDP (in Rs billion) for PIA States

3.6 India and PIA Outlook

3.6.1 India's past performance and outlook for future

India's growth trend during the recent years has been presented in **Figure 3-6**.

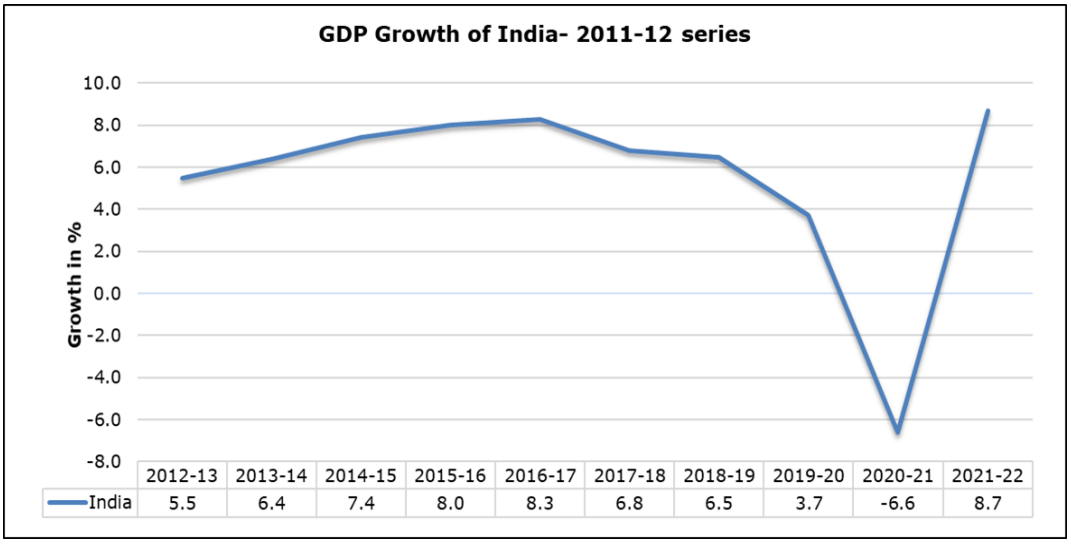


Figure 3-6: GDP Growth in India

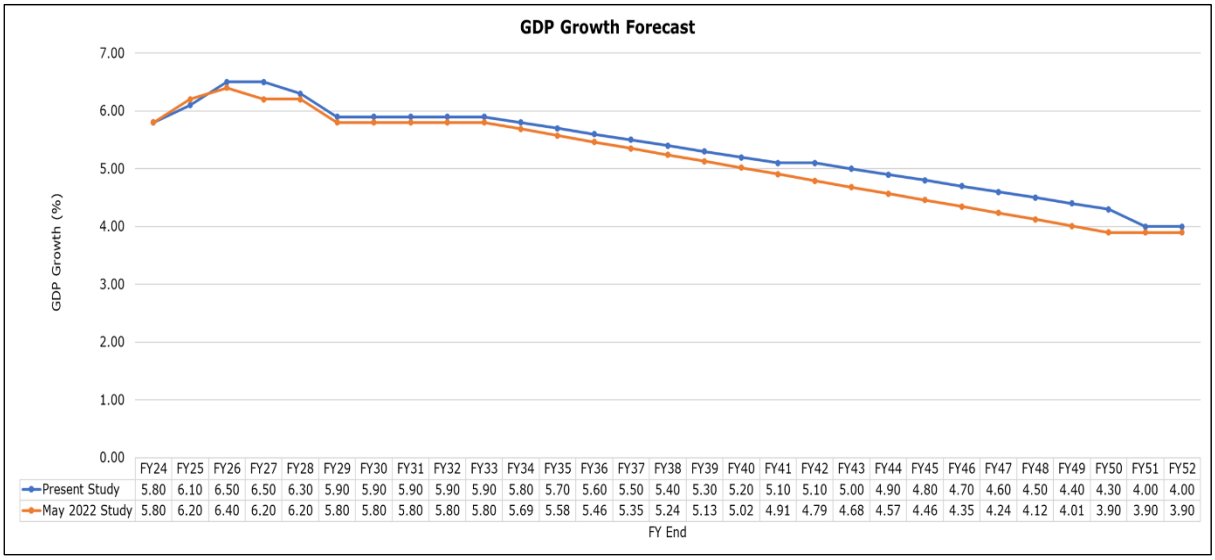
Economic growth in India has been broadly on an accelerating path till FY18. It is likely to be the fastest growing major economy in the world in the medium-term. The growth in real GDP was 8.3 percent for FY17 and 6.8 percent in FY18, while the growth in FY19 was slightly lower at 6.5 percent. The long-term trend line growth of 7.2 percent has been achieved between FY12 to FY19. During FY20, growth has slowed down due to some structural issues and global headwinds resulting in an average GDP growth rate of 3.7 percent.

With the outbreak of COVID-19, global recession was witnessed across all the economies. The lockdown period announced by Indian government had an adverse impact on the economy. The first quarter estimated for FY21 has indicated a contraction of 23.9

percent, second quarter showed a rebound in growth by contracting 7.5 percent and third & fourth quarter grew by 0.5 percent and 1.6 percent respectively. The resultant contraction for FY21 has been 6.6 percent.

The Indian economy is likely to see the impact of global slowdown due to COVID-19 and hence, the GDP forecast for India by various international agencies has been revised for the next two years. As per the latest update by Central Statistical Organisation (CSO), GDP in FY22 has grown by 8.7 percent. As per Economic Survey of India for FY23, the economy is predicted to have a growth rate of 7.0 percent in FY23 and 6.0-6.8 percent in FY24. As per the latest forecast of RBI, the economy is likely to grow at 6.4 percent in FY24.

The year-on-year growth for Indian economy as provided by the client based on the forecast by Consensus Economics from FY24 and beyond in May 2022 study and present study are presented in **Figure 3-7**.



	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40	FY41	FY42	FY43	FY44	FY45	FY46	FY47	FY48	FY49	FY50	FY51	FY52
Present Study	5.80	6.10	6.50	6.50	6.30	5.90	5.90	5.90	5.90	5.90	5.80	5.70	5.60	5.50	5.40	5.30	5.20	5.10	5.10	5.00	4.90	4.80	4.70	4.60	4.50	4.40	4.30	4.00	4.00
May 2022 Study	5.80	6.20	6.40	6.20	6.20	5.80	5.80	5.80	5.80	5.80	5.69	5.58	5.46	5.35	5.24	5.13	5.02	4.91	4.79	4.68	4.57	4.46	4.35	4.24	4.12	4.01	3.90	3.90	3.90

Figure 3-7: GDP Forecast of India

3.6.2 PIA States Outlook

A snapshot of the main economic indicators in the past for the PIA states is presented in **Table 3-5**.

Indicators	Maharashtra	Karnataka	Tamil Nadu	Kerala	Gujarat
GSDP in Rs Billion	20,439.8	11,498.3	12,438.4	5,665.2	12,652.8
GSDP growth (FY12 to FY20) in %	6.3	8.8	6.9	6.0	9.6
Per capita Income in Rs (FY20)	166,422	173,942	163,874	162,610	186,980
Sector Share in %, FY20					
Agriculture and allied	13.9	10.6	11.8	8.8	17.2
Industry	28.5	24.2	36.5	25.9	46.3
Services	57.6	65.1	51.6	65.3	36.4

Table 3-5: Main Economic Indicators of PIA States

In order to arrive at the forecast of the PIA states, past performance of the State GDPs vis-a-vis India GDP has been studied and the multipliers have been derived for both short term and long term. The past and adopted multipliers for PIA states to Indian economy are presented in **Table 3-6**.

Period	India	Maharashtra	Karnataka	Tamil Nadu	Kerala	Gujarat
Past Growth %						
FY12 to FY20	6.9	6.3	8.8	6.9	6.0	9.6
FY15 to FY20	6.8	5.8	9.0	7.1	6.4	9.5
Past Multipliers						
FY12 to FY20		0.9	1.3	1.0	0.9	1.4
FY15 to FY20		0.9	1.3	1.0	0.9	1.4
Adopted Multipliers						
States w.r.t. India		1.0	1.2	1.0	0.9	1.4

Table 3-6: Past Multipliers and Future Outlook of PIA States

Based on the normalised OD shares of the toll plaza and the outlooks adopted for PIA states, the mode-wise future weighted income is presented in **Table 3-7**.

FY/Modes	Car/MLCV	M Bus/ LCV	Bus	2A	3A	MAV
2024	5.9	6.0	5.9	6.0	6.1	6.2
2025	6.2	6.3	6.2	6.3	6.4	6.5
2026	6.6	6.7	6.6	6.7	6.8	6.9
2027	6.6	6.7	6.6	6.7	6.8	6.9
2028	6.4	6.5	6.4	6.5	6.6	6.7
2029	6.0	6.1	6.0	6.1	6.2	6.3
2030	6.0	6.1	6.0	6.1	6.2	6.3
2031	6.0	6.1	6.0	6.1	6.2	6.3
2032	6.0	6.1	6.0	6.1	6.2	6.3
2033	6.0	6.1	6.0	6.1	6.2	6.3
2034	5.9	6.0	5.9	6.0	6.1	6.2
2035	5.8	5.9	5.8	5.9	6.0	6.0
2036	5.7	5.8	5.7	5.8	5.9	5.9
2037	5.6	5.7	5.6	5.7	5.8	5.8
2038	5.5	5.6	5.5	5.6	5.7	5.7
2039	5.4	5.5	5.4	5.5	5.6	5.6
2040	5.3	5.4	5.3	5.4	5.4	5.5
2041	5.2	5.3	5.2	5.3	5.3	5.4
2042	5.2	5.3	5.2	5.3	5.3	5.4
2043	5.1	5.1	5.1	5.2	5.2	5.3
2044	5.0	5.0	5.0	5.1	5.1	5.2
2045	4.9	4.9	4.9	5.0	5.0	5.1
2046	4.8	4.8	4.8	4.9	4.9	5.0
2047	4.7	4.7	4.7	4.8	4.8	4.9
2048	4.6	4.6	4.6	4.7	4.7	4.8
2049	4.5	4.5	4.5	4.6	4.6	4.7
2050	4.4	4.4	4.4	4.5	4.5	4.6
2051	4.1	4.1	4.1	4.1	4.2	4.2
2052	4.1	4.1	4.1	4.1	4.2	4.2

Table 3-7: Future Mode-Wise Weighted Income of PIA States

3.7 Review of Past Traffic Data and Comparison with Previous Estimates

The toll plaza traffic data for the project road from Jan-2021 till Mar-2023 was provided by the client. The comparison of AADT for FY22/FY23 in the earlier study of May 2022 with FY23 AADT in present study is presented in **Table 3-8**.

Location/ Mode	Car	LCV	2-axle Truck	3-axle Truck	MAV	O/size/ HME	Total	PCU
A. AADT FY22 Actual								
TP01 – Kognoli	8,006	1,410	1,975	863	1,637	5	13,895	26,024
TP02 – Hattargi	9,000	1,512	2,806	987	1,757	6	16,069	30,581
B. AADT FY22 Adopted (May 2022 Study)								
TP01 – Kognoli	9,839	1,341	2,167	919	1,724	5	15,995	28,889
TP02 – Hattargi	10,154	1,685	3,107	1,052	1,849	7	17,854	33,511
C. AADT FY23 Forecasted (May 2022 Study)								
TP01 – Kognoli	10,656	1,382	2,231	947	1,845	5	17,066	30,588
TP02 – Hattargi	10,997	1,736	3,197	1,085	1,978	7	19,001	35,380
D. AADT FY23 (Present Study)								
TP01 – Kognoli	12,354	1,440	2,996	966	1,901	8	19,665	34,991
TP02 – Hattargi	11,964	1,675	3,635	1,136	2,068	11	20,489	38,145
E. FY23 Present study vs FY22 Actual (D vs A)								
TP01 – Kognoli	54.3%	2.2%	51.7%	12.0%	16.1%	65.3%	41.5%	34.5%
TP02 – Hattargi	32.9%	10.7%	29.6%	15.1%	17.6%	70.8%	27.5%	24.7%
F. FY23 Present study vs FY22 Adopted May 2022 (D vs B)								
TP01 – Kognoli	25.6%	7.4%	38.3%	5.2%	10.3%	54.7%	22.9%	21.1%
TP02 – Hattargi	17.8%	-0.6%	17.0%	8.0%	11.8%	55.0%	14.8%	13.8%

Table 3-8: AADT in Earlier (May 2022 Report) and Present Study

Comparison of FY23 AADT with FY23 forecast in May 2022 study (C vs D)

- The FY23 AADT in present study is about 4,403 PCUs (or 14.4 percent) higher at TP01 and about 2,766 PCUs (or 7.8 percent) higher at TP02. Notably, positive differences in car and 2-Axle categories are the leading contributor to the variation in overall PCUs. With boom in tourism post Covid-19, there has been an increase in cars, especially Goa bound traffic which is more pronounced at TP01 as some of the traffic diverts towards the Mumbai – Goa coastal route after crossing TP01.

Comparison of Actual FY22 AADT with FY23 AADT in present study (D vs A)

- Comparison between the actual AADT of FY22 and FY23 indicates very high growth in car (54 percent at TP01 and 33 percent at TP02) and 2-Axle categories (52 percent at TP01 and 30 percent at TP02) while moderate to high growth have been witnessed in other categories for both the toll plazas. It is worth noting that Q1 of FY22 was impacted due to the 2nd wave of Covid-19.

Comparison of FY23 AADT with AADT Adopted for FY22 in May 2022 study (D vs B)

- A comparison of FY23 AADT with the AADT adopted for FY22 (corrected for Q1 of FY22 in May 2022 Report) at TP01 shows a growth of about 25.6 percent in car, 38.3 percent in 2A trucks and about 10.3 percent in MAVs resulting in about 21.1 percent growth in PCU terms. Similarly, at TP02, growth of about 17.8 percent in car, 17.0

percent in 2A trucks and about 11.8 percent in MAVs have been witnessed which results in about 13.8 percent growth in PCU terms. The toll plaza traffic data for the project road for FY21 was available in DPR and FY22 & FY23 is provided by the client. The past traffic data along with the FY23 AADT is presented in **Figure 3-8**.

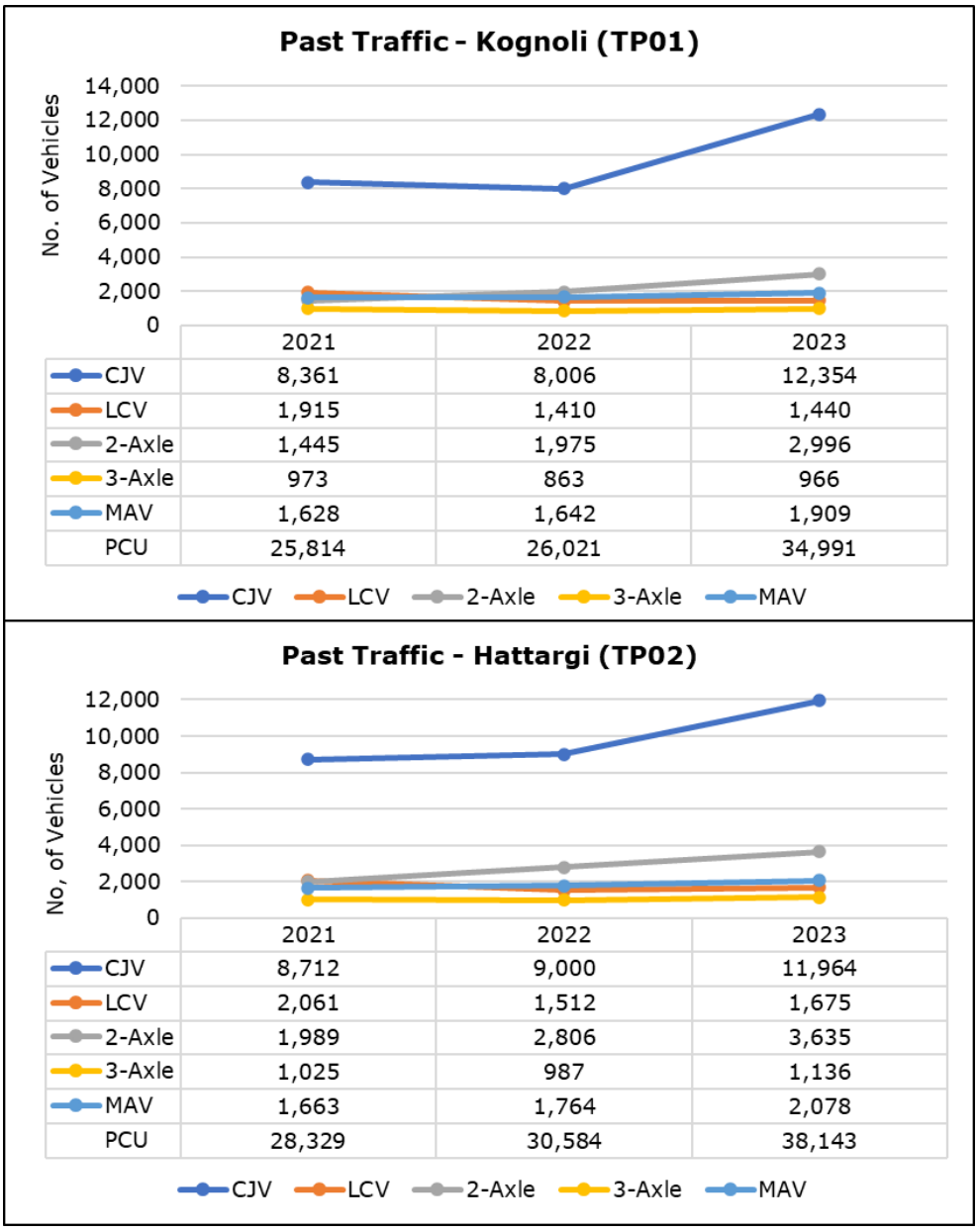


Figure 3-8: Past Traffic data

An analysis of the traffic data and a comparison of the yearly averages with the current estimates of FY23 of the total traffic is presented in **Table 3-9**.

Vehicle Type	CJV	LCV	2A	3A	MAV	PCU
Growth (%)						
TP01 - Kognoli						
FY21 vs FY22	-4.2	-26.4	36.6	-11.3	0.8	0.8
FY22 vs FY23	54.3	2.2	51.7	12.0	16.3	34.5
FY21 vs FY23	21.6	-13.3	44.0	-0.3	8.3	16.4
TP02 - Hattargi						
FY21 vs FY22	3.3	-26.6	41.1	-3.7	6.1	8.0
FY22 vs FY23	32.9	10.7	29.6	15.1	17.8	24.7

Vehicle Type	CJV	LCV	2A	3A	MAV	PCU
FY21 vs FY23	17.2	-9.9	35.2	5.3	11.8	16.0

Table 3-9: Past Traffic Growth Analysis

A comparison of FY23 vs FY21 shows car traffic growth of about 21.6 percent, 17.2 percent at TP01 and TP02 respectively.

In case of MAVs, a growth of about 8-12 percent each has been observed at TP01 & TP02 during FY21 to FY23. Similarly, comparison of FY23 with FY22 has shown a double-digit growth of 16-18 percent in MAVs at TP01 & TP02.

LCVs are showing negative growth in recent years which could be attributed to the tonnage shifts happening across all highways between the LCV category from LCV to Mini LCV or could be a classification issue between LCVs and 2A trucks.

Also, an overall growth of about 16 percent PCUs has been observed in FY23 vs FY21 comparison across the project road.

3.8 Past and Future Transport Demand Elasticity

The econometric model applied for the project, relates traffic growth to changes in state domestic product via an elasticity factor according to IRC guidelines. The elasticity by vehicle types have been estimated based on the regression analysis of weighted income of PIA states with the actual traffic data.

A regression between GSDP (as independent variable) and registered vehicles (as dependant variable) of Maharashtra and Karnataka was carried out. The registered vehicle elasticity in case of cars is 1.3 during FY12 to FY19 for the state of Maharashtra and 1.1 for Karnataka. In case of all trucks combined, the registered vehicle elasticity is varying between 0.9 to 1 during the same period for both the states.

Vehicle registration data is also used as a proxy wherein operational toll data is not available. Vehicle registration data represents all vehicles registered in the state, but does not indicate actual number of vehicles plying on the road as it does not account for factors such vehicles taken off the road due to lack road worthiness, those registered in a state but mostly used elsewhere, etc. Consequently, the elasticity values based on vehicle registration may not be representative of the traffic growth trends on the project road. Past elasticity and growth trends on the nearby national highways have been the basis of growth for the project road.

The derived elasticities on other National Highways across India have also formed the basis for choosing the recommended elasticities on PR. The elasticities derived using the operational toll data regressed with the applicable state incomes (mode wise weighted shares) for the respective projects on some of the National Highways is presented in **Table 3-10**.

NH	Period	Car	2A	3A/MAV
NH-21	FY12-FY20	1.23	-0.42	0.54
SH-25	FY15-FY20	1.28	0.26	0.47

NH	Period	Car	2A	3A/MAV
SH-17 & SH-7	FY13-FY20	1.26	0.51	0.33
NH-19	FY15-FY20	0.78	1.36	1.40
NH-1	FY12-FY20	1.02	0.74	
NH-6	FY14-FY20	1.11	1.68	0.42
NH-8A	FY16-FY20	0.73	0.28	0.94
NH-48 (Old NH-4)	FY15-FY20	0.87	0.18	0.84
NH-6	FY16 to FY19	1.25	1.28	0.78

Table 3-10: Past Elasticity on Other National Highways

The past elasticity values have been observed in the range of 1-1.3 for cars on various National Highways and around 0.5-0.9 for 3A/MAV combined. Individually, 3A trucks have shown a negative elasticity in some of the assets with MAVs showing a higher positive elasticity.

Cars

- The elasticities and the past growth levels for cars are a result of increasing income levels, increasing vehicle ownership, and higher propensity to travel on highways in India due to network level developments and higher levels of service. These levels of growth are likely to continue in the near to medium term since car ownership levels are still very low and the road network is undergoing continual development.
- In case of cars, the elasticity values derived across the toll roads in the region is between 1.0 to 1.3. Car elasticity has been considered as 1.1 for the period up to FY25 and tapered thereafter.
- The motorisation levels in India also play an important role in determining car growth. With the increasing car ownership levels, propensity to travel and network level improvements on National Highways, car growth is likely to be at a high rate as witnessed in the recent past. The low motorization rate suggests that there is room for continued growth for many years to come. With the continual increase in motorization rate and improved road network usage by cars for inter-urban travel, car growth is expected to be robust.

Bus

- Over the years in India, there has been a change in passenger's travel mode preferences with increasingly more people shifting from public transport systems towards personalised modes. This has resulted, in general, in elasticity of bus traffic/demand to GSDP lower than unity ranging between 0.3 to 0.8 across the operational National Highways.
- Bus elasticity has been recommended as 0.5 till the end of the concession period.

Trucks

- The switch between MLCV and LCV is being observed across other national highways wherein MLCVs (mostly charged in car category) have been gaining importance lately

over LCV category. For LCVs, an elasticity of 0.4 has been adopted for the entire concession period.

- For 2A Trucks, elasticity has been recommended as 0.3 till the end of concession period.
- For the project road, an elasticity of 0.4 has been adopted for 3A trucks till the end of the concession period. In case of MAV trucks, an elasticity of 0.9 has been adopted till FY25 and tapered thereafter.
- It is likely that this growth would slow down over time as the market becomes more mature and saturated, therefore elasticity to GSDP can be expected to decline over time. With the anticipated growth momentum in the coming years, higher elasticity values have been considered in the initial slabs and further tapering has been done in the future.
- In India as a whole, the freight vehicle mix has been changing in the last decade favouring MAV to 2 Axle/ 3Axle vehicles for long-distance traffic, given the operational efficiencies achievable with larger vehicles. Considering the ongoing technical advancements in automobile industry, some of the standard 2 Axle/ 3 Axle trucks would gradually be replaced by MAVs. Mature national highways with tolling in operation for few years, have already witnessed the shift in 2A/3A trucks to MAV for long distance movement.
- On an overall level, due consideration has been given to the tonnage shifts happening in the market with Mini LCV gaining importance for short distance movements over LCVs and MAVs being preferred over 2A/3A for long distance movements due to better operational efficiencies. Some of the 2A/3A trucks are also being used for local movements.

While assigning elasticities to different modes, freight travel pattern and over all elasticity of cargo tonnage with respect to weighted GSDP has been an important consideration. The recommended elasticity values adopted for all vehicle types in line with the traffic growth being observed on other national highways and changes in freight traffic pattern observed on the project road are presented in **Table 3-11**.

Period/ Modes	Car/ MLCV	M Bus/ LCV	Bus	2A	3A	MAV
TP01 & TP02						
2023-2025	1.1	0.4	0.5	0.3	0.4	0.9
2026-2030	1.0	0.4	0.5	0.3	0.4	0.8
2031-2035	1.0	0.4	0.5	0.3	0.4	0.7
2036-2040	0.9	0.4	0.5	0.3	0.4	0.7
Beyond 2040	0.9	0.4	0.5	0.3	0.4	0.7

Table 3-11: Recommended Elasticity for Project Road

It has been assumed that transport demand elasticity, for both freight and passenger traffic, would gradually decline over time, despite growth in per capita income, as regions

becomes more mature, self-sufficient and with alternative mode of transport available to users. In the future growth forecast, the gradation in elasticity of freight over the years takes into account to cover the impact of network level changes in both rail and road networks apart from economic changes.

3.9 Projected Traffic Growth Rates

The estimated traffic growth rates for the project road in the earlier study have been presented in **Table 3-13**.

FY/Modes	Car/MLCV	M Bus/ LCV	Bus	2A	3A	MAV
TP01 & TP02						
2023	8.4	3.1	3.8	2.3	3.1	7.1
2024	7.4	2.7	3.4	2.1	2.8	6.2
2025	8.6	3.1	3.9	2.4	3.2	7.2
2026	7.6	3.1	3.8	2.3	3.1	6.3
2027	7.4	3.0	3.7	2.3	3.0	6.1
2028	7.1	2.9	3.6	2.2	2.9	5.9
2029	6.8	2.8	3.4	2.1	2.8	5.6
2030	6.6	2.7	3.3	2.0	2.7	5.4
2031	6.4	2.6	3.2	2.0	2.6	4.6
2032	6.2	2.5	3.1	1.9	2.5	4.4
2033	5.9	2.4	3.0	1.8	2.4	4.3
2034	5.6	2.3	2.8	1.7	2.3	4.1
2035	5.3	2.1	2.7	1.6	2.2	3.8
2036	4.5	2.0	2.5	1.5	2.1	3.6
2037	4.4	2.0	2.4	1.5	2.0	3.5
2038	4.3	1.9	2.4	1.4	1.9	3.4
2039	4.1	1.9	2.3	1.4	1.9	3.3
2040	4.0	1.8	2.3	1.4	1.8	3.2
2041	3.9	1.8	2.2	1.3	1.8	3.2
2042	3.8	1.7	2.1	1.3	1.7	3.1
2043	3.7	1.7	2.1	1.3	1.7	3.0
2044	3.6	1.6	2.0	1.2	1.7	2.9
2045	3.5	1.6	2.0	1.2	1.6	2.8
2046	3.4	1.5	1.9	1.2	1.6	2.8
2047	3.3	1.5	1.9	1.1	1.5	2.7
2048	3.2	1.5	1.8	1.1	1.5	2.6
2049	3.1	1.4	1.8	1.1	1.4	2.5
2050	3.0	1.4	1.7	1.0	1.4	2.4
2051	2.9	1.3	1.6	1.0	1.3	2.4
2052	2.9	1.3	1.6	1.0	1.3	2.4

Table 3-12: Projected Traffic Growth Rates for Project Road in Earlier Study (%)

Under the present study, based on the perspective elasticity values and the projected growth rates of the income for PIA states (updated with the latest regional distribution of PIA from the ODs of this study), the future average annual compound traffic growth rates by vehicle type have been estimated for the project road by using the following relationship:

Tgr = (GSDPgr) x E; where,

Tgr – Traffic growth rate for mode

GSDPgr – Growth rate of GSDP

E – Elasticity value for mode

Using the year-on-year mode wise weighted income for PIA and elasticity for different time periods, traffic growth rates have been estimated for each year till FY52. The estimated traffic growth rates for the project road have been presented in **Table 3-13**.

FY/Modes	Car/MLCV	M Bus/ LCV	Bus	2A	3A	MAV
TP01 & TP02						
2024	6.5	2.4	3.0	1.8	2.4	5.5
2025	6.8	2.5	3.1	1.9	2.6	5.8
2026	6.6	2.7	3.3	2.0	2.7	5.5
2027	6.6	2.7	3.3	2.0	2.7	5.5
2028	6.4	2.6	3.2	2.0	2.6	5.3
2029	6.0	2.4	3.0	1.8	2.5	5.0
2030	6.0	2.4	3.0	1.8	2.5	5.0
2031	6.0	2.4	3.0	1.8	2.5	4.4
2032	6.0	2.4	3.0	1.8	2.5	4.4
2033	6.0	2.4	3.0	1.8	2.5	4.4
2034	5.9	2.4	3.0	1.8	2.4	4.3
2035	5.8	2.3	2.9	1.8	2.4	4.2
2036	5.1	2.3	2.9	1.7	2.3	4.2
2037	5.0	2.3	2.8	1.7	2.3	4.1
2038	5.0	2.2	2.8	1.7	2.3	4.0
2039	4.9	2.2	2.7	1.6	2.2	3.9
2040	4.8	2.1	2.7	1.6	2.2	3.9
2041	4.7	2.1	2.6	1.6	2.1	3.8
2042	4.7	2.1	2.6	1.6	2.1	3.8
2043	4.6	2.1	2.6	1.6	2.1	3.7
2044	4.5	2.0	2.5	1.5	2.1	3.6
2045	4.4	2.0	2.5	1.5	2.0	3.6
2046	4.3	1.9	2.4	1.5	2.0	3.5
2047	4.2	1.9	2.3	1.4	1.9	3.4
2048	4.1	1.9	2.3	1.4	1.9	3.3
2049	4.0	1.8	2.2	1.4	1.8	3.3
2050	3.9	1.8	2.2	1.3	1.8	3.2
2051	3.7	1.6	2.0	1.2	1.7	3.0
2052	3.7	1.6	2.0	1.2	1.7	3.0

Table 3-13: Projected Traffic Growth Rates for Project Road (%)

In derivation of above growth rates, the likely shift of buses to cars in case of passenger vehicles and the replacement/ tonnage shift of 2A/3A trucks to MAV for long distance in case of freight vehicles has been duly considered.

The car traffic on the project road has exhibited high growth rates of 54 percent at TP01 and 32 percent at TP02. This could be due to some pent-up demand increase post Covid-19. In view of this, zero growth rate for car traffic have been considered till FY25. The estimated growth rates for car traffic based on elasticity approach have been considered from FY26 onwards. However, for all other modes growth rates based on elasticity approach have been considered for the entire duration of concession period.

The implied traffic growth rates for freight vehicles of 2A/3A and MAV after considering the impact of diversion to Pune-Bangalore Expressway in FY30 to FY32 under the base case have been presented in **Table 3-14**.

FY/Modes	TP01			TP02		
	2A	3A	MAV	2A	3A	MAV
2030	-12.3	-16.8	-15.3	-9.1	-14.0	-13.6
2031	-6.4	-9.4	-8.1	-4.3	-7.3	-6.9
2032	-7.1	-11.0	-9.8	-4.7	-8.3	-8.3

Table 3-14: Implied Traffic Growth Rates for Project Road After Diversion to Pune-Bangalore Expressway (%)

The above growth rates relate to the most likely Base Case. In addition, two sets of traffic growth rates under low and high cases have also been considered and impact on toll revenue evaluated for both these cases. Based on the risk analysis of key parameters like economic growth and elasticity of travel demand impacting traffic growth, two additional growth scenarios have been presented. Low growth scenario considers a 20 percent reduction in growth rates relating to about 10 percent decline each in elasticity and economic growth. The High growth scenario considers a 20 percent increase in growth rates signifying about 10 percent increase each in elasticity and economic parameters.

3.10 Projected Mode-wise Traffic

Mode-wise projected traffic for the two toll plazas of the project road under the base case after considering diversion impacts till FY52 is presented in **Table 3-15** and **Table 3-16**.

FY END	Car	LCV	Bus	2-axle Truck	3-axle Truck	MAV	OSV	PCU
2023	12,354	1,440	1,314	1,682	966	1,901	8	34,991
2024	12,354	1,474	1,353	1,712	989	2,006	8	35,796
2025	12,354	1,511	1,395	1,745	1,015	2,123	9	36,680
2026	13,172	1,552	1,441	1,780	1,042	2,240	9	38,415
2027	14,044	1,593	1,489	1,816	1,071	2,364	10	40,245
2028	14,945	1,635	1,537	1,852	1,099	2,490	10	42,115
2029	15,843	1,674	1,584	1,886	1,126	2,615	11	43,959
2030	16,550	1,715	1,631	1,653	937	2,215	12	41,807
2031	17,415	1,757	1,680	1,548	848	2,035	12	41,492
2032	18,324	1,800	1,731	1,438	755	1,835	13	41,109
2033	19,425	1,843	1,783	1,464	774	1,915	13	42,932
2034	20,572	1,887	1,836	1,491	793	1,998	14	44,813
2035	21,767	1,932	1,889	1,517	812	2,082	14	46,754
2036	22,884	1,976	1,944	1,544	831	2,169	15	48,629
2037	24,038	2,021	1,998	1,570	850	2,258	15	50,552
2038	25,228	2,066	2,053	1,596	869	2,348	16	52,522
2039	26,454	2,111	2,109	1,623	888	2,441	17	54,538
2040	27,715	2,156	2,165	1,649	908	2,535	17	56,599
2041	29,010	2,201	2,221	1,675	927	2,631	18	58,703
2042	30,367	2,248	2,279	1,702	947	2,731	19	60,893
2043	31,759	2,294	2,337	1,728	967	2,832	19	63,128
2044	33,185	2,340	2,396	1,754	987	2,935	20	65,405
2045	34,645	2,386	2,455	1,781	1,006	3,040	21	67,723
2046	36,138	2,433	2,513	1,807	1,026	3,146	22	70,080
2047	37,662	2,479	2,573	1,832	1,046	3,254	22	72,474
2048	39,216	2,525	2,632	1,858	1,066	3,362	23	74,903
2049	40,797	2,570	2,691	1,883	1,085	3,472	24	77,364
2050	42,406	2,616	2,750	1,909	1,105	3,583	25	79,854
2051	43,961	2,659	2,806	1,932	1,123	3,690	25	82,252
2052	45,573	2,703	2,863	1,956	1,142	3,799	26	84,727
AADT CAGR%								
FY23 - FY25	0.0%	2.5%	3.0%	1.8%	2.5%	5.7%	5.7%	2.4%
FY25 - FY30	6.0%	2.6%	3.2%	-1.1%	-1.6%	0.9%	5.3%	2.7%

FY END	Car	LCV	Bus	2-axle Truck	3-axle Truck	MAV	OSV	PCU
FY30 - FY35	5.6%	2.4%	3.0%	-1.7%	-2.8%	-1.2%	4.3%	2.3%
FY35 - FY40	5.0%	2.2%	2.8%	1.7%	2.3%	4.0%	4.0%	3.9%
FY40 - FY45	4.6%	2.1%	2.5%	1.5%	2.1%	3.7%	3.7%	3.7%
FY45 - FY50	4.1%	1.9%	2.3%	1.4%	1.9%	3.3%	3.3%	3.4%
FY50 - FY52	3.7%	1.6%	2.0%	1.2%	1.7%	3.0%	3.0%	3.0%
FY23 - FY52	4.6%	2.2%	2.7%	0.5%	0.6%	2.4%	4.2%	3.1%

Table 3-15: Projected Mode-wise Traffic at TP01

FY END	Car	LCV	Bus	2-axle Truck	3-axle Truck	MAV	OSV	PCU
2023	11,964	1,675	1,462	2,173	1,136	2,068	11	38,145
2024	11,964	1,715	1,505	2,212	1,164	2,183	12	39,054
2025	11,964	1,758	1,552	2,254	1,193	2,310	12	40,049
2026	12,756	1,805	1,604	2,300	1,226	2,437	13	41,877
2027	13,601	1,853	1,657	2,346	1,259	2,572	14	43,802
2028	14,473	1,902	1,710	2,392	1,293	2,709	14	45,767
2029	15,343	1,948	1,762	2,436	1,324	2,845	15	47,702
2030	16,020	1,995	1,815	2,214	1,140	2,457	16	45,645
2031	16,852	2,044	1,870	2,119	1,056	2,288	17	45,421
2032	17,727	2,093	1,926	2,019	968	2,099	17	45,130
2033	18,792	2,144	1,984	2,056	992	2,191	18	47,046
2034	19,902	2,195	2,043	2,093	1,016	2,285	19	49,021
2035	21,058	2,247	2,102	2,131	1,040	2,382	20	51,056
2036	22,139	2,299	2,162	2,168	1,065	2,481	20	53,029
2037	23,255	2,351	2,223	2,205	1,089	2,583	21	55,050
2038	24,406	2,403	2,284	2,242	1,114	2,686	22	57,119
2039	25,592	2,455	2,346	2,279	1,139	2,792	23	59,234
2040	26,812	2,508	2,409	2,315	1,164	2,900	24	61,394
2041	28,066	2,561	2,471	2,352	1,188	3,010	25	63,598
2042	29,378	2,614	2,536	2,389	1,214	3,124	26	65,889
2043	30,724	2,668	2,601	2,427	1,239	3,240	27	68,225
2044	32,104	2,722	2,666	2,464	1,265	3,358	28	70,604
2045	33,517	2,776	2,731	2,500	1,290	3,477	29	73,023
2046	34,961	2,830	2,797	2,537	1,316	3,599	30	75,481
2047	36,436	2,883	2,862	2,573	1,341	3,722	31	77,976
2048	37,939	2,937	2,928	2,609	1,366	3,846	32	80,504
2049	39,469	2,990	2,994	2,645	1,391	3,972	33	83,065
2050	41,025	3,043	3,060	2,680	1,417	4,099	34	85,654
2051	42,529	3,093	3,122	2,713	1,440	4,221	35	88,145
2052	44,088	3,144	3,186	2,747	1,464	4,346	36	90,715
AADT CAGR%								
FY23 - FY25	0.0%	2.5%	3.0%	1.8%	2.5%	5.7%	5.7%	2.5%
FY25 - FY30	6.0%	2.6%	3.2%	-0.4%	-0.9%	1.2%	5.3%	2.7%
FY30 - FY35	5.6%	2.4%	3.0%	-0.8%	-1.8%	-0.6%	4.3%	2.3%
FY35 - FY40	5.0%	2.2%	2.8%	1.7%	2.3%	4.0%	4.0%	3.8%
FY40 - FY45	4.6%	2.1%	2.5%	1.5%	2.1%	3.7%	3.7%	3.5%
FY45 - FY50	4.1%	1.9%	2.3%	1.4%	1.9%	3.3%	3.3%	3.2%
FY50 - FY52	3.7%	1.6%	2.0%	1.2%	1.7%	3.0%	3.0%	2.9%
FY23 - FY52	4.6%	2.2%	2.7%	0.8%	0.9%	2.6%	4.2%	3.0%

Table 3-16: Projected Mode-wise Traffic at TP02

3.11 Traffic Projections and Capacity Analysis

Table 3-17 presents the projections of the total vehicles based on the most likely growth rates till FY52 as assessed in this study.

FY	Traffic Before Diversion			Traffic After Diversion		
	TP01-Kognoli	TP02-Hattargi	Average	TP01-Kognoli	TP02-Hattargi	Average
2023	34,991	38,145	36,568	34,991	38,145	36,568
2024	35,796	39,054	37,425	35,796	39,054	37,425
2025	36,680	40,049	38,365	36,680	40,049	38,365
2026	38,415	41,877	40,146	38,415	41,877	40,146
2027	40,245	43,802	42,024	40,245	43,802	42,024
2028	42,115	45,767	43,941	42,115	45,767	43,941
2029	43,959	47,702	45,831	43,959	47,702	45,831
2030	45,895	49,731	47,813	41,807	45,645	43,726
2031	47,849	51,775	49,812	41,492	45,421	43,456
2032	49,898	53,915	51,907	41,109	45,130	43,120
2033	52,047	56,157	54,102	42,932	47,046	44,989
2034	54,262	58,465	56,364	44,813	49,021	46,917
2035	56,543	60,841	58,692	46,754	51,056	48,905
2036	58,763	63,158	60,961	48,629	53,029	50,829
2037	61,037	65,531	63,284	50,552	55,050	52,801
2038	63,365	67,957	65,661	52,522	57,119	54,820
2039	65,746	70,437	68,091	54,538	59,234	56,886
2040	68,178	72,968	70,573	56,599	61,394	58,996
2041	70,659	75,548	73,104	58,703	63,598	61,151
2042	73,239	78,230	75,735	60,893	65,889	63,391
2043	75,870	80,962	78,416	63,128	68,225	65,676
2044	78,549	83,742	81,146	65,405	70,604	68,004
2045	81,275	86,568	83,921	67,723	73,023	70,373
2046	84,044	89,438	86,741	70,080	75,481	72,780
2047	86,855	92,349	89,602	72,474	77,976	75,225
2048	89,704	95,299	92,502	74,903	80,504	77,704
2049	92,590	98,284	95,437	77,364	83,065	80,214
2050	95,508	101,301	98,405	79,854	85,654	82,754
2051	98,316	104,201	101,259	82,252	88,145	85,199
2052	101,212	107,193	104,203	84,727	90,715	87,721

Table 3-17: Projected Traffic in PCUs on the Project Road

The project road is being upgraded to a six-lane section starting FY23 as part of six laning of Golden Quadrilateral. The projected traffic for the project road is not reaching the designed capacity of 1,20,000 PCUs till FY52.

4. TOLL REVENUE PROJECTIONS

4.1 Tolling Strategy

The project road has an "Open System" of toll collection which enables the concessionaire to collect tolls from through traffic as well as from short distance one.

As mentioned earlier, there are two operational toll plazas on the project road - TP01- Kognoli and TP02- Hattargi with an effective tolling length of 60.730 km and 23.74 km respectively being charged. Post completion of six laning, the revised effective tolling lengths would be 79.39 km and 41.83 km at the two respective toll plazas.

4.2 Schedule of User Fee

As per Schedule of User Fee for the project, the per km toll rates applicable from 2007-08 for normal tolling length, bypasses and permanent structures, the revision basis and concessions are provided.

The concessions to traffic have been given in the form of rates as below:

Local traffic

Car / Jeep / Vans - includes local users owning a vehicle registered for non-commercial purposes, residing within a distance of 20 km from the toll plaza and crossing the same for commuting purposes.

Commercial vehicles - includes local users owning a commercial vehicle (excluding vehicles under National Permit), registered with address on the Registration Certificate of a particular district and uses such vehicle for commuting on a section of National Highway, permanent bridge, tunnel or bypass, as the case may be, which is located within that district, shall be levied user fee on all toll plazas which are located within that district at the rate of fifty per cent of the prescribed rate of fee (single journey rate). No such concession shall be provided, if a service road or alternative road is available for use by such commercial vehicles. Thus, local commercial traffic has to pay only 50 percent of the normal ticket.

Daily Pass

When the vehicle has to cross the tolled section more than once in a day, the user shall have the option to pay one and half times (1.5 times) of the fee for a single entry; this pass shall be valid for 2 entries within 24 hours of purchase.

Monthly Pass

A user, who makes use of the project road frequently during a month, may opt to purchase a monthly pass upon payment of a charge equal to two-thirds of the fee payable for 50 single journeys; this pass can be used for a maximum 50 one-way journeys over the month of validity.

Thus, the different categories of toll tickets are as follows:

(i) Traffic paying normal toll rates (single trip)

(ii) Traffic paying return journey rates

(iii) Traffic paying monthly pass rates

(iv) Traffic paying local personal rates

(v) Traffic paying local commercial rates

4.3 Tolling Streams

The tolling segmentation considered in the earlier study is presented in **Table 4-1**.

Ticket Type/ Modes	Car	LCV	Bus/2A Truck	3A Truck	4-6 A Truck	OSV
TP01 - Kognoli						
Single	50.7	57.8	74.7	89.6	91.3	98.1
Return	38.2	29.7	21.7	10.0	8.4	0.5
Monthly	0.0	0.0	0.0	0.0	0.0	0.0
Local personal	2.5	0.0	0.0	0.0	0.0	0.0
Local commercial	0.0	0.0	2.8	0.0	0.0	0.0
Exempt	8.5	12.6	0.9	0.3	0.3	1.4
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
TP02 - Hattargi						
Single	40.4	57.0	56.3	84.5	88.2	93.3
Return	50.0	35.9	29.3	14.6	11.2	0.8
Monthly	0.0	0.0	0.1	0.0	0.0	0.0
Local personal	0.7	0.0	0.0	0.0	0.0	0.0
Local commercial	0.3	1.4	13.5	0.4	0.1	0.0
Exempt	8.6	5.7	0.7	0.5	0.5	5.9
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 4-1: Tolling Distribution in Earlier Study of July 2021 to April 2022 (%)

The tolling stream distribution under the present study has been derived from the toll data taking an average of FY23 and the same is presented in **Table 4-2**.

Ticket Type/ Modes	Car	LCV	Bus/ 2A Truck	3 A Truck	4-6 A Truck	OSV
TP01 - Kognoli						
Single	47.6	74.1	63.4	87.1	90.9	96.8
Return	42.4	21.6	32.6	12.3	8.7	2.6
Monthly	0.0	0.0	0.0	0.0	0.0	0.0
Local personal	5.5	0.0	0.0	0.0	0.0	0.0
Local commercial	0.0	0.0	3.3	0.0	0.0	0.1
Exempt	4.4	4.3	0.7	0.6	0.3	0.5
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
TP02 - Hattargi						
Single	40.6	71.6	56.2	81.0	87.8	79.6
Return	53.1	24.0	34.6	18.4	11.9	2.7
Monthly	0.0	0.0	0.2	0.0	0.0	0.0
Local personal	1.5	0.0	0.0	0.0	0.0	0.0
Local commercial	0.2	0.8	8.6	0.2	0.1	0.0
Exempt	4.7	3.6	0.4	0.4	0.3	17.7
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 4-2: Tolling Distribution from Toll Data of present study (%)

The level of exemptions witnessed (adopted in the present study) in Cars and LCV category are around 3.0-5.0 percent while it is negligible in other freight modes.

In case of cars, the normal toll paying traffic is likely to be about 47.6 percent and 40.6 percent at TP01 and TP02 respectively. Daily Pass traffic has a share of 42.4 percent at TP01 whereas on TP02 it is 53.1 percent in case of cars. In case of LCV around 74.1 and 71.6 percent of the traffic at both toll plazas is paying for single ticket. In case of 3A/MAV, around 81-91 percent of the truck traffic is opting for normal ticket at both the toll plazas due to their long lead of travel and around 8-18 percent each of 3A trucks and MAV falling under return pass category at both the toll plazas.

Trip rate for local pass users is considered as 1.0, for monthly pass it is 1.67 across all modes. For daily pass, trip rate of 2.0 has been considered for all the modes.

4.4 Toll Rates

This section presents details on the toll rates that are likely to be imposed on the users of the project road during the study period. The toll rates (Rs/km) for the base year 2007-08 for different vehicle categories as per toll fee rules are presented in **Table 4-3**.

Mode	Base rate per km (in Rs)
Car, Jeep, Van, LMV	0.65
LCV /M Bus	1.05
Bus/ 2 Axle Truck	2.20
3 Axle	2.40
MAV	3.45
Oversized	4.20

Table 4-3: Toll Rates in Rs/km for Different Vehicle Categories

The toll notification states that the 2007 toll rates shall be increased without compounding by three per cent each year with effect from the 1st day of April 2008 and such increased rate shall be deemed to be the base rate for the subsequent years.

In addition to this, the rate of fee for use of bypass forming part of a section of a National Highway constructed with a cost of Rs 10 crore or more, for the base year 2007, shall be one and a half times of the per km base rates specified above and the length of such bypass shall be excluded from the length of such section of National Highway. Also, the fee levied and collected hereunder for permanent bridge/ structures, as the case may be, having a length of 60 m or more on the basis of the equivalent length for structure as specified shall be due and payable at the toll plaza.

In case of the project road, the details of normal tolling lengths, bypass length (at 1.5 times) and equivalent structure lengths being charged at toll plazas are presented in **Table 4-4** along with the length which will be charged post augmentation to six lane configurations.

Toll Plazas	TP01	TP02
Existing Tolling Length till FY24	60.73	23.74
Tolling Length post six laning from FY25	79.39	41.83

Table 4-4: Tolling Lengths (in km) for Kagal-Belgaum

The applicable base rates shall be revised annually with effect from April 1 each year to reflect the increase in wholesale price index for the month of December of the immediate preceding year in which such revision is undertaken but such revision shall be restricted for 40 per cent of the increase in wholesale price index.

For the present study, actual WPI information for December 2021 of 150.5 under 2011-12 series converted into 1999-00 series (150.5*1.873*1.641=462.576) has been used which indicates a growth of 5.02 percent as compared to last year. The forecast of 3.5 percent WPI for future years beyond FY24 has been adopted for the period till FY52.

As per the applicable tolling notifications for six laning, during construction period, the toll rates will be charged at 75 percent of the applicable tolling length during construction and kept constant till full COD is achieved. The construction for six laning for the project road has started from November in FY23 and is likely to continue till the end of FY25 during which the toll rates will be 75 percent of the applicable toll rates of FY23 and will be constant till the end of construction period. Also, for FY26 and FY27 toll rates are capped at 25 percent higher than the toll rates in the preceding year.

The stream of toll rates to be charged at two toll plazas of the project road till FY52 is presented in **Table 4-5**. The toll fee has been rounded to nearest 5 Rupees as per toll fee rules.

FY End	Car	LCV/ M Bus	Bus/ 2A Truck	3-axle Truck	MAV	O/size/HME	Car Local
TP01 - Kognoli							
2023* (Since Nov 2022)	60	100	210	230	330	400	315
2025*	60	100	210	230	330	400	315
2026	100	165	345	375	540	655	360
2027	125	205	430	470	670	820	375
2028	135	215	450	495	710	865	390
2030	145	235	490	535	770	935	420
2035	175	285	600	655	940	1,145	515
2040	215	350	730	800	1,145	1,395	630
2045	265	425	895	975	1,400	1,705	770
2050	325	520	1,095	1,190	1,715	2,085	940
2052	350	565	1,185	1,290	1,855	2,260	1,015
TP02 - Hattargi							
2023* (Since Nov 2022)	25	40	80	90	130	155	315
2025*	25	40	80	90	130	155	315
2026	55	85	180	195	285	345	360
2027	65	110	225	245	355	430	375
2028	70	115	240	260	375	455	390
2030	75	125	260	280	405	495	420
2035	95	150	315	345	495	600	515
2040	115	185	385	420	605	735	630
2045	140	225	470	515	740	900	770
2050	170	275	575	630	905	1,100	940
2052	185	300	625	680	980	1,190	1,015

**Toll rates at 75% during six laning*

Table 4-5: Toll Rates at Toll Plaza (in Rs)

The users purchasing return journey tickets will pay 1.5 times the above toll rates; the traffic opting for monthly passes will pay 33.3 times (two-thirds of 50 single journeys) the normal traffic toll rates. All passes have been rounded to the nearest 5 Rupees as per fee rules.

4.5 Toll Revenue Estimates

The toll revenue estimates of the earlier study of May 2022 are presented in **Table 4-6**.

FY End	Toll Revenue in Rs Million
2023	986.3
2024	1,036.0
2025	1,960.1
2026	2,503.7
2027	2,728.4
2028	2,965.3
2029	3,214.2
2030	3,204.6
2031	3,327.1
2032	3,460.6
2033	3,748.8
2034	4,058.7
2035	4,390.9
2036	4,758.6
2037	5,127.2
2038	5,555.8
2039	6,000.3
2040	6,458.2
2041	6,965.8
2042	7,484.0
2043	8,071.0
2044	8,679.1
2045	9,316.2
2046	9,994.6
2047	10,694.4
2048	11,550.6
2049	12,311.9
2050	13,190.5
2051	14,112.9
2052	10,763.2
PV12 FY23 till 15th Dec in FY52	28,109

Table 4-6: Toll Revenue in Earlier Study

The projections of revenue under the present study for the project road have been presented till 15th December of FY52. Toll revenue streams have been calculated assuming that toll would be collected for all 365 days in a year and for 366 days in a leap year. The toll revenue by mode for the project road for the base case is presented in **Table 4-7**.

Toll Revenue in Rs Million								
FY End	Car	LCV	Bus	2-axle Truck	3-axle Truck	MAV	O/size/ HME	Total
2023	371.5	82.5	151.3	202.7	135.4	378.9	2.0	1,324.3
2024	308.7	71.3	131.7	174.6	116.6	336.7	1.8	1,141.4
2025	307.9	72.9	135.5	177.4	119.3	355.3	1.9	1,170.1
2026	588.8	134.8	253.5	331.2	220.3	675.4	3.6	2,207.5
2027	779.0	174.0	327.5	422.5	283.8	885.9	4.7	2,877.5
2028	886.9	188.1	356.6	454.7	308.5	990.4	5.2	3,190.4
2029	982.7	200.7	381.8	481.3	327.7	1,080.1	5.7	3,460.0
2030	1,055.1	214.3	409.7	445.9	286.6	958.0	6.2	3,376.0
2031	1,159.7	228.5	439.6	438.7	273.4	918.5	6.8	3,465.1
2032	1,275.6	244.3	471.5	428.9	257.0	873.5	7.4	3,558.2
2033	1,406.9	259.4	504.9	453.8	274.3	941.6	8.0	3,848.8
2034	1,548.5	275.1	541.7	481.7	291.6	1,023.3	8.7	4,170.6
2035	1,700.4	292.3	580.2	510.1	311.1	1,112.6	9.4	4,516.0
2036	1,861.4	313.1	623.8	542.5	332.1	1,210.7	10.2	4,893.8
2037	2,027.6	333.5	664.0	571.1	353.4	1,307.1	11.1	5,267.8
2038	2,233.6	352.4	710.1	604.4	374.9	1,416.4	12.0	5,703.8
2039	2,440.5	374.6	759.8	640.0	398.6	1,527.1	12.9	6,153.6
2040	2,653.8	401.9	812.9	677.9	425.6	1,656.6	14.0	6,642.6
2041	2,903.1	424.3	864.0	713.3	451.4	1,788.0	15.1	7,159.3
2042	3,151.7	453.2	927.4	758.1	479.3	1,931.7	16.3	7,717.7
2043	3,441.6	478.3	987.4	799.2	509.7	2,083.0	17.6	8,316.7
2044	3,742.7	510.1	1,058.8	849.0	542.6	2,252.6	19.1	8,974.9
2045	4,055.5	539.3	1,123.0	891.8	575.1	2,423.0	20.5	9,628.1
2046	4,378.7	574.5	1,196.8	941.8	609.9	2,612.6	22.1	10,336.6
2047	4,750.5	607.9	1,276.7	995.5	645.9	2,810.8	23.8	11,111.0
2048	5,174.4	646.7	1,362.6	1,053.1	688.5	3,032.1	25.7	11,983.1
2049	5,600.4	683.4	1,447.6	1,109.5	728.4	3,245.6	27.5	12,842.4
2050	6,069.0	722.7	1,540.1	1,170.2	771.3	3,495.7	29.6	13,798.6
2051	6,510.2	767.1	1,636.4	1,233.7	816.4	3,743.8	31.7	14,739.4
2052	5,014.7	578.2	1,235.7	924.4	614.1	2,854.2	24.2	11,245.4

** Till 15th December FY52*

Table 4-7: Toll Revenue for the Project Road by Mode

Majority of the revenue is expected to come from cars with about 40.2 percent of the total revenue. About 48 percent of the total revenue is likely to be generated by freight vehicles. MAVs/OSVs represent a share of around 25.8 percent of total revenue followed by 10 percent and 6.4 percent by 2 axle trucks and 3 axle trucks. LCV category and Bus category is likely to generate about 5.7 percent and 11.8 percent revenue respectively.

Vehicles paying normal tolls are around 71.9 percent of total toll revenues for the project road sections and around 27.2 percent of the traffic may opt for daily pass category. Remaining 0.9 percent may fall in monthly pass and local concession category.

4.6 Scenario Analysis

For toll road projects, revenue streams are generally based on the assessment of the traffic volume (base and future) crossing the toll plazas and the applicable toll imposed

on the user of the road. There is an inherent element of uncertainty in any forecast and whilst is not possible to measure risk in a strictly statistical sense (as many of the risks are largely or partly unknown), in this section an attempt is made at quantifying the main risks that could have an impact on this forecast.

The econometric approach used to derive traffic growth, is based on the estimation of GSDP growth rates for the influence area economies and traffic demand elasticity by mode; the estimation of both variables contains a certain degree of uncertainty which can be represented in the scenario analysis. Scenario analysis has been done in the following subheadings for the base case:

High Case

The high case is based on a more optimistic economic outlook for future years and higher elasticity values as compared to the base case. Therefore, traffic growth rates of 20 percent higher than the base case for every year and for all the mode are considered.

Low Case

A growth rate of 20 percent lower than base case for all types of vehicles has been considered in the present analysis to reflect uncertainty with regard to economic performance of PIA states and lower elasticity values.

The results of different scenarios are presented in **Table 4-8**. A comparison versus base case has been presented for the Present Value (at 12 percent discount rate) of the project revenue from FY24 till 15th December of FY52.

FY End	Toll Revenue in Rs Million		
	Base Case	High Case (+20%)	Low Case (-20%)
2023	1,324.3	1,324.3	1,324.3
2024	1,141.4	1,147.2	1,135.5
2025	1,170.1	1,182.5	1,157.7
2026	2,207.5	2,250.4	2,165.1
2027	2,877.5	2,959.3	2,797.5
2028	3,190.4	3,309.6	3,074.9
2029	3,460.0	3,618.9	3,307.4
2030	3,376.0	3,559.0	3,201.7
2031	3,465.1	3,681.8	3,260.4
2032	3,558.2	3,811.4	3,321.0
2033	3,848.8	4,157.2	3,562.6
2034	4,170.6	4,542.4	3,828.6
2035	4,516.0	4,959.3	4,111.9
2036	4,893.8	5,415.8	4,421.9
2037	5,267.8	5,874.6	4,723.7
2038	5,703.8	6,410.2	5,075.8
2039	6,153.6	6,967.8	5,435.5
2040	6,642.6	7,577.1	5,825.0
2041	7,159.3	8,227.7	6,231.8
2042	7,717.7	8,934.2	6,670.0
2043	8,316.7	9,698.9	7,135.5
2044	8,974.9	10,541.2	7,646.4
2045	9,628.1	11,389.4	8,145.5

FY End	Toll Revenue in Rs Million		
	Base Case	High Case (+20%)	Low Case (-20%)
2046	10,336.6	12,312.0	8,685.9
2047	11,111.0	13,325.8	9,273.8
2048	11,983.1	14,469.8	9,935.0
2049	12,842.4	15,611.2	10,577.9
2050	13,798.6	16,884.5	11,292.1
2051	14,739.4	18,144.0	11,991.6
2052*	11,245.4	13,929.4	9,093.3
PV12 FY24 till 15th Dec in FY52	30,809.2	33,963.3	28,053.1
PV12 till 15th Dec in FY52 vs base		10.2%	-8.9%
CAGR FY24 to FY51	9.9%	10.8%	9.1%

** Till 15th Dec FY52*

Table 4-8: Comparison of Annual Revenue Forecasts Under Different Scenarios

The low growth scenario has a negative impact on revenue PV of about 8.9 percent versus base case, whilst the optimistic growth scenario would generate about 10.2 percent higher PV than the base case.

APPENDICES

APPENDIX 2.1
PAST TRAFFIC

Traffic Study for Kagal-Belgaum section of NH-4 in the state of Maharashtra and Karnataka

Toll Plaza- Kognoli								
Month	**CJV**	**LCV**	**2-Axle**	**3-Axle**	**MAV**	**OSV**	**Total Traffic**	**PCUs**
Jan-21	11,162	1,461	2,527	936	1,658	5	17,749	31,225
Feb-21	10,471	1,498	2,633	1,008	1,787	6	17,403	31,708
Mar-21	7,329	1,410	2,516	985	1,796	5	14,041	28,051
Apr-21	9,654	1,456	2,558	976	1,747	5	16,397	30,328
May-21	9,169	1,427	2,249	915	1,665	5	15,431	28,317
Jun-21	8,684	1,398	1,940	855	1,583	4	14,464	26,306
Jul-21	6,201	1,201	1,593	777	1,477	5	11,253	21,781
Aug-21	6,739	1,354	1,861	907	1,724	5	12,590	24,856
Sep-21	8,354	1,387	1,976	926	1,745	4	14,392	27,011
Oct-21	8,252	1,234	1,841	766	1,412	5	13,509	24,298
Nov-21	13,876	1,575	2,002	873	1,590	5	19,920	32,040
Dec-21	10,394	1,749	2,177	984	1,817	5	17,126	30,699
Jan-22	8,404	1,694	2,156	940	1,817	5	15,017	28,433
Feb-22	11,061	1,832	2,513	1,009	1,884	5	18,304	32,874
Mar-22	10,861	1,707	2,716	1,033	1,938	8	18,262	33,425
Apr-22	12,011	1,497	2,837	973	1,839	6	19,163	33,988
May-22	15,221	1,555	3,188	972	1,813	5	22,754	38,214
Jun-22	12,203	1,509	2,994	983	1,855	4	19,548	34,764
Jul-22	9,655	1,456	2,885	965	1,788	6	16,755	31,463
Aug-22	11,205	1,383	2,888	968	1,825	7	18,278	33,097
Sep-22	10,389	1,391	2,935	961	1,806	9	17,490	32,327
Oct-22	13,406	1,315	2,907	909	1,769	8	20,314	34,825
Nov-22	12,766	1,406	2,977	962	1,976	8	20,095	35,621
Dec-22	13,576	1,416	2,991	977	1,995	10	20,965	36,626
Jan-23	12,837	1,380	3,065	948	2,007	8	20,245	36,013
Feb-23	13,177	1,492	3,188	994	2,104	9	20,963	37,468
Mar-23	11,801	1,479	3,101	987	2,032	13	19,412	35,483

Toll Plaza- Hattargi								
Month	**CJV**	**LCV**	**2-Axle**	**3-Axle**	**MAV**	**OSV**	**Total Traffic**	**PCUs**
Jan-21	10,862	2,153	3,678	1,169	1,791	10	19,663	36,737
Feb-21	10,074	2,143	3,431	1,218	1,925	12	18,804	35,954
Mar-21	8,219	1,892	3,050	1,132	1,870	9	16,171	32,055
Apr-21	9,718	2,063	3,386	1,173	1,862	10	18,213	34,915
May-21	10,468	2,148	3,555	1,194	1,858	11	19,233	36,345
Jun-21	8,422	1,382	2,348	887	1,632	6	14,677	27,570
Jul-21	8,508	1,354	2,286	848	1,608	7	14,611	27,208
Aug-21	8,963	1,541	2,629	1,005	1,869	8	16,014	30,621
Sep-21	7,796	1,250	2,129	809	1,418	4	13,406	24,882
Oct-21	10,436	1,621	3,020	1,105	1,926	7	18,115	33,942
Nov-21	12,215	1,429	3,187	976	1,708	6	19,520	34,559
Dec-21	10,617	1,543	3,545	1,147	1,944	7	18,802	35,784
Jan-22	9,191	1,692	3,630	1,114	1,977	7	17,610	34,885
Feb-22	11,703	1,958	3,834	1,203	2,002	7	20,707	38,790
Mar-22	10,878	1,877	3,451	1,188	2,040	9	19,444	36,835
Apr-22	12,025	1,706	3,357	1,124	1,999	7	20,217	37,049
May-22	14,188	1,712	3,572	1,106	1,954	6	22,538	39,611
Jun-22	12,035	1,705	3,401	1,104	2,100	6	20,351	37,586
Jul-22	10,415	1,646	3,196	1,057	1,966	7	18,287	34,521
Aug-22	11,038	1,570	3,232	1,071	1,979	8	18,899	35,247
Sep-22	10,666	1,592	3,287	1,065	1,956	10	18,576	34,955
Oct-22	12,546	1,530	3,413	1,060	1,897	9	20,456	36,841
Nov-22	12,180	1,687	4,074	1,295	2,136	13	21,384	40,487
Dec-22	12,955	1,767	4,175	1,312	2,163	17	22,390	41,879
Jan-23	12,024	1,733	4,292	1,308	2,171	14	21,541	41,254
Feb-23	12,126	1,877	4,079	1,407	2,303	14	21,806	41,824
Mar-23	11,366	1,881	3,626	1,338	2,218	19	20,449	39,148

APPENDIX 2.2
TRAFFIC ZONING SYSTEM

Traffic Study for Kagal-Belgaum section of NH-4 in the state of Maharashtra and Karnataka
Traffic Zoning System

Zone	Place/Region	District/ State	State/Country/Region
1	**Kagal**	Project Corridor:Kagal-Belagavi	Maharashtra
2	Karnoor/Vandur/Shankarwadi/Sulgaon		
3	Koganoli/Dattawade/Hanabarawadi/Hanchinal		Karnataka
4	Soundalga/Appachiwadi/Kurli		
5	Yamagarni/Shripewadi/Naganur		
6	**Nipani/Pattankudi**		
7	Kanagala/Hitani/Karajaga		
8	Sankeshwar/Ganganagar		
9	Hebbal/Gotur/Chikkalgud		
10	U. Khanapur/Hanchinal/Halkarni		
11	Hattargi/Anandpur/Yamakanmardi		
12	Gudagunahatti/Manahatti/Nagalotimath/Dadabanahatti		
13	Kataballi/Sutabatti		
14	Vantmuri/Ramdurg		
15	Ghugrenhatti/Bhutramhatti/Kattanbhavi		
16	**Belagavi**		
17	Desur/Khanapur	Belagavi district	
18	Hirebagewai/MK Hubli	Belagavi district	
19	Baihongal	Belagavi district	
20	Gokak/Nabapur/Hidkal/Pachapur	Belagavi district	
21	Ghatprabha/Konnur	Belagavi district	
22	Hukkeri	Belagavi district	
23	Shamanewadi/Chikodi	Belagavi district	
24	Raibag/Kudachi	Belagavi district	
25	Sadalga/Donage Tota	Belagavi district	
26	Gokul Shirgaon	Kolhapur District	Maharashtra
27	**Kolhapur**	Kolhapur District	
28	Ichalkaranji	Kolhapur District	
29	Peth Vadgaon/Vathar Tarf Vadgaon	Kolhapur District	
30	**Sangli/Miraj**	Sangli District	
31	Karad/Malkapur	Satara District	
32	**Satara**	Satara District	
33	Ratnagiri/Ganpatipule	Ratnagiri District	
34	Padharpur	Padharpur District	
35	**Solapur**	Solapur District	
36	**Pune/Lonavala/Mahabaleshwar**	Pune District	
37	**Mumbai**	Mumbai Suburban	
38	Mumbai JNPT	Mumbai Suburban	
39	Latur/Nanded	Latur/Nanded District	
40	**Aurangabad/Jalna/Ahmednagar**	Aurangabad District	
41	Dhule/Jalgaon/Nandurbar	Dhule District	
42	**Nashik**	Nashik District	
43	**Nagpur/Akola/Amravati/Yavatmal/Wardha/ Gondia/Chandrapur**	Nagpur/Akola/Amravati/Yavatmal/ Wardha/ Gondia/Chandrapur	
44	Rest of Maharashtra	Rest of Maharashtra	
45	**Hubli/Dharwad**	Hubli/Dharwad district	Karnataka
46	Bagalkote	Bagalkote district	
47	**Vijaypura**	Vijaypura district	
48	Kalaburagi	Kalaburagi district	
49	Ballari/Hosapete	Ballari district	
50	Devanagere	Devanagere district	
51	Udupi/Mangaluru	Udupi district	
52	Hassan/Chikmangalur	Hassan/Chikmanglur district	
53	**Bengaluru city**	Bengaluru district	
54	**Mysore city**	Mysore district	
55	Rest of Karnataka	Rest of Karnataka	
56	**Hyderabad city**	Hyderabad city	Telangana
57	Nizamabad/Nirmal/Adilabad/Warangal	Nizamabad/Nirmal/Adilabad/Wara ngal	
58	Rest of Telangana	Rest of Telangana	
59	Vishakhapatnam/Vijayawada	Vishakhapatnam/Vijayawada	Andhra Pradesh
60	Tirupati/Nellore/Kadapa	Tirupati/Nellore/Kadapa	
61	Rest of Andhra Pradesh	Rest of Andhra Pradesh	
62	**Chennai city**	Chennai city	Tamil Nadu
63	Madurai/Coimbatore/Tiruppur	Madurai/Coimbatore/Tiruppur	
64	Rest of Tamil Nadu	Rest of Tamil Nadu	
65	**Thiruvananthapuram/Kochi**	Thiruvananthapuram/Kochi	Kerala
66	Rest of Kerala	Rest of Kerala	
67	**Jaipur/Ajmer/Kota**	Jaipur/Ajmer/Kota	Rajasthan
68	Jodhpur/Bikaner/Udaipur	Jodhpur/Bikaner/Udaipur	
69	Rest of Rajasthan	Rest of Rajasthan	
70	**Ahmedabad/Vadodara**	Ahmedabad/Vadodara	Gujarat
71	Surat/Hazira	Surat/Hazira	
72	Rajkot/Morbi	Rajkot/Morbi	
73	Rest of Gujarat	Rest of Gujarat	
74	**Indore city**	Indore City	Madhya Pradesh
75	Bhopal	Bhopal	
76	Rest of Madhya Pradesh	Rest of Madhya Pradesh	
77	Noida/Ghaziabad	Noida/Ghaziabad	Uttar Pradesh
78	Agra/Mathura	Agra/Mathura	
79	**Lucknow/Kanpur**	Lucknow/Kanpur	
80	Rest of Uttar Pradesh	Rest of Uttar Pradesh	
81	**Delhi**	Delhi	Delhi
82	Gurgaon/Faridabad	Gurgaon/Faridabad	Haryana
83	Rest of Haryana	Rest of Haryana	
84	Punjab	Punjab	Punjab
85	Chandigarh	Chandigarh	Chandigarh
86	Uttarakhand	Uttarakhand	Uttarakhand
87	Himachal Pradesh	Himachal Pradesh	Himachal Pradesh
88	Jammu Kashmir & Ladakh	Jammu Kashmir & Ladakh	Jammu Kashmir & Ladakh
89	Bihar	Bihar	Bihar
90	West Bengal	West Bengal	West Bengal
91	Chhattisgarh	Chhattisgarh	Chhattisgarh
92	Odisha	Odisha	Odisha
93	Jharkhand	Jharkhand	Jharkhand
94	Goa	Goa	Goa
95	Assam /North eastern states	Assam /North eastern states	Assam /North eastern states

APPENDIX 2.3
MODE WISE TOP 20 OD PAIRS

Traffic Study for Kagal-Belgaum section of NH-4 in the state of Maharashtra and Karnataka

TOP 20 Origin Destination Pairs at TP01-KOGNOLI

Car

S.No.	Origin	Destination	% of total
1	Nipani/Pattankudi	Kolhapur	19%
2	Belagavi	Kolhapur	11%
3	Kagal	Nipani/Pattankudi	6%
4	Sankeshwar/Gangangar	Kolhapur	6%
5	Nipani/Pattankudi	Pune/Lonavala/Mahabaleshwar	4%
6	Kolhapur	Goa	3%
7	Kagal	Belagavi	3%
8	Belagavi	Pune/Lonavala/Mahabaleshwar	3%
9	Shamanewadi/Chikodi	Kolhapur	2%
10	Belagavi	Mumbai	2%
11	Nipani/Pattankudi	Sangli/Miraj	2%
12	Nipani/Pattankudi	Mumbai	2%
13	Belagavi	Sangli/Miraj	1%
14	Pune/Lonavala/Mahabaleshwar	Bengaluru city	1%
15	Kagal	Soundalga/Appachiwadi/Kurli	1%
16	Kagal	Sankeshwar/Gangangar	1%
17	Soundalga/Appachiwadi/Kurli	Kolhapur	1%
18	Kagal	Shamanewadi/Chikodi	1%
19	Sankeshwar/Gangangar	Mumbai	1%
20	Kagal	Goa	1%
		Total	**71%**

Mini Bus

S.No.	Origin	Destination	% of total
1	Nipani/Pattankudi	Kolhapur	20%
2	Belagavi	Kolhapur	17%
3	Belagavi	Pune/Lonavala/Mahabaleshwar	9%
4	Belagavi	Mumbai	8%
5	Kagal	Nipani/Pattankudi	6%
6	Sankeshwar/Gangangar	Pune/Lonavala/Mahabaleshwar	4%
7	Shamanewadi/Chikodi	Mumbai	4%
8	Mumbai	Bengaluru city	4%
9	Mumbai	Goa	4%
10	Kagal	Belagavi	3%
11	Soundalga/Appachiwadi/Kurli	Mumbai	2%
12	Nipani/Pattankudi	Mumbai	2%
13	Sankeshwar/Gangangar	Kolhapur	2%
14	Sadalga/Donage Tota	Mumbai	2%
15	Kolhapur	Bengaluru city	2%
16	Pune/Lonavala/Mahabaleshwar	Bengaluru city	2%
17	Pune/Lonavala/Mahabaleshwar	Rest of Tamil Nadu	2%
18	Pune/Lonavala/Mahabaleshwar	Rest of Kerala	2%
19	Pune/Lonavala/Mahabaleshwar	Goa	2%
20	Mumbai	Rest of Kerala	2%
		Total	**97%**

Bus

S.No.	Origin	Destination	% of total
1	Belagavi	Kolhapur	24%
2	Nipani/Pattankudi	Kolhapur	10%
3	Kagal	Nipani/Pattankudi	8%
4	Sankeshwar/Gangangar	Kolhapur	7%
5	Belagavi	Pune/Lonavala/Mahabaleshwar	5%
6	Hattargi/Anandpur/Yamakanmardi	Nagpur/Akola/Amravati/Yavatmal/Wardha/ Gondia/Chandrapur	4%
7	Pune/Lonavala/Mahabaleshwar	Bengaluru city	3%
8	Nipani/Pattankudi	Mumbai	3%
9	Belagavi	Mumbai	3%
10	Kagal	Belagavi	2%
11	Kolhapur	Bengaluru city	2%
12	Belagavi	Satara	2%
13	Nipani/Pattankudi	Pune/Lonavala/Mahabaleshwar	2%
14	Shamanewadi/Chikodi	Mumbai	1%
15	Shamanewadi/Chikodi	Kolhapur	1%
16	Mumbai	Bengaluru city	1%
17	Pune/Lonavala/Mahabaleshwar	Goa	1%
18	Kolhapur	Bagalkote	1%
19	Sankeshwar/Gangangar	Mumbai	1%
20	Sankeshwar/Gangangar	Pune/Lonavala/Mahabaleshwar	1%
		Total	**82%**

MLCV

S.No.	Origin	Destination	% of total
1	Nipani/Pattankudi	Kolhapur	17%
2	Belagavi	Kolhapur	15%
3	Kagal	Nipani/Pattankudi	5%
4	Nipani/Pattankudi	Mumbai	4%
5	Sankeshwar/Gangangar	Kolhapur	4%
6	Belagavi	Mumbai	4%
7	Hebbal/Gotur/Chikkaloud	Kolhapur	3%
8	Kagal	Belagavi	3%
9	Pune/Lonavala/Mahabaleshwar	Bengaluru city	3%
10	Belagavi	Pune/Lonavala/Mahabaleshwar	2%
11	Kolhapur	Hubli/Dharwad	2%
12	Kolhapur	Bengaluru city	2%
13	Soundalga/Appachiwadi/Kurli	Kolhapur	2%
14	Nipani/Pattankudi	Nagpur/Akola/Amravati/Yavatmal/Wardha/ Gondia/Chandrapur	2%
15	Belagavi	Nagpur/Akola/Amravati/Yavatmal/Wardha/ Gondia/Chandrapur	2%
16	Belagavi	Sangli/Miraj	2%
17	Nipani/Pattankudi	Pune/Lonavala/Mahabaleshwar	2%
18	Hebbal/Gotur/Chikkaloud	Mumbai	2%
19	Kagal	Soundalga/Appachiwadi/Kurli	1%
20	Hebbal/Gotur/Chikkaloud	Pune/Lonavala/Mahabaleshwar	1%
		Total	**78%**

Traffic Study for Kagal-Belgaum section of NH-4 in the state of Maharashtra and Karnataka

TOP 20 Origin Destination Pairs at TP01-KOGNOLI

LCV

S.No.	Origin	Destination	% of total
1	Mumbai	Bengaluru city	10%
2	Belagavi	Mumbai	9%
3	Belagavi	Kolhapur	9%
4	Pune/Lonavala/Mahabaleshwar	Bengaluru city	6%
5	Belagavi	Pune/Lonavala/Mahabaleshwar	6%
6	Nipani/Pattankudi	Kolhapur	5%
7	Kolhapur	Bengaluru city	4%
8	Pune/Lonavala/Mahabaleshwar	Chennai city	3%
9	Kagal	Nipani/Pattankudi	2%
10	Hebbal/Gotur/Chikkaloud	Pune/Lonavala/Mahabaleshwar	2%
11	Mumbai	Chennai city	2%
12	Mumbai	Hubli/Dharwad	2%
13	Hebbal/Gotur/Chikkaloud	Kolhapur	2%
14	Pune/Lonavala/Mahabaleshwar	Hubli/Dharwad	1%
15	Mumbai	Rest of Tamil Nadu	1%
16	Belagavi	Rest of Gujarat	1%
17	Nipani/Pattankudi	Mumbai	1%
18	Kolhapur	Hubli/Dharwad	1%
19	Pune/Lonavala/Mahabaleshwar	Rest of Tamil Nadu	1%
20	Pune/Lonavala/Mahabaleshwar	Rest of Kerala	1%
		Total	**71%**

2 Axle

S.No.	Origin	Destination	% of total
1	Belagavi	Mumbai	12%
2	Mumbai	Bengaluru city	10%
3	Belagavi	Pune/Lonavala/Mahabaleshwar	9%
4	Pune/Lonavala/Mahabaleshwar	Bengaluru city	7%
5	Belagavi	Kolhapur	6%
6	Nipani/Pattankudi	Kolhapur	4%
7	Kolhapur	Bengaluru city	3%
8	Nipani/Pattankudi	Mumbai	2%
9	Belagavi	Satara	2%
10	Kagal	Nipani/Pattankudi	2%
11	Pune/Lonavala/Mahabaleshwar	Rest of Tamil Nadu	2%
12	Mumbai	Chennai city	1%
13	Satara	Bengaluru city	1%
14	Kolhapur	Goa	1%
15	Belagavi	Nagpur/Akola/Amravati/Yavatmal/Wardha/ Gondia/Chandrapur	1%
16	Nagpur/Akola/Amravati/Yavatmal/Wardha/ Gondia/Chandrapur	Bengaluru city	1%
17	Nagpur/Akola/Amravati/Yavatmal/Wardha/ Gondia/Chandrapur	Rest of Karnataka	1%
18	Bengaluru city	Rest of Gujarat	1%
19	Mumbai	Rest of Kerala	1%
20	Belagavi	Sangli/Miraj	1%
		Total	**68%**

3 Axle

S.No.	Origin	Destination	% of total
1	Mumbai	Bengaluru city	13%
2	Belagavi	Mumbai	9%
3	Pune/Lonavala/Mahabaleshwar	Bengaluru city	6%
4	Belagavi	Kolhapur	6%
5	Belagavi	Pune/Lonavala/Mahabaleshwar	5%
6	Kolhapur	Bengaluru city	4%
7	Mumbai	Rest of Tamil Nadu	4%
8	Mumbai	Chennai city	3%
9	Mumbai	Rest of Kerala	3%
10	Bengaluru city	Rest of Gujarat	3%
11	Nipani/Pattankudi	Kolhapur	2%
12	Belagavi	Rest of Gujarat	2%
13	Mumbai	Hubli/Dharwad	2%
14	Rest of Tamil Nadu	Rest of Gujarat	2%
15	Satara	Bengaluru city	2%
16	Hebbal/Gotur/Chikkaloud	Pune/Lonavala/Mahabaleshwar	1%
17	Belagavi	Nagpur/Akola/Amravati/Yavatmal/Wardha/ Gondia/Chandrapur	1%
18	Nagpur/Akola/Amravati/Yavatmal/Wardha/ Gondia/Chandrapur	Bengaluru city	1%
19	Hebbal/Gotur/Chikkaloud	Kolhapur	1%
20	Hebbal/Gotur/Chikkaloud	Mumbai	1%
		Total	**72%**

MAV

S.No.	Origin	Destination	% of total
1	Mumbai	Bengaluru city	11%
2	Bengaluru city	Rest of Gujarat	8%
3	Mumbai	Rest of Tamil Nadu	7%
4	Pune/Lonavala/Mahabaleshwar	Bengaluru city	6%
5	Belagavi	Mumbai	5%
6	Belagavi	Kolhapur	5%
7	Kolhapur	Bengaluru city	4%
8	Belagavi	Pune/Lonavala/Mahabaleshwar	4%
9	Rest of Tamil Nadu	Rest of Gujarat	3%
10	Mumbai	Rest of Kerala	2%
11	Belagavi	Rest of Gujarat	2%
12	Mumbai	Hubli/Dharwad	2%
13	Mumbai	Chennai city	2%
14	Nipani/Pattankudi	Kolhapur	2%
15	Pune/Lonavala/Mahabaleshwar	Rest of Tamil Nadu	2%
16	Nagpur/Akola/Amravati/Yavatmal/Wardha/ Gondia/Chandrapur	Bengaluru city	1%
17	Rest of Kerala	Rest of Gujarat	1%
18	Pune/Lonavala/Mahabaleshwar	Rest of Kerala	1%
19	Hebbal/Gotur/Chikkaloud	Mumbai	1%
20	Sankeshwar/Ganganagar	Kolhapur	1%
		Total	**73%**

Traffic Study for Kagal-Belgaum section of NH-4 in the state of Maharashtra and Karnataka
TOP 20 Origin Destination Pairs at TP02-HATTARGI

Car

S.No.	Origin	Destination	% of total
1	Belagavi	Kolhapur	13%
2	Sankeshwar/Ganganagar	Belagavi	11%
3	Belagavi	Shamanewadi/Chikodi	10%
4	Nipani/Pattankudi	Belagavi	7%
5	Belagavi	Hukkeri	6%
6	Kolhapur	Goa	6%
7	Belagavi	Pune/Lonavala/Mahabaleshwar	3%
8	Belagavi	Sangli/Miraj	3%
9	Hatibal/Gotur/Chikkaloud	Belagavi	2%
10	Kagal	Belagavi	2%
11	Sankeshwar/Ganganagar	Hattargi/Anandpur/Yamakanmardi	2%
12	Sankeshwar/Ganganagar	Hubli/Dharwad	2%
13	Shamanewadi/Chikodi	Hubli/Dharwad	2%
14	Belagavi	Rabkavi/Kudachi	2%
15	Nipani/Pattankudi	Hubli/Dharwad	2%
16	Pune/Lonavala/Mahabaleshwar	Bengaluru city	1%
17	Belagavi	Vijayapura	1%
18	Belagavi	Mumbai	1%
19	Kolhapur	Ramnagara city	1%
20	U. Khanapur/Hanchinal/Hatkanni	Belagavi	1%
		Total	**74%**

Mini Bus

S.No.	Origin	Destination	% of total
1	Sankeshwar/Ganganagar	Belagavi	19%
2	Belagavi	Shamanewadi/Chikodi	8%
3	Nipani/Pattankudi	Belagavi	7%
4	Hatibal/Gotur/Chikkaloud	Belagavi	7%
5	Belagavi	Hukkeri	5%
6	Belagavi	Kolhapur	4%
7	U. Khanapur/Hanchinal/Hatkanni	Belagavi	4%
8	Kanal	Belagavi	3%
9	Belagavi	Satara	3%
10	Nipani/Pattankudi	Hattargi/Anandpur/Yamakanmardi	3%
11	Hatibal/Gotur/Chikkaloud	Hattargi/Anandpur/Yamakanmardi	3%
12	Pune/Lonavala/Mahabaleshwar	Hubli/Dharwad	3%
13	Pune/Lonavala/Mahabaleshwar	Bengaluru city	3%
14	Belagavi	Sangli/Miraj	2%
15	Belagavi	Pune/Lonavala/Mahabaleshwar	2%
16	Kamoor/Vandur/Shankarwadi/Sulagon	Ghutrenhatti/Bhutramhatti/Kattanbhavi	1%
17	Nipani/Pattankudi	Hubli/Dharwad	1%
18	Nipani/Pattankudi	Thiruvananthapuram/Kochi	1%
19	Nipani/Pattankudi	Goa	1%
20	Hatibal/Gotur/Chikkaloud	Ghutrenhatti/Bhutramhatti/Kattanbhavi	1%
		Total	**79%**

Bus

S.No.	Origin	Destination	% of total
1	Belagavi	Kolhapur	17%
2	Belagavi	Shamanewadi/Chikodi	14%
3	Belagavi	Vijayapura	9%
4	Sankeshwar/Ganganagar	Belagavi	6%
5	Belagavi	Hukkeri	5%
6	Belagavi	Pune/Lonavala/Mahabaleshwar	4%
7	Belagavi	Sangli/Miraj	4%
8	Belagavi	Belagavi	3%
9	Sankeshwar/Ganganagar	Hattargi/Anandpur/Yamakanmardi	3%
10	Belagavi	Mumbai	2%
11	Belagavi	Rabkavi/Kudachi	2%
12	Pune/Lonavala/Mahabaleshwar	Hubli/Dharwad	2%
13	Kolhapur	Hubli/Dharwad	2%
14	Shamanewadi/Chikodi	Bengaluru city	2%
15	Kagal	Belagavi	2%
16	Belagavi	Ghattarganti	1%
17	Pune/Lonavala/Mahabaleshwar	Bengaluru city	1%
18	Hatibal/Gotur/Chikkaloud	Belagavi	1%
19	Mumbai	Bengaluru city	1%
20	Kolhapur	Davanagere	1%
		Total	**82%**

LCV

S.No.	Origin	Destination	% of total
1	Sankeshwar/Ganganagar	Belagavi	13%
2	Sankeshwar/Ganganagar	Hattargi/Anandpur/Yamakanmardi	10%
3	Nipani/Pattankudi	Belagavi	10%
4	Pattankudi	Kolhapur	8%
5	Pattankudi	Shamanewadi/Chikodi	6%
6	Pattankudi	Mudkavi	4%
7	Pattankudi	Pune/Lonavala/Mahabaleshwar	3%
8	Belagavi	Ghatprabha/Konnur	3%
9	Belagavi	Mumbai	3%
10	Pune/Lonavala/Mahabaleshwar	Hubli/Dharwad	3%
11	Pattankudi	Sangli/Miraj	3%
12	Hatibal/Gotur/Chikkaloud	Belagavi	3%
13	Kolhapur	Hubli/Dharwad	1%
14	Pattankudi	Rachan/Vrutachi	1%
15	Sankeshwar/Ganganagar	Ramdurg city	1%
16	Nipani/Pattankudi	Hubli/Dharwad	1%
17	Nipani/Pattankudi	Hattargi/Anandpur/Yamakanmardi	1%
18	Kamoor/Vandur/Shankarwadi/Sulagon	Belagavi	1%
19	Hattargi/Anandpur/Yamakanmardi	Shamanewadi/Chikodi	1%
20	Hattargi/Anandpur/Yamakanmardi	Kolhapur	1%
		Total	**74%**

Traffic Study for Kagal-Belgaum section of NH-4 in the state of Maharashtra and Karnataka
TOP 20 Origin Destination Pairs at TP02-HATTARGI

LCV			
S. No.	**Origin**	**Destination**	**% of total**
1	Mumbai	Bengaluru city	10%
2	Belagavi	Kolhapur	9%
3	Pune/Lonavala/Mahabaleshwar	Bengaluru city	8%
4	Belagavi	Pune/Lonavala/Mahabaleshwar	5%
5	Nipani/Pattankudi	Belagavi	5%
6	Sankeshwar/Gjanyanagar	Belagavi	4%
7	Belagavi	Mumbai	4%
8	Belagavi	Shamgnewadi/Chikodi	4%
9	Pune/Lonavala/Mahabaleshwar	Hubli/Dharwad	3%
10	Kolhapur	Bengaluru city	3%
11	Kolhapur	Hubli/Dharwad	2%
12	Belagavi	Hukkeri	2%
13	Pune/Lonavala/Mahabaleshwar	Chennai city	1%
14	Nipani/Pattankudi	Bengaluru city	1%
15	Belagavi	Sanoli/Mirai	1%
16	Belagavi	Rest of Gujarat	1%
17	H. Khasanur/Hanchinal/Hattiganti	Hathern/Assandivor/Yamakanmardi	1%
18	Shamgnewadi/Chikodi	Hubli/Dharwad	1%
19	Mumbai	Rest of Kerala	1%
20	Kagal	Belagavi	1%
		Total	**68%**

2 Axle			
S.No.	**Origin**	**Destination**	**% of total**
1	Belagavi	Hukkeri	11%
2	Belagavi	Pune/Lonavala/Mahabaleshwar	9%
3	Belagavi	Mumbai	9%
4	Mumbai	Bengaluru city	7%
5	Pune/Lonavala/Mahabaleshwar	Bengaluru city	5%
6	Belagavi	Kolhapur	4%
7	Kolhapur	Bengaluru city	9%
8	Pune/Lonavala/Mahabaleshwar	Hubli/Dharwad	5%
9	Kolhapur	Hubli/Dharwad	3%
10	Nipani/Pattankudi	Belagavi	3%
11	Belagavi	Shamgnewadi/Chikodi	3%
12	Sankeshwar/Gjanyanagar	Belagavi	1%
13	Mumbai	Chennai city	1%
14	Kolhapur	Rest of Tamil Nadu	1%
15	Pune/Lonavala/Mahabaleshwar	Chennai city	1%
16	Bengaluru city	Surat/Hazira	1%
17	Hattargi/Anandpur/Yamakanmardi	Pune/Lonavala/Mahabaleshwar	1%
18	Nipani/Pattankudi	Hubli/Dharwad	1%
19	Kanasala/Hitani/Karalasa	Belagavi	1%
20	Hattargi/Anandpur/Yamakanmardi	Kolhapur	1%
		Total	**66%**

3 Axle			
S. No.	**Origin**	**Destination**	**% of total**
1	Mumbai	Bengaluru city	10%
2	Belagavi	Hukkeri	9%
3	Pune/Lonavala/Mahabaleshwar	Bengaluru city	8%
4	Belagavi	Kolhapur	5%
5	Belagavi	Pune/Lonavala/Mahabaleshwar	5%
6	Mumbai	Rest of Tamil Nadu	4%
7	Belagavi	Mumbai	3%
8	Sankeshwar/Gjanyanagar	Belagavi	3%
9	Kolhapur	Bengaluru city	2%
10	Pune/Lonavala/Mahabaleshwar	Hubli/Dharwad	2%
11	Bengaluru city	Rest of Gujarat	2%
12	Mumbai	Chennai city	2%
13	Mumbai	Rest of Kerala	2%
14	Nipani/Pattankudi	Belagavi	2%
15	Kolhapur	Hubli/Dharwad	1%
16	Bengaluru city	Ahmedabad/Vadodara	1%
17	Belagavi	Rest of Gujarat	1%
18	Pune/Lonavala/Mahabaleshwar	Kasaol/Mangaluru	1%
19	Mumbai	Hubli/Dharwad	1%
20	Nipani/Pattankudi	Hubli/Dharwad	1%
		Total	**65%**

MAV			
S. No.	**Origin**	**Destination**	**% of total**
1	Mumbai	Bengaluru city	8%
2	Pune/Lonavala/Mahabaleshwar	Bengaluru city	8%
3	Mumbai	Chennai city	6%
4	Bengaluru city	Rest of Gujarat	5%
5	Belagavi	Mumbai	4%
6	Belagavi	Kolhapur	4%
7	Belagavi	Pune/Lonavala/Mahabaleshwar	4%
8	Mumbai	Rest of Tamil Nadu	3%
9	Nipani/Pattankudi	Belagavi	2%
10	Pune/Lonavala/Mahabaleshwar	Hubli/Dharwad	2%
11	Belagavi	Rest of Gujarat	2%
12	Chennai city	Rest of Gujarat	2%
13	Kolhapur	Bengaluru city	2%
14	Mumbai	Uttan/Mangaluru	1%
15	Mumbai	Rest of Kerala	1%
16	Sankeshwar/Gjanyanagar	Belagavi	1%
17	Pune/Lonavala/Mahabaleshwar	Chennai city	1%
18	Pune/Lonavala/Mahabaleshwar	Rest of Kerala	1%
19	Rannebenn city	Delhi	1%
20	Mumbai	Hubli/Dharwad	1%
		Total	**69%**

Intended for

NATIONAL HIGHWAYS INFRA PROJECTS PRIVATE LIMITED

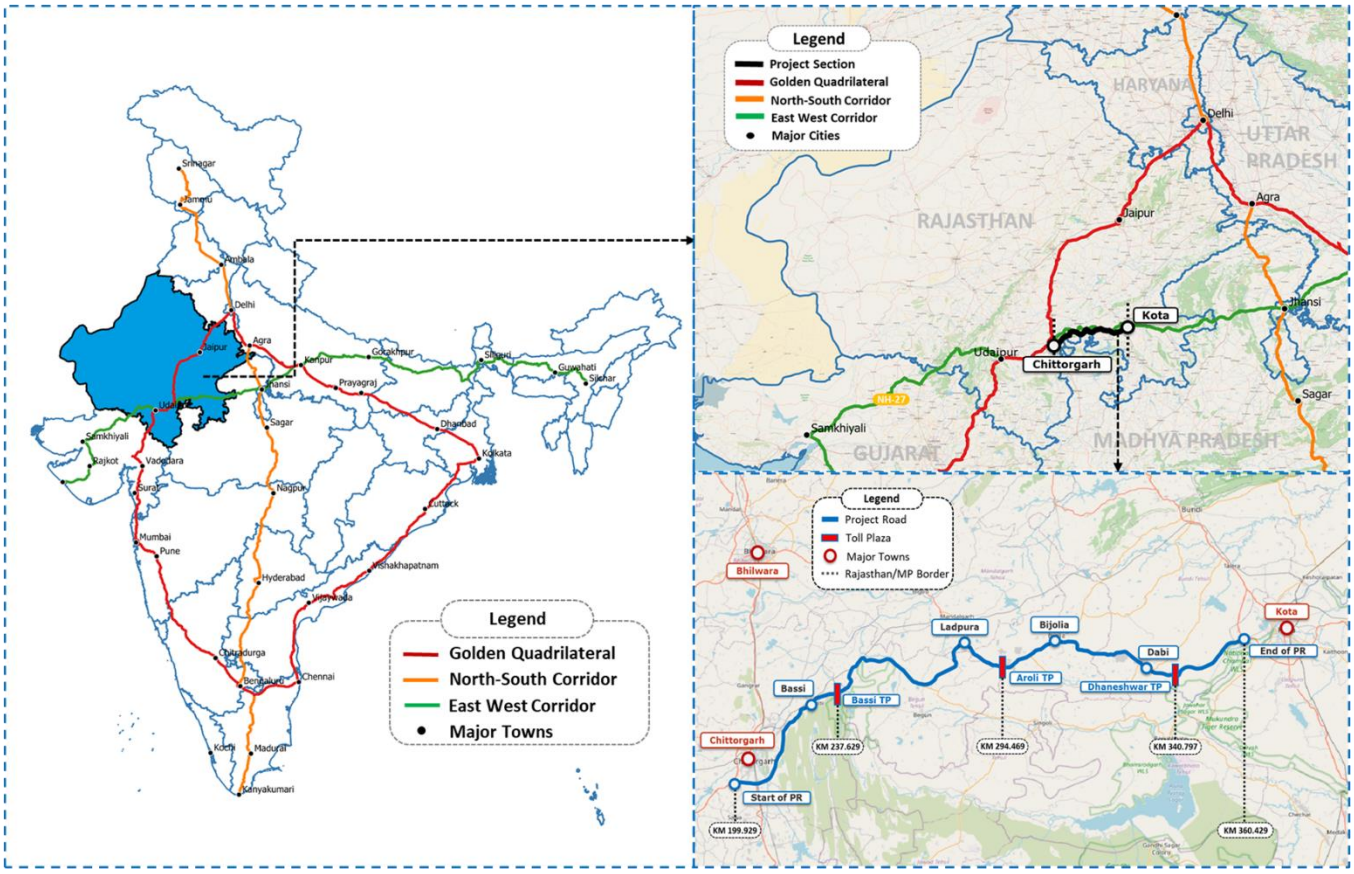
Document type

Traffic Study Report

Date

May 2023

TRAFFIC STUDY FOR CHITTORGARH-KOTA SECTION OF NH-27 IN THE STATE OF RAJASTHAN



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ABBREVIATIONS

%	Percentage
2A	2 Axle truck
3A	3 Axle truck
AADT	Annual Average Daily Traffic
ADT	Average Daily Traffic
AR	Alternate Route
BIA	Broad Influence Area
CAGR	Compounded Annual Growth Rate
FY	Financial Year
GDP	Gross Domestic Product
GSDP	Gross State Domestic Product
IIA	Immediate Influence Area
IRC	Indian Road Congress
Km	Kilometre
LCV	Light Commercial Vehicle
M Bus	Minibus
MAV	Multi Axle Vehicle
MLCV	Mini LCV
NH	National Highway
NHAI	National Highway Authority of India
NHDP	National Highway Development Program
NHIIMPL	National Highways Infra Investment Managers Private Limited
NPV	Net Present Value
OD	Origin-Destination survey
PCU	Passenger Car Unit
PIA	Project Influence Area
PR	Project Road
PV	Present Value
Rs/₹	Rupees
SEZ	Special Economic Zone
Sq.km	Square Kilometre
TP	Toll Plaza
WPI	Wholesale Price Index
YOY	Year on Year

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Appendix 2.3 Top 20 OD pairs

EXECUTIVE SUMMARY

Project Overview

The project highway, NH-27, is part of the East – West corridor envisaged under National Highway Development Program (Phase – II). The total length of NH-27 is roughly 3,530 km starting from Porbandar in the state of Gujarat and ending at Silchar in the state of Assam while passing through the states of Rajasthan, Madhya Pradesh, Uttar Pradesh, Bihar and West Bengal. NH–27 connects important tourist and industrial cities and towns like Porbandar (port city), Rajkot, Palanpur, Udaipur, Chittorgarh, Jhansi, Kanpur, Lucknow, Muzaffarpur, Purnea, Siliguri, Jalpaiguri etc.

The project road section Chittorgarh-Kota, with approximate length of 160.5 km, starts near Chittorgarh in Chittorgarh district and ends near Kota in Kota district. There are three operational toll plazas on the project road, one near Bassi (TP01), one near Aroli Bassi (TP02), and another near Dhaneshwar Bassi (TP03).

Figure 0-1 shows the network context and alignment of project road with major places along the highway.

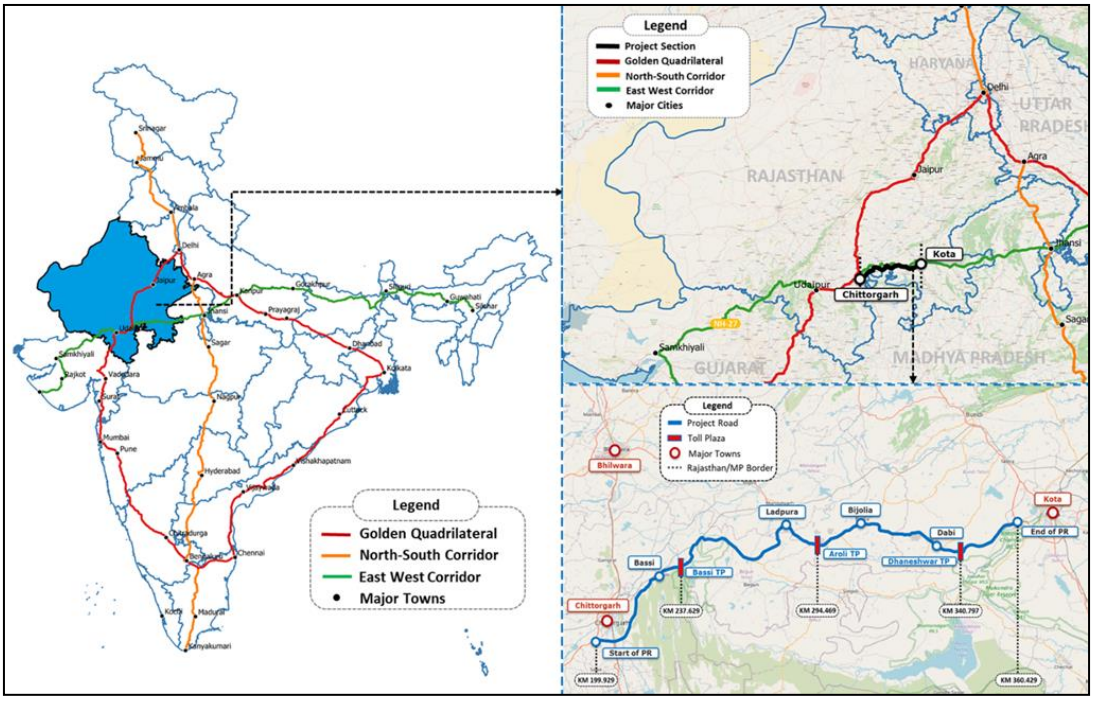


Figure 0-1: Chittorgarh-Kota Section and Location of Toll Plazas

Project Road Characteristics and Profile of Influencing Districts

The project road serves as a major route for east-west long-distance traffic which is majorly plying between Lucknow/Gorakhpur/eastern region and Palanpur/Rajkot/ western region, while also catering to short-distance traffic between Bundi/ Kota/ Baran and Udaipur/ Chittorgarh areas. The project road section is located in the districts of Chittorgarh, Bhilwara, Bundi and Kota districts in the state of Rajasthan.

The economy of Chittorgarh district is predominated by agriculture with major crops grown in the district are maize, soyabean, groundnut, sorghum, cotton and black gram in kharif season and wheat, mustard, gram, barley and opium in rabi season. The district is rich in mineral resources like barytes, china clay, limestone, sandstone and ochre.

Bhilwara district is located in south-eastern part of Rajasthan and its economy driven by agriculture with major crops grown in the district being maize, oil seeds, wheat, pulses, jowar, bajra and some fruits and vegetables. The district is also well established in textile industry along with several agro based industries. The district is also rich in mineral resources like lead, zinc, soap stone, china clay, feldspar, quartz, mica, marble, granite, asbestos and garnet.

Bundi district is also mainly dependent on agriculture for its economic growth with major agricultural crops include pulses, wheat, gram, barley, cotton, tobacco and oil seeds. Important fruit trees in Bundi include orange, pomegranate, lemon, guava and mango. Textile, tourism, handicrafts and small-scale industries play a pivotal role in the economic prosperity of Bundi in Rajasthan.

Kota district is trade centre for cotton, millet, wheat, coriander and oilseeds. Major cultivated crops include soybean, paddy and maize in kharif season while rapeseed & mustard, wheat, coriander and gram in rabi season. The industries prevalent in the district include cotton and oilseed milling, textile weaving, distilling, dairying, and the manufacture of metal handcrafts. Kota city is known as the "Education hub of India" with the presence of several coaching institutes for engineering and medical entrance exams. Kota is one of the industrial hubs in northern India, with chemical, cement, engineering, and power plants. Kota is rich in Kota stone, limestone, red clay, glass sand, dolomite and kankar along with reported occurrence of iron ore, fire clay, red and yellow ochre.

Historical Traffic Volume and Vehicle Composition

The past toll traffic data for all the toll plazas was made available by the client from January 2021 to March 2023 is presented in **Figure 0-2**.

Figure 0-2: Month on Month Traffic Data for Bassi TP, Aroli TP and Dhaneshwar TP

AADT for FY23

The past toll traffic data for all the toll plazas was made available by the client from January 2021 to March 2023.

For the period from April 2022 to July 2022, the corresponding monthly data for reusage of local pass and exemptions for cars were either not recorded or there were inconsistencies. Therefore, for reusage of local pass, the average between August 2022 to March 2023 has been considered to be applicable for the months of April 2022 to June/July 2022 for the three toll plazas. In case of exemptions, the average between August 2022 to March 2023 has been considered for the months of April 2022 to July 2022 for all the toll plazas to arrive at the monthly ADT for these months. For FY23, high

numbers were recorded for cars in cash-violation category have not been considered for the AADT estimation. The 12-month average traffic from April 2022 to March 2023 has been taken as the AADT for FY23 at all the three toll plaza locations which are presented in **Table 0-1**.

Location/ Mode	Car/Jeep/ Van/Taxi	LCV	2A	3A	MAV	OSV	PCUs
TP01	2,288	87	382	261	1,202	3	9,767
TP02	2,410	98	485	284	1,273	3	10,605
TP03	2,262	100	516	455	1,486	4	12,029

Table 0-1: AADT for FY23

Travel Pattern

- The car traffic originating from/to Chittorgarh & surroundings to/from Kota & surroundings is about 11.4-12.8 percent at all the toll plazas.
- About 11.1-14.4 percent of car traffic at TP02 and TP03 were found to be traveling between Bhilwara & surroundings and Kota & beyond.
- In case of MAV, 14.7-18.2 percent of MAV at TP02 and TP03 were found to be travelling between Bhilwara & surroundings and Kota & beyond.
- The MAV traffic originating from/to Chittorgarh & surroundings to/from Kota & surroundings is about 25.6-39.1 percent at all the toll plazas.

Network Impacts

Delhi–Mumbai Expressway is an under-construction greenfield (8 lane facility) 1,380 km long controlled-access highway connecting the national capital Delhi with India's commercial capital Mumbai and will cut down the travel time between the two cities from 25 hours to 12 hours.

The estimation of traffic diversion away or to the project road has been done for three different streams of traffic which are listed below:

- Diversion away from PR for the traffic plying between Gandhidham/ Ahmedabad/ rest of Gujarat to Kota & beyond (towards Jhansi/ Lucknow/ Kanpur) - Stream A
- Diversion away from PR for the traffic plying between Vadodara & surroundings to Kota & beyond (towards Jhansi/ Lucknow/ Kanpur) - Stream B
- Diversion to PR for the traffic plying between Haryana/ Delhi & beyond to Chittorgarh/ Udaipur & surroundings currently using the route via Delhi – Jaipur – Kishangarh – Chittorgarh (via NH8/NH76/NH79A)

The impacts for both the cases have been derived separately and their net impact has been presented in **Table 0-2**.

Modes	3A	MAV
Loss from PR- Stream A		
Potential Traffic	42	108
% Diversion from PR	60.2	62.4
Diversion from PR	-25	-68
Loss from PR- Stream B		
Potential Traffic	25	106
% Diversion from PR	96.5	96.7
Diversion from PR	-24	-102
Total Loss from PR		
Expected loss from PR (Stream A+ Stream B)	-49	-170
Gain to PR		
Potential Traffic	306	794
% Gain in PR Traffic	32.7	30.7
Expected Gain to PR	100	244
Net gain to the PR		
Net Gain to PR	51	74
As Percentage of AADT		
TP01	19.5%	6.2%
TP02	18.0%	5.8%
TP03	11.2%	5.0%
Adopted – 50% gain		
TP01	9.8%	3.1%
TP02	9.0%	2.9%
TP03	5.6%	2.5%

Table 0-2: Impacts due to Delhi - Mumbai Expressway (DME)

The DME is likely to be fully operational by FY25. The adopted total divertible traffic corresponds to about 6-10 percent of 3A Trucks and 2-3 percent of MAVs across all the toll plazas. The traffic shift is likely to happen gradually and hence the traffic gain has been considered in phases with 50 percent in FY25, 75 percent in FY26 and 100 percent from FY27 onwards.

Traffic Growth Rates

The estimated traffic growth rates for the project road have been presented in **Table 0-3**.

FY/Modes	Cars/MLCV	Bus	LCV/M Bus	2A	3A	MAV
2024	5.9	4.0	2.9	2.7	4.0	5.7
2025	6.2	4.2	3.0	2.8	4.2	6.0
2026	6.6	4.5	3.2	3.0	4.5	6.4
2027	6.6	4.5	3.2	3.0	4.5	6.4
2028	6.4	4.3	3.1	2.9	4.4	6.2
2029	6.0	4.0	2.9	2.8	4.1	5.8
2030	6.0	4.0	2.9	2.8	4.1	5.8
2031	5.5	4.0	2.9	2.8	4.1	5.2
2032	5.5	4.0	2.9	2.8	4.1	5.2
2033	5.5	4.0	2.9	2.8	4.1	5.2
2034	5.4	4.0	2.9	2.7	4.0	5.1
2035	5.3	3.9	2.8	2.7	4.0	5.0
2036	5.2	3.8	2.8	2.6	3.9	4.9
2037	5.1	3.8	2.7	2.6	3.8	4.8
2038	5.0	3.7	2.7	2.5	3.7	4.8
2039	4.9	3.6	2.6	2.5	3.7	4.7
2040	4.8	3.6	2.6	2.4	3.6	4.6
2041	4.7	3.5	2.5	2.4	3.5	4.5
2042	4.7	3.5	2.5	2.4	3.5	4.5
2043	4.6	3.4	2.5	2.3	3.5	4.4
2044	4.5	3.4	2.4	2.3	3.4	4.3
2045	4.4	3.3	2.4	2.2	3.3	4.2
2046	4.4	3.2	2.3	2.2	3.3	4.1
2047	4.3	3.2	2.3	2.1	3.2	4.1
2048	4.2	3.1	2.2	2.1	3.1	4.0
2049	4.1	3.0	2.2	2.1	3.0	3.9
2050	4.0	3.0	2.1	2.0	3.0	3.8
2051	3.7	2.7	2.0	1.9	2.8	3.5
2052	3.7	2.7	2.0	1.9	2.8	3.5

Table 0-3: Projected Traffic Growth Rates for Project Road (%)

The implied traffic growth rates for freight vehicles of 2A/3A and MAV after considering the impact of diversion from DME in FY25 to FY27 under the base case have been presented in **Table 0-4**.

FY/Modes	TP01			TP02			TP03		
	2A	3A	MAV	2A	3A	MAV	2A	3A	MAV
2025	2.8	9.3	7.6	2.8	8.9	7.5	2.8	7.1	7.3
2026	3.0	6.9	7.2	3.0	6.7	7.1	3.0	5.9	7.0
2027	3.0	6.9	7.2	3.0	6.7	7.1	3.0	5.9	7.0

Table 0-4: Implied Traffic Growth Rates for Project Road After Diversion to DME (%)

Projected Mode-wise Traffic

Mode-wise projected traffic for the three toll plazas of the project road under the base case after considering diversion impacts till FY52 is presented in **Table 0-5**, **Table 0-6** and **Table 0-7**.

FY	Car	LCV	Bus	2-axle Truck	3-axle Truck	MAV	O/size/HME	PCU
2023	2,288	87	209	172	261	1,202	3	9,767
2024	2,423	89	217	177	271	1,270	3	10,284
2025	2,574	92	226	182	297	1,367	3	10,992
2026	2,744	95	237	187	317	1,465	4	11,717
2027	2,926	98	247	193	339	1,570	4	12,491
2028	3,114	101	258	199	354	1,666	4	13,213
2029	3,301	104	268	204	369	1,763	4	13,930
2030	3,499	107	279	210	384	1,864	5	14,687
2031	3,690	110	290	215	399	1,961	5	15,418
2032	3,892	113	302	221	416	2,063	5	16,186
2033	4,104	117	314	227	433	2,170	5	16,993
2034	4,325	120	327	234	450	2,281	6	17,827
2035	4,553	123	340	240	468	2,396	6	18,687
2036	4,789	127	353	246	486	2,514	6	19,574
2037	5,033	130	366	252	504	2,636	6	20,486
2038	5,285	134	380	259	523	2,761	7	21,425
2039	5,544	137	393	265	543	2,890	7	22,389
2040	5,811	141	407	272	562	3,022	7	23,379
2041	6,086	144	422	278	582	3,158	8	24,393
2042	6,373	148	436	285	603	3,300	8	25,451
2043	6,668	152	451	291	623	3,445	8	26,535
2044	6,970	155	466	298	645	3,594	9	27,642
2045	7,280	159	482	305	666	3,746	9	28,774
2046	7,597	163	497	312	688	3,901	9	29,927
2047	7,921	166	513	318	710	4,059	10	31,102
2048	8,251	170	529	325	732	4,220	10	32,297
2049	8,587	174	545	332	754	4,383	11	33,512
2050	8,929	177	561	338	777	4,549	11	34,743
2051	9,260	181	576	345	798	4,710	11	35,932
2052	9,603	184	592	351	820	4,876	12	37,162
AADT CAGR (%)								
FY23 - FY25	6.1	2.9	4.1	2.8	6.6	6.6	5.8	6.1
FY25 - FY30	6.3	3.1	4.3	2.9	5.3	6.4	6.1	6.0
FY30 - FY35	5.4	2.9	4.0	2.7	4.0	5.1	5.1	4.9
FY35 - FY40	5.0	2.7	3.7	2.5	3.7	4.8	4.8	4.6
FY40 - FY45	4.6	2.4	3.4	2.3	3.5	4.4	4.4	4.2
FY45 - FY50	4.2	2.2	3.1	2.1	3.1	4.0	4.0	3.8
FY50 - FY52	3.7	2.0	2.7	1.9	2.8	3.5	3.5	3.4
FY23 - FY52	5.1	2.6	3.7	2.5	4.0	4.9	4.8	4.7

Table 0-5: Projected Mode Wise Traffic at TP01

FY	Car	LCV	Bus	2-axle Truck	3-axle Truck	MAV	O/size/HME	PCU
2023	2,410	98	226	260	284	1,273	3	10,609
2024	2,552	101	235	267	295	1,345	3	11,164
2025	2,711	104	245	275	322	1,446	3	11,914
2026	2,890	107	256	283	343	1,549	4	12,686
2027	3,082	111	267	292	366	1,660	4	13,508
2028	3,280	114	279	300	382	1,762	4	14,281
2029	3,477	117	290	308	398	1,864	4	15,048
2030	3,686	121	302	317	414	1,971	5	15,856
2031	3,887	124	314	326	431	2,074	5	16,639
2032	4,099	128	327	335	449	2,181	5	17,460
2033	4,323	132	340	344	467	2,295	5	18,324
2034	4,555	135	353	353	486	2,412	6	19,215

FY	Car	LCV	Bus	2-axle Truck	3-axle Truck	MAV	O/size/HME	PCU
2035	4,796	139	367	363	505	2,533	6	20,135
2036	5,045	143	381	372	525	2,658	6	21,082
2037	5,301	147	396	382	545	2,787	6	22,057
2038	5,567	151	410	391	565	2,919	7	23,060
2039	5,840	155	425	401	586	3,056	7	24,090
2040	6,121	159	440	411	607	3,195	7	25,146
2041	6,410	163	456	420	629	3,339	8	26,229
2042	6,713	167	472	431	651	3,489	8	27,359
2043	7,023	171	488	441	673	3,643	8	28,515
2044	7,342	175	504	451	696	3,800	9	29,697
2045	7,668	179	521	461	719	3,960	9	30,904
2046	8,002	183	538	471	743	4,124	9	32,134
2047	8,343	187	555	481	767	4,292	10	33,387
2048	8,691	191	572	491	791	4,462	10	34,662
2049	9,045	195	589	501	815	4,635	11	35,956
2050	9,405	200	607	511	839	4,810	11	37,269
2051	9,753	204	623	521	862	4,979	11	38,536
2052	10,115	208	640	531	886	5,155	12	39,847
AADT CAGR (%)								
FY23 - FY25	6.1	2.9	4.1	2.8	6.4	6.6	5.8	6.0
FY25 - FY30	6.3	3.1	4.3	2.9	5.2	6.4	6.1	5.9
FY30 - FY35	5.4	2.9	4.0	2.7	4.0	5.1	5.1	4.9
FY35 - FY40	5.0	2.7	3.7	2.5	3.7	4.8	4.8	4.5
FY40 - FY45	4.6	2.4	3.4	2.3	3.5	4.4	4.4	4.2
FY45 - FY50	4.2	2.2	3.1	2.1	3.1	4.0	4.0	3.8
FY50 - FY52	3.7	2.0	2.7	1.9	2.8	3.5	3.5	3.4
FY23 - FY52	5.1	2.6	3.7	2.5	4.0	4.9	4.8	4.7

Table 0-6: Projected Mode Wise Traffic at TP02

FY	Car	LCV	Bus	2-axle Truck	3-axle Truck	MAV	O/size/HME	PCU
2023	2,262	100	227	289	455	1,486	4	12,030
2024	2,396	103	236	297	473	1,570	4	12,654
2025	2,544	106	246	305	507	1,685	4	13,480
2026	2,713	109	257	315	537	1,803	5	14,338
2027	2,893	113	268	324	569	1,929	5	15,251
2028	3,078	116	280	334	594	2,048	5	16,116
2029	3,263	120	291	343	618	2,167	6	16,975
2030	3,459	123	303	352	643	2,292	6	17,880
2031	3,648	127	315	362	670	2,411	6	18,756
2032	3,848	130	328	372	697	2,536	7	19,677
2033	4,058	134	341	382	726	2,668	7	20,643
2034	4,276	138	355	393	755	2,804	7	21,641
2035	4,501	142	369	403	784	2,945	8	22,670
2036	4,735	146	383	414	815	3,090	8	23,730
2037	4,976	150	397	424	846	3,240	9	24,821
2038	5,225	154	412	435	878	3,394	9	25,942
2039	5,481	158	427	446	910	3,552	9	27,094
2040	5,745	162	442	457	943	3,715	10	28,274
2041	6,016	166	458	467	976	3,882	10	29,484
2042	6,300	170	474	479	1,011	4,056	11	30,746
2043	6,592	174	490	490	1,046	4,235	11	32,037
2044	6,891	178	507	501	1,081	4,418	12	33,356
2045	7,198	183	523	512	1,117	4,604	12	34,703
2046	7,511	187	540	523	1,153	4,795	13	36,076

FY	Car	LCV	Bus	2-axle Truck	3-axle Truck	MAV	O/size/HME	PCU
2047	7,831	191	557	535	1,190	4,989	13	37,474
2048	8,157	195	574	546	1,227	5,187	14	38,896
2049	8,489	199	592	557	1,265	5,388	14	40,339
2050	8,827	204	609	568	1,302	5,592	15	41,803
2051	9,154	208	626	579	1,338	5,789	15	43,216
2052	9,493	212	643	590	1,376	5,993	16	44,676
AADT CAGR (%)								
FY23 - FY25	6.1	2.9	4.1	2.8	5.6	6.5	5.8	5.9
FY25 - FY30	6.3	3.1	4.3	2.9	4.9	6.3	6.1	5.8
FY30 - FY35	5.4	2.9	4.0	2.7	4.0	5.1	5.1	4.9
FY35 - FY40	5.0	2.7	3.7	2.5	3.7	4.8	4.8	4.5
FY40 - FY45	4.6	2.4	3.4	2.3	3.5	4.4	4.4	4.2
FY45 - FY50	4.2	2.2	3.1	2.1	3.1	4.0	4.0	3.8
FY50 - FY52	3.7	2.0	2.7	1.9	2.8	3.5	3.5	3.4
FY23 - FY52	5.1	2.6	3.7	2.5	3.9	4.9	4.8	4.6

Table 0-7: Projected Mode Wise Traffic at TP03

Projected Traffic in PCUs

Total traffic in PCUs at the project road under the base case after considering diversion impacts at respective toll plaza location till FY52 is presented in **Table 0-8**.

FY	TP1 - Bassi	TP2 - Aroli	TP3 - Dhaneshwar	Average
2023	9,767	10,609	12,030	10,802
2024	10,284	11,164	12,654	11,367
2025	10,992	11,914	13,480	12,129
2026	11,717	12,686	14,338	12,914
2027	12,491	13,508	15,251	13,750
2028	13,213	14,281	16,116	14,537
2029	13,930	15,048	16,975	15,317
2030	14,687	15,856	17,880	16,141
2031	15,418	16,639	18,756	16,938
2032	16,186	17,460	19,677	17,774
2033	16,993	18,324	20,643	18,653
2034	17,827	19,215	21,641	19,561
2035	18,687	20,135	22,670	20,497
2036	19,574	21,082	23,730	21,462
2037	20,486	22,057	24,821	22,455
2038	21,425	23,060	25,942	23,476
2039	22,389	24,090	27,094	24,524
2040	23,379	25,146	28,274	25,600
2041	24,393	26,229	29,484	26,702
2042	25,451	27,359	30,746	27,852
2043	26,535	28,515	32,037	29,029
2044	27,642	29,697	33,356	30,232
2045	28,774	30,904	34,703	31,460
2046	29,927	32,134	36,076	32,713
2047	31,102	33,387	37,474	33,988
2048	32,297	34,662	38,896	35,285
2049	33,512	35,956	40,339	36,602
2050	34,743	37,269	41,803	37,939
2051	35,932	38,536	43,216	39,228
2052	37,162	39,847	44,676	40,562

FY	TP1 - Bassi	TP2 - Aroli	TP3 - Dhaneshwar	Average
CAGR (%) (FY24 to FY52)	4.7%	4.6%	4.6%	4.6%

Table 0-8: Projected Traffic on PR in PCUs (After Diversion)

Tolling Segmentation

Tolling distribution considered for respective toll plaza location across the project road is based on the average ticket distribution of FY23 toll data and the same has been presented in **Table 0-9**.

Ticket Type/Modes	Car	LCV	Bus	2 A Truck	3 A Truck	4-6 A Truck	OSV
TP01-Bassi							
Single	40.9	57.9	47.4	47.4	59.7	72.2	87.7
Return	44.8	39.1	43.2	43.2	39.9	18.0	11.2
Monthly	0.0	0.5	0.0	0.0	0.0	0.0	0.0
Local personal	1.3	0.0	0.0	0.0	0.0	0.0	0.0
Local commercial	0.1	0.9	9.1	9.1	0.2	9.6	0.0
Exempt	13.0	1.6	0.3	0.3	0.2	0.2	1.1
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
TP02-Aroli							
Single	43.9	54.3	43.3	43.3	57.7	68.5	85.4
Return	51.8	44.2	56.6	56.6	42.2	31.5	14.4
Monthly	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Local personal	3.3	0.0	0.0	0.0	0.0	0.0	0.0
Local commercial	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exempt	1.0	1.5	0.0	0.0	0.0	0.0	0.2
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
TP03-Dhaneshwar							
Single	40.3	51.4	43.0	43.0	40.7	52.7	58.9
Return	46.7	46.5	54.4	54.4	53.6	44.5	40.9
Monthly	0.0	1.4	0.0	0.0	0.0	0.0	0.0
Local personal	10.9	0.0	0.0	0.0	0.0	0.0	0.0
Local commercial	0.0	0.0	2.4	2.4	5.6	2.8	0.0
Exempt	2.1	0.7	0.2	0.2	0.1	0.0	0.2
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 0-9: Tolling Distribution

Tollable Length and Toll Rates

The details of normal tolling lengths, bypass length (at 1.5 times) and equivalent structure lengths being charged at toll plaza as per the information in the latest revision fee notification for FY23 and details as per Schedule R regarding lengths during and after construction are presented in **Table 0-10**.

Toll Plazas	TP01-Bassi	TP02-Aroli	TP03-Dhaneshwar
A. Normal length	36.627	53.909	53.5
B. Bypass length @ 1.5 times	16.021	0	0
C. Equivalent Structure length	3.52	0.91	0
D. Total tolling length=(A+1.5*B+C)	64.1785	54.819	53.5

Table 0-10: Tolling Lengths (in km) for Chittorgarh-Kota

The stream of toll rates to be charged at the toll plaza of the project road in cardinal years till FY52 is presented in **Table 0-11**.

FY End	Car	LCV	Bus	2A Truck	3A Truck	MAV	O/size/HME	Car Local
TP01-Bassi								
2023	85	140	295	295	325	465	565	315
2025	95	155	325	325	355	505	620	345
2030	115	190	395	395	430	620	755	420
2035	145	230	485	485	530	760	925	515
2040	175	280	590	590	645	930	1,130	630
2045	215	345	725	725	790	1,135	1,380	770
2050	260	420	885	885	965	1,385	1,685	940
2052	285	455	955	955	1,045	1,500	1,830	1,015
TP02-Aroli								
2023	75	120	255	255	275	395	480	315
2025	80	130	275	275	300	435	530	345
2030	100	160	340	340	370	530	645	420
2035	120	195	415	415	450	650	790	515
2040	150	240	505	505	550	790	965	630
2045	180	295	615	615	675	970	1,180	770
2050	225	360	755	755	825	1,185	1,440	940
2052	240	390	820	820	890	1,285	1,560	1,015
TP03-Dhaneshwar								
2023	75	120	245	245	270	385	470	315
2025	80	130	270	270	295	425	515	345
2030	100	160	330	330	360	520	630	420
2035	120	195	405	405	440	635	770	515
2040	145	235	495	495	540	775	940	630
2045	180	290	600	600	655	945	1,150	770
2050	220	350	735	735	805	1,155	1,405	940
2052	235	380	800	800	870	1,250	1,525	1,015

Table 0-11: Toll Rates at Toll Plazas (in Rs)

Project Road Revenue

The project road revenue under the base case scenario is presented in **Table 0-12**

FY End	Toll Revenue in Rs Million
	Base Case
2023	908.3
2024	1,006.8
2025	1,116.6
2026	1,240.8
2027	1,377.0
2028	1,518.9
2029	1,657.3
2030	1,820.1
2031	1,985.9
2032	2,177.2
2033	2,374.0
2034	2,588.0
2035	2,829.6
2036	3,086.8
2037	3,353.8
2038	3,644.9
2039	3,967.0
2040	4,322.0
2041	4,673.2
2042	5,080.7
2043	5,504.0
2044	5,988.3
2045	6,467.3
2046	6,999.6
2047	7,573.7
2048	8,195.8
2049	8,826.5
2050	9,530.0
2051	10,241.5
2052	7,850.4
PV12 FY23 till 15th Dec in FY52	19,217.4
CAGR FY24 to FY51	9.0%

** Till 15th December FY52*

Table 0-12: Base Case Revenue

The project road revenues will have a CAGR of 9.0 percent for the period FY24 to FY51.

1. INTRODUCTION

1.1 General

National Highways Authority of India (NHAI) has setup NHAI InvIT to monetize its completed and operational national highways projects with the objective of mobilizing additional resources through capital markets. In this context, National Highways Infra Projects Private Limited (NHIPPL) is acting as SPV for the projects under NHAI InvIT. Under Round1 (R1), NHAI InvIT has added a portfolio of five operating toll roads with an aggregate length of 390 kilometers located across the states of Gujarat, Karnataka, Rajasthan, and Telangana.

The section viz., Chittorgarh-Kota of NH-27 in the state of Rajasthan referred to as Project Road (PR) hereinafter, is part of the R1 portfolio of InvIT.

The project highway, NH-27, is part of the East – West corridor envisaged under National Highway Development Program (Phase – II). The total length of NH-27 is roughly 3,530 km starting from Porbandar in the state of Gujarat and ending at Silchar in the state of Assam while passing through the states of Rajasthan, Madhya Pradesh, Uttar Pradesh, Bihar and West Bengal. NH–27 connects important tourist and industrial cities and towns like Porbandar (port city), Rajkot, Palanpur, Udaipur, Chittorgarh, Jhansi, Kanpur, Lucknow, Muzaffarpur, Purnea, Siliguri, Jalpaiguri etc. **Figure 1-1** shows the alignment of NH-27 with major places along the highway.

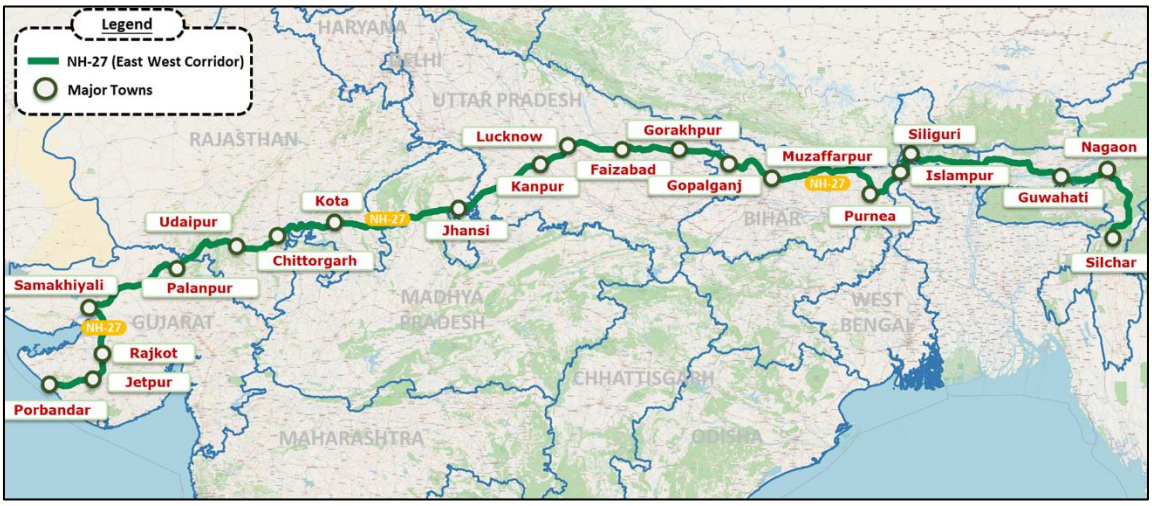


Figure 1-1: Alignment of NH-27 with Major Places

National Highways Infra Projects Private Limited, has appointed Ramboll India Private Ltd as the Traffic Consultant to carry out a study for assessing the present traffic levels, travel pattern and future traffic & revenue estimation till year FY52 duly considering the network characteristics, future economic perspective in the influence area of the project.

1.2 Scope of Services

The scope of the study includes the following:

- Undertake Traffic Survey on the highway section as per the following:
  - Seven days 24 hours Videography Traffic Counts at or near the existing toll plaza locations on the project road to derive the Average Daily Traffic (ADT)
  - One day Origin-Destination survey at or near the existing toll plaza locations to assess the existing travel pattern of vehicles plying on the project road – origin and destination
- Estimation of the base year AADT, FY23
- Analysis of OD data to cover:
  - Regional distribution of traffic and influence factors for different zones contributing traffic on the corridor
  - Identification of Project Influence Area from analysis of travel pattern - regional distribution of traffic,
  - Main traffic generators (industrial areas, towns, ports etc.)
  - Commodity composition- Goods type distribution
  - Top OD pairs by vehicle types
  - Travel frequency and trip purpose distribution
- Review of past traffic studies, traffic/toll data and other relevant reports as may be available to determine category wise volume of traffic for past years as well as for current year
- To identify competing route and analyse the network conditions, traffic characteristics & level of toll charged and the advantage/ disadvantage of the competing road and their impact on the project traffic
- Carry out a study of past economic performance of influence area
- Diversion analysis, wherever needed – cost ratio-based diversion analysis using spreadsheets to be carried out for respective potential OD pairs.
- Preparation of traffic projections till year FY52 in three scenarios – low, most likely and high
- Capacity analysis of the road or any other requirements for potential capacity augmentation
- Estimation of tollable traffic streams by toll category and estimation of toll revenue as per categories of traffic streams stipulated in the tolling schedule for the study period

- Review future road and transportation network developments in the area of influence of the project and identify those schemes that may impact positively or negatively traffic on the toll road
- Identify factors which may have a positive and / or negative impact on the traffic - all major developments like DFC, industrial corridors, economic corridors, ports, Bharatmala, Sagarmala
- Scenario Analysis of toll revenue – Critical parameters of diversion (if applicable) and three scenarios of traffic growth (most likely, low and high).

1.3 Report Structure

This report is divided into four chapters, including this introduction chapter. Chapter 2 details upon the project road characteristics and socio – economic profile of the districts in the project influence area including the estimation of AADT and travel characteristics in the Project Influence Area (PIA). Chapter 3 contains the details on the derivation of traffic growth rates used for traffic forecasting and presents traffic projections for the study period. Chapter 4 presents the details regarding tolling strategy, toll rates and the revenue projections for the duration of the concession.

2. TRAFFIC SURVEY AND ANALYSIS

2.1 General

In order to understand the traffic characteristics, the volume of traffic and travel pattern of vehicles plying on the project road were collected through primary surveys. This chapter presents the details of the project road characteristics, traffic surveys carried out, their analysis and the salient findings. The results of the analysis will be utilized in assessing the traffic growth and estimation of traffic and revenue forecast on the project road for the concession period.

2.2 Project Road Characteristics

The project road section, Chittorgarh-Kota, part of the NH-27 in the state of Rajasthan, starts at km 199.929 of NH-27 near Chittorgarh and ends at km 360.429 of NH- 27 at Kota with a length of about 160.5 km. The project road falls under the jurisdiction of Chittorgarh, Bhilwara, Bundi and Kota districts passing through settlements of Chittorgarh, Bassi, Aroli, Ladpura, Bijolia, Dhaneshwar, Dabi and Kota. There are three operational toll plazas on the project road, one near Bassi (km 237.629), one near Aroli (km 294.469), and another near Dhaneshwar (km 340.797). There are 10 tolling lanes (5 in each direction) at Bassi and Dhaneshwar toll plazas, whereas Aroli has 6 lanes (3 in each direction).

The alignment of project road and toll plaza locations is shown in **Figure 2-1**.

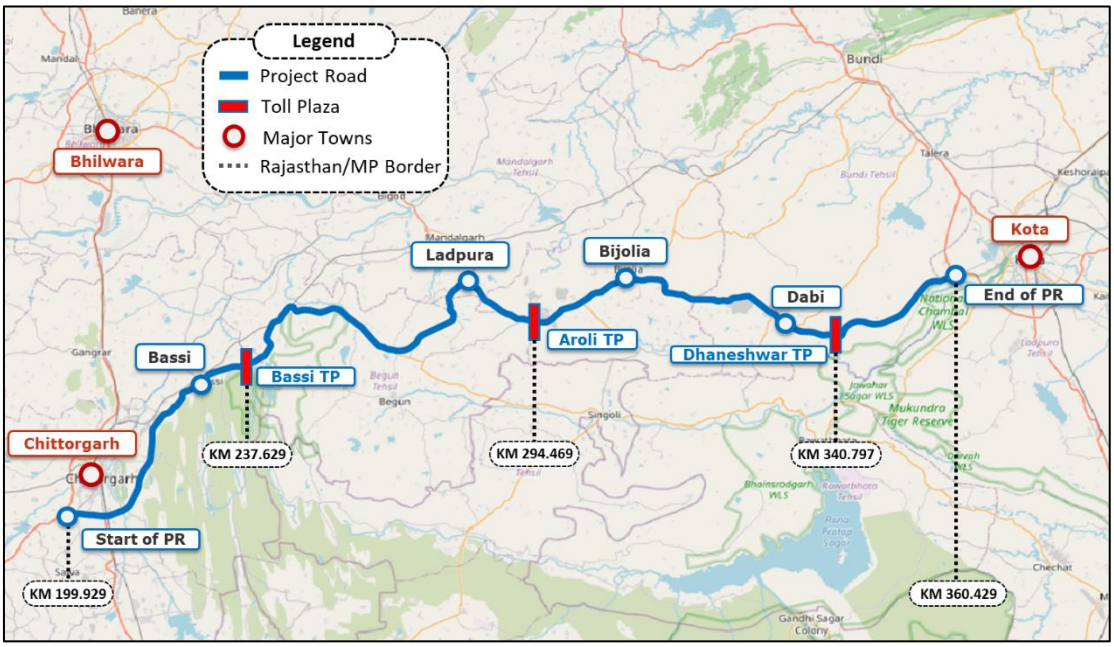


Figure 2-1: Project Road and Location of Toll Plazas

The project road in wider context serves for east-west long-distance traffic which is majorly plying between Lucknow/Gorakhpur/eastern region and Palanpur/Rajkot/ western region. Apart from long distance traffic, it also serves the short distance traffic which is mainly generated between Bundi/ Kota/ Baran and Udaipur/ Chittorgarh areas.

It is worth mentioning here that, the project section is influenced by the presence of large scale cement industries and thermal power plants in the vicinity which influence the traffic on the corridor viz, Birla Cement, Ultratech, NUVOCO, Shree cement, JK cement, Wonder Cement etc., and thermal power plant at Kota, Jhalawar and Chhabra. Apart from the above industries, various medium scale industries related to iron/steel, agro-based and food processing units are also observed in and around the project section. The location of major cement/thermal power plants located in the state of Rajasthan and in the proximity of the project corridor is presented in the **Figure 2-2**.

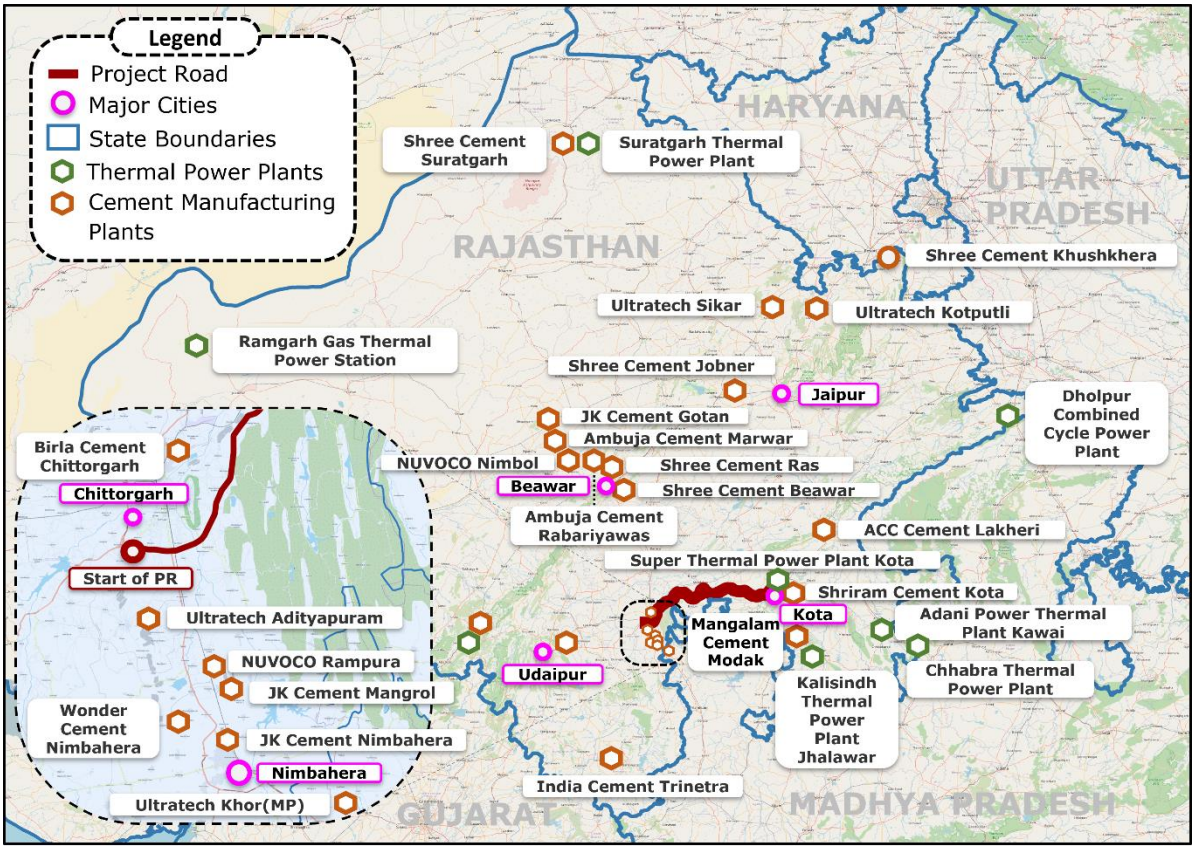


Figure 2-2: Cement Plants & Thermal Power Plants in State of Rajasthan

2.2.1 Profile of Project Influence Area District

The project section falls under the jurisdiction of Chittorgarh, Bhilwara, Bundi and Kota districts in the state of Rajasthan. A brief description of the profile of these four districts is presented below.

Chittorgarh District

Chittorgarh district is situated in south-east part of Rajasthan. The population of Chittorgarh district as per 2011 census is 1.54 million of which 18.5 percent population is urban. The major towns are Chittorgarh, Nimbahera and Rawatbhata. The work participation rate (WPR) of the district is about 52 percent.

The economy of the district is predominated by agriculture with about 72 percent of the workers being involved in agriculture or as agricultural labourers. The major crops grown in the district are maize, soyabean, groundnut, sorghum, cotton and black gram in kharif

season and wheat, mustard, gram, barley and opium in rabi season. Also, cultivation of fruits and vegetables in done in limited portions of land.

The district is rich in mineral resources like barytes, china clay, limestone, sandstone and ochre. Several industries like cement, fabric processing units, chemical and fertilizer manufacturing units, polypropylene, HDPE woven sacks and fabric manufacturing units are present in the district. The cement plants include Birla Corporation Limited, Wonder Cement Limited, Aditya Cement Limited, Lafarge India Private Ltd. and J K Cement Works. Hindustan Zinc Limited has various plants spread across the district which produce sulphuric acid, refined zinc, refined lead etc. There is an atomic power plant and a heavy water plant located at Rawatbhata beside Rana Pratap Sagar dam. In addition to this, the presence of Chittorgarh fort and palaces makes it a famous tourist destination.

Bhilwara District

Bhilwara district is located in the south-eastern part of Rajasthan and its economy driven by agriculture with 62.6 percent of the total workers involved in the primary sector. As per the 2011 Census, the district has a population of 2.40 million of which 21.3 percent population is urban. The work participation rate (WPR) of the district is 47.7 percent.

The major crops grown in the district include maize, oil seeds, wheat, pulses, jowar, barley and fibres with small quantities of different spices, bajra and some fruits and vegetables. The major agro-based industries here are oil mills, flour mills, ice candy manufacturing units, dal mills and units producing biscuits, confectionary items, khandsari, masala and cattle feed.

The district is also well established in textile industry and known as Vastra Nagari and Manchester of Rajasthan. It is famous for manufacturing of synthetics and cotton mix fabric and synthetic yarn. Cotton textile industries include cotton spinning, cotton ginning, doubling yarn, cotton dying, handloom and power loom fabrics and cotton tape producing units.

The mineral resources available in the district include lead, zinc, soap stone, china clay, feldspar, quartz, mica, marble, granite, asbestos and garnet. It is one of the largest producers of raw material required for ceramic industry – quartz feldspar, china clay etc. Several units for manufacturing insulation bricks, mica grinding, marble cutting and polishing, china clay, washing powder etc., have come up attributing to these mineral resources. Rampura Agucha is a zinc and lead mine located on a massive sulphide deposit in the district.

The major products exported from the district are polyester, viscose, woollen blankets, cotton fabric, cotton yarn, woollen shoddy yarn and wool tops.

Bundi District

Agriculture contributes a major portion to the economic growth in Bundi. Major agricultural crops include pulses, wheat, gram, barley, cotton, tobacco and oil seeds.

Among oil seeds, mustard and rapeseed are the mostly produced. Important fruit trees in Bundi include orange, pomegranate, lemon, guava and mango. Textile, tourism, handicrafts and small-scale industries play a pivotal role in the economic prosperity of Bundi in Rajasthan. Polyester fibre is the major produce as a part of textiles. The district is famous for its beautiful forts and palaces which have been converted into heritage hotels and step-well reservoirs to attract more tourists.

Limestone and sandstone are important mineral resources found in Bundi district which are the source of raw materials to the cement plant at Lakheri. Other minerals found in the district include silica sand, barytes, marble, clays, granite, sandstone, red ochre and iron ore.

The district has a population of 1.11 million as per 2011 Census with a rural population share at 80 percent and Work Participation Rate (WPR) of the district is about 47 percent.

Kota District

Kota is the trade centre for cotton, millet, wheat, coriander and oilseeds. Major cultivated crops include soybean, paddy and maize in kharif season while rapeseed & mustard, wheat, coriander and gram in rabi season. Ramganj mandi in Kota is famous for the stone and coriander market. It is the largest market for coriander in India.

The industries prevalent in the district include cotton and oilseed milling, textile weaving, distilling, dairying, and the manufacture of metal handcrafts. Kota city is known as the "Education hub of India" with the presence of several coaching institutes for engineering and medical entrance exams.

Kota is one of the industrial hubs in northern India, with chemical, cement, engineering, and power plants. It is also known for Kota stone, a fine-grained variety of limestone and has an extensive industry of stone-polishing. The district is the 2nd largest producer of limestone stone after Jodhpur. There are deposits of red clay, glass sand, dolomite and kankar in the district along with reported occurrence of iron ore, fire clay, red and yellow ochre. Chambal Fertilizers, one of the largest private sector producers has two plants in the district. Kota has several industrial estates and many chemical units as well.

The district population as per 2011 census is 1.95 million of which 60.3 percent is urban and work participation rate (WPR) is about 38 percent.

2.3 Traffic Surveys

In order to understand the characteristics and the volume of traffic using the project road, data on road network, traffic and travel pattern of vehicles plying on the project road were collected through primary traffic surveys. Traffic volume video graphic survey for seven days and origin-destination (OD) survey as roadside interview for one day at toll plaza locations were conducted on the project road. The schedule of the traffic surveys and locations on the project road are given in **Table 2-1**.

Location	Chainage	Duration	Date(s)
Classified Traffic Volume Counts			
TP01-Bassi	km 237.629	7 Days	10th March–16th March 2023
TP02-Aroli	km 294.469		
TP03-Dhaneshwar	km 340.797		
Origin and Destination Survey			
TP01-Bassi	km 237.629	1 Day	13th March 2023
TP02-Aroli	km 294.469		
TP03-Dhaneshwar	km 340.797		

Table 2-1: Traffic Survey Locations and Schedule

Trained enumerators were engaged for conducting traffic surveys under the supervision of experienced transport planner. The vehicle classification as generally used in the traffic surveys of NHAI studies along with their PCU values, as suggested in IRC: 64 – 1990, are presented in **Table 2-2**.

Vehicle Type	PCU Factor
Motorized Vehicles	
Car, Jeep, Van &Taxi	1.0
Two –Wheeler	0.5
Three-Wheeler (Auto-Rickshaw)	1.0
Mini-Bus/ School Bus	1.5
Govt. Bus/ Private Bus	3.0
Mini LCV/Max Pick Up	1.0
Light Commercial Vehicle (LCV)	1.5
2-Axle Truck	3.0
3-Axle Truck	3.0
Multi-Axle Vehicle (MAV 4-6 Axle)	4.5
HME	4.5
Agricultural Tractor	1.5
Agricultural Tractor with Trailer	4.5
Non – Motorised Vehicles	
Cycle	0.5
Cycle Rickshaw	2.0
Animal Drawn Cart	6.0

Table 2-2: Vehicle classification and PCU factors

2.4 Traffic Characteristics

The data collected from the traffic volume count survey was analysed in order to get the results with respect to existing traffic intensity, flow pattern, hourly variation and composition of traffic on the study road network. The various traffic characteristics have been analysed under the following heads:

- Average Daily Traffic (ADT)
- Daily variation, Hourly variation and Traffic composition
- Annual Average Daily Traffic (AADT)

2.4.1 Average Daily Traffic (ADT)

The traffic volume data collected at the toll plaza locations during the seven days survey has been analysed. The summary of ADT in terms of vehicles and PCUs is presented in **Table 2-3**.

Mode	TP01-Bassi Toll Plaza	TP02-Aroli Toll Plaza	TP03-Dhaneshwar Toll Plaza
Tollable vehicles			
Car/Jeep/Van/Taxi	2,036	2,385	2,342
Minibus	17	17	13
Standard Bus	157	181	175
Mini LCV	224	237	264
LCV	195	205	152
2 Axle	129	208	223
3 Axle	271	306	423
MAV (4-6 Axle)	1,322	1,369	1,481
HMV/ MAV (=>7 Axle)	4	4	5
Non Tollable vehicles			
Two-Wheeler	3,307	2,811	2,093
Auto Rickshaw	70	37	43
Agri. Tractors	155	224	321
Total Non-Motorised	7	1	3
Total Vehicles/PCUs			
Total Tollable Vehicles	**4,355**	**4,913**	**5,078**
Total Non Tollable Vehicles	**3,539**	**3,072**	**2,459**
Total Vehicles	**7,894**	**7,985**	**7,537**
Total PCU	**12,615**	**13,646**	**14,528**
Tollable PCU	**10,214**	**11,221**	**12,004**

Table 2-3: Average Daily Traffic at TP01, TP02 & TP03

- The observed total vehicles are around 7,894 at TP01, about 7,985 vehicles at TP02 and around 7,537 vehicles at TP03.
- Car traffic has a share of around 25.8 percent (2,036 vehicles) at TP01, about 29.9 percent (2,385 vehicles) at TP02 and around 31.1 percent (2,342 vehicles) at TP03 of total traffic.
- Total freight vehicles account for a share of 29.1 percent at TP01, 32.0 percent at TP02 and 38.1 percent at TP03. Within the freight traffic, MAV accounts for 16.7 percent (1,322 vehicles) at TP01, 17.1 percent (1,369 vehicles) at TP02 and 19.7 percent (1,481 vehicles) at TP03.
- The tollable traffic recorded at TP01 is 55.2 percent, about 61.5 percent at TP02 and 67.4 percent at TP03.
- Other motorised non-tollable vehicles (two-wheeler, auto rickshaw and tractor) account for about 44.8 percent at Bassi toll plaza, about 38.5 percent at Aroli toll plaza and 32.6 percent at Dhaneshwar toll plaza.

2.4.2 Daily Variation, Hourly Variation, and Traffic Composition

The day wise variation, hourly variation and the traffic composition at the toll plaza locations is presented in **Figure 2-3**.

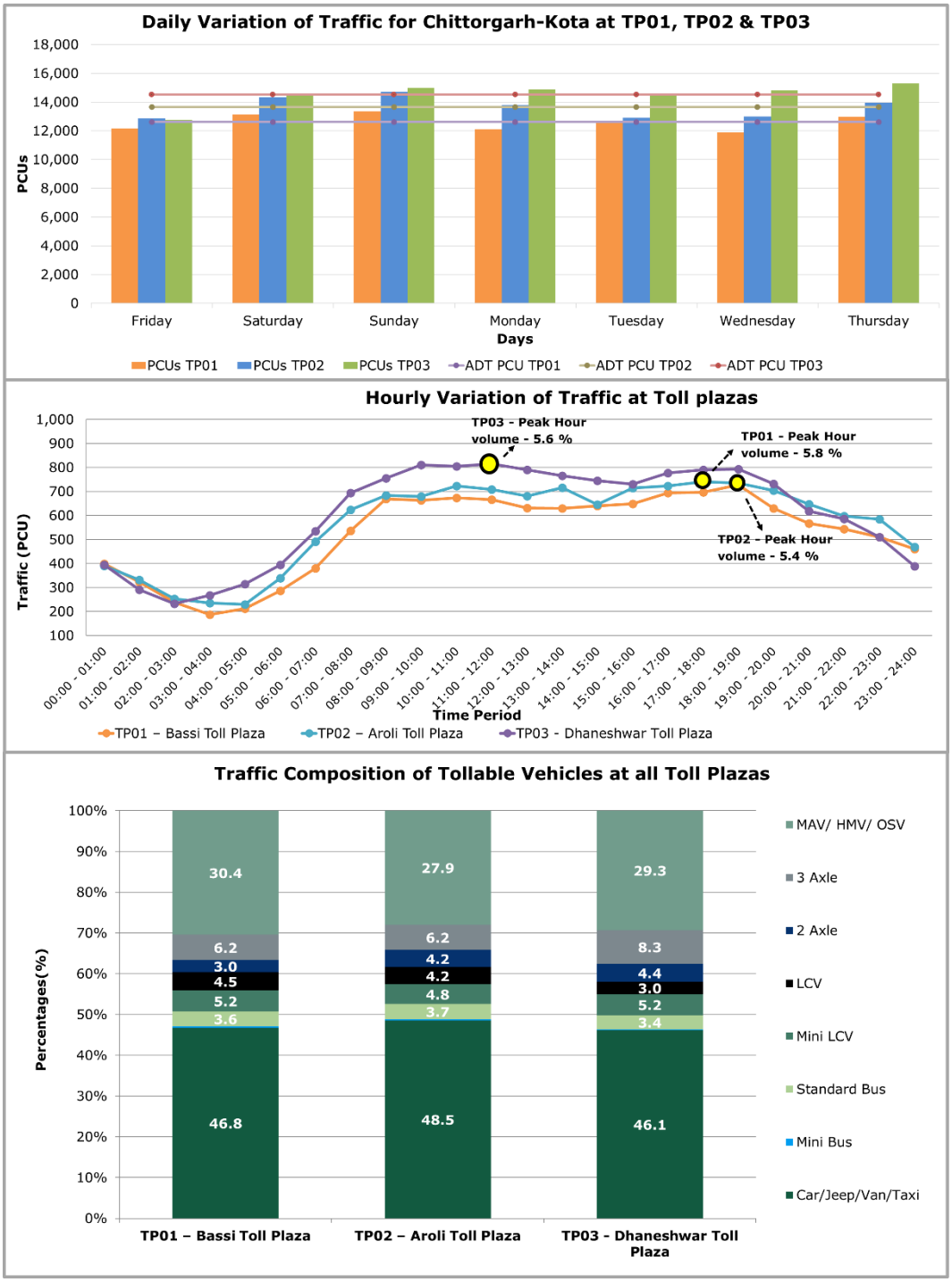


Figure 2-3: Daily & Hourly Variation and Traffic Composition

- It was observed that the traffic at the toll plazas is consistent with minor fluctuations during the days of volume count survey.
- The directional distribution at the toll plaza location is almost equal with Chittorgarh-Kota having a directional distribution of 46.1 percent at TP01, 47.4 percent at TP02 and 48.0 percent at TP03.

2.4.3 Comparison of Toll Data with TVC

Toll Data vs TVC

The TVC survey was conducted from 10th March 2023 to 16th March 2023. A comparison between TVC and Toll Data for the days of the survey is presented in **Table 2-4**.

Day/Date	CJV	LCV	2-Axle	3-Axle	MAV/ OSV	LCV /2A	Total	PCUs
TP01-Bassi Toll Plaza								
TVC								
Friday, March 10, 2023	2,410	222	217	262	1,175	439	4,286	9,468
Saturday, March 11, 2023	2,358	216	275	267	1,381	491	4,497	10,523
Sunday, March 12, 2023	2,849	188	283	243	1,362	471	4,925	10,838
Monday, March 13, 2023	2,286	215	268	265	1,244	483	4,278	9,806
Tuesday, March 14, 2023	2,038	207	312	297	1,368	519	4,222	10,332
Wednesday, March 15, 2023	1,822	197	312	272	1,349	509	3,952	9,940
Thursday, March 16, 2023	2,062	238	335	289	1,401	573	4,325	10,596
Average	2,261	212	286	271	1,326	498	4,355	10,214
Toll Data								
Friday, March 10, 2023	2,424	71	317	256	1,164	388	4,232	9,488
Saturday, March 11, 2023	2,321	88	361	304	1,356	449	4,430	10,550
Sunday, March 12, 2023	2,855	53	376	252	1,363	429	4,899	10,952
Monday, March 13, 2023	2,293	84	351	270	1,249	435	4,247	9,903
Tuesday, March 14, 2023	1,997	82	407	302	1,346	489	4,134	10,304
Wednesday, March 15, 2023	1,860	63	417	270	1,363	480	3,973	10,149
Thursday, March 16, 2023	2,079	96	436	285	1,412	532	4,308	10,740
Average	2,261	77	381	277	1,322	457	4,318	10,298
Toll Data MINUS TVC								
Friday, March 10, 2023	*14*	*-151*	*100*	*-6*	*-11*	*-51*	*-54*	*20*
Saturday, March 11, 2023	*-37*	*-128*	*86*	*37*	*-25*	*-42*	*-67*	*28*
Sunday, March 12, 2023	*6*	*-135*	*93*	*9*	*1*	*-42*	*-26*	*114*
Monday, March 13, 2023	*7*	*-131*	*83*	*5*	*5*	*-48*	*-31*	*97*
Tuesday, March 14, 2023	*-41*	*-125*	*95*	*5*	*-22*	*-30*	*-88*	*-28*
Wednesday, March 15, 2023	*38*	*-134*	*105*	*-2*	*14*	*-29*	*21*	*209*
Thursday, March 16, 2023	*17*	*-142*	*101*	*-4*	*11*	*-41*	*-17*	*145*
Average	*1*	*-135*	*95*	*6*	*-4*	*-40*	*-37*	*84*
TP02-Aroli Toll Plaza								
TVC								
Friday, March 10, 2023	2,828	214	354	266	1,171	568	4,833	10,279
Saturday, March 11, 2023	2,959	243	365	337	1,397	608	5,301	11,716
Sunday, March 12, 2023	3,169	217	419	265	1,414	636	5,484	11,910
Monday, March 13, 2023	2,617	212	384	300	1,368	596	4,881	11,143
Tuesday, March 14, 2023	2,220	238	384	326	1,352	622	4,520	10,791
Wednesday, March 15, 2023	2,096	224	386	310	1,454	610	4,470	11,063
Thursday, March 16, 2023	2,465	206	435	339	1,456	641	4,901	11,648
Average	2,622	222	390	306	1,373	612	4,913	11,221
Toll Data								
Friday, March 10, 2023	2638	282	430	265	1175	712	4790	10,434
Saturday, March 11, 2023	2,653	230	425	329	1,405	655	5,042	11,583
Sunday, March 12, 2023	2,777	166	473	259	1,419	639	5,094	11,608
Monday, March 13, 2023	2,343	185	472	286	1,372	657	4,658	11,069
Tuesday, March 14, 2023	1,911	178	465	318	1,377	643	4,249	10,724
Wednesday, March 15, 2023	1,885	157	498	299	1,429	655	4,268	10,942

Day/Date	CJV	LCV	2-Axle	3-Axle	MAV/ OSV	LCV /2A	Total	PCUs
Thursday, March 16, 2023	2,181	163	504	309	1,485	667	4,642	11,547
Average	2,341	194	467	295	1,380	661	4,678	11,129
Toll Data MINUS TVC								
Friday, March 10, 2023	*-190*	*68*	*76*	*-1*	*4*	*144*	*-43*	*155*
Saturday, March 11, 2023	*-306*	*-13*	*60*	*-8*	*8*	*47*	*-259*	*-134*
Sunday, March 12, 2023	*-392*	*-51*	*54*	*-6*	*5*	*3*	*-390*	*-302*
Monday, March 13, 2023	*-274*	*-27*	*88*	*-14*	*4*	*61*	*-223*	*-75*
Tuesday, March 14, 2023	*-309*	*-60*	*81*	*-8*	*25*	*21*	*-271*	*-68*
Wednesday, March 15, 2023	*-211*	*-67*	*112*	*-11*	*-25*	*45*	*-202*	*-121*
Thursday, March 16, 2023	*-284*	*-43*	*69*	*-30*	*29*	*26*	*-259*	*-101*
Average	*-281*	*-28*	*77*	*-11*	*7*	*50*	*-235*	*-92*
TP03-Dhaneshwar Toll Plaza								
TVC								
Friday, March 10, 2023	2,659	165	326	359	1,218	491	4,727	10,443
Saturday, March 11, 2023	2,891	183	349	453	1,433	532	5,309	12,020
Sunday, March 12, 2023	2,822	157	427	379	1,546	584	5,331	12,433
Monday, March 13, 2023	2,635	136	396	418	1,525	532	5,110	12,144
Tuesday, March 14, 2023	2,437	173	402	470	1,469	575	4,951	11,923
Wednesday, March 15, 2023	2,323	183	433	432	1,596	616	4,967	12,375
Thursday, March 16, 2023	2,474	158	455	449	1,615	613	5,151	12,691
Average	2,606	165	398	423	1,486	563	5,078	12,004
Toll Data								
Friday, March 10, 2023	2,415	76	389	332	1,237	465	4,449	10,259
Saturday, March 11, 2023	2,557	104	396	436	1,464	500	4,957	11,797
Sunday, March 12, 2023	2,469	82	465	358	1,575	547	4,949	12,149
Monday, March 13, 2023	2,214	68	447	410	1,524	515	4,663	11,745
Tuesday, March 14, 2023	2,005	99	461	440	1,477	560	4,482	11,503
Wednesday, March 15, 2023	1,934	96	492	420	1,618	588	4,560	12,095
Thursday, March 16, 2023	2,173	95	494	446	1,631	589	4,839	12,475
Average	2,252	89	449	406	1,504	538	4,700	11,717
Toll Data MINUS TVC								
Friday, March 10, 2023	*-244*	*-89*	*63*	*-27*	*19*	*-26*	*-278*	*-184*
Saturday, March 11, 2023	*-334*	*-79*	*47*	*-17*	*31*	*-32*	*-352*	*-223*
Sunday, March 12, 2023	*-353*	*-75*	*38*	*-21*	*29*	*-37*	*-382*	*-284*
Monday, March 13, 2023	*-421*	*-68*	*51*	*-8*	*-1*	*-17*	*-447*	*-399*
Tuesday, March 14, 2023	*-432*	*-74*	*59*	*-30*	*8*	*-15*	*-469*	*-420*
Wednesday, March 15, 2023	*-389*	*-87*	*59*	*-12*	*22*	*-28*	*-407*	*-280*
Thursday, March 16, 2023	*-301*	*-63*	*39*	*-3*	*16*	*-24*	*-312*	*-216*
Average	*-353*	*-76*	*51*	*-17*	*18*	*-26*	*-378*	*-286*

Table 2-4: Comparison Between TVC and Toll Data

The main observations from the comparison are:

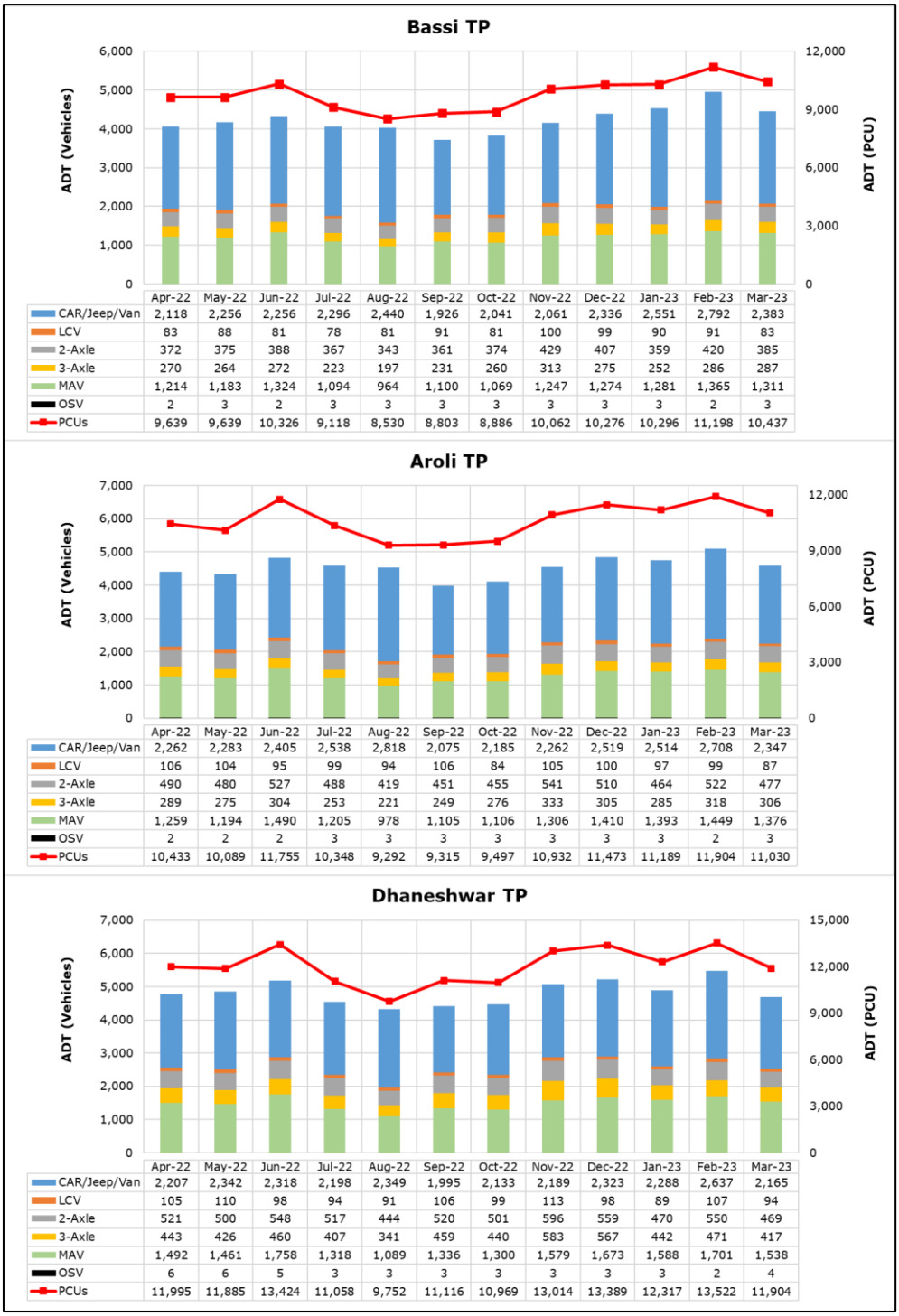
- The variation of TVC vs toll data for all the modes at TP01 Bassi is negligible. However, at TVC data is higher than the toll data in cars for all the survey days at TP02 and TP03.
- The average variation of total traffic with respect to TVC is about 5-8 percent at TP02 & TP03 and about 1 percent at TP01.
- The variation in LCV/2A could be due to cross classification amongst these modes.
- The variation of total traffic excluding cars is less than 1 percent at all the plazas.

2.4.4 Annual Average Daily Traffic (AADT)

The traffic plying on any road generally varies over different periods of the year depending on the cycle of different socio-economic activities in the regions through which it passes. Therefore, in order to have a more realistic picture of the traffic on the project road, it is required to assess its seasonal variation to estimate the annual average daily traffic (AADT).

The past toll traffic data for all the toll plazas was made available by the client from January 2021 to March 2023 as presented in **Appendix 2.1**.

For the period from April 2022 to July 2022, the corresponding monthly data for reusage of local pass and exemptions for cars were either not recorded or there were inconsistencies. Therefore, for reusage of local pass, the average between August 2022 to March 2023 has been considered to be applicable for the months of April 2022 to June/July 2022 for the three toll plazas. In case of exemptions, the average between August 2022 to March 2023 has been considered for the months of April 2022 to July 2022 for all the toll plazas to arrive at the monthly ADT for these months. For FY23, high numbers were recorded for cars in cash-violation category have not been considered for the AADT estimation. The month-on-month mode wise traffic for the period from April 2022 to March 2023 for all three toll plazas is presented in **Figure 2-4**.



Bassi TP	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23
CAR/Jeep/Van	2,118	2,256	2,256	2,296	2,440	1,926	2,041	2,061	2,336	2,551	2,792	2,383
LCV	83	88	81	78	81	91	81	100	99	90	91	83
2-Axle	372	375	388	367	343	361	374	429	407	359	420	385
3-Axle	270	264	272	223	197	231	260	313	275	252	286	287
MAV	1,214	1,183	1,324	1,094	964	1,100	1,069	1,247	1,274	1,281	1,365	1,311
OSV	2	3	2	3	3	3	3	3	3	3	2	3
PCUs	9,639	9,639	10,326	9,118	8,530	8,803	8,886	10,062	10,276	10,296	11,198	10,437

Aroli TP	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23
CAR/Jeep/Van	2,262	2,283	2,405	2,538	2,818	2,075	2,185	2,262	2,519	2,514	2,708	2,347
LCV	106	104	95	99	94	106	84	105	100	97	99	87
2-Axle	490	480	527	488	419	451	455	541	510	464	522	477
3-Axle	289	275	304	253	221	249	276	333	305	285	318	306
MAV	1,259	1,194	1,490	1,205	978	1,105	1,106	1,306	1,410	1,393	1,449	1,376
OSV	2	2	2	3	3	3	3	3	3	3	2	3
PCUs	10,433	10,089	11,755	10,348	9,292	9,315	9,497	10,932	11,473	11,189	11,904	11,030

Dhaneshwar TP	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23
CAR/Jeep/Van	2,207	2,342	2,318	2,198	2,349	1,995	2,133	2,189	2,323	2,288	2,637	2,165
LCV	105	110	98	94	91	106	99	113	98	89	107	94
2-Axle	521	500	548	517	444	520	501	596	559	470	550	469
3-Axle	443	426	460	407	341	459	440	583	567	442	471	417
MAV	1,492	1,461	1,758	1,318	1,089	1,336	1,300	1,579	1,673	1,588	1,701	1,538
OSV	6	6	5	3	3	3	3	3	3	3	2	4
PCUs	11,995	11,885	13,424	11,058	9,752	11,116	10,969	13,014	13,389	12,317	13,522	11,904

Figure 2-4: Month on Month Traffic Data for TP01, TP02 and TP03

The 12-month average traffic from April 2022 to March 2023 has been taken as the AADT for FY23 at all the three toll plaza locations which are presented in **Table 2-5**.

Location/ Mode	Car/Jeep/ Van/Taxi	LCV	2A	3A	MAV	OSV	PCUs
TP01	2,288	87	382	261	1,202	3	9,767
TP02	2,410	98	485	284	1,273	3	10,605
TP03	2,262	100	516	455	1,486	4	12,029

Table 2-5: AADT for FY23

2.5 Travel Characteristics

2.5.1 Survey Methodology

In order to understand the travel demand pattern in the region and tollable traffic streams, origin and destination (OD) surveys were carried out at the toll plaza locations. The OD survey was carried out for 24 hours, by roadside interview method as described in IRC: 102-1988. Both passenger and commercial vehicles plying on the project road were stopped on a random sampling basis and interviewed.

The travel characteristics obtained by OD survey facilitate the identification of:

1. Local and through traffic on the project road.
2. Potential divertible traffic to/from project road to various alternative routes.

Trained enumerators under the supervision of transport planners collected the trip characteristics using survey forms designed for this purpose. The OD survey elicited characteristics like origin, destination, frequency, purpose of trip for passenger vehicles and commodity being transported for goods vehicles. The information pertaining to origin and destination of trips collected during roadside interviews was analysed to obtain the trip distribution based on a zoning system suitably designed for the present study.

2.5.2 Traffic Zoning System

To understand the spatial dimensions of the trip characteristics of the vehicles interviewed during the O-D survey, a detailed zoning system was developed giving due consideration to the following factors:

- The road network catering to the traffic on the project road and its generating points
- Important towns, villages, factories and industrial centres around the project road area
- Administrative boundaries of districts and states.
- Configuration of the project road in the regional road network with respect to other roads

Two major types of areas were identified for analysis purpose: -

Immediate Influence Area (IIA): It includes the cities/towns/villages and districts along the project road and adjacent to it, which generate/attract trips to the project road. In this study, it consists of districts of Chittorgarh, Bhilwara, Bundi and Kota in the state of Rajasthan.

Broad Influence Area (BIA): It includes the remaining districts of Rajasthan and Gujarat and other neighbouring states such as Madhya Pradesh, Gujarat, and remaining states of India.

Detailed zoning system is prepared for IIA, while more aggregate or broad zoning is developed for BIA. The zoning system adopted for data collection was based on 97 zones and is presented in **Appendix 2.2**.

2.5.3 Sample Size

The toll traffic data does not provide the individual traffic volume count of all categories of vehicles. The seven-day traffic volume video count at the existing toll plazas was analysed to get the individual volume count of all categories of vehicles along with the direction split.

The vehicles during the OD surveys were interviewed on a random sample basis. **Table 2-6** shows the AADT and the sample size (both in absolute numbers and in percentage terms) captured during the exercise.

Modes	Car	Minibus	Bus	Mini - LCV	LCV	2Axle	3Axle	MAV	Total
TP01- Bassi									
Sample	1,127	9	76	154	133	144	241	800	1,127
AADT	2,061	7	209	227	80	172	261	1,205	4,222
Percentage (%)	**54.7**	**130.8**	**36.3**	**67.8**	**165.5**	**83.5**	**92.4**	**66.4**	**63.6**
TP02- Aroli									
Sample	1,239	8	144	169	148	186	220	765	2,879
AADT	2,192	8	226	218	91	260	284	1,275	4,553
Percentage (%)	**56.5**	**106.6**	**63.8**	**77.5**	**163.5**	**71.6**	**77.3**	**60.0**	**63.2**
TP03- Dhaneshwar									
Sample	1,404	7	140	120	105	168	339	888	3,171
AADT	2,033	8	227	229	92	289	455	1,490	4,823
Percentage (%)	**69.1**	**85.8**	**61.7**	**52.3**	**114.0**	**58.1**	**74.6**	**59.6**	**65.8**

Table 2-6: Sample Size Collected in OD Survey at TP01, TP02 & TP03

Based on the sample size of different categories of vehicles interviewed during the OD survey, direction-wise expansion factors were calculated based on FY23 AADT. The OD matrices for all vehicle categories were generated and analysis was done in terms of regional distribution, travel pattern and commodity distribution.

2.5.4 Regional Distribution

Based on the OD matrices, the regional distribution of tollable vehicles at the toll plaza locations has been calculated. **Table 2-7** gives the distribution indicating the attraction and generation zones for the traffic on the project road.

Region/Modes	Car	M Bus	Bus	MLCV	LCV	2A	3A	MAV
TP01-Bassi Toll Plaza								
Rajasthan	93.3	100.0	89.7	93.8	83.4	94.1	83.4	79.1
Gujarat	3.1	0.0	5.8	4.2	15.1	3.8	11.2	10.5
Madhya Pradesh	2.5	0.0	0.0	0.7	0.4	0.3	0.7	1.3
Uttar Pradesh	0.6	0.0	3.8	0.4	0.8	1.5	3.7	4.4
Maharashtra	0.1	0.0	0.0	0.0	0.4	0.0	1.0	0.5
Southern Indian States	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.4
Rest of India	0.4	0.0	0.7	0.7	0.0	0.4	0.2	3.8
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
TP02-Aroli Toll Plaza								
Rajasthan	96.3	90.1	87.7	96.2	87.8	90.9	77.2	83.9
Gujarat	2.0	6.6	9.4	1.8	8.8	6.2	12.7	9.0
Madhya Pradesh	0.9	3.3	0.4	1.2	2.1	1.2	1.6	1.9
Uttar Pradesh	0.7	0.0	2.1	0.7	0.9	1.5	3.6	2.8
Maharashtra	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.2
Southern Indian States	0.0	0.0	0.4	0.0	0.0	0.0	0.2	0.1
Rest of India	0.1	0.0	0.0	0.0	0.4	0.2	4.4	2.2
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
TP03-Dhaneshwar Toll Plaza								
Rajasthan	94.5	100.0	86.2	96.3	89.4	96.8	88.9	87.2
Gujarat	3.4	0.0	11.6	2.0	7.1	1.5	8.3	7.1
Madhya Pradesh	1.1	0.0	1.3	0.8	1.0	0.3	0.5	0.8
Uttar Pradesh	0.6	0.0	0.4	0.0	2.0	1.4	0.9	2.5
Maharashtra	0.1	0.0	0.0	0.0	0.5	0.0	0.1	0.4
Southern Indian States	0.1	0.0	0.0	0.0	0.0	0.0	0.3	0.4
Rest of India	0.2	0.0	0.4	0.9	0.0	0.0	0.9	1.7
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Combined (Avg. TP01, TP02 & TP03)								
Rajasthan	94.8	87.8	87.8	94.0	84.2	83.7	94.8	87.8
Gujarat	2.8	9.0	9.5	3.7	10.3	8.7	2.8	9.0
Madhya Pradesh	1.4	0.6	1.2	0.6	0.8	1.3	1.4	0.6
Uttar Pradesh	0.6	2.1	1.1	1.5	2.4	3.1	0.6	2.1
Maharashtra	0.1	0.0	0.3	0.0	0.4	0.4	0.1	0.0
Southern Indian States	0.1	0.1	0.0	0.0	0.2	0.3	0.1	0.1
Rest of India	0.2	0.4	0.1	0.2	1.7	2.5	0.2	0.4
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 2-7: Regional Distribution of Tollable Traffic (in %) On Project Road

Passenger traffic:

- In case of car traffic, Rajasthan contributes about 93.3 percent at TP01, 96.3 percent at TP02 and 94.5 percent at TP03, followed by Gujarat which contributes about 2.0-3.4 percent at all three toll plazas.

- In case of Bus traffic, Rajasthan contributes about 89.7 percent at TP01, 87.7 percent at TP02 and 86.2 percent at TP03, followed by Gujarat which contributes about 5.8-11.6 percent at all three toll plazas.

Freight Traffic

- In case of Mini LCV, Rajasthan contributes about 93.8 percent at TP01, 96.2 percent at TP02 and 96.3 percent at TP03.
- In case of 3A traffic, Rajasthan contributes about 83.4 percent at TP01, 77.2 percent at TP02 and 88.9 percent at TP03.
- In case of MAVs, share of Rajasthan state at TP01 is 79.1 percent, at TP02 is 83.9 percent and at TP03 is about 87.2 percent, followed by Gujarat which contributes about 7.1-10.5 percent at all three toll plazas.
- The MAV traffic is observed to be having Chittorgarh-Kota as top OD pair at all three toll plazas.

The mode wise top 20 OD pairs are given in **Appendix 2.3**.

2.5.5 Travel Pattern

In order to assess the travel pattern of vehicles, the important streams of traffic plying on the project road are estimated. The list of the popular movements found at the toll plaza locations is presented in **Table 2-8**, **Table 2-9** and **Table 2-10**.

Sr. No.	Traffic Streams	Car	Mini Bus	Bus	MLCV	LCV	2A	3A	MAV
1	Chittorgarh & surroundings - Kota & surroundings	11.4	29.1	22.4	24.9	29.0	71.1	47.7	39.1
2	Chittorgarh & surroundings - Indore/Guna/Nagpur & Beyond	2.1	0.0	0.0	0.5	1.5	0.6	0.4	1.9
3	Chittorgarh & surroundings - Jaipur/Delhi & Beyond	0.9	0.0	2.6	5.4	3.0	1.5	1.9	1.4
4	Chittorgarh & surroundings - Agra/Lucknow & Beyond	0.4	0.0	0.0	0.8	0.0	2.9	3.0	4.5
5	Bhilwara & Surroundings-Kota & Beyond	1.7	0.0	1.2	1.6	2.1	1.4	0.0	0.5
6	Udaipur & surroundings - Kota & surroundings	12.4	0.0	21.6	5.7	14.4	3.0	13.5	4.4
7	Udaipur & surroundings - Indore/Guna/Nagpur & Beyond	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
8	Udaipur & surroundings - Jaipur/Delhi & Beyond	0.6	0.0	1.4	0.0	0.0	0.0	0.5	0.3
9	Udaipur & surroundings - Agra/Lucknow & Beyond	0.6	0.0	1.4	0.5	0.8	0.0	0.4	1.3
10	Ahmedabad/Vadodara & surroundings - Kota & surroundings	1.3	0.0	2.6	6.2	21.1	5.3	10.6	13.1

Sr. No.	Traffic Streams	Car	Mini Bus	Bus	MLCV	LCV	2A	3A	MAV
11	Beyond Ahmedabad - Beyond Kota	3.7	0.0	8.9	0.5	7.4	2.3	11.9	17.5
12	Jodhpur/Pali & surroundings - Kota & Beyond	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.8
13	Ajmer/Kishangarh & surroundings - Kota & Beyond	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	Chittorgarh & Beyond - Zones between TP01 & TP02	43.3	70.9	36.7	41.7	14.4	9.7	6.8	13.1
15	Chittorgarh & Beyond - Zones between TP02 & TP03	20.1	0.0	1.2	11.9	6.2	2.2	3.3	1.8
Total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 2-8: Traffic Streams at TP01-Bassi Toll Plaza

Sr. No.	Traffic Streams	Car	Mini Bus	Bus	MLCV	LCV	2A	3A	MAV
1	Chittorgarh & surroundings - Kota & surroundings	12.8	19.8	12.5	17.4	24.7	15.1	24.8	37.7
2	Chittorgarh & surroundings - Indore/Gwalior/Guna/Nagpur & Beyond	0.3	0.0	0.0	0.5	1.4	0.4	1.3	0.3
3	Chittorgarh & surroundings - Jaipur/Delhi & Beyond	0.4	0.0	0.0	0.7	0.8	0.7	0.0	0.1
4	Chittorgarh & surroundings - Agra/Lucknow & Beyond	0.2	0.0	1.4	1.5	0.0	0.4	1.4	1.6
5	Bhilwara & Surroundings- Kota & Beyond	11.1	53.8	41.6	25.7	21.8	15.4	17.0	18.2
6	Udaipur & surroundings - Kota & surroundings	10.0	0.0	11.1	4.9	6.7	7.3	10.0	3.9
7	Udaipur & surroundings - Indore/Gwalior/Guna/Nagpur & Beyond	0.1	0.0	0.7	0.0	0.8	0.0	0.0	0.1
8	Udaipur & surroundings - Jaipur/Delhi & Beyond	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
9	Udaipur & surroundings - Agra/Lucknow & Beyond	0.3	0.0	0.0	0.0	1.1	0.0	0.0	0.4
10	Ahmedabad/Vadodara & surroundings - Kota & surroundings	2.0	0.0	13.0	1.7	8.7	6.2	7.8	9.9
11	Beyond Ahmedabad - Beyond Kota	1.5	13.2	5.7	1.5	9.0	4.3	17.3	16.8
12	Jodhpur/Pali & surroundings - Kota & Beyond	0.2	0.0	0.0	0.7	0.0	0.7	0.5	0.6
13	Ajmer/Kishangarh & surroundings - Kota & Beyond	1.7	0.0	1.3	0.7	0.8	2.6	0.4	0.8
14	Zones between TP01 & TP02 - Kota & Beyond	16.8	6.6	7.6	8.3	3.1	7.2	6.3	3.3
15	Chittorgarh & Beyond - Zones between TP02 & TP03	34.8	0.0	4.2	30.4	18.5	34.5	11.8	5.9

Sr. No.	Traffic Streams	Car	Mini Bus	Bus	MLCV	LCV	2A	3A	MAV
16	Zones between TP01 & TP02-Zones between TP02 & TP03	7.6	6.6	0.7	5.9	2.5	5.2	1.3	0.3
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 2-9: Traffic Streams at TP02-Aroli Toll Plaza

Sr. No.	Traffic Streams	Car	Mini Bus	Bus	MLCV	LCV	2A	3A	MAV
1	Chittorgarh & surroundings - Kota & surroundings	11.8	0.0	16.2	5.7	11.7	12.0	17.3	25.6
2	Chittorgarh & surroundings - Indore/Gwalior/Guna/Nagpur & Beyond	0.2	0.0	0.9	0.0	0.0	0.0	0.0	0.6
3	Chittorgarh & surroundings - Jaipur/Delhi & Beyond	0.6	0.0	0.6	0.0	0.9	0.0	0.3	0.2
4	Chittorgarh & surroundings - Agra/Lucknow & Beyond	0.3	0.0	0.0	0.0	1.0	1.1	0.6	1.0
5	Bhilwara & Surroundings-Kota & Beyond	14.2	13.8	20.2	14.4	17.2	12.3	10.0	14.7
6	Udaipur & surroundings - Kota & surroundings	9.4	0.0	17.0	2.4	16.3	7.9	12.6	10.3
7	Udaipur & surroundings - Indore/Gwalior/Guna/Nagpur & Beyond	0.4	0.0	0.9	0.0	1.0	0.0	0.3	0.3
8	Udaipur & surroundings - Jaipur/Delhi & Beyond	1.1	0.0	0.0	0.0	0.0	0.6	0.0	0.2
9	Udaipur & surroundings - Agra/Lucknow & Beyond	0.3	0.0	0.0	0.0	0.0	0.6	0.0	1.0
10	Ahmedabad/Vadodara & surroundings - Kota & surroundings	2.2	0.0	15.3	1.7	9.4	0.6	5.9	5.0
11	Beyond Ahmedabad - Beyond Kota	4.7	0.0	8.0	2.4	5.9	2.3	10.7	11.8
12	Jodhpur/Pali & surroundings - Kota & Beyond	0.6	0.0	6.8	0.0	1.0	0.0	0.3	0.7
13	Ajmer/Kishangarh & surroundings - Kota & Beyond	1.3	0.0	0.9	0.0	0.0	0.6	0.0	0.0
14	Zones between TP01 & TP02 - Kota & Beyond	3.1	0.0	0.6	0.8	1.0	3.5	0.5	2.7
15	Zones between TP02 & TP03 - Kota & Beyond	49.6	86.2	12.8	72.8	34.5	58.4	41.6	25.9
Total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 2-10: Traffic Streams at TP03-Dhaneshwar Toll Plaza

Passenger Traffic:

- The car traffic originating from/to Chittorgarh & surroundings to/from Kota & surroundings (stream 1) is about 11.4-12.8 percent (235-280 vehicles) at all the toll plazas. It may be noted that majority of car trips were found to be for the purpose of work and business which accounts to about 83-84 percent, followed by social/shopping trips accounting to about 5-7 percent at all the toll plazas.
- In case of car traffic, about 11.1-14.4 percent (244-289 vehicles) at TP02 and TP03 were found to be traveling between Bhilwara & surroundings and Kota & beyond (stream 5). It may be noted that the traffic originating/destined from/to Bhilwara takes an entry/exit from Ladpura town (located between Bassi TP and Aroli TP).
- In case of Bus, about 11.1-21.6 percent (25-45 vehicles) at TP01, TP02 and TP03 were found to be travelling between Udaipur & surroundings and Kota & surroundings (stream 6).

Freight Traffic:

- In case of 3A trucks, about 17.3-47.7 percent (70-124 vehicles) at TP01, TP02 and TP03 were found to be traveling from/to Chittorgarh & surroundings to/from Kota & surroundings (stream 1).
- In case of MAV, 14.7-18.2 percent (219-231 vehicles) of MAV at TP02 and TP03 were found to be travelling between Bhilwara & surroundings and Kota & beyond (stream 5).
- The MAV traffic originating from/to Chittorgarh & surroundings to/from Kota & surroundings (stream 1) is about 25.6-39.1 percent (381-479 vehicles) at all the toll plazas.

2.5.6 Commodity Distribution

The location of major cement/thermal plants and sandstone source points located in and around the project road are presented in **Figure 2-5**.

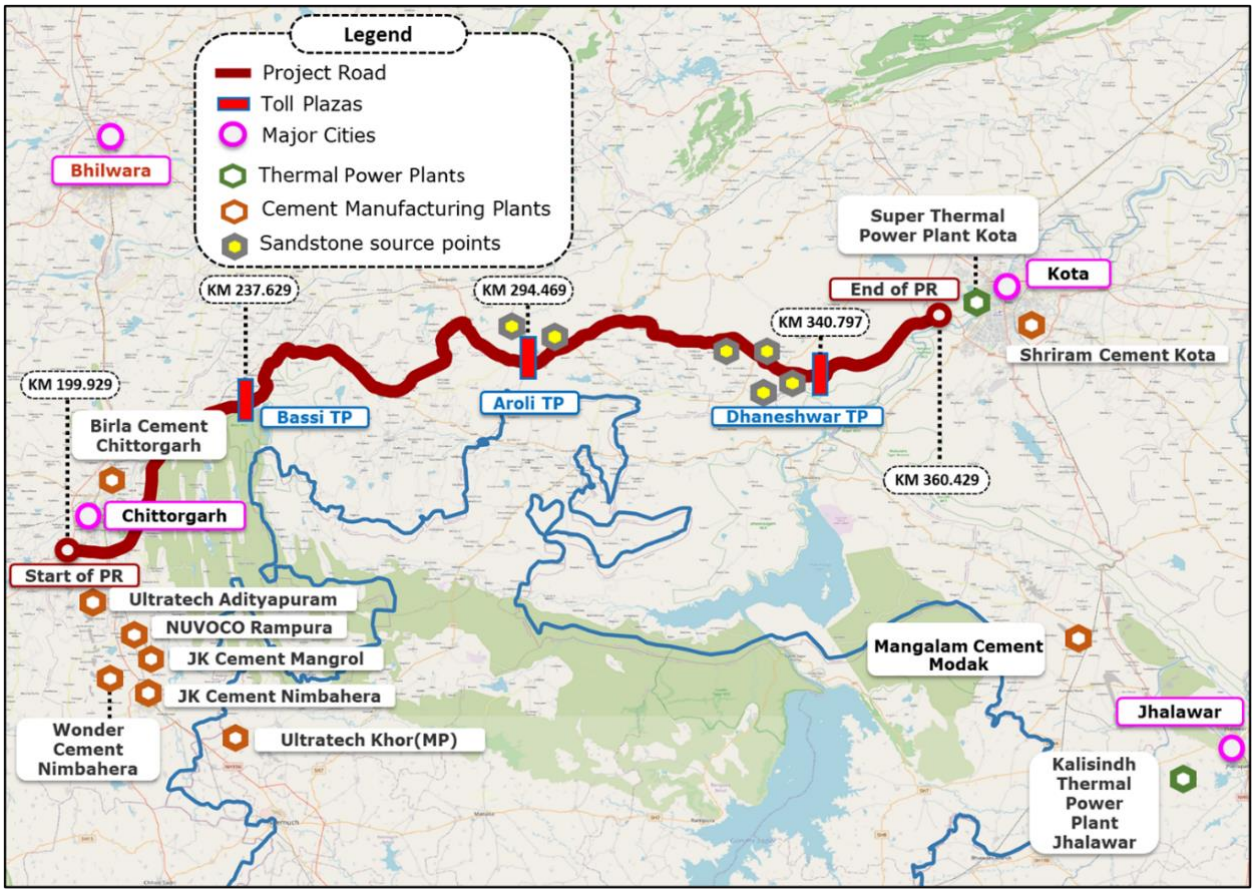


Figure 2-5: Cement Plants & Thermal Power Plants in the vicinity of the project corridor

Analysis was also carried out to understand the different commercial vehicles being used to transport different commodities. The commodity distribution for project corridor is presented in **Figure 2-6**.

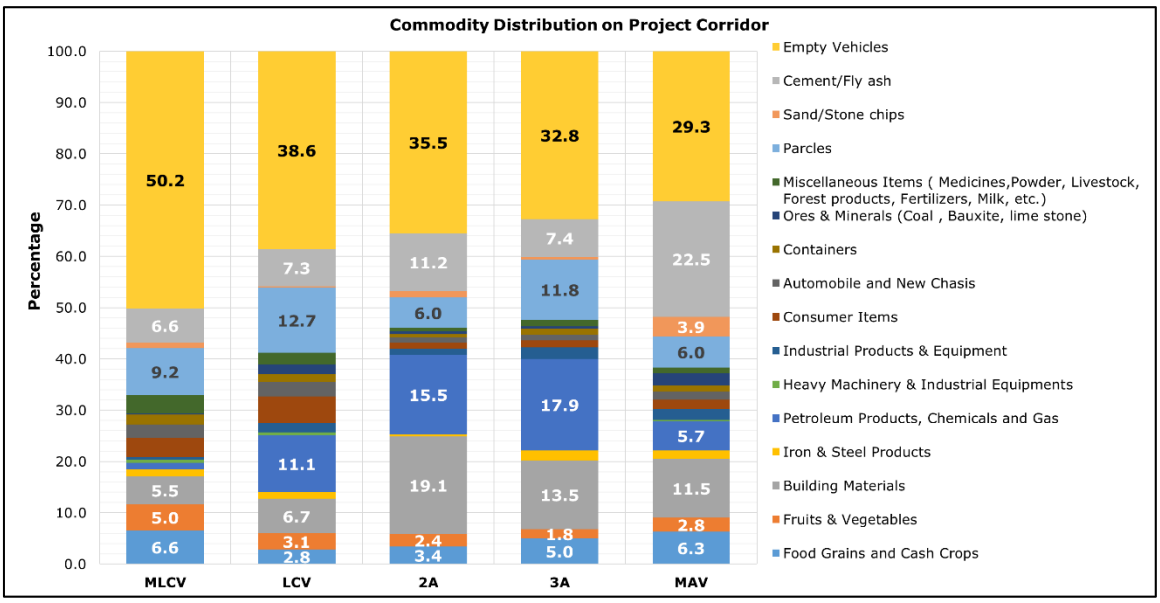


Figure 2-6: Commodity Distribution for Project Corridor

- Around 4 percent of MAV are found to be transporting sand/stone chips along the entire project corridor.
- Around 22.5 percent of MAV are found to be transporting cement/fly ash along the entire project corridor.

- Around 11-13 percent of 3A/MAV are found to be transporting building materials along the entire project corridor.

Also, commodity-wise share of the total commercial traffic at each of the toll plazas on the project road are presented in **Table 2-11**.

Commodity Type	MLCV	LCV	2 Axle	3 Axle	MAV
TP01-Bassi Toll Plaza					
Food Grains and Cash Crops	3.9	4.5	4.2	7.5	5.8
Fruits & Vegetables	3.2	3.8	2.8	3.3	2.6
Building Materials	4.5	1.5	3.5	2.5	7.6
Iron & Steel Products	1.3	0.8	0.7	2.1	1.3
Petroleum Products, Chemicals and Gas	2.6	9.0	22.2	17.8	6.6
Heavy Machinery & Industrial Equipment	0.0	0.8	0.0	0.0	0.0
Industrial Products & Equipment	1.3	1.5	1.4	2.1	2.0
Consumer Items	3.2	7.5	0.0	0.8	0.5
Automobile and New Chassis	1.3	3.8	0.7	1.2	2.1
Containers	0.0	0.0	0.0	0.0	0.0
Ores & Minerals (Coal, Bauxite, limestone)	0.0	1.5	1.4	0.8	2.9
Miscellaneous Items (Medicines, Powder, Livestock, Forest products, Fertilizers, Milk, etc.)	5.2	5.3	0.7	2.9	2.1
Parcels	3.2	9.8	5.6	7.5	4.4
Sand/Stone chips	1.9	0.0	1.4	0.4	7.4
Cement/Fly ash	10.4	6.8	20.8	10.8	29.0
Empty Vehicles	57.8	43.6	34.7	40.2	25.8
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
TP02-Aroli Toll Plaza					
Food Grains and Cash Crops	8.4	1.4	2.7	5.9	10.1
Fruits & Vegetables	7.3	3.4	3.2	1.4	2.6
Building Materials	3.4	8.1	26.9	9.5	10.3
Iron & Steel Products	1.7	2.0	0.0	0.9	0.8
Petroleum Products, Chemicals and Gas	0.6	16.9	13.4	22.7	4.8
Heavy Machinery & Industrial Equipment	0.6	0.0	0.0	0.0	0.1
Industrial Products & Equipment	0.0	1.4	0.5	0.5	0.3
Consumer Items	3.9	3.4	1.1	1.4	1.3
Automobile and New Chassis	1.7	2.0	1.1	0.0	1.3
Containers	4.5	3.4	1.6	3.6	3.1
Ores & Minerals (Coal, Bauxite, limestone)	0.0	0.7	0.5	0.0	1.4
Miscellaneous Items (Medicines, Powder, Livestock, Forest products, Fertilizers, Milk, etc.)	2.2	1.4	0.5	0.0	0.3
Parcels	15.6	12.8	4.8	16.4	4.6
Sand/Stone chips	1.1	0.0	0.5	0.5	2.5
Cement/Fly ash	3.4	7.4	5.9	5.9	21.6
Empty Vehicles	45.8	35.8	37.1	31.4	34.9

Commodity Type	MLCV	LCV	2 Axle	3 Axle	MAV
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
TP03-Dhaneshwar Toll Plaza					
Food Grains and Cash Crops	7.3	2.9	3.6	2.7	3.5
Fruits & Vegetables	4.1	1.9	1.2	0.9	3.0
Building Materials	9.8	11.4	23.8	23.9	15.9
Iron & Steel Products	0.8	1.0	0.6	2.4	2.8
Petroleum Products, Chemicals and Gas	0.8	5.7	11.9	14.7	5.6
Heavy Machinery & Industrial Equipment	1.6	1.0	0.0	0.0	0.6
Industrial Products & Equipment	0.0	2.9	1.8	3.5	3.8
Consumer Items	4.1	4.8	2.4	1.8	3.3
Automobile and New Chassis	5.7	2.9	1.2	1.5	1.6
Containers	0.8	1.0	0.0	0.6	0.5
Ores & Minerals (Coal, Bauxite, limestone)	0.8	3.8	0.0	0.6	2.6
Miscellaneous Items (Medicines, Powder, Livestock, Forest products, Fertilizers, Milk, etc.)	3.3	0.0	0.6	0.9	1.1
Parcels	7.3	16.2	7.7	11.8	8.8
Sand/Stone chips	0.0	1.0	1.8	0.6	1.9
Cement/Fly ash	6.5	7.6	8.9	5.9	17.5
Empty Vehicles	47.2	36.2	34.5	28.3	27.6
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 2-11: Commodity Distribution on Project Road

- Major commodities being transported across all three toll plazas are food grains, fly ash/cement, sand/stone, petroleum/gas products, parcels etc.
- Around 11-13 percent of 2A and about 14-22 percent of 3A across all the three toll plazas were found to be transporting petroleum products and chemicals. It may be noted that these tankers are laden from oil refineries/mills located near Udaipur/ Bhilwara for distributive purposes.
- Around 12-17 percent of MAVs at TP02 and TP03 respectively are laden with sand/stone chips and building materials. It may be noted that this commodity is sourced at major mining sites located near Dabi (between Aroli TP and Dhaneshwar TP) and is travelling in both the directions.
- About 17-29 percent of MAV were found to be transporting cement/fly ash across all the three toll plazas. It is to be mentioned that fly ash is a by-product of thermal power plant which is located at Kota, Jhalawar and Chhabra. This commodity is transported to cement plants located at Chittorgarh, Nimbahera and Dabok for the manufacture of fly ash-based products (such as bricks & pozzolana cement). After unloading, some of these trucks return empty back to thermal power plant and some are laden with cement from plants to different demand centres located across Rajasthan.

3. TRAFFIC GROWTH RATE AND PROJECTIONS

3.1 General

The project road is currently under NHAI InVIT and the projections of traffic and revenue have been presented till FY52. The estimation of the traffic using the tolled highway and its future growth are important elements to assess the project's economics as these are generally the main/sole source of revenue for the project This chapter details various aspects of the current traffic of the project road and its growth potential as assessed by Ramboll.

3.2 Project Road Traffic

The traffic that is likely to use the project road was estimated on the basis of the traffic and travel characteristics gathered as part of the study. The traffic on the project road would normally consist of the following components:

- Normal Traffic
- Diverted Traffic
- Induced/Developmental Traffic

3.2.1 Normal Traffic

Normal traffic is the traffic which is already plying on the project road as assessed in section 2.4.4.

3.2.2 Diverted Traffic

Diverted traffic is generally dictated by the presence of an alternative route at a lower generalised cost, which is in-turn defined by the road configuration and its condition, the type of vehicle and its operating costs, the average riding speed, the route distance and any tolling that may apply on a specific route.

In context of the project road, there are no routes in vicinity of toll plazas to avoid the project road. The development of the under-construction green-field Delhi-Mumbai Expressway (DME) may impact the project road traffic which has been detailed in section 3.3.

3.2.3 Induced/ Development Traffic

Developmental /new generated traffic is the one which would be generated, over and above normal growth, because of lowering of transport costs or new developments in the immediate influence area of the project road. In case of the project road, there is no development envisaged in the vicinity of the project road.

Bharatmala Pariyojana is the second largest highways construction project in the country since NHDP, under which almost 50,000 km or highway roads were targeted across the country. It will look to improve connectivity particularly on economic corridors, border

areas and far-flung areas with an aim of quicker movement of cargo and boosting exports.

It will connect 550 district headquarters to minimum 4-lane highway by raising the number of corridors to 50 (from current 6) and move 80 percent freight traffic (currently 40 percent) to national highways by connecting 24 logistics parks and 7 north east multimodal waterway ports.

The Phase-I includes economic corridors of around 9,000 km; inter-corridor and feeder routes of around 6,000 km; 5,000 km roads under the National Corridors Efficiency Program, border and international connectivity roads of around 2,000 km; coastal and port connectivity roads of around 2,000 km; expressways of around 800 km and 10,000 km of NHDP roads. The total length in phase 1 comes to around 34,800 km.

In the context of the project influence area, there are a few economic corridors and inter corridors listed in the Rajasthan. The economic corridors planned in this state are Sri Ganganagar- Samakhiayali, Agra-Indore and Jaipur-Udaipur and is likely to improve connectivity with an aim to provide quicker movement of cargo.

As the project road caters to the long/ short distance traffic, it is likely to have a potential for growth in view of the developments of these economic corridors and feeder roads. This project section being a part of 4 laned tolled East-West Corridor, will continue to remain an important highway for the East-West movement especially Kanpur & beyond to Udaipur & beyond and may see sustained growth in the future. Kota city is known as the "Education hub of India" with the presence of a number of coaching institutes. Chittorgarh is a famous tourist destination with presence of Chittorgarh Fort. The other tourist attractions in Project Influence Area are Udaipur (City of Lakes), Haldighati, Kumbalgarh, Kota, and Bundi. The travel pattern signifies that majority of the larger axle trucks (2A, 3A and MAV) are crossing all the 3 toll plazas on project road which are mainly making the trips from Chittorgarh / Udaipur and beyond to Kota and beyond.

3.3 Impact of Delhi – Mumbai Expressway

Delhi–Mumbai Expressway is an under-construction 1,380 km long controlled-access highway connecting the national capital Delhi with India's commercial capital Mumbai. The expressway is proposed on a greenfield-alignment and will be 8-lane facility (4 lanes in each direction). Being a signal-free access-controlled corridor between the two cities running across five states will cut down the travel time from 25 hours to 12 hours.

This Expressway was first announced in April 2018 by Union Minister Nitin Gadkari and as per the latest update, the section from Sohna-Dausa-Lalsot recently opened for public use and the remaining sections is targeted to be completed by end of 2024. The alignment of Delhi – Mumbai Expressway passes through the states of Haryana (80km), Rajasthan (375km), Madhya Pradesh (245km), Gujarat (425 km) and Maharashtra

(170km). The alignment of the project road and the Delhi – Mumbai Expressway is presented in **Figure 3-1**.

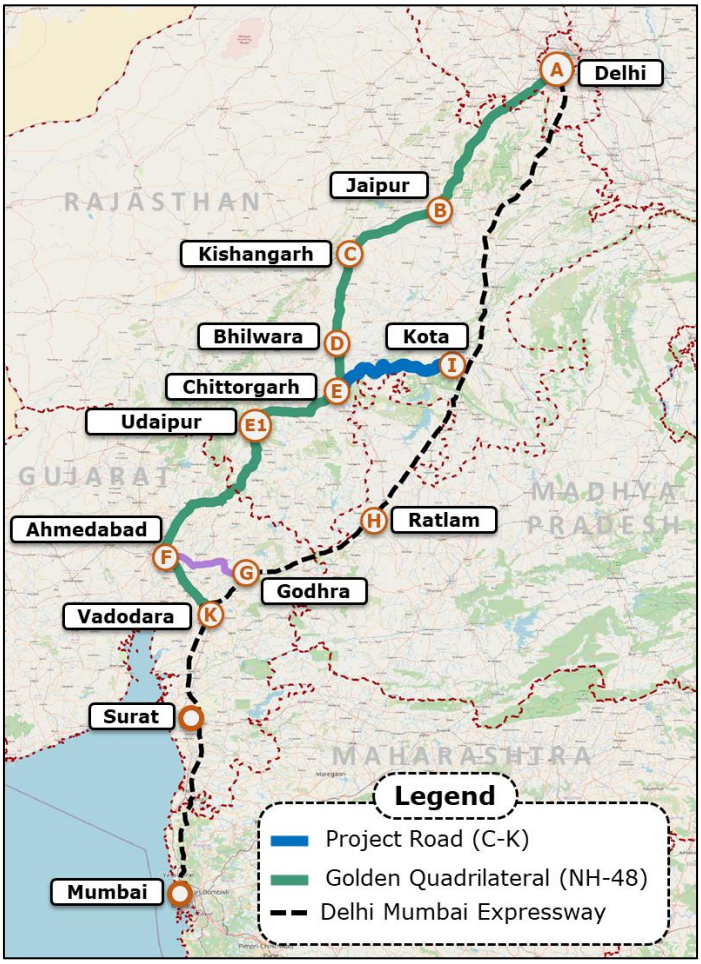


Figure 3-1: Project Road and Alternate Routes via DME

Diversion analysis considers the toll rates for DME section (I-H-G-F) as 1.35 times of the normal NHAI per km toll rates based on the actual toll rates on the operational section of DME from Delhi-Lalsot.

The assessment of any likely traffic diversion away from the Project Road (PR) has been done using the cost ratio analysis as described below:

- Assessment of the potential divertible traffic sensitive to network improvements based on the observed travel pattern
- Calculation of road user cost of travelling on the project road and the alternative route. The road user cost includes vehicle operating cost (VOC), travel time cost (TTC) and toll cost (TC), if any.

The road user cost is estimated based on vehicle operating cost equations presented in IRC SP-30,2019 which is based on updation of Road User Cost Study (RUCS) carried out by Central Road Research Institute in 2019 for Ministry of Road Transport and Highways. Using the likely traffic stream speeds and lane configuration, the vehicle operating, and travel time costs are estimated for each of the routes. Road user cost on the identified routes is calculated and diversion percentages are estimated using diversion curve

method mainly for trucks. In this method, traffic likely to be diverted from/to the project road, was estimated using Logit model, which computes expected diversion percentage based on the ratio of perceived cost on the existing and proposed facilities. The perceived cost is the financial vehicle operating cost and the time saving cost including toll charges (if any). According to the model, a vehicle will shift if the perceived cost on an alternative route is lower in comparison to existing route. The diversion equations for estimating diversion have been adopted from Indian National Expressway Network Report, MORTH (2009) as mentioned in IRC 108:2015. These equations are presented in **Table 3-1**.

Vehicle	Cost Ratio (CR) Interval	Equations
Truck & Bus	<= 0.750	% Div. = 100 - ((CR/0.75) * 5)
	0.750 <= CR <= 1.250	% Div. = 95 - ((CR-0.75)/0.5) * 90
	1.250 <= CR <= 2.0	% Div. = ((2-CR)/0.75) * 5

Source: IRC 108-2015

Table 3-1: Diversion Equations Used for Analysis

The diversion percentages are estimated for the future conditions keeping in view, the updated project road network and surrounding road network. The diversion percentages are then applied to the potential divertible traffic/corridor by OD pair to calculate the traffic that would divert to/from the project road.

The estimation of traffic diversion away or to the project road has been done for three different streams of traffic which are listed below:

- Diversion away from PR for the traffic plying between Gandhidham/ Ahmedabad/ rest of Gujarat to Kota & beyond (towards Jhansi/ Lucknow/ Kanpur) - Stream A
- Diversion away from PR for the traffic plying between Vadodara & surroundings to Kota & beyond (towards Jhansi/ Lucknow/ Kanpur) - Stream B
- Diversion to PR for the traffic plying between Haryana/ Delhi & beyond to Chittorgarh/ Udaipur & surroundings currently using the route via Delhi – Jaipur – Kishangarh – Chittorgarh (via NH8/NH76/NH79A)

A detailed comparison of both the cases, i.e., diversion away from PR involving two streams and diversion to PR involving one stream, are presented below.

A. Diversion away from PR

The traffic from/to Gandhidham/ Ahmedabad/ rest of Gujarat to/from Kota & beyond (towards Jhansi/ Lucknow/ Kanpur) will have two route choice options once DME is operational. The existing route via PR is along I-E-E1-F which is about 546 km whereas the route via DME is along I-H-G-F which is about 514 km. Similarly, the traffic from/to Vadodara & surroundings to/from Kota & beyond (towards Jhansi/ Lucknow/ Kanpur) will have two route choice options in future. The existing route via PR is along I-E-E1-F-K which is about 639 km whereas the route via DME is along I-H-G-K which is about 455

km. Once DME is operational, some of the traffic plying along both the streams which is currently using the route via PR may shift to the route via DME as DME maybe more attractive from the point of view of total cost. The total potential for both the streams of traffic have been estimated from the OD surveys conducted on the project road.

B. Diversion to PR

The traffic from/to Haryana/ Delhi & beyond to Chittorgarh/ Udaipur & surroundings will have two route choice options once DME is operational. At present, traffic is primarily using the route via Delhi – Jaipur – Kishangarh – Bhilwara – Chittorgarh (A-B-C-D-E) which in future will have an option to use Delhi – Kota – Chittorgarh via PR (A-I-E). The route via PR is about 713 km whereas the route via AR is about 591 km. Once the DME section between Delhi to Kota (A-I) is completed, some of the freight traffic using the alternate route may divert to the project route. The potential traffic between Haryana/ Delhi & beyond to Chittorgarh/ Udaipur & surroundings has been derived from the OD surveys conducted in an earlier study on Kishangarh – Chittorgarh section which was available with the consultant.

The impacts for both the cases have been derived separately and their net impact has been presented in **Table 3-2**.

Modes	3A	MAV
Loss from PR- Stream A		
Potential Traffic	42	108
% Diversion from PR	60.2	62.4
Diversion from PR	-25	-68
Loss from PR- Stream B		
Potential Traffic	25	106
% Diversion from PR	96.5	96.7
Diversion from PR	-24	-102
Total Loss from PR		
Expected loss from PR (Stream A+ Stream B)	-49	-170
Gain to PR		
Potential Traffic	306	794
% Gain in PR Traffic	32.7	30.7
Expected Gain to PR	100	244
Net gain to the PR		
Net Gain to PR	51	74
As Percentage of AADT		
TP01	19.5%	6.2%
TP02	18.0%	5.8%
TP03	11.2%	5.0%
Adopted – 50% gain		
TP01	9.8%	3.1%
TP02	9.0%	2.9%
TP03	5.6%	2.5%

Table 3-2: Impacts due to Delhi - Mumbai Expressway (DME)

The cost-ratio based analysis indicates a net gain of 11-19 percent in 3A and 5-6 percent in MAV category. However, adopting a conservative approach, the net gain of traffic

considered in the base case is adopted as 50 percent of the gain derived from the cost ratio analysis.

The DME is likely to be fully operational by FY25. The adopted total divertible traffic corresponds to about 6-10 percent of 3A Trucks and 2-3 percent of MAVs across all the toll plazas. The traffic shift is likely to happen gradually and hence the traffic gain has been considered in phases with 50 percent in FY25, 75 percent in FY26 and 100 percent from FY27 onwards.

3.4 Methodology for Traffic Growth Rate Estimation

Traffic growth for both passenger and freight vehicles has been estimated using the econometric approach as described in IRC-108, 2015. For freight traffic, due consideration has been given to the total tonnage transported and the shift in types of vehicles used for moving goods.

The econometric model applied, relates traffic growth to changes in state (or district) domestic product via an elasticity factor. According to IRC guidelines, elasticity based econometric model for highway projects should be derived in the following form:

$Log_e(P) = A0 + A1\ Log_e\ (EI)$, where:

P - Traffic Volume

EI - Economic Indicator

A0 - Regression Constant

A1 - Regression Co-efficient (Elasticity Index)

In order to estimate traffic on the project road, the methodology described below has been followed:

- Identify the influence area - From the analysis of OD survey data, the project influencing states and districts, which are likely to impact the traffic growth on the project road, were identified.
- Review Past traffic Data – Based on toll data available for the project, a review of past traffic and tonnage growth is carried out.
- Analysis of economic growth of the Project Influencing Area (PIA) - For each PIA state, an economic profile describing past performance and future outlook was prepared. This also considers India's past economic performance and its future outlook.
- Estimation of traffic elasticity to income – in order to translate economic growth into traffic growth, an elasticity factor was estimated.
- Derivation of traffic growth rates – On the basis of the weighted (based on OD shares) PIA outlook and related traffic elasticity, traffic growth rates were estimated.

The methodology thus adopted incorporates, as basic data inputs, the perspective growth envisaged in the influence area and the changes in transport demand elasticities over a period of time. The traffic growth rates by vehicle type for the project road have been determined till FY52.

3.5 Identification of PIA States

The regional distribution observed on the project road shows that Rajasthan and Gujarat are the main contributors of traffic on the project road for passenger vehicles. In case of freight traffic, states of Madhya Pradesh and Uttar Pradesh also contribute to the project road traffic in addition to the states of Rajasthan and Gujarat.

The states of Rajasthan and Gujarat have, therefore, been considered as the PIA states for passenger traffic and in addition to these PIA states, Madhya Pradesh and Uttar Pradesh have also been considered as the PIA states for freight traffic. The mode wise normalized regional distribution shares are presented in **Figure 3-2**.

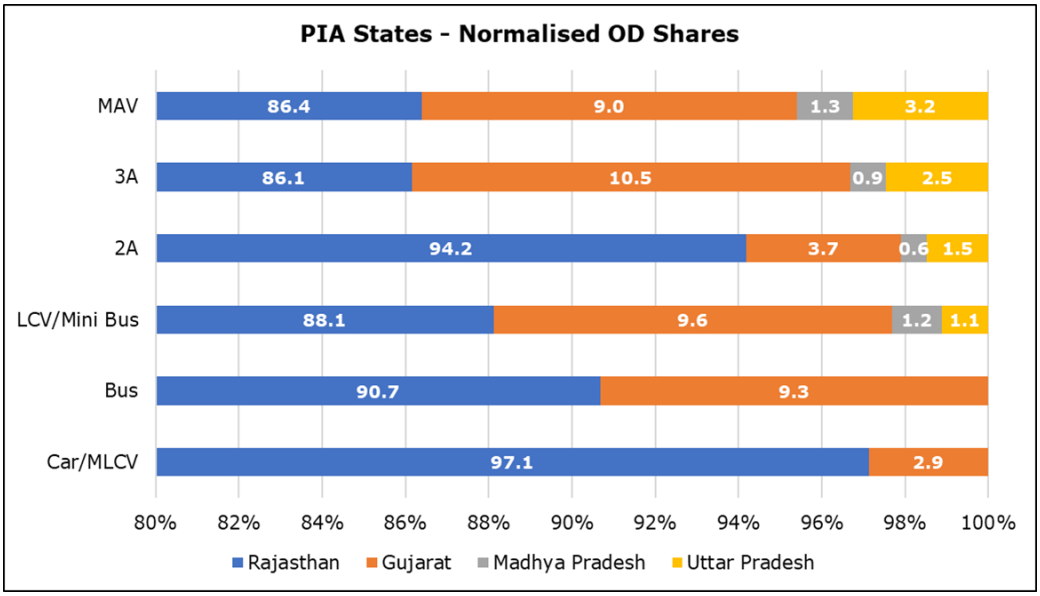


Figure 3-2: Normalised Regional Distribution (%) for the PR

Rajasthan has a share of 97.1 percent in cars and 90.7 percent in buses and Gujarat contributes around 2.9 percent in cars and 9.3 percent in buses.

In case of freight vehicles, Rajasthan contributes the highest around 86 percent each in 3A and MAV trucks and 94 percent in 2A. Gujarat has a share of around 9-11 percent in case of 3A and MAV trucks and 3.7 percent in 2A trucks. Uttar Pradesh and Madhya Pradesh also have a significant share of about 1-3 percent in freight vehicles.

3.6 Past Economic Growth of PIA

Growth of traffic on the project road depends on existing development and future growth prospects of the connecting regions. A number of economic indicators for the PIA states, as published by Central Statistical Organisation (2011-12 prices), have been studied to assess their past performance.

Rajasthan

- Rajasthan's Gross State Domestic Product (GSDP) stood at Rs 6,795.6 billion in 2019-20 and has been growing at a compounded annual growth rate of 6.0 percent since 2011-12. The GSDP for the year 2021-22 is Rs 7,330.2 billion.
- The state's growth had been between 5-8 percent since FY15 up to FY20. The state has shown a 11 percent growth in FY22 which could be due to the low base in FY21.
- The services sector is the largest contributor to GSDP (44.8 percent), agriculture allied activities sector at 31.7 percent and secondary sector at 23.5 percent of the GSDP in 2021-22.

The change of sectoral composition of GSDP over the years is presented in **Figure 3-3**.

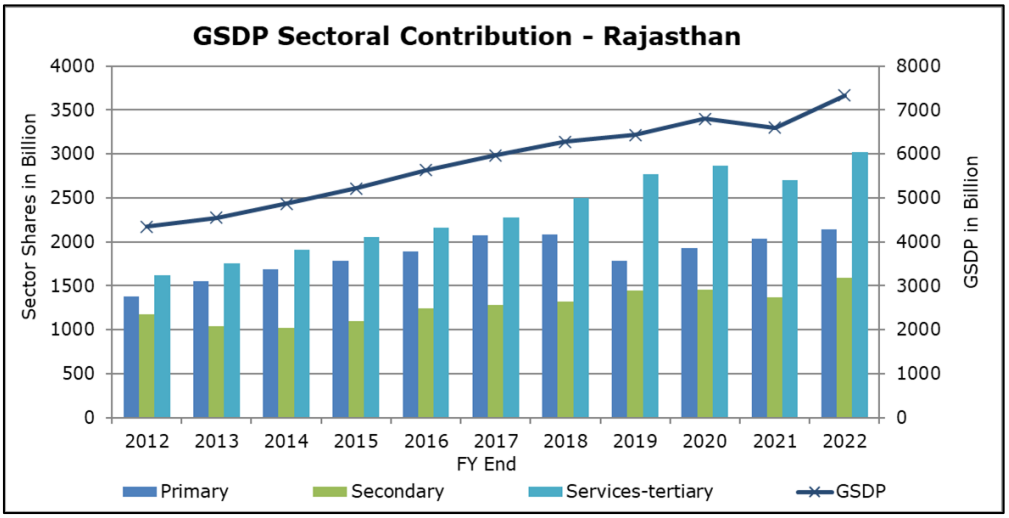


Figure 3-3: GSDP (in Rs billion) and its Sectoral Composition for Rajasthan

The performance of the state economy and its different sectors has been studied using time trend analysis. The average annual growth rates as obtained using regression analysis are presented in **Table 3-3**.

Particulars	2011-12 to 2019-20	2014-15 to 2019-20
GSDP	6.0	5.2
Agriculture and Allied	4.0	0.7
Industry	4.2	5.5
Services	7.4	7.4
Construction	2.2	3.0
Per Capita Income	4.4	3.6

Table 3-3 : Average Annual Growth Rates (%) of State Income for Rajasthan

Rajasthan is known for its textile industry and the state is the fourth largest producer of spun yarn in India. The main industries of Rajasthan include textile, rugs, woollen goods, vegetable oil and dyes. Heavy industries consist of copper and zinc smelting and the manufacture of railway rolling stock. The other industries related to private sector include steel, cement, ceramics, and glass wares, electronic, leather and footwear, stone and other chemical industries.

Rajasthan has huge reserves of cement-grade and Steel Melting-Shop (SMS) grade limestone. SMS-grade limestone from Jaisalmer is supplied to various steel plants in the country. Rajasthan has 21 major cement plants, having a total capacity of 55 million tonnes per annum (MTPA). It is the largest cement-producing state in India. The state has about 17 per cent share in cement grade limestone reserves of India. Given the availability of huge cement grade limestone reserves, more than 10 cement plants would be installed in the state in near future, particularly in Chittorgarh, Jaipur, Jhunjhunu, Nagaur and Pali.

The state is a leading producer of major minerals such as lead-zinc, calcite, gypsum, rock phosphate, ochre, silver as well as minor minerals such as marble, sandstone, serpentine (green marble), etc. which contribute a major percentage to national production.

According to the Department for Promotion of Industry and Internal Trade (DPIIT), foreign direct investment (FDI) inflows in the state stood at US$ 1.6 billion between FY2000 and FY2022.

In September 2020, the state government entered an understanding with SVP International Group for an investment of Rs. 4,000 crore (US$ 541.57 million) for development of facilities related to textile, defense, and aviation sectors.

The state is developing sector specific infrastructure, such as special purpose industrial parks and special economic zones (SEZs) for exports of handicrafts, IT and electronic goods. There are six notified SEZs in the state. The primary industries for these SEZs are IT/ITES, Handicrafts, Gems and Jewellery, Engineering, and related services.

The per capita income of Rajasthan is Rs 91,868 in the year 2021-22 and has been growing at 3.7 percent during FY12 to FY22. The growth in per capita income is presented in **Figure 3-4**.

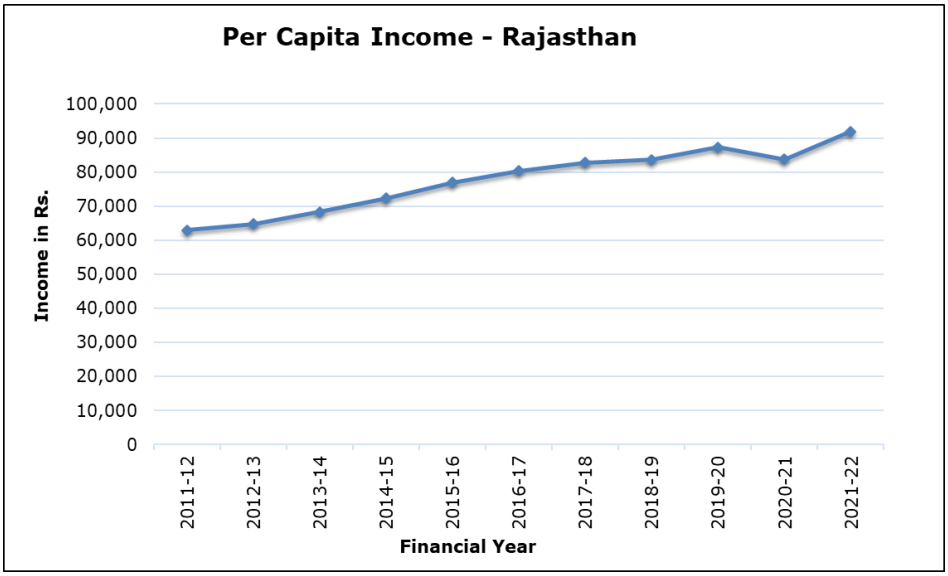


Figure 3-4: Per Capita Income of Rajasthan from 2011-12 to 2021-22

Other PIA States

The other PIA states contributing to the traffic on the project road are Gujarat, Madhya Pradesh, and Uttar Pradesh.

- Gross State Domestic Product (GSDP) of Gujarat stood at Rs 12,652.8 billion in 2019-20 and has been growing at a compounded annual growth rate of 9.6 percent since 2011-12. The GSDP estimates for the year FY21 is Rs 12,481.9 billion
- Madhya Pradesh's Gross State Domestic Product (GSDP) stood at Rs 5,755.5 billion in FY20 and has been growing at a compounded annual growth rate of 7.8 percent since FY12. The GSDP estimates for the year FY22 is Rs 6,216.5 billion. The state has shown a 10.1 percent growth in FY22 which could be due to the low base in FY21.
- Gross State Domestic Product (GSDP) of Uttar Pradesh stood at Rs 11,402.8 billion in 2019-20 and has been growing at a compounded annual growth rate of 6.3 percent since 2011-12. The GSDP estimates for the year FY22 is Rs 11,230.9 billion. The growth in the recent year of FY22 is 4.2 percent.
- The secondary sector is the largest contributor to GSDP (46.3 percent) in the PIA state of Gujarat and the services sector is the largest contributor to GSDP of the other two PIA states, 39 percent in Madhya Pradesh and 50.3 percent in Uttar Pradesh. Also, the contribution of primary sector in GSDP of Madhya Pradesh is quite prominent with a share of about 35 percent in FY20.

The average annual growth rates as obtained using regression analysis for the period FY12 to FY20 are presented in **Table 3-4**.

Particular/States	Gujarat	Madhya Pradesh	Uttar Pradesh
2011-12 to 2019-20			
GSDP	9.6	7.8	6.3
Primary	6.5	6.9	3.9
Secondary	10.9	7.8	7.1
Tertiary	8.6	7.1	7.3
Construction	3.7	3.9	5.2
Per Capita Income	8.2	6.2	4.7

Table 3-4: Average Annual Growth Rates (%) of State Income for Other PIA States

The GSDP over the years for the states of Rajasthan, Gujarat, Madhya Pradesh, and Uttar Pradesh are presented in **Figure 3-5**.

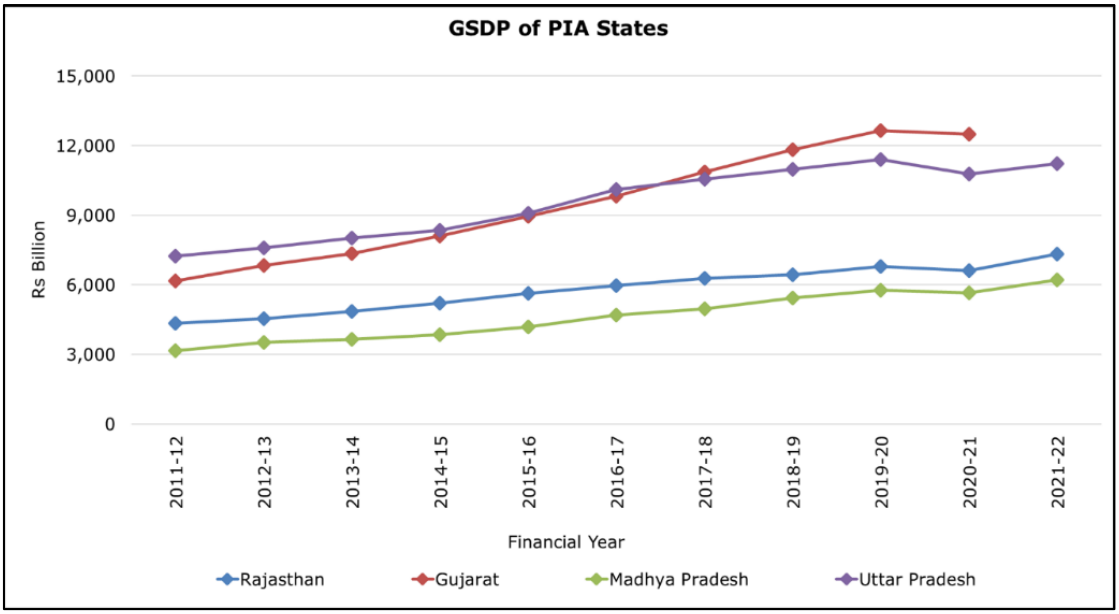


Figure 3-5: GSDP (in Rs billion) for Other PIA States

3.7 India and PIA Outlook

3.7.1 India's past performance and outlook for future

India's growth trend during the recent years has been presented in **Figure 3-6**.

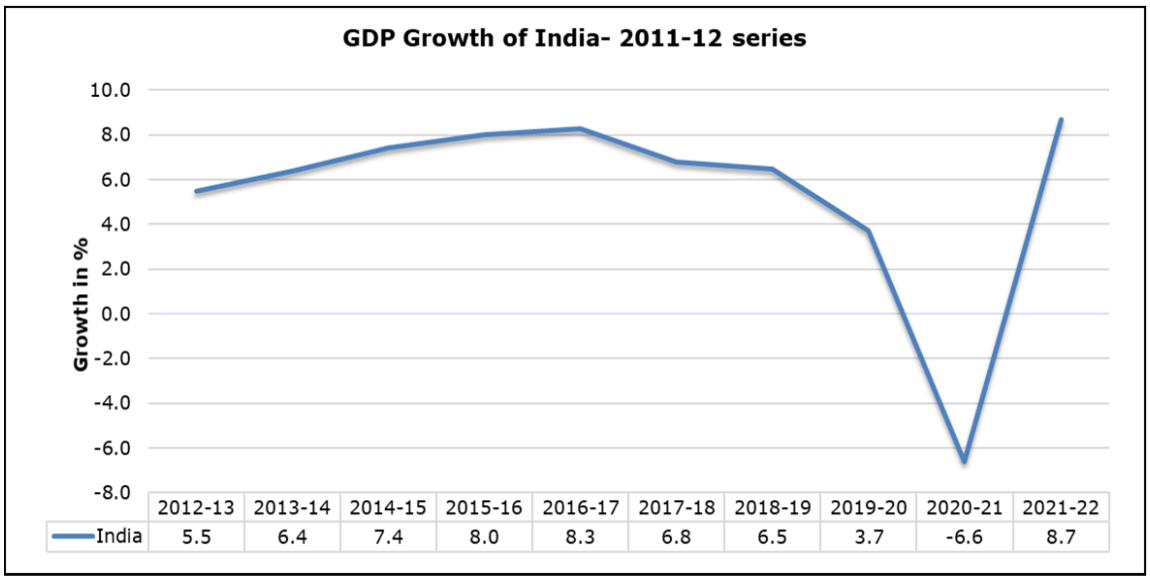


Figure 3-6: GDP Growth in India

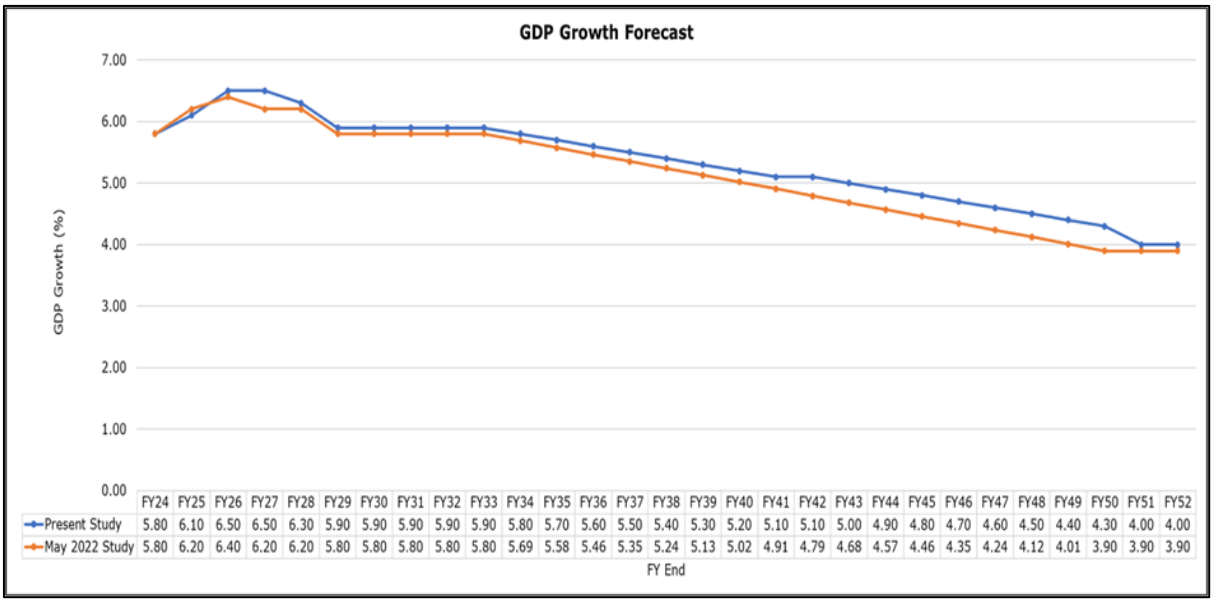
Economic growth in India has been broadly on an accelerating path till FY18. It is likely to be the fastest growing major economy in the world in the medium-term. The growth in real GDP was 8.3 percent for FY17 and 6.8 percent in FY18, while the growth in FY19 was slightly lower at 6.5 percent. The long-term trend line growth of 7.2 percent has been achieved between FY12 to FY19. During FY20, growth has slowed down due to some structural issues and global headwinds resulting in an average GDP growth rate of 3.7 percent.

With the outbreak of COVID-19, global recession was witnessed across all the economies. The lockdown period announced by Indian government had an adverse impact on the

economy. The first quarter estimated for FY21 has indicated a contraction of 23.9 percent, second quarter showed a rebound in growth by contracting 7.5 percent and third & fourth quarter grew by 0.5 percent and 1.6 percent respectively. The resultant contraction for FY21 has been 6.6 percent.

The Indian economy is likely to see the impact of global slowdown due to COVID-19 and hence, the GDP forecast for India by various international agencies has been revised for the next two years. As per the latest update by Central Statistical Organisation (CSO), GDP in FY22 has grown by 8.7 percent. As per Economic Survey of India for FY23, the economy is predicted to have a growth rate of 7.0 percent in FY23 and 6.0-6.8 percent in FY24. As per the latest forecast of RBI, the economy is likely to grow at 6.4 percent in FY24.

The year-on-year growth for Indian economy as provided by the Client based on the forecast by Consensus Economics from FY24 and beyond in May 2022 study and present study are presented in **Figure 3-7**.



	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40	FY41	FY42	FY43	FY44	FY45	FY46	FY47	FY48	FY49	FY50	FY51	FY52
Present Study	5.80	6.10	6.50	6.50	6.30	5.90	5.90	5.90	5.90	5.90	5.80	5.70	5.60	5.50	5.40	5.30	5.20	5.10	5.10	5.00	4.90	4.80	4.70	4.60	4.50	4.40	4.30	4.00	4.00
May 2022 Study	5.80	6.20	6.40	6.20	6.20	5.80	5.80	5.80	5.80	5.80	5.69	5.58	5.46	5.35	5.24	5.13	5.02	4.91	4.79	4.68	4.57	4.46	4.35	4.24	4.12	4.01	3.90	3.90	3.90

Figure 3-7: GDP Forecast of India

3.7.2 PIA States Outlook

A snapshot of the main economic indicators in the past for the PIA states is presented in **Table 3-5**.

Indicators	Rajasthan	Gujarat	Madhya Pradesh	Uttar Pradesh
GSDP in Rs Billion	6,795.6	12,652.8	5,755.5	11,402.8
GSDP growth (FY12 to FY20) in %	6.0	9.6	7.8	6.3
Per capita Income in Rs (FY20)	87,288	186,980	69,429	50,089
Sector Share in %, FY20				
Agriculture and allied	30.9	17.2	35.2	22.8
Industry	23.3	46.3	25.9	26.9
Services	45.9	36.4	39.0	50.3

Table 3-5: Main Economic Indicators of PIA States

In order to arrive at the forecast of the PIA states, past performance of the State GDPs vis-a-vis India GDP has been studied and the multipliers have been derived for both short term and long term. The past and adopted multipliers for PIA states to Indian economy are presented in **Table 3-6**.

Period	India	Rajasthan	Gujarat	Madhya Pradesh	Uttar Pradesh
Past Growth %					
FY12 to FY20	6.9	6.0	9.6	7.8	6.3
FY15 to FY20	6.8	5.2	9.5	8.5	6.4
Past Multipliers					
FY12 to FY20		0.9	1.4	1.1	0.9
FY15 to FY20		0.8	1.4	1.3	0.9
Adopted Multipliers					
States w.r.t. India		0.9	1.4	1.1	0.9

Table 3-6: Past Multipliers and Future Outlook of PIA States

Based on the normalised OD shares of the toll plaza and the outlooks adopted for PIA states, the mode-wise future weighted income is presented in **Table 3-7**.

FY/Modes	Cars/MLCV	Bus	LCV/MBus	2A	3A	MAV
2024	5.4	5.7	5.7	5.4	5.7	5.7
2025	5.6	6.0	6.0	5.7	6.0	6.0
2026	6.0	6.4	6.4	6.1	6.4	6.4
2027	6.0	6.4	6.4	6.1	6.4	6.4
2028	5.8	6.2	6.2	5.9	6.2	6.2
2029	5.5	5.8	5.8	5.5	5.8	5.8
2030	5.5	5.8	5.8	5.5	5.8	5.8
2031	5.5	5.8	5.8	5.5	5.8	5.8
2032	5.5	5.8	5.8	5.5	5.8	5.8
2033	5.5	5.8	5.8	5.5	5.8	5.8
2034	5.4	5.7	5.7	5.4	5.7	5.7
2035	5.3	5.6	5.6	5.3	5.6	5.6
2036	5.2	5.5	5.5	5.2	5.5	5.5
2037	5.1	5.4	5.4	5.1	5.4	5.4
2038	5.0	5.3	5.3	5.0	5.3	5.3
2039	4.9	5.2	5.2	5.0	5.2	5.2
2040	4.8	5.1	5.1	4.9	5.1	5.1
2041	4.7	5.0	5.0	4.8	5.0	5.0
2042	4.7	5.0	5.0	4.8	5.0	5.0
2043	4.6	4.9	4.9	4.7	5.0	4.9
2044	4.5	4.8	4.8	4.6	4.9	4.8
2045	4.4	4.7	4.7	4.5	4.8	4.7
2046	4.4	4.6	4.6	4.4	4.7	4.6
2047	4.3	4.5	4.5	4.3	4.6	4.5
2048	4.2	4.4	4.4	4.2	4.5	4.4
2049	4.1	4.3	4.3	4.1	4.4	4.3
2050	4.0	4.2	4.2	4.0	4.3	4.2
2051	3.7	3.9	3.9	3.7	4.0	3.9
2052	3.7	3.9	3.9	3.7	4.0	3.9

Table 3-7: Future Mode-wise Weighted Income of PIA States

3.8 Review of Past Traffic Data and Comparison with Previous Estimates

Past toll data of FY22 and FY23 for the project road toll plaza is made available by the client. The comparison of AADT for FY22/ FY23 in the earlier study of May 2022 with FY23 AADT in present study is presented in **Table 3-8**.

Location/ Mode	Car	LCV	2-Axle	3-Axle	MAV	OSV	Total	PCU
A. AADT FY22 Actual								
TP01 – Bassi	2,709	164	305	214	1,068	2	4,462	9,327
TP02 – Aroli	2,568	204	404	237	1,145	2	4,560	9,959
TP03 – Dhaneshwar	2,603	202	459	403	1,269	2	4,938	11,212
B. AADT FY22 Adopted (May 2022 Study)								
TP01 – Bassi	2,974	136	326	222	1,091	2	4,751	9,741
TP02 – Aroli	2,939	133	427	244	1,173	1	4,917	10,435
TP03 – Dhaneshwar	2,736	125	470	426	1,322	2	5,081	11,570
C. AADT FY23 Forecasted (May 2022 Study)								
TP01 – Bassi	3,199	141	340	233	1,170	2	5,085	10,404
TP02 – Aroli	3,161	138	445	256	1,258	1	5,259	11,137
TP03 – Dhaneshwar	2,943	129	490	448	1,418	2	5,430	12,341
D. AADT FY23 (Present Study)								
TP01 – Bassi	2,288	87	382	261	1,202	3	4,223	9,770
TP02 – Aroli	2,410	98	485	284	1,273	3	4,553	10,606
TP03 – Dhaneshwar	2,262	100	516	455	1,486	4	4,823	12,030
E. FY23 Present study vs FY22 Actual (D vs A)								
TP01 – Bassi	-15.5%	-46.8%	25.0%	21.8%	12.5%	20.8%	-5.4%	4.7%
TP02 – Aroli	-6.2%	-52.0%	20.2%	20.2%	11.2%	30.9%	-0.2%	6.5%
TP03 – Dhaneshwar	-13.1%	-50.5%	12.4%	12.9%	17.1%	92.7%	-2.3%	7.3%
F. FY23 Present study vs FY22 Adopted May 2022 (D vs B)								
TP01 – Bassi	-23.1%	-35.9%	17.1%	17.4%	10.2%	36.3%	-11.1%	0.3%
TP02 – Aroli	-18.0%	-26.3%	13.7%	16.6%	8.5%	167.7%	-7.4%	1.6%
TP03 – Dhaneshwar	-17.3%	-19.8%	9.8%	6.7%	12.4%	84.7%	-5.1%	4.0%

Table 3-8: AADT in Earlier (May 2022 Report) and Present Study

Comparison of FY23 AADT with FY23 forecast in May 2022 study (C vs D)

- The FY23 AADT in present study is about 639 PCUs (or 6.1 percent) lower at TP01, about 534 PCUs (or 4.8 percent) lower at TP02 and about 311 PCUs (or 2.5 percent) lower at TP03 than the forecasted AADT for FY23 in May 2022 report. Notably, the 2A, 3A and MAV traffic is higher while remaining modes are lower.
- The high negative variation of about 23-29 percent at all the three toll plazas in car traffic could be due to the higher estimates provided in earlier study which contained duplication errors due to violation transaction generated during ETC/boom operations in car traffic. This error has been corrected to arrive at the AADT in present study.

Comparison of Actual FY22 AADT with FY23 AADT in present study (D vs A)

- Comparison between the actual AADT for FY22 and FY23 indicates negative growth in cars and LCVs whereas a high double digit positive growths in 2A/3A (12-25 percent) and MAV trucks (11-17 percent) is observed. It is worth noting that Q1 of FY22 was impacted due to the 2nd wave of Covid-19.

Comparison of FY23 AADT with AADT Adopted for FY22 in May 2022 study (D vs B)

- A comparison of FY23 AADT with the AADT adopted for FY22 (corrected for Q1 of FY22 in May 2022 Report) indicates a growth of about 14-17 percent in 2A & 3A trucks at TP01 & TP02, about 8-9 percent in MAVs at TP01 & TP02 and about 7-12 percent across 2A & 3A trucks and MAVs at TP03.

3.9 Past and Future Transport Demand Elasticity

The econometric model applied for the project, relates traffic growth to changes in state domestic product via an elasticity factor according to IRC guidelines. The elasticity by vehicle types have been estimated based on the regression analysis of weighted income of PIA states with the actual traffic data.

A regression between GSDP (as independent variable) and registered vehicles (as dependant variable) of Rajasthan was carried out. The registered vehicle elasticity in case of cars is 1.7 during FY12 to FY19. In case of all trucks combined, the registered vehicle elasticity is 1.5 during the same period.

Vehicle registration data is also used as a proxy wherein operational toll data is not available. Vehicle registration data represents all vehicles registered in the state, but does not indicate actual number of vehicles plying on the road as it does not account for factors such vehicles taken off the road due to lack road worthiness, those registered in a state but mostly used elsewhere, etc. Consequently, the elasticity values based on vehicle registration may not be representative of the traffic growth trends on the project road. Past elasticity and growth trends on the nearby national highways have been the basis of growth for the project road.

The derived elasticities on other National Highways across India have also formed the basis for choosing the recommended elasticities on PR. The elasticities derived using the operational toll data regressed with the applicable state incomes (mode wise weighted shares) for the respective projects on some of the National Highways is presented in **Table 3-9**.

NH	Period	Car	2A	3A/MAV
NH-21	FY12-FY20	1.23	-0.42	0.54
SH-25	FY15-FY20	1.28	0.26	0.47
SH-17 & SH-7	FY13-FY20	1.26	0.51	0.33
NH-19	FY15-FY20	0.78	1.36	1.40
NH-1	FY12-FY20	1.02	0.74	
NH-6	FY14-FY20	1.11	1.68	0.42
NH-8A	FY16-FY20	0.73	0.28	0.94
NH-4	FY15-FY20	0.87	0.18	0.84
NH-6	FY16-FY19	1.25	1.28	0.78

Table 3-9: Past Elasticity on Other National Highways

The past elasticity values have been observed in the range of 1-1.3 for cars on various National Highways and around 0.5-0.9 for 3A/MAV combined. Individually, 3A trucks

have shown a negative elasticity in some of the assets with MAVs showing a higher positive elasticity.

Cars

- The elasticities and the past growth levels for cars are a result of increasing income levels, increasing vehicle ownership, and higher propensity to travel on highways in India due to network level developments and higher levels of service. These levels of growth are likely to continue in the near to medium term since car ownership levels are still very low and the road network is undergoing continual development.
- In case of cars, the elasticity values derived across the toll roads in the region is between 1.0 to 1.3. Car elasticity has been considered as 1.1 for the period up to FY30, tapered to 1.0 beyond FY30 in view of the tourism activities in the region and presence of educational hub in Kota.
- The motorisation levels in India also play an important role in determining car growth. With the increasing car ownership levels, propensity to travel and network level improvements on National Highways, car growth is likely to be at a high rate as witnessed in the recent past. The low motorization rate suggests that there is room for continued growth for many years to come. With the continual increase in motorization rate and improved road network usage by cars for inter-urban travel, car growth is expected to be robust.
- In case of PIA state of Rajasthan, motorization rate of cars has gone up from 28.3 in 2011 to 57.4 in 2019 with CAGR of about 9.3 percent during the same period.

Bus

- Over the years in India, there has been a change in passenger's travel mode preferences with increasingly more people shifting from public transport systems towards personalised modes. This has resulted, in general, in elasticity of bus traffic/demand to GSDP lower than unity ranging between 0.3 to 0.8 across the operational National Highways.
- Going forward Bus elasticity has been recommended as 0.7 till the end of the concession period.

Trucks

- The switch between MLCV and LCV is being observed across other national highways wherein MLCVs (mostly charged in car category) have been gaining importance lately over LCV category. For LCVs and 2A trucks, an elasticity of 0.5 has been adopted for the entire concession period.
- An elasticity of 0.7 has been adopted for 3A trucks till the end of the concession period. In case of MAV trucks, an elasticity of 1.0 has been adopted till FY30, tapered to 0.9 beyond FY30.

It is likely that this growth would slow down over time as the market becomes more mature and saturated, therefore elasticity to GSDP can be expected to decline over time. With the anticipated growth momentum in the coming years, higher elasticity values have been considered in the initial slabs and further tapering has been done in the future.

In India as a whole, the freight vehicle mix has been changing in the last decade favouring MAV to 2 Axle/ 3Axle vehicles for long-distance traffic, given the operational efficiencies achievable with larger vehicles. Considering the ongoing technical advancements in automobile industry, some of the standard 2 Axle/ 3 Axle trucks would gradually be replaced by MAVs. Mature national highways with tolling in operation for few years, have already witnessed the shift in 2A/3A trucks to MAV for long distance movement.

On an overall level, due consideration has been given to the tonnage shifts happening in the market with Mini LCV gaining importance for short distance movements over LCVs and MAVs being preferred over 2A/3A for long distance movements due to better operational efficiencies. Some of the 2A/3A trucks are also being used for local movements.

While assigning elasticities to different modes, freight travel pattern and over all elasticity of cargo tonnage with respect to weighted GSDP has been an important consideration. The recommended elasticity values adopted for all vehicle types in line with the traffic growth being observed on other national highways and changes in freight traffic pattern observed on the project road are presented in **Table 3-10**.

Period/Modes	Cars/MLCV	Bus	LCV/M Bus	2A	3A	MAV
2023-2025	1.1	0.7	0.5	0.5	0.7	1.0
2026-2030	1.1	0.7	0.5	0.5	0.7	1.0
2031-2035	1.0	0.7	0.5	0.5	0.7	0.9
2036-2040	1.0	0.7	0.5	0.5	0.7	0.9
Beyond 2040	1.0	0.7	0.5	0.5	0.7	0.9

Table 3-10: Recommended Elasticity for Project Road

It has been assumed that transport demand elasticity, for both freight and passenger traffic, would gradually decline over time, despite growth in per capita income, as regions becomes more mature, self-sufficient and with alternative mode of transport available to users. In the future growth forecast, the gradation in elasticity of freight over the years takes into account to cover the impact of network level changes in both rail and road networks apart from economic changes.

3.10 Projected Traffic Growth Rates

The estimated traffic growth rates for the project road in the earlier study conducted by Ramboll in May 2022 have been presented in **Table 3-11**.

FY/Modes	Cars/MLCV	LCV/M Bus	Bus	2A	3A	MAV
TP01 Bassi, TP02 Aroli and TP03 Dhaneshwar						
2023	7.6	3.6	5.0	3.7	5.1	7.3
2024	6.3	3.0	4.2	3.1	4.3	6.1
2025	6.3	3.0	4.2	3.1	4.3	6.1
2026	6.5	3.1	4.4	3.2	4.4	6.3
2027	6.3	3.0	4.2	3.1	4.3	6.1
2028	6.3	3.0	4.2	3.1	4.3	6.1
2029	5.9	2.8	3.9	2.9	4.0	5.7
2030	5.9	2.8	3.9	2.9	4.0	5.7
2031	5.4	2.8	3.9	2.9	4.0	5.1
2032	5.4	2.8	3.9	2.9	4.0	5.1
2033	5.4	2.8	3.9	2.9	4.0	5.1
2034	5.3	2.8	3.9	2.9	3.9	5.0
2035	5.2	2.7	3.8	2.8	3.8	4.9
2036	5.1	2.7	3.7	2.7	3.8	4.8
2037	5.0	2.6	3.6	2.7	3.7	4.7
2038	4.9	2.5	3.6	2.6	3.6	4.6
2039	4.8	2.5	3.5	2.6	3.5	4.5
2040	4.7	2.4	3.4	2.5	3.5	4.4
2041	4.6	2.4	3.3	2.5	3.4	4.3
2042	4.5	2.3	3.3	2.4	3.3	4.2
2043	4.3	2.3	3.2	2.4	3.2	4.1
2044	4.2	2.2	3.1	2.3	3.2	4.0
2045	4.1	2.2	3.0	2.2	3.1	3.9
2046	4.0	2.1	3.0	2.2	3.0	3.8
2047	3.9	2.1	2.9	2.1	2.9	3.7
2048	3.8	2.0	2.8	2.1	2.8	3.6
2049	3.7	1.9	2.7	2.0	2.8	3.5
2050	3.6	1.9	2.7	2.0	2.7	3.4
2051	3.6	1.9	2.7	2.0	2.7	3.4
2052	3.6	1.9	2.7	2.0	2.7	3.4

Table 3-11 Projected Traffic Growth Rates for Project Road in Earlier Study (%)

Under the present study, based on the perspective elasticity values and the projected growth rates of the income for PIA states (updated with the latest regional distribution of PIA from the ODs of this study), the future average annual compound traffic growth rates by vehicle type have been estimated for the project road by using the following relationship:

Tgr = (GSDPgr) x E; where,

Tgr – Traffic growth rate for mode

GSDPgr – Growth rate of GSDP

E – Elasticity value for mode

Using the year-on-year mode wise weighted income for PIA and elasticity for different time periods, traffic growth rates have been estimated for each year till FY52. The estimated traffic growth rates for the project road have been presented in **Table 3-12**.

FY/Modes	Cars/MLCV	Bus	LCV/M Bus	2A	3A	MAV
2024	5.9	4.0	2.9	2.7	4.0	5.7
2025	6.2	4.2	3.0	2.8	4.2	6.0
2026	6.6	4.5	3.2	3.0	4.5	6.4
2027	6.6	4.5	3.2	3.0	4.5	6.4
2028	6.4	4.3	3.1	2.9	4.4	6.2
2029	6.0	4.0	2.9	2.8	4.1	5.8
2030	6.0	4.0	2.9	2.8	4.1	5.8
2031	5.5	4.0	2.9	2.8	4.1	5.2
2032	5.5	4.0	2.9	2.8	4.1	5.2
2033	5.5	4.0	2.9	2.8	4.1	5.2
2034	5.4	4.0	2.9	2.7	4.0	5.1
2035	5.3	3.9	2.8	2.7	4.0	5.0
2036	5.2	3.8	2.8	2.6	3.9	4.9
2037	5.1	3.8	2.7	2.6	3.8	4.8
2038	5.0	3.7	2.7	2.5	3.7	4.8
2039	4.9	3.6	2.6	2.5	3.7	4.7
2040	4.8	3.6	2.6	2.4	3.6	4.6
2041	4.7	3.5	2.5	2.4	3.5	4.5
2042	4.7	3.5	2.5	2.4	3.5	4.5
2043	4.6	3.4	2.5	2.3	3.5	4.4
2044	4.5	3.4	2.4	2.3	3.4	4.3
2045	4.4	3.3	2.4	2.2	3.3	4.2
2046	4.4	3.2	2.3	2.2	3.3	4.1
2047	4.3	3.2	2.3	2.1	3.2	4.1
2048	4.2	3.1	2.2	2.1	3.1	4.0
2049	4.1	3.0	2.2	2.1	3.0	3.9
2050	4.0	3.0	2.1	2.0	3.0	3.8
2051	3.7	2.7	2.0	1.9	2.8	3.5
2052	3.7	2.7	2.0	1.9	2.8	3.5

Table 3-12: Projected Traffic Growth Rates for Project Road (%)

In derivation of above growth rates, the likely shift of buses to cars in case of passenger vehicles and the replacement/ tonnage shift of 2A/3A trucks to MAV for long distance in case of freight vehicles has been duly considered.

The implied traffic growth rates for freight vehicles of 2A/3A and MAV after considering the impact of diversion from DME in FY25 to FY27 under the base case have been presented in **Table 3-13**.

FY/Modes	TP01			TP02			TP03		
	2A	3A	MAV	2A	3A	MAV	2A	3A	MAV
2025	2.8	9.3	7.6	2.8	8.9	7.5	2.8	7.1	7.3
2026	3.0	6.9	7.2	3.0	6.7	7.1	3.0	5.9	7.0
2027	3.0	6.9	7.2	3.0	6.7	7.1	3.0	5.9	7.0

Table 3-13: Implied Traffic Growth Rates for Project Road After Diversion to DME (%)

The above growth rates relate to the most likely Base Case. In addition, two sets of traffic growth rates under low and high cases have also been considered and impact on toll revenue evaluated for both these cases. Based on the risk analysis of key parameters like economic growth and elasticity of travel demand impacting traffic growth, two additional growth scenarios have been presented. Low growth scenario considers a 20 percent reduction in growth rates relating to about 10 percent decline each in elasticity and economic growth. The High growth scenario considers a 20 percent increase in growth rates signifying about 10 percent increase each in elasticity and economic parameters.

3.11 Mode-wise Traffic Projections

Mode-wise projected traffic for the three toll plazas of the project road under the base case after considering diversion impacts till FY52 is presented in **Table 3-14, Table 3-15** and **Table 3-16**.

FY	Car	LCV	Bus	2-axle Truck	3-axle Truck	MAV	OSV	PCU
2023	2,288	87	209	172	261	1,202	3	9,767
2024	2,423	89	217	177	271	1,270	3	10,284
2025	2,574	92	226	182	297	1,367	3	10,992
2026	2,744	95	237	187	317	1,465	4	11,717
2027	2,926	98	247	193	339	1,570	4	12,491
2028	3,114	101	258	199	354	1,666	4	13,213
2029	3,301	104	268	204	369	1,763	4	13,930
2030	3,499	107	279	210	384	1,864	5	14,687
2031	3,690	110	290	215	399	1,961	5	15,418
2032	3,892	113	302	221	416	2,063	5	16,186
2033	4,104	117	314	227	433	2,170	5	16,993
2034	4,325	120	327	234	450	2,281	6	17,827
2035	4,553	123	340	240	468	2,396	6	18,687
2036	4,789	127	353	246	486	2,514	6	19,574
2037	5,033	130	366	252	504	2,636	6	20,486
2038	5,285	134	380	259	523	2,761	7	21,425
2039	5,544	137	393	265	543	2,890	7	22,389
2040	5,811	141	407	272	562	3,022	7	23,379
2041	6,086	144	422	278	582	3,158	8	24,393
2042	6,373	148	436	285	603	3,300	8	25,451
2043	6,668	152	451	291	623	3,445	8	26,535
2044	6,970	155	466	298	645	3,594	9	27,642
2045	7,280	159	482	305	666	3,746	9	28,774
2046	7,597	163	497	312	688	3,901	9	29,927
2047	7,921	166	513	318	710	4,059	10	31,102
2048	8,251	170	529	325	732	4,220	10	32,297

FY	Car	LCV	Bus	2-axle Truck	3-axle Truck	MAV	OSV	PCU
2049	8,587	174	545	332	754	4,383	11	33,512
2050	8,929	177	561	338	777	4,549	11	34,743
2051	9,260	181	576	345	798	4,710	11	35,932
2052	9,603	184	592	351	820	4,876	12	37,162
AADT CAGR (%)								
FY23 - FY25	6.1	2.9	4.1	2.8	6.6	6.6	5.8	6.1
FY25 - FY30	6.3	3.1	4.3	2.9	5.3	6.4	6.1	6.0
FY30 - FY35	5.4	2.9	4.0	2.7	4.0	5.1	5.1	4.9
FY35 - FY40	5.0	2.7	3.7	2.5	3.7	4.8	4.8	4.6
FY40 - FY45	4.6	2.4	3.4	2.3	3.5	4.4	4.4	4.2
FY45 - FY50	4.2	2.2	3.1	2.1	3.1	4.0	4.0	3.8
FY50 - FY52	3.7	2.0	2.7	1.9	2.8	3.5	3.5	3.4
FY23 - FY52	5.1	2.6	3.7	2.5	4.0	4.9	4.8	4.7

Table 3-14: Projected Mode-wise Traffic at TP01

FY	Car	LCV	Bus	2-axle Truck	3-axle Truck	MAV	OSV	PCU
2023	2,410	98	226	260	284	1,273	3	10,609
2024	2,552	101	235	267	295	1,345	3	11,164
2025	2,711	104	245	275	322	1,446	3	11,914
2026	2,890	107	256	283	343	1,549	4	12,686
2027	3,082	111	267	292	366	1,660	4	13,508
2028	3,280	114	279	300	382	1,762	4	14,281
2029	3,477	117	290	308	398	1,864	4	15,048
2030	3,686	121	302	317	414	1,971	5	15,856
2031	3,887	124	314	326	431	2,074	5	16,639
2032	4,099	128	327	335	449	2,181	5	17,460
2033	4,323	132	340	344	467	2,295	5	18,324
2034	4,555	135	353	353	486	2,412	6	19,215
2035	4,796	139	367	363	505	2,533	6	20,135
2036	5,045	143	381	372	525	2,658	6	21,082
2037	5,301	147	396	382	545	2,787	6	22,057
2038	5,567	151	410	391	565	2,919	7	23,060
2039	5,840	155	425	401	586	3,056	7	24,090
2040	6,121	159	440	411	607	3,195	7	25,146
2041	6,410	163	456	420	629	3,339	8	26,229
2042	6,713	167	472	431	651	3,489	8	27,359
2043	7,023	171	488	441	673	3,643	8	28,515
2044	7,342	175	504	451	696	3,800	9	29,697
2045	7,668	179	521	461	719	3,960	9	30,904
2046	8,002	183	538	471	743	4,124	9	32,134
2047	8,343	187	555	481	767	4,292	10	33,387
2048	8,691	191	572	491	791	4,462	10	34,662
2049	9,045	195	589	501	815	4,635	11	35,956
2050	9,405	200	607	511	839	4,810	11	37,269
2051	9,753	204	623	521	862	4,979	11	38,536
2052	10,115	208	640	531	886	5,155	12	39,847
AADT CAGR (%)								
FY23 - FY25	6.1	2.9	4.1	2.8	6.4	6.6	5.8	6.0
FY25 - FY30	6.3	3.1	4.3	2.9	5.2	6.4	6.1	5.9
FY30 - FY35	5.4	2.9	4.0	2.7	4.0	5.1	5.1	4.9
FY35 - FY40	5.0	2.7	3.7	2.5	3.7	4.8	4.8	4.5
FY40 - FY45	4.6	2.4	3.4	2.3	3.5	4.4	4.4	4.2
FY45 - FY50	4.2	2.2	3.1	2.1	3.1	4.0	4.0	3.8
FY50 - FY52	3.7	2.0	2.7	1.9	2.8	3.5	3.5	3.4

FY	Car	LCV	Bus	2-axle Truck	3-axle Truck	MAV	OSV	PCU
FY23 - FY52	5.1	2.6	3.7	2.5	4.0	4.9	4.8	4.7

Table 3-15: Projected Mode-wise Traffic at TP02

FY	Car	LCV	Bus	2-axle Truck	3-axle Truck	MAV	OSV	PCU
2023	2,262	100	227	289	455	1,486	4	12,030
2024	2,396	103	236	297	473	1,570	4	12,654
2025	2,544	106	246	305	507	1,685	4	13,480
2026	2,713	109	257	315	537	1,803	5	14,338
2027	2,893	113	268	324	569	1,929	5	15,251
2028	3,078	116	280	334	594	2,048	5	16,116
2029	3,263	120	291	343	618	2,167	6	16,975
2030	3,459	123	303	352	643	2,292	6	17,880
2031	3,648	127	315	362	670	2,411	6	18,756
2032	3,848	130	328	372	697	2,536	7	19,677
2033	4,058	134	341	382	726	2,668	7	20,643
2034	4,276	138	355	393	755	2,804	7	21,641
2035	4,501	142	369	403	784	2,945	8	22,670
2036	4,735	146	383	414	815	3,090	8	23,730
2037	4,976	150	397	424	846	3,240	9	24,821
2038	5,225	154	412	435	878	3,394	9	25,942
2039	5,481	158	427	446	910	3,552	9	27,094
2040	5,745	162	442	457	943	3,715	10	28,274
2041	6,016	166	458	467	976	3,882	10	29,484
2042	6,300	170	474	479	1,011	4,056	11	30,746
2043	6,592	174	490	490	1,046	4,235	11	32,037
2044	6,891	178	507	501	1,081	4,418	12	33,356
2045	7,198	183	523	512	1,117	4,604	12	34,703
2046	7,511	187	540	523	1,153	4,795	13	36,076
2047	7,831	191	557	535	1,190	4,989	13	37,474
2048	8,157	195	574	546	1,227	5,187	14	38,896
2049	8,489	199	592	557	1,265	5,388	14	40,339
2050	8,827	204	609	568	1,302	5,592	15	41,803
2051	9,154	208	626	579	1,338	5,789	15	43,216
2052	9,493	212	643	590	1,376	5,993	16	44,676
AADT CAGR (%)								
FY23 - FY25	6.1	2.9	4.1	2.8	5.6	6.5	5.8	5.9
FY25 - FY30	6.3	3.1	4.3	2.9	4.9	6.3	6.1	5.8
FY30 - FY35	5.4	2.9	4.0	2.7	4.0	5.1	5.1	4.9
FY35 - FY40	5.0	2.7	3.7	2.5	3.7	4.8	4.8	4.5
FY40 - FY45	4.6	2.4	3.4	2.3	3.5	4.4	4.4	4.2
FY45 - FY50	4.2	2.2	3.1	2.1	3.1	4.0	4.0	3.8
FY50 - FY52	3.7	2.0	2.7	1.9	2.8	3.5	3.5	3.4
FY23 - FY52	5.1	2.6	3.7	2.5	3.9	4.9	4.8	4.6

Table 3-16: Projected Mode-wise Traffic at TP03

3.12 Traffic Projections and Capacity Analysis

Table 3-17 presents the projections of the total vehicles after considering diversion impacts at respective toll plaza location based on the most likely growth rates till FY52 as assessed in this study.

FY	TP1 - Bassi	TP2 - Aroli	TP3 - Dhaneshwar	Average
2023	9,767	10,609	12,030	10,802
2024	10,284	11,164	12,654	11,367
2025	10,992	11,914	13,480	12,129
2026	11,717	12,686	14,338	12,914
2027	12,491	13,508	15,251	13,750
2028	13,213	14,281	16,116	14,537
2029	13,930	15,048	16,975	15,317
2030	14,687	15,856	17,880	16,141
2031	15,418	16,639	18,756	16,938
2032	16,186	17,460	19,677	17,774
2033	16,993	18,324	20,643	18,653
2034	17,827	19,215	21,641	19,561
2035	18,687	20,135	22,670	20,497
2036	19,574	21,082	23,730	21,462
2037	20,486	22,057	24,821	22,455
2038	21,425	23,060	25,942	23,476
2039	22,389	24,090	27,094	24,524
2040	23,379	25,146	28,274	25,600
2041	24,393	26,229	29,484	26,702
2042	25,451	27,359	30,746	27,852
2043	26,535	28,515	32,037	29,029
2044	27,642	29,697	33,356	30,232
2045	28,774	30,904	34,703	31,460
2046	29,927	32,134	36,076	32,713
2047	31,102	33,387	37,474	33,988
2048	32,297	34,662	38,896	35,285
2049	33,512	35,956	40,339	36,602
2050	34,743	37,269	41,803	37,939
2051	35,932	38,536	43,216	39,228
2052	37,162	39,847	44,676	40,562

Table 3-17: Projected Traffic on the Project Road (with Diversion)

The projected traffic for the project road is not likely to reach the designed capacity of 60,000 PCU till FY52.

4. TOLL REVENUE PROJECTIONS

4.1 Tolling Strategy

The project road has an "Open System" of toll collection which enables the concessionaire to collect tolls from through traffic as well as from short distance one.

As mentioned earlier, there are three operational toll plazas on the project road - TP01-Bassi, TP02- Aroli and TP03-Dhaneshwar with effective tolling lengths of 64.1785 km, 54.819 km and 53.5 km respectively being charged.

4.2 Schedule of User Fee

As per Schedule of User Fee for the project, the per km toll rates applicable from 2007-08 for normal tolling length, bypasses and permanent structures, the revision basis and concessions are provided.

The concessions to traffic have been given in the form of rates as below:

Local traffic

Car / Jeep / Vans - includes local users owning a vehicle registered for non-commercial purposes, residing within a distance of 20 km from the toll plaza and crossing the same for commuting purposes.

Commercial vehicles - includes local users owning a commercial vehicle (excluding vehicles under National Permit), registered with address on the Registration Certificate of a particular district and uses such vehicle for commuting on a section of National Highway, permanent bridge, tunnel or bypass, as the case may be, which is located within that district, shall be levied user fee on all toll plazas which are located within that district at the rate of fifty per cent of the prescribed rate of fee (single journey rate). No such concession shall be provided, if a service road or alternative road is available for use by such commercial vehicles. Thus, local commercial traffic has to pay only 50 percent of the normal ticket.

Daily Pass

When the vehicle has to cross the tolled section more than once in a day, the user shall have the option to pay one and half times (1.5 times) of the fee for a single entry; this pass shall be valid for 2 entries within 24 hours of purchase.

Monthly Pass

A user, who makes use of the project road frequently during a month, may opt to purchase a monthly pass upon payment of a charge equal to two-thirds of the fee payable for 50 single journeys; this pass can be used for a maximum 50 one-way journeys over the month of validity.

Thus, the different categories of toll tickets are as follows:

(i) Traffic paying normal toll rates (single trip)
(ii) Traffic paying return journey rates
(iii) Traffic paying monthly pass rates
(iv) Traffic paying local personal rates
(v) Traffic paying local commercial rates

4.3 Tolling Streams

The tolling segmentation considered in the earlier study adopted by Ramboll in May 2022 is presented in **Table 4-1**.

Ticket Type/Modes	Car			LCV	Bus/ 2A Truck	3A Truck	MAV	OSV
	FY22	FY23	FY24 onwards					
TP01-Bassi								
Single	28.9	28.9	28.9	45.1	44.4	60.5	73.4	88.1
Return	28.9	39.2	48.2	51.7	49.0	38.5	16.3	7.8
Monthly	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
Local personal	0.0	6.9	12.9					
Local commercial	0.0	0.0	0.0	1.5	6.3	0.8	10.2	1.0
Exempt	42.2	25.0	10.0	1.4	0.2	0.2	0.2	3.2
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
TP02-Aroli								
Single	34.8	34.8	34.8	41.3	40.2	58.7	67.2	89.1
Return	37.9	45.3	48.3	57.0	59.7	41.2	32.7	8.9
Monthly	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Local personal	0.0	4.9	6.9					
Local commercial	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0
Exempt	27.3	15.0	10.0	0.6	0.1	0.1	0.0	2.0
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
TP03-Dhaneshwar								
Single	31.9	31.9	31.9	36.2	34.7	33.8	51.7	62.1
Return	36.4	40.4	49.4	63.5	62.6	64.0	47.8	37.6
Monthly	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Local personal	0.0	2.7	8.7					
Local commercial	0.0	0.0	0.0	0.2	2.7	2.1	0.5	0.0
Exempt	31.7	25.0	10.0	0.1	0.0	0.0	0.0	0.4
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 4-1: Tolling Distribution in Earlier Study (%)

In the earlier study three sets of tolling distribution for car traffic were adopted in view of decreased exemptions to be achieved with better tolling regime. Since, FY23 tolling segmentation data has already shown a considerable decline in exempted vehicles, a single set of tolling distribution for each toll plaza location has been considered in the present study.

Tolling distribution considered for respective toll plaza location across the project road is based on the average ticket distribution of FY23 toll data and the same has been presented in **Table 4-2**.

Ticket Type/Modes	Car	LCV	Bus	2 A Truck	3 A Truck	4-6 A Truck	OSV
TP01-Bassi							
Single	40.9	57.9	47.4	47.4	59.7	72.2	87.7
Return	44.8	39.1	43.2	43.2	39.9	18.0	11.2
Monthly	0.0	0.5	0.0	0.0	0.0	0.0	0.0
Local personal	1.3	0.0	0.0	0.0	0.0	0.0	0.0
Local commercial	0.1	0.9	9.1	9.1	0.2	9.6	0.0
Exempt	13.0	1.6	0.3	0.3	0.2	0.2	1.1
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
TP02-Aroli							
Single	43.9	54.3	43.3	43.3	57.7	68.5	85.4
Return	51.8	44.2	56.6	56.6	42.2	31.5	14.4
Monthly	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Local personal	3.3	0.0	0.0	0.0	0.0	0.0	0.0
Local commercial	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exempt	1.0	1.5	0.0	0.0	0.0	0.0	0.2
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
TP03-Dhaneshwar							
Single	40.3	51.4	43.0	43.0	40.7	52.7	58.9
Return	46.7	46.5	54.4	54.4	53.6	44.5	40.9
Monthly	0.0	1.4	0.0	0.0	0.0	0.0	0.0
Local personal	10.9	0.0	0.0	0.0	0.0	0.0	0.0
Local commercial	0.0	0.0	2.4	2.4	5.6	2.8	0.0
Exempt	2.1	0.7	0.2	0.2	0.1	0.0	0.2
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 4-2: Tolling Distribution for present study (in %)

In case of cars, majority of vehicles (45-52 percent) are opting for return tickets followed by single ticket (40-44 percent). Exemptions in cars are found to be comparatively higher with about 13 percent at TP01 while the other two toll plaza locations have about 1-2 percent share of exempted vehicles.

In case of LCVs, about 51-58 percent of freight traffic is paying for normal ticket. In case of MAVs, share of single ticket is about 69-72 at TP01 & TP02, while at TP03 the share of single ticket is about 53 percent. About 44.5 percent of MAVs at TP03 are falling under return pass category. Similarly, about 58-60 percent of 3A trucks at TP01 & TP02 and about 41 percent at TP03 are falling under single ticket category. Also, a higher percentage of about 40-54 percent of 3A trucks along the project road are paying for return passes. This could be due to shorter lead of travel between the three toll plazas and presence of stone quarries in the region.

Additionally, the local commercial passes have a significant share in freight modes at TP01 and TP03. About 10 percent and 3 percent of MAVs are opting for local commercial passes at TP01 and TP03 respectively.

Trip rate for local pass users is considered as 1.0, for monthly pass it is 1.67 across all modes. For daily pass, trip rate of 2.0 has been considered for all the modes.

4.4 Toll Rates

This section presents details on the toll rates that are likely to be imposed on the users of the project road during the study period. The toll rates (Rs/km) for the base year 2007-08 for different vehicle categories as per toll fee rules are presented in **Table 4-3**.

Mode	Base rate per km (in Rs)
Car, Jeep, Van, LMV	0.65
LCV /M Bus	1.05
Bus/ 2 Axle Truck	2.20
3 Axle	2.40
MAV	3.45
Oversized	4.20

Table 4-3: Toll Rates in Rs/km for Different Vehicle Categories

The toll notification states that the 2007 toll rates shall be increased without compounding by three per cent each year with effect from the 1st day of April 2008 and such increased rate shall be deemed to be the base rate for the subsequent years.

In addition to this, the rate of fee for use of bypass forming part of a section of a National Highway constructed with a cost of Rs 10 crore or more, for the base year 2007, shall be one and a half times of the per km base rates specified above and the length of such bypass shall be excluded from the length of such section of National Highway. Also, the fee levied and collected hereunder for permanent bridge/ structures, as the case may be, having a length of 60 m or more on the basis of the equivalent length for structure as specified shall be due and payable at the toll plaza.

In case of the project road, the details of normal tolling lengths, bypass length (at 1.5 times) and equivalent structure lengths being charged at toll plazas are presented in **Table 4-4**.

Toll Plazas	TP01-Bassi	TP02-Aroli	TP03-Dhaneshwar
A. Normal length	36.627	53.909	53.5
B. Bypass length @ 1.5 times	16.021	0	0
C. Equivalent Structure length	3.52	0.91	0
D. Total tolling length=(A+1.5*B+C)	64.1785	54.819	53.5

Table 4-4: Tolling Lengths (in km) for Chittorgarh-Kota

The applicable base rates shall be revised annually with effect from April 1 each year to reflect the increase in wholesale price index for the month of December of the immediate preceding year in which such revision is undertaken but such revision shall be restricted for 40 per cent of the increase in wholesale price index.

For the present study, actual WPI information for December 2021 of 150.5 under 2011-12 series converted into 1999-00 series (150.5*1.873*1.641=462.576) has been used which indicates a growth of 5.02 percent as compared to last year. The forecast of 3.3 percent WPI for future years beyond FY24 has been adopted for the period till FY52.

The stream of toll rates to be charged at three toll plazas of the project road till FY52 is presented in **Table 4-5**. The toll fee has been rounded to nearest 5 Rupees as per toll fee rules.

FY End	Car	LCV	Bus	2A Truck	3A Truck	MAV	O/size/HME	Car Local
TP01-Bassi								
2023	85	140	295	295	325	465	565	315
2025	95	155	325	325	355	505	620	345
2030	115	190	395	395	430	620	755	420
2035	145	230	485	485	530	760	925	515
2040	175	280	590	590	645	930	1,130	630
2045	215	345	725	725	790	1,135	1,380	770
2050	260	420	885	885	965	1,385	1,685	940
2052	285	455	955	955	1,045	1,500	1,830	1,015
TP02-Aroli								
2023	75	120	255	255	275	395	480	315
2025	80	130	275	275	300	435	530	345
2030	100	160	340	340	370	530	645	420
2035	120	195	415	415	450	650	790	515
2040	150	240	505	505	550	790	965	630
2045	180	295	615	615	675	970	1,180	770
2050	225	360	755	755	825	1,185	1,440	940
2052	240	390	820	820	890	1,285	1,560	1,015
TP03-Dhaneshwar								
2023	75	120	245	245	270	385	470	315
2025	80	130	270	270	295	425	515	345
2030	100	160	330	330	360	520	630	420
2035	120	195	405	405	440	635	770	515
2040	145	235	495	495	540	775	940	630
2045	180	290	600	600	655	945	1,150	770
2050	220	350	735	735	805	1,155	1,405	940
2052	235	380	800	800	870	1,250	1,525	1,015

Table 4-5: Toll Rates at Toll Plaza (in Rs)

The users purchasing return journey tickets will pay 1.5 times the above toll rates; the traffic opting for monthly passes will pay 33.3 times (two-thirds of 50 single journeys) the normal traffic toll rates. All passes have been rounded to the nearest 5 Rupees as per fee rules.

4.5 Toll Revenue Estimates

The toll revenue estimates of the earlier study of May 2022 are presented in **Table 4-6**.

FY End	Toll Revenue in Rs Million
2023	894.2
2024	1,027.2
2025	1,134.7
2026	1,260.0
2027	1,382.9
2028	1,525.5
2029	1,670.7
2030	1,828.8
2031	1,998.2
2032	2,187.9
2033	2,383.8
2034	2,597.7
2035	2,833.4
2036	3,092.1
2037	3,360.2
2038	3,646.8
2039	3,964.8
2040	4,309.3
2041	4,654.5
2042	5,048.4
2043	5,462.8
2044	5,917.4
2045	6,383.6
2046	6,886.2
2047	7,425.5
2048	8,022.9
2049	8,610.3
2050	9,276.4
2051	9,968.1
2052*	7,628.6
PV12 FY23 till 15th Dec in FY52	17,944.1

Table 4-6: Toll Revenue in Earlier Study

The projections of revenue under the present study for the project road have been presented till 15th December of FY52. Toll revenue streams have been calculated assuming that toll would be collected for all 365 days in a year and for 366 days in a leap year. The toll revenue by mode for the project road for the base case is presented is presented in **Table 4-7**.

Toll Revenue in Rs Million								
FY End	Car	Bus	LCV	2-axle Truck	3-axle Truck	MAV	OSV	Total
2023	154.9	11.4	54.4	58.4	90.8	536.7	1.7	908.3
2024	173.8	12.4	59.5	63.2	99.2	596.7	1.9	1,006.8
2025	190.1	13.3	64.3	67.4	111.5	667.8	2.1	1,116.6
2026	214.2	14.2	69.9	72.2	123.8	744.2	2.3	1,240.8
2027	237.0	15.3	76.2	77.8	137.3	830.9	2.6	1,377.0
2028	261.7	16.6	82.9	83.4	149.4	922.2	2.9	1,518.9
2029	287.7	17.6	89.4	88.8	161.5	1,009.3	3.1	1,657.3
2030	317.8	18.9	97.0	95.2	174.9	1,112.7	3.5	1,820.1
2031	347.6	20.2	105.0	101.8	189.5	1,218.0	3.8	1,985.9
2032	383.5	21.7	114.2	109.3	206.0	1,338.3	4.2	2,177.2
2033	422.2	23.3	123.0	116.2	222.1	1,462.6	4.5	2,374.0
2034	457.2	24.9	133.5	124.6	241.2	1,601.7	5.0	2,588.0
2035	507.5	26.6	144.5	133.3	260.7	1,751.6	5.4	2,829.6
2036	554.9	28.5	156.4	142.6	282.9	1,915.4	5.9	3,086.8
2037	604.8	30.5	168.4	151.7	304.5	2,087.5	6.5	3,353.8
2038	661.2	32.5	182.0	162.1	329.1	2,271.0	7.1	3,644.9
2039	725.6	34.6	196.4	173.0	354.9	2,474.8	7.7	3,967.0
2040	791.8	37.1	212.2	184.9	383.9	2,703.7	8.4	4,322.0
2041	857.4	39.5	228.1	196.6	412.5	2,930.0	9.1	4,673.2
2042	939.3	42.1	245.2	209.0	444.9	3,190.3	9.9	5,080.7
2043	1,018.6	45.1	264.2	222.9	478.6	3,463.8	10.8	5,504.0
2044	1,114.5	48.1	285.5	238.4	515.6	3,774.5	11.7	5,988.3
2045	1,208.2	51.2	305.6	252.4	554.5	4,082.8	12.7	6,467.3
2046	1,311.7	54.5	328.5	268.7	595.4	4,427.2	13.7	6,999.6
2047	1,425.7	58.0	353.4	286.3	639.9	4,795.6	14.9	7,573.7
2048	1,544.5	61.8	379.8	304.7	688.6	5,200.2	16.2	8,195.8
2049	1,673.4	65.7	405.9	322.5	736.7	5,605.0	17.4	8,826.5
2050	1,813.9	69.5	435.1	342.6	790.8	6,059.3	18.8	9,530.0
2051	1,950.7	74.0	465.4	363.4	845.0	6,522.6	20.3	10,241.5
2052*	1,500.5	55.8	354.2	274.2	643.1	5,007.1	15.6	7,850.4

** Till 15th December FY52*

Table 4-7: Toll Revenue for the Project Road by Mode

Majority of the revenue is expected to come from MAV with about 63 percent of the total revenue. Amongst other categories, cars represent a share of 18.5 percent of total revenue followed by 8.7 percent by 3 axle trucks and 4.8 percent by LCV. 2-axle truck category and Bus category is likely to generated about 4.1 percent and 0.8 percent revenue respectively.

Vehicles paying normal tolls are around 65.2 percent of total toll revenues for the project road sections and around 32.8 percent of the traffic may opt for daily pass category. Remaining 2 percent may fall in monthly pass and local concession category.

4.6 Scenario Analysis

For toll road projects, revenue streams are generally based on the assessment of the traffic volume (base and future) crossing the toll plazas and the applicable toll imposed on the user of the road. There is an inherent element of uncertainty in any forecast and whilst is not possible to measure risk in a strictly statistical sense (as many of the risks are largely or partly unknown), in this section an attempt is made at quantifying the main risks that could have an impact on this forecast.

The econometric approach used to derive traffic growth, is based on the estimation of GSDP growth rates for the influence area economies and traffic demand elasticity by mode; the estimation of both variables contains a certain degree of uncertainty which can be represented in the scenario analysis. Scenario analysis has been done in the following subheadings for the base case:

High Case

The high case is based on a more optimistic economic outlook for future years and higher elasticity values as compared to the base case. Therefore, traffic growth rates of 20 percent higher than the base case for every year and for all the mode are considered.

Low Case

A growth rate of 20 percent lower than base case for all types of vehicles has been considered in the present analysis to reflect uncertainty with regard to economic performance of PIA states and lower elasticity values.

1. The results of different scenarios are presented in *** Till** *15th December FY52*

Table 4-8. A comparison versus base case has been presented for the Present Value (at 12 percent discount rate) of the project revenue from FY24 till 15th December of FY52.

FY End	Toll Revenue in Rs Million		
	Base Case	High Case (+20%)	Low Case (-20%)
2023	908.3	908.3	908.3
2024	1,006.8	1,016.8	996.8
2025	1,116.6	1,139.5	1,094.0
2026	1,240.8	1,280.3	1,202.1
2027	1,377.0	1,436.7	1,319.2
2028	1,518.9	1,602.0	1,439.4
2029	1,657.3	1,766.0	1,554.5
2030	1,820.1	1,959.4	1,689.6
2031	1,985.9	2,158.1	1,826.1
2032	2,177.2	2,388.5	1,983.1
2033	2,374.0	2,629.2	2,141.8
2034	2,588.0	2,893.0	2,313.1
2035	2,829.6	3,192.4	2,505.7
2036	3,086.8	3,514.2	2,708.7
2037	3,353.8	3,852.4	2,916.8
2038	3,644.9	4,223.6	3,142.2

FY End	Toll Revenue in Rs Million		
	Base Case	High Case (+20%)	Low Case (-20%)
2039	3,967.0	4,636.8	3,390.3
2040	4,322.0	5,094.7	3,662.3
2041	4,673.2	5,554.8	3,927.0
2042	5,080.7	6,090.1	4,233.7
2043	5,504.0	6,651.6	4,548.9
2044	5,988.3	7,295.6	4,909.3
2045	6,467.3	7,941.8	5,260.1
2046	6,999.6	8,662.4	5,648.9
2047	7,573.7	9,444.4	6,065.9
2048	8,195.8	10,296.5	6,515.3
2049	8,826.5	11,170.4	6,965.4
2050	9,530.0	12,147.4	7,466.9
2051	10,241.5	13,141.5	7,971.0
2052	7,850.4	10,141.0	6,069.2
PV12 FY24 till 15th Dec in FY52	19,217.4	21,828.1	16,992.4
PV12 till 15th Dec in FY52 vs base		13.6%	-11.6%
CAGR FY24 to FY51	9.0%	9.9%	8.0%

** Till 15th December FY52*

Table 4-8: Comparison of Annual Revenue Forecasts Under Different Scenarios

The low growth scenario has a negative impact on revenue PV of about 11.6 percent versus base case (till FY52), whilst the optimistic growth scenario would generate about 13.6 percent higher PV than the base case.

APPENDICES

APPENDIX 2.1
PAST TRAFFIC

Traffic Study for Chittorgarh-Kota section of NH-27 in the state of Rajasthan

Toll Plaza- Bassi								
Month	**CJV**	**LCV**	**2-Axle**	**3-Axle**	**MAV**	**OSV**	**Total Traffic**	**PCUs**
Jan-21	2,567	274	410	237	1,470	4	4,962	11,553
Feb-21	2,347	279	416	261	1,536	4	4,842	11,725
Mar-21	1,989	226	336	233	1,361	3	4,149	10,176
Apr-21	2,948	211	324	227	1,129	4	4,843	10,017
May-21	2,915	156	303	189	978	1	4,544	9,036
Jun-21	2,861	241	306	190	971	1	4,569	9,082
Jul-21	2,801	218	309	199	1,051	1	4,580	9,389
Aug-21	3,030	197	298	179	906	1	4,610	8,835
Sep-21	2,753	189	310	192	955	1	4,399	8,844
Oct-21	2,553	206	328	239	1,108	1	4,436	9,555
Nov-21	2,966	177	315	214	921	1	4,595	8,971
Dec-21	3,210	140	336	229	1,140	2	5,056	10,251
Jan-22	2,956	72	305	204	1,107	3	4,647	9,585
Feb-22	3,280	85	355	241	1,232	2	5,196	10,751
Mar-22	2,880	75	338	250	1,279	3	4,824	10,523
Apr-22	2,118	83	372	270	1,214	2	4,059	9,639
May-22	2,256	88	375	264	1,183	3	4,169	9,639
Jun-22	2,256	81	388	272	1,324	2	4,323	10,326
Jul-22	2,296	78	367	223	1,094	3	4,061	9,118
Aug-22	2,440	81	343	197	964	3	4,027	8,530
Sep-22	1,926	91	361	231	1,100	3	3,712	8,803
Oct-22	2,041	81	374	260	1,069	3	3,827	8,886
Nov-22	2,061	100	429	313	1,247	3	4,153	10,062
Dec-22	2,336	99	407	275	1,274	3	4,394	10,276
Jan-23	2,551	90	359	252	1,281	3	4,536	10,296
Feb-23	2,792	91	420	286	1,365	2	4,956	11,198
Mar-23	2,383	83	385	287	1,311	3	4,452	10,437

Toll Plaza- Aroli								
Month	**CJV**	**LCV**	**2-Axle**	**3-Axle**	**MAV**	**OSV**	**Total Traffic**	**PCUs**
Jan-21	3,039	310	828	310	1,713	4	6,204	14,644
Feb-21	3,056	417	695	309	1,662	4	6,144	14,194
Mar-21	2,028	277	481	259	1,267	3	4,315	10,376
Apr-21	3,047	268	400	243	1,080	2	5,040	10,246
May-21	2,988	156	404	217	1,073	1	4,840	9,919
Jun-21	2,920	241	400	218	1,056	1	4,836	9,891
Jul-21	2,797	255	425	228	1,208	1	4,915	10,580
Aug-21	3,179	231	383	205	938	1	4,938	9,517
Sep-21	2,783	224	392	221	1,022	1	4,642	9,558
Oct-21	2,415	246	408	253	1,180	1	4,503	10,083
Nov-21	2,820	220	385	225	948	1	4,599	9,250
Dec-21	2,916	166	440	252	1,219	1	4,994	10,731
Jan-22	2,810	89	420	231	1,227	2	4,780	10,429
Feb-22	3,293	107	473	263	1,365	2	5,503	11,811
Mar-22	2,855	96	453	272	1,360	3	5,040	11,310
Apr-22	2,262	106	490	289	1,259	2	4,408	10,433
May-22	2,283	104	480	275	1,194	2	4,339	10,089
Jun-22	2,405	95	527	304	1,490	2	4,823	11,755
Jul-22	2,538	99	488	253	1,205	3	4,587	10,348
Aug-22	2,818	94	419	221	978	3	4,533	9,292
Sep-22	2,075	106	451	249	1,105	3	3,987	9,315
Oct-22	2,185	84	455	276	1,106	3	4,110	9,497
Nov-22	2,262	105	541	333	1,306	3	4,550	10,932
Dec-22	2,519	100	510	305	1,410	3	4,847	11,473
Jan-23	2,514	97	464	285	1,393	3	4,756	11,189
Feb-23	2,708	99	522	318	1,449	2	5,097	11,904
Mar-23	2,347	87	477	306	1,376	3	4,595	11,030

Toll Plaza- Dhaneshwar								
Month	**CJV**	**LCV**	**2-Axle**	**3-Axle**	**MAV**	**OSV**	**Total Traffic**	**PCUs**
Jan-21	2,676	274	813	442	1,813	4	6,022	15,031
Feb-21	2,738	327	829	481	1,815	4	6,194	15,344
Mar-21	1,670	285	545	379	1,394	2	4,275	11,153
Apr-21	2,707	260	488	348	1,147	2	4,952	10,777
May-21	2,884	253	500	366	1,284	2	5,290	11,651
Jun-21	2,382	247	512	385	1,420	3	4,948	11,845
Jul-21	2,333	260	486	372	1,299	1	4,751	11,147
Aug-21	2,554	243	389	331	963	1	4,481	9,416
Sep-21	2,259	256	435	412	1,111	1	4,474	10,186
Oct-21	2,356	278	479	515	1,341	1	4,970	11,793
Nov-21	2,817	246	400	408	1,004	1	4,876	10,132
Dec-21	2,951	178	500	466	1,386	1	5,482	12,359
Jan-22	2,690	88	476	410	1,408	2	5,074	11,825
Feb-22	2,956	101	542	467	1,622	2	5,690	13,441
Mar-22	2,922	101	472	435	1,594	4	5,528	12,984
Apr-22	2,207	105	521	443	1,492	6	4,774	11,995
May-22	2,342	110	500	426	1,461	6	4,844	11,885
Jun-22	2,318	98	548	460	1,758	5	5,188	13,424
Jul-22	2,198	94	517	407	1,318	3	4,537	11,058
Aug-22	2,349	91	444	341	1,089	3	4,316	9,752
Sep-22	1,995	106	520	459	1,336	3	4,419	11,116
Oct-22	2,133	99	501	440	1,300	3	4,476	10,969
Nov-22	2,189	113	596	583	1,579	3	5,063	13,014
Dec-22	2,323	98	559	567	1,673	3	5,223	13,389
Jan-23	2,288	89	470	442	1,588	3	4,880	12,317
Feb-23	2,637	107	550	471	1,701	2	5,467	13,522
Mar-23	2,165	94	469	417	1,538	4	4,687	11,904

APPENDIX 2.2
TRAFFIC ZONING SYSTEM

Traffic Study for Chittorgarh-Kota section of NH-27 in the state of Rajasthan
Traffic Zoning System

Zone	Place/Region	District/ State	State/Country/Region
1	Chittorgarh	Project Corridor - Chittorgarh District	Rajasthan
2	Anvalhera	Project Corridor - Chittorgarh District	
3	Bassi	Project Corridor - Chittorgarh District	
4	Parsoli	Project Corridor - Chittorgarh District	
5	Bichhor	Project Corridor - Chittorgarh District	
6	Katoda	Project Corridor - Chittorgarh District	
7	Padampura	Project Corridor - Bhilwara District	
8	Ladpura	Project Corridor - Bhilwara District	
9	Menal	Project Corridor - Chittorgarh District	
10	Golam Garh	Project Corridor - Bhilwara District	
11	Salawatiya	Project Corridor - Bhilwara District	
12	Bijolia	Project Corridor - Bhilwara District	
13	Budhpura	Project Corridor - Bundi District	
14	Dabi	Project Corridor - Bundi District	
15	Sootra	Project Corridor - Bundi District	
16	Shambhoopura	Project Corridor - Bundi District	
17	Kota	Project Corridor - Kota District	
18	Nimbahera	Rest of Chittorgarh District	
19	Rawatbhata	Rest of Chittorgarh District	
20	Mangalwad	Rest of Chittorgarh District	
21	Rest of Chittorgarh district	Rest of Chittorgarh District	
22	Bhilwara	Rest of Bhilwara District	
23	Rest of Bhilwara district	Rest of Bhilwara District	
24	Bundi	Rest of Bundi District	
25	Rest of Bundi district	Rest of Bundi District	
26	Ramganj Mandi	Rest of Kota District	
27	Rest of Kota district	Rest of Kota District	
28	Udaipur	Udaipur District	
29	Gogunda	Udaipur District	
30	Rest of Udaipur	Udaipur District	
31	Rajsamand	Rajsamand district	
32	Deogarh	Rajsamand district	
33	Rest of Rajsamand district	Rajsamand district	
34	Baran	Baran District	
35	Rest of Baran district	Baran District	
36	Jhalawar	Jhalawar District	
37	Ajmer / Kishangarh	Ajmer district	
38	Beawar	Ajmer district	
39	Rest of Ajmer district	Ajmer district	
40	Jaipur	Jaipur district	
41	Rest of Jaipur	Jaipur district	
42	Tonk	Tonk District	
43	Deoli	Tonk District	
44	Pratapgarh	Pratapgarh District	
45	Jaisalmer	North western Rajasthan	
46	Bikaner	North western Rajasthan	
47	Jodhpur	North western Rajasthan	
48	Nagaur	North western Rajasthan	
49	Mount Abu	Southern Rajasthan	
50	Banswara	Southern Rajasthan	
51	Sawai Madhopur	Eastern Rajasthan	
52	Alwar	Eastern Rajasthan	
53	Rest of Rajasthan	Rest of Rajasthan	
54	Ahmedabad	Northern & Eastern Gujarat	Gujarat
55	Vadodara	Northern & Eastern Gujarat	
56	Mehsana	Northern & Eastern Gujarat	
57	Godhra	Northern & Eastern Gujarat	
58	Anand	Northern & Eastern Gujarat	
59	Surat	Southern Gujarat	
60	Rajkot	Central & Western Gujarat	
61	Palanpur	Central & Western Gujarat	
62	Kandla / Mundra / Mandvi / Tuna	Central & Western Gujarat	
63	Bhavnagar	Central & Western Gujarat	
64	Kachh / Bhuj	Central & Western Gujarat	
65	Rest of Gujarat	Rest of Gujarat	
66	Neemuch	Northern Madhya Pradesh	Madhya Pradesh
67	Shivpuri	Northern Madhya Pradesh	
68	Guna	Northern Madhya Pradesh	
69	Biaora / Rajgarh	Northern Madhya Pradesh	
70	Gwalior / Morena / Bhind	Northern Madhya Pradesh	
71	Indore	Western Madhya Pradesh	
72	Ujjain	Western Madhya Pradesh	
73	Bhopal	Central Madhya Pradesh	
74	Jabalpur / Chhindwara	Central Madhya Pradesh	
75	Rest of Madhya Pradesh	Rest of Madhya Pradesh	
76	Gurugram / Manesar / Rewari	Southern Haryana	Haryana
77	Rest of Haryana	Northern Haryana	
78	Mumbai	Mumbai	Maharashtra
79	Pune	Pune	
80	Nagpur	Nagpur	
81	Rest of Maharashtra	Rest of Maharashtra	
82	Agra	Western Uttar Pradesh	Uttar Pradesh
83	Jhansi	Western Uttar Pradesh	
84	Lucknow	Central Uttar Pradesh	
85	Kanpur / Allahabad / Varanasi	Central Uttar Pradesh	
86	Rest of Uttar pradesh (Moradabad/Bareily)	Rest of Uttar Pradesh	
87	Delhi	Delhi	Delhi
88	Punjab / Chandigarh	Punjab	Punjab
89	Uttrakhand / Jammu & Kashmir / Himachal Pradesh	Northern Indian States	Northern Indian States
90	West Bengal / Orissa / Chattisgarh / Bihar /Jharkhand	Eastern Indian States	Eastern Indian States
91	Meghalaya / Sikkim / Tripura / Mizoram / Manipur / Nagaland / Assam / Arunachal Pradesh	North Eastern Indian States	North Eastern Indian States
92	Goa	Goa	Goa
93	Andhra Pradesh	Southern Indian States	Southern Indian States
94	Telangana	Southern Indian States	
95	Kerala	Southern Indian States	
96	Tamilnadu	Southern Indian States	
97	Karnataka	Southern Indian States	

APPENDIX 2.3
MODE WISE TOP 20 OD PAIRS

Traffic Study for Chittorgarh-Kota section of NH-27 in the state of Rajasthan

TOP 20 Origin Destination Pairs at TP01-BASSI

Car

S.No.	Origin	Destination	% of total
1	Chittorgarh	Bijolia	12%
2	Kota	Udaipur	11%
3	Chittorgarh	Katoda	10%
4	Chittorgarh	Parsoli	6%
5	Bassi	Parsoli	5%
6	Parsoli	Udaipur	5%
7	Chittorgarh	Kota	4%
8	Bassi	Katoda	4%
9	Chittorgarh	Ladpura	2%
10	Chittorgarh	Bichhor	2%
11	Bassi	Bichhor	2%
12	Katoda	Udaipur	1%
13	Bassi	Kota	1%
14	Chittorgarh	Rawatbhata	1%
15	Chittorgarh	Bundi	1%
16	Kota	Surat	1%
17	Chittorgarh	Baran	1%
18	Bassi	Biaora / Rajgarh	1%
19	Kota	Neemuch	1%
20	Kota	Rest of Gujarat	1%
		Total	**76%**

Mini Bus

S.No.	Origin	Destination	% of total
1	Chittorgarh	Katoda	52%
2	Chittorgarh	Kota	19%
3	Chittorgarh	Ladpura	10%
4	Bassi	Parsoli	10%
5	Kota	Pratapgarh	10%
		Total	**100%**

Bus

S.No.	Origin	Destination	% of total
1	Kota	Udaipur	20%
2	Chittorgarh	Kota	20%
3	Chittorgarh	Katoda	17%
4	Katoda	Udaipur	10%
5	Ahmedabad	Kanpur / Allahabad / Varanasi	4%
6	Chittorgarh	Parsoli	3%
7	Chittorgarh	Ladpura	1%
8	Chittorgarh	Menal	1%
9	Chittorgarh	Ramganj Mandi	1%
10	Chittorgarh	Rest of Haryana	1%
11	Anyalhera	Bichhor	1%
12	Bichhor	Udaipur	1%
13	Kota	Surat	1%
14	Bundi	Ahmedabad	1%
15	Udaipur	Jaipur	1%
16	Udaipur	Jhansi	1%
17	Chittorgarh	Rawatbhata	1%
18	Chittorgarh	Jaipur	1%
19	Parsoli	Udaipur	1%
20	Kota	Nimbahera	1%
		Total	**93%**

MLCV

S.No.	Origin	Destination	% of total
1	Chittorgarh	Kota	11%
2	Chittorgarh	Katoda	8%
3	Chittorgarh	Ladpura	6%
4	Chittorgarh	Bijolia	6%
5	Chittorgarh	Parsoli	5%
6	Kota	Udaipur	5%
7	Bassi	Parsoli	5%
8	Bassi	Kota	5%
9	Kota	Ahmedabad	4%
10	Chittorgarh	Rawatbhata	3%
11	Katoda	Nimbahera	3%
12	Kota	Nimbahera	3%
13	Chittorgarh	Bichhor	2%
14	Chittorgarh	Bundi	2%
15	Chittorgarh	Jaipur	2%
16	Bassi	Katoda	2%
17	Ladpura	Nimbahera	2%
18	Bassi	Jaipur	2%
19	Chittorgarh	Sawai Madhopur	1%
20	Bijolia	Nimbahera	1%
		Total	**79%**

Traffic Study for Chittorgarh-Kota section of NH-27 in the state of Rajasthan

TOP 20 Origin Destination Pairs at TP01-BASSI

LCV

S.No.	Origin	Destination	% of total
1	Chittorgarh	Kota	20%
2	Kota	Ahmedabad	14%
3	Kota	Udaipur	11%
4	Kota	Nimbahera	4%
5	Kota	Surat	4%
6	Chittorgarh	Bijolia	3%
7	Chittorgarh	Parsoli	3%
8	Chittorgarh	Katoda	2%
9	Bassi	Parsoli	2%
10	Kota	Ralkot	2%
11	Bundi	Rest of Gujarat	2%
12	Chittorgarh	Rawatbhata	2%
13	Udaipur	Baran	2%
14	Chittorgarh	Jhalawar	1%
15	Kota	Bhilwara	1%
16	Bundi	Ahmedabad	1%
17	Chittorgarh	Ladpura	1%
18	Chittorgarh	Deoli	1%
19	Chittorgarh	Rest of Maharashtra	1%
20	Bassi	Rawatbhata	1%
		Total	**78%**

2 Axle

S.No.	Origin	Destination	% of total
1	Chittorgarh	Kota	46%
2	Kota	Nimbahera	17%
3	Chittorgarh	Ladpura	4%
4	Kota	Ahmedabad	4%
5	Chittorgarh	Bundi	3%
6	Chittorgarh	Parsoli	2%
7	Kota	Udaipur	2%
8	Chittorgarh	Baran	2%
9	Chittorgarh	Katoda	2%
10	Kota	Rest of Gujarat	2%
11	Nimbahera	Lucknow	2%
12	Chittorgarh	Bijolia	1%
13	Kota	Rest of Bhilwara district	1%
14	Chittorgarh	Bichhor	1%
15	Chittorgarh	Jhalawar	1%
16	Chittorgarh	Jaipur	1%
17	Chittorgarh	Lucknow	1%
18	Chittorgarh	Delhi	1%
19	Bassi	Sawai Madhopur	1%
20	Ladpura	Nimbahera	1%
		Total	**93%**

3 Axle

S.No.	Origin	Destination	% of total
1	Chittorgarh	Kota	25%
2	Kota	Udaipur	11%
3	Kota	Nimbahera	10%
4	Chittorgarh	Bundi	7%
5	Kota	Ahmedabad	6%
6	Kota	Rest of Gujarat	3%
7	Chittorgarh	Katoda	2%
8	Chittorgarh	Jaipur	1%
9	Chittorgarh	Kanpur / Allahabad / Varanasi	1%
10	Bundi	Ahmedabad	1%
11	Chittorgarh	Baran	1%
12	Nimbahera	Bundi	1%
13	Katoda	Nimbahera	1%
14	Kota	Mount Abu	1%
15	Kota	Banswara	1%
16	Kota	Kandla / Mundra / Mandvi / Tuna	1%
17	Kota	Mumbai	1%
18	Ahmedabad	Jhansi	1%
19	Ahmedabad	Lucknow	1%
20	Ahmedabad	Kanpur / Allahabad / Varanasi	1%
		Total	**78%**

MAV

S.No.	Origin	Destination	% of total
1	Kota	Nimbahera	17%
2	Chittorgarh	Kota	14%
3	Kota	Ahmedabad	7%
4	Katoda	Udaipur	5%
5	Chittorgarh	Katoda	5%
6	Ahmedabad	West Bengal / Orissa / Chattisgarh / Bihar /Jharkhand	4%
7	Kota	Rest of Gujarat	2%
8	Kota	Udaipur	2%
9	Kota	Surat	2%
10	Nimbahera	Baran	2%
11	Chittorgarh	Baran	1%
12	Bundi	Rest of Gujarat	1%
13	Baran	Ahmedabad	1%
14	Kota	Kandla / Mundra / Mandvi / Tuna	1%
15	Chittorgarh	West Bengal / Orissa / Chattisgarh / Bihar /Jharkhand	1%
16	Nimbahera	Bundi	1%
17	Ahmedabad	Kanpur / Allahabad / Varanasi	1%
18	Rest of Gujarat	Kanpur / Allahabad / Varanasi	1%
19	Chittorgarh	Jhalawar	1%
20	Kota	Banswara	1%
		Total	**70%**

Traffic Study for Chittorgarh-Kota section of NH-27 in the state of Rajasthan
TOP 20 Origin Destination Pairs at TP02-AROL1

Car

S.No.	Origin	Destination	% of total
1	Ladpura	Kota	15%
2	Chittorgarh	Kota	13%
3	Bhilwara	Bhilwara	8%
4	Kota	Udaipur	8%
5	Chittorgarh	Kota	6%
6	Salawatiya	Bhilwara	6%
7	Kota	Bhilwara	4%
8	Bhilwara	Bundi	2%
9	Chittorgarh	Bundi	2%
10	Dabi	Bhilwara	2%
11	Manal	Salawatiya	2%
12	Ladpura	Salawatiya	2%
13	Manal	Bhilwa	2%
14	Chittorgarh	Salawatiya	1%
15	Ladpura	Bhilwa	1%
16	Bhilwara	Jhalawar	1%
17	Kota	Kanpur / Allahabad	1%
18	Kota	Ahmedabad	1%
19	Manal	Kota	1%
20	Chittorgarh	Jhalawar	1%
		Total	**81%**

Mini Bus

S.No.	Origin	Destination	% of total
1	Kota	Rest of Bhilwara district	54%
2	Chittorgarh	Kota	13%
3	Ladpura	Bhilla	7%
4	Ladpura	Kota	7%
5	Kota	Mansalwad	7%
6	Jhalawar	Rest of Gujarat	3%
7	Rest of Gujarat	Gwalior / Morena / Bhind	3%
		Total	**87%**

Bus

S.No.	Origin	Destination	% of total
1	Kota	Bhilwara	40%
2	Kota	Ahmedabad	11%
3	Chittorgarh	Kota	10%
4	Kota	Udaipur	8%
5	Ladpura	Kota	7%
6	Rest of Gujarat	Kanpur / Allahabad / Varanasi	2%
7	Kota	Surat	1%
8	Jhalawar	Ahmedabad	1%
9	Chittorgarh	Bhilla	1%
10	Chittorgarh	Agra	1%
11	Bhilla	Bhilwara	1%
12	Kota	Rest of Gujarat	1%
13	Udaipur	Baran	1%
14	Kota	Banaar	1%
15	Ladpura	Dabi	1%
16	Salawatiya	Jodhpur	1%
17	Bhilla	Jodhpur	1%
18	Kota	Rest of Bhilwara district	1%
19	Kota	Rajsamand	1%
20	Bhilwara	Telangana	1%
		Total	**93%**

LCv

S.No.	Origin	Destination	% of total
1	Kota	Bhilwara	16%
2	Bhilla	Bhilwara	12%
3	Chittorgarh	Kota	9%
4	Salawatiya	Bhilwara	8%
5	Ladpura	Kota	7%
6	Kota	Udaipur	3%
7	Ladpura	Salawatiya	3%
8	Chittorgarh	Baran	3%
9	Chittorgarh	Salawatiya	3%
10	Dabi	Bhilwara	3%
11	Chittorgarh	Bundi	2%
12	Ladpura	Bhilla	2%
13	Bhilwara	Bundi	1%
14	Bhilwara	Baran	1%
15	Chittorgarh	Bhilla	1%
16	Ladpura	Dabi	1%
17	Bhilla	Udaipur	1%
18	Kota	Surat	1%
19	Mansalwad	Bundi	1%
20	Bundi	Ahmedabad	1%
		Total	**82%**

Traffic Study for Chittorgarh-Kota section of NH-27 in the state of Rajasthan
TOP 20 Origin Destination Pairs at TP02-AROL1

LCV

S. No.	Origin	Destination	% of total
1	Kota	Bhilwara	16%
2	Chittorgarh	Kota	15%
3	Kota	Ahmedabad	9%
4	Bundi	Bhilwara	8%
5	Kota	Udaipur	6%
6	Kota	Rest of Gujarat	5%
7	Salawatiya	Bhilwara	4%
8	Chittorgarh	Baran	4%
9	Chittorgarh	Bundi	2%
10	Ladpura	Salawatiya	2%
11	Chittorgarh	Jhalawar	2%
12	Ladpura	Rest of Kota district	2%
13	Dabi	Bhilwara	2%
14	Kota	Ranewara	1%
15	Kota	Surat	1%
16	Bhilwara	Bundi	1%
17	Chittorgarh	Salawatiya	1%
18	Udaipur	Kannur / Allahabad / Varanasi	1%
19	Chittorgarh	Gurugram / Manesar / Rewari	1%
20	Ladpura	Rawatbhata	1%
		Total	**86%**

2 Axle

S. No.	Origin	Destination	% of total
1	Kota	Bhilwara	12%
2	Chittorgarh	Kota	10%
3	Kota	Udaipur	7%
4	Chittorgarh	Salawatiya	6%
5	Ladpura	Kota	6%
6	Bundi	Bhilwara	6%
7	Salawatiya	Bhilwara	5%
8	Kota	Ahmedabad	5%
9	Ladpura	Salawatiya	4%
10	Salawatiya	Mandalgarh	3%
11	Chittorgarh	Bundi	3%
12	Dabi	Bhilwara	3%
13	Salawatiya	Udaipur	2%
14	Chittorgarh	Dabi	2%
15	Chittorgarh	Jhalawar	2%
16	Bhilwara	Bundi	2%
17	Bundi	Ahmedabad	1%
18	Kota	Ajmer / Kishangarh	1%
19	Salawatiya	Beawar	1%
20	Kota	Rest of Gujarat	1%
		Total	**80%**

3 Axle

S. No.	Origin	Destination	% of total
1	Chittorgarh	Kota	18%
2	Kota	Bhilwara	10%
3	Kota	Udaipur	7%
4	Kota	Ahmedabad	5%
5	Ladpura	Kota	5%
6	Dabi	Bhilwara	4%
7	Ahmedabad	Delhi	3%
8	Bhilwara	Bundi	3%
9	Chittorgarh	Baran	2%
10	Kota	Rest of Gujarat	2%
11	Chittorgarh	Salawatiya	2%
12	Chittorgarh	Jhalawar	1%
13	Bhilwara	Jhalawar	1%
14	Chittorgarh	Dabi	1%
15	Bundi	Bhilwara	1%
16	Bhilwara	Baran	1%
17	Ahmedabad	West Bengal / Orissa / Chattisgarh / Bihar /Jharkhand	1%
18	Ahmedabad	Meghalaya / Sikkim / Tripura / Mizoram / Manipur / Nagaland / Assam / Arunachal Pradesh	1%
19	Rajkot	Gurgaon	1%
20	Rest of Gujarat	West Bengal / Orissa / Chattisgarh / Bihar /Jharkhand	1%
		Total	**71%**

MAV

S. No.	Origin	Destination	% of total
1	Chittorgarh	Kota	26%
2	Kota	Bhilwara	13%
3	Chittorgarh	Baran	5%
4	Kota	Rest of Gujarat	4%
5	Kota	Ahmedabad	4%
6	Kota	Udaipur	3%
7	Ladpura	Kota	3%
8	Kota	Neemkathana	3%
9	Kota	Rajkot	3%
10	Bhilwara	Baran	1%
11	Chittorgarh	Bundi	1%
12	Chittorgarh	Jhalawar	1%
13	Baran	Ahmedabad	1%
14	Baran	Rest of Gujarat	1%
15	Bhilwara	Jhalawar	1%
16	Bundi	Ahmedabad	1%
17	Chittorgarh	West Bengal / Orissa / Chattisgarh / Bihar /Jharkhand	1%
18	Ahmedabad	West Bengal / Orissa / Chattisgarh / Bihar /Jharkhand	1%
19	Bhilwara	Bhilwara	1%
20	Dabi	Bhilwara	1%
		Total	**79%**

Traffic Study for Chittorgarh-Kota section of NH-27 in the state of Rajasthan

TOP 20 Origin Destination Pairs at TP03-DHANESHWAR

Car

S.No.	Origin	Destination	% of total
1	Dabi	Kota	20%
2	Bhilla	Kota	11%
3	Kota	Bhilwara	10%
4	Kota	Udaipur	7%
5	Chittorgarh	Kota	6%
6	Dabi	Bundi	4%
7	Budhpura	Kota	3%
8	Sootra	Kota	3%
9	Kota	Rest of Gujarat	2%
10	Bhilla	Bundi	2%
11	Chittorgarh	Baran	1%
12	Kota	Ahmedabad	1%
13	Dabi	Baran	1%
14	Udaipur	Baran	1%
15	Bhilla	Baran	1%
16	Bhilwara	Baran	1%
17	Kota	Rajasthan	1%
18	Kota	Rajasthan	1%
19	Chittorgarh	Bundi	1%
20	Kota	Rest of Bhilwara district	1%
		Total	**77%**

Mini Bus

S.No.	Origin	Destination	% of total
1	Bhilla	Jhalawar	59%
2	Bhilla	Kota	21%
3	Kota	Bhilwara	14%
4	Sootra	Kota	7%
		Total	**100%**

Bus

S.No.	Origin	Destination	% of total
1	Kota	Bhilwara	18%
2	Kota	Udaipur	16%
3	Chittorgarh	Kota	12%
4	Kota	Ahmedabad	12%
5	Kota	Jodhpur	6%
6	Dabi	Kota	6%
7	Kota	Rest of Gujarat	4%
8	Kota	Raipur	3%
9	Bhilla	Kota	3%
10	Kota	Mangalwad	3%
11	Chittorgarh	Rest of Madhya Pradesh	1%
12	Dabi	Baran	1%
13	Kota	Rest of Bhilwara district	1%
14	Kota	Rajawar	1%
15	Udaipur	Indore	1%
16	Ahmedabad	Indore	1%
17	Ahmedabad	Kanpur / Allahabad / Varanasi	1%
18	Ahmedabad	West Bengal / Orissa / Chattisgarh / Bihar /Jharkhand	1%
19	Chittorgarh	Bundi	1%
20	Chittorgarh	Jhalawar	1%
		Total	**90%**

MLCV

S.No.	Origin	Destination	% of total
1	Dabi	Kota	40%
2	Kota	Bhilwara	12%
3	Bhilla	Kota	12%
4	Sootra	Kota	8%
5	Chittorgarh	Kota	6%
6	Dabi	Bundi	3%
7	Kota	Udaipur	3%
8	Dabi	Rest of Kota district	2%
9	Sootra	Gurgaram / Manasar / Rewari	2%
10	Budhpura	Kota	2%
11	Kota	Rest of Gujarat	2%
12	Bhilla	Rest of Bundi district	1%
13	Sootra	Bundi	1%
14	Kota	Rajasthan	1%
15	Baran	Ahmedabad	1%
16	Rajkhiya	Kota	1%
17	Bhilla	Bundi	1%
18	Bhilla	Baran	1%
19	Dabi	Baran	1%
20	Dabi	Rest of Baran district	1%
		Total	**95%**

Traffic Study for Chittorgarh-Kota section of NH-27 in the state of Rajasthan
TOP 20 Origin Destination Pairs at TP03-DHANESHWAR

LCV

S. No.	Origin	Destination	% of total
1	Dabi	Kota	10%
2	Kota	Udaipur	10%
3	Kota	Bhilwara	9%
4	Chittorgarh	Kota	8%
5	Bilolia	Kota	8%
6	Sagtra	Kota	6%
7	Kota	Ahmedabad	6%
8	Bhilwara	Baran	5%
9	Rudhpura	Kota	5%
10	Udaipur	Baran	4%
11	Chittorgarh	Baran	2%
12	Kota	Rest of Gujarat	2%
13	Bilolia	Baran	2%
14	Chittorgarh	Shambhoopura	1%
15	Chittorgarh	Kanpur / Allahabad / Varanasi	1%
16	Manal	Bundi	1%
17	Nimbla	Rest of Bundi district	1%
18	Nimbla	Rest of Kota district	1%
19	Dabi	Lucknow	1%
20	Kota	Bhavnagar	1%
		Total	**84%**

2 Axle

S.No.	Origin	Destination	% of total
1	Dabi	Kota	21%
2	Sagtra	Kota	9%
3	Kota	Bhilwara	8%
4	Bilolia	Kota	8%
5	Kota	Udaipur	6%
6	Chittorgarh	Kota	5%
7	Rudhpura	Kota	4%
8	Sagtra	Sanur	3%
9	Chittorgarh	Shambhoopura	3%
10	Dabi	Rest of Kota district	3%
11	Nimbla	Bundi	3%
12	Nimbla	Baran	3%
13	Kota	Nimbahera	2%
14	Bhilwara	Rest of Kota district	1%
15	Chittorgarh	Baran	1%
16	Dabi	Bundi	1%
17	Udaipur	Baran	1%
18	Kota	Rest of Gujarat	1%
19	Bhilwara	Bundi	1%
20	Chittorgarh	Rest of Bundi district	1%
		Total	**82%**

3 Axle

S. No.	Origin	Destination	% of total
1	Dabi	Kota	20%
2	Chittorgarh	Kota	8%
3	Kota	Udaipur	8%
4	Kota	Bhilwara	7%
5	Rudhpura	Kota	5%
6	Kota	Rest of Gujarat	3%
7	Chittorgarh	Baran	3%
8	Kota	Ahmedabad	3%
9	Bilolia	Kota	3%
10	Kota	Nimbahera	3%
11	Sagtra	Kota	3%
12	Baran	Ahmedabad	2%
13	Nimbla	Baran	2%
14	Bhilwara	Baran	2%
15	Kota	Surat	1%
16	Bhilwara	Bundi	1%
17	Udaipur	Baran	1%
18	Rudhpura	Baran	1%
19	Udaipur	Jhalawar	1%
20	Baran	Surat	1%
		Total	**82%**

MAV

S. No.	Origin	Destination	% of total
1	Chittorgarh	Kota	13%
2	Kota	Bhilwara	9%
3	Dabi	Kota	9%
4	Kota	Udaipur	7%
5	Kota	Nimbahera	6%
6	Bilolia	Kota	4%
7	Kota	Rest of Gujarat	3%
8	Sagtra	Kota	3%
9	Kota	Ahmedabad	3%
10	Chittorgarh	Baran	2%
11	Rudhpura	Kota	2%
12	Bhilwara	Baran	2%
13	Udaipur	Baran	1%
14	Lalsoya	Kota	1%
15	Rest of Gujarat	Rest of Uttar pradesh	1%
16	Dabi	Baran	1%
17	Baran	Ahmedabad	1%
18	Baran	Rest of Gujarat	1%
19	Nimbla	Baran	1%
20	Bhilwara	Jhalawar	1%
		Total	**71%**

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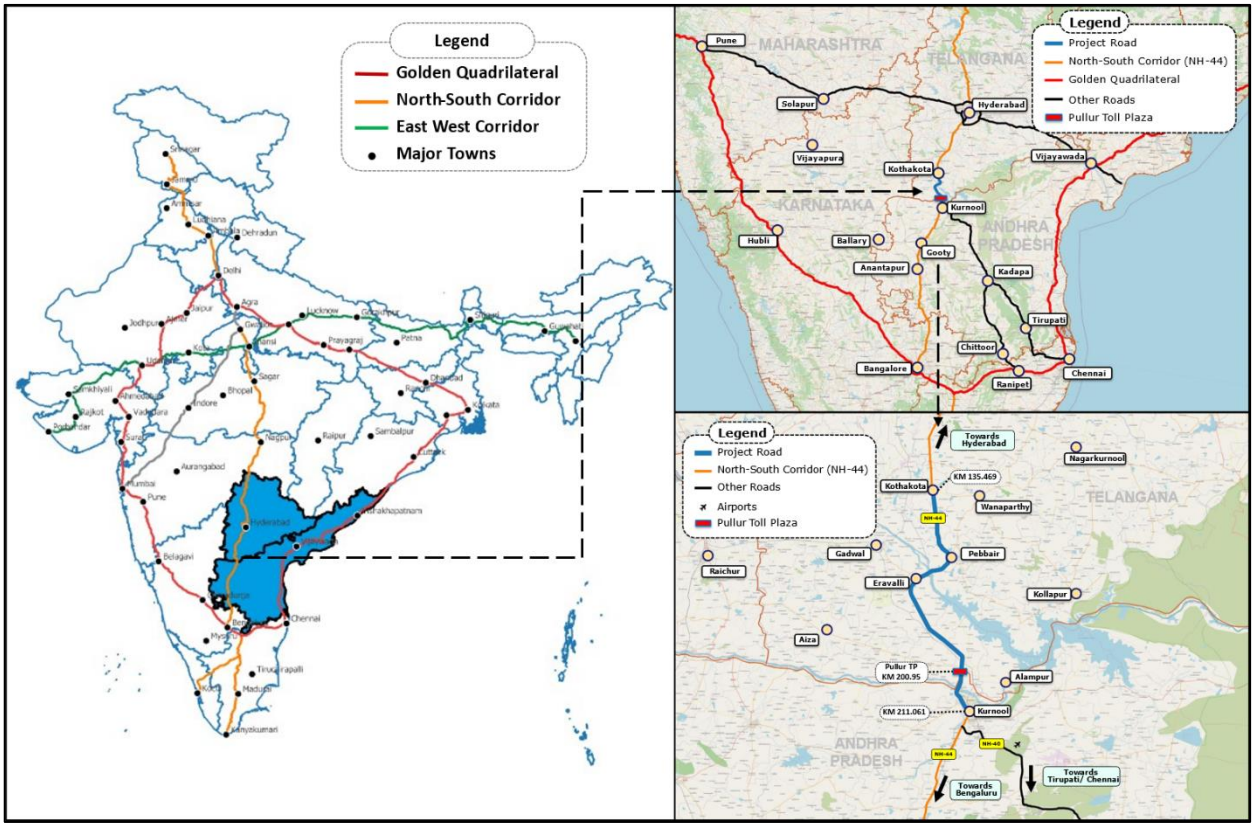
TRAFFIC STUDY FOR KOTHAKOTA-KURNOOL SECTION OF NH-44 IN THE STATE OF TELANGANA & ANDHRA PRADESH



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ABBREVIATIONS

%	Percentage
2A	2 Axle truck
3A	3 Axle truck
AADT	Annual Average Daily Traffic
ADT	Average Daily Traffic
AR	Alternate Route
BIA	Broad Influence Area
CAGR	Compounded Annual Growth Rate
FY	Financial Year
GDP	Gross Domestic Product
GSDP	Gross State Domestic Product
IIA	Immediate Influence Area
IRC	Indian Road Congress
Km	Kilometre
LCV	Light Commercial Vehicle
M Bus	Minibus
MAV	Multi Axle Vehicle
MLCV	Mini LCV
NH	National Highway
NHAI	National Highway Authority of India
NHDP	National Highway Development Program
NHIIMPL	National Highways Infra Investment Managers Private Limited
NPV	Net Present Value
OD	Origin-Destination survey
PCU	Passenger Car Unit
PIA	Project Influence Area
PR	Project Road
PV	Present Value
Rs/₹	Rupees
SEZ	Special Economic Zone
Sq.km	Square Kilometre
TP	Toll Plaza
WPI	Wholesale Price Index
YOY	Year on Year

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EXECUTIVE SUMMARY

Project Overview

The project highway, NH-44, is the longest highway in India connecting Srinagar with Kanyakumari and is part of North-South corridor envisaged under National Highway Development Program (Phase – II). The NH 44 highway covers a huge distance of 4,112 kilometres and passes through the states of Jammu and Kashmir, Punjab, Haryana, Delhi, Uttar Pradesh, Madhya Pradesh, Maharashtra, Telangana, Andhra Pradesh, Karnataka, and Tamil Nadu.

The project road section, Kothakota-Kurnool starts at km 135.469 near Kothakota and ends at km 211.061 at Kurnool with a length of about 74.6 km. There is one operational toll plaza on the PR near Pullur (km 200.95).

Figure 0-1 shows the context and alignment of project road with major places along the highway.

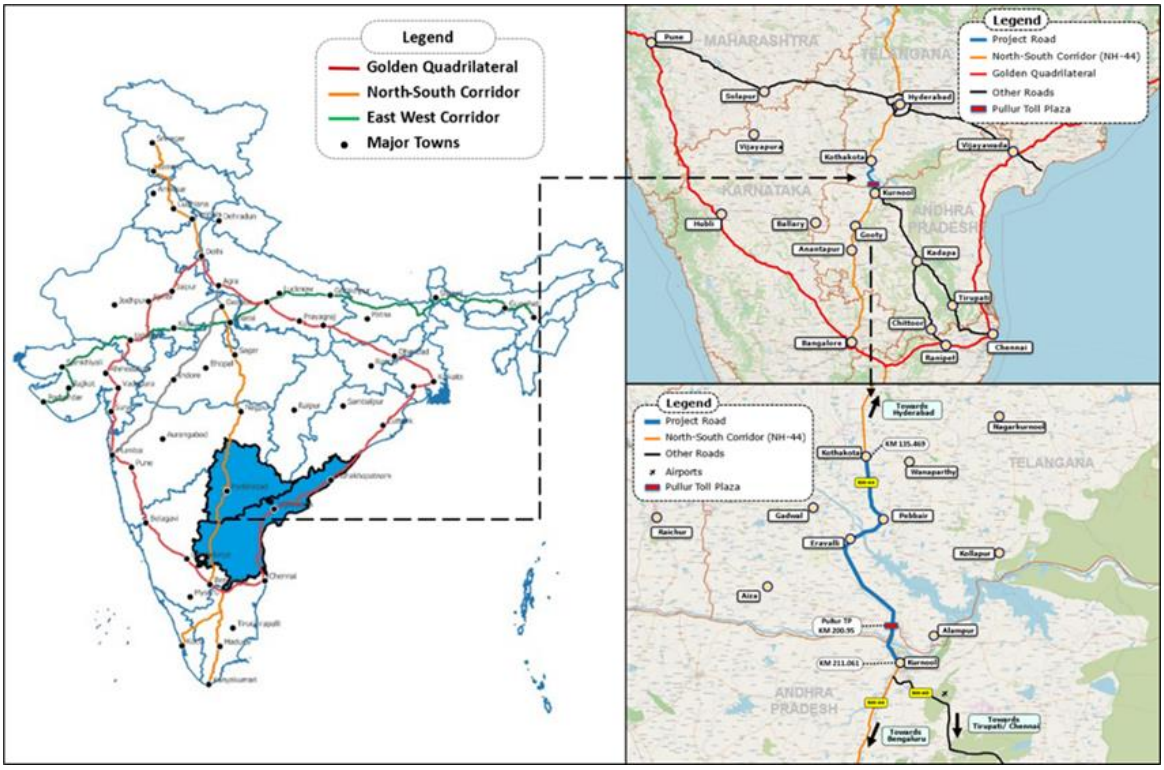


Figure 0-1: Kothakota-Kurnool Section and Location of Toll Plaza

Project Road Characteristics and Profile of Influencing Districts

The project road serves for long distance traffic, which is majorly plying between Hyderabad/ Nagpur/ northern region and Bengaluru/ Chennai/ southern region. Apart from long distance traffic, it also serves the short distance traffic which is mainly generated between Mahbubnagar/ Kothakota/ Wanaparthy/ Pebbair/ Gadwal located on the north of toll plaza and Kurnool/ Anantapur/ Nandyal areas located on the south of toll plaza. The project road section is located in the districts of Wanaparthy and Jogulamba Gadwal in the state of Telangana and Kurnool in the state of Andhra Pradesh.

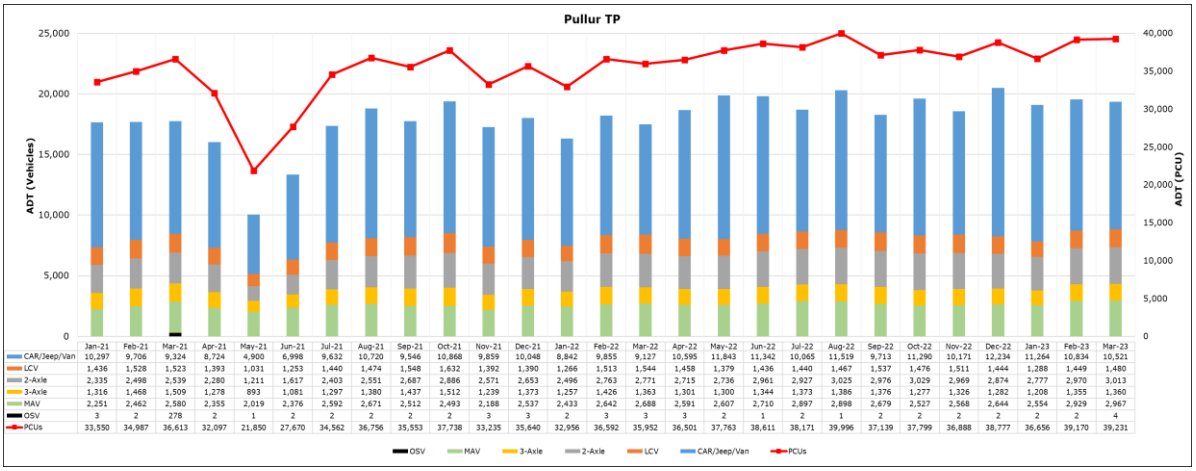
Jogulamba Gadwal district is situated in south-western part of Telangana state. Agriculture is the main livelihood of the people in Wanaparthy district with 75% total workers engaged in agro-based labour. Red sandy soil and sandy loam soil covers 89% of the area. Paddy, groundnut, jowar, maize, red gram, castor, cotton, and chili are the major crops cultivated within the district.

Jogulamba Gadwal district is renowned all over the world for its exclusive handloom Zari sarees and other useful fabrics and materials.

Kurnool district is situated in Western part of Andhra Pradesh. Almost half of the geographical area is under agriculture use. Paddy, cotton, tomato, and onion are the major crops grown in the district. Mining/quarrying is the prevailing industry in the district.

Historical Traffic Volume and Vehicle Composition

The past toll traffic data for the toll plaza was made available by the client from January 2021 to March 2023 is presented in **Figure 0-2**.



	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23
CAR/Jeep/Van	10,297	9,706	9,324	8,724	4,900	6,998	9,632	10,720	9,546	10,868	9,859	10,048	8,842	9,855	9,127	10,595	11,843	11,342	10,065	11,519	9,713	11,290	10,171	12,234	11,264	10,834	10,521
LCV	1,436	1,528	1,523	1,393	1,031	1,253	1,440	1,474	1,548	1,632	1,392	1,390	1,266	1,513	1,544	1,458	1,379	1,436	1,440	1,467	1,537	1,476	1,511	1,444	1,288	1,449	1,480
2-Axle	2,335	2,498	2,539	2,280	1,211	1,617	2,403	2,551	2,687	2,886	2,571	2,653	2,496	2,763	2,771	2,715	2,736	2,961	2,927	3,025	2,976	3,029	2,969	2,874	2,777	2,970	3,013
3-Axle	1,316	1,468	1,509	1,278	893	1,081	1,297	1,380	1,437	1,512	1,239	1,373	1,257	1,426	1,363	1,301	1,300	1,344	1,373	1,386	1,376	1,277	1,326	1,282	1,208	1,355	1,360
MAV	2,251	2,462	2,580	2,355	2,019	2,376	2,592	2,671	2,512	2,493	2,188	2,537	2,433	2,642	2,688	2,591	2,607	2,710	2,897	2,898	2,679	2,527	2,568	2,644	2,554	2,929	2,967
OSV	3	2	278	2	1	2	2	2	2	2	3	3	2	3	3	3	2	1	2	1	2	2	2	2	2	2	4
PCUs	33,550	34,987	36,613	32,097	21,850	27,670	34,562	36,756	35,553	37,738	33,235	35,640	32,956	36,592	35,952	36,501	37,763	38,611	38,171	39,996	37,139	37,799	36,888	38,777	36,656	39,170	39,231

Figure 0-2: Month on Month Traffic Data for Pullur TP

AADT for FY23

The past toll traffic data for the toll plaza was made available by the client from January 2021 to March 2023.

For the period from April 2022 to July 2022, the corresponding monthly data for reusage of local pass and exemptions for cars were not recorded. Therefore, the respective category average between August 2022 to March 2023 has been considered to be applicable for the months of April 2022 to July 2022 to arrive at the monthly ADT for these months.

It has been learnt that due to old tolling system/ETC reading issues at the Pullur toll plaza, some duplicate entries are created in exemptions/violations for smooth flow of traffic. This duplication error results in reported exemptions traffic being higher than the actual exemptions traffic plying on road. The details of actual exemptions and violations and the duplication entries for the months of January 2023 and February 2023 has been

provided by the client which has been used to estimate the actual exemptions/violations for the other months throughout the year.

Therefore, the average duplication error has been deducted from the 12-month average traffic of April 2022 to March 2023 for the estimation of AADT for FY23 and is presented in **Table 0-1**.

Particulars	Car/ Jeep/ Van	LCV	2-Axle	3-Axle	MAV	OSV	PCUs
12-month ADT (Apr 2022 – Mar 2023)	10,949	1,447	2,914	1,324	2,714	2	38,059
Average Duplication Error	313	37	65	28	63	0	933
AADT for FY23	10,636	1,410	2,849	1,296	2,651	2	37,125

Table 0-1: AADT for FY23 for the Project Road

Travel Pattern

- About 43 percent of car traffic and about 48 percent of bus traffic ply from/to Hyderabad/ Nizamabad/ Adilabad to/from Kurnool/ Anantapur/ Bangalore/ Tamil Nadu.
- About 35 percent of cars are found to be travelling between Mahabubnagar/ Gadwal/ Rest of Telangana and Kurnool/ Anantapur/ Bangalore/ Tamil Nadu areas.
- About 31-47 percent of all freight vehicles plies from/to Hyderabad/ Nizamabad/ Adilabad to/from Kurnool/ Anantapur/ Bangalore/ Tamil Nadu.
- Long distance traffic movement between Nanded/ MP/ Delhi/ UP/ Northern India and Kurnool/ Anantapur/ Bangalore/ Tamil Nadu is about 15 percent of 2A trucks and 20-21 percent of 3A and MAVs.

Network Impacts

In the context of the project road of Kothakota – Kurnool section, there are two proposed alternative routes i.e., Surat-Chennai Economic Corridor and Hyderabad – Tirupati Highway which can impact the traffic plying on the project road. The potential divertible traffic and diverted traffic for each of the network developments is presented in **Table 0-2**.

Alternate Routes / Modes	Car	LCV	2A	3A	MAV
Surat – Chennai Economic Corridor					
Potential Traffic as % of AADT	0.9	0.9	4.5	2.6	6.0
Divertible traffic as % of AADT	0.8	0.8	4.3	2.5	5.7
Hyderabad – Tirupati Highway					
Potential Traffic as % of AADT	10.7	14.2	18.5	20.7	15.5
Divertible traffic as % of AADT	8.4	11.1	14.4	17.2	10.4
Combined Impact (%)					
Total Potential Traffic	11.5	15.1	23.0	23.3	21.5
Total Divertible Traffic	9.2	11.9	18.7	19.7	16.1

Table 0-2: Impact due to Alternate Routes for Project Road

The two proposed alternate routes are likely to result in net traffic diversion of about 9.2 percent in cars and 11.9 percent in LCVs and about 16-20 percent in rest of freight traffic. Presently, the two routes are in the initial stages of implementation and are likely to be completed by FY26. To account for the gradual build-up of traffic on the alternate routes, the traffic shift is assumed to take place in phases with about 50 percent in FY27, 75 percent in FY28 and 100 percent from FY29 onwards.

Traffic Growth Rates

The estimated traffic growth rates for the project road using elasticity approach have been estimated for each year till FY52 and is presented in **Table 0-3**.

FY/Modes	Car/MLCV	LCV/M Bus	Bus	Truck	3A	MAV
2024	7.0	3.5	2.1	2.0	2.0	5.9
2025	7.3	3.7	2.2	2.1	2.1	6.2
2026	7.8	3.9	2.3	2.2	2.2	6.6
2027	7.8	3.9	2.3	2.2	2.2	6.6
2028	7.6	3.8	2.3	2.1	2.1	6.4
2029	7.1	3.5	2.1	2.0	2.0	6.0
2030	7.1	3.5	2.1	2.0	2.0	6.0
2031	6.4	2.8	2.1	2.0	2.0	5.3
2032	6.4	2.8	2.1	2.0	2.0	5.3
2033	6.4	2.8	2.1	2.0	2.0	5.3
2034	6.3	2.8	2.1	2.0	2.0	5.2
2035	6.2	2.7	2.1	1.9	1.9	5.1
2036	6.0	2.7	2.0	1.9	1.9	5.0
2037	5.9	2.6	2.0	1.9	1.9	4.9
2038	5.8	2.6	1.9	1.8	1.8	4.9
2039	5.7	2.5	1.9	1.8	1.8	4.8
2040	5.6	2.5	1.9	1.8	1.8	4.7
2041	5.5	2.4	1.8	1.7	1.7	4.6
2042	5.5	2.4	1.8	1.7	1.7	4.6
2043	5.4	2.4	1.8	1.7	1.7	4.5
2044	5.3	2.4	1.8	1.7	1.7	4.4
2045	5.2	2.3	1.7	1.6	1.6	4.3
2046	5.1	2.3	1.7	1.6	1.6	4.2
2047	5.0	2.2	1.7	1.6	1.6	4.1
2048	4.9	2.2	1.6	1.5	1.5	4.0
2049	4.8	2.1	1.6	1.5	1.5	4.0
2050	4.6	2.1	1.5	1.5	1.5	3.9
2051	4.3	1.9	1.4	1.4	1.4	3.6
2052	4.3	1.9	1.4	1.4	1.4	3.6

Table 0-3: Projected Traffic Growth Rates for Project Road (%)

The implied traffic growth rates for freight vehicles after considering the impact of diversion under the base case have been presented in **Table 0-4**.

FY/Modes	TP01		
	2A	3A	MAV
2027	-7.3	-7.9	-2.0
2028	-3.1	-3.4	1.7
2029	-3.5	-3.9	1.1

Table 0-4: Implied Traffic Growth Rates for Project Road After Diversion (%)

Projected Mode-wise Traffic

Mode-wise projected traffic for the toll plaza of the project under the base case after considering diversion impacts till FY52 is presented in **Table 0-5**.

FY/Modes	Car	LCV	Bus	2A	3A	MAV	OSV	PCU
2023	10,636	1,410	1,564	1,285	1,296	2,651	2	37,125
2024	11,376	1,459	1,597	1,310	1,322	2,806	2	38,889
2025	12,209	1,512	1,632	1,337	1,349	2,979	2	40,849
2026	13,161	1,571	1,670	1,367	1,379	3,175	2	43,064
2027	13,535	1,536	1,709	1,267	1,270	3,111	3	42,589
2028	14,208	1,543	1,748	1,227	1,227	3,165	3	43,379
2029	14,838	1,546	1,785	1,183	1,179	3,200	3	44,010
2030	15,888	1,600	1,823	1,207	1,202	3,391	3	46,257
2031	16,900	1,646	1,861	1,231	1,226	3,570	3	48,408
2032	17,977	1,692	1,901	1,256	1,251	3,760	3	50,674
2033	19,123	1,740	1,941	1,281	1,276	3,959	4	53,061
2034	20,321	1,789	1,982	1,306	1,301	4,165	4	55,533
2035	21,572	1,838	2,023	1,332	1,326	4,379	4	58,092
2036	22,876	1,887	2,063	1,357	1,352	4,599	4	60,737
2037	24,235	1,937	2,104	1,382	1,377	4,826	4	63,468
2038	25,649	1,987	2,145	1,408	1,402	5,060	5	66,286
2039	27,117	2,038	2,186	1,433	1,427	5,301	5	69,190
2040	28,640	2,088	2,227	1,458	1,452	5,549	5	72,179
2041	30,217	2,140	2,268	1,484	1,478	5,803	5	75,252
2042	31,881	2,192	2,310	1,509	1,503	6,069	5	78,471
2043	33,603	2,245	2,351	1,535	1,529	6,342	6	81,778
2044	35,381	2,297	2,393	1,561	1,554	6,621	6	85,170
2045	37,215	2,350	2,434	1,586	1,579	6,907	6	88,646
2046	39,104	2,403	2,475	1,611	1,605	7,198	6	92,203
2047	41,047	2,456	2,516	1,637	1,630	7,496	7	95,839
2048	43,042	2,509	2,557	1,662	1,654	7,799	7	99,550
2049	45,087	2,562	2,597	1,686	1,679	8,107	7	103,334
2050	47,181	2,615	2,638	1,711	1,704	8,420	8	107,186
2051	49,220	2,666	2,676	1,734	1,727	8,723	8	110,915
2052	51,346	2,717	2,714	1,758	1,750	9,036	8	114,787
AADT CAGR (%)								
FY23 - FY25	7.1	3.6	2.1	2.0	2.0	6.0	6.0	4.9
FY25 - FY30	5.4	1.1	2.2	-2.0	-2.3	2.6	6.3	2.5
FY30 - FY35	6.3	2.8	2.1	2.0	2.0	5.2	5.2	4.7
FY35 - FY40	5.8	2.6	1.9	1.8	1.8	4.9	4.9	4.4
FY40 - FY45	5.4	2.4	1.8	1.7	1.7	4.5	4.5	4.2
FY45 - FY50	4.9	2.2	1.6	1.5	1.5	4.0	4.0	3.9

FY50 - FY52	4.3	1.9	1.4	1.4	1.4	3.6	3.6	3.5
FY23 - FY52	5.6	2.3	1.9	1.1	1.0	4.3	5.0	4.0

Table 0-5: Projected Mode-wise Traffic

Projected Traffic in PCUs

Total traffic in PCUs at the project road under the base case after considering diversion impacts is presented in **Table 0-6**.

FY end	Total PCU
2023	37,125
2024	38,889
2025	40,849
2026	43,064
2027	42,589
2028	43,379
2029	44,010
2030	46,257
2031	48,408
2032	50,674
2033	53,061
2034	55,533
2035	58,092
2036	60,737
2037	63,468
2038	66,286
2039	69,190
2040	72,179
2041	75,252
2042	78,471
2043	81,778
2044	85,170
2045	88,646
2046	92,203
2047	95,839
2048	99,550
2049	103,334
2050	107,186
2051	110,915
2052	114,787
CAGR (%) (FY24 to FY51)	4.0

Table 0-6: Projected Traffic at PR in PCUs (after diversion)

Tolling Segmentation

The tolling stream distribution for FY23 is presented in **Table 0-7**.

Type	Car	LCV	Bus/ 2A Trucks	3A Trucks	MAV	OSV
Single	50.5	68.3	54.8	81.9	91.4	90.6
Return	39.5	31.5	43.9	18.0	8.5	9.4
Monthly	0.0	0.0	1.2	0.0	0.0	0.0
Local personal	8.7	0.0	0.0	0.0	0.0	0.0
Local commercial	0.0	0.0	0.0	0.0	0.0	0.0
Exempt	1.2	0.2	0.1	0.1	0.1	0.0
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 0-7: Tolling Distribution

Tollable Length and Toll Rates

In case of the project road, the details of normal tolling lengths, bypass length (at 1.5 times) and equivalent structure lengths being charged at Pullur toll plaza are presented in **Table 0-8**.

Pullur (TP01) at km 200.95	Existing Length
A. Normal length	69.857
B. Bypass length @ 1.5 times	2.95
C. Equivalent Structure length	18.15
D. Total tolling length=(A+1.5*B+C)	92.432

Table 0-8: Tolling Lengths (in km) for the Project Road

The stream of toll rates to be charged at the toll plaza of the project road in cardinal years till FY52 is presented in **Table 0-9**.

FY	Car	LCV/ M Bus	Bus/2A	3A	MAV	OSV	Car Local
2023	125	205	425	465	670	815	315
2024	130	215	445	490	700	855	330
2025*	105	165	350	380	550	665	260
2026*	105	165	350	380	550	665	260
2030	170	270	570	620	895	1,090	420
2035	205	335	695	760	1,095	1,330	515
2040	250	405	850	930	1,335	1,625	630
2045	310	495	1,040	1,135	1,630	1,985	770
2050	375	605	1,270	1,390	1,995	2,430	940
2052	405	660	1,380	1,505	2,165	2,635	1,015

*Toll rates at 75% during six laning

Table 0-9: Toll Rates at Toll Plaza (in Rs)

Project Road Revenue

The project road revenue under the base case scenario is presented in **Table 0-10**.

FY Ending March	Base Case
2023	1,727.3
2024	1,896.8
2025	1,559.8
2026	1,642.5
2027	2,019.2
2028	2,472.9
2029	2,597.1
2030	2,845.1
2031	3,091.6
2032	3,384.1
2033	3,662.4
2034	3,990.4
2035	4,334.3
2036	4,727.0
2037	5,129.9
2038	5,556.4
2039	6,036.2
2040	6,558.3
2041	7,088.8
2042	7,707.7
2043	8,343.6
2044	9,061.3
2045	9,782.8
2046	10,575.3
2047	11,451.1
2048	12,364.4
2049	13,315.1
2050	14,378.8
2051	15,457.2
2052*	11,849.2
PV12 FY24 till 15th Dec in FY52	29,445.9
CAGR FY24 to FY51	8.1%

** Till 15th December FY52*

Table 0-10: Base Case Revenue (in Rs million)

The project road will have a CAGR of 8.1 percent for the period between FY24 to FY51.

1. INTRODUCTION

1.1 General

National Highways Authority of India (NHAI) has setup NHAI InvIT to monetize its completed and operational national highway projects with the objective of mobilizing additional resources through capital markets. In this context, National Highways Infra Projects Private Limited (NHIPPL) is acting as SPV for the projects under NHAI InvIT. Under Round1 (R1), NHAI InvIT has added a portfolio of five operating toll roads with an aggregate length of 390 kilometers located across the states of Gujarat, Karnataka, Rajasthan and Telangana.

The section viz., Kothakota-Kurnool of NH-44 in the states of Telangana and Andhra Pradesh referred to as Project Road (PR) hereinafter, is part of the R1 portfolio of InvIT.

The project highway, NH-44, is the longest highway in India connecting Srinagar with Kanyakumari and is part of North-South corridor envisaged under National Highway Development Program (Phase – II). NH-44 passes through the cities of Jammu, Jalandhar, Delhi, Faridabad, Agra, Gwalior, Jhansi, Sagar, Nagpur, Hyderabad, Bengaluru and Salem. **Figure 1-1** shows the alignment of project highway NH 44.

Figure 1-1: Alignment of Project Highway – NH44

National Highways Infra Projects Private Limited, has appointed Ramboll India Private Ltd as the traffic consultant to carry out a study for assessing the present traffic levels, travel pattern and future traffic & revenue estimation till FY52 duly considering the network characteristics, future economic perspective in the influence area of the project.

1.2 Scope of Services

The scope of the study includes the following:

- Undertake Traffic Survey on the highway section as per the following:
  - Seven days 24 hours Videography Traffic Counts at or near the existing toll plaza locations on the project road to derive the Average Daily Traffic (ADT)
  - One day Origin-Destination survey at or near the existing toll plaza locations to assess the existing travel pattern of vehicles plying on the project road – origin and destination
- Estimation of the base year AADT using seasonality factors for conversion of ADT to AADT
- Analysis of OD data to cover:
  - Regional distribution of traffic and influence factors for different zones contributing traffic on the corridor
  - Identification of Project Influence Area from analysis of travel pattern - regional distribution of traffic,
  - Main traffic generators (industrial areas, towns, ports etc.)
  - Commodity composition- Goods type distribution
  - Top OD pairs by vehicle types
  - Travel frequency and trip purpose distribution
- Review of past traffic studies, traffic/toll data and other relevant reports as may be available to determine category wise volume of traffic for past years as well as for current year
- To identify competing route and analyse the network conditions, traffic characteristics & level of toll charged and the advantage/ disadvantage of the competing road and their impact on the project traffic
- Carry out a study of past economic performance of influence area
- Diversion analysis, wherever needed – cost ratio-based diversion analysis using spreadsheets to be carried out for respective potential OD pairs.
- Preparation of traffic projections till FY52 in three scenarios – low, most likely and high
- Capacity analysis of the road or any other requirements for potential capacity augmentation
- Estimation of tollable traffic streams by toll category and estimation of toll

revenue as per categories of traffic streams stipulated in the tolling schedule for the study period

- Review future road and transportation network developments in the area of influence of the project and identify those schemes that may impact positively or negatively traffic on the toll road
- Identify factors which may have a positive and / or negative impact on the traffic - all major developments like DFC, industrial corridors, economic corridors, ports, Bharatmala, Sagarmala
- Scenario Analysis of toll revenue – Critical parameters of diversion (if applicable) and three scenarios of traffic growth (most likely, low and high).

1.3 Structure of Report

This report is divided into four chapters, including this introduction chapter. Chapter 2 details upon the project road characteristics and socio – economic profile of the districts in the project influence area including the estimation of AADT and travel characteristics in the Project Influence Area (PIA). Chapter 3 contains the details on the derivation of traffic growth rates used for traffic forecasting and presents traffic projections for the study period. Chapter 4 presents the details regarding tolling strategy, toll rates and the revenue projections for the duration of the concession.

2. TRAFFIC SURVEY AND ANALYSIS

2.1 General

In order to understand the traffic characteristics, the volume of traffic and travel pattern of vehicles plying on the project road were collected through primary surveys. This chapter presents the details of the project road characteristics, traffic surveys carried out, their analysis and the salient findings. The results of the analysis will be utilized in assessing the traffic growth and estimation of traffic and revenue forecast on the project road for the concession period.

2.2 Project Road Characteristics

The project road section, Kothakota – Kurnool, a part of the NH-44 in the states of Telangana and Andhra Pradesh, starts at km 135.469 near Kothakota and ends at km 211.061 at Kurnool with a length of about 74.6 km. The project road falls under the jurisdiction of Wanaparthy, Jogulamba Gadwal and Kurnool districts passing through settlements of Pebbair and Beechupalli. There is one operational toll plaza on the project road near Pullur (km 200.95) as part of the concession. There are 10 tolling lanes (5 in each direction) at the toll plaza location.

The alignment of project road and toll plaza location is shown in **Figure 2-1**.

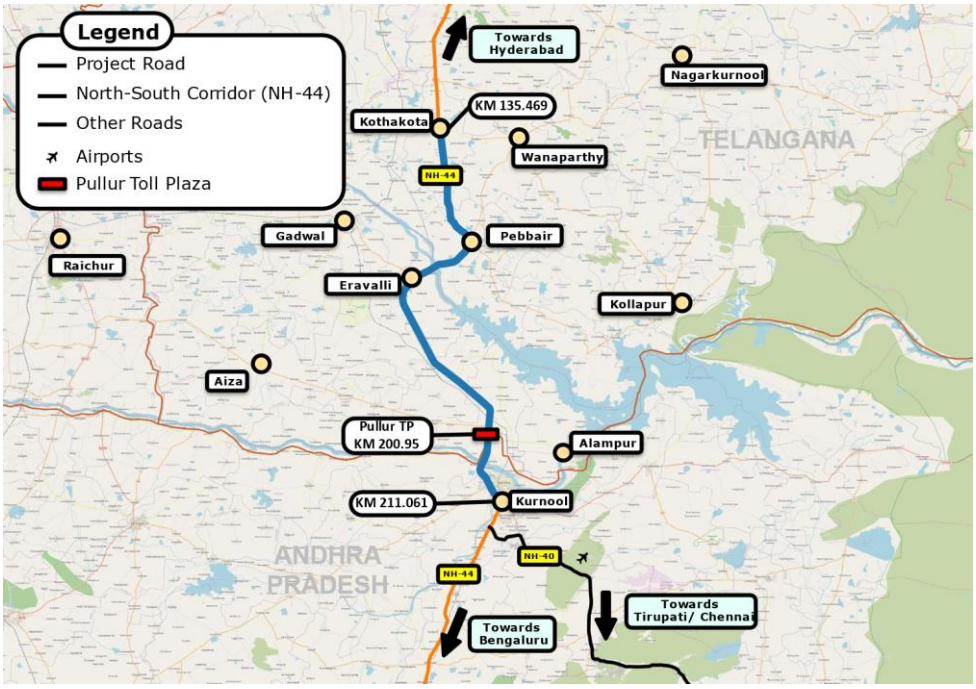


Figure 2-1: Project Road and Location of Toll Plaza

The project road, in wider context, serves for long distance traffic, which is majorly plying between Hyderabad/ Nagpur/ northern region and Bengaluru/ Chennai/ southern region. Apart from long distance traffic, it also serves the short distance traffic which is mainly generated between Mahbubnagar/ Kothakota/ Wanaparthy/ Pebbair/ Gadwal located on the north of toll plaza and Kurnool/ Anantapur/ Nandyal areas located on the south of toll plaza.

2.2.1 Profile of Project Influence Area Districts

The project road section passes through the districts of Wanaparthy and Jogulamba Gadwal in the state of Telangana and Kurnool in the state of Andhra Pradesh. A brief description of the profile of these districts is presented below.

Wanaparthy District

Wanaparthy district is situated in south-western part of Telangana state, sharing border with Mahabubnagar district in north, Jogulamba Gadwal district in south, Nagarkurnool district in east and Narayanpet district in west. As per 2011 census, 0.57 million people reside in the district over an area of 2,152 sq. km.

Agriculture is the main livelihood of the people in Wanaparthy district with 75% total workers engaged in agro-based labour. Red sandy soil and sandy loam soil covers 89% of the area. Paddy, groundnut, jowar, maize, red gram, castor, cotton and chili are the major crops cultivated within the district. Sri Ranganayaka Temple, Ghanpur Fort, Pangal Fort, Wanaparthy Palace, Saralasagar Project are few tourist attractions present in the district.

Jogulamba Gadwal District

Jogulamba Gadwal district is situated in south-western part of Telangana state, sharing boundaries with Wanaparthy district in north, Narayanpet district in north-west, the states of Andhra Pradesh and Karnataka in south and west respectively. The district is spread across an area of 2,575.5 sq.km and has a population of 0.61 million as per Census of India 2011.

Gadwal is renowned all over the world for its exclusive handloom zari sarees and other useful fabrics and materials. The historic town in the state of Telangana is well-known for its quality fabrics. Jurala dam, located near Gadwal town offers a pleasant sight and has become a popular tourist attraction, attracting people from all over. Alampur, situated on the bank of the holy river of Tungabhadra has a historically significant temple.

Kurnool District

Kurnool district is situated in Western part of Andhra Pradesh. It is surrounded by Nagarkurnool, Wanaparthy districts of Telangana state in north, Kadapa and Anantapur districts in south, the Bellary district of Karnataka state in west and Prakasam district in the east. As per 2011 census, 4.05 million people reside in the district over an area of 17,658 sq. km.

Almost half of the geographical area is under agriculture use. Paddy, cotton, tomato and onion are the major crops grown in the district. Mining/quarrying is the prevailing industry in the district. District has deposits of limestone, iron ore, barites and shale within its geographical area with an annual exploitation of 32.15 lakh metric tons. Belum caves, Mahanandi, Manthralayam, Srisailam and Rollapadu sanctuary are the main tourist attractions in the district.

2.3 Traffic Surveys

In order to understand the characteristics and the volume of traffic using the project road, data on road network, traffic and travel pattern of vehicles plying on the project road were collected through primary traffic surveys. Traffic volume video graphic survey for seven days and origin-destination (OD) survey as roadside interview for one day at toll plaza location was conducted on the project road. The schedule of the traffic surveys and location on the project road are given in **Table 2-1**.

Location	Chainage	Duration	Date(s)
Classified Traffic Volume Counts			
TP01-Pullur	km 200.95	7 Days	1st March 2023 – 7th March 2023
Origin and Destination Survey			
TP01- Pullur	km 200.95	1 Day	6th March 2023

Table 2-1: Traffic Survey Locations and Schedule

Trained enumerators were engaged for conducting traffic surveys under the supervision of experienced transport planner. The vehicle classification as generally used in the traffic surveys of NHAI studies along with their PCU values, as suggested in IRC: 64 – 1990, are presented in **Table 2-2**.

Vehicle Type	PCU Factor
Motorized Vehicles	
Car, Jeep, Van &Taxi	1.0
Two –Wheeler	0.5
Three-Wheeler (Auto-Rickshaw)	1.0
Mini-Bus/ School Bus	1.5
Govt. Bus/ Private Bus	3.0
Mini LCV/Max Pick Up	1.0
Light Commercial Vehicle (LCV)	1.5
2-Axle Truck	3.0
3-Axle Truck	3.0
Multi-Axle Vehicle (MAV 4-6 Axle)	4.5
HME	4.5
Agricultural Tractor	1.5
Agricultural Tractor with Trailer	4.5
Non – Motorised Vehicles	
Cycle	0.5
Cycle Rickshaw	2.0
Animal Drawn Cart	6.0

Table 2-2: Vehicle classification and PCU factors

2.4 Traffic Characteristics

The data collected from the traffic volume count survey was analysed in order to get the results with respect to existing traffic intensity, flow pattern, hourly variation and composition of traffic on the study road network. The various traffic characteristics have been analysed under the following heads:

- Average Daily Traffic (ADT)

- Daily variation, Hourly variation and Traffic composition
- Annual Average Daily Traffic (AADT)

2.4.1 Average Daily Traffic (ADT)

The traffic volume data collected at the toll plaza location during the seven days survey has been analysed. The summary of ADT in terms of vehicles and PCUs is presented in **Table 2-3**.

Mode	TP01-Pullur Toll Plaza
Tollable vehicles	
Car/Jeep/Van/Taxi	8,486
Mini Bus	97
Standard Bus	1,272
Mini LCV	1,362
LCV	2,386
2 Axle	1,045
3 Axle	1,201
MAV(4-6 Axle)	2,879
HMV/ MAV(=>7 Axle)	6
Non Tollable vehicles	
Two Wheeler	9,941
Auto Rickshaw	2,274
Agri. Tractors	132
Total Non Motorised	13
Total Vehicles/PCUs	
Total Tollable Vehicles	**18,733**
Total Non Tollable Vehicles	**12,361**
Total Vehicles	**31,094**
Total PCU	**44,940**
Tollable PCU	**37,109**

Table 2-3: Average Daily Traffic at Pullur Toll Plaza

- Total vehicles of about 31,094 were observed on an average crossing Pullur Toll Plaza across the seven days.
- The share of passenger and freight vehicles in total traffic is 71.0 percent (22,084 vehicles) and 29.0 percent (9,011 vehicles), respectively.
- Considering the passenger vehicle categories, car traffic has a share of around 27.0 percent (8,486 vehicles) while buses have a share of around 4 percent (1,272 vehicles) of total traffic.
- In freight traffic, MAV traffic has a share of about 9.0 percent (2,879 vehicles), 3A trucks have a share of about 4 percent (1,201 vehicles) and 2A trucks account for 3.0 percent (1,045 vehicles) of total traffic.

2.4.2 Daily Variation, Hourly Variation and Traffic Composition

The day wise variation, hourly variation and the traffic composition at the toll plaza location is presented in **Figure 2-2**.

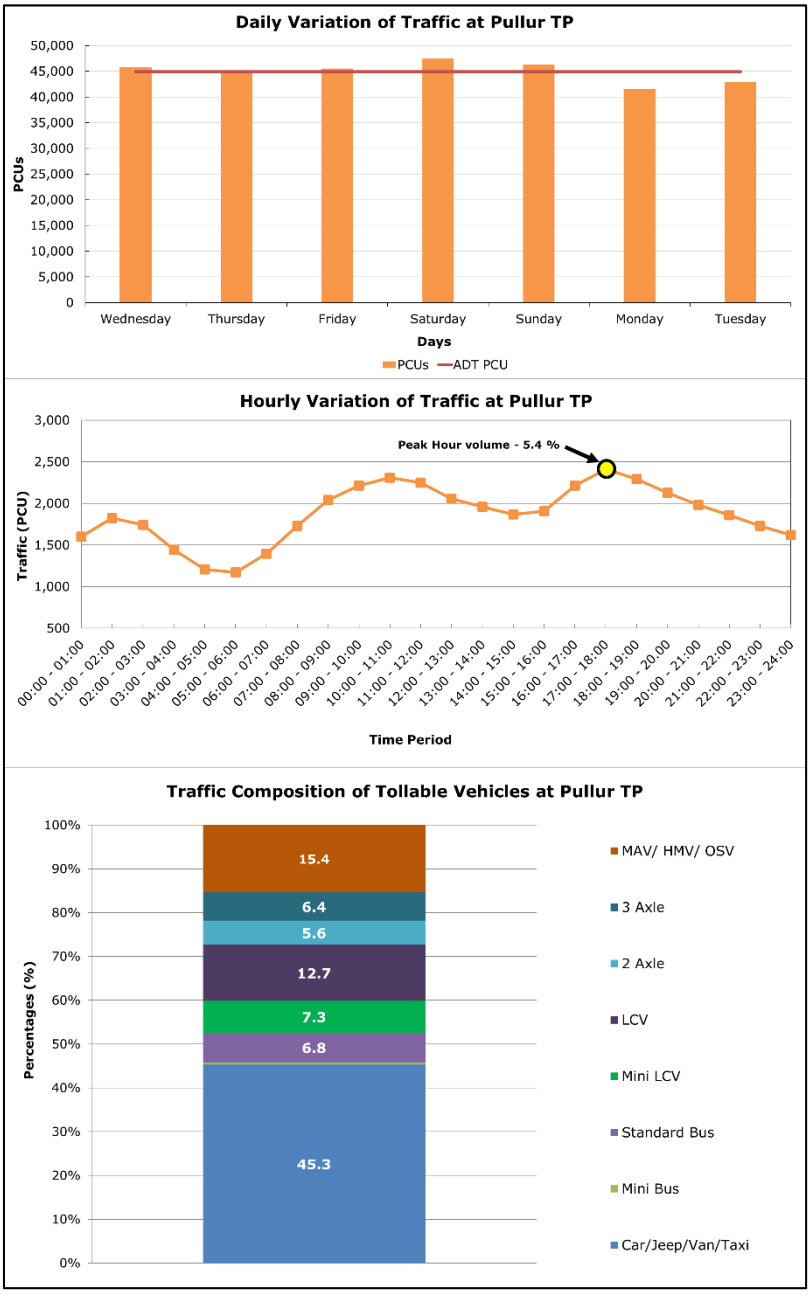


Figure 2-2: Daily Variation, Hourly Variation and Traffic Composition

- It was observed that the traffic at the toll plaza is found to be consistent during weekdays and slightly higher traffic during weekends.
- The directional distribution at the toll plaza location is almost equal with Kothakota - Kurnool having a directional share of 50.8 percent.

2.4.3 Comparison of Toll Data with TVC

The TVC survey was conducted from 1st March 2023 to 7th March 2023. A comparison between TVC and Toll Data for the days of the survey is presented in **Table 2-4**.

Day/Date	CJV	LCV	2-Axle	3-Axle	MAV/ OSV	LCV/ 2A	Total	PCUs
TVC								
Wednesday, March 1, 2023	9,284	2,827	2,342	1,310	3,015	5,169	18,778	38,048
Thursday, March 2, 2023	9,167	2,727	2,323	1,206	2,992	5,050	18,415	37,309

Day/Date	CJV	LCV	2-Axle	3-Axle	MAV/ OSV	LCV/ 2A	Total	PCUs
Friday, March 3, 2023	9,301	2,609	2,471	1,232	2,970	5,080	18,583	37,689
Saturday, March 4, 2023	11,554	2,521	2,417	1,165	2,915	4,938	20,572	39,199
Sunday, March 5, 2023	11,018	2,565	2,401	1,354	2,924	4,966	20,262	39,289
Monday, March 6, 2023	9,626	1,797	2,138	1,086	2,511	3,935	17,158	33,293
Tuesday, March 7, 2023	8,984	2,329	2,130	1,053	2,869	4,459	17,365	34,937
Average	9,848	2,482	2,317	1,201	2,885	4,800	18,733	37,109
Toll Data								
Wednesday, March 1, 2023	9,809	1,780	3,142	1,462	3,242	4,922	19,435	40,880
Thursday, March 2, 2023	9,702	1,625	3,039	1,397	3,148	4,664	18,911	39,614
Friday, March 3, 2023	9,893	1,626	3,165	1,449	3,085	4,791	19,218	40,057
Saturday, March 4, 2023	12,176	1,588	3,068	1,404	2,986	4,656	21,222	41,411
Sunday, March 5, 2023	11,712	1,585	3,151	1,528	3,073	4,736	21,049	41,955
Monday, March 6, 2023	10,032	1,041	2,617	1,218	2,626	3,658	17,534	34,916
Tuesday, March 7, 2023	9,291	1,415	2,744	1,275	2,977	4,159	17,702	36,867
Average	10,374	1,523	2,989	1,390	3,020	4,512	19,296	39,386
Toll Data MINUS TVC								
Wednesday, March 1, 2023	525	-1,047	800	152	227	-247	657	2,832
Thursday, March 2, 2023	535	-1,102	716	191	156	-386	496	2,305
Friday, March 3, 2023	592	-983	694	217	115	-289	635	2,368
Saturday, March 4, 2023	622	-933	651	239	71	-282	650	2,212
Sunday, March 5, 2023	694	-980	750	174	149	-230	787	2,667
Monday, March 6, 2023	406	-756	479	132	115	-277	376	1,623
Tuesday, March 7, 2023	307	-914	614	222	108	-300	337	1,930
Average	526	-959	672	190	134	-287	563	2,277

Table 2-4: Comparison Between TVC and Toll Data

The main observations from the comparison are:

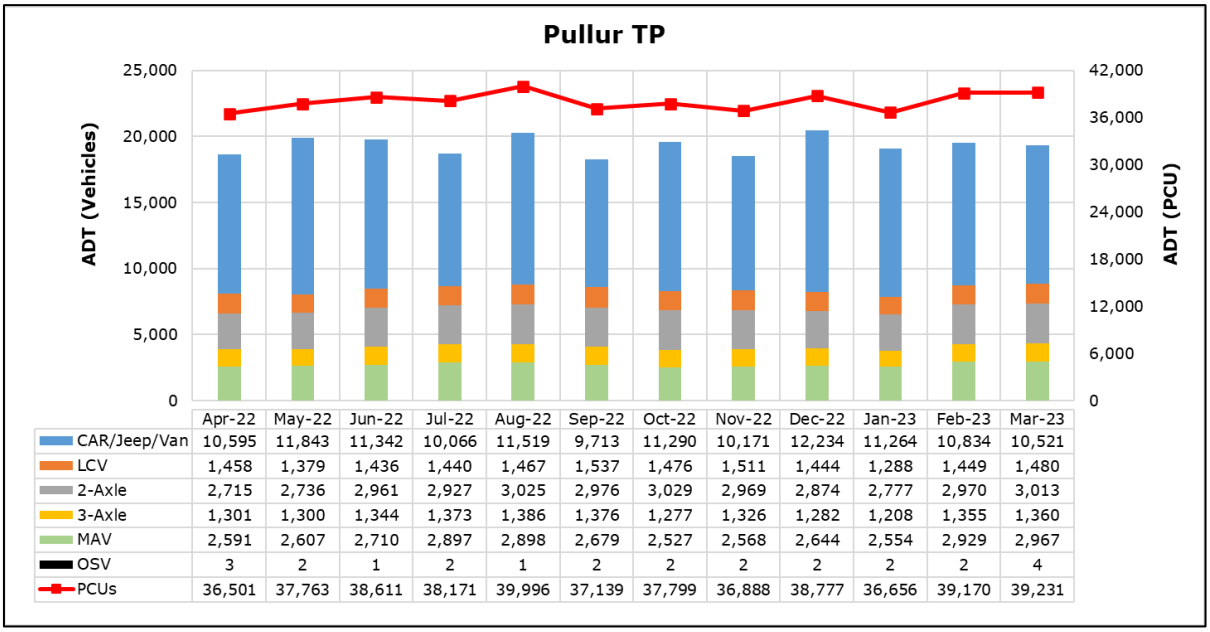
- Toll data is higher in car, 2 and 3-Axle trucks and MAVs while TVC is higher in LCV category.
- The variation in total traffic is about 2-4 percent on an average per day. The toll data includes duplication error in reported exemptions leading to reported vehicles being higher than actual traffic on road. Considering this, the variation is minimal between TVC and toll data.

2.4.4 Annual Average Daily Traffic (AADT)

The traffic plying on any road generally varies over different periods of the year depending on the cycle of different socio-economic activities in the regions through which it passes. Therefore, in order to have a more realistic picture of the traffic on the project road, it is required to assess its seasonal variation to estimate the annual average daily traffic (AADT).

The past toll traffic data for the toll plaza was made available by the client from January 2021 to March 2023 is presented in **Appendix 2.1**.

For the period from April 2022 to July 2022, the corresponding monthly data for reusage of local pass and exemptions for cars were not recorded. Therefore, the respective category average between August 2022 to March 2023 has been considered to be applicable for the months of April 2022 to July 2022 to arrive at the monthly ADT for these months. The month-on-month mode-wise traffic for the period from April 2022 to March 2023 is presented in **Figure 2-3**.



	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23
CAR/Jeep/Van	10,595	11,843	11,342	10,066	11,519	9,713	11,290	10,171	12,234	11,264	10,834	10,521
LCV	1,458	1,379	1,436	1,440	1,467	1,537	1,476	1,511	1,444	1,288	1,449	1,480
2-Axle	2,715	2,736	2,961	2,927	3,025	2,976	3,029	2,969	2,874	2,777	2,970	3,013
3-Axle	1,301	1,300	1,344	1,373	1,386	1,376	1,277	1,326	1,282	1,208	1,355	1,360
MAV	2,591	2,607	2,710	2,897	2,898	2,679	2,527	2,568	2,644	2,554	2,929	2,967
OSV	3	2	1	2	1	2	2	2	2	2	2	4
PCUs	36,501	37,763	38,611	38,171	39,996	37,139	37,799	36,888	38,777	36,656	39,170	39,231

Figure 2-3: Month-on-Month Traffic Data for TP01-Pullur Toll Plaza

It has been learnt that due to old tolling system/ETC reading issues at the Pullur toll plaza, some duplicate entries are created in exemptions/violations for smooth flow of traffic. This duplication error results in reported exemptions traffic being higher than the actual exemptions traffic plying on road. The details of actual exemptions and violations and the duplication entries for the months of January 2023 and February 2023 has been provided by the client which has been used to estimate the actual exemptions/violations for the other months throughout the year.

Therefore, the average duplication error has been deducted from the 12-month average traffic of April 2022 to March 2023 for the estimation of AADT for FY23 which is presented in **Table 2-5**.

Particulars	Car/ Jeep/ Van	LCV	2-Axle	3-Axle	MAV	OSV	PCUs
12-month ADT (Apr 2022 – Mar 2023)	10,949	1,447	2,914	1,324	2,714	2	38,059
Average Duplication Error	313	37	65	28	63	0	933
AADT for FY23	10,636	1,410	2,849	1,296	2,651	2	37,125

Table 2-5: AADT for FY23

2.5 Travel Characteristics

2.5.1 Survey Methodology

In order to understand the travel demand pattern in the region and tollable traffic streams, origin and destination (OD) surveys were carried out at the toll plaza locations. The OD survey was carried out for 24 hours, by roadside interview method as described in IRC: 102-1988. Both passenger and commercial vehicles plying on the project road were stopped on a random sampling basis and interviewed.

The travel characteristics obtained by OD survey facilitate the identification of:

1. Local and through traffic on the project road.
2. Potential divertible traffic to/from project road to various alternative routes.

Trained enumerators under the supervision of transport planners collected the trip characteristics using survey forms designed for this purpose. The OD survey elicited characteristics like origin, destination, frequency, purpose of trip for passenger vehicles and commodity being transported for goods vehicles. The information pertaining to origin and destination of trips collected during roadside interviews was analysed to obtain the trip distribution based on a zoning system suitably designed for the present study.

2.5.2 Traffic Zoning System

To understand the spatial dimensions of the trip characteristics of the vehicles interviewed during the O-D survey, a detailed zoning system was developed giving due consideration to the following factors:

- The road network catering to the traffic on the project road and its generating points
- Important towns, villages, factories, and industrial centres around the project road area
- Administrative boundaries of districts and states.
- Configuration of the project road in the regional road network with respect to other roads

Two major types of areas were identified for analysis purpose: -

Immediate Influence Area (IIA): It includes the cities/towns/villages and districts along the project road and adjacent to it, which generate/attract trips to the project road. In this study, it consists of districts of Wanaparthy, Jogulamba Gadwal and Kurnool in the states of Telangana and Andhra Pradesh.

Broad Influence Area (BIA): It includes the remaining districts of Telangana, Andhra Pradesh and other neighbouring states such as Karnataka, Tamil Nadu, Kerala, Maharashtra, Odisha, Chhattisgarh and the remaining states of India.

Detailed zoning system is prepared for IIA, while more aggregate or broad zoning is developed for BIA. The zoning system adopted for data collection was based on 99 zones and is presented in **Appendix 2.2**.

2.5.3 Sample Size

The toll traffic data does not provide the individual traffic volume count of all categories of vehicles. The seven-day traffic volume video count at the existing toll plaza was analysed to get the individual volume count of all categories of vehicles along with the direction split.

The vehicles during the OD surveys were interviewed on a random sample basis. **Table 2-6** shows the AADT and the sample size (both in absolute numbers and in percentage terms) captured during the exercise.

Modes	Car	Mini-Bus	Bus	MLCV	LCV	2-Axle	3-Axle	MAV/ OSV
Sample	1,868	27	562	460	652	489	871	991
AADT	9,165	55	1,564	1,471	1,355	1,285	1,296	2,653
Percentage (%)	20.4	49.2	35.9	31.3	48.1	38.1	67.2	37.4

Table 2-6: Sample Size Collected in OD Survey at TP

Based on the sample size of different categories of vehicles interviewed during the OD survey, direction-wise expansion factors were calculated based on FY23 AADT. The OD matrices for all vehicle categories were generated and analysis was done in terms of regional distribution, travel pattern and commodity distribution.

2.5.4 Regional Distribution

Based on the OD matrices, the regional distribution of tollable vehicles at the toll plaza location has been calculated. **Table 2-7** gives the distribution indicating the attraction and generation zones for the traffic on the project road.

Region/Modes	Car	M Bus	Bus	MLCV	LCV	2A	3A	MAV
Telangana	46.9	50.0	48.4	47.9	42.4	34.7	32.7	30.4
Andhra Pradesh	43.6	42.4	45.3	42.3	32.3	24.3	23.3	22.3
Karnataka	6.2	5.9	5.4	7.3	12.6	14.5	14.3	14.7
Tamil Nadu	0.9	1.7	0.6	1.8	5.4	10.4	11.1	11.3
Maharashtra	0.6	0.0	0.1	0.6	3.3	5.0	4.0	5.3
Delhi	0.2	0.0	0.0	0.0	0.7	3.8	4.9	4.4
Kerala	0.1	0.0	0.1	0.0	1.1	1.5	2.5	2.6
Uttar Pradesh	0.4	0.0	0.0	0.1	0.4	1.5	1.4	2.0
Rest of India	1.0	0.0	0.1	0.1	1.8	4.4	5.8	7.0
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 2-7: Regional Distribution of Tollable Traffic (in %) On Project Road

The traffic on the project corridor is generated primarily from the states of Telangana, Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra, Delhi, Kerala and Uttar Pradesh

which has remained constant in comparison with the previous study. A brief description of the contribution of these states to passenger and freight traffic is presented below.

Passenger traffic:

- In case of passenger traffic, Telangana and Andhra Pradesh are the two major traffic contributors. Telangana contributes about 47-48 percent in cars and buses while Andhra Pradesh contributes about 44-45 percent in cars and buses.
- Karnataka contributes about 5-6 percent each in cars and buses while the states of Tamil Nadu and Maharashtra contribute upto 2 percent each in passenger traffic.

Freight Traffic

- The project road section is part of NH-44 which is the north-south corridor connecting Srinagar to Kanyakumari. This section has influence of traffic from multiple states. However, Telangana and Andhra Pradesh are the major freight traffic contributors followed by Karnataka and Tamil Nadu.
- Telangana contributes about 42-48 percent in MLCV & LCV and about 30-35 percent each in 2A & 3A trucks and MAVs.
- Andhra Pradesh contributes about 32-42 percent in MLCV & LCV and about 22-24 percent each in 2A & 3A trucks and MAVs.
- Karnataka contributes about 7-15 percent each across all the modes while Tamil Nadu contributes about 2-11 percent with higher shares in larger freight modes reflecting preference of larger modes for long-distance transport of goods.
- Maharashtra, Delhi, Kerala and Uttar Pradesh contribute upto 5 percent each across different modes.

The mode wise top 20 OD pairs are given in **Appendix 2.3**.

2.5.5 Travel Pattern

In order to assess the travel pattern of vehicles, the important streams of traffic plying on the project road are estimated. The list of the popular movements found at the toll plaza location is presented in **Table 2-8**.

Sr. No.	Traffic Streams	Car	Mini Bus	Bus	MLCV	LCV	2A	3A	MAV
1	Hyderabad/ Nizamabad/ Adilabad - Nandyal/ Kadapa/ Tirupati/ Chennai	11.5	15.1	13.5	6.5	12.8	12.8	14.0	10.1
2	Hyderabad/ Nizamabad/ Adilabad - Kurnool/ Anantapur/ Bangalore/ Tamil Nadu	43.1	48.7	48.2	40.4	47.0	38.8	35.9	31.1
3	Mahabubnagar/ Gadwal/ Rest of Telangana - Nandyal/ Kadapa/ Tirupati/ Chennai	6.3	6.7	2.7	4.7	5.3	4.7	3.9	5.6
4	Mahabubnagar/ Gadwal/ Rest of Telangana - Kurnool/ Anantapur/ Bangalore/ Tamil Nadu	34.8	29.4	35.3	46.7	22.8	15.1	14.2	16.4
5	Solapur/ Pune/ Mumbai/ Gujarat/ Rajasthan - Kurnool/ Nandyal/ Southern Andhra Pradesh/ Chennai	1.0	0.0	0.2	0.2	0.9	4.5	2.6	6.0

Sr. No.	Traffic Streams	Car	Mini Bus	Bus	MLCV	LCV	2A	3A	MAV
6	Solapur/ Pune/ Mumbai/ Gujarat/ Rajasthan - Bangalore/ Mysore/ Tamil Nadu	0.2	0.0	0.0	0.0	0.9	2.3	2.4	2.6
7	Nanded/ MP/ Delhi/ UP/ Northern India - Nandyal/ Kadapa/ Tirupati/ Chennai	0.9	0.0	0.2	0.2	2.0	5.7	6.6	5.5
8	Nanded/ MP/ Delhi/ UP/ Northern India - Kurnool/ Anantapur/ Bangalore/ Tamil Nadu	1.9	0.0	0.0	1.2	7.8	15.1	19.5	20.9
9	Odisha/ West Bengal/ Eastern India - Nandyal/ Kadapa/ Tirupati/ Chennai	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0
10	Odisha/ West Bengal/ Eastern India - Kurnool/ Anantapur/ Bangalore/ Tamil Nadu	0.2	0.0	0.0	0.0	0.5	0.9	0.7	1.9
Total		**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 2-8: Traffic Streams (%) at Pullur Toll Plaza

Passenger Traffic:

- Majority of the passenger traffic travels from/to Hyderabad/ Nizamabad/ Adilabad to/from Kurnool/ Anantapur/ Bangalore/ Tamil Nadu. About 43 percent (3,954 vehicles) cars and about 48 percent (754 vehicles) buses ply along this route (stream 2).
- Significant share of traffic was observed to flow between areas of Mahabubnagar/ Gadwal/ Rest of Telangana and Kurnool/ Anantapur/ Bangalore/ Tamil Nadu areas. About 35 percent (3,188 vehicles) cars and about 35 percent (552 vehicles) buses ply along this route (stream 4).
- Around 88 cars were found to travel between areas of Solapur/ Pune/ Mumbai/ Gujarat/ Rajasthan and areas of Kurnool/ Nandyal/ Southern Andhra Pradesh/ Chennai (stream 5). This stream of traffic is the potential for Surat – Chennai Expressway which has a greenfield alignment from Solapur (Akkalkot) to Kurnool.
- Cars travelling between Hyderabad & beyond (including Northern India) and Nandyal/ Kadapa/ Tirupati/ Chennai is the potential traffic for Hyderabad – Tirupati highway (streams 1 & 7). About 12 percent (1,136 vehicles) cars were found to travel along this route.
- Around 85 percent of the car trips are undertaken for work and business purpose which are destined towards bigger towns and cities. About 4 percent of the trips are social trips and about 5 percent are religious trips to Alampur, Gadwal, etc.

Freight Traffic:

- Highest share of freight traffic travels from/to Hyderabad/ Nizamabad/ Adilabad to/from Kurnool/ Anantapur/ Bangalore/ Tamil Nadu. About 31-47 percent of all freight plies along this route which accounts for about 600-650 MLCV and LCVs, 450-500 2A and 3A trucks and about 800 MAVs (stream 2). Hyderabad and Bangalore are the two capitals of the states of Telangana and Karnataka, and high interaction was

observed with vehicles carrying commodities such as electronics, parcels, automobile and parts, manufactured items, etc.

- Long distance movement is preferred over larger vehicles which is evident from the traffic movement between Nanded/ MP/ Delhi/ UP/ Northern India and Kurnool/ Anantapur/ Bangalore/ Tamil Nadu. About 15 percent (193 vehicles) of 2A trucks and about 20-21 percent of 3A trucks and MAVs accounting for about 253 and 555, respectively, ply along this route (stream 8).
- The traffic movement between Solapur/ Pune/ Mumbai/ Gujarat/ Rajasthan and Kurnool/ Nandyal/ Southern Andhra Pradesh/ Chennai is the potential traffic for Surat – Chennai Expressway between Akkalkot and Kurnool (stream 5). Primarily larger freight vehicles ply along this route which include about 3-4 percent of 2A and 3A trucks (accounting for 58 2A trucks and 34 3A trucks) and about 6 percent of MAVs (accounting for 158 MAVs).
- Freight traffic travelling between Hyderabad & beyond (including Northern India) and Nandyal/ Kadapa/ Tirupati/ Chennai is the potential traffic for Hyderabad – Tirupati highway (streams 1 & 7). This accounts for about 15-21 percent of all freight except MLCV which accounts for about 201 LCVs, 238 2A trucks, 268 3A trucks and 412 MAVs.

2.5.6 Commodity Distribution

Analysis was also carried out to understand the different commercial vehicles being used to transport different commodities. **Table 2-9** presents the commodity-wise share of the total commercial traffic at the toll plaza on the project road.

Commodity Type	MLCV	LCV	2 Axle	3 Axle	MAV
Food Grains & Cash Crops	11.1	9.4	8.4	9.2	14.1
Fruits & Vegetables	14.8	16.0	11.9	11.8	12.1
Building Materials & Cement	3.9	4.0	7.0	9.5	13.5
Iron & Steel Products	2.0	5.7	4.9	5.6	7.3
Petroleum Products, Chemicals & Gas	0.7	3.8	6.7	6.3	5.9
Heavy Machinery	0.7	1.1	1.0	1.1	1.8
Industrial Products & Equipment	7.4	9.4	7.8	8.4	7.2
Consumer Items	8.7	8.9	7.4	7.2	5.5
Automobile & Spares	0.9	2.9	5.7	4.8	5.9
Containers	0.0	0.0	0.4	0.1	0.5
Ores & Minerals (Coal, Bauxite, Limestone)	0.2	0.0	0.6	1.6	1.0
Miscellaneous Items (Medicines, Livestock, Forest Products, Fertilizers, Milk, etc.)	9.8	7.4	9.4	7.2	6.6
Parcels	6.5	9.5	14.5	11.8	6.8
Empty Vehicles	33.5	22.1	14.3	15.2	11.9
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 2-9: Commodity Distribution on Project Road

- Major commodities being transported are food grains & cash crops, fruits and vegetables, parcels, building materials, consumer items and industrial products.

- About 12-16 percent of all modes carry fruits and vegetables. Major traffic generators on the north of toll plaza are Hyderabad, Nagpur, etc. while major traffic generators on the south of toll plaza are Kurnool district, Anantapur, Chittoor, etc. Similarly, about 8-14 percent of all modes carry food grains and cash crops.
- About 7-15 percent of all modes carry parcels across the toll plaza. Major traffic movement is between Hyderabad and Kurnool/Bengaluru. The parcel carrying vehicles are primarily 2A or 3A trucks.
- Industrial products to the tune of about 7-9 percent and consumer items to the tune of about 6-9 percent are being carried across all modes. Industrial products are generated from areas around Bangalore, Hosur, south Tamil Nadu as well as Chennai on the south of toll plaza and Hyderabad, Nagpur, etc., on the north of toll plaza.
- About 10 percent of 3A trucks and 14 percent of MAVs carry building materials and cement. Notably, large number of cement plants as well as stone crushing units are present around Banaganapally, Tadipatri areas in Kurnool, Nandyal and Anantapur districts.
- About 5-6 percent of 2A and 3A trucks and MAVs carry automobile and spares. These are generated from areas around Bangalore, Hosur, Coimbatore, Chennai, etc. on the south of plaza and areas around Hyderabad, Pune, Delhi and surroundings, etc.

3. BASE TRAFFIC ASSESSMENT AND PROJECTIONS

3.1 General

The project road is a part of the NHAI InvIT portfolio, and the projections of traffic and revenue have been presented till FY52. The estimation of the traffic using the tolled highway and its future growth are important elements to assess the project's economics as these are generally the main/sole source of revenue for the project This chapter details various aspects of the current traffic of the project road and its growth potential as assessed by Ramboll.

3.2 Project Road Traffic

The traffic that is likely to use the project road was estimated on the basis of the traffic and travel characteristics gathered as part of the study. The traffic on the project road would normally consist of the following components:

- Normal Traffic
- Diverted Traffic
- Induced/Developmental Traffic

3.2.1 Normal Traffic

Normal traffic is the traffic which is already plying on the project road as assessed in section 2.4.4.

3.2.2 Diverted Traffic

Diverted traffic is generally dictated by the presence of an alternative route at a lower generalised cost, which is in-turn defined by the road configuration and its condition, the type of vehicle and its operating costs, the average riding speed, the route distance and any tolling that may apply on a specific route.

The assessment of any likely traffic addition to/diversion away from the Project Road (PR) has been done using the cost ratio analysis as described below:

- Assessment of the potential divertible traffic sensitive to network improvements based on the observed travel pattern
- Calculation of road user cost of travelling on the project road and the alternative route. The road user cost includes vehicle operating cost (VOC), travel time cost (TTC) and toll cost (TC), if any. VOC comprises of the cost of fuel, spare parts, maintenance labour, tyre, engine oil, grease, fixed cost, depreciation and crew wages.
- The potential long- distance traffic for cars is negligible; therefore, analysis has not been done for passenger traffic. The diversion analysis has been done only for

larger axle trucks as these vehicles travel long lead and are potential to shift to alternate route.

The road user cost is estimated based on vehicle operating cost equations presented in IRC SP-30,2019 which is based on updation of Road User Cost Study (RUCS) carried out by Central Road Research Institute in 2019 for Ministry of Road Transport and Highways. Using the likely traffic stream speeds and lane configuration, the vehicle operating, and travel time costs are estimated for each of the routes. Road user cost on the identified routes is calculated and diversion percentages are estimated using diversion curve method mainly for trucks. In this method, traffic likely to be diverted from/to the project road, was estimated using Logit model, which computes expected diversion percentage based on the ratio of perceived cost on the existing and proposed facilities. The perceived cost is the financial vehicle operating cost and the time saving cost including toll charges (if any). According to the model, a vehicle will shift if the perceived cost on an alternative route is lower in comparison to existing route. The diversion equations for estimating diversion have been adopted from Indian National Expressway Network Report, MORTH (2009) as mentioned in IRC 108:2015. These equations are presented in **Table 3-1**.

Vehicle	Cost Ratio (CR) Interval	Equations
Truck	<= 0.750	% Div. = 100 - ((CR/0.75) * 5)
	0.750 <= CR <= 1.250	% Div. = 95 - ((CR-0.75)/0.5) * 90
	1.250 <= CR <= 2.0	% Div. = ((2-CR)/0.75) * 5

Source: IRC 108-2015

Table 3-1: Diversion Equations Used for Analysis

In the context of the project road of Kothakota – Kurnool section, there are two proposed alternative routes which can impact the traffic plying on the project road. These two alternative route sections are:

A. Surat-Chennai Economic Corridor

B. Hyderabad – Tirupati Highway

A. Impact of Surat – Chennai Economic Corridor

The Surat – Solapur (Akkalkot) – Chennai Economic Corridor is partly a brownfield and partly greenfield project which is to be developed under Bharatmala Pariyojana. Once operational, it will reduce the current Surat – Chennai distance by about 330 km. The 1,261 km long corridor will pass through some of the prominent towns/cities such as Nashik, Ahmednagar, Solapur, Kalaburagi, Kurnool, Kadapa and Tirupati. The entire corridor is segregated into two separate corridors. i.e., Surat – Solapur (Akkalkot) and Solapur (Akkalkot) – Chennai corridors. The Surat – Solapur (Akkalkot) corridor is proposed to be entirely greenfield in nature which will end at Akkalkot near Solapur while the Solapur – Chennai corridor will be a mix of greenfield and brownfield sections.

The 6-lane, 280 km long, greenfield Akkalkot – Kurnool section, a part of the Solapur – Chennai corridor, will provide an alternate route for the potential traffic between Solapur/

Pune/ Mumbai/ Western Maharashtra/ Gujarat and Kurnool/ Southern Andhra Pradesh/ Chennai. The alignment of the route choices for the potential stream of traffic via the project road as well as via the green field alignment of Akkalkot – Kurnool section of Surat – Chennai Economic Corridor are presented in **Figure 3-1**.

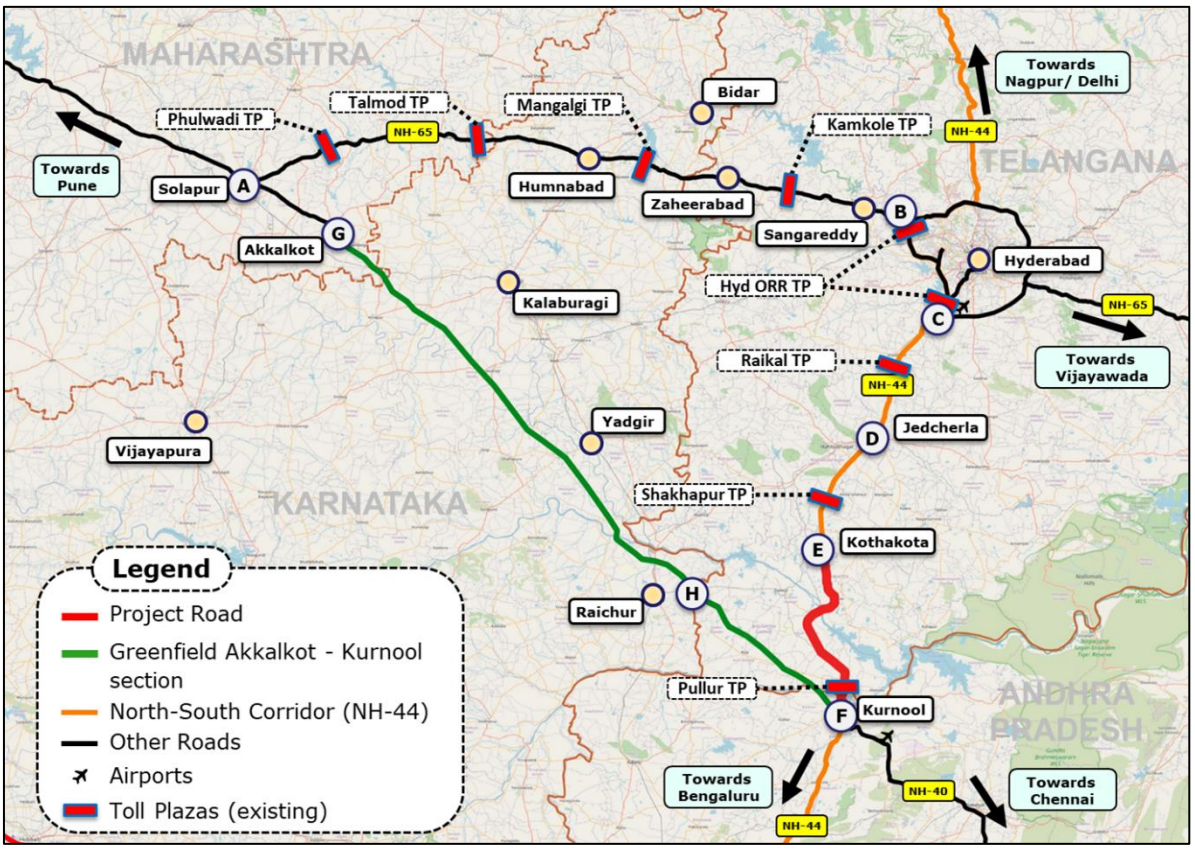


Figure 3-1: Alignment of Route Choices Between Solapur and Kurnool

The route choice via project road for this stream of traffic is via NH-65 & NH-44 sections passing through Humnabad, Zaheerabad, Sangareddy, Jadcherla and Kothakota (A-B-C-D-E-F) measuring about 500 km between Solapur and Kurnool. The route choice via greenfield alignment of Akkalkot – Kurnool section measures about 320 km between Solapur to Kurnool, indicating that alternate route will be about 180 km shorter. Construction works have commenced for the Akkalkot – Kurnool sections under different packages.

B. Impact of Hyderabad – Tirupati highway

To cut down the distance between Hyderabad and the temple town of Tirupati, a new bridge across river Krishna will be constructed at Somasila which will connect the section from Kalwakurthy to Nandyal which has been declared as a national highway, to be called as NH-167K. The highway will start from Kalwakurthy at the junction with NH-765 and will pass through the towns of Nagarkurnool, Kollapur, Somasila, Atmakur and end at Nandyal on NH-40. The entire length of the highway will be about 174 km.

At present, the section from Hyderabad ORR to Kalwakurthy (E-F) is of 2-Lane with paved shoulder and is being tolled at Kadthal toll plaza. As per the information available at the time of May 2022 study, the alternate route section between E to F was to be upgraded

to a 4 lane highway and Kalwakurthy to Nandyal section to a six-lane highway. However, as per information presently available in public domain, the stretch between E to F will remain two lane with paved shoulders and the section from Kalwakurthy to Nandyal (F-G-H-D) is planned to be a mix of greenfield sections and brownfield upgradations to 2-Lane with paved shoulder and a 4-lane double-decker bridge across river Krishna will be constructed to connect Telangana and Andhra Pradesh parts of the highway. The development of NH-167K will provide an alternate route for the traffic plying from Hyderabad & beyond to Nandyal/Kadapa/Tirupati/Chennai. The two route choice options are depicted in **Figure 3-2**.

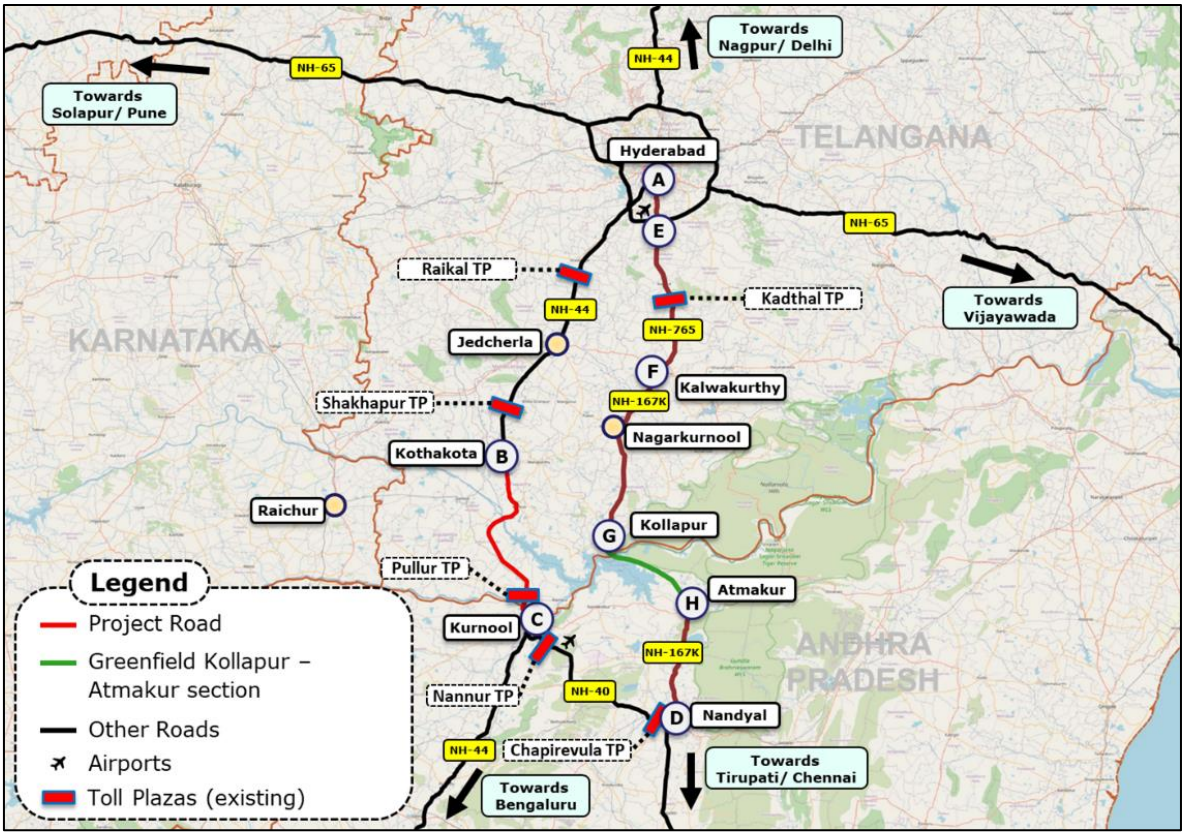


Figure 3-2: Alignment of Route Choices Between Hyderabad and Nandyal

Presently, traffic plies on NH-44 via project road (A-B-C-D). Post the completion of the alternate route (A-E-F-G-H-D), some of the traffic may shift to the alternate route as it is about 40 km shorter than the route via project road.

For the two different highway development projects of Surat – Chennai Economic Corridor and Hyderabad – Tirupati Highway, the potential divertible traffic for each case has been estimated from the OD survey carried out on the project road. The cost ratios and the diversion percentages have been estimated for the future scenario when both the alternate routes become operational. The diversion results are presented in **Table 3-2**.

Alternate Routes / Modes	Car	LCV	2A	3A	MAV
Surat – Chennai Economic Corridor					
Potential Traffic as % of AADT	0.9%	0.9%	4.5%	2.6%	6.0%
Cost Ratio (AR/PR)	0.61	0.66	0.61	0.60	0.61
Future AR Traffic Share	90.9%	95.6%	95.9%	96.0%	95.9%

Alternate Routes / Modes	Car	LCV	2A	3A	MAV
(or % Loss of PR Traffic)					
Divertible traffic as % of AADT	0.8%	0.8%	4.3%	2.5%	5.7%
Hyderabad – Tirupati Highway					
Potential Traffic as % of AADT	10.7%	14.2%	18.5%	20.7%	15.5%
Cost Ratio (AR/PR)	0.75	0.85	0.85	0.82	0.91
Future AR Traffic Share (or % Loss of PR Traffic)	78.5%	77.9%	77.6%	83.1%	66.7%
Divertible traffic as % of AADT	8.4%	11.1%	14.4%	17.2%	10.4%
Combined Impact					
Total Potential Traffic	11.5%	15.1%	23.0%	23.3%	21.5%
Total Divertible Traffic	9.2%	11.9%	18.7%	19.7%	16.1%

Table 3-2: Impact due to Alternate Routes for Project Road

The two proposed alternate routes are likely to result in net traffic diversion of about 9.2 percent in cars and 11.9 percent in LCVs and about 16-20 percent in rest of freight traffic. Presently, the two routes are in the initial stages of implementation and are likely to be completed by FY26.

To account for the gradual build-up of traffic on the alternate routes, the traffic shift is assumed to take place in phases with about 50 percent in FY27, 75 percent in FY28 and 100 percent from FY29 onwards.

3.2.3 Induced/ Development Traffic

Developmental/ new generated traffic is the one which would be generated, over and above normal growth, because of lowering of transport costs or new developments in the immediate influence area of the project road. In case of the project road, there is no development envisaged in the vicinity of the project road.

Bharatmala Pariyojana is the second largest highways construction project in the country since NHDP, under which almost 50,000 km or highway roads were targeted across the country. It will look to improve connectivity particularly on economic corridors, border areas and far-flung areas with an aim of quicker movement of cargo and boosting exports.

It will connect 550 district headquarters to minimum 4-lane highway by raising the number of corridors to 50 (from current 6) and move 80 percent freight traffic (currently 40 percent) to national highways by connecting 24 logistics parks and 7 north east multimodal waterway ports.

The Phase-I includes economic corridors of around 9,000 km; inter-corridor and feeder routes of around 6,000 km; 5,000 km roads under the National Corridors Efficiency Program, border and international connectivity roads of around 2,000 km; coastal and port connectivity roads of around 2,000 km; expressways of around 800 km and 10,000 km of NHDP roads. The total length in phase 1 comes to around 34,800 km.

In the context of the project influence area, there are a few economic corridors and inter corridors listed in the Telangana and Andhra Pradesh. The economic corridors planned in these states are Chennai-Kurnool, Solapur-Mahbubnagar and Pune-Vijayawada and is likely to improve connectivity with an aim to provide quicker movement of cargo.

As the project road caters to the long/ short distance traffic, it is likely to have a potential for growth in view of the developments of these economic corridors and feeder roads. This project section being a part of 4 laned tolled North-South corridor, will continue to remain an important highway for the North-South movement especially Hyderabad-Bangalore/Chennai and may see sustained growth in the future. The project road caters to the North-South traffic from Maharashtra which is around 4-5 percent in 3A and MAV trucks. The traffic generated from Gujarat and North Indian States is around 11 percent in 3A trucks and 12 percent in MAVs. The traffic on this highway is likely to grow at a faster pace to fulfill the industrial demands from/to Hyderabad/ North India to/from Bangalore/Chennai and other parts of South India.

3.3 Methodology for Traffic Growth Rate Estimation

Traffic growth for both passenger and freight vehicles has been estimated using the econometric approach as described in IRC-108, 2015. For freight traffic, due consideration has been given to the total tonnage transported and the shift in types of vehicles used for moving goods.

The econometric model applied, relates traffic growth to changes in state (or district) domestic product via an elasticity factor. According to IRC guidelines, elasticity based econometric model for highway projects should be derived in the following form:

$Log_e(P) = A0 + A1\ Log_e\ (EI)$, where:

P - Traffic Volume
EI - Economic Indicator
A0 - Regression Constant
A1 - Regression Co-efficient (Elasticity Index)

In order to estimate traffic on the project road, the methodology described below has been followed:

- Identify the influence area - From the analysis of OD survey data, the project influencing states and districts, which are likely to impact the traffic growth on the project road, were identified.
- Review Past traffic Data – Based on toll data available for the project, a review of past traffic and tonnage growth is carried out.
- Analysis of economic growth of the Project Influencing Area (PIA) - For each PIA state, an economic profile describing past performance and future outlook was prepared. This also considers India’s past economic performance and its future outlook.

- Estimation of traffic elasticity to income – in order to translate economic growth into traffic growth, an elasticity factor was estimated.
- Derivation of traffic growth rates – On the basis of the weighted (based on OD shares) PIA outlook and related traffic elasticity, traffic growth rates were estimated.

The methodology thus adopted incorporates, as basic data inputs, the perspective growth envisaged in the influence area and the changes in transport demand elasticities over a period of time. The traffic growth rates by vehicle type for the project road have been determined till FY52.

3.4 Identification of PIA States

The regional distribution shows that Telangana, Andhra Pradesh and Karnataka are the main contributors of traffic on the project road in case of passenger vehicles. In case of freight traffic, states of Tamil Nadu, Maharashtra, Delhi, Kerala and Uttar Pradesh also contribute to the project road traffic in addition to the states of Telangana, Andhra Pradesh and Karnataka.

The states of Telangana and Andhra Pradesh has been considered as PIA states for passenger vehicles and in addition to these primary PIA states, Karnataka, Tamil Nadu, Maharashtra, Delhi, Kerala and Uttar Pradesh have, also been considered as the PIA states for freight traffic. The mode wise normalized regional distribution shares are presented in **Figure 3-3**.

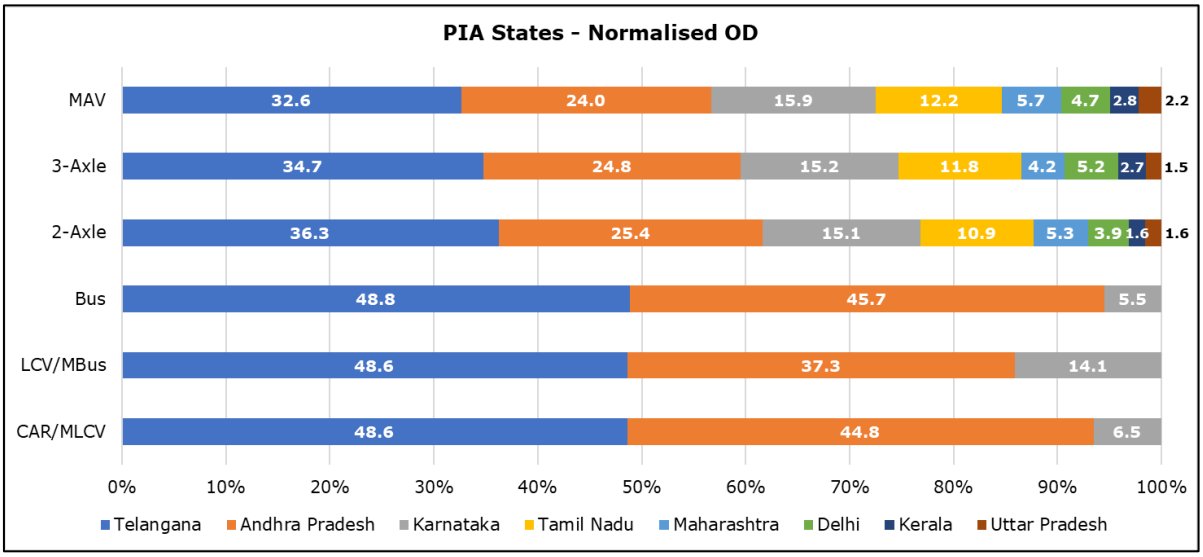


Figure 3-3: Normalised Regional Distribution (%) for the PR

Telangana accounts for the majority share of about 49 percent in Cars and Buses, while Andhra Pradesh and Karnataka contribute around 45-46 percent and 6-7 percent, respectively, to each passenger vehicular mode.

In case of freight vehicles, Telangana contributes the highest percentage, accounting for approximately 32-36 percent in each of the larger freight vehicles (2A/3A/MAV), on the project road. Andhra Pradesh follows closely behind with a share of around 24-25 percent

in these categories of trucks. Karnataka and Tamil Nadu contribute around 11-16 percent each, while Maharashtra and Delhi each contribute around 4-6 percent. Kerala and Uttar Pradesh contribute around 2-3 percent each in 2A, 3A and MAV trucks.

3.5 Past Economic Growth of PIA

Growth of traffic on the project road depends on existing development and future growth prospects of the connecting regions. A number of economic indicators for the PIA states, as published by Central Statistical Organisation (2011-12 prices), have been studied to assess their past performance.

- Telangana's Gross State Domestic Product (GSDP) stood at Rs 6,412.4 billion in 2019-20 and has been growing at a compounded annual growth rate of 8.2 percent since 2011-12. The GSDP estimates for the year FY22 is Rs 6,763 billion.
- Andhra Pradesh's Gross State Domestic Product (GSDP) is reported to be Rs 6,697.8 billion in 2019-20 with an annual growth rate of 8.2 percent since 2011-12. The GSDP estimates for the year FY22 is Rs 7,469.1 billion.
- The state of Telangana and Andhra Pradesh have shown economic growth between 5-12 percent each since 2013-14 up to 2019-20. Both the states have shown a double growth of about 11 percent each between FY21 and FY22, which could be due to low base in FY21.
- The tertiary sector is the largest contributor to GSDP of the primary PIA states, about 61.5 percent in Telangana and 42.2 percent in Andhra Pradesh. Secondary sector stood at 20.7 percent and 22.8 percent and agriculture and allied activities sector at 17.8 percent and 42.2 percent of the GSDP in 2021-22 for the states of Telangana and Andhra Pradesh respectively.

The change of sectoral composition of GSDP over the years is presented in **Figure 3-4**.

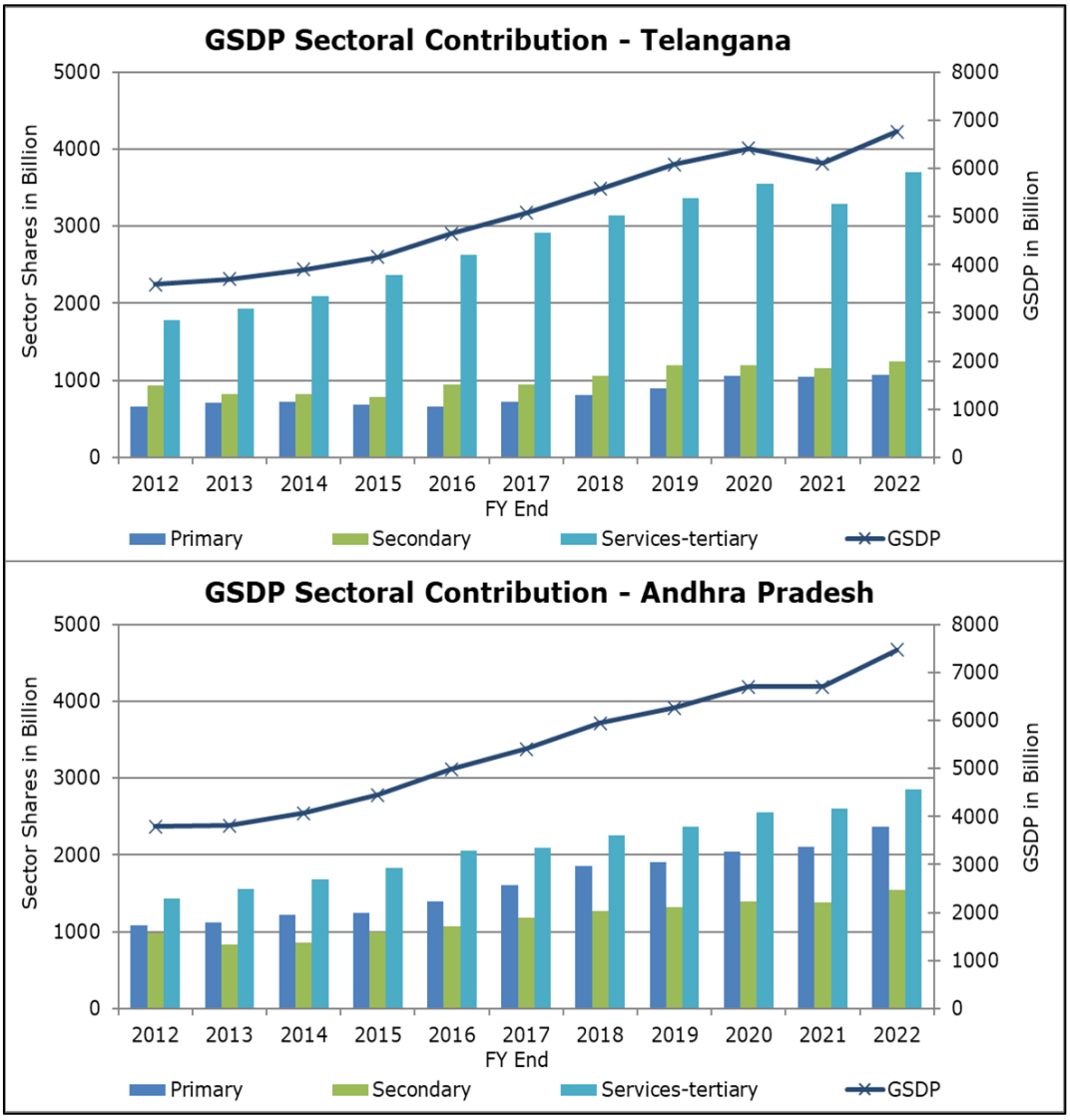


Figure 3-4: GSDP (in Rs billion) and Sectoral Composition for Primary PIA states

The performance of the primary PIA states economy and its different sectors has been studied using time trend analysis. The average annual growth rates as obtained using regression analysis are presented in **Table 3-3**.

Particulars	2011-12 to 2019-20		2014-15 to 2019-20	
	Telangana	Andhra Pradesh	Telangana	Andhra Pradesh
GSDP	8.2	8.2	9.1	8.4
Agriculture and Allied	4.8	9.1	9.5	10.7
Industry	4.9	6.5	8.7	7.2
Services	9.5	7.4	8.5	6.4
Construction	3.4	3.5	4.5	3.3
Per Capita Income	7.5	7.6	8.9	7.8

Table 3-3: Average Annual Growth Rates (%) of State Income for Primary PIA States

Telangana

Telangana is a predominant exporter of Drug Formulations, Biologicals, Residual Chemical and Allied Products and Bulk Drugs, etc.

Currently, the state has 35 operational Special Economic Zones (SEZs). Also, 64 more have been formally approved and 57 have been notified. These SEZs are dispersed over a manifold range of sectors including biotechnology, aerospace industry, electronics hardware, multi-product, gems and jewellery, IT SEZs, etc.

In FY21, the Telangana State Industrial Infrastructure Corporation (TSIIC) developed 10 new industrial parks and allotted 810 acres of land to 453 industries with an expected investment of Rs. 6,023 crore (US$ 822 million) and potential employment of 7,623 people.

According to by Department for Promotion of Industry and Internal Trade (DPIIT), the state has enticed the Foreign Direct Investment (FDI) equity inflows worth US$ 20.2 billion during the period April 2000 to March 2021.

In order to attract high investments and catalyze growth, the state is highlighting the need to facilitate port logistics and road infrastructure development. The state has anticipated to develop six industrial corridors. The state has also planned to monetize Nehru Outer Ring Road (NORR), which is a 158 km expressway encircling the capital city of Hyderabad.

The state houses 63 formally approved IT related SEZs and has emerged as an IT hub with 1500 IT companies in the state which provides employment to approximately 6.3 lakhs IT professionals. The key IT players in the state are Google, Qualcomm, Facebook, Amazon, Microsoft, etc.

The state is also the leading exporter of pharmaceuticals products in India and accounts for about 20 per cent of the country’s Pharmaceuticals related exports. The state supports many pharmaceutical units belonging to evident global and national players like Dr. Reddy, Aurobindo Pharma, Divis Laboratories and Granules India. Total Pharma related Exports from the state stood at US$ 4.66 billion in FY22.

Andhra Pradesh

Andhra Pradesh is a predominant exporter of drugs, pharmaceuticals and allied chemicals and plastics, agriculture and agro-based products, engineering products, mineral products, handicrafts and carpets, textiles, leather, animal and marine products.

Currently, the state has 24 operational Special Economic Zones (SEZs). Also, 32 more have been formally approved and 27 have been notified. These SEZs are dispersed over a manifold range of sectors including textiles & apparel, food processing, footwear & leather products, multi-product, pharma, IT SEZs, etc.

A National Investment and Manufacturing Zone (NIMZ) in Prakasam district is also under implementation with land acquisition in progress. In 2021, 7,107 Micro, Small and Medium enterprises (MSMEs) were established in Andhra Pradesh, with an investment of Rs. 2,099 crores, providing employment to 46,811 people.

The first coastal corridor, the Vishakhapatnam Chennai Industrial Corridor (VCIC), has already been in process. It is expected to connect four decisive hubs of the state: Vishakhapatnam, Kakinada, Kankipadu-Gannavaram and Yerpedu-Srikalahasti. Once completed, this project is expected to generate around 50,000 jobs and attract investments of worth US$ 16.7 billion.

The state of Andhra Pradesh has the second longest coastline of around 974 km in India. The state has 1 major port: Vishakapatnam, with about 14 other non-major ports.

In order to attract high investments and catalyze growth, the state is highlighting the need to facilitate port logistics and road infrastructure development. The JSW group invested for building a jetty at Ramayapatnam Port is under implementation. The group is also expected to expand their logistic footprint.

According to by Department for Promotion of Industry and Internal Trade (DPIIT), the state has enticed the Foreign Direct Investment (FDI) equity inflows worth US$ 19.20 billion during the period April 2000 to March 2020.

The state houses many pharma manufacturing units belonging to evident global and national players. Exports of pharmaceuticals from the state stood at US$ 1.79 billion in FY21.

The state has the major share in the export of seafood products from India in value terms. In FY22, Andhra Pradesh ranks first in terms of marine exports from India with a 38% contribution to the US$ 7.74 billion worth of total marine exports.

The per capita income of Telangana and Andhra Pradesh is Rs 1,78,841 and 1,42,947 in the year 2021-22 and has been growing at 6.6 and 6.9 percent respectively during 2011-12 to 2021-22. The growth in per capita income is presented in **Figure 3-5**.

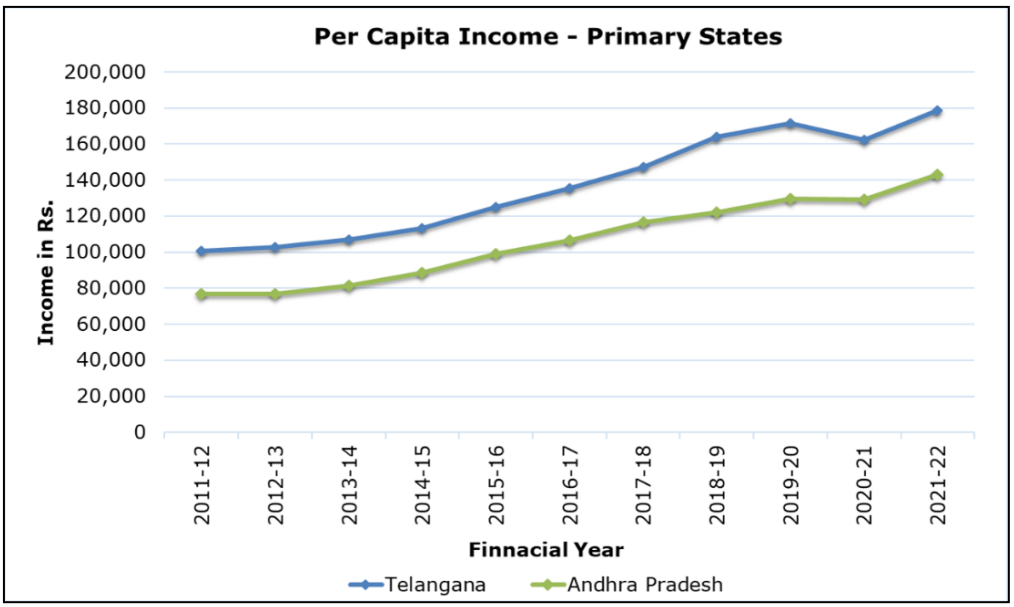


Figure 3-5: Per Capita Income of Primary PIA states from 2011-12 to 2021-22

Other PIA States

The other PIA states contributing to the traffic on the project road are Karnataka, Tamil Nadu, Maharashtra, Delhi, Kerala, and Uttar Pradesh.

- Karnataka's Gross State Domestic Product (GSDP) is Rs 11,498.3 billion in 2019-20 and has been growing at a compounded annual growth rate of 8.8 percent since 2011-12. The state has shown a growth of 9.5 percent in FY22 which is partially due to the low base in FY21.
- Gross State Domestic Product (GSDP) of Tamil Nadu stood at Rs 12,438.3 billion in 2019-20 and has been growing at a compounded annual growth rate of 6.9 per cent since 2011-12. The state has shown an 8 percent growth in FY22 which can be attributed to the low base in FY21.
- Maharashtra's Gross State Domestic Product (GSDP) stood at Rs 20,439.8 billion in 2019-20 and has been growing at a compounded annual growth rate of 6.3 percent since 2011-12. The state has shown a negative growth of 7.6 percent in FY21 due to the impact of COVID-19.
- Delhi's Gross State Domestic Product (GSDP) stood at Rs 5,873.2 billion in 2019-20 and has been growing at a compounded annual growth rate of 7.4 percent since 2011-12. The state has shown a 10.2 percent growth in FY22 which could be due to the low base in FY21.
- Gross State Domestic Product (GSDP) of Kerala stood at Rs 5,665.2 billion in 2019-20 and has been growing at a compounded annual growth rate of 6.0 per cent since 2011-12. The state has shown a 7.1 percent growth in FY22.
- Uttar Pradesh's Gross State Domestic Product (GSDP) stood at Rs 11,402.7 billion in 2019-20 and has been growing at a compounded annual growth rate of 6.3 percent since 2011-12. The growth in the recent year of FY22 is 4.2 percent.
- The services sector is the largest contributor to GSDP of the other PIA states. In FY20, Delhi has a service sector share of around 84.3 percent followed by around 65 percent share in each state of Karnataka and Kerala, and 57.6 percent share in the state of Maharashtra. Service sector has a share of about 50-51 percent in Tamil Nadu and Uttar Pradesh in state GSDP.

The average annual growth rates as obtained using regression analysis for the period FY12 to FY20 are presented in **Table 3-4**.

State/ Particulars	Karnataka	Tamil Nadu	Maharashtra	Delhi	Kerala	Uttar Pradesh
2011-12 to 2019-20						
GSDP	8.8	6.9	6.3	7.4	6.0	6.3
Primary	3.1	5.5	2.7	4.1	-2.0	3.9
Secondary	7.1	6.9	5.4	6.9	5.2	7.1

State/ Particulars	Karnataka	Tamil Nadu	Maharashtra	Delhi	Kerala	Uttar Pradesh
Tertiary	9.9	6.5	7.5	7.3	6.4	7.3
Construction	3.1	4.5	3.1	4.4	3.3	5.2
Per Capita Income	7.8	6.2	5.2	5.2	5.5	4.7

Table 3-4: Average Annual Growth Rates (%) of State Income for Other PIA States

The GSDP over the years for the PIA states of the project road are presented in **Figure 3-6**.

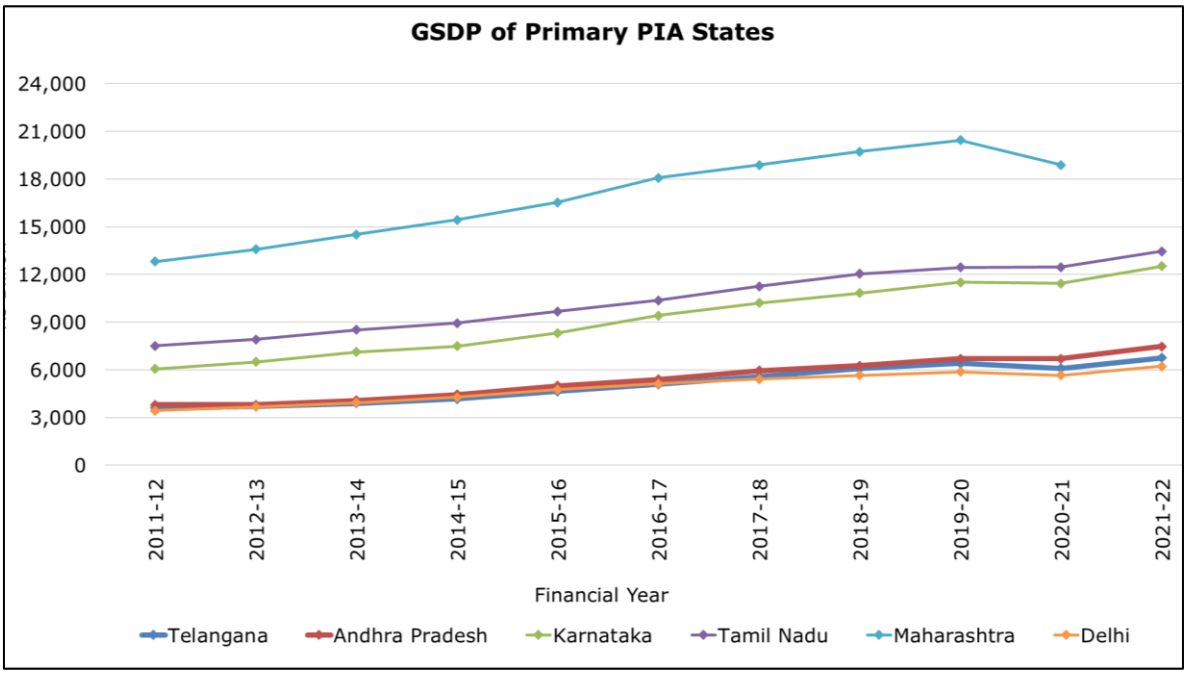


Figure 3-6: GSDP (in Rs billion) for PIA States

3.6 India and PIA Outlook

3.6.1 India's past performance and outlook for future

India's growth trend during the recent years has been presented in **Figure 3-7**.

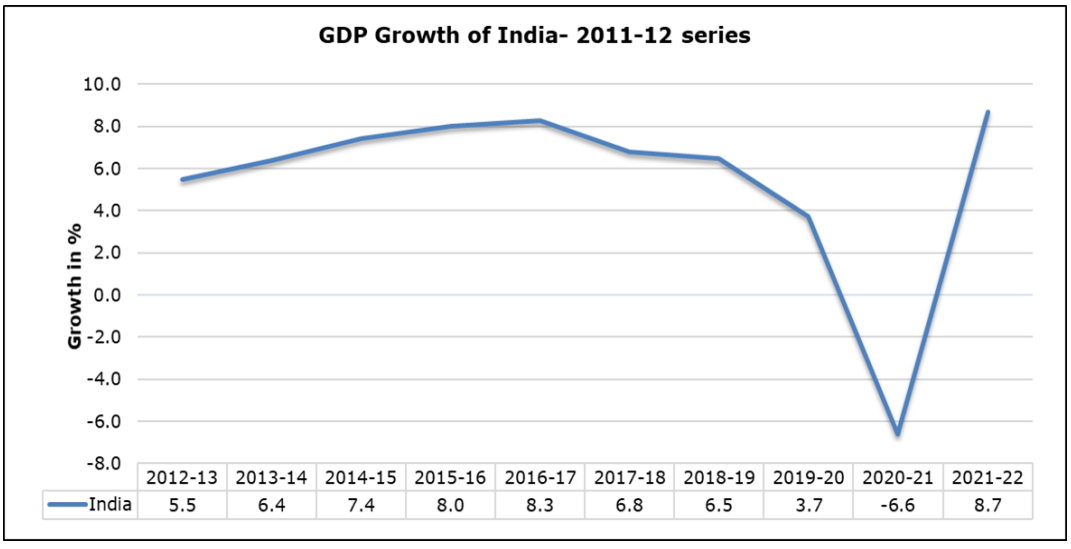


Figure 3-7: GDP Growth in India

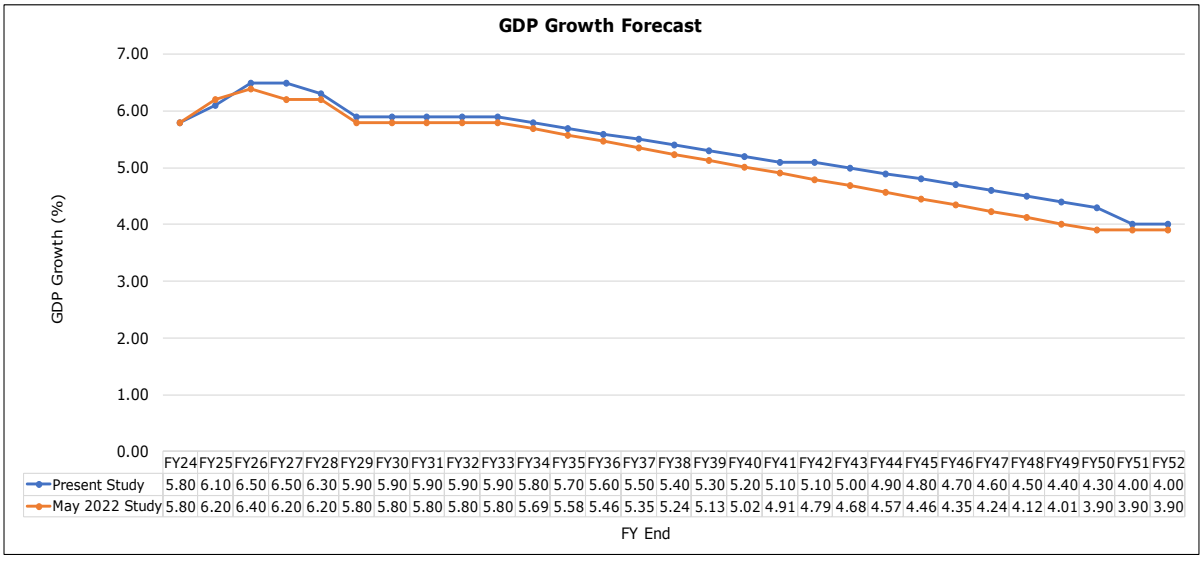
Economic growth in India has been broadly on an accelerating path till FY18. It is likely to be the fastest growing major economy in the world in the medium-term. The growth

in real GDP was 8.3 percent for FY17 and 6.8 percent in FY18, while the growth in FY19 was slightly lower at 6.5 percent. The long-term trend line growth of 7.2 percent has been achieved between FY12 to FY19. During FY20, growth has slowed down due to some structural issues and global headwinds resulting in an average GDP growth rate of 3.7 percent.

With the outbreak of COVID-19, global recession was witnessed across all the economies. The lockdown period announced by Indian government had an adverse impact on the economy. The first quarter estimated for FY21 has indicated a contraction of 23.9 percent, second quarter showed a rebound in growth by contracting 7.5 percent and third & fourth quarter grew by 0.5 percent and 1.6 percent respectively. The resultant contraction for FY21 has been 6.6 percent.

The Indian economy is likely to see the impact of global slowdown due to COVID-19 and hence, the GDP forecast for India by various international agencies has been revised for the next two years. As per the latest update by Central Statistical Organisation (CSO), GDP in FY22 has grown by 8.7 percent. As per Economic Survey of India for FY23, the economy is predicted to have a growth rate of 7.0 percent in FY23 and 6.0-6.8 percent in FY24. As per the latest forecast of RBI, the economy is likely to grow at 6.4 percent in FY24.

The year-on-year growth for Indian economy as provided by the client based on the forecast by Consensus Economics from FY24 and beyond in May 2022 study and present study are presented in **Figure 3-8**.



	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40	FY41	FY42	FY43	FY44	FY45	FY46	FY47	FY48	FY49	FY50	FY51	FY52
Present Study	5.80	6.10	6.50	6.50	6.30	5.90	5.90	5.90	5.90	5.90	5.80	5.70	5.60	5.50	5.40	5.30	5.20	5.10	5.10	5.00	4.90	4.80	4.70	4.60	4.50	4.40	4.30	4.00	4.00
May 2022 Study	5.80	6.20	6.40	6.20	6.20	5.80	5.80	5.80	5.80	5.80	5.69	5.58	5.46	5.35	5.24	5.13	5.02	4.91	4.79	4.68	4.57	4.46	4.35	4.24	4.12	4.01	3.90	3.90	3.90

Figure 3-8: GDP Forecast of India

3.6.2 PIA States Outlook

A snapshot of the main economic indicators in the past and the growth adopted for future for the PIA state is presented in **Table 3-5**.

Indicators/ States	Telangana	Andhra Pradesh	Karnataka	Tamil Nadu	Maharashtra	Delhi	Kerala	Uttar Pradesh
GSDP in Rs. Billion	6,412.4	6,697.8	11,498.3	12,438.4	20,439.8	5,873.2	5,665.2	11,402.8
GSDP growth (2011/12 to last year) in %	8.2	8.2	8.8	6.9	6.3	7.4	6.0	6.3
Per capita Income in Rs (FY20)	171,704	129,697	173,942	163,874	166,422	293,145	162,610	50,089
Sector share in %, FY20								
Agriculture and allied	18.1	34.1	10.6	11.8	13.9	2.8	8.8	22.8
Industry	20.6	23.2	24.2	36.5	28.5	12.9	25.9	26.9
Services	61.3	42.7	65.1	51.6	57.6	84.3	65.3	50.3

Table 3-5: Main Economic Indicators of PIA States

In order to arrive at the forecast of the PIA states, past performance of the State GDPs vis-a-vis India GDP has been studied and the multipliers have been derived for both short term and long term. The past and adopted multipliers for PIA states to Indian economy are presented in **Table 3-6**.

Period	India	Telangana	Andhra Pradesh	Karnataka	Tamil Nadu	Mahar ashtra	Delhi	Kerala	Uttar Pradesh
Past growth %									
2011-12 to 2019-20	6.9	8.2	8.2	8.8	6.9	6.3	7.4	6.0	6.3
2014-15 to 2019-20	6.8	9.1	8.4	9.0	7.1	5.8	6.3	6.4	6.4
Past Multipliers vis-a-vis India									
2011-12 to 2019-20		1.2	1.2	1.3	1.0	0.9	1.1	0.9	0.9
2014-15 to 2019-20		1.3	1.2	1.3	1.0	0.9	0.9	0.9	0.9
Multipliers adopted for future									
States w.r.t. India		1.2	1.2	1.2	1.0	1.0	1.1	0.9	0.9

Table 3-6: Past Multipliers and Future Outlook of PIA States

Based on the normalised OD shares of the toll plaza and the outlooks adopted for PIA states, the mode-wise future weighted income is presented in **Table 3-7**.

Period/Modes	Car/MLCV	LCV/M Bus	Bus	Truck	3A	MAV
2024	7.0	7.0	7.0	6.6	6.6	6.5
2025	7.3	7.3	7.3	6.9	6.9	6.9
2026	7.8	7.8	7.8	7.4	7.4	7.3
2027	7.8	7.8	7.8	7.4	7.4	7.3
2028	7.6	7.6	7.6	7.1	7.1	7.1
2029	7.1	7.1	7.1	6.7	6.7	6.6
2030	7.1	7.1	7.1	6.7	6.7	6.6
2031	7.1	7.1	7.1	6.7	6.7	6.6
2032	7.1	7.1	7.1	6.7	6.7	6.6
2033	7.1	7.1	7.1	6.7	6.7	6.6
2034	7.0	7.0	7.0	6.6	6.6	6.5
2035	6.8	6.8	6.8	6.5	6.4	6.4
2036	6.7	6.7	6.7	6.3	6.3	6.3
2037	6.6	6.6	6.6	6.2	6.2	6.2

Period/Modes	Car/MLCV	LCV/M Bus	Bus	Truck	3A	MAV
2038	6.5	6.5	6.5	6.1	6.1	6.1
2039	6.4	6.4	6.4	6.0	6.0	6.0
2040	6.2	6.2	6.2	5.9	5.9	5.8
2041	6.1	6.1	6.1	5.8	5.8	5.7
2042	6.1	6.1	6.1	5.8	5.8	5.7
2043	6.0	6.0	6.0	5.7	5.7	5.6
2044	5.9	5.9	5.9	5.5	5.5	5.5
2045	5.8	5.8	5.8	5.4	5.4	5.4
2046	5.6	5.6	5.6	5.3	5.3	5.3
2047	5.5	5.5	5.5	5.2	5.2	5.2
2048	5.4	5.4	5.4	5.1	5.1	5.1
2049	5.3	5.3	5.3	5.0	5.0	4.9
2050	5.2	5.2	5.2	4.9	4.9	4.8
2051	4.8	4.8	4.8	4.5	4.5	4.5
2052	4.8	4.8	4.8	4.5	4.5	4.5

Table 3-7: Future Mode-wise Weighted Income of PIA States

3.7 Review of Past Traffic Data and Comparison with Previous Estimates

The toll plaza traffic data for the project road from 2017 till 2023 was provided by the client. The comparison of AADT for FY22/FY23 in the earlier study of May 2022 with FY23 AADT in present study is presented in **Table 3-8**.

Car	LCV	2-Axle	3-Axle	MAV	OSV	Total	PCUs
A. AADT FY22 Actual							
9,093	1,406	2,407	1,295	2,459	2	16,662	33,383
B. AADT FY22 Adopted (May 2022 Study)							
9,745	1,527	2,649	1,358	2,535	2	17,816	35,473
C. AADT FY23 Forecasted (May 2022 Study)							
10,610	1,595	2,717	1,392	2,723	2	19,039	37,592
D. AADT FY23 (Present Study)							
10,636	1,410	2,849	1,296	2,651	2	18,844	37,125
E. FY23 Present Study vs FY22 Actual (D vs A)							
17.0%	0.3%	18.3%	0.1%	7.8%	-4.7%	13.1%	11.2%
F. FY23 Present Study vs FY22 Adopted May 2022 (D vs B)							
9.1%	-7.6%	7.6%	-4.6%	4.6%	4.8%	5.8%	4.7%

Table 3-8: AADT in Earlier (May 2022 Report) and Present Study

Comparison of FY23 AADT with FY23 forecast in May 2022 study (C vs D)

- The FY23 AADT in present study is about 468 PCUs (or 1.2 percent) lower than the forecasted AADT for FY23 in May 2022 report. Notably, car and 2-Axle category is higher while traffic under rest of the categories is lower.

Comparison of Actual FY22 AADT with FY23 AADT in present study (D vs A)

- Comparison between the actual AADT of FY22 and FY23 indicates high growth of about 17.0 percent in car, 18 percent in 2A trucks and 7.8 percent in MAVs resulting in about 11.2 percent growth in PCU terms. It is worth noting that Q1 of FY22 was impacted due to the 2nd wave of Covid-19.

Comparison of FY23 AADT with AADT Adopted for FY22 in May 2022 study (D vs B)

- A comparison of FY23 AADT with the AADT adopted for FY22 (corrected for Q1 of FY22 in May 2022 Report) indicates a growth of about 9.1 percent in car, 7.6 percent in 2A trucks and about 4.6 percent in MAVs resulting in about 4.7 percent growth in PCU terms.
- The past traffic data along with the FY23 AADT is presented in **Figure 3-9**: Past Traffic data on The Project Road

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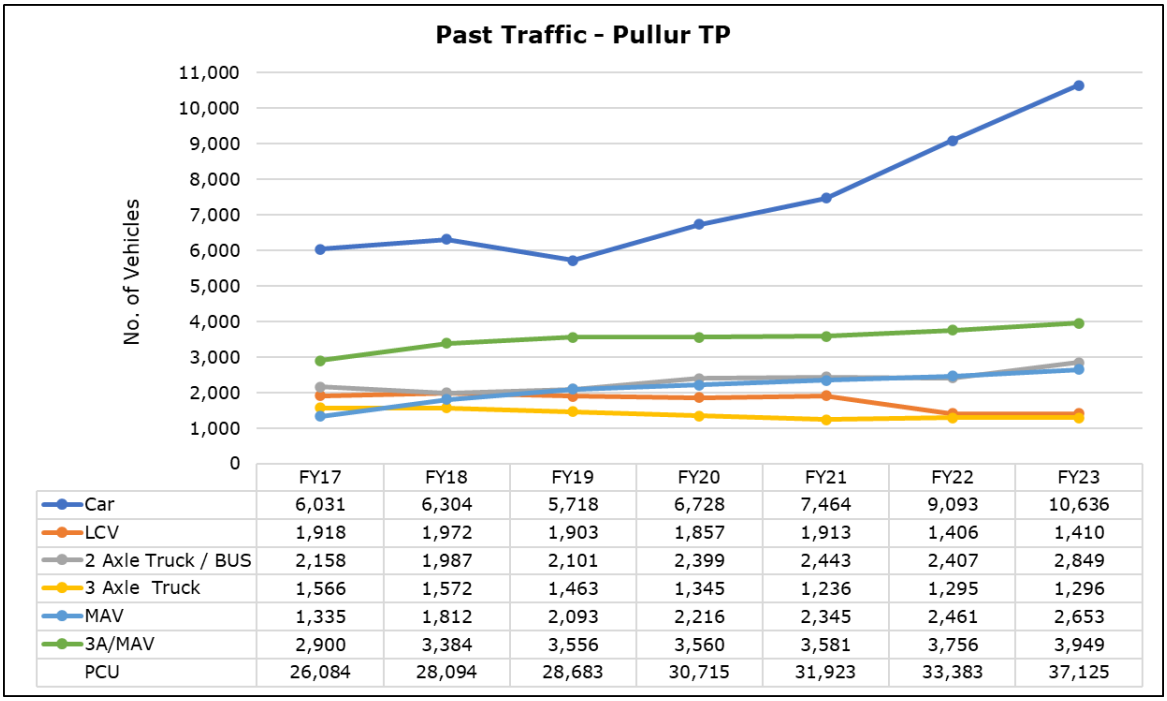

	FY17	FY18	FY19	FY20	FY21	FY22	FY23
Car	6,031	6,304	5,718	6,728	7,464	9,093	10,636
LCV	1,918	1,972	1,903	1,857	1,913	1,406	1,410
2 Axle Truck / BUS	2,158	1,987	2,101	2,399	2,443	2,407	2,849
3 Axle Truck	1,566	1,572	1,463	1,345	1,236	1,295	1,296
MAV	1,335	1,812	2,093	2,216	2,345	2,461	2,653
3A/MAV	2,900	3,384	3,556	3,560	3,581	3,756	3,949
PCU	26,084	28,094	28,683	30,715	31,923	33,383	37,125

Figure 3-9: Past Traffic data on The Project Road

An analysis of the traffic data and a comparison of the yearly averages with the current estimates of FY23 of the total traffic is presented in **Table 3-9**.

	Car	LCV	2 A Truck/Bus	3A Truck	MAV	PCU
End Point Growth						
FY23 vs FY18	11.0	-6.5	7.5	-3.8	7.9	5.7
FY23 vs FY20	16.5	-8.8	5.9	-1.2	6.2	6.5

Table 3-9: Past Growth analysis

The analysis of data from FY23 in comparison to FY18 and FY20 reveals that there has been a significant double-digit growth of about 11-16 percent in the number of cars passing through the toll plaza location. However, there has been a negative growth in

the number of LCVs, which could be attributed to a classification issue between MLCVs and LCVs.

The growth rate for Bus/2A trucks has been observed to be 7.5 percent in comparison between FY23 and FY18. On the other hand, MAVs have shown a double-digit growth rate in the past, whereas 3A trucks have shown a decline. However, in recent years, MAVs have shown a growth rate of around 6-8 percent.

3.8 Past and Future Transport Demand Elasticity

The econometric model applied for the project, relates traffic growth to changes in state domestic product via an elasticity factor according to IRC guidelines.

A regression between weighted GSDP (as independent variable) and weighted registered vehicles (as dependant variable) of PIA states was carried out. The registered vehicle elasticity in case of cars is 1.2 during FY13 to FY19 for Telangana and 1.0 for the state of Andhra Pradesh between FY12 and FY19. In case of all trucks combined, the registered vehicle elasticity is around 1.0 during the same period for both the main PIA states.

Vehicle registration data is also used as a proxy wherein operational toll data is not available. Vehicle registration data represents all vehicles registered in the state, but does not indicate actual number of vehicles plying on the road as it does not account for factors such vehicles taken off the road due to lack road worthiness, those registered in a state but mostly used elsewhere, etc. Consequently, the elasticity values based on vehicle registration may not be representative of the traffic growth trends on the project road.

Also, the elasticity values from the adjacent sections of WATL and JEPL have been assessed in forming the project road future elasticities. The end point elasticities observed in WATL and JEPL over the past years is presented in **Table 3-10** and **Table 3-11**.

FY/Mode	Car	LCV	BUS	2A	MAV	2A/3A/MAVs
FY12 to FY20	1.4	0.1	0.0	0.3	0.6	1.2
FY12 to FY15	1.9	1.1	-0.8	-1.6	0.4	1.5
FY15 to FY20	1.2	-0.3	0.2	1.3	0.7	1.1
FY15 to FY23	1.3	0.0	0.1	1.3	0.6	1.1

Table 3-10: Past Elasticities on WATL

In case of WATL, Car elasticity has been around 1.2 from FY15 to FY20. 2A trucks has shown an elasticity of 0.7 during the same period. Combined elasticity value for 2A/3A/MAV is observed to be around 1.1.

FY/Mode	Car/Jeep/van	LCV/ Minibus	Truck/Bus	MAV
FY12 vs FY20	1.4	0.4	0.0	0.5
FY12 vs FY15	1.7	1.1	-1.0	0.0
FY16 vs FY20	1.2	-0.1	0.8	0.7
FY16 vs FY23	1.3	0.1	0.9	0.8

Table 3-11: Past Elasticities on JEPL

In case of JEPL, Car elasticity is around 1.2 from FY16 to FY20. Bus/2A trucks has shown an elasticity of 0.8 during the same period. In case of 3A/MAV combined, an elasticity value of 0.7 has been observed between FY16 and FY20.

The derived elasticities on other National Highways across India have also formed the basis for choosing the recommended elasticities on PR. The elasticities derived using the operational toll data regressed with the applicable state incomes (mode wise weighted shares) for the respective projects on some of the National Highways is presented in **Table 3-12**.

NH	Period	Car	2A	3A/MAV
NH-21	FY12-FY20	1.23	-0.42	0.54
SH-25	FY15-FY20	1.28	0.26	0.47
SH-17 & SH-7	FY13-FY20	1.26	0.51	0.33
NH-19	FY15-FY20	0.78	1.36	1.40
NH-1	FY12-FY20	1.02	0.74	
NH-6	FY14-FY20	1.11	1.68	0.42
NH-8A	FY16-FY20	0.73	0.28	0.94
NH-4	FY15-FY20	0.87	0.18	0.84
NH-6	FY16 to FY19	1.25	1.28	0.78

Table 3-12: Past Elasticity on Other National Highways

The past elasticity values have been observed in the range of 1-1.3 for cars on various National Highways and around 0.5-0.9 for 3A/MAV combined. Individually, 3A trucks have shown a negative elasticity in some of the assets with MAVs showing a higher positive elasticity.

Cars

- The elasticities and the past growth levels for cars are a result of increasing income levels, increasing vehicle ownership, and higher propensity to travel on highways in India due to network level developments and higher levels of service. These levels of growth are likely to continue in the near to medium term since car ownership levels are still very low and the road network is undergoing continual development.
- Car elasticity has been considered as 1.0 for the period up to FY30 and tapered to 0.9 for the rest of years till the end of the concession period.
- The motorisation levels in India also play an important role in determining car growth. With the increasing car ownership levels, propensity to travel and network level improvements on National Highways, car growth is likely to be at a high rate as witnessed in the recent past. The low motorization rate suggests that there is room for continued growth for many years to come. With the continual increase in motorization rate and improved road network usage by cars for inter-urban travel, car growth is expected to be robust.
- It is likely that this growth would slow down over time as the market becomes more mature and saturated, therefore elasticity to GSDP can be expected to decline over time. With the anticipated growth momentum in the coming years, higher elasticity

values have been considered for the slab up to FY30 and further tapering has been done in the next slab.

Bus/Truck

- Over the years in India, there has been a change in passenger's travel mode preferences with increasingly more people shifting from public transport systems towards personalised modes. This has resulted, in general, in elasticity of bus traffic/demand to GSDP lower than unity ranging between 0.3 to 0.7 across the operational National Highways.
- The toll plaza data shows a past elasticity of 0.47 in FY17 to FY20 comparison in combined Bus/Truck category. 2A trucks have also shown a positive growth in the past in the adjacent toll section of WATL. Going forward Bus and Truck elasticity has been recommended as 0.3 for the entire concession period.

Trucks

- For smaller axle trucks like LCV, a higher elasticity value of 0.5 has been adopted till FY30 and 0.4 for the remaining concession period. The adjacent sections of WATL and JEPL have shown an elasticity ranging between 0.1 and 0.4 during the long- term period of FY11 to FY20.
- The project road toll plaza data for 3A/MAV has shown an elasticity of 1.0 in FY20 and FY23 comparison. WATL also shows an elasticity of 0.6 over the long term of FY12 to FY20. An elasticity of 0.3 has been adopted for 3A trucks for the entire concession period. For MAV trucks, an elasticity of 0.9 has been adopted till FY30 and further tapered to 0.8 for the rest of the concession period.

It is likely that this growth would slow down over time as the market becomes more mature and saturated, therefore elasticity to GSDP can be expected to decline over time. With the anticipated growth momentum in the coming years, higher elasticity values have been considered for the slab up to FY30 for Cars, LCV & MAV and further tapering has been done in the next slab.

In India as a whole, the freight vehicle mix has been changing in the last decade favouring MAV to 2 Axle/ 3Axle vehicles for long-distance traffic, given the operational efficiencies achievable with larger vehicles. Considering the ongoing technical advancements in automobile industry, some of the standard 2 Axle/ 3 Axle trucks would gradually be replaced by MAVs. Mature national highways with tolling in operation for few years, have already witnessed the shift in 2A/3A trucks to MAV for long distance movement and some of the 2A trucks are still being used for local movements.

On an overall level, due consideration has been given to the tonnage shifts happening in the market with Mini LCV gaining importance for short distance movements over LCVs and MAVs being preferred over 2A/3A for long distance movements due to better

operational efficiencies. Some of the 2A/3A trucks are also being used for local movements.

While assigning elasticities to different modes, freight travel pattern and over all elasticity of cargo tonnage with respect to weighted GSDP has been an important consideration. The recommended elasticity values adopted for all vehicle types in line with the traffic growth being observed on other national highways and changes in freight traffic pattern observed on the project road are presented in **Table 3-13**.

Period/Modes	Car/MLCV	LCV/ Mini Bus	Bus	Truck	3A	MAV
2023-2025	1.0	0.5	0.3	0.3	0.3	0.9
2026-2030	1.0	0.5	0.3	0.3	0.3	0.9
2031-2035	0.9	0.4	0.3	0.3	0.3	0.8
2036-2040	0.9	0.4	0.3	0.3	0.3	0.8
Beyond 2040	0.9	0.4	0.3	0.3	0.3	0.8

Table 3-13: Recommended Elasticity for Project

It has been assumed that transport demand elasticity, for both freight and passenger traffic, would gradually decline over time, despite growth in per capita income, as regions becomes more mature, self-sufficient and with alternative mode of transport available to users. In the future growth forecast, the gradation in elasticity of freight over the years takes into account to cover the impact of network level changes in both rail and road networks apart from economic changes.

3.9 Projected Traffic Growth Rates

The estimated traffic growth rates for the project road in the earlier study conducted by Ramboll in May 2022 have been presented in **Table 3-14**.

FY/Modes	Car/MLCV	LCV/M Bus	Bus	Truck	3A	MAV
2023	8.9	4.4	2.7	2.5	2.5	7.4
2024	7.4	3.7	2.2	2.1	2.1	6.2
2025	7.4	3.7	2.2	2.1	2.1	6.2
2026	7.7	3.8	2.3	2.1	2.1	6.4
2027	7.4	3.7	2.2	2.1	2.1	6.2
2028	7.4	3.7	2.2	2.1	2.1	6.2
2029	7.0	3.5	2.1	1.9	1.9	5.8
2030	7.0	3.5	2.1	1.9	1.9	5.8
2031	6.3	2.8	2.1	1.9	1.9	5.2
2032	6.3	2.8	2.1	1.9	1.9	5.2
2033	6.3	2.8	2.1	1.9	1.9	5.2
2034	6.1	2.7	2.0	1.9	1.9	5.1
2035	6.0	2.7	2.0	1.9	1.9	5.0
2036	5.9	2.6	2.0	1.8	1.8	4.9
2037	5.8	2.6	1.9	1.8	1.8	4.8
2038	5.7	2.5	1.9	1.7	1.8	4.7
2039	5.5	2.5	1.8	1.7	1.7	4.6
2040	5.4	2.4	1.8	1.7	1.7	4.5

FY/Modes	Car/MLCV	LCV/M Bus	Bus	Truck	3A	MAV
2041	5.3	2.4	1.8	1.6	1.6	4.4
2042	5.2	2.3	1.7	1.6	1.6	4.3
2043	5.1	2.2	1.7	1.6	1.6	4.2
2044	4.9	2.2	1.6	1.5	1.5	4.1
2045	4.8	2.1	1.6	1.5	1.5	4.0
2046	4.7	2.1	1.6	1.4	1.5	3.9
2047	4.6	2.0	1.5	1.4	1.4	3.8
2048	4.5	2.0	1.5	1.4	1.4	3.7
2049	4.3	1.9	1.4	1.3	1.3	3.6
2050	4.2	1.9	1.4	1.3	1.3	3.5
2051	4.2	1.9	1.4	1.3	1.3	3.5
2052	4.2	1.9	1.4	1.3	1.3	3.5

Table 3-14: Projected Traffic Growth Rates for Project Road in Earlier Study (%)

Under the present study, based on the perspective elasticity values and the projected growth rates of the income for PIA states (updated with the latest regional distribution of PIA from the ODs of this study), the future average annual compound traffic growth rates by vehicle type have been estimated for the project road by using the following relationship:

Tgr = (GSDPgr) x E; where,

Tgr – Traffic growth rate for mode

GSDPgr – Growth rate of GSDP

E – Elasticity value for mode

Using the year-on-year mode wise weighted income for PIA and elasticity for different time periods, traffic growth rates have been estimated for each year till FY52. The estimated traffic growth rates for the project road have been presented in **Table 3-15**.

FY/Modes	Car/MLCV	LCV/M Bus	Bus	Truck	3A	MAV
2024	7.0	3.5	2.1	2.0	2.0	5.9
2025	7.3	3.7	2.2	2.1	2.1	6.2
2026	7.8	3.9	2.3	2.2	2.2	6.6
2027	7.8	3.9	2.3	2.2	2.2	6.6
2028	7.6	3.8	2.3	2.1	2.1	6.4
2029	7.1	3.5	2.1	2.0	2.0	6.0
2030	7.1	3.5	2.1	2.0	2.0	6.0
2031	6.4	2.8	2.1	2.0	2.0	5.3
2032	6.4	2.8	2.1	2.0	2.0	5.3
2033	6.4	2.8	2.1	2.0	2.0	5.3
2034	6.3	2.8	2.1	2.0	2.0	5.2
2035	6.2	2.7	2.1	1.9	1.9	5.1
2036	6.0	2.7	2.0	1.9	1.9	5.0
2037	5.9	2.6	2.0	1.9	1.9	4.9
2038	5.8	2.6	1.9	1.8	1.8	4.9
2039	5.7	2.5	1.9	1.8	1.8	4.8
2040	5.6	2.5	1.9	1.8	1.8	4.7

FY/Modes	Car/MLCV	LCV/M Bus	Bus	Truck	3A	MAV
2041	5.5	2.4	1.8	1.7	1.7	4.6
2042	5.5	2.4	1.8	1.7	1.7	4.6
2043	5.4	2.4	1.8	1.7	1.7	4.5
2044	5.3	2.4	1.8	1.7	1.7	4.4
2045	5.2	2.3	1.7	1.6	1.6	4.3
2046	5.1	2.3	1.7	1.6	1.6	4.2
2047	5.0	2.2	1.7	1.6	1.6	4.1
2048	4.9	2.2	1.6	1.5	1.5	4.0
2049	4.8	2.1	1.6	1.5	1.5	4.0
2050	4.6	2.1	1.5	1.5	1.5	3.9
2051	4.3	1.9	1.4	1.4	1.4	3.6
2052	4.3	1.9	1.4	1.4	1.4	3.6

Table 3-15: Projected Traffic Growth Rates for Project Road (%)

In derivation of above growth rates, the likely shift of buses to cars in case of passenger vehicles and the replacement/ tonnage shift of 2A/3A trucks to MAV for long distance in case of freight vehicles has been duly considered.

The implied traffic growth rates for freight vehicles of 2A/3A and MAV after considering the impact of diversion to Surat – Chennai economic corridor and Hyderabad – Tirupati corridor in FY27 to FY29 under the base case have been presented in **Table 3-16**.

FY/Modes	TP01		
	2A	3A	MAV
2027	-7.3%	-7.9%	-2.0%
2028	-3.1%	-3.4%	1.7%
2029	-3.5%	-3.9%	1.1%

Table 3-16: Implied Traffic Growth Rates for Project Road After Diversion (%)

The above growth rates relate to the most likely Base Case. In addition, two sets of traffic growth rates under low and high cases have also been considered and impact on toll revenue evaluated for both these cases. Based on the risk analysis of key parameters like economic growth and elasticity of travel demand impacting traffic growth, two additional growth scenarios have been presented. Low growth scenario considers a 20 percent reduction in growth rates relating to about 10 percent decline each in elasticity and economic growth. The High growth scenario considers a 20 percent increase in growth rates signifying about 10 percent increase each in elasticity and economic parameters.

3.10 Projections Mode-wise Traffic

Mode-wise projected traffic for the toll plaza of the project under the base case after considering diversion impacts till FY52 is presented in **Table 3-17**.

FY/Modes	Car	LCV	Bus	2A	3A	MAV	OSV	PCU
2023	10,636	1,410	1,564	1,285	1,296	2,651	2	37,125
2024	11,376	1,459	1,597	1,310	1,322	2,806	2	38,889
2025	12,209	1,512	1,632	1,337	1,349	2,979	2	40,849

2026	13,161	1,571	1,670	1,367	1,379	3,175	2	43,064
2027	13,535	1,536	1,709	1,267	1,270	3,111	3	42,589
2028	14,208	1,543	1,748	1,227	1,227	3,165	3	43,379
2029	14,838	1,546	1,785	1,183	1,179	3,200	3	44,010
2030	15,888	1,600	1,823	1,207	1,202	3,391	3	46,257
2031	16,900	1,646	1,861	1,231	1,226	3,570	3	48,408
2032	17,977	1,692	1,901	1,256	1,251	3,760	3	50,674
2033	19,123	1,740	1,941	1,281	1,276	3,959	4	53,061
2034	20,321	1,789	1,982	1,306	1,301	4,165	4	55,533
2035	21,572	1,838	2,023	1,332	1,326	4,379	4	58,092
2036	22,876	1,887	2,063	1,357	1,352	4,599	4	60,737
2037	24,235	1,937	2,104	1,382	1,377	4,826	4	63,468
2038	25,649	1,987	2,145	1,408	1,402	5,060	5	66,286
2039	27,117	2,038	2,186	1,433	1,427	5,301	5	69,190
2040	28,640	2,088	2,227	1,458	1,452	5,549	5	72,179
2041	30,217	2,140	2,268	1,484	1,478	5,803	5	75,252
2042	31,881	2,192	2,310	1,509	1,503	6,069	5	78,471
2043	33,603	2,245	2,351	1,535	1,529	6,342	6	81,778
2044	35,381	2,297	2,393	1,561	1,554	6,621	6	85,170
2045	37,215	2,350	2,434	1,586	1,579	6,907	6	88,646
2046	39,104	2,403	2,475	1,611	1,605	7,198	6	92,203
2047	41,047	2,456	2,516	1,637	1,630	7,496	7	95,839
2048	43,042	2,509	2,557	1,662	1,654	7,799	7	99,550
2049	45,087	2,562	2,597	1,686	1,679	8,107	7	103,334
2050	47,181	2,615	2,638	1,711	1,704	8,420	8	107,186
2051	49,220	2,666	2,676	1,734	1,727	8,723	8	110,915
2052	51,346	2,717	2,714	1,758	1,750	9,036	8	114,787
AADT CAGR (%)								
FY23 - FY25	7.1	3.6	2.1	2.0	2.0	6.0	6.0	4.9
FY25 - FY30	5.4	1.1	2.2	-2.0	-2.3	2.6	6.3	2.5
FY30 - FY35	6.3	2.8	2.1	2.0	2.0	5.2	5.2	4.7
FY35 - FY40	5.8	2.6	1.9	1.8	1.8	4.9	4.9	4.4
FY40 - FY45	5.4	2.4	1.8	1.7	1.7	4.5	4.5	4.2
FY45 - FY50	4.9	2.2	1.6	1.5	1.5	4.0	4.0	3.9
FY50 - FY52	4.3	1.9	1.4	1.4	1.4	3.6	3.6	3.5
FY23 - FY52	5.6	2.3	1.9	1.1	1.0	4.3	5.0	4.0

Table 3-17: Projected Mode-wise Traffic

3.11 Traffic Projections and Capacity Analysis

Table 3-18 presents the projections of the total vehicles based on the most likely growth rates till FY52 as assessed in this study.

FY	Total Traffic Before Diversion	Total Traffic After Diversion
2023	37,125	37,125
2024	38,889	38,889
2025	40,849	40,849
2026	43,064	43,064
2027	45,421	42,589
2028	47,853	43,379
2029	50,274	44,010
2030	52,837	46,257
2031	55,290	48,408
2032	57,872	50,674
2033	60,593	53,061
2034	63,411	55,533
2035	66,326	58,092
2036	69,339	60,737
2037	72,451	63,468
2038	75,660	66,286
2039	78,967	69,190
2040	82,371	72,179
2041	85,869	75,252
2042	89,534	78,471
2043	93,298	81,778
2044	97,158	85,170
2045	101,114	88,646
2046	105,161	92,203
2047	109,297	95,839
2048	113,519	99,550
2049	117,822	103,334
2050	122,202	107,186
2051	126,443	110,915
2052	130,844	114,787

Table 3-18: Projected Traffic at Kothakota-Kurnool

As per the latest information related to InvIT CA, the six laning augmentation is done after the traffic projections on the PR crosses 40,000 PCUs and remains above 40,000 PCUs for three more consecutive years, after which NHAI may invite bids for DPR preparation. As per the information available, the capacity augmentation process has already started on the project road and the construction period is likely to be in FY25 and FY26.

Once six laned, the projected traffic for the project road is not likely to reach designed capacity of 120,000 PCU for six-lane till FY52 while considering the diversion impact.

4. TOLL REVENUE PROJECTIONS

4.1 Tolling Strategy

The project road has an "Open System" of toll collection which enables the concessionaire to collect tolls from through traffic as well as from short distance one.

As mentioned earlier, one toll plaza is operational on the Kothakota-Kurnool Road with an effective tolling length of 92.432 km.

4.2 Schedule of User Fee

As per Schedule of User Fee for the project, the per km toll rates applicable from 2007-08 for normal tolling length and permanent structures, the revision basis and concessions are provided.

The concessions to traffic have been given in the form of rates as below:

Local traffic

Car / Jeep / Vans - includes local users owning a vehicle registered for non-commercial purposes, residing within a distance of 20 km from the toll plaza and crossing the same for commuting purposes.

Commercial vehicles - includes local users owning a commercial vehicle (excluding vehicles under National Permit), registered with address on the Registration Certificate of a particular district and uses such vehicle for commuting on a section of National Highway, permanent bridge, tunnel or bypass, as the case may be, which is located within that district, shall be levied user fee on all toll plazas which are located within that district at the rate of fifty per cent of the prescribed rate of fee (single journey rate). No such concession shall be provided, if a service road or alternative road is available for use by such commercial vehicles. Thus, local commercial traffic has to pay only 50 percent of the normal ticket.

Daily Pass

When the vehicle has to cross the tolled section more than once in a day, the user shall have the option to pay one and half times (1.5 times) of the fee for a single entry; this pass shall be valid for 2 entries within 24 hours of purchase.

Monthly Pass

A user, who makes use of the project road frequently during a month, may opt to purchase a monthly pass upon payment of a charge equal to two-thirds of the fee payable for 50 single journeys; this pass can be used for a maximum 50 one-way journeys over the month of validity.

Thus, the different categories of toll tickets are as follows:

(i) Traffic paying normal toll rates (single trip)

(ii) Traffic paying return journey rates

(iii) Traffic paying monthly pass rates

(iv) Traffic paying local personal rates

(v) Traffic paying local commercial rates

4.3 Tolling Streams

The tolling segmentation considered in the earlier study adopted by Ramboll is presented in **Table 4-1**.

Ticket Type/ Modes	Car	LCV	Bus/ 2A Truck	3A Truck	MAV	OSV
Single	49.9	58.5	56.5	86.1	90.7	97.9
Return	40.6	40.9	42.0	13.3	8.7	1.3
Monthly Pass	0.0	0.0	0.9	0.0	0.0	0.0
Local personal	0.0	0.0	0.0	0.0	0.0	0.0
Local commercial	4.3	0.0	0.0	0.0	0.0	0.0
Exempt	5.2	0.7	0.6	0.6	0.6	0.8
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 4-1: Tolling Distribution in Earlier Study

The tolling segmentation adopted in earlier study indicated around 5.2 percent of cars are under exemption category. Whereas less than 1 percent of the freight vehicles were under exemption category.

The tolling stream distribution under the present study has been derived from the toll data taking an average of ticket wise traffic of FY23 and is presented in **Table 4-2**.

Ticket Type/Modes	Car	LCV	Bus/ 2A Truck	3A Truck	MAV	OSV
Single	50.5	68.3	54.8	81.9	91.4	90.6
Return	39.5	31.5	43.9	18.0	8.5	9.4
Monthly	0.0	0.0	1.2	0.0	0.0	0.0
Local personal	8.7	0.0	0.0	0.0	0.0	0.0
Local commercial	0.0	0.0	0.0	0.0	0.0	0.0
Exempt	1.2	0.2	0.1	0.1	0.1	0.0
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 4-2: Tolling Distribution from Toll Data for present study (in %)

The tolling segmentation observed during present study indicates a lower exemption percentage in almost all categories as compared to the segmentation adopted in earlier study. It is to be noted that in the present study, the duplication error has been removed to derive the actual traffic and correct segmentation.

In case of cars, the normal toll paying traffic is likely to be about 50.5 percent. Daily Pass traffic has a share of 39.5 percent and Local personal traffic is around 9 percent in cars.

In case of LCV, around 68 percent of the traffic is paying for single ticket and 31.5 percent are opting for daily pass. In case of 3A/MAV, around 82-91 percent of the traffic is opting for normal pass due to their long lead of travel with around 18 percent of 3A trucks and 8.5 percent of MAV falling under return pass category.

Trip rate for local pass users is considered as 1.0, for monthly pass it is 1.67 across all modes. For daily pass, trip rate of 2.0 has been considered for all the modes.

4.4 Toll Rates

This section presents details on the toll rates that are likely to be imposed on the users of the project road during the study period. The toll rates (Rs/km) for the base year 2007-08 for different vehicle categories as per toll fee rules are presented in **Table 4-3**.

Mode	Base rate per km (in Rs)
Car, Jeep, Van, LMV	0.65
LCV /M Bus	1.05
Bus/ 2 Axle Truck	2.20
3 Axle	2.40
MAV	3.45
Oversized	4.20
Local Passenger	150

Table 4-3: Toll Rates in Rs/km for Different Vehicle Categories

The toll notification states that the 2007 toll rates shall be increased without compounding by three per cent each year with effect from the 1st day of April 2008 and such increased rate shall be deemed to be the base rate for the subsequent years.

In addition to this, the rate of fee for use of bypass forming part of a section of a National Highway constructed with a cost of Rs 10 crore or more, for the base year 2007, shall be one and a half times of the per km base rates specified above and the length of such bypass shall be excluded from the length of such section of National Highway.

In addition to this, the fee levied and collected hereunder for permanent bridge/ structures, as the case may be, having a length of 60 m or more on the basis of the equivalent length for structure as specified shall be due and payable at the toll plaza.

In case of the project road, the details of normal tolling lengths, bypass length (at 1.5 times) and equivalent structure lengths being charged at Pullur toll plaza are presented in **Table 4-4**.

	Kothakota-Kurnool
A. Normal length	69.857
B. Bypass length @ 1.5 times	2.95
C. Equivalent Structure length	18.15
D. Total tolling length=(A+1.5*B+C)	92.432

Table 4-4: Tolling Lengths at Kothakota-Kurnool

The effective tolling length is 92.432 at this toll plaza. The applicable base rates shall be revised annually with effect from April 1 each year to reflect the increase in wholesale price index for the month of December of the immediately preceding year in which sub revision is undertaken but such revision shall be restricted for 40 per cent of the increase in wholesale price index.

A WPI growth forecast of 5.5 percent for FY24 and 3.5 percent for future years beyond 24 was considered in the earlier study.

For the present study, actual WPI information for December 2022 of 150.4 under 2011-12 series converted into 1999-00 series (150.4*1.873*1.641=462.268) has been used which indicated a growth of 5.02 percent as compared to last year. The forecast of 3.5 percent WPI for future years beyond FY24 has been adopted for the period till FY52.

As per the applicable tolling notifications for six laning, during construction period, the toll rates will be charged at 75 percent of the applicable tolling length during construction and kept constant till full COD is achieved. The construction period for six laning for this project is likely to be from FY25 to FY26 during which the toll rates will be 75 percent of the applicable toll rates of FY25 and will be constant for FY26. Also, for FY27, the toll rates are capped at 25 percent higher than the toll rates in FY26.

The stream of toll rates to be charged at the toll plaza of the project road for different years till FY52 is presented in **Table 4-5**.

The table also presents the constant toll rates to be charged during the construction period applicable during six laning of the project section. The toll fee has been rounded to nearest 5 Rupees as per toll fee rules.

FY End	Car	LCV/ M Bus	Bus/2A	3A	MAV	OSV	Car Local
2023	125	205	425	465	670	815	315
2024	130	215	445	490	700	855	330
2025*	105	165	350	380	550	665	260
2026*	105	165	350	380	550	665	260
2027	130	210	435	475	685	835	375
2028	155	250	525	575	825	1,005	390
2029	160	260	550	600	860	1,045	405
2030	170	270	570	620	895	1,090	420
2035	205	335	695	760	1,095	1,330	515
2040	250	405	850	930	1,335	1,625	630
2045	310	495	1,040	1,135	1,630	1,985	770
2050	375	605	1,270	1,390	1,995	2,430	940
2052	405	660	1,380	1,505	2,165	2,635	1,015

* Toll rates at 75% during six laning

Table 4-5: Toll Rates at Toll Plaza (in Rs)

The users purchasing return journey tickets will pay 1.5 times the above toll rates; the traffic opting for monthly passes will pay 33.3 times (two-thirds of 50 single journeys) the normal traffic toll rates. All passes have been rounded to the nearest 5 Rupees as per fee rules.

4.5 Toll Revenue Estimates

The toll revenue estimates of the earlier study of May 2022 are presented in **Table 4-6**.

FY End	Total
2022	1,502.5

FY End	Total
2023	1,756.8
2024	1,954.3
2025	2,125.9
2026	2,326.4
2027	2,370.9
2028	2,508.6
2029	2,618.4
2030	2,868.9
2031	2,331.8
2032	2,442.7
2033	3,186.3
2034	4,019.0
2035	4,348.9
2036	4,743.8
2037	5,136.9
2038	5,571.1
2039	6,046.4
2040	6,563.2
2041	7,081.9
2042	7,646.4
2043	8,254.2
2044	8,947.2
2045	9,652.8
2046	10,371.2
2047	11,190.8
2048	12,099.5
2049	12,958.1
2050	13,917.3
2051	15,016.0
2052*	11,484.1

* Till 15th December FY52

Table 4-6: Toll Revenue in Earlier Study

The projections of revenue under the present study for the project road have been presented till 15th December of FY52. Toll revenue streams have been calculated assuming that toll would be collected for all 365 days in a year and for 366 days in a leap year. The mode wise breakdown of toll revenue for the project road for the base case is presented in **Table 4-7**.

FY End	Car	LCV	Bus	2-axle Truck	3-axle Truck	MAV	OSV	Total
2023	394.6	96.8	215.1	176.7	209.7	633.8	0.6	1,727.3
2024	442.1	105.4	230.5	189.2	225.8	703.2	0.6	1,896.8
2025	376.3	84.0	184.5	151.2	178.4	584.7	0.5	1,559.8
2026	405.7	87.2	188.8	154.6	182.4	623.2	0.6	1,642.5
2027	520.3	108.2	240.6	178.3	210.2	760.9	0.8	2,019.2
2028	654.7	129.8	297.6	208.9	246.1	934.7	1.0	2,472.9
2029	706.5	134.9	316.5	209.8	246.0	982.3	1.1	2,597.1
2030	797.6	145.5	335.7	222.3	259.7	1,083.2	1.2	2,845.1
2031	876.5	157.2	357.5	236.5	277.3	1,185.3	1.3	3,091.6
2032	981.4	168.3	381.1	251.8	294.7	1,305.4	1.4	3,384.1

FY End	Car	LCV	Bus	2-axle Truck	3-axle Truck	MAV	OSV	Total
2033	1,073.0	178.4	404.2	266.8	311.2	1,427.4	1.6	3,662.4
2034	1,192.8	192.1	429.1	282.8	330.7	1,561.2	1.7	3,990.4
2035	1,309.9	206.3	454.6	299.3	350.9	1,711.4	1.9	4,334.3
2036	1,452.2	219.4	485.1	319.0	372.9	1,876.3	2.0	4,727.0
2037	1,605.8	234.0	513.7	337.5	395.3	2,041.3	2.2	5,129.9
2038	1,751.5	250.4	544.5	357.4	419.5	2,230.7	2.4	5,556.4
2039	1,931.8	266.7	579.2	379.7	444.6	2,431.5	2.7	6,036.2
2040	2,130.7	285.0	614.2	402.2	471.5	2,651.9	2.9	6,558.3
2041	2,331.2	304.9	649.0	424.6	496.5	2,879.5	3.2	7,088.8
2042	2,583.1	323.7	689.8	450.8	526.0	3,130.8	3.4	7,707.7
2043	2,822.0	346.5	729.3	476.2	558.5	3,407.3	3.7	8,343.6
2044	3,097.2	367.6	775.2	505.6	591.3	3,720.3	4.1	9,061.3
2045	3,393.4	390.8	817.9	533.0	624.2	4,019.2	4.4	9,782.8
2046	3,695.4	415.7	867.2	564.6	659.4	4,368.2	4.8	10,575.3
2047	4,053.1	444.5	917.6	596.9	697.8	4,736.1	5.2	11,451.1
2048	4,405.1	472.9	972.8	632.2	739.3	5,136.4	5.6	12,364.4
2049	4,793.4	502.7	1,024.9	665.5	780.3	5,542.3	6.1	13,315.1
2050	5,233.6	531.4	1,083.4	702.8	824.1	5,996.8	6.6	14,378.8
2051	5,668.7	564.4	1,144.9	742.1	868.5	6,461.5	7.1	15,457.2
2052*	4,376.2	427.6	861.1	557.7	652.4	4,968.8	5.4	11,849.2

** Till 15th December FY52*

Table 4-7: Toll Revenue for Kothakotta-Kurnool by Mode

Cars represent around 33.4 percent share in total revenue with Buses having a share of 4.2 percent only. Amongst the freight vehicles category, MAVs represent the highest share of around 40.7 percent of total revenue. 3A trucks account for a share of 6.9 percent, LCVs and 2A trucks have a share of 8.9 percent and 5.9 percent respectively.

Vehicles paying normal tolls are around 77.1 percent of total toll revenues for the project road sections and around 22.5 percent of the traffic may opt for daily pass category. Remaining 0.4 percent may fall in monthly pass and local concession category.

4.6 Scenario Analysis

For toll road projects, revenue streams are generally based on the assessment of the traffic volume (base and future) crossing the toll plazas and the applicable toll imposed on the user of the road. There is an inherent element of uncertainty in any forecast and whilst is not possible to measure risk in a strictly statistical sense (as many of the risks are largely or partly unknown), in this section an attempt is made at quantifying the main risks that could have an impact on this forecast.

The econometric approach used to derive traffic growth, is based on the estimation of GSDP growth rates for the influence area economies and traffic demand elasticity by mode; the estimation of both variables contains a certain degree of uncertainty which

can be represented in the scenario analysis. Scenario analysis has been done in the following subheadings for the base case:

High Case

The high case is based on a more optimistic economic outlook for future years as compared than the base case and therefore, based on traffic growth rates of 100 basis points (1 per cent) higher than the base case for every year and for all modes.

Low Case

A growth rate of 200 basis point (2 percent) lower than base case for all types of vehicles has been considered in the present analysis to reflect uncertainty with regard to economic performance of PIA states. The results of different scenarios are presented in Table 4-8. A comparison versus base case has been presented for the Present Value (at 12 percent discount rate) of the project revenue from FY24 till 15th December of FY52.

Financial Year (FY) ending March	Base	High Growth (+20%)	Low Growth (-20%)
2023	1,727.3	1,727.3	1,727.3
2024	1,896.8	1,913.7	1,880.0
2025	1,559.8	1,588.6	1,531.3
2026	1,642.5	1,690.0	1,596.0
2027	2,019.2	2,099.4	1,941.8
2028	2,472.9	2,597.5	2,353.8
2029	2,597.1	2,754.8	2,448.2
2030	2,845.1	3,048.6	2,655.2
2031	3,091.6	3,342.8	2,859.4
2032	3,384.1	3,693.6	3,100.9
2033	3,662.4	4,034.8	3,325.3
2034	3,990.4	4,437.6	3,589.6
2035	4,334.3	4,864.9	3,863.6
2036	4,727.0	5,354.9	4,175.5
2037	5,129.9	5,865.1	4,490.6
2038	5,556.4	6,409.9	4,821.3
2039	6,036.2	7,026.4	5,191.6
2040	6,558.3	7,702.9	5,591.3
2041	7,088.8	8,399.6	5,991.6
2042	7,707.7	9,215.6	6,457.5
2043	8,343.6	10,063.2	6,930.8
2044	9,061.3	11,024.3	7,463.3
2045	9,782.8	12,005.2	7,989.9
2046	10,575.3	13,086.7	8,567.0
2047	11,451.1	14,289.7	9,200.7
2048	12,364.4	15,554.2	9,856.8
2049	13,315.1	16,885.9	10,531.4
2050	14,378.8	18,381.4	11,284.2
2051	15,457.2	19,906.0	12,043.8
2052*	11,849.2	15,373.1	9,166.0
PV12 FY24 till 15th Dec in FY52	29,445.9	33,329.7	26,177.5
PV12 till 15th Dec in FY52 vs base		13.2%	-11.1%
CAGR FY24 to FY51	8.1%	9.1%	7.1%

* *Till 15th December FY52*

Table 4-8: Comparison of Annual Revenue Forecasts Under Different Scenarios

The low growth scenario has a negative impact on revenue PV of about 11.1 percent versus base case (till FY52), whilst the optimistic growth scenario would generate about 13.2 percent higher PV than the base case.

APPENDICES

APPENDIX 2.1
PAST TRAFFIC

Traffic Study for Kothakota - Kurnool Section of NH-44 in Telangana and Andhra Pradesh

Month	CJV	LCV	2-Axle	3-Axle	MAV	OSV	Total Traffic	PCUs
Jan-21	10,297	1,436	2,335	1,316	2,251	3	17,639	33,550
Feb-21	9,706	1,528	2,498	1,468	2,462	2	17,665	34,987
Mar-21	9,324	1,523	2,539	1,509	2,580	278	17,753	36,613
Apr-21	9,776	1,393	2,280	1,278	2,355	2	17,085	33,149
May-21	10,002	1,458	2,410	1,394	2,468	2	17,733	34,712
Jun-21	10,176	1,457	2,477	1,338	2,632	2	18,082	35,659
Jul-21	9,632	1,440	2,403	1,297	2,592	2	17,365	34,562
Aug-21	10,720	1,474	2,551	1,380	2,671	2	18,799	36,756
Sep-21	9,546	1,548	2,687	1,437	2,512	2	17,733	35,553
Oct-21	10,868	1,632	2,886	1,512	2,493	2	19,393	37,738
Nov-21	9,859	1,392	2,571	1,239	2,188	3	17,252	33,235
Dec-21	10,048	1,390	2,653	1,373	2,537	3	18,004	35,640
Jan-22	8,842	1,266	2,496	1,257	2,433	2	16,296	32,956
Feb-22	9,855	1,513	2,763	1,426	2,642	3	18,202	36,592
Mar-22	9,127	1,544	2,771	1,363	2,688	3	17,496	35,952
Apr-22	10,595	1,458	2,715	1,301	2,591	3	18,663	36,501
May-22	11,843	1,379	2,736	1,300	2,607	2	19,868	37,763
Jun-22	11,342	1,436	2,961	1,344	2,710	1	19,794	38,611
Jul-22	10,065	1,440	2,927	1,373	2,897	2	18,704	38,171
Aug-22	11,519	1,467	3,025	1,386	2,898	1	20,295	39,996
Sep-22	9,713	1,537	2,976	1,376	2,679	2	18,283	37,139
Oct-22	11,290	1,476	3,029	1,277	2,527	2	19,600	37,799
Nov-22	10,171	1,511	2,969	1,326	2,568	2	18,547	36,888
Dec-22	12,234	1,444	2,874	1,282	2,644	2	20,480	38,777
Jan-23	11,264	1,288	2,777	1,208	2,554	2	19,094	36,656
Feb-23	10,834	1,449	2,970	1,355	2,929	2	19,539	39,170
Mar-23	10,521	1,480	3,013	1,360	2,967	4	19,345	39,231

APPENDIX 2.2
TRAFFIC ZONING SYSTEM

Traffic Study for Kothakota - Kurnool Section of NH-44 in Telangana and Andhra Pradesh

Traffic Zoning System

Zone	Place/Region	District/ State	State
1	Kothakota/Kanayapally/Palem/Rajanagaram/Amadabakalu	Project Corridor: Kothakota-Kurnool (Telangana)	Telangana
2	Mummallapalle/Natavalli/Rayanpet/Ullamkonda		
3	Pebbair/Chelimilla/Thomapalle/Kanchiraopalle/Sheripalli		
4	Rangapur/Beechupalli/Erravalli		
5	Kondair/Jinkalla Palli		
6	Putandoddi/Kodandapur/Vemula/Dharmavaram		
7	Boravalle/Jallapur/Itkyalpadu/Narayanpur/Vallur		
8	Pullur/Undavelly/Bhairapur		
9	Panchalingala/Managalapadu/Mamudala Padu	Project Corridor: Kothakota-Kurnool (Andhra Pradesh)	Andhra Pradesh
10	Kurnool		
11	Penchikalapadu/Salakapuram/Peddapadu	Kurnool District	
12	Chinna Tekaru/Dupadu/Bastipadu		
13	Yemmiganur/Mantralayam		
14	Dhone		
15	Orvakul/Nannur		
16	Nandyala		
17	Atmakur/Nandikotkur		
18	Aspari/ Alur/ Pattikonda		
19	Gondiparla		
20	Cement Nagar/ Thammarajupalli/ Banaganapalli/ Betamcherla/ Kolimigundla		
21	Anantapur/ Gooty		
22	Kadapa	Kadapa District	
23	Nellore	Nellore District	
24	Tirupati/Sri Kalahasti	Chittoor District	
25	Ongole	Prakasam District	
26	Vijaywada/Guntur	Krishna/Guntur District	
27	Vishakhapatnam/Rajahmundry/Kakinada	Vishakhapatnam/East & West Godavari	
28	Rest of Andhra Pradesh	Rest of Andhra Pradesh	
29	Gadwal	Jogulamba Gadwal District	Telangana
30	Alampur	Jogulamba Gadwal District	
31	Wanaparthy/ Nagarkurnool	Mahbubnagar District	
32	Mahbubnagar/ Jadcherla/ Shadnagar/ Balanagar	Mahbubnagar District	
33	Narayanpet	Narayanpet District	
34	Hyderabad/ Secunderabad	Hyderabad District	
35	Khammam/Nalgonda/Suryapet	Khammam/ Nalgonda/ Suryapet Districts	
36	Warangal	Warangal District	
37	Karimnagar/Jagtial	Karimnagar District	
38	Nizamabad	Nizamabad District	
39	Nirmal	Nirmal District	
40	Adilabad	Adilabad District	
41	Mancherial	Mancherial District	
42	Rest of Telangana	Rest of Telangana	
43	Raichur	Raichur District	Karnataka
44	Ballari	Ballari District	
45	Kalaburagi/ Humnabad/ Bidar	Kalaburagi/ Humnabad District	
46	Vijayapura/ Bagalkote	Vijayapura/ Bagalkote District	
47	Hubli/Belagavi	Dharwad/Belagavi District	
48	Bengaluru	Bengaluru District	
49	Mysuru	South Karnataka	
50	Devanagere/ Chitradurga/ Tumakuru/ Rest of Karnataka		
51	Chennai/ Chennai Port/ Ennore/ Kattupalli	North Tamil Nadu	Tamil Nadu
52	Vellore/ Ranipet/ Arcot/ Tiruttani/ Kanchipuram		
53	Coimbatore/ Erode/ Salem/ Krishnagiri/ Hosur	West Tail Nadu	
54	Madurai/ Dindigul/ Tirunelveli/ Nagercoil/ Kanyakumari/Rameshwaram	South Tamil Nadu	
55	Trichy/ Rest of Tamil Nadu	Trichy/ Rest of Tamil Nadu District	
56	Puducherry	Puducherry	Puducherry
57	Thiruvananthapuram/ Kollam	South Kerala	Kerala
58	Kochi/ Ernakulam/ Thrissur/ Alappuzha/ Alleppey/ Kottayam	Central Kerala	
59	Kannur/ Kozhikode/ Rest of Kerala	North Kerala	
60	Nanded	Districts of Maharashtra	Maharashtra
61	Solapur		
62	Nagpur/Yavatmal/Amravati/Chandrapur/ Wardha/ Akola/ Bhandara		
63	Aurangabad/Jalna/Jalgaon/ Dhule		
64	Ahmednagar/ Shirdi		
65	Satara/Kolhapur/ Sangli		
66	Mumbai		
67	Mumbai JNPT/ Port		
68	Pune		
69	Nashik		
70	Rest of Maharashtra		
71	Raipur/Bilaspur/ Ambikapur	Districts of Chhattisgarh	Chhattisgarh
72	Durg/Bhilai		
73	Rest of Chhattisgarh		
74	Sambalpur/ Roukela/ Jharsuguda	Districts of Odisha	Odisha
75	Bhubaneshwar/ Cuttak/ Puri/ Rest of Odisha		
76	Indore/Bhopal/ Ujjain/ Guna/ Gwalior	Indore/Bhopal District	Madhya Pradesh
77	Jabalpur/ Rewa/ Katni/ Rest of Madhya Pradesh	Rest of Madhya Pradesh	
78	Surat/ Hazira/ Bharuch	South Gujarat	Gujarat
79	Ahmedabad /Gandhinagar	North & Central Gujarat	
80	Vadodara/ Anand/ Godhra		
81	Kandla/ Mundra/ Gandhidham/ Rajkot/ Morbi/ Jamnagar/ Rest of Gujarat	West Gujarat	
82	Jaipur/Ajmer	North Rajasthan	Rajasthan
83	Kota/ Bhilwara/ Chittorgarh/ Udaipur	South Rajasthan	
84	Jodhpur/ Bikaner/ Rest of Rajasthan	West Rajasthan	
85	Delhi	Delhi	Delhi
86	Punjab	Punjab	Punjab
87	Haryana	Haryana	Haryana
88	Agra/ Noida	Agra District	Uttar Pradesh
89	Kanpur	Kanpur District	
90	Lucknow	Lucknow District	
91	Varanasi/ Prayagraj/ Rest of Uttar Pradesh	East Uttar Pradesh	
92	Bihar	Bihar	Bihar
93	Jharkhand	Jharkhand	Jharkhand
94	West Bengal	West Bengal	West Bengal
95	Goa	Goa	Goa
96	Uttarakhand	Uttarakhand	Uttarakhand
97	Himachal Pradesh	Himachal Pradesh	Himachal Pradesh
98	Assam/ Tripura/ Manipur/ Nagaland/ Arunachal Pradesh/ Sikkim/ Meghalaya/ Mizoram	North Eastern States	North Eastern States
99	Jammu & Kashmir/ Ladakh	Jammu & Kashmir/ Ladakh	Jammu & Kashmir/ Ladakh

APPENDIX 2.3
MODE WISE TOP 20 OD PAIRS

Traffic Study for Kothaota - Kurnool Section of NH-44 in Telangana and Andhra Pradesh

Top 20 Origin Destination Pairs at TP01-Pullur Toll Plaza

Car/ Jeep

S.No.	Origin	Destination	% of total
1	Kurnool	Hyderabad/ Secunderabad	27%
2	Kurnool	Gadwal	9%
3	Hyderabad/ Secunderabad	Bengaluru	6%
4	Tirupati/Sri Kalahasti	Hyderabad/ Secunderabad	6%
5	Anantapur/ Gooty	Hyderabad/ Secunderabad	5%
6	Kurnool	Alampur	4%
7	Kadapa	Hyderabad/ Secunderabad	3%
8	Kurnool	Mahbubnagar/ Jadcherla/ Shadnagar/ Balanagar	3%
9	Kurnool	Wanaparthy/ Nagarkurnool	2%
10	Nandyala	Hyderabad/ Secunderabad	2%
11	Boravalle/Jallapur/Itkyalpadu/Narayanpur/Vallur	Kurnool	1%
12	Pebbair/Chelimilla/Thomapalle/Kanchiraopalle/Sheripalli	Kurnool	1%
13	Tirupati/Sri Kalahasti	Warangal	1%
14	Anantapur/ Gooty	Mahbubnagar/ Jadcherla/ Shadnagar/ Balanagar	1%
15	Hyderabad/ Secunderabad	Ballari	1%
16	Kurnool	Raichur	1%
17	Anantapur/ Gooty	Gadwal	1%
18	Rangapur/Beechupalli/Erravalli	Kurnool	1%
19	Hyderabad/ Secunderabad	Trichy/ Rest of Tamil Nadu	1%
20	Kothakota/Kanayapally/Palem/Rajanagaram/Amadabakalu	Kurnool	1%
		Total	**76%**

Mini Bus

S.No.	Origin	Destination	% of total
1	Anantapur/ Gooty	Hyderabad/ Secunderabad	20%
2	Pebbair/Chelimilla/Thomapalle/Kanchiraopalle/Sheripalli	Kurnool	8%
3	Kurnool	Mahbubnagar/ Jadcherla/ Shadnagar/ Balanagar	8%
4	Tirupati/Sri Kalahasti	Hyderabad/ Secunderabad	8%
5	Kurnool	Hyderabad/ Secunderabad	7%
6	Kurnool	Gadwal	4%
7	Cement Nagar/ Thammarajupalli/ Banaganapalli/ Betamcherla/ Kolimigundla	Hyderabad/ Secunderabad	4%
8	Hyderabad/ Secunderabad	Bengaluru	4%
9	Hyderabad/ Secunderabad	Devanagere/ Chitradurga/ Tumakuru/ Rest of Karnataka	4%
10	Panchalingala/Managalapadu/Mamudala Padu	Hyderabad/ Secunderabad	3%
11	Kurnool	Alampur	3%
12	Dhone	Hyderabad/ Secunderabad	3%
13	Nandyala	Hyderabad/ Secunderabad	3%
14	Atmakur/Nandikotkur	Alampur	3%
15	Atmakur/Nandikotkur	Hyderabad/ Secunderabad	3%
16	Aspari/ Alur/ Pattikonda	Hyderabad/ Secunderabad	3%
17	Kadapa	Alampur	3%
18	Khammam/Nalgonda/Suryapet	Bengaluru	3%
19	Khammam/Nalgonda/Suryapet	Chennai/ Chennai Port/ Ennore/ Kattupalli	3%
		Total	**100%**

Bus

S.No.	Origin	Destination	% of total
1	Kurnool	Hyderabad/ Secunderabad	32%
2	Kurnool	Gadwal	17%
3	Hyderabad/ Secunderabad	Bengaluru	8%
4	Kurnool	Wanaparthy/ Nagarkurnool	7%
5	Nandyala	Hyderabad/ Secunderabad	5%
6	Tirupati/Sri Kalahasti	Hyderabad/ Secunderabad	4%
7	Anantapur/ Gooty	Hyderabad/ Secunderabad	4%
8	Kurnool	Mahbubnagar/ Jadcherla/ Shadnagar/ Balanagar	3%
9	Kadapa	Hyderabad/ Secunderabad	3%
10	Kurnool	Raichur	2%
11	Pebbair/Chelimilla/Thomapalle/Kanchiraopalle/Sheripalli	Kurnool	1%
12	Anantapur/ Gooty	Gadwal	1%
13	Atmakur/Nandikotkur	Hyderabad/ Secunderabad	1%
14	Rangapur/Beechupalli/Erravalli	Kurnool	1%
15	Hyderabad/ Secunderabad	Trichy/ Rest of Tamil Nadu	1%
16	Dhone	Hyderabad/ Secunderabad	1%
17	Nandyala	Gadwal	1%
18	Cement Nagar/ Thammarajupalli/ Banaganapalli/ Betamcherla/ Kolimigundla	Hyderabad/ Secunderabad	1%
19	Tirupati/Sri Kalahasti	Warangal	1%
20	Kothakota/Kanayapally/Palem/Rajanagaram/Amadabakalu	Kurnool	0%
		Total	**91%**

Traffic Study for Kothaota - Kurnool Section of NH-44 in Telangana and Andhra Pradesh

Top 20 Origin Destination Pairs at TP01-Pullur Toll Plaza			
Mini LCV			
S.No.	**Origin**	**Destination**	**% of total**
1	Kurnool	Hyderabad/ Secunderabad	25%
2	Kurnool	Gadwal	12%
3	Hyderabad/ Secunderabad	Bengaluru	8%
4	Kurnool	Alampur	6%
5	Kurnool	Mahbubnagar/ Jadcherla/ Shadnagar/ Balanagar	3%
6	Anantapur/ Gooty	Hyderabad/ Secunderabad	3%
7	Kurnool	Wanaparthy/ Nagarkurnool	3%
8	Nandyala	Hyderabad/ Secunderabad	2%
9	Kurnool	Raichur	2%
10	Rangapur/Beechupalli/Erravalli	Kurnool	2%
11	Pebbair/Chelimilla/Thomapalle/Kanchiraopalle/Sheripalli	Kurnool	2%
12	Hyderabad/ Secunderabad	Chennai/ Chennai Port/ Ennore/ Kattupalli	2%
13	Kadapa	Hyderabad/ Secunderabad	1%
14	Putandoddi/Kodandapur/Vemula/Dharmavaram	Kurnool	1%
15	Pullur/Undavelly/Bhairapur	Kurnool	1%
16	Boravalle/Jallapur/Itkyalpadu/Narayanpur/Vallur	Kurnool	1%
17	Tirupati/Sri Kalahasti	Hyderabad/ Secunderabad	1%
18	Hyderabad/ Secunderabad	Devanagere/ Chitradurga/ Tumakuru/ Rest of Karnataka	1%
19	Mahbubnagar/ Jadcherla/ Shadnagar/ Balanagar	Bengaluru	1%
20	Dhone	Wanaparthy/ Nagarkurnool	1%
		Total	**77%**
LCV			
S.No.	**Origin**	**Destination**	**% of total**
1	Kurnool	Hyderabad/ Secunderabad	17%
2	Hyderabad/ Secunderabad	Bengaluru	13%
3	Anantapur/ Gooty	Hyderabad/ Secunderabad	7%
4	Kurnool	Gadwal	5%
5	Kadapa	Hyderabad/ Secunderabad	4%
6	Hyderabad/ Secunderabad	Chennai/ Chennai Port/ Ennore/ Kattupalli	3%
7	Hyderabad/ Secunderabad	Trichy/ Rest of Tamil Nadu	3%
8	Nandyala	Hyderabad/ Secunderabad	2%
9	Kurnool	Mahbubnagar/ Jadcherla/ Shadnagar/ Balanagar	2%
10	Kurnool	Wanaparthy/ Nagarkurnool	2%
11	Tirupati/Sri Kalahasti	Hyderabad/ Secunderabad	2%
12	Kurnool	Raichur	1%
13	Cement Nagar/ Thammarajupalli/ Banaganapalli/ Betamcherla/ Kolimigundla	Hyderabad/ Secunderabad	1%
14	Bengaluru	Rest of Maharashtra	1%
15	Hyderabad/ Secunderabad	Devanagere/ Chitradurga/ Tumakuru/ Rest of Karnataka	1%
16	Kurnool	Alampur	1%
17	Hyderabad/ Secunderabad	Mysuru	1%
18	Hyderabad/ Secunderabad	Coimbatore/ Erode/ Salem/ Krishnagiri/ Hosur	1%
19	Kurnool	Rest of Maharashtra	1%
20	Bengaluru	Nagpur/Yavatmal/Amravati/Chandrapur/ Wardha/ Akola/ Bhandara	1%
		Total	**68%**

Traffic Study for Kothaota - Kurnool Section of NH-44 in Telangana and Andhra Pradesh

Top 20 Origin Destination Pairs at TP01-Pullur Toll Plaza

Truck

S.No.	Origin	Destination	% of total
1	Kurnool	Hyderabad/ Secunderabad	14%
2	Hyderabad/ Secunderabad	Bengaluru	11%
3	Hyderabad/ Secunderabad	Chennai/ Chennai Port/ Ennore/ Kattupalli	5%
4	Hyderabad/ Secunderabad	Trichy/ Rest of Tamil Nadu	4%
5	Bengaluru	Delhi	4%
6	Anantapur/ Gooty	Hyderabad/ Secunderabad	3%
7	Kadapa	Hyderabad/ Secunderabad	3%
8	Nandyala	Hyderabad/ Secunderabad	3%
9	Kurnool	Gadwal	2%
10	Kurnool	Mahbubnagar/ Jadcherla/ Shadnagar/ Balanagar	2%
11	Hyderabad/ Secunderabad	Devanagere/ Chitradurga/ Tumakuru/ Rest of	1%
12	Kurnool	Alampur	1%
13	Bengaluru	Haryana	1%
14	Chennai/ Chennai Port/ Ennore/ Kattupalli	Rest of Maharashtra	1%
15	Kurnool	Delhi	1%
16	Cement Nagar/ Thammarajupalli/ Banaganapalli/	Hyderabad/ Secunderabad	1%
17	Kadapa	Mahbubnagar/ Jadcherla/ Shadnagar/ Balanagar	1%
18	Chennai/ Chennai Port/ Ennore/ Kattupalli	Mumbai	1%
19	Gadwal	Bengaluru	1%
20	Chennai/ Chennai Port/ Ennore/ Kattupalli	Delhi	1%
		Total	**61%**

3A

S.No.	Origin	Destination	% of
1	Hyderabad/ Secunderabad	Bengaluru	12%
2	Kurnool	Hyderabad/ Secunderabad	11%
3	Hyderabad/ Secunderabad	Chennai/ Chennai Port/ Ennore/ Kattupalli	6%
4	Hyderabad/ Secunderabad	Trichy/ Rest of Tamil Nadu	3%
5	Bengaluru	Delhi	3%
6	Anantapur/ Gooty	Hyderabad/ Secunderabad	2%
7	Kadapa	Hyderabad/ Secunderabad	2%
8	Nandyala	Hyderabad/ Secunderabad	2%
9	Kurnool	Gadwal	2%
10	Hyderabad/ Secunderabad	Kannur/ Kozhikode/ Rest of Kerala	2%
11	Tirupati/Sri Kalahasti	Hyderabad/ Secunderabad	2%
12	Cement Nagar/ Thammarajupalli/ Banaganapalli/	Hyderabad/ Secunderabad	1%
13	Kurnool	Delhi	1%
14	Hyderabad/ Secunderabad	Devanagere/ Chitradurga/ Tumakuru/ Rest of	1%
15	Kurnool	Mahbubnagar/ Jadcherla/ Shadnagar/ Balanagar	1%
16	Kurnool	Alampur	1%
17	Chennai/ Chennai Port/ Ennore/ Kattupalli	Rest of Maharashtra	1%
18	Chennai/ Chennai Port/ Ennore/ Kattupalli	Delhi	1%
19	Coimbatore/ Erode/ Salem/ Krishnagiri/ Hosur	Delhi	1%
20	Hyderabad/ Secunderabad	Mysuru	1%
		Total	**57%**

MAV

S.No.	Origin	Destination	% of
1	Hyderabad/ Secunderabad	Bengaluru	10%
2	Kurnool	Hyderabad/ Secunderabad	10%
3	Hyderabad/ Secunderabad	Chennai/ Chennai Port/ Ennore/ Kattupalli	4%
4	Bengaluru	Delhi	4%
5	Hyderabad/ Secunderabad	Trichy/ Rest of Tamil Nadu	3%
6	Kurnool	Gadwal	3%
7	Kurnool	Alampur	2%
8	Kadapa	Hyderabad/ Secunderabad	2%
9	Bengaluru	Nagpur/Yavatmal/Amravati/Chandrapur/ Wardha/	2%
10	Anantapur/ Gooty	Hyderabad/ Secunderabad	2%
11	Kurnool	Wanaparthy/ Nagarkurnool	1%
12	Chennai/ Chennai Port/ Ennore/ Kattupalli	Kandla/ Mundra/ Gandhidham/ Rajkot/ Morbi/	1%
13	Chennai/ Chennai Port/ Ennore/ Kattupalli	Delhi	1%
14	Nandyala	Hyderabad/ Secunderabad	1%
15	Bengaluru	Haryana	1%
16	Tirupati/Sri Kalahasti	Hyderabad/ Secunderabad	1%
17	Kurnool	Mahbubnagar/ Jadcherla/ Shadnagar/ Balanagar	1%
18	Hyderabad/ Secunderabad	Thiruvananthapuram/ Kollam	1%
19	Bengaluru	Rest of Maharashtra	1%
20	Chennai/ Chennai Port/ Ennore/ Kattupalli	Mumbai	1%
		Total	**52%**

Report
May 2023

Project Drone III: Traffic and Revenue due diligence – Agra Bypass: Raibha Toll Plaza

National Highway Infra Projects Private Limited (NHIPPL)
May 2023
Our ref: 24265605

steer

Report
May 2023

Project Drone III: Traffic and Revenue due diligence – Agra Bypass: Raibha Toll Plaza

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Our ref: 24265605

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Disclaimer

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While the estimates contained in the Report are not precise forecasts, they do represent, in our view a reasonable expectation of the future, based on information we have been provided with or sourced. However, the estimates necessarily rely on numerous assumptions and judgements, and circumstances may occur over the timeframe of the project that go counter to these assumptions and judgements and that affect the project's realized revenues. Actual events may differ from those assumed, and events are subject to change. Therefore, Steer makes or provides no warranty, whether implied or otherwise, as to the accuracy of forward-looking information presented. Further, it is important to note that forecasts presented represent long term growth profiles; the results for individual time periods may vary from forecasted values.

Traffic Consultant developed the relationships in the models used to produce the forecasts for the projects based on data available through March 2023. Since March 2020, the outbreak of the virus known as COVID- 19 has spread throughout the world and has been defined by the World Health Organization as a "pandemic". The COVID-19 outbreak had a material impact on global economic and political affairs including having a significant impact on all the transportation industries, including toll road traffic, where in particular vehicle volumes fell in response to quarantine and self-care measures that governments imposed as a response to the different waves of infection rates in different parts of the country.

As of the date of distribution of this Report, the COVID-19 outbreak is continuing to have a material and uncertain impact on economic and political affairs in some jurisdictions, which may have a significant impact on the transportation sector including the actual usage of tolled highways. In such jurisdictions, these factors may introduce additional uncertainty into forward looking outputs included in our Report. Further, there are a wide range of views by authoritative sources concerning future travel patterns post-COVID, which adds uncertainty to forecasting in this regard.

As a result, no assurance can be provided by Traffic Consultant that the scenarios and assumptions Traffic Consultant has identified will prove to be accurate. Given the uncertainty inherent in this unprecedented pandemic, Traffic Consultant advises that all readers of the Reports consider the Reports in the context of their own assessment of the impact of COVID-19 on travel patterns post-COVID.

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Glossary Items

Acronym	Meaning
2A	2-Axle
3A	3-Axle
AADC	Annual Average Daily Collection
AADT	Annual Average Daily Traffic
ADT	Average Daily Traffic
AB	Agra Bypass
BCF	Base Correction Factor
CAGR	Compound Annual Growth Rate
CJV	Cars / Jeeps / Vans
CPI	Consumer Price Index
Cr	Crore
COD	Commercial Operations Date
DPR	Detailed Project Report
DME	Delhi Mumbai Expressway
EME	Earth Moving Equipment
EDFC	Eastern Dedicated Freight corridor
ETC	Electronic Toll Collection
FY	Financial Year
GDP	Gross Domestic Product
GJC	Generalised Journey Cost
GSDP	Gross State Domestic Product
HCM	Heavy Commercial Vehicles
IAOI	Immediate Area of Influence
IHMCL	Indian Highways Management Company Limited
INR	Indian Rupee
LCV	Light Commercial Vehicles
LoS	Level of Service
MADT	Monthly Average Daily Traffic
MAV	Multi Axle Vehicle
MLCV	Mini LCV
NH	National Highway

Acronym	Meaning
NHAI	National Highways Authority of India
NHIPPL	National Highways Infra Projects Private Limited
NPV	Net Present Value
OD	Origin Destination
OSV	Over Sized Vehicle
PCI	Per Capita Income
PCU	Passenger Car Unit
RFID	Radio Frequency Identification
RoS	Rest of State
SH	State Highway
T&R	Traffic and Revenue
TMS	Traffic Management System
TP	Toll Plaza
TVC	Traffic Volume Count
VOC	Vehicle Operating Costs
VOT	Value of Time
WADT	Weekly Average Daily Traffic
WDFC	Western Dedicated Freight corridor
WPI	Wholesale Price Index
YTD	Year to Date

Executive Summary for Agra Bypass connecting NH19 to NH14 ('Asset')

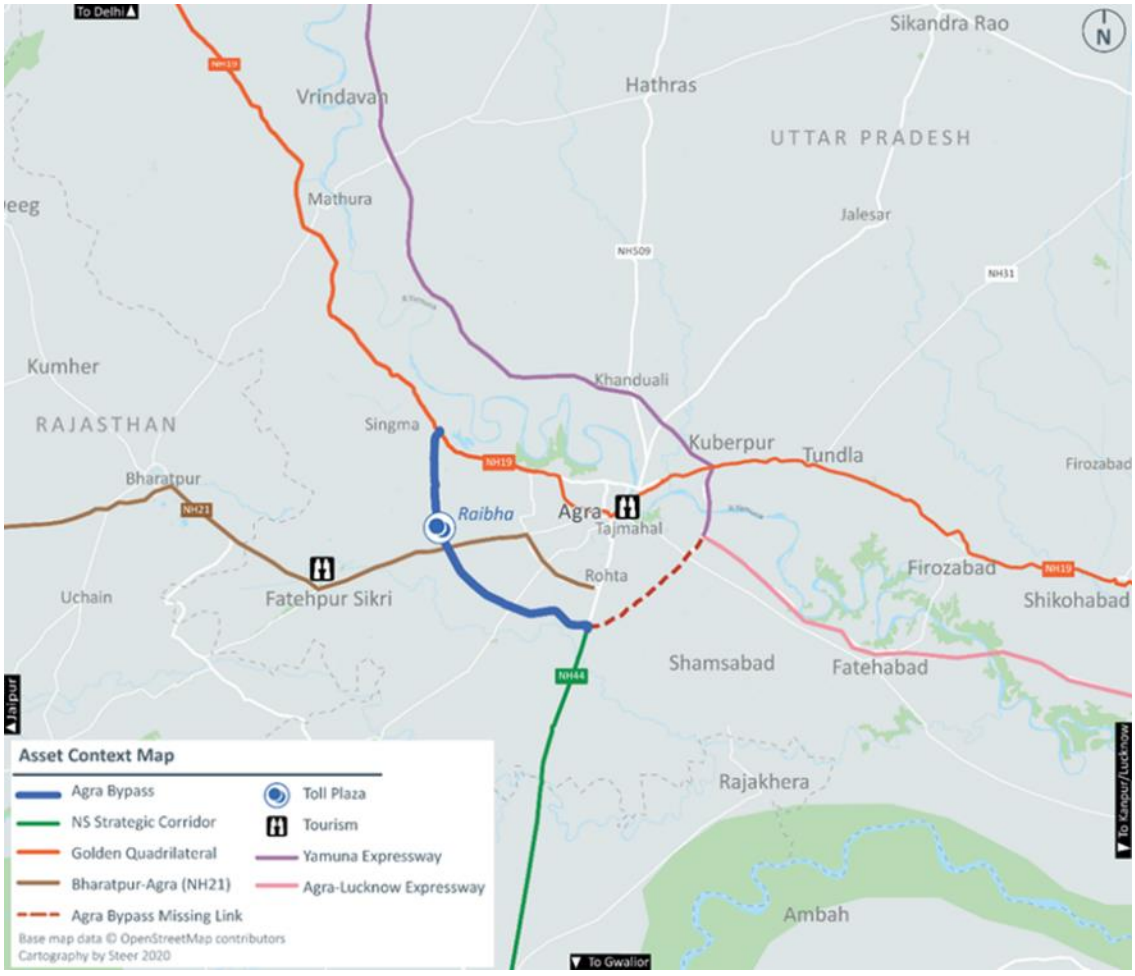
Project overview

The Asset is a 32.8 km four-lane road, forming part of the section connecting NH19 (old NH2) to NH44 (old NH7) in Uttar Pradesh, branches out to NH52 (old NH3) and NH44 (old NH7) at Gwalior. The Asset lies on the outskirts of Agra, bypassing the city and acting as a key connection between Delhi to the regions of Gwalior and south. It further connects the traffic originating from west from areas such as Gujarat and Jaipur to the cities in the East (Kanpur, Lucknow and beyond), thereby supporting the east-west movement.

There is one toll plaza on the asset and is located at and is shown in the map below:

- TP1 Raibha (KM 10.800)

Figure: Asset context - AB: Raibha



Source: Steer cartography using OpenStreetMap data

Salient growth features and traffic generators

The Asset is present in the agrarian state of Uttar Pradesh, the most populous state in India with a population of nearly 200 million people. AB forms part of the section connecting NH19 to NH44, later branching out to NH52 and NH44 at Gwalior.

The Asset caters to the demands generated by the states connected through the above-mentioned highways. NH19 runs over 1,465 kms completing the east – west movement and

connects some of the major states and industrial centres of Delhi, Haryana, Uttar Pradesh with the eastern states of Bihar, Jharkhand, and West Bengal. On the contrary, NH44 completes the north-south movement of the country as it connects the northern states/UTs of Jammu and Kashmir, Punjab, Haryana, Delhi, Uttar Pradesh, Rajasthan, Madhya Pradesh, Maharashtra with the southern states of Telangana, Andhra Pradesh, Karnataka, and Tamil Nadu. Following a parallel route with NH44, NH52 starts in Punjab and ends in Karnataka.

The Asset lies on the outskirts of Agra which has several small and medium-scale industries and is one of the prime centres of the handloom, plastic pallets, and automotive spares, in addition to being a key tourist destination because of the Taj Mahal. Numerous major tourist attractions also exist in the vicinity of the Asset. Agra, Mathura, Fatehpur Sikri and other towns in the region are home to several historical monuments, places of worship and heritage sites.

Mathura, in north of the Asset, is a popular tourist place because of its religious importance. There are several industries in Mathura in the sectors of chemicals, manufacturing, production. It also has a refinery which is owned and operated by the state-run Indian Oil Corporation (IOCL) in Uttar Pradesh since 1982. IOCL has recently announced a future strategic plan to use the wind power generated electricity from Rajasthan to produce green hydrogen units in Mathura refinery. The refinery is a vital source of petroleum and related commodities carrying traffic on the Asset.

The Asset acts as a key connection between Delhi NCR and cities in Madhya Pradesh such as Gwalior and Indore, a city in south of the Asset in the state of Madhya Pradesh. Gwalior has an existing industrial area where the economy is driven by textile mills, artificial silk manufacturing plants, handicraft, and hand loom industries, tanning industries, and chemical industries. The city is also home to Gwalior Chemical Industries Limited. The group is primarily into the business of manufacturing and marketing of specialty chemicals, catering to both the domestic and exports customers in the agrochemical, paints and coatings, dyes, and flavour & fragrance industries. Indore has large industrial cluster for automobile and other ancillary industries. Pithampur industrial area is one of the biggest industrial clusters in the country and support large industrial activity.

Several major tourist attractions exist in and around the Asset, with both Delhi and Agra being two of the three nodes part of the Golden Triangle (Delhi, Agra, Jaipur) – one of India's most popular tourist packages for international tourists. Delhi, Agra, Fatehpur Sikri and other towns in the region are home to several historical monuments and heritage sites, including the famed Taj Mahal (Agra).

Religious tourism and pilgrimage sites include Surajkund, Badkhal Lake, ISKON temple (all in and around Central NCR), and Banke Bihari, and other major temples of Mathura and Vrindavan.

Traffic volume and composite of vehicles

Historical traffic data

The toll plaza data, segmented with ticket categories, is available from 1st Apr-21 to 27th Mar-21, which has been used for FY23 base year estimation. For CJV and LCV, the number of exemptions/ violations traffic number is considerable. Therefore, due to unreliability of data, we have considered:

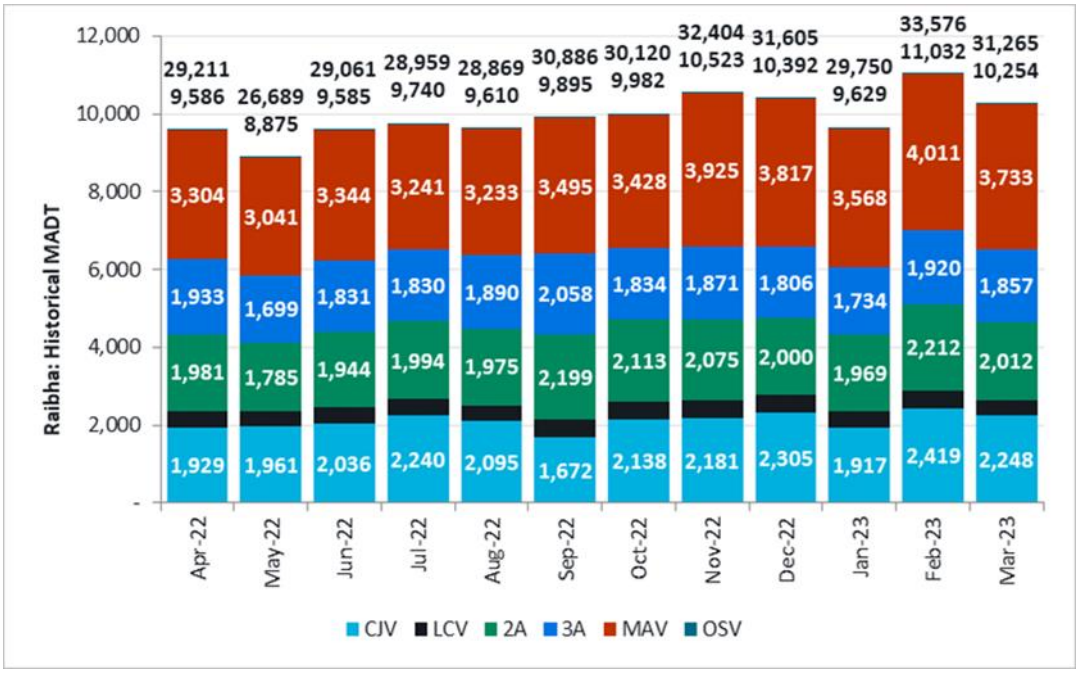
- For CJV and LCV: Cash + ETC data has been used; and for

- Remaining vehicle types (2A, 3A, and MAV): Cash + ETC + exemptions/ violations have been used for historical and base year traffic analysis.

The Asset trends at 29,000-32,000 PCU levels in FY23 with robust truck performance continuing in Q4 FY23. ETC proportion of reported traffic exceeds 95% in the recent months of FY23. The Asset has performed well, recording a PCU growth of ~10.9% in FY23 with respect to FY22N. The traffic is dominated by 3A/MAVs.

On an average, the daily revenue collection on the Asset is ~INR 25 lakhs.

Figure: PCU and MADT for FY23 - AB: Raibha



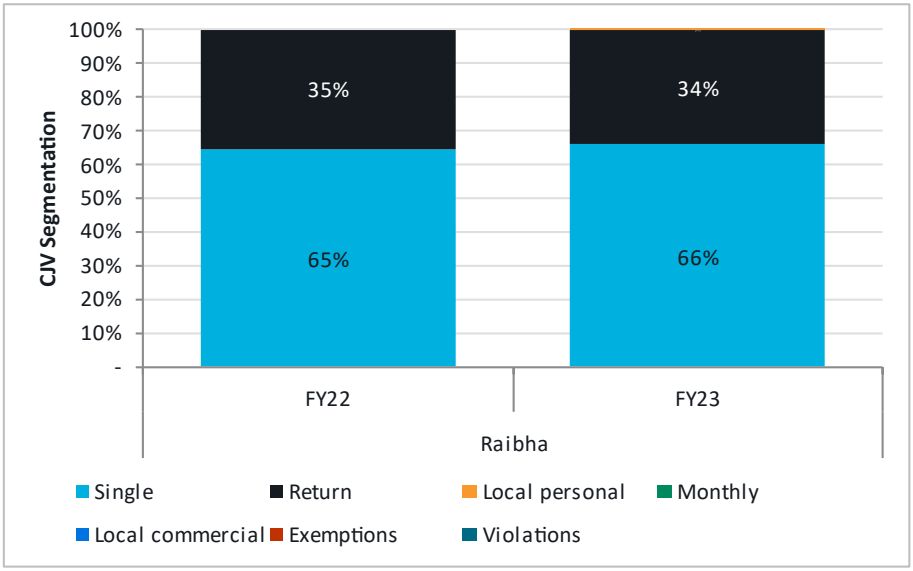
Source: Steer analysis of client toll plaza data

Toll segmentation

On the Asset, CJVs have a considerable share of Return tickets as they primarily cater to short to medium distance movements which might lead to a user crossing the plaza several times in a day.

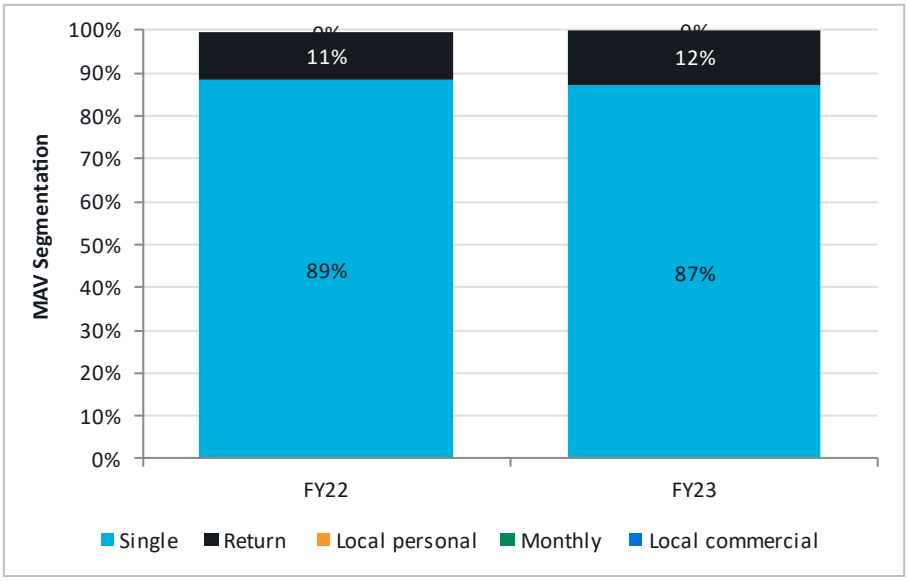
2A, 3A and MAV's report high proportion of single trips, this is further validated by the long trip length of the vehicles as observed in our OD data. 90%-95% of the commercial vehicles plying on the Asset are observed to buy single tickets as the Asset caters to strategic long-distance movements. Return trips are primarily attributed to the short distance trips in the vicinity of the Asset.

Figure: Segmentation CJV -AB: Raibha



Source: Steer analysis

Figure: Segmentation MAV – AB: Raibha

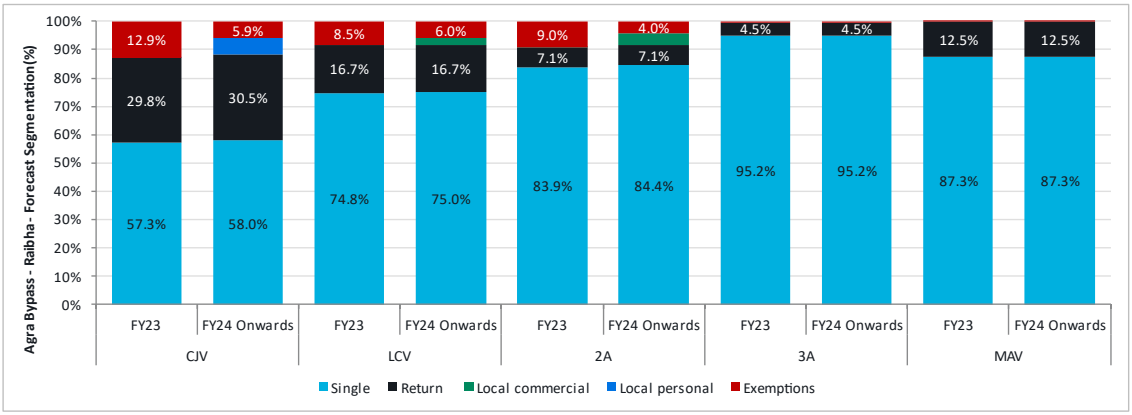


Source: Steer analysis

However, as the above-mentioned segmentation doesn't correctly reflect the share of non-toll paying traffic, i.e., violations and exemptions. The same has been assessed based on the difference between TMS and TVC dataset in the final adopted segmentation.

The final forecast segmentation is shown in the charts below. The changes in forecast toll segmentation observed on toll plaza is due to our understanding that once the Assets are taken over by the Client, the overall reporting practises will improve as the toll plaza will be operated by a reputed toll operator and may result in a decrease in total exemptions. Increasing compliance due to better operational efficiency in the next year will see the number of exemptions decrease further, with a subsequent increase in the Local passes, as well as the Single and Return ticket categories.

Figure: Toll segmentation (%) FY23 onwards– Raibha



Source: Steer analysis

Traffic forecast

The increase of traffic on any existing road alignment depends on how fast the background travel demand (background growth) will grow; and on how successfully the project road is in attracting that traffic (traffic capture). Background travel demand is driven by the prevalent socio-economic conditions in the region, which include:

- Changes in factors such as population, employment, and income distribution
- Economic growth (GSDP, and GDP).
- Growth of local industries near the Asset.

The model uses India GDP and Uttar Pradesh GSDP as the two macro-economic inputs which operate as growth drivers on our base year forecasts.

The network developments near the Asset's alignment which Steer believes would affect traffic on the Asset during the concession period are DME, WDFC, Agra Bypass completion and correction in 3A/ MAV traffic due to completion of local activities.

Steer has developed traffic and revenue forecasts for the Asset by taking into consideration all inputs discussed above – base year estimates, macro-economic assumptions, growth drivers, elasticities, and forecast ticket segmentation. The table below provides the final (background plus impacts) traffic growth on the Asset.

Table: Final (background plus impacts) AADT forecast – AB: Raibha

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	2,174	2,434	3,268	4,319	5,603	6,485
Mini LCV	228	238	269	301	335	355
LCV	480	483	527	590	656	696
Bus	55	56	62	67	73	76
2A	2,154	2,117	2,700	3,207	3,765	4,118
3A	1,854	1,799	2,296	2,885	3,569	4,019
MAV	3,505	3,572	4,852	6,446	8,396	9,735
OSV	3	3	4	5	7	8
AADT	**10,451**	**10,702**	**13,978**	**17,821**	**22,403**	**25,491**

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
PCUs	**31,094**	**31,400**	**41,354**	**53,015**	**66,956**	**76,364**

Table: Final (background plus impacts) AADT CAGR (%) – AB: Raibha

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	5.8%	6.1%	5.7%	5.3%	5.0%	5.6%
Mini LCV	2.3%	2.4%	2.3%	2.1%	2.0%	2.2%
LCV	0.4%	1.7%	2.3%	2.1%	2.0%	1.9%
Bus	1.7%	1.8%	1.7%	1.6%	1.5%	1.7%
2A	(0.9%)	5.0%	3.5%	3.3%	3.0%	3.3%
3A	(1.5%)	5.0%	4.7%	4.3%	4.0%	3.9%
MAV	0.9%	6.3%	5.8%	5.4%	5.1%	5.2%
OSV	5.4%	5.6%	5.3%	4.9%	4.5%	5.2%
AADT	**1.2%**	**5.5%**	**5.0%**	**4.7%**	**4.4%**	**4.6%**
PCU's	**0.5%**	**5.7%**	**5.1%**	**4.8%**	**4.5%**	**4.6%**

Source: Steer analysis

Tollable Length and Toll Rates

In terms of tollable length, the Asset currently (FY24) comprises 7.055 km + 32.094 km bypass length, whereas it was 8.050 km + 31.995 km bypass length in FY23. In India, toll rates are as per notification by the Ministry of Road Transport and Highways in the National Gazette. The present toll rates are determined with reference to the published base toll rates and are adjusted annually at the beginning of each fiscal year equal to 40% of the movement in the wholesale price index in December of the preceding year plus a fixed 3%.

According to the NHAI's toll notification for FY24, i.e., April 1, 2023, onwards, the toll rates at the Raibha toll plaza for Asset are as follows:

Table: FY24 toll rates – AB: Raibha

Vehicle Type	Single	Return	Monthly
CJV	80	120	2630
LCV	130	190	4250
Bus/Truck	265	400	8905
3A	290	435	9715
MAV/ HCM/EME	420	630	13965
OSV	510	765	17000

1 Introduction

1.1 National Highways Infra Projects Private Limited (**'NHIPPL'** or the '**Client'**) has commissioned Steer Davies Gleave India Private Limited (hereafter called '**Steer**') for a Annual review traffic assessment study for the following project road **('Asset').** This Asset include one toll plaza.

- Agra Bypass section connecting NH19 (old NH2) to NH44 (old NH7) in Uttar Pradesh with one toll plaza.

1.2 Further, as part of this study, we have also covered a comparison with the estimates provided in the earlier traffic and revenue due diligence study performed in FY23 (Aug-22) by Steer.

1.3 The National Highways Authority of India (**'NHAI'**) has set up an Infrastructure Investment Trust ('**InvIT**') namely National Highways Infra Trust and is acting as its Sponsor to the said InvIT. The National Highway Infrastructure Investment Managers Private Limited (NHIIMPL) has been incorporated and appointed as the Investment Manager for the proposed InvIT by NHAI and NHIPPL is the entity under NHIIMPL, which is responsible for the operation and maintenance of this Asset.

Table 1.1: Description of Assets

Asset ID	Asset: AB
Asset name	Agra Bypass
State	Uttar Pradesh
NH	NH19 – NH44
Length (km)	32.8 km
Chainage	Km. 00.000 to Km. 32.800
Nos. of toll plaza	1
Toll plaza locations	Raibha at Km 32.800
Operational since*	March 2017
Proposed concession period	20 years (taken over by NHIPPL in Mar'23)
Tollable length (km)	• FY23: 8.050Km + 32Km (bypass) • FY24 onwards: 7.06Km + 32.09Km (bypass)

Source: NHAI

Scope of work

1.4 Our scope of work for carrying out a T&R due diligence exercise covered:

- Review of available data, and concession agreements.
- Primary traffic survey and analysis as per the schedule presented in the table below:
  - 7-days video based classified traffic volume count (TVC).
  - 24 hours origin-destination (OD) survey and commodity analysis

- Assembly of the toll plaza level base data from PIU, where available, and review of the recent growth trends.
- Identify appropriate benchmarks for historical performance, seasonality, ticket type segmentation for the asset.
- Estimate the base traffic and revenue position utilising the above information.
- Establishing traffic growth estimates based on key economic growth drivers such as GDP, GSDP, commodity, etc. and estimating underlying growth elasticities based on these growth drivers.
- Assessing impacts from exogenous factors, including network change impacts.
- Developing traffic forecasts by vehicle class and segmentation categories; and
- Toll revenue estimation for entire concession period.

Table 1.2: Data collection schedule

Survey	AB - Raibha
TVC survey (7 x 24 hours)	28 Feb – 6 Mar 2023
OD survey (1 x 24 hours)	2 Mar 2023

Source: Steer

Our approach

1.5 The approach employed by Steer in the preparation of the traffic and revenue forecasts was developed to take advantage of the existing knowledge of the Asset and of the available data. It follows normal practices well established in addressing the issue of forecasting on-going traffic growth on a brownfield project. The key difference in this exercise as compared to a typical secondary market transaction, where the vendor provides detailed information on the historical performance of their asset, is that the historical traffic and revenue information provided by the client is very limited (and had reporting variations) and therefore less reliable than what could be expected. Therefore, significant efforts had to be put into developing a credible base year position and growth expectations through benchmarking with other asset in close vicinity of the asset under consideration.

1.6 The analysis focused on two sets of issues:

- understanding and verifying the traffic which is, at present, using the Asset; and
- identifying how and why that traffic will change in the future.

1.7 Regarding the former (i.e., current traffic on the asset), independent primary data collection was commissioned as part of this study and then compared against the available traffic data from various sources (as discussed in the table below).

1.8 To arrive at the base position, we have utilised information from various sources – including the toll plaza data shared by NHAI and client, Steer independent primary surveys to validate the network understanding and ensure quality in the data collection process, and our context knowledge, to assess a reasonable demand on the corridor for the base year which formed the basis of future year forecasts.

1.9 Further base year revenue validation exercise has been undertaken to ensure both base traffic and segmentation assumptions are robust.

1.10 This approach is be-spoke for such projects where long time series consistent historical data is not available. Therefore, significant efforts had to be put into developing a credible base year position and growth expectations.

1.11 The estimation of future traffic demand on the Asset is driven by:

- Growth of 'background' traffic: this depends to a certain extent on the on-going socio-economic and demographic development of the area served by the Asset; and
- Change in the local and international industry: which drives heavy goods traffic on the Asset; and
- Change in the competitive position of the Asset: this reflects changes in highway capacity of competing roads and the relative changes in service levels (time, congestion, price, etc.) for the Asset, and their competitors.

1.12 The information related to the concession agreements, toll notifications, toll calculations and target revenue and designed capacity was provided as part of the commission.

1.13 We have analysed traffic data from multiple sources as well to understand the current traffic on the Asset. The list of data sources available and discussed in later chapters in detail are presented below:

Table 1.3: List of data sources available

Data sources	Provided by	Agra Bypass (AB)
Monthly toll plaza data sourced by Client (TMS)	Client	Monthly level traffic and revenue starting 1st Apr 2021 up to 27th March 2023.
ETC Daily Data	Client	ETC Daily data from 1 Feb 2023 to 15 Mar 2023.
Toll Notifications	Publicly sourced from NHAI website	Historical and latest toll notification detailing toll computations.
Steer TVC counts	Steer	Commissioned by Steer, 7 days TVC counts from 28 Feb -6 Mar 2023
Origin-Destination (OD) survey	Steer	Commissioned by Steer, 24 hours on 2 Mar 2023

Source: Steer's review of data points

Evolution of Covid19 pandemic in India in FY21 and FY22

1.14 On 24th March 2020, the Central government announced a nationwide 21-day lockdown which was extended for another three weeks until May 3rd. Further extensions until May 17th and again until May 31 featured relaxations in 'green' and 'orange' zones. Starting 8th June 2020, 'Unlock' phases began. States have also taken their own measures, with Central guidelines being the minimum expected restrictions from States. The tolling across all national highways

in India was stopped between 25th March 2020 and 20th April 2020. These lockdowns resulted in significant disruptions to traffic, with a reduction of both commuting trips to work (as people were required to work from home or stay at home) and leisure trips (due to the closure of various entertainment venues, places of worship, tourist destinations, etc.). Goods movements, while still impacted, continued to a lesser extent due to a need to supply essential goods such as food, etc.

1.15 The traffic volumes since then gradually started recovering on most Asset in India, with varying extent. By Q3 of FY21 traffic levels were already at par FY20 AADT numbers and even higher in some cases. The traffic trends observed on most of the India toll roads during Q4FY21, showed sustained traffic levels as were witnessed in Q3FY21, which reflected sustained demand revival in the Indian economy. These traffic levels reflected the longer-term trends of a strong economic recovery, in segments like auto manufacturing, road construction, energy consumption /production etc., are more stable and are driving the growth over and above FY20 levels and are expected to continue as more segments of the economy, like hospitality, tourism, etc., recover fully from the pandemic.

1.16 This second wave of Covid19 was accompanied by various local and state level night curfews and lockdowns starting from April until end of June. The second wave of Covid19, although had a higher infection rate, the movement of traffic and goods was not impacted by the same magnitude as the first wave when whole country went under strict lockdown for two quarters. This can be attributed to the fact that almost all the restrictions were localised or at state level. Moreover, there was no restriction on movement of goods vehicles and other services. As the industries and agricultural activities continued to operate, the truck traffic did not fall as steeply as it did in Q1 FY21. The second half of the year from October'21 showed sustained traffic levels due to the resumption in Economic activities and easing of restrictions.

1.17 Post which, there was a third wave of Covid19 in Jan-Feb'22. It lived for a short period and hence, the impact on traffic was observed only for these two period at some of the toll plazas in India. Since, then there hasn't been any material impact of Covid19 on traffic.

1.18 Therefore, FY23 is considered as normal year and has been considered for base estimation (without any Covid19 specific adjustments) for FY23 which is explained in detail in Chapter 6.

Contents of this Report

1.19 The report has been divided into 6 chapters, including:

- Chapter 2 describes the key features of the Asset.
- Chapter 3 provides a historic traffic and revenue overview of the Asset, and presents all the survey data collection, and analysis.
- Chapter 4 discusses the socio-economic context in the corridors containing the Asset.
- Chapter 5 presents our base year traffic estimates and forecasting assumptions.
- Chapter 6 summarises our key forecasting assumptions, assessment of network impacts, and presents our traffic and revenue forecasts for the Asset.

2 The Asset

Introduction

2.1 This chapter provides a description of the Asset, based on primary data (from site visits), our understanding of the region and network surrounding the Assets. We cover the strategic network context, followed by key economic activities and network developments around the Assets.

Figure 2.1: Asset location

Source: Steer cartography

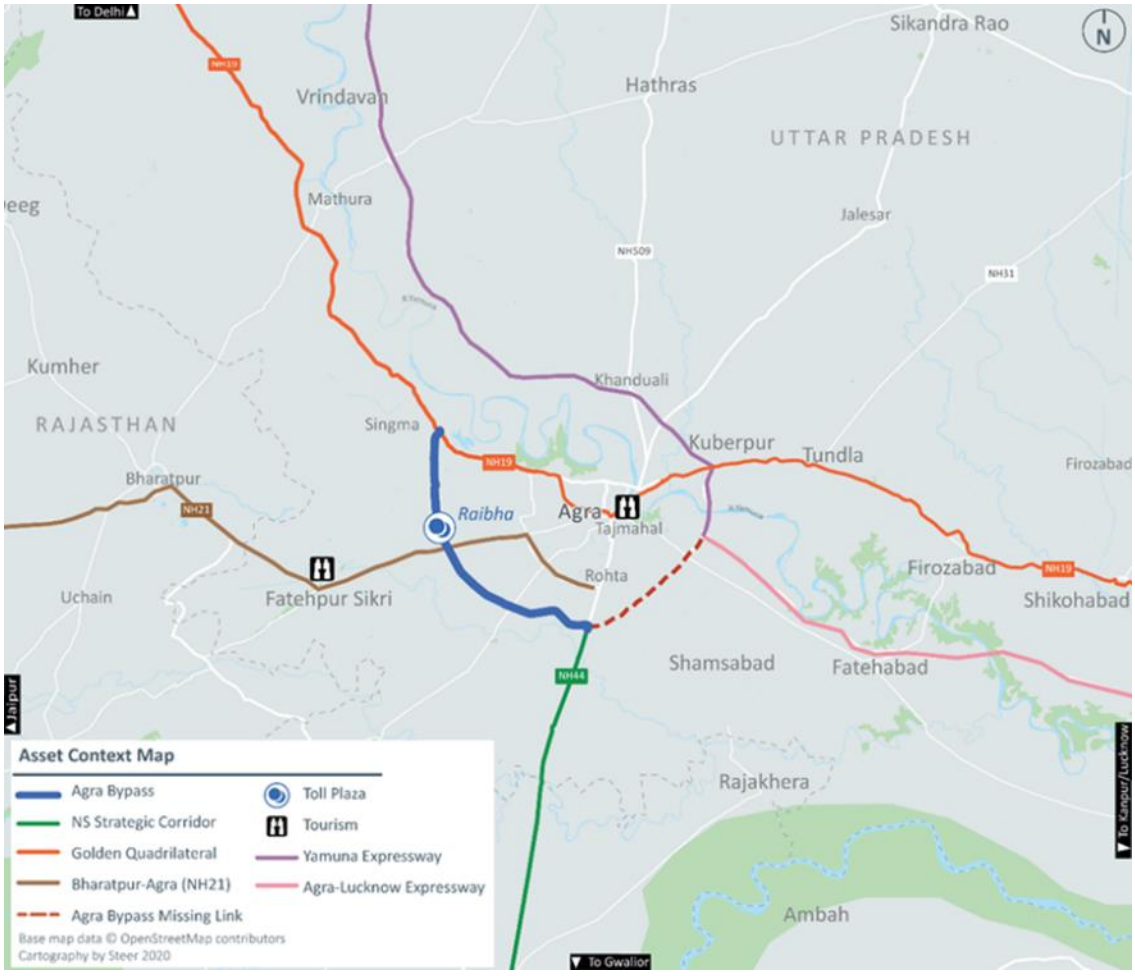
Asset context

Context

2.2 The Asset is a 32.8 km four-lane road, forming part of the section connecting NH19 (old NH2) to NH44 (old NH7) in Uttar Pradesh, branches out to NH52 (old NH3) and NH44 (old NH7) at Gwalior. As per available information, the Asset is in operations since Mar'17. As this Asset acts as a bypass to the city of Agra, structures on the Asset are already 6 laned as this was required as per the construction requirements when the Asset's construction was completed by NHAI's contractors. There is one toll plaza on the asset and is located at and is shown in the map below:

- TP1 Raibha (KM 10.800)

Figure 2.2 Asset context - AB: Raibha



Source: Steer cartography using OpenStreetMap data

2.3 The Asset lies on the outskirts of Agra, bypassing the city and acting as a key connection between Delhi to the regions of Gwalior and south. It further connects the traffic originating from west from areas such as Gujarat and Jaipur to the cities in the East (Kanpur, Lucknow and beyond), thereby supporting the east-west movement.

2.4 As per the figure above, a small section of Agra Bypass is currently incomplete. We do believe that this link will get completed in the due course of time, as pressure on local government and NHAI increases, due to growing urban settlements within Agra.

2.5 Agra has also been in the news for environmental and pollution related reasons impacting Taj Mahal. Similar concerns have been raised for Delhi and Jaipur as well. Two expressways namely Eastern Peripheral Expressway (EPE) and Western Peripheral expressways (KMPE) were built for trucks to bypass Delhi and similarly Jaipur ring road is almost complete now. Once these ring roads have been built the through goods traffic have been forced to take these ring roads to bypass the city. Therefore, we believe there is enough evidence and precedence available that the missing link of the Agra bypass will be built.

2.6 The figures below show a typical cross-section of the Asset and its toll plazas as captured during site visits.

Figure 2.3: Typical cross-sections and toll plazas on the Asset-AB: Raibha

Source: Steer site visit

2.7 The major commodities observed during surveys are manufacturing, courier/parcel, agricultural, and building material. Average trip lengths of more than 1000 kms were observed on the toll plaza, this is validated by the analysis of the OD data.

2.8 The Asset location in the regional context is shown in map below.

Figure 2.4: Asset location in the regional network context

Source: Steer cartography using OpenStreetMap data

2.9 The Asset serves the

- NH19/NH2 – North to Central/Eastern movements originating from Delhi and northern parts of the country (Punjab, Haryana, Himachal Pradesh, Jammu and Kashmir) to the central (UP, Bihar) and eastern (West Bengal, Jharkhand, Chhattisgarh, North-Eastern region) of the country.
- NH2/19 – NH52 and NH44 connection. This is the traditional north south movement between Delhi (and northern states) to destination such as Indore (Madhya Pradesh), Maharashtra, and all southern states. The traffic having OD's to south of the Asset split at Gwalior to use NH52 and NH44 depending on the destination.
  - NH52 (old NH3): predominantly serves the Indore, Nashik, Mumbai movement in addition to movements between Delhi-Bangalore, Goa, and other destinations.
  - NH44 (old NH7): serves the Karnataka, Telangana, Andhra Pradesh, Tamil Nadu, and Kerala movements.
- East-West movements NH21 traffic between Gujarat, Rajasthan, and Kanpur/Lucknow in addition to the Gujarat, Rajasthan – Delhi (and north) movements.

2.10 The traffic profile is predominantly goods vehicles undertaking long distance movements between the locations discussed above. The commodity mix carried by the vehicles observed at the toll plaza during site visit was mix of manufacturing, courier/parcel, automobile, and agriculture confirming the long-distance nature of the traffic.

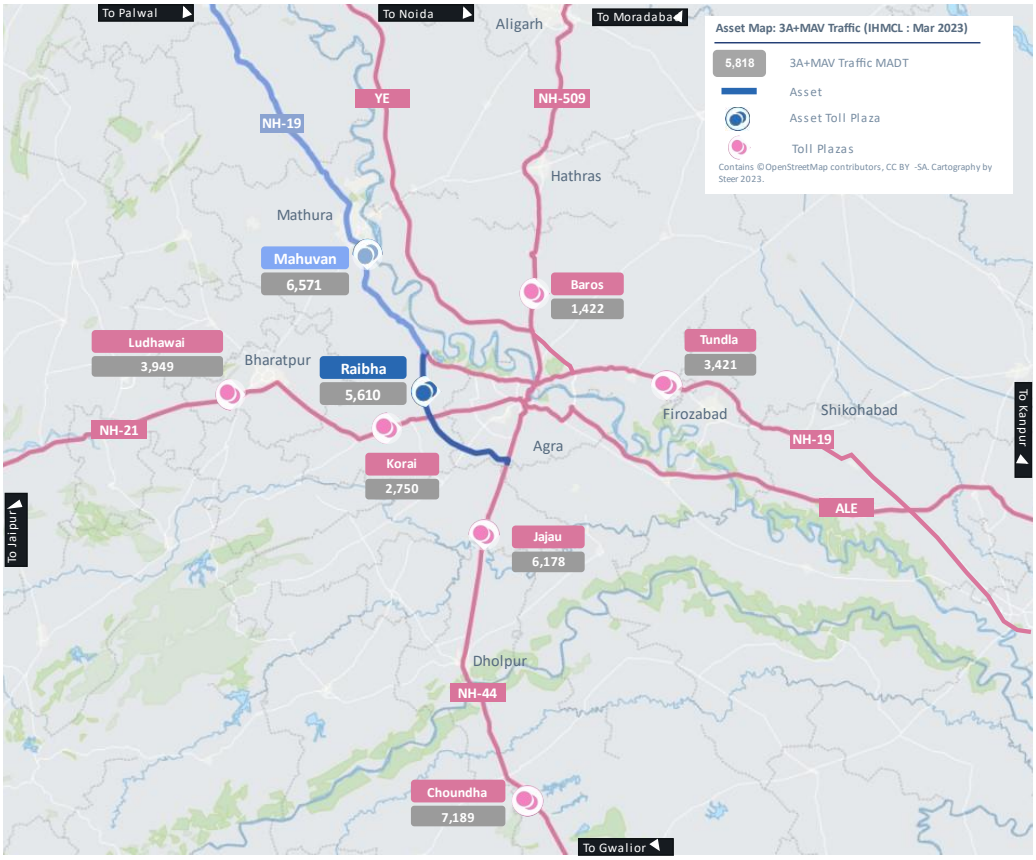
2.11 Proportion of local traffic observed on the toll plaza was lower than the proportion which is both medium and long distance, this is also validated by the OD survey, however some local village movement was observed for light vehicles, in addition movement to local regions such as Agra, Mathura and other surroundings regions was visible as per the OD data. Mathura refinery and Faridabad automobile cluster are a key contributor to regional movement on the Asset. Overall, the Asset serves national long distance strategic traffic.

2.12 This Asset primarily caters to three different types of traffic movements:

- **Short-distance trips** undertaken by passenger vehicles for work/business and tourism trips between Agra, Mathura, Vrindavan towards Morena, Bad, Dhaulpur. Some of the local consumption demand generated by these towns is met by the short distance goods movement on the Asset.
- **Medium-distance trips** undertaken between the urban and industrial centres in vicinity of the Asset in state of Uttar Pradesh as well as in the neighbouring states such as Delhi NCR, Jaipur, Gwalior, East Rajasthan etc. A significant number of medium distance trips are catering to the manufacturing, parcels and couriers related demand from the neighbouring states and the states along NH44 (old NH7).
- **Long-distance trips**, by 3A and MAVs, catering to the movement between urban and industrial centres connecting the northern states of Haryana, Punjab, Uttar Pradesh with the states of Madhya Pradesh (Indore), Maharashtra, Andhra Pradesh, Telangana etc.

2.13 The Asset location in the context of traffic volumes on surrounding assets is shown in map below.

Figure 2.5: Traffic volumes as per IHMCL ETC data for Mar-23



2.14 Asset acts a connecting link for east-west and north-south movements. Majorly it observes long-medium distance traffic plying on NH19-NH44, between north India (NCR) and Hyderabad/ Bangalore/ other southern parts of India. This traffic can be observed both at Mahuvan and Jajau toll plazas. Similarly for the traffic originating in western India, such as Rajasthan (Jodhpur, Ajmer, Jaipur, etc.) and moving towards Meerut, Bareilly, Kanpur, Lucknow direction can be observed at Ludhwai – Korai and Baros/ Tundla/ Agra Lucknow expressway.

Concession and tolling details

2.15 As discussed in chapter 1, the tolling length as per the latest technical schedules available from NHAI refer to a tolling length change. The concession and tolling details are provided in the email below.

Table 2.1: Summary of concession

Asset ID	AB: Raibha
Asset name	Agra Bypass
State	Uttar Pradesh
Length (km)	32.8 km
Chainage	Km. 00.000 of NH – 2/19 to Km. 32.800
Nos. of toll plaza	1
Toll plaza locations	Raibha at Km 32.800
Taken over by NHIPPL in	Mar 2023
Proposed concession period	20 years (Taken over since Mar'23)
Tollable length (km)	FY23: 8.050Km + 32Km (bypass) FY24 onwards: 7.06Km + 32.09Km (bypass)

Source: Information provided in NHAI technical schedules

2.16 The Asset has been recently handed over full control to the client and they have started operating the toll plaza on 9th Mar-23. However, the tolling systems, the AVCC, and other software and hardware equipment being used is still not replaced. The client has informed that the new tolling systems are currently under procurement and will be installed and operational by end of Q2 FY24.

Micro Diversion

2.17 There is a micro diversion near the Raibha flyover just before the toll plaza while coming from Mathura, which can be used by users to avoid paying toll. However, toll plaza guards were deployed to divert the traffic taking the NH21 and bypassing the toll booth. Site visit confirmed good quality road, however only used by local LCVs and very few MAVs with Rajasthan number plates. This has also been confirmed by the traffic report shared by NHAI. This is not seen as a traffic risk to the Asset; however, we believe this continues to remain an issue which the Client will need to manage while operating the toll plaza.

Figure 2.6: Typical cross-sections of the micro diversion near Raibha TP

Source: Steer site visit

Toll plazas and toll rates

2.18 As discussed earlier in section, the Asset has one toll plaza. The toll plaza on the Asset has 5+5 lane configuration on each side for FASTag collection on all lanes for mandatory electronic tolling.

2.19 The road users having valid FASTag installed on their respective vehicles approach the ETC lanes where the installed RFID readers detect the tag and deduct toll charges equalling single trip or for Local/monthly pass/discounts wherever applicable. In case, the RFID reader is not able to detect the FASTag, handheld devices are used to read the vehicle's tag. Further, in cases where FASTag is blacklisted or not working, the user can only buy single cash ticket and are charged twice the single trip fare. The users crossing toll plaza twice within 24 hours automatically get return discount.

2.20 Like the other National Highway plazas, the Asset has Single, Return, Local Commercial, Local Personal, Monthly and Local Monthly tickets. Single toll rates and categories on each of the toll plaza are presented in the table below.

Table 2.2: Toll rates on the Asset (INR), applicable April 2022 to March 2023

Type of Vehicle	Single	Return	Monthly
CJV	75	115	2545
LCV	125	185	4105
Bus/Truck	260	385	8605
3A	280	420	9390
MAV/ HCM/EME	405	605	13495
OSV	495	740	16430

Source: NHAI - User fee Rate w.e.f. 01.04.2022

Table 2.3: Toll rates on the Asset (INR), applicable for FY24

Type of Vehicle	Single	Return	Monthly
CJV	80	120	2630
LCV	130	190	4250
Bus/Truck	265	400	8905

Type of Vehicle	Single	Return	Monthly
3A	290	435	9715
MAV/ HCM/EME	420	630	13965
OSV	510	765	17000

Source: NHAI - User fee Rate w.e.f. 01.04.2023

2.21 The following table shows the change in tolling length.

Table 2.4: Tolling lengths for the Asset

Road	FY23	FY24 onwards
Road length	8.05 Km	7.06 Km
Bypass length	32.00 Km	32.09 Km

Source: NHAI – User fee rate and Schedule-M for FY24 as shared by Client.

Key economic activities

Industrial Influence

2.22 The Asset is present in the agrarian state of Uttar Pradesh, the most populous state in India with a population of nearly 200 million people. AB forms part of the section connecting NH19 to NH44, later branching out to NH52 and NH44 at Gwalior.

2.23 The Asset caters to the demands generated by the states connected through the above-mentioned highways. NH19 runs over 1,465 kms completing the east – west movement and connects some of the major states and industrial centres of Delhi, Haryana, Uttar Pradesh with the eastern states of Bihar, Jharkhand, and West Bengal. On the contrary, NH44 completes the north-south movement of the country as it connects the northern states/UTs of Jammu and Kashmir, Punjab, Haryana, Delhi, Uttar Pradesh, Rajasthan, Madhya Pradesh, Maharashtra with the southern states of Telangana, Andhra Pradesh, Karnataka, and Tamil Nadu. Following a parallel route with NH44, NH52 starts in Punjab and ends in Karnataka.

2.24 The Asset lies on the outskirts of Agra which has several small and medium-scale industries and is one of the prime centres of the handloom, plastic pallets, and automotive spares, in addition to being a key tourist destination because of the Taj Mahal. Numerous major tourist attractions also exist in the vicinity of the Asset. Agra, Mathura, Fatehpur Sikri and other towns in the region are home to several historical monuments, places of worship and heritage sites.

2.25 Mathura, in north of the Asset, is a popular tourist place because of its religious importance. There are several industries in Mathura in the sectors of chemicals, manufacturing, production. It also has a refinery which is owned and operated by the state-run Indian Oil Corporation (IOCL) in Uttar Pradesh since 1982. IOCL has recently announced a future strategic plan to use the wind power generated electricity from Rajasthan to produce green hydrogen units in Mathura refinery. The refinery is a vital source of petroleum and related commodities carrying traffic on the Asset.

2.26 The Asset acts as a key connection between Delhi NCR and cities in Madhya Pradesh such as Gwalior and Indore, a city in south of the Asset in the state of Madhya Pradesh. Gwalior has an existing industrial area where the economy is driven by textile mills, artificial silk manufacturing plants, handicraft, and hand loom industries, tanning industries, and chemical industries. The city is also home to Gwalior Chemical Industries Limited. The group is primarily

into the business of manufacturing and marketing of specialty chemicals, catering to both the domestic and exports customers in the agrochemical, paints and coatings, dyes, and flavour & fragrance industries. Indore has large industrial cluster for automobile and other ancillary industries. Pithampur industrial area is one of the biggest industrial clusters in the country and support large industrial activity.

Tourism Influence

2.27 Several major tourist attractions exist in and around the Asset, with both Delhi and Agra being two of the three nodes part of the Golden Triangle (Delhi, Agra, Jaipur) – one of India's most popular tourist packages for international tourists. Delhi, Agra, Fatehpur Sikri and other towns in the region are home to several historical monuments and heritage sites, including the famed Taj Mahal (Agra).

2.28 Religious tourism and pilgrimage sites include Surajkund, Badkhal Lake, ISKON temple (all in and around Central NCR), and Banke Bihari, and other major temples of Mathura and Vrindavan.

Network developments

2.29 The section below details the impacts which we believe would influence the traffic levels on the Assets during the concession period.

2.30 The subsections below include a narrative of each of the network and infrastructure improvements, which are expected to impact the traffic on the Asset.

Western Dedicated Freight Corridor

2.31 The Government of India has plans to develop two Dedicated Freight Rail Corridors: The Western Dedicated Freight Corridor (WDFC) linking Dadri, east of Delhi, to Mumbai and the Eastern Dedicated Freight Corridor (EDFC) linking Ludhiana to Dankuni in West Bengal.

2.32 We estimate that on completion of WDFC, the relevant goods carried via roads will shift to rail, causing a reduction in traffic volume on the corridor. As per the DFC website, base commodities which are expected to be carried on WDFC include containers, POL, fertilizers, iron & steel and cement, groceries, agricultural products such as food grains, among other bulk commodities and travelling more than 750Kms to Rail from Road. Additional commodities such as manufacturing, chemicals, courier/parcel, and other ecommerce related commodities will also have an alternate to shift to the DFC. However, these commodities may take a longer duration to shift since related first mile and last mile connectivity infrastructure needs to be developed for seamless loading/unloading process. The Rewari to Palanpur section of the DFC commissioned in April 2021 and first RO-RO service from Palanpur was flagged off in August 2021. Whereas, the Dadri-Rewari section has undergone trial runs on the section in Mar-23. The completion of the WDFC is expected to negatively affect traffic on the Asset.

Delhi Mumbai Expressway

2.33 NHAI is building a greenfield expressway connecting Delhi and Mumbai. The Delhi-Mumbai Expressway (DME) will connect Delhi to Mumbai with a dual carriageway with six lanes per direction. At 1,350km long, it will drastically reduce travel length and times from Delhi to Mumbai. With this alignment, it is expected that once it's completed the Delhi-Mumbai Expressway could attract long-distance traffic from the north including Delhi/North of Delhi regions and going that is presently using the asset.

2.34 DME will be the longest high-speed grade separated expressway road corridor in the country. It is expected to have significant impact on the road logistics sector with new options of moving goods across the major economic activity centres of Maharashtra (e.g., JNPT, Mumbai, Navi Mumbai, Bhiwandi) Gujarat (e.g., Surat, Vadodara, Godhra), Madhya Pradesh (e.g., Indore, Ratlam), Rajasthan (e.g., Kota, Jaipur, Bhiwadi), Haryana (e.g., Manesar, Sohna) and Delhi. The section between Sohna (Haryana) to Dausa (Rajasthan) was made operational in Feb-23. The latest status[1] as posted by NHAI projects that by Mar-24 the section between Delhi and Ratlam-Indore will be operational.

2.35 The time and operating cost savings offered by such an expressway is expected to result in significant shifts in operating patterns adopted by truck operators who would look to take benefit of reliable journey times offered by such an expressway. This would include deploying their fleet on long distance movements with faster turnaround times which enables better fleet utilisation therefore more competitive position in a very cost sensitive market.

Agra Bypass missing link

2.36 A small section of 8-10 kms on the southern end of Agra Bypass is currently incomplete and as per the information gathered from stakeholders during the site visit, it is understood that due to land acquisition issues and financing hurdles, the work to complete the ring is currently on hold. Also, there are no publicly available documents available which confirm the alignment of the missing link of the bypass.

2.37 However, we do believe that this link will get completed in the due course of time, as pressure on local government and NHAI increases, due to growing urban settlements within Agra. As the city of Agra grows and the bypass is completed, similar to Jaipur and Delhi, NGT bans due to pollution and general traffic congestion is expected to result in the NH19 section passing through the city being closed during daytime for truck traffic. This will result in in the shift of traffic plying on NH19 and crossing the city to the newly constructed bypass. This share of traffic will then appear at Raibha plaza in order to bypass the city of Agra and hence, the traffic levels are believed to increase once the construction of missing link is completed.

2.38 Since the section is relatively small in length a two-year construction timeline with expected completion by the end of FY25.

Agra Bypass diversion

2.39 The opening of the missing link will result in a new route for east-west traffic between Gujarat/Southern states and Kanpur and Lucknow/beyond. This share of traffic currently uses the NH21/NH44 – Asset – NH19 (through Agra city) – NH19 route to traverse the east/south-west movement. Once the construction of the missing link is completed, the above-mentioned traffic will have the option to avoid crossing Raibha plaza. The new route choice will be NH21/NH44 – missing link - Agra-Lucknow Expressway/NH19. Hence, the completion of missing link is expected to result in a decrease of traffic levels.

[1]DME status as on March'2023, **https://nhai.gov.in/nhai/sites/default/files/mix_file/Delhi-Mumbai-Award-Status-Mar-23_v1.pdf**

3 Traffic and revenue description

Introduction

3.1 This Chapter outlines the historical and current traffic and revenues on the Asset and how these are used to establish the current/base year demand (in terms of AADTs), which forms the basis of our forecasts. We then use our independent traffic volume counts (TVC) to validate the AADTs and estimate shares of toll violations and unreported exemptions.

3.2 For a traffic and revenue due diligence exercise, the data provided by the toll plaza is typically the primary source of establishing a road asset's base position, in terms of vehicle level AADT and PCU levels, as well as historical performance in terms of growth trends by vehicle type. However due to the unique nature of the asset under consideration in this assignment, being operated under different Operate Manage and Transfer (OMT) contracts, basically independent contractors, the toll plaza based historical data available was affected by reporting variations and was found to be reporting some extra non-paying traffic in the CJV and LCV category. Therefore, it was important to validate the toll plaza data against other independent data sources to entrust confidence in the data used for base position estimation.

3.3 An independent traffic count is often a good way to validate the toll plaza information which has been used in combination with data shared by the Client team. A fresh set forecasting approach was also developed using this independent data and benchmarks available from other studies. These data sources, described in detail below, were helpful in establishing the base position as well as the historical trends that could be relied upon for developing a robust set of forecasts.

Historical traffic and revenue analysis from various sources

3.4 This section below presents the sources from which the historical traffic and revenue of the Asset has been analysed. For this study, traffic data is made available from different sources shared by the Client, namely:

- IHMCL counts; and
- Schedule – M and/ or Schedule V; and
- Toll plaza data (ETC + Cash + Violations/ Exemptions) sourced from Client[2]

3.5 During the due diligence which was undertaken in Aug-2022, these data sources were analysed in addition to the independent primary survey data being collected by Steer. During that study it was established that Toll Plaza data along with primary survey data as mentioned above was the most reliable data source. Therefore, For the purposes of this study, we now have this dataset available for a longer time series i.e., from April'21 to 27th Mar'23. Therefore,

[2] The Violations/ Exemptions data is missing for some months, as detailed in the subsequent section.

for the purposes of historical analysis and FY23 base AADT estimation we have utilised only this data source (along with steer primary survey).

3.6 The following section outlines the current and historical traffic and revenue datasets available on the Asset, as well as our analysis of primary traffic count data, collected as a part of this project. In addition to the data available through secondary sources we have conducted our own independent Traffic Volume Counts (TVC) counts to validate the AADT and estimate shares of vehicle classes, where data are not available or aggregated.

3.7 The sections below discuss each data source in detail that was analysed to estimate the base AADT and revenue position.

Historical traffic

IHMCL Data

3.8 During the earlier study undertaken by Steer in Aug-2022, the Client had provided the IHMCL data to us. IHMCL 7-day traffic counts are available on the Asset toll plaza for different months from December 2016 (FY17) to September 2020 (FY21). The counts are classified by vehicle type and present a reasonable position of the traffic.

3.9 In order to observe the correct characteristics of the Asset, the IHMCL WADTs were corrected for seasonality using an SCF factor. In absence of reliable historical toll plaza data, the SCF were benchmarked from the toll plazas located in close vicinity of the Asset which we have studied in the past and where a reasonable long-term historical data was available. The converted AADTs and the corresponding long-term CAGR is provided in Appendix – C.

Schedule M Data

3.10 Schedule M data was shared by the Client during the earlier study, which included historical traffic data for FY20. In absence of recent monthly data from Schedule V, we haven't used this data to analyse traffic growth on the Asset.

3.11 Schedule M data also confirmed that the IHMCL counts presented earlier vary significantly in their split among various vehicle types. The data as obtained is provided in Appendix – C.

Toll plaza data (ETC + Cash + Violations/ Exemptions) as shared by Client

3.12 The toll plaza data was available from 1st Apr 2021 till 27th Mar 2023. The corresponding revenue for the stated period was also provided by the Client. In this dataset, It was found that the exemptions and violations data missing for Aug-22, Dec-22, and Jan-23 across all vehicle categories for Raibha toll plaza.

3.13 Further, as discussed above, Raibha toll plaza was observed to over-reporting exemptions/ violations in some categories (as was found in Aug-22 study as well). For CJV and LCV, the number of exemptions/ violations traffic number is considerable. Therefore, due to unreliability of data, we have considered:

- For CJV and LCV: Cash + ETC data has been used; and for
- Remaining vehicle types (2A, 3A, and MAV): Cash + ETC + exemptions/ violations have been used for historical and base year traffic analysis.

3.14 The following table explains the quarterly recorded MADT by vehicle class, at the Asset's toll plaza over the period of 24 months from Apr-21 to Mar-23 (as provided by the client).

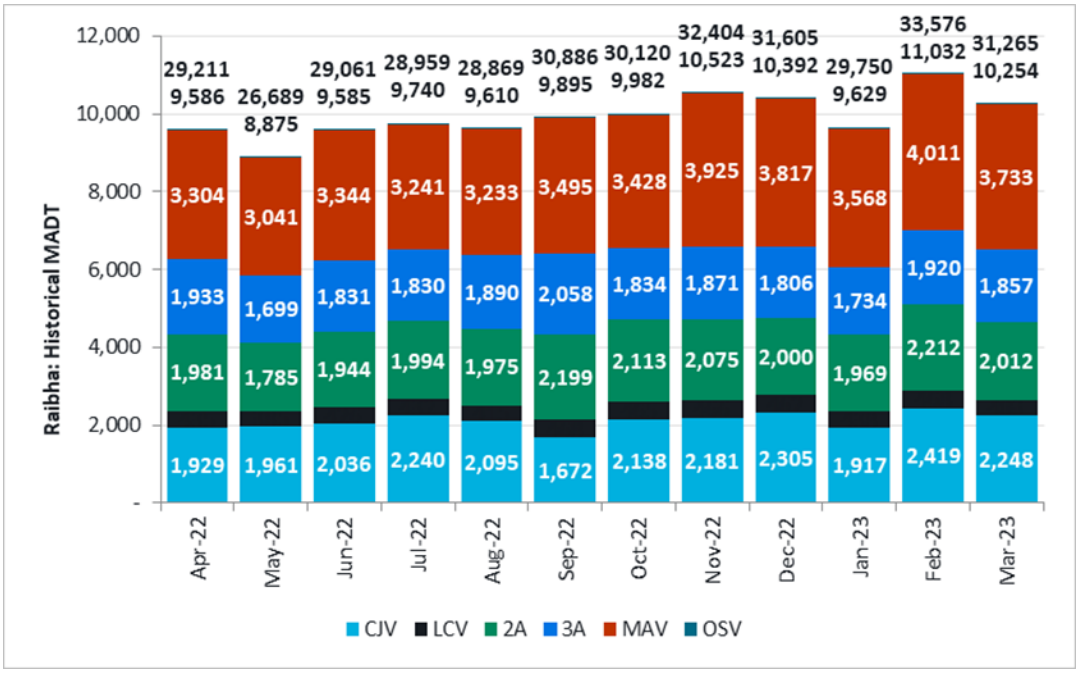
Table 3.1: Reported AADT and growth rates at Raibha

Vehicle	FY22	FY22 N	FY23 YTD	Q1 FY23	Q2 FY23	Q3 FY23	Q4 FY23	FY23 vs FY22	FY23 vs FY22N
CJV	1,826	2,006	2,092	1,976	2,002	2,208	2,195	14.6%	4.3%
LCV	390	421	439	416	438	464	436	12.5%	4.3%
Bus/ 2A	1,653	1,806	2,020	1,903	2,056	2,063	2,064	22.8%	11.9%
3A	1,764	1,765	1,854	1,821	1,926	1,837	1,837	5.1%	5.1%
MAV	2,930	3,072	3,505	3,230	3,323	3,723	3,771	19.6%	14.1%
OSV	3	3	3	3	3	4	2	6.9%	(9.0%)
Total	**8,566**	**9,073**	**9,913**	**9,349**	**9,748**	**10,299**	**10,305**	15.7%	9.3%
Total PCUs	**25,863**	**27,189**	**30,158**	**28,320**	**29,572**	**31,376**	**31,530**	16.6%	10.9%

Source: Steer analysis of client data from 1st Apr-21 to 27th Mar-23, FY22N is H2FY22 traffic adjusted for seasonality. CJV, LCV do not include exemption + violation data, other categories do include all ticket type data.

3.15 Figure below shows the PCU and MADT reported for the Asset in FY23.

Figure 3.1: PCU and MADT for FY23 - AB: Raibha



Source: Steer analysis of client toll plaza data

3.16 The Asset trends at 29,000-32,000 PCU levels in FY23 with robust truck performance continuing in Q4 FY23. ETC proportion of reported traffic exceeds 95% in the recent months of FY23.

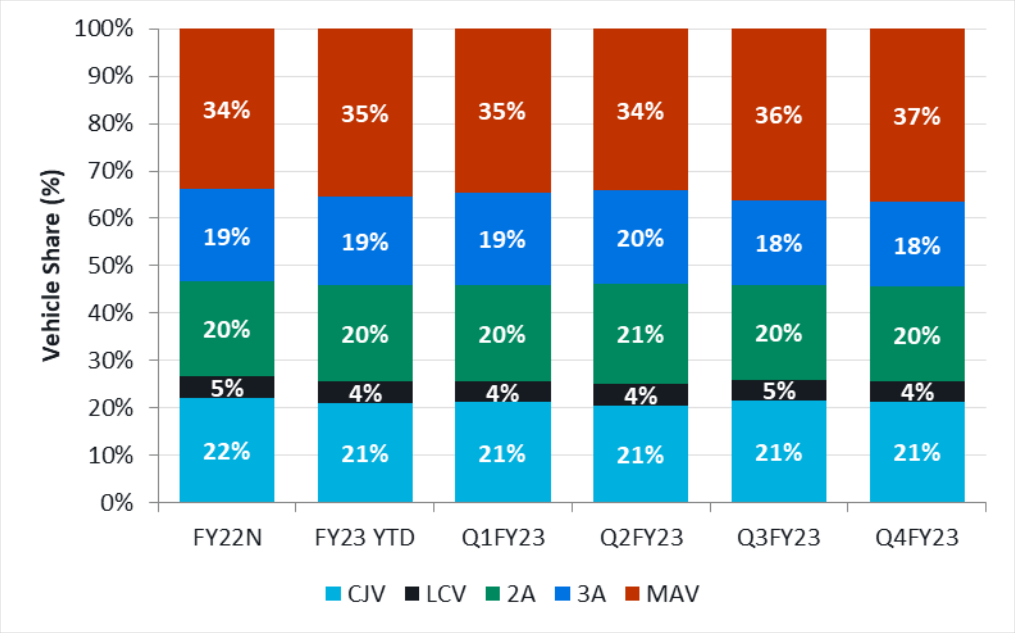
3.17 The Asset has performed well, recording a PCU growth of ~10.9% in FY23 with respect to FY22N. Further, it has realized growth in all the quarters throughout the FY23, with highest growth (over 6%) witnessed from Q2 to Q3.

3.18 The Asset has observed growth in traffic among all vehicles between FY22 and FY23. The leading ones are 2A and MAV, which witnessed a double-digit growth between FY23 and FY22N, followed by 3A, CJV, and LCV witnessing a growth of 4-5%.

3.19 In FY23, CJVs contributed ~22% to the total traffic. CJV traffic observed an increase of ~15% from FY22, the increase being driven by post-Covid19 increase in traffic, revival of tourism circuit, local traffic, coupled with the natural growth of traffic on the Asset. The average CJV movement has also shown increasing trend across all quarters of the year. At a half yearly level, it (ETC + cash) volume was 1,990 in H1 FY23 vis-à-vis 2,200 in H2 FY23, which shows an increase of ~10.6%.

3.20 The figures below show the category-wise share of traffic at the toll plazas for FY22 N and FY23 YTD. It can be seen that MAVs make up the highest proportion of vehicle share with an average 35% of total vehicles and has shown a small increase in its proportion, signalling the highest growth among all vehicle categories. Accordingly, as expected, MAVs derive the highest proportion of revenue with an average of ~53% of total revenue in FY23.

Figure 3.2: Vehicle share at AB: Raibha



Source: Steer analysis of client data from 1st Apr-21 to 27th Mar-23

3.21 As per the reported data, it can be observed that the Asset witnesses a strong contribution of good vehicles. In FY23, the Asset observed ~9,925 traffic daily which was dominated by 3A/MAV trucks. The Asset observes a significant share of trucks (3A/MAV) as it acts as a key connector between Delhi NCR and Gwalior/south on NH3. In FY23, 3A/MAVs contributed ~55% to the total traffic where the plaza saw ~5400 3A/MAVs AADT. This category has recorded an average growth of 10% between FY22N and FY23. This robust performance is due to sustained demand from large urban centers such as Mumbai, Indore, Bangalore, Hyderabad, Nagpur and Chennai among others on the North south movements and between Delhi/North, UP and Rajasthan and Gujarat on the east west movements. During site visit it

was noted that a small proportion of recent increase in 3A+MAV traffic has also been influenced by local movements within the region, fueled by increase in construction activity and an increase in local traffic in Agra. This is also validated in egional traffic analysis and also in the OD data collected on the Asset. This temporary increase has been considered for correction in base traffic and is discussed in later sections.

3.22 Bus/2As also contribute significantly to the total traffic share. ~2000 Bus/2As plied on the Asset in FY23, an increase of ~22% from ~1650 Bus/2As in FY22. Buses and 2As are reported together on the toll plaza. However, it was observed in the TVC counts that 2As dominate the traffic in the Bus/2A category as about 50 buses per day were observed in the TVC data. This is further discussed in the data collection section.

3.23 We have verified the traffic volumes by conducting our own independent TVC counts. The difference between TVC counts and the 'paying' traffic (cash + ETC) for CJV/ LCV and total traffic (cash + ETC + violations/ exemptions) for 2A/3A/ MAV/OSV and is being treated as unreported 'exemptions/violations' (non-paying traffic) in our forecasts explained in detail in TVC comparison section.

Historical Revenue

3.24 Revenue details were available split by vehicle category and ticket in the toll plaza data dataset. The dataset reported revenue on a daily level split by payment via FASTag and via cash. As observed in the traffic data, more than 99.8% of revenue generated on the Asset is collected via ETC/FASTag.

3.25 The revenue details from the datasets are shown in the charts below.

Table 3.2: AB: annual revenue (INR Cr)

Vehicle	AB: Raibha		
	FY22	**FY23 (YTD)**	**FY23 vs FY22**
CJV	4.3	5.2	~20.0%
LCV	1.6	1.9	~18.8%
Bus/2A	15.4	18.3	~18.8%
3A	15.5	18.3	~18.1%
MAV	41.0	49.2	~20.0%
Total	**77.9**	**93.0**	~19.4%

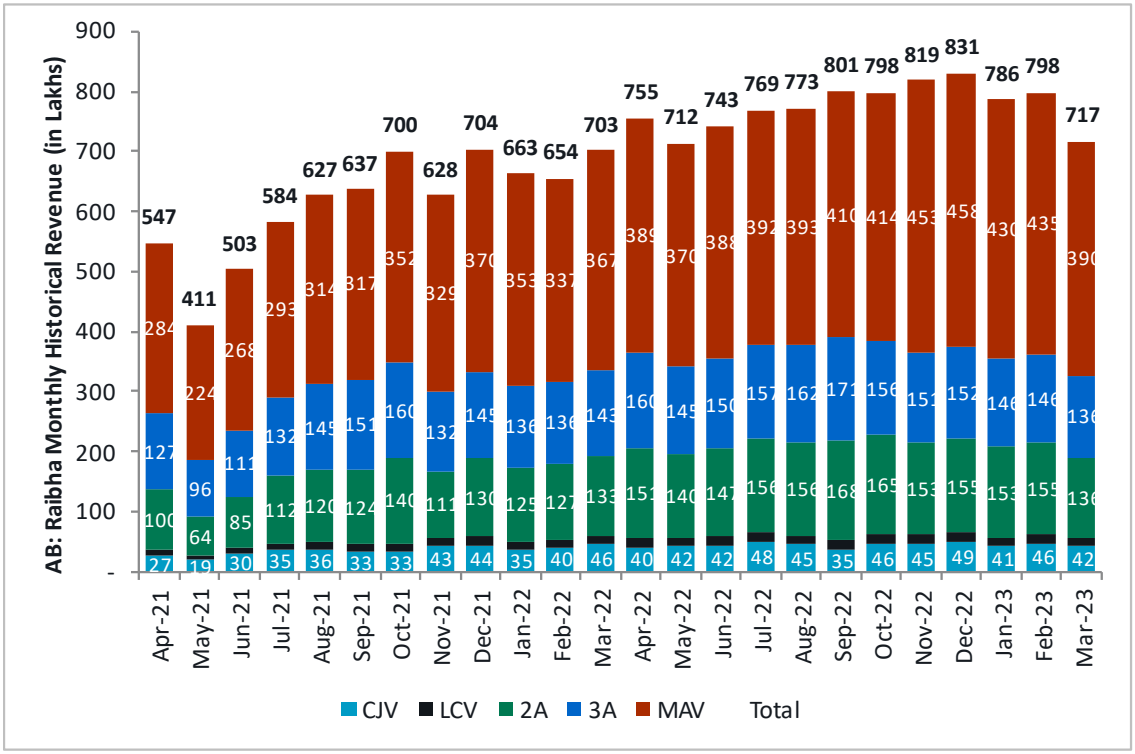
Source: Steer analysis of client data till 27th Mar'23. YTD represents period from 1st Apr 2022 to 27th Mar 2023

3.26 The Asset has reported INR 93 Cr in FY23 YTD[3], an increase of ~19% from total collection of INR 77.9 Cr in FY22. The revenue collection is dominated by the share of 3A/MAVs, driven by the high traffic volumes and the high toll rates of the category. 3A/MAVs contributed 73% to the total revenue share in FY23 YTD. This was followed by ~20% contribution from Bus/2As.

3.27 The average monthly collection is presented below:

[3] YTD includes revenue data from 1st Apr-22 to 27th Mar-23. Further, this does not include the cash data for Jan-23 to Mar-23.

Figure 3.3: AB: Raibha - Monthly revenue reported in toll plaza data (INR Lakhs)



Source: Steer analysis of client data till 27th Mar'23

3.28 In FY23 YTD, the average monthly collection on the Asset was ~INR 7.7 Cr. The average daily collection for the Asset was ~INR 25 lakhs.

Toll Frequencies

3.29 Toll frequency or segmentation is typically the share of each ticket category recorded for a particular vehicle type. Each vehicle category has different segmentation. As a part of historical analysis, we calculate the toll frequency for each vehicle category from the monthly data shared by the client. The most common ticket categories observed on a typical national highway concession are: Single, Return, Monthly, Local and Exempt.

3.30 Understanding the toll frequency gives insights into the nature of traffic. CJVs (Cars) generally have higher shares of return passes or monthly passes as the CJV users on Indian national highways tend to make shorter distance and more frequent trips. However heavy trucks mostly have single tickets since they travel long distance. This varies from asset to asset or even toll plaza to toll plaza. The asset catering to short distance local traffic generally observes high share of return or other local monthly passes while the asset catering to strategic long-distance traffic generally observes high share of single ticket traffic.

FASTag implementation

3.31 Generally, over the period the shares of single/return/monthly tickets tend to stabilise within 2-3 years from start of an asset operation. This is related to the stability of trip patterns are not expected to change significantly in absence of any major external events. During the last two years, two key events impacted the traffic patterns throughout the country: Covid19 and FASTag implementation.

3.32 With the FASTag implementation in Dec'19, it was ensured that only FASTag users benefited from discounted tickets such as return/monthly and cash users were only allowed to buy single tickets, thus leading to a drastic increase in single ticket users between January 2020 till Feb- 2021. The removal of discounts for cash users and significant push by NHAI and toll plaza operators to promote use of FASTag has resulted in significant increase in %age transactions via FASTag. This in turn has resulted in ticket type use patterns have begun to return to their previous segmentation levels as observed prior to the FASTag implementation.

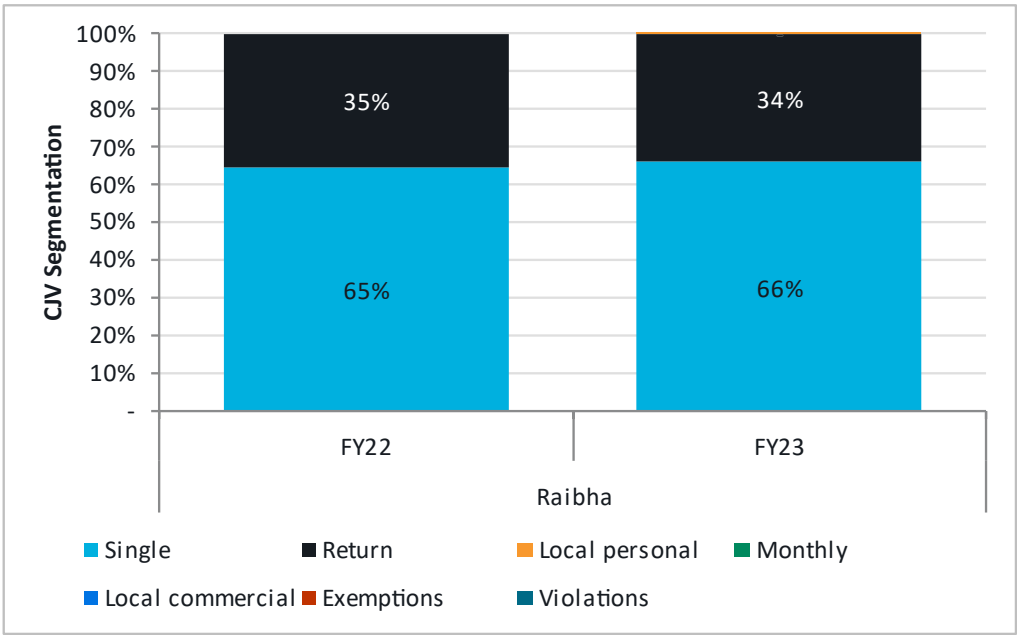
3.33 The following are the types of tickets are sold at the plazas as per the concession agreement.

Table 3.3: Typical ticket types sold at NHAI plazas

Category	Description
Single	Allows the vehicle to cross the toll plaza once
Return	Daily pass for crossing the toll plaza multiple times within 24 hours. Charged 1.5 times the single toll
Monthly	Monthly pass
Local Personal	Discounted monthly pass only for private cars of residents within 20km radius of toll plaza
Local Commercial	50% discount on single trips for commercial vehicles registered in the local district
Exemptions	Officially exempted vehicles like ambulance, police cars, key political personnel etc.

3.34 The observed ticket segmentation on the Asset is presented in the chart below.

Figure 3.4: Ticket segmentation (%) CJV- AB: Raibha

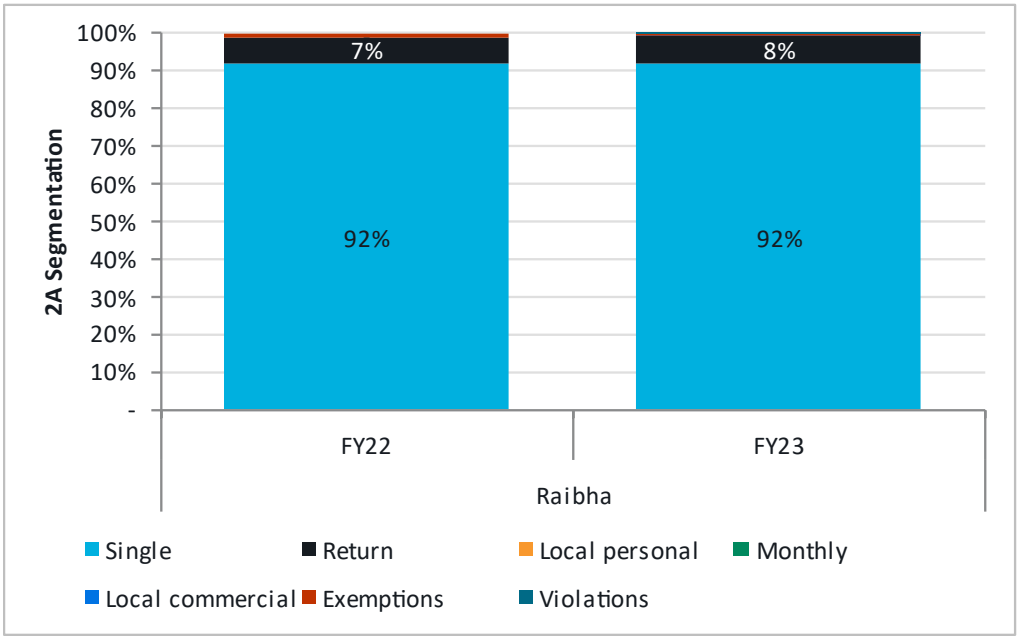


Source: Steer analysis of client data

3.35 While the ticket type is dominated by Single journeys, CJVs have considerable share of Return tickets as they primarily cater to short to medium distance movements which might lead to a user crossing the plaza several times in a day.

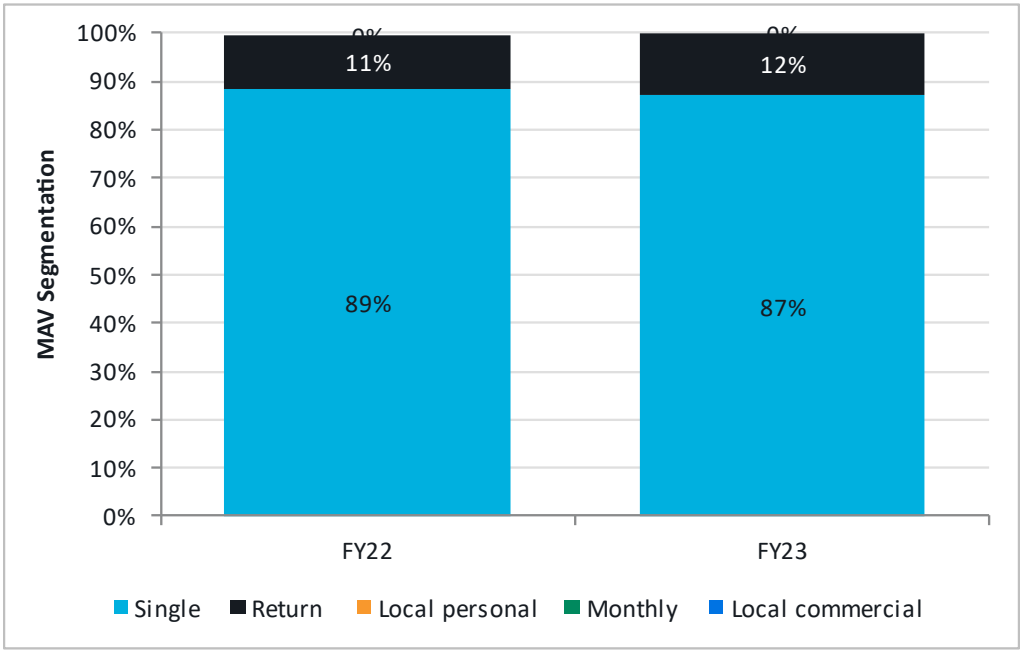
3.36 2A, 3A and MAV's report high proportion of single trips, this is further validated by the long trip length of the vehicles as observed in our OD data.

Figure 3.5: Ticket Segmentation (%) 2A – AB: Raibha



Source: Steer analysis of client data

Figure 3.6: Ticket segmentation (%) MAV- AB: Raibha



Source: Steer analysis of client data

3.37 90%-95% of the commercial vehicles plying on the Asset are observed to buy single tickets as the Asset caters to strategic long-distance movements. Return trips are primarily attributed to the short distance trips in the vicinity of the Asset.

Conclusions – historical traffic and revenue analysis

3.38 The chapter outlined the current and historical traffic and revenue datasets available on the Asset, as well as our analysis of primary traffic count data, collected as a part of this project. Historical data records were obtained from several sources (PIU, ETC, DPR, etc.) and a review of all the sources was done to estimate the robust traffic and revenue numbers.

3.39 Multiple data sources including traffic data provided by client and Steer survey results for the Asset have been analysed and presented in detail in this chapter.

3.40 The analysis of these data sets confirms that the Asset carries high volumes of goods traffic which connect large urban centres and industrial clusters located in various parts of the country. Both traffic and revenue information are available for the toll plaza for a relatively short period. Independent TVC counts, and OD surveys undertaken by Steer to understand the primary traffic movements on each of the Asset.

3.41 Both traffic and revenue information are available for the toll plaza for a relatively short period of two years. For the traffic data was available as reported in toll plaza (ETC+cash+violations/ exemptions) datasets. However, violations/ exemptions data was found to be unreliable for CJV and LCV, therefore, we have considered only ETC+cash for these two vehicle categories and entire data (ETC+cash+violations/ exemptions) for 2A, 3A, and MAV.

3.42 The Asset trends is trending at 29,000-32,000 PCU levels in FY23 with robust truck performance continuing in Q4 FY23. The traffic is dominated by 3A/MAVs. On an average, the daily revenue collection on the Asset is ~INR 25 lakhs.

3.43 Further, the Asset has observed strong traffic performance, recording a PCU CAGR of 10.9% in FY23 as compared to FY22N.

Survey data analysis

3.44 As mentioned earlier, to validate and inform various inputs used in our forecasting, we undertook primary data collection on the Asset, comprising the surveys listed below. OD survey data was collected on behalf of the Client, TVC surveys were commissioned by Steer with a third party. OD data collection typically involves manual data entry by enumerators based on oral surveys with road users crossing toll plazas, which Steer also commissioned with a third party. TVC data collection involves video-graphic capture of traffic passing crossing the toll plazas, followed by manual counting.

3.45 It should be noted that, in our experience, traffic on national highways shows variation across the week due to the economic activities surrounding each road. To derive a representative TVC count considering daily variation, three-day to seven-day traffic counts are generally recommended, and hence, in order to fully understand the impact of this weekly fluctuation on the Asset, we collected seven-day counts at each toll plaza.

3.46 Steer commissioned the following primary data collection at the Asset:

- 7-day 24-hour Traffic Volume Count (TVC)
- 24-hour Origin-Destination (OD) survey

3.47 This section presents the analysis of the primary data collected and its use thereof.

Key findings of the TVC data analysis

WADT estimates

3.48 As mentioned earlier, camera based Total Vehicle Counts (TVC) forms a key part of our primary data collection exercise. Using the TVC data and taking a simple average of the seven-day TVC counts, we obtained the Weekly Average Daily Traffic (WADT) for each toll plaza. The WADT excludes non-tollable vehicle such as tractors, two-wheelers, bullock-carts, etc., but includes officially exempt vehicles such as police cars, ambulances, emergency response vehicle, government vehicle and other vehicle types officially allowed as 'exempted' under the concession agreement.

3.49 During the site visits, our team makes sure that the cameras are located at a location where complete tollable traffic is captured. Additionally, emphasis is laid on positioning camera at such a location that the traffic from local leakages or bypass is also captured, if any.

3.50 In order to check the reliance of the TVC data, several checks are applied before using it in our analysis. Directional counts are verified by matching the sum of both the directions with the total counts. Our TVC data is directly used for validating our base year AADT and benchmarked with respect to traffic volumes on the sections in close vicinity of the Asset (discussed in Chapter 6).

3.51 The table below present the 7-day average (WADT) of independent counts undertaken by Steer.

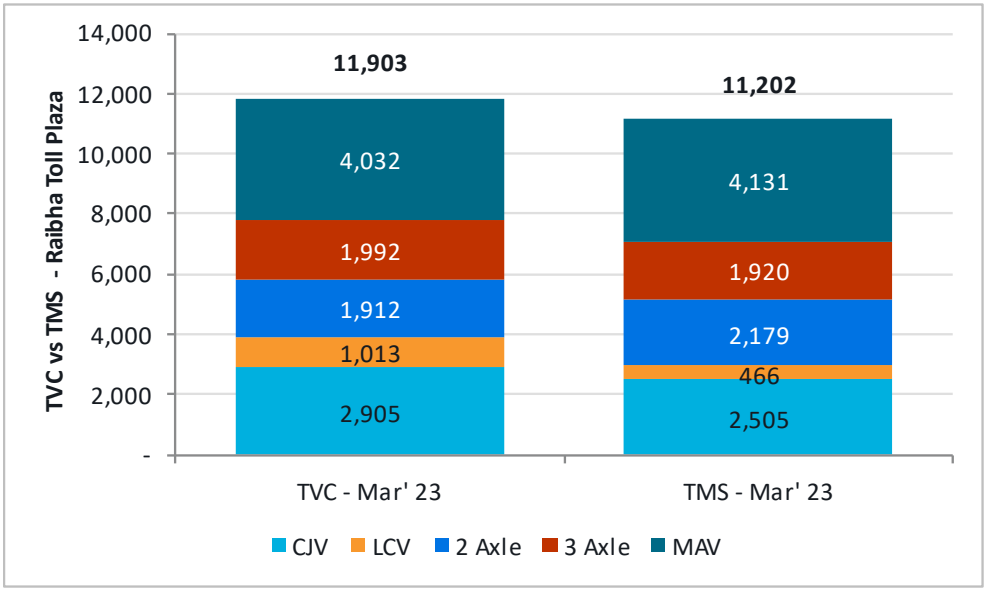
Table 3.4: WADT at Asset arrived using TVC

Vehicle Category	AB: Raibha
CJV	2,630
Mini LCV	275
LCV	1,013
Bus	47
2 Axle	1,912
3 Axle	1,992
MAV	4,032
OSV	2
Total	11,903

Source: Steer analysis of TVC data

3.52 The figure below compares the vehicle wise traffic as recorded by TVC and TMS datasets on Raibha toll plaza.

Figure 3.5: Vehicle TVC comparison

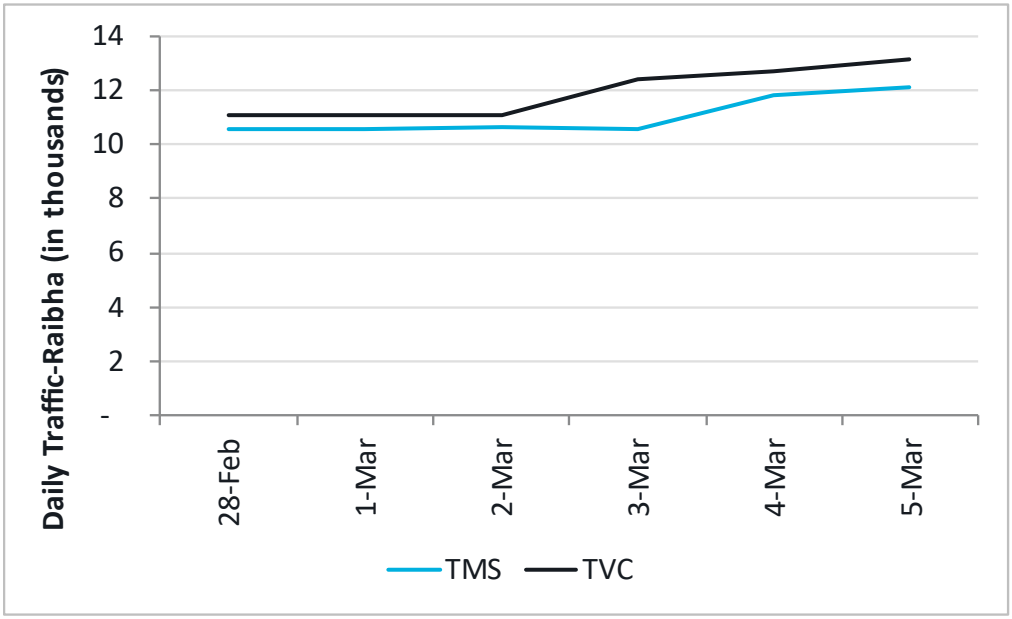


Source: Steer analysis of TVC counts, and TMS data

3.53 The TVC counts conducted in the month of Mar'23. The total average traffic recorded was 11,093 WADT. Moreover, the Asset was dominated by the traffic shares of MAVs followed by CJVs.

3.54 The following figure shows the daily traffic observed in our TVC-TMS (ETC only) counts for the toll plaza.

Figure 3.6 Daily TVC counts – AB: Raibha



Source: Steer analysis of TVC counts, and TMS (ETC only) data, Cash data not available

3.55 TVC and TMS (ETC only) traffic data on the Asset follows similar trend on all days, the difference in the two sources may be due to some vehicles which pay in cash or are not paying (exemptions + violations) at the toll plaza.

3.56 On an overall level, Steer independent TVC has reported higher traffic volumes than the TMS data. The difference is primarily observed in CJV's, 2As, and LCVs.

3.57 TVC counts report lesser 2As, but higher LCVs as compared to TMS counts. This could be due to the error in categorization of LCVs and 2As post FASTag implementation. On the whole, TVC reports higher LCV+Bus+2A traffic which can be attributed to the fact that a share of this traffic crosses the plaza without paying and hence isn't getting recorded. The same is the reason for additional CJVs being counted in TVC counts. 3A+MAV traffic levels are similar in both the counts.

Outputs from TVC analysis

3.58 We have further analysed the TVC and TMS data at vehicular category level to ascertain the following outputs:

Base Correction: As observed in the TVC-TMS analysis, the volume of traffic in CJV, LCV, and 2A categories saw a difference in the counts. While estimating the base, the delta is being incorporated as 'base correction factor'. The base correction factor is the % delta between TVC and toll plaza data (ETC+cash for CJV/LCV/2A and ETC+Cash+Violations for 3A+MAVS) counts for each vehicle category. The delta is added on the base traffic of FY23 to account for the unreported traffic is crossing the plaza without paying. The percentage of delta for 3A/MAVs is not being incorporated as the negligible delta can be attributed to the reconciliation of traffic numbers with the data received from the bank**.** This adjustment was necessary to understand the capacity at which the Asset is operating.

Table 3.5: Base Correction Factors

Vehicle Category	AB: Raibha
CJV	14.8%
LCV	9.3%
2A	9.3%

Source: Steer analysis of TVC/TMS data

- **Exemption adjustment:** The additional traffic being added to the base of our forecasts, as mentioned in the previous paragraph, is being treated as 'non-paying' traffic as the traffic isn't getting reported in the TMS counts as provided by the Client. Hence, in the ticket segmentation, the additional traffic in the corrected base traffic is assumed to be unreported 'exemptions'.
- **Traffic splits:** TVC WADT of each plaza was considered to derive the traffic splits for Bus and 2A, the split is not present in the data shared by the Client. It is summarized in the table below:

Table 3.6: Traffic splits from TVC analysis

Vehicle Category	AB: Raibha
Bus and 2A traffic split	
Bus	2.5%
2A	97.5%
CJV and Mini LCV traffic split	
CJV	90.5%

Vehicle Category	AB: Raibha
Mini LCV	9.5%

Source: Steer analysis of TVC/TMS data

Key findings of origin-destination analysis

Overview

3.67 OD surveys were conducted on the toll plaza locations across the Asset, through interviews for 24 hours at the toll location, typically starting at 8 AM and finishing at same time on the following day. The interviews began on 2 March 2023 on the Asset's toll plaza. Each toll lane had an interviewer filling OD records with supervisor monitoring them to minimise errors in data collected. This was accompanied by Steer staff visiting the toll plaza to ensure the data is being collected to quality and standards required to understand the traffic patterns on the Asset.

3.68 Data collected was segregated into vehicle types, origin area, origin zone, destination area, destination zones, commodity being carried, total load, and frequency of travel. The zones were further segmented into Internal, Rest of State, and External zones. The zones were also used to calculate the trip distances of the traffic plying on the Asset.

3.69 Before using the data for final analysis, the data is first cleaned, and numerous checks are applied. Some of these checks include verifying that the zones are physically apart as well as these zones are located within a reasonable distance and boundary. Reliability checks are also used which confirms that the sample rates are 25% for passenger and 50% for goods. Sanity checks includes verifying the sanctity of direction wise origin and destination as well as establishing that the share of empty vehicles is in line with the site visit observations (not more than 50% in any case). The final check includes matching the OD numbers with the TVC counts of the particular day and substantiating that the OD numbers aren't greater than the TVC counts.

3.70 Origin-destination (OD) analysis enables the understanding of the nature of traffic movement on the Asset. We have analysed the regional drivers of demand based on the following analysis:

- Zonal influence
- Commodity distribution
- Top OD pairs
- Trip length distribution

3.71 While zonal analysis and the list of top OD pairs help to understand 'where' people and goods travel, commodity distribution sheds light on 'what' goods get transported on this asset. Trip length distribution shows 'how far' vehicles and people travel, and goods get transported. This set of analysis is used to estimate key drivers of traffic and aid in making informed forecasting assumptions related to traffic demand elasticities, growth drivers and exogenous impacts.

Sample rates

3.72 Sample rates help understand the reliability of OD data. They are calculated by dividing OD samples by the TVC count observed on the same date for each vehicle category at the toll plaza. The table below presents the sample rates for key vehicle type aggregations at the toll

plaza. We believe that the sample rates of the OD data are reasonable for the analysis required.

Table 3.7: Sample rates for OD data

Vehicle type	AB Raibha
CJV	26%
LCV	17%
Bus + 2 Axle	42%
3 Axle + MAV	47%

Source: Steer analysis of OD data

3.73 CJV users are traditionally difficult to interview primarily because their waiting times have reduced significantly due to FASTag implementation, and they are also reluctant to answer questions due to Covid19 related concerns.

Zone categories

3.74 To facilitate better interpretation of key regional drivers of traffic as determined by their OD zones, and influenced by various towns, cities, states, and regions in the vicinity of the Asset, we have aggregated zonal data as described in the table below.

Table 3.8: Zone aggregations for zonal influence analysis, AB

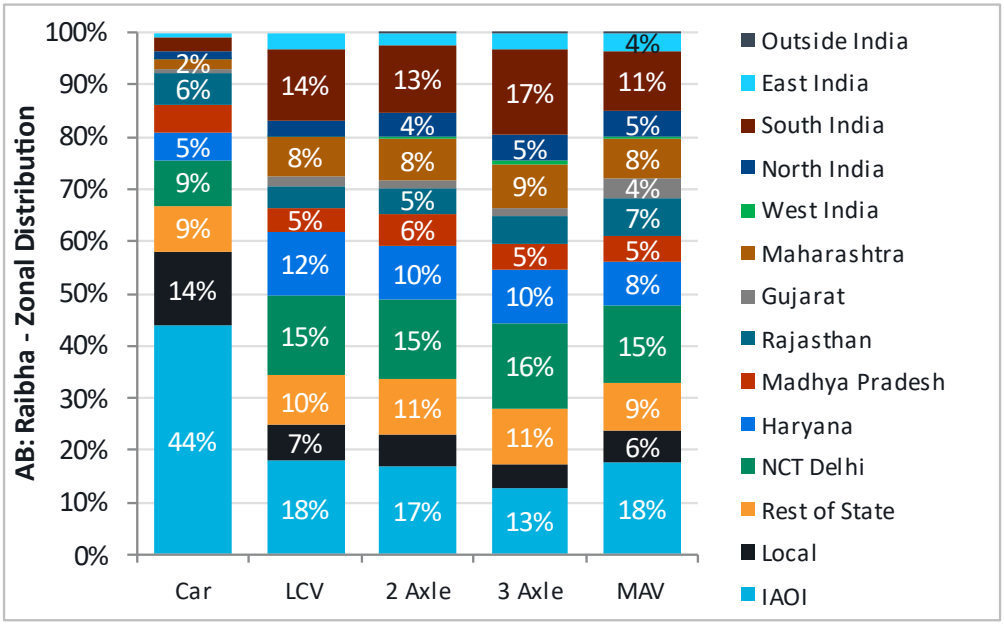
Aggregate Zone	Description
Local	Local zones are those that fall on or very close to the Asset.
IAOI	IAOI zones are the locations which generate traffic and lie within approximately 75-150 km distance from the Asset.
Rest of State	Rest of the cities/Districts in the state that Asset lies in (other than Local/IAOI)
NCT Delhi	National Capital Territory of Delhi
Haryana	Haryana state
Madhya Pradesh	Madhya Pradesh state
Rajasthan	Rajasthan state
Maharashtra	Maharashtra state
Gujarat	Gujarat state
North India	Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab, Uttarakhand.
South India	Andhra Pradesh, Kerala, Tamil Nadu, Telangana, Karnataka
East India	Bihar, West Bengal, Arunachal Pradesh, Assam, Bihar, Jharkhand, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Tripura, Sikkim, Chhattisgarh
Outside India	Nepal, Bangladesh, Bhutan

Source: Steer analysis

Zonal influence

3.75 The zonal influence is the contribution of the zone or the zonal aggregation to trips by a vehicle type. This section presents the zonal influence[4] at the toll plaza for the Asset, based on zonal aggregation listed in the previous sub-section. it should be noted that zonal influence is analysed on trip ends and not trips. Asset wise zonal influence is presented as follows.

Figure 3.7: Zonal distribution: AB: Raibha toll plaza



Source: Steer analysis of OD data

3.76 Given strategic nature of the Asset, facilitating north-south movements by connecting to NH44 and NH19, the zonal influence of this Asset is diverse. Significant zonal influence of Delhi-NCR, UP, Haryana, Maharashtra, Tamil Nadu, and Karnataka is observed for heavy vehicles (2A+3A+MAV).

3.77 Zones that are located within Uttar Pradesh, collectively contribute to 25-30% in case of 3A and MAV. The remaining 75% is a diverse mix of other zones, including Delhi, Haryana, Rajasthan, south India, Maharashtra, among others. The long-distance nature of this Asset is evident from ~15% share of zonal influence of South India in case of 2A/3A vehicles, followed by major shares of Delhi, Haryana, and Maharashtra.

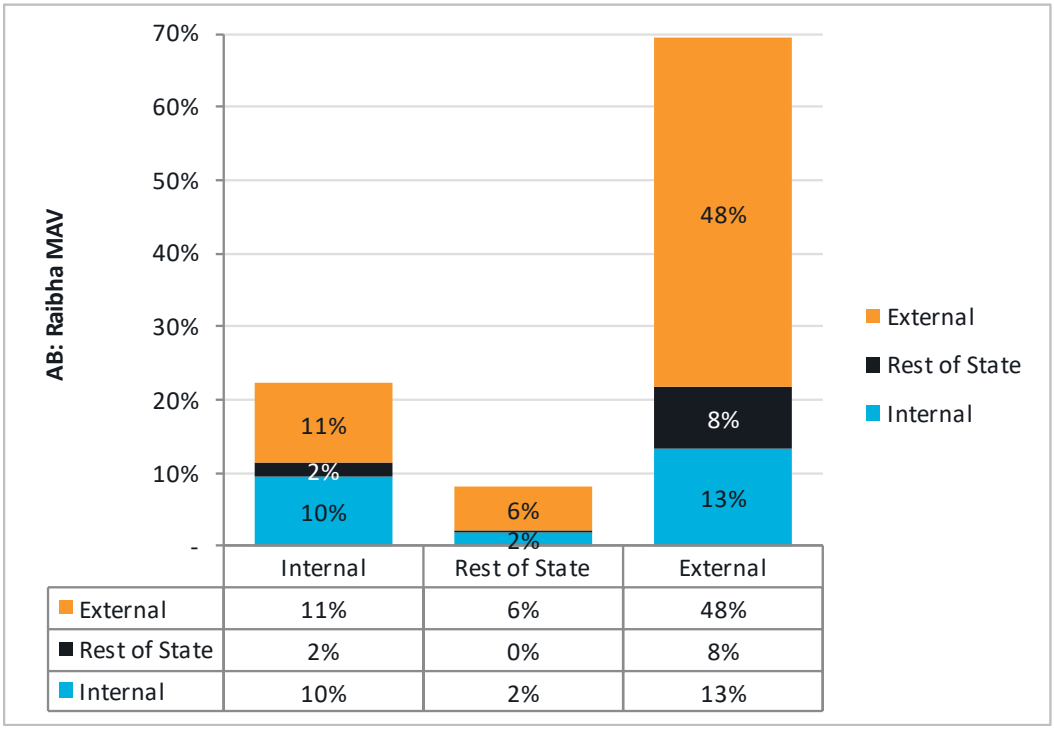
3.78 In comparison to the zonal influence observed based on the OD surveys (undertaken as part of earlier study in Aug-22), we found that the zonal influence largely remains unchanged. Except for the trips from/ destined to RoS+Local+IAOI zones, which have now increased by 9% and 5% for 3A and MAV respectively. Further, details are provided in Appendix-B.

[4] For example, if out of 100 trips at a toll plaza on an Asset, 10 trips are between Hyderabad and Delhi and 90 trips are between Hyderabad and Chennai, then zonal influence of Hyderabad would be 50% since one end of all trips are at Hyderabad. Likewise, zonal influence of Delhi and Chennai would be 5% and 45%, respectively.

Internal External analysis

3.79 Internal-External analysis helps in identifying the trips which have both an origin and destination on or near the Asset i.e., local/IAOI zones (Internal-Internal or I-I), any one end on the Asset (Internal-External or I-E), or neither end on the Asset i.e., through trips (External-External or E-E). Rest of State here represents areas within the state which are neither local nor IAOI. 'Internal' zones are those that were analysed as 'local' and 'IAOI' in the zonal influence analysis, i.e., lying on the Asset, while 'External' zones are areas lying outside the state.

Figure 3.8: Zonal influence: AB: Raibha toll plaza



	Internal	Rest of State	External
External	11%	6%	48%
Rest of State	2%	0%	8%
Internal	10%	2%	13%

Source: Steer analysis of OD data

3.80 The internal-external distribution further validates the strategic nature of the asset, with 65% influence pertaining to zones that are external. This is further to the zonal distribution that showed that Local and Rest of the State had relatively less influence on the Asset, while aggregate of the remaining zones categorized as External exert the significant proportion of influence on the traffic. This validates that the long-distance nature of the Asset, facilitating long distance through movement—that is trips that originate and end outside of Uttar Pradesh, traversing via the Asset.

Commodity distribution

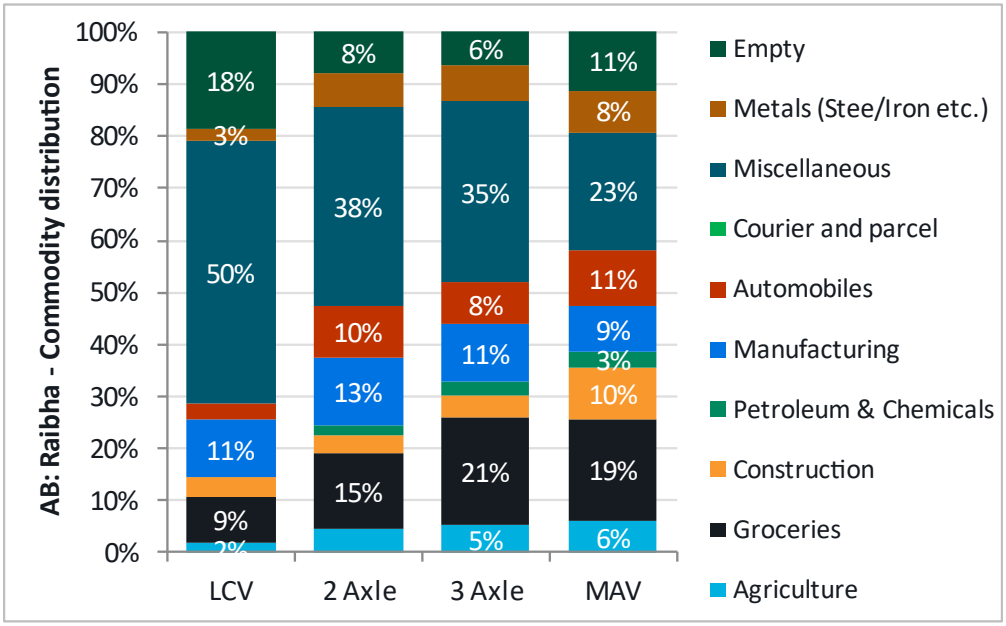
3.81 We have grouped various commodities into aggregate categories for ease of interpretation, as shown in the table below. The charts in the following sub-section present information in terms of aggregate commodity categories.

Table 3.9: Aggregate commodity categories

Commodity Description	Code	Combined codes used for charts
Agricultural Products / Cash crops (Wheat, Rice, Sugar cane, Maize etc.)	AGR	AGR
Perishable Items (Fruits, vegetables, milk, meat, fish etc.)	PER	
Cattle Food / Livestock (sheep, goat, cow, cattle food etc)	LIV	
Building Material / Construction (Cement, Lime, Brick etc)	CNS	CNS
Container	CTR	CTR
Empty	EMT	EMT
Groceries / Food items (Soap, Salt, Sugar, Pulses, Spices, Biscuits, bread, cool drinks, beer etc.)	GRO	GRO
Machinery / Spare parts	MAC	MAC
Steel / Metal (Iron, steel etc)	STL	MAN
Chemicals / Fertilizers (Acids, Fertilizers etc.)	CHM	
Manufacturing (Electronic items, Medicine, Leather, Wine, Rubber/ Tyre, Plastics, Cloth, Paper etc.)	MAN	
Automobiles (Finished products)	AUT	
Basic / Fabricated Metals (steel, iron)	MET	
Raw Wood, Cork & Wood Products, Fern	WUD	
Mining Minerals (Coal, Gypsum, Cobalt etc.)	MIN	MIN
Miscellaneous (Parcel, Courier, Household items etc.)	MSC	MSC
Passengers	PAS	
Petroleum Products (Oil, LPG, CNG, etc.)	PET	PET
Sand	SND	SND
Stone (Kota stone, marble, Granite, Aggregate stone etc.)	STN	STN
Cement	CMT	CMT

Source: Steer Analysis

Figure 3.9: Commodity distribution, AB: Raibha toll plaza



Source: Steer OD analysis

3.82 Among all the vehicle types, the largest proportion of goods being carried belong to the miscellaneous category, which includes parcels, couriers, and e-commerce deliveries that are mainly transported from warehouses in Agra, Indore, Hyderabad, Bengaluru, Maharashtra, Gujarat to local areas, Delhi NCR, Rajasthan, Haryana, and other North India regions. Followed by it are the groceries which are majorly being transported from Delhi and NCR regions to the consumption centres in central and southern India.

3.83 It was observed that, manufacturing goods have the next highest share in the commodities, which comprise of diversity of goods such as plastic, rubber, textiles, pipes, tyres, electronic goods, etc. These are being transported from industrial centres of Maharashtra, Gujarat, Hyderabad, Gwalior, Indore, parts of south India to Delhi NCR, Haridwar, Agra, Mathura, Punjab, Haryana, and other north India regions. Following this is agriculture, which is largely being carried long distance by bigger truck segment- 3A+MAV.

3.84 A mix of agricultural commodities such as lentils, cotton, spices, onions, wheat, etc is being carried across similar locations originating from south and West India regions to major vegetable wholesale markets of Delhi, Agra, Kolkata, Haryana and Punjab, among other regions.

3.85 Direction wise commodity splits are given below:

Table 3.10: Directional commodity distribution – AB, Raibha toll plaza

Mathura to Gwalior					Gwalior to Mathura			
LCV	**2 Axle**	**3 Axle**	**MAV**		**LCV**	**2 Axle**	**3 Axle**	MAV
1.5%	2.5%	4.8%	6.0%	Agriculture	4.8%	6.4%	5.9%	6.5%
5.1%	7.4%	11.3%	12.2%	Groceries	33.3%	22.9%	28.7%	26.5%
4.4%	1.3%	1.5%	3.4%	Construction	0.0%	5.3%	6.5%	16.7%
0.0%	2.5%	3.5%	2.4%	Petroleum & Chemicals	0.0%	1.7%	2.1%	3.5%
11.8%	15.0%	10.7%	9.6%	Manufacturing	4.8%	10.3%	11.3%	8.7%

Mathura to Gwalior					Gwalior to Mathura			
3.7%	11.4%	11.3%	14.8%	Automobiles	0.0%	8.8%	5.4%	6.6%
53.7%	47.7%	47.8%	29.5%	Miscellaneous	28.6%	28.2%	23.2%	15.4%
2.9%	5.8%	3.9%	5.9%	Metals (Stee/Iron etc.)	0.0%	7.4%	9.6%	9.8%
16.9%	6.5%	5.2%	16.4%	Empty	28.6%	9.1%	7.3%	6.2%

Source: Steer Analysis of OD data

3.86 The direction wise distribution of commodities for each vehicle types helps to gauge a better understanding of the distribution as per the direction of goods movement. The profile of commodities being carried in both the directions is overall is somewhat similar. As for the direction Gwalior to Mathura, groceries, manufacturing and miscellaneous category are among the highest contribution to commodities being carried. Mathura to Gwalior, a significant proportion are miscellaneous products—couriers and parcels.

3.87 The commodity distribution has largely remained unchanged (except some increase in proportion of construction commodities) based on the comparison of OD surveys from this and earlier study (Aug-22). There is some minor variation for LCVs, where the proportion of Miscellaneous commodities has increased. Further, details are provided in Appendix-B.

Trip length analysis

3.88 Trip-length distribution provides the distance-based profile of various vehicle categories. This aids in validating assumptions around the share of macro-economic drivers, inputs from zonal influence and toll segmentation. For ease of interpretation, we have categorised distances into 4 groups – local and short distance (0-250km), medium-distance (250-500 km), long-distance (500-1000 km) and very-long-distance (+1,000 km). The trip distances were derived as driving distances from Google Distance Matrix Tool based on zonal coordinates for OD pairs.[5]

3.89 The following table states the average trip lengths of traffic plying on the Asset across the toll plazas.

Table 3.11: Average trip lengths (Kms)

	CJV	LCV	2 Axle	3 Axle	MAV
AB - Raibha	454	1,102	1,102	1,272	1,126

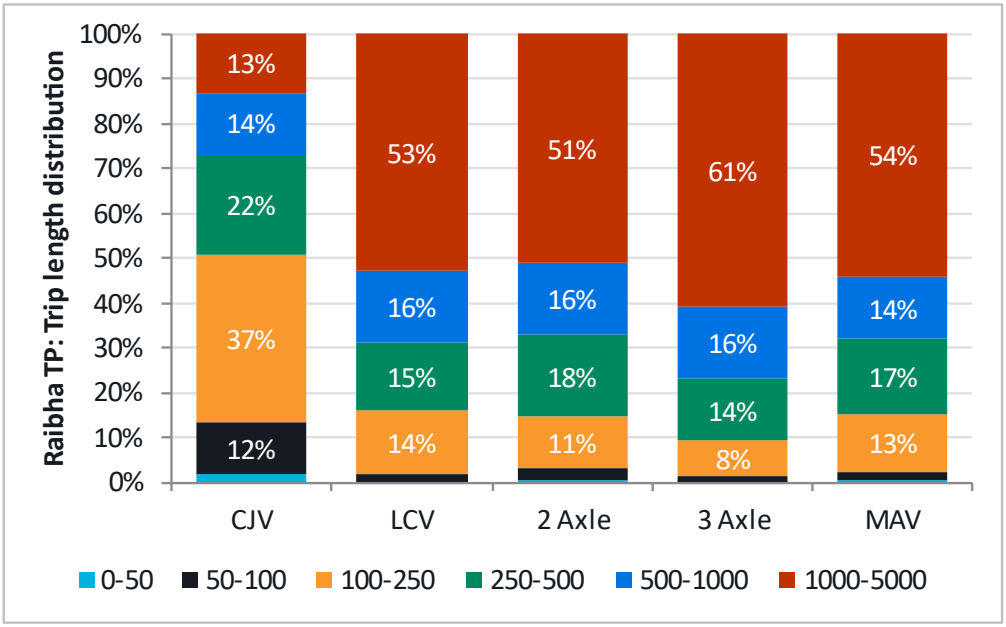
Source: Steer analysis of OD data

3.90 As discussed in the above sections, the Asset cater to the demands of long-distance strategic movements of both, east – west and north – south movements. The same is validated by the average trip lengths observed in the table above where 2A/3A/MAV trucks are travelling more than 1,000 kms per trip.

3.91 The trip length proportions for each vehicle type for each of the toll plaza is discussed below.

[5] Google Distance API is a tool that is available on a chargeable basis from Google Maps Platform. Link: https://developers.google.com/maps/documentation/distance-matrix/start. Travel distance and time information for driving/transit under various congestion scenarios can be extracted through this tool by using macro-enabled Excel, R, etc.

Figure 3.10: Trip length distribution, AB: Raibha toll plaza



Source: Steer analysis of OD data

3.92 As understood from the zonal distribution and commodities' distribution, that the strategic nature of this Asset serves long-distance north-south, east-south/ west movements. Accordingly, over 55-60% of the trip distances of 2 Axle, 3 Axle and MAV are traveling very long-distance movement of over 1,000 km.

Conclusions – primary surveys

3.93 Key takeaways from the data analysis obtained from primary and secondary sources are:

- The strategic nature of traffic on the Asset was validated by the zonal distribution of the OD analysis as for MAVs, more than 80% of influence was from the states connected via NH19 or NH44. The same was confirmed by the internal-external analysis too as the Asset was dominated by the share of external trips and hence, suggesting the presence of through traffic. In line with these observations, the trip length analysis saw that 3As and MAVs covered ~1,200 kms per trip.
- The Asset, being situated in agrarian states, observed Agri-related commodities being transported. Furthermore, miscellaneous goods (parcels and couriers) also hold a considerable share as they are transported from the warehouses in the neighbouring states, along the strategic corridor of the Asset, towards the other states of the country. Other commodities observed on the Asset were manufacturing, petroleum, groceries, and automobile goods.
- Steer TVC counts when compared to the TMS data on the overlapping dates observed a difference in the traffic volumes for CJVs, LCVs and 2As.
- To account for the delta, we found in the TVC-TMS analysis, the observed unreported vehicle traffic has been added as 'Exemptions' during the calculation of our base position. This is necessary to identify the true traffic currently moving on the toll plazas.

4 Socio Economic Context

Introduction

4.1 The growth of traffic on existing (brownfield) roads depends on, firstly, how quickly the background travel demand grows (background growth); and secondly, how successful the Asset is in attracting that traffic (traffic capture). Background travel demand is driven by the socio-economic conditions of the region where the Asset is located and conditions at a national level. These include:

- Changes in macro-economic factors such as population, economic growth (regional and national) and industrial production; and
- Other local factors such as strategic port growth, and growth of industries in the vicinity of the Asset.

4.2 The change in the competitive position of the Asset (and thus of the traffic capture it will achieve) derives from the level of service and associated cost on the Asset in comparison to competing roads; and whether any new competing road facilities are available.

4.3 In this chapter, we assess the socio-economic indicators relevant to traffic growth on the Asset. The relevant growth drivers where reliable information was available have been selected for establishing growth trends in the traffic forecasts.

Population growth

National Level

4.4 The total population in India has grown at a Compound Annual Growth Rate (CAGR) of 1.5% since 2000, and have been showing decreasing trends over the years, as presented in the table below. The World Bank forecasts this growth to decrease to 0.6% CAGR by the 2030-45 period.

Table 4.1: CAGR of population in India

Years	CAGR		
	Total Population (m)	Rural Population (m)	Urban Population (m)
1970 - 1985	2.3%	1.9%	3.8%
1985 - 2000	2.0%	1.7%	2.9%
2000 - 2015	1.5%	1.0%	2.6%
2015 – 2030*	1.0%	0.3%	2.3%
2030 – 2045*	0.6%	-0.3%	1.9%

Source: World Bank Data on Health Nutrition and Population Statistics, *forecast population growth

4.5 The asset lies in the state of Uttar Pradesh. Uttar Pradesh, the most populated state of India represents 17% of the country's population, with the total state population of 200 million (2011 Census).

4.6 The growth rate of urban population in Uttar Pradesh is consistently higher than that of the national population estimates. Uttar Pradesh is largely rural with the share of urban population being 23%. The table below shows population evolution in Uttar Pradesh compared to that of the country.

Table 4.2: Population Growth in India (2001 – 2011)

State	2001 Population (m)			2011 Population (m)			CAGR (2001 – 2011)		
	Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban
Uttar Pradesh	166	132	35	200	155	44	1.8%	1.7%	2.6%
India	1,028.7	742.6	286.1	1,210.9	833.7	377.1	1.6%	1.2%	2.8%

Source: Census 2011 Data

4.7 However, due to complexities in urbanisation trends, and the dynamic nature of local population migration (which are very difficult to forecast), we do not use population growth as a proxy for understanding future travel demand growth on the Asset. It has been included in this section to provide the overall context of the region in which the Assets are located.

Economic Indicators

GDP and GSDP Growth

4.8 The Indian economy has grown at a CAGR of 6.6% during FY12-20, aided by a strong growth in the services/tertiary sector. The economic growth of Uttar Pradesh (GSDP)[6] has been slower than the country overall. Uttar Pradesh approximately contribute 8% to the India's GDP. There was a decline in both GDP and GSDP after FY20 on account of Covid-19.

Uttar Pradesh

4.9 Uttar Pradesh is the most populous state in India with a population of ~200 million people. The state has a large pool of skilled, semi-skilled and unskilled labour. Uttar Pradesh is also considered the largest consumer base in the country. The tertiary sector has the highest sectoral contribution to the state GDP followed by the secondary and primary sectors, with shares remaining stable during the past five years.

4.10 The tourism and transport sector constitute a majority of the state's tertiary sector. Uttar Pradesh is considered as a favoured tourist destination in India, with key tourist attractions being Agra, Varanasi, Mathura and Prayagraj. In 2019, the state attracted the highest domestic tourist in the country with a share of 23% in domestic tourist arrivals. The state holds third position in the country in foreign tourist arrivals with over 4.74 million[7] visitors.

4.11 In secondary sector, the state has key industrial areas in Khurja (ceramic); Moradabad (metals); Meerut, Bareilly, Mirzapur and Lucknow (handloom & handicrafts); Kanpur and Noida (leather and tannery). The state has an Indian oil corporation refinery in Mathura.

4.12 The state has fertile land with a large share of population dependent upon agriculture sector for the livelihood. The key primary industries in the state include food processing, crop

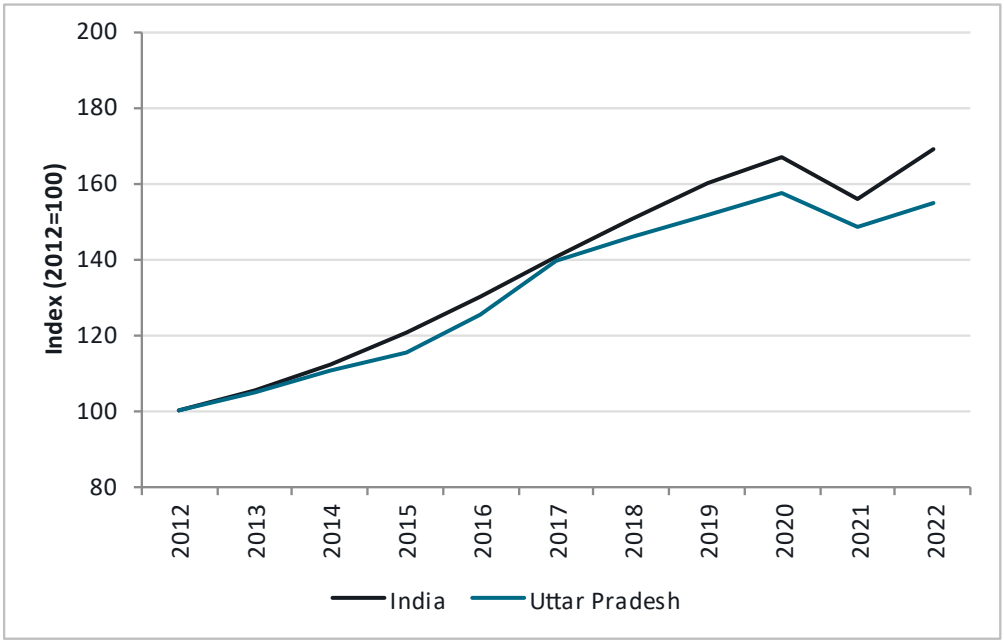
[6] GSDP is the Gross State Domestic Product i.e., the GDP equivalent for a particular state, it is the final value of goods and services produced by a particular state

[7] Tourism Statistics 2020

production and horticulture. The state is mainly known for production of wheat, sugarcane, potato, and mango.

4.13 Uttar Pradesh's GSDP CAGR was 6.1% between FY12-20 and its relative share to the national GDP was around 8% in FY20. There was a decline in both GDP and GSDP after FY20 on account of Covid-19.

Table 4.3: GDP/GSDP index (2012=100)



Source: Central Statistical Organisation (CSO)

4.14 The official historical GDP and GSDP data for India are released by the Central Statistical Organisation (CSO). The GDP forecasts for India are available from various reliable sources such as Oxford and Consensus, but the state level GSDP forecasts are not published. However, using the long-term historical trends between GDP and GSDP, we have developed factors which are used to forecast GSDPs for each state.

4.15 Therefore, in our view, GDP is the best source to be used as a growth driver for long term forecasts of traffic.

Summary

4.16 For any indicator to be used as a growth driver to forecast traffic, a reliable source of historical and forecast available for that indicator is the key requirement. Of the key socioeconomic indicators discussed above GDP seems to be the only growth driver for which reliable data is available both in terms of historical and forecast data, therefore, to forecast traffic we would be using GDP/GSDP as our key growth drivers.

Indicator	Remarks
GDP/GSDP	Available annually ***National level reliable historical and forecast available***
Population/Urbanisation	Revised every 10 years, last available 2011. Population estimates are not available annually, making it difficult to run regressions. Also, the very dynamic nature of local population migration (which are very difficult to forecast with accuracy), we do

Indicator	Remarks
	not use population growth as a proxy for understanding future travel demand growth on the Asset. *Forecast available but historical data is a constraint*

Source: Steer analysis

5 Base traffic, revenue validation, and forecasting assumptions

5.1 In this chapter, we present our approach to arrive at the base year position and assumptions for baseline (or background) traffic growth for each vehicle category on the Asset.

5.2 The two most important inputs that go into traffic and revenue forecasts are:

- The base position – both in terms of traffic and revenue levels currently being generated by an asset; and
- The future growth trends – which can be correlated to the various growth drivers and used to develop an informed view of the forecasts.

5.3 The following sections discuss our approach to arrive at each of these inputs for both the Assets.

FY23 Base year AADT estimates

FY23 base traffic (without correction)

5.4 The base year is the year on which long-term background forecast growth rates are applied to derive year-wise average annual daily traffic (AADT) estimates for forecast years. This is therefore an important aspect of our forecasting approach as baseline traffic and ultimately revenue forecasts for future years are built on top of the base year traffic estimate. We have used FY23 as the base year for AADT estimates for the forecast years.

5.5 As described previously in Chapter 3, to establish the base year (FY23) traffic position, we utilised information from various sources – including from the Client and our context knowledge, to assess a reasonable demand on the corridor for the base year FY23 which formed the basis of future year forecasts.

5.6 FY23 has not been affected by any unexpected event(s) and can be considered as a normal year for the purposes of base year estimation. We have arrived at our Base year traffic using the actual data 1st Apr'22 – 27th Mar'23. 27 days data for Mar'23 was prorated to arrive at full month MADT. The average traffic of actual traffic of FY23 is the base traffic (without correction) of our forecasts. As the exemptions/ violations data is not reliable for CJV and LCV vehicle categories, only cash + ETC toll plaza data is considered, whereas, for 2A, 3A, and MAV, the cash + ETC + exemptions/ violation data is considered.

5.7 Base correction factors are then applied on FY23 base (without correction) to incorporate the unreported share of traffic. The corrected FY23 is the base of traffic forecasts.

5.8 The table provided below provides a comparison between the FY23 base year and FY22 normalized (FY22 N).

5.9 As discussed in initial chapters, the second wave of COVID-19 infections peaked in the country during April and May 2021. Therefore, the traffic volumes on the Assets were impacted during Q1FY22. In Q2FY22, the traffic gradually returned to normal as the impact of second wave weaned away, including an element of residual (pent up) demand (from Q1 FY22) impacting traffic on the Asset. The period starting October 2021 up until March 2022 is devoid of any significant event, except Jan 2022 when the third wave of COVID-19 affected traffic volumes. However, the impact was short lived and had limited impact on the goods volumes of the Asset. Further, we believe that the traffic levels observed during the October 2021 to March 2022 period when seasonally adjusted, were representative of normalised traffic on the Asset and not a result of temporary shifts or impacts. H2 FY22 period is assumed to be 'normal' as the period.

5.10 FY22 second half is not affected by any external event(s) and provides a more suitable benchmark for growth observations in FY23. FY22 N is derived using the weighted average of SCF adjusted MADTs from Oct-21 to Mar-22 based on number of days in respective months.

Table 5.1: FY23 base traffic

Vehicle Category	FY22 N	FY23 base traffic	Growth rate
CJV	2,006	2,092	4.3%
LCV	421	439	4.3%
Bus/2A	1,806	2,020	11.9%
3A	1,765	1,854	5.1%
MAV	3,072	3,505	14.1%
OSV	3	3	(9.0%)
Total	**9,073**	**9,913**	9.3%
PCU	**27,189**	**30,158**	10.9%

Source: Steer Analysis, FY23 numbers doesn't include Base Correction Factor

5.11 Reasonable growth is observed across all vehicle categories in FY23. However, higher growth in case of MAVs is observed at Agra Bypass representing a relatively outperformance by this category in FY23. The revised base suggests a growth of ~14.5% as compared to FY22N. On further due diligence of the surrounding assets, on NH44 and NH21, covering the north/ south and east/ west plazas, it is found that Raibha has seen higher growth rate among all the toll plazas, pointing towards some local factors adding to the growth of Raibha plaza. This is discussed later.

Base correction for FY23

5.12 To arrive at the true base traffic position, we have used a base correction factor to adjust the traffic volumes for CJVs, LCVs and 2As. The percentage of this correction has been calculated by comparing the toll plaza traffic volumes with TVC data as explained earlier in the report. As the base AADT of our forecasts is derived using the TMS data, it is imperative to validate the robustness of the reported traffic volumes with independent counts.

5.13 The difference between reported TMS data and the traffic in Steer independent TVC counts is added as part of the base to account for the vehicles which are crossing the plaza as 'unreported' traffic. The traffic observed in the independent counts conducted by Steer report ~6% higher than the traffic reported in TMS in the same week. This difference is largely driven

by CJVs and LCV/Bus/2A categories. The TMS data is for the same dates as the TVC and an average of 7 days.

5.14 To correctly account for true traffic levels, we have added the difference between Steer TVC and TMS counts (as a % of TMS) on the FY23 normalised position. We believe that this share of additional and unreported traffic does not pay at the plaza and hence, we treat this share as 'Exemptions' in our forecasts, allowing us to estimate the correct capacity of operations at both the toll plazas.

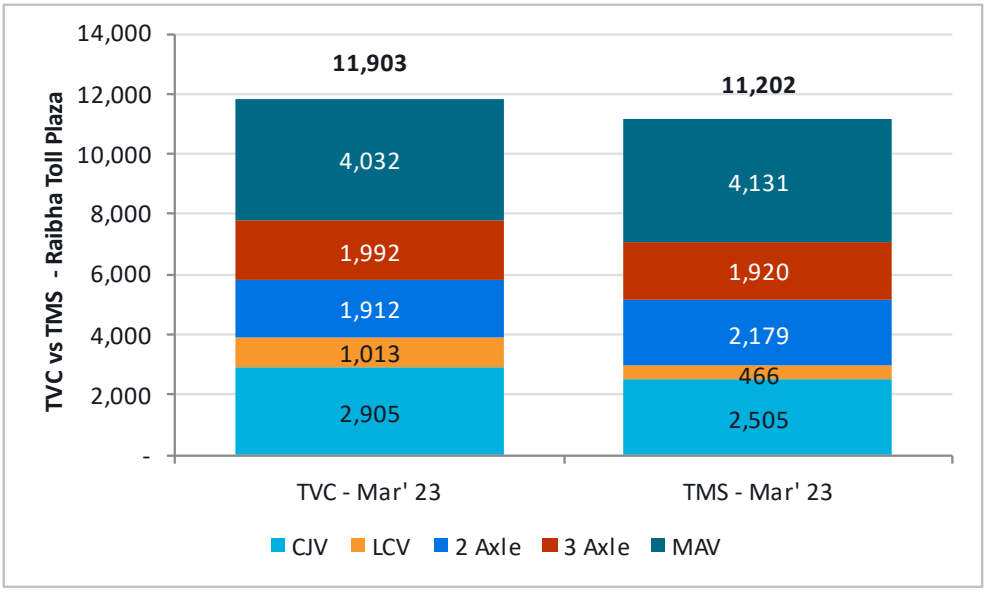
5.15 The table below illustrates the adjustment for the delta, and how it is factored into our base position:

Table 5.2: Base correction factor adjustment

Vehicle Category	AB: Raibha		
	FY23	**Base Correction Factor**	**FY23 Base**
CJV	2,092	14.8%	2,401
LCV	439	9.3%	480
Bus	50	9.3%	55
2A	1,970	9.3%	2,154
3A	1,854		1,854
MAV	3,505		3,505
OSV	3		3
Total	**9,913**		**10,451**

Source: Steer analysis, AB (data pertains to ETC+cash only for CJV and LCV)

Figure 5.1: TVC vs TMS comparison



Source: Steer analysis, for AB (data pertains to ETC only)

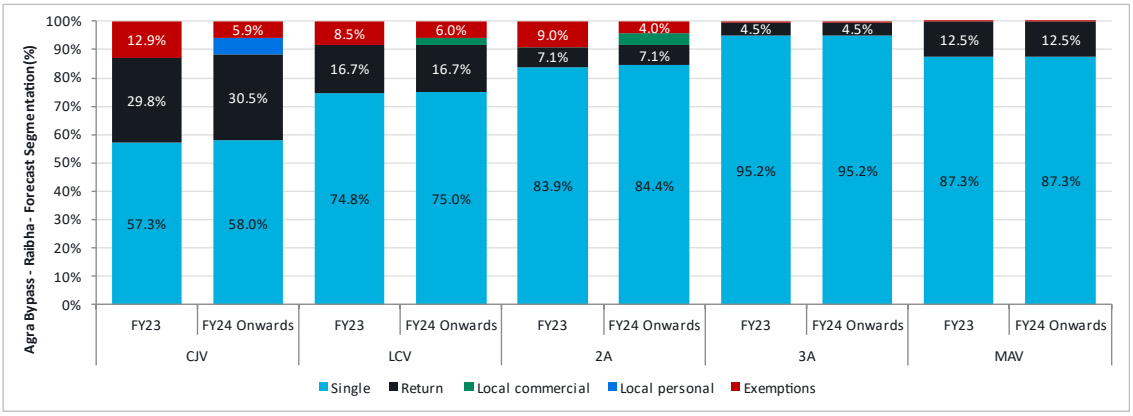
Revenue Estimates

5.16 To estimate the base revenue for the toll plaza, we used the estimated FY23 AADT, established as part of the analysis above, as the assumptions for base FY23 traffic. We then used the segmentation assumptions, discussed in chapter 3, as a starting point to arrive at the base year revenue. This is further discussed in the section below.

Toll Segmentation

5.17 As discussed in chapter 3, segmentation trends have largely been stabilising over the last few months, with FASTag now being in a compulsory implementation since Feb'21 and more than 95% of transactions are via FASTag, it can be assumed that travel patterns have stabilised. Therefore, we believe the FY23 average of the segmentation is representative of the travel patterns on the Asset. This is presented below:

Figure 5.2: Toll segmentation (%) for AB FY23 and FY24 onwards



Source: Steer analysis

5.18 The changes in forecast toll segmentation observed on toll plaza is due to our understanding that once the Assets are taken over by the Client, the overall reporting practises will improve as the toll plaza will be operated by a reputed toll operator and may result in a decrease in total exemptions. Increasing compliance due to better operational efficiency in the next year will see the number of exemptions decrease further, with a subsequent increase in the Local passes, as well as the Single and Return ticket categories.

Revenue reconciliation – validation of forecast segmentation

5.19 As part of validating the data provided by the Client, as well as our assumptions around toll calculations and forecast segmentation, we have reconciled the actual reported revenue on a monthly level for the Asset. To reconcile we have used our FY23 segmentation as mentioned in the previous section, MADT of the month and compared it with the reported revenue for FY 23.

5.20 The Steer revenue calculations have been built up from monthly raw traffic data files, containing monthly data and ticket type information; and the toll notifications – all shared by the Client. The comparison, as shown in the table below, depicts the difference between modelled revenue and the reported revenue is within 0.5-0.6% for the Asset, this gives us the confidence on the assumptions around segmentation and trip factors used for estimating forecasting revenue.

5.21 The table below shows the delta between our modelled revenue and the actual revenue reported in the toll plaza data. The slight difference is also contributed by unavailability of cash data from Jan-23 to Mar-23 and few other months in FY23.

Table 5.3: Revenue Reconciliation for AB (INR Cr)

Revenue	Modelled	Reported	Delta
AB: Raibha	94.65	94.10	0.6%

Source: Steer analysis. 'Reported' is adjusted reported data for revenues till 31st Mar-23

Base year (FY23) Comparison

Traffic comparison

5.22 The table presented below is the comparison of FY23 corrected base traffic as assumed in the previous study in Aug-22 (2nd round of InVIT) and the FY23 base traffic as assumed in the present study. The Asset has outperformed the forecasted traffic volumes, witnessing a growth of 10.9% over the normalized FY22.

5.23 Growth in CJV volumes is slightly lower than the expected numbers. However, this could be attributed to revival in buses operations as the economy recovered from the Covid-19.

Table 5.4: Base Year Traffic Comparison

	Current Study	Earlier Study	Delta
CJV	2,401	2,457	(2.3%)
LCV	480	480	(0.1%)
2A	2,208	2,148	2.8%
3A	1,854	1,927	(3.8%)
MAV	3,505	3,342	4.9%
Total	**10,451**	**10,357**	0.9%
PCU	**31,094**	**30,455**	2.1%

Source: Steer Analysis, Previous Study was carried in July'22.

5.24 As a trend, it has been seen that the MAVs have observed a strong growth and 3As a slower growth across most of the toll plazas. On Raibha, growth in MAVs has been derived from a strong performance across the NH44 and NH21 corridors, which is why we observe a 2.1% increase in overall PCU on the Asset. The decrease in 3As can be said to be compensated by an increase in 2A category. Across other categories, the differences observed can be said to be in a reasonable range.

Revenue comparison

5.25 The table provided below shows the comparison between the revenue estimated as part of current study vis-à-vis the earlier study.

Table 5.5: Revenue comparison (FY23)

Vehicle Category	Current Study INR Cr	Earlier Study INR Cr	Delta (%)
CJV	5.27	5.13	2.7%
LCV	1.91	1.76	8.6%
2A	18.69	17.33	7.9%

Vehicle Category	Current Study INR Cr	Earlier Study INR Cr	Delta (%)
3A	18.68	19.04	(1.9%)
MAV	50.06	46.52	7.6%
Total	94.65	89.81	5.4%

5.26 The difference in the revenue is on account of higher base year traffic, higher tolling length vis-à-vis the one considered in the earlier study and a difference in the segmentation for FY23.

6 Traffic and Revenue forecasts

Introduction

6.1 Following the discussion on our forecast of background growth elasticity relationships in the previous chapter, this chapter first covers the forecasting assumptions around estimation of base year AADT and potential network impacts on traffic growth on the Asset. Thereafter, we present our assumptions around toll segmentations, trip factors and evolution of toll rates for the forecast period which are used to forecast revenues as derived from forecast traffic. In the final section, this chapter summarises traffic growth rates for the forecast years.

6.2 The following table lists key intermediate and final outputs that have presented in previous Chapters and in this chapter.

Table 6.1: Key intermediate and final outputs in the forecast

Forecast	Final outputs	Intermediate outputs	Inputs	Chapter
Traffic	Base year AADT	AADT	Historical and year-to-date AADT	Chapter 3, 5
	Background traffic growth	Background forecast elasticity	Background historical elasticities with respect to growth drivers	Chapter 3, 4
		Forecasts for growth drivers	Historical performance of growth drivers along with Macro assumptions (GDP and GSDP)	Chapter 6
	Impact growth rates and staging	Impacts	Network analysis	Chapters 6
Revenue	Annual/daily revenue forecasts	Forecast toll segmentation: Trip frequencies and trip factors	Historical trip frequencies	Chapter 3
			Historical trip factors	Chapter 6
		Future toll rates	Toll evolution	Chapter 6

Source: Steer

Analysis of potential impacts

Summary of alternate routes and impact assessments

6.3 The section below details the impacts which we believe would affect traffic on the Asset during the concession period. As discussed in earlier Chapters, in order to assess the impacts on the Asset, whether positive or negative, we have studied developments (alternate roads, feeder roads and regulatory) in the surrounding road network.

6.4 The following table lists the impacts considered on the Asset.

Table 6.2: Summary of impact

Impact	Probability/Scale of impact	Year of impact	Impact (+/-)
3A, MAV Downward correction	Medium/Low	FY24 onwards	-ve
Delhi Mumbai Expressway	High/High	FY25 onwards	-ve
WDFC	High/Low	FY25 onwards	-ve
Agra Bypass (diversion)	Medium/ Medium	FY26 onwards	-ve
Agra Bypass (city congestion)	Medium/ High	FY26 onwards	+ve

Source: Steer analysis of OD data

3A, MAV base correction

6.5 3A and MAV Volumes observed on the asset are showing higher growth as compared to the surrounding assets. Based on the due diligence of the surrounding assets, on NH44 and NH21, covering the north/ south and east/ west plazas, it is found that Raibha has seen the highest growth rate among all the toll plazas, pointing towards upliftment in growth due to local factors. We have validated the same through our OD survey data, as per which the proportion of Rajasthan and local trips show an increase as compared to OD surveys conducted in Q2, FY23.

6.6 We believe that this growth in MAVs is contributed by temporary reasons, local to the asset region (such as construction activities which have pushed additional demand to Agra bypass). We believe that this additional demand is temporary and will not continue in future once the construction activities are completed. Therefore, MAV volumes against an incremental growth component is adjusted in FY24 (50%) and FY25 (100%).

6.7 The impact in volume terms is equivalent to 150 vehicles (33% - 3As, 67% - MAVs). The negative impact considered here is presented below:

Table 7.6: 3A, MAV downward impact (%)

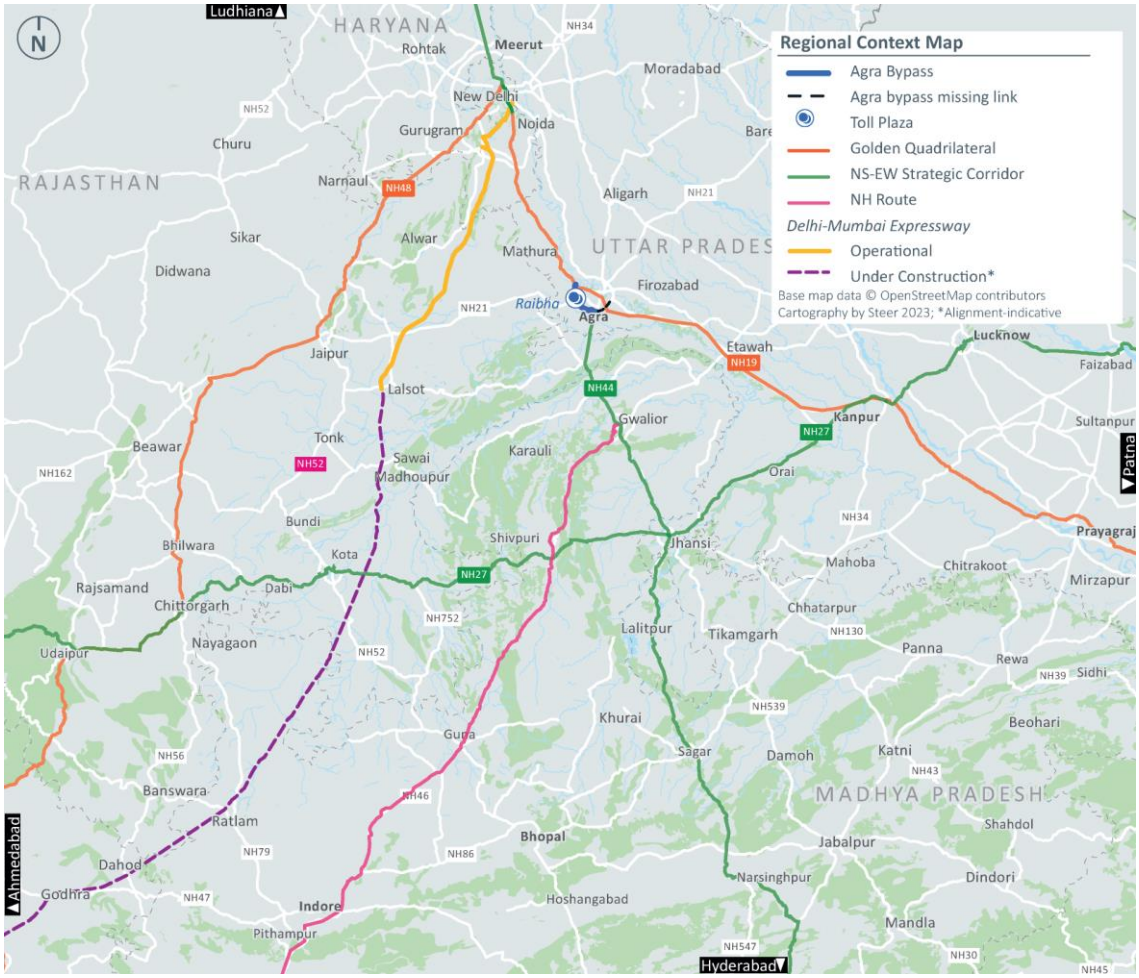
Impact	3A	MAV
3A, MAV downward correction	(2.5%)	(2.5%)

Source: Steer Analysis

6.8 The network context in which these upgrades are planned can be analysed in conjunction with the network map below.

Figure 6.1: Asset route shown against the regional network context

6.9



Source: Steer analysis and cartography

6.10 The subsections below include a narrative of each of the improvements, and impacts associated from each of these on our traffic forecasts. Please note that all traffic volumes for impacts were estimated as impact rates applied on FY23 AADT.

Western Dedicated Freight Corridor (WDFC)

6.11 The Government of India has plans to develop two Dedicated Freight Rail Corridors (DFC): The WDFC will link Dadri (east Delhi) to Mumbai via rail and EDFC between Ludhiana and Dankuni. We estimate that on completion of WDFC in FY25, the relevant goods carried via roads will shift to rail, causing a reduction in traffic volume on the corridor. As per the DFC website, base commodities which are expected to be carried on WDFC include containers, POL, fertilizers, iron & steel and cement, groceries, agricultural products such as food grains, among other bulk commodities and travelling more than 750Kms to Rail from Road. The Rewari to Palanpur section of the DFC commissioned in April 2021 and first RO-RO service from Palanpur was flagged off in August 2021. Whereas, the Dadri-Rewari section has undergone trial runs on the section in Mar-23.

6.12 The in-scope demand is all trips travelling more than 750 kms, carrying the above-mentioned commodities travelling between Delhi and Mumbai

Delhi Mumbai Expressway

6.13 NHAI is building a greenfield expressway connecting Delhi and Mumbai as shown in the figure 7.1above. The Delhi-Mumbai Expressway (DME) will connect Delhi to Mumbai with a dual carriageway with six lanes per direction. At 1350km long, it will drastically reduce travel length and times from Delhi to Mumbai. With this alignment, it is expected that once it's completed, the Delhi-Mumbai Expressway could attract long-distance traffic from the north including Delhi/North of Delhi regions and going that is presently using the asset.

6.14 The section between Sohna (Haryana) to Dausa (Rajasthan) was made operational in Feb-23. The latest status[8] as posted by NHAI projects that by Mar-24 the section between Delhi and Ratlam-Indore will be operational. Majority of the section between Vadodara to Virar is under construction/ award stage and is projected to be completed by Jun-24 (FY25). Similarly, the last section, which is, Virar to JNPT is also expected to be completed by Jun-24 (FY25).

6.15 The In-scope trips considered include movements between

- Delhi and north India including states of Haryana, Punjab, and
- West Madhya Pradesh (Indore) and Maharashtra (excluding trips to Nagpur), Bangalore and west Karnataka, parts of Tamil Nadu.

6.16 We expect such shifts to take place over course of time once the benefits of the expressway are fully visible and could be influenced by three factors:

- the last and first mile connectivity; and
- roadside facilities typically seen along the national highway network such as truck stops, rest/refresh areas, affordable food/drink facilities; and
- fuel and repair shops coming up along the expressway network.

6.17 The benefits will also be most valued by long distance users which can make end to end movements as compared to those users with intermittent destinations. Given the novelty of the expressway and its expected impacts on a fragmented logistics market, we have assumed that 80% of impact will be realised within the first year of its completion whereas the 100% will occur in the subsequent year.

6.18 The commissioning of DME is expected to significantly impact the traffic on the Asset. Since the in-scope traffic for WDFC and DME is same (WDFC as a subset of the total DME in scope), the combined impact is discussed below. For calculation of impact magnitude, we have considered Delhi and Indore (Madhya Pradesh) as entry/exit points where the option of diverting to an alternate route would be available for the road users. The Generalized Journey Cost based estimation suggests that up to 75% of the inscope trips are expected to shift to the expressway post completion starting FY25. The table below summarizes the DME impact on the Asset.

Table 6.3: DME impact - AB: Raibha

	LCV	2A	3A	MAV
Impact %	(4.4%)	(10.2%)	(11.3%)	(8.1%)

[8]DME status as on March'2023, **https://nhai.gov.in/nhai/sites/default/files/mix_file/Delhi-Mumbai-Award-Status-Mar-23_v1.pdf**

Source: Steer analysis

6.19 To estimate the impact magnitude of shift to WDFC, we have taken out trips carrying containers, POL, fertilizers, iron & steel and cement, groceries, agricultural products such as food grains, among other bulk commodities between Delhi and Mumbai and are travelling greater than 750 kms. The impact of WDFC on Agra Bypass is presented in the table below:

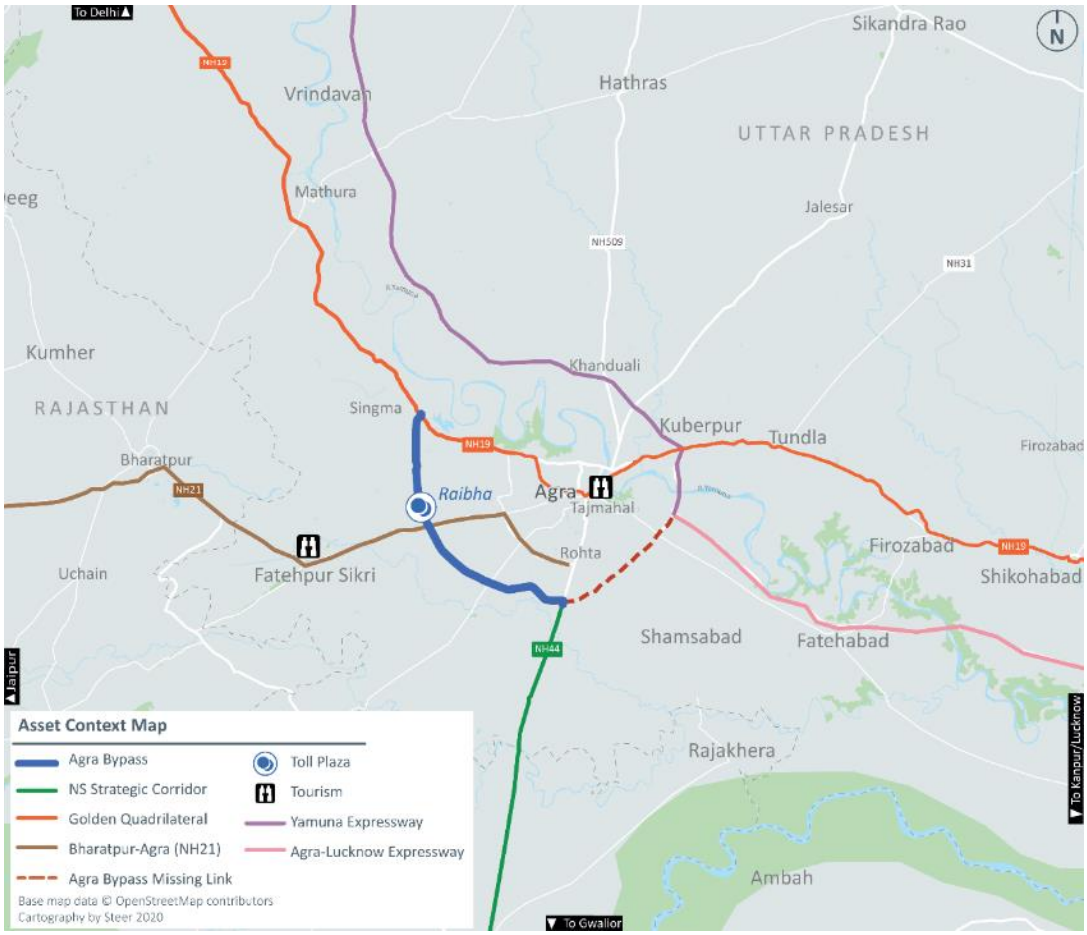
Table 6.4: WDFC impact-AB: Raibha

	LCV	2 Axle	3 Axle	MAV
Impact %	(1.2%)	(1.3%)	(1 %)	(1.3%)

Source: Steer Analysis, overall impact, the impact will be phased over 4 years on DME and five years on WDFC

Agra Bypass missing link

Figure 6.2: Agra Bypass missing link



Source: Steer cartography using OpenStreetMap data

6.20 The missing link would provide an option for east-west traffic current using the Asset to use bypass route and continue towards NH19 or Agra Lucknow expressway by avoiding the toll plaza.

6.21 Presently, the east-west traffic, plying between centres on NH21 and NH19, crosses Raibha toll plaza to cross the city of Agra to either exit at NH21 or NH19/Agra-Lucknow Expressway. With the completion of the missing link, the traffic will have the option to remain on the bypass

when covering the east-west movement. The impact on overall traffic is summarised in the table below:

Table 6.5: Agra Bypass diversion impact (%)

Impact	LCV	2A	3A	MAV
Agra Bypass diversion	(1.3%)	(1.3%)	(1.8%)	(5.8%)

Source: Steer Analysis

Agra Bypass (city congestion)

6.22 The completion of the missing link would also have a positive impact as the current NH19 alignment passes through the city, which is already quite congested, therefore post the entire bypass is completed, we believe that the city authorities would ban movement of trucks within the city during daytime resulting in positive diversion on the Asset. Once any such travel ban is imposed, the traffic, which is presently traveling through the city using NH19, would have to divert to the bypass. The impact assumed is presented below:

Table 6.6: Agra Bypass (city congestion) impact (%)

Impact	2A	3A	MAV
Agra Bypass (city congestion)	10%	5%	9%

Source: Steer Analysis

Forecasts for growth drivers

6.23 In this section, we have described our assumptions in relation to forecasts of the key macro-economic drivers of traffic growth. India's GDP and the relevant state GSDPs are the primary macroeconomic variables that have been used to drive our traffic growth forecasts.

Macro assumptions: GDP, GSDP and WPI

National GDP

6.24 For the past 2 decades, the Indian economy has grown at an average of about 7% annually. Between 2014-2018, India was the fastest growing major economy globally. In the year 2019-20, there was a trend of economic downturn observed in the country, nevertheless, with government initiatives such as Make in India, and Production-Linked Incentive (PLI) scheme, the national economy was expected to improve.

6.25 The Input assumptions on GDP, GSDP and WPI are presented below. GDP is sourced from Consensus forecasts. For UP state GSDP, there are significant investments expected to take place as part of the state's plan and Uttar Pradesh is expected to receive a significant proportion of these investments, given its leading position in industrial investments. The higher-than-expected GSDP growth rate across the concession period could be achieved if such investments were realised as they are expected to give an additional boost to Uttar Pradesh's state economy.

6.26 In the long term, we believe that as other smaller state economies of India catch up with the national economic growth, the gap between growth rates of larger state economies, such as Gujarat, Maharashtra and Karnataka, and the national GDP growth rate will start reducing.

Table 6.7: GDP, GSDP UP, and WPI assumptions

	GDP	GSDP UP	WPI
FY24	5.8%	5.6%	5.02%*
FY25	6.2%	6.0%	3.5%
FY26	6.5%	6.3%	3.5%
FY27	6.5%	6.3%	3.5%
FY28	6.3%	6.2%	3.5%
FY29	5.9%	5.8%	3.5%
FY30	5.9%	5.8%	3.5%
FY31	5.9%	5.8%	3.5%
FY32	5.9%	5.8%	3.5%
FY33	5.9%	5.8%	3.5%
FY34	5.8%	5.7%	3.5%
FY35	5.7%	5.6%	3.5%
FY36	5.6%	5.5%	3.5%
FY37	5.5%	5.4%	3.5%
FY38	5.4%	5.3%	3.5%
FY39	5.3%	5.3%	3.5%
FY40	5.2%	5.2%	3.5%
FY41	5.1%	5.1%	3.5%
FY42	5.1%	5.0%	3.5%
FY43	5.0%	4.9%	3.5%

Source: Projections of GDP from Consensus, *RBI Estimates, https://www.rbi.org.in/Scripts/PublicationsView.aspx?id=20931, WPI future input is provided by client

6.27 WPI for FY24 is sourced from the Dec'22 release of RBI estimates. According to the concession agreement, the RBI release of December is to be referred to vehicle incorporating WPI in the toll rate revision. We have assumed 3.5% WPI growth each year FY25 onwards based on the inputs provided by the Client.

Elasticity and growth drivers

6.28 In this section, we present our approach, and assumptions around estimation of elasticities and forecast assumptions of macro parameters for each vehicle category on the Asset.

6.29 Traffic growth is commonly related to a variety of macro-economic and industry- or commodity-specific factors (hereafter referred to as 'traffic growth drivers'). These growth drivers are typically identified from the results of the OD data analysis and the site visits that help us appreciate the nature of traffic movement – 'what' travels 'where' and 'why'.

6.30 On Asset where long time series historical data is available, to understand the historical traffic trends in relation to these growth drivers, we typically carry out regression analysis, to

determine the historical relationship between traffic belonging to each major vehicle category and its macroeconomic growth driver at the toll plaza. The dynamics of traffic demand is the dependent variable while the dynamics of one or more identified growth drivers are the independent or explanatory variables. This is the primary approach to determine the elasticity relationships. However, for Assets under consideration where only limited historical data is available, we have adopted a benchmark approach to finalise our elasticity estimates.

6.31 While working on several Asset across the country where historical data is available, it has been observed that typically, growth of passenger and light commercial vehicles like cars, buses and LCVs which have relatively shorter trip lengths (<200-250 km) is more closely linked to the local economic growth drivers where the Asset is located. These categories are generally driven by the demand of local production/consumption centres and are in most cases captive to the Asset. Local factors coupled with tourism driven demand is often seen as the key driver for consumption of goods and services in the areas. Therefore, we typically link the growth rate of these vehicle categories with GSDP growth rates of the state where the asset is located as that is closest proxy of the local economic activity in the region.

6.32 Whereas heavy vehicle traffic like 3A trucks (sometimes 2A trucks as well) and MAVs tend to have a much longer average trip lengths (>350-500 km) and serve multiple economic activity centres located along an Asset as well beyond the Asset across multiple states of the country. For these vehicle categories we therefore assume these vehicle categories to grow in line with the national GDP.

6.33 This is because most light goods vehicles tend to travel shorter distances within the state, whereas a significant proportion of heavy vehicles carry commodities for long - distances across the country and have much longer trip lengths. These commodities also tend to be part of industry ecosystems whose demand-supply relationships are scattered across the country and therefore relate more with GDP growth. Therefore, using the OD data trip lengths of various vehicle types and the commodity carried by these goods vehicles form the basis for estimating the elasticity relationships.

6.34 The forecast elasticities are assumed to remain constant over the concession period as the logistics sector in still in early stages of development in India (95% of trucks still owned by operators owning less than 5 trucks). Car ownership levels are still around 22 per 1000 people, and it is likely to take a few years before the market reaches maturity. These trends are based on a long-term understanding of historical relationships and an overall outlook on the growth of the region and the country.

6.35 The table below detail out the reasoning for selection of respective growth driver(s) and elasticity adopted for each vehicle category for the Asset.

Table 6.8: Assumed Elasticities for the AB: Raibha toll plaza

Vehicle Category	Adopted elasticity	Growth Driver	Comments
CJV	1.0	GSDP UP	Car traffic is largely driven by the local demand. CJVs are expected to grow with 1 elasticity on both the asset, as the car ownership levels continue to increase in the region with the increase in per capita income levels in future years. An increase in car ownership levels and overall economic growth of the region is likely to result in a healthy growth of CJV's on the asset.

Vehicle Category	Adopted elasticity	Growth Driver	Comments
Buses	0.3	GSDP UP	Buses are primarily a mix of public and private inter-city buses. Buses currently are serving local intercity demand. As these cities grow, the buses are also expected to grow to serve the increasing demand however only at a muted rate.
MLCV/LCV	0.4	GSDP UP	LCVs are also found to undertake long distance trips with lengths up to 800km in addition to catering to the local demand. The emergence of ecommerce companies which transport high value low tonnage products over long distances prefer the use of LCV/2A vehicles. It is evident from the survey data that LCV/2A trucks are being used for transporting such materials. Further both LCV and 2A are also serving the manufactured goods industry. Therefore, we believe that the LCV/2A category will continue to grow in the future. However, the classification between 2A and LCV still colours the performance of this category and hence a lower growth assumption on LCV compared to 2A has been assumed on forecasts.
2A	0.6	India GDP	
3A	0.8	India GDP	3A and MAV's make medium to long distance movements. The Asset benefit from agricultural, groceries and industrial movement. More than 65-70% of the 3A and MAV are doing an average trip length of more than 1000 kms on both the asset. MAVs are doing strategic north-south long-distance movements catering to the New Delhi and north India movement towards southern India including Mumbai, Bengaluru, Chennai, Hyderabad, and Karnataka etc. Moreover, an average trip length of around 1000kms just aids the fact that this asset has significant long-distance traffic and is expected to have a closer growth relationship with national GDP. Therefore, an assumption of 1.0 to GDP has been assumed for the forecasts. Although the trip nature of 3As is similar to MAVs, a lower elasticity parameter is considered for 3As due to gradual shift observed from lower to higher axle trucks after a new Axle Load Policy was implemented in FY19, and economies of scale achieved by carrying higher loads per km of distance covered.
MAV	1.0	India GDP	

Source: Steer analysis

Revenue Forecasting Assumptions

6.36 To forecast the revenues for a particular financial year, the traffic forecast for each vehicle type is converted into tickets sold, which is then multiplied with the corresponding toll rate, which grows over the years as defined in the Concession Agreement. While "trip factors" provide the conversion factor to the former, i.e., traffic (trips) to tickets sold, "toll segmentation" provides the latter i.e., the breakup of trips paying each ticket type. This section discusses assumptions related to trip factors, and toll rates for the forecast period.

Trip factors

6.37 As discussed in chapter 3, a user can by different type of tickets to pay toll depending on the vehicle type. Apart from the single trips, trips such as return, monthly, local commercial, local

personal, are discounted tickets that are offered to the users. The revenue realised from these discounted trips is lower than a single trip fare. Therefore, in order to calculate the revenue for the trips made on discounted tickets (or passes) a trip factor is applied to calculate revenue realised from that particular pass sold.

6.38 The following trip factors are assumed for both the Asset.

Table 6.9: Trip factors for the forecast years

Ticket category	CJV	LCV	Bus	2A	3A	MAV	OSV
Single	1	1	1	1	1	1	1
Return	2	2	2	2	2	2	2
Monthly	45	45	45	45	45	45	45
Local Commercial	1	1	1	1	1	1	1
Local Personal	30						

Source: Steer analysis of toll plaza data

Toll evolution

6.39 Based on the concession agreement and the gazetted toll notification, we see that base toll rates increase every year on 1st April based on WPI-linked inflation (December print of previous FY) to provide us unrounded toll rates. These are rounded up to the nearest five to estimate the rounded toll rates charged to the road user. We have used actual toll rates of FY23 toll notifications to validate the modelling of toll evolution. These toll lengths are presented in the table below:

Table 6.10: Tolling lengths for toll evolution assumed- AB

Length (km)	Raibha	
	Existing toll lengths (FY23)	**Revised toll lengths (FY24 onwards)**
Road length excluding bypass	-	-
Structure on road	0.805	0.7055
Converted length of structures	8.050	7.055
Net Tollable length	8.050	7.055
Bypass length	31.995	32.094

Source: Steer analysis of toll notifications and concession agreement (CA) and information shared with Client

Traffic and Revenue forecasts

PCU factor assumption for forecasts

6.40 The PCU factors considered are given in the table below. These are derived from IRC: 16-1990 code. The splits for the same have been derived from the TVC counts that we have undertaken.

Table 6.11: PCU factors

Vehicle Category	PCU Factor
CJV	1.0
LCV	1.5
Bus	3.0

Vehicle Category	PCU Factor
2A	3.0
3A	3.0
MAV	4.5
OSV	4.5

Source: Steer analysis, IRC Codes

6.41 Based on the traffic and revenue-related forecast assumptions discussed above, we have modelled the traffic and revenue forecasts for the forecast period for the Asset. The table below presents the traffic and revenue forecast growth rates and CAGRs on this Asset. Further, Appendix D presents the AADT and revenues for the forecast period.

Traffic and revenue forecasts

Table 6.12: Final (background plus impacts) AADT forecast – AB Raibha

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	2,174	2,434	3,268	4,319	5,603	6,485
Mini LCV	228	238	269	301	335	355
LCV	480	483	527	590	656	696
Bus	55	56	62	67	73	76
2A	2,154	2,117	2,700	3,207	3,765	4,118
3A	1,854	1,799	2,296	2,885	3,569	4,019
MAV	3,505	3,572	4,852	6,446	8,396	9,735
OSV	3	3	4	5	7	8
AADT	**10,451**	**10,702**	**13,978**	**17,821**	**22,403**	**25,491**
PCU's	**31,094**	**31,400**	**41,354**	**53,015**	**66,956**	**76,364**

Source: Steer analysis

Table 6.13: Final (background plus impacts) AADT CAGR (%) – AB Raibha

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	5.8%	6.1%	5.7%	5.3%	5.0%	5.6%
Mini LCV	2.3%	2.4%	2.3%	2.1%	2.0%	2.2%
LCV	0.4%	1.7%	2.3%	2.1%	2.0%	1.9%
Bus	1.7%	1.8%	1.7%	1.6%	1.5%	1.7%
2A	(0.9%)	5.0%	3.5%	3.3%	3.0%	3.3%
3A	(1.5%)	5.0%	4.7%	4.3%	4.0%	3.9%
MAV	0.9%	6.3%	5.8%	5.4%	5.1%	5.2%
OSV	5.4%	5.6%	5.3%	4.9%	4.5%	5.2%
AADT	**1.2%**	**5.5%**	**5.0%**	**4.7%**	**4.4%**	**4.6%**
PCU's	**0.5%**	**5.7%**	**5.1%**	**4.8%**	**4.5%**	**4.6%**

Source: Steer analysis

Table 6.14: Final (background plus impacts) revenue (INR crores) forecast – AB Raibha

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	4.77	5.87	9.74	16.03	25.12	32.86
Mini LCV	0.50	0.58	0.80	1.12	1.50	1.80
LCV	1.91	2.11	2.81	3.82	5.21	6.19
Bus	0.46	0.51	0.68	0.91	1.21	1.43
2A	18.23	19.89	30.82	44.71	64.64	79.46
3A	18.68	19.74	30.57	47.24	71.46	90.40
MAV	50.06	54.83	91.56	148.91	237.52	309.08
OSV	0.05	0.06	0.09	0.15	0.23	0.29
Total Revenue	**94.65**	**103.58**	**167.07**	**262.88**	**406.89**	**521.51**

Source: Steer analysis

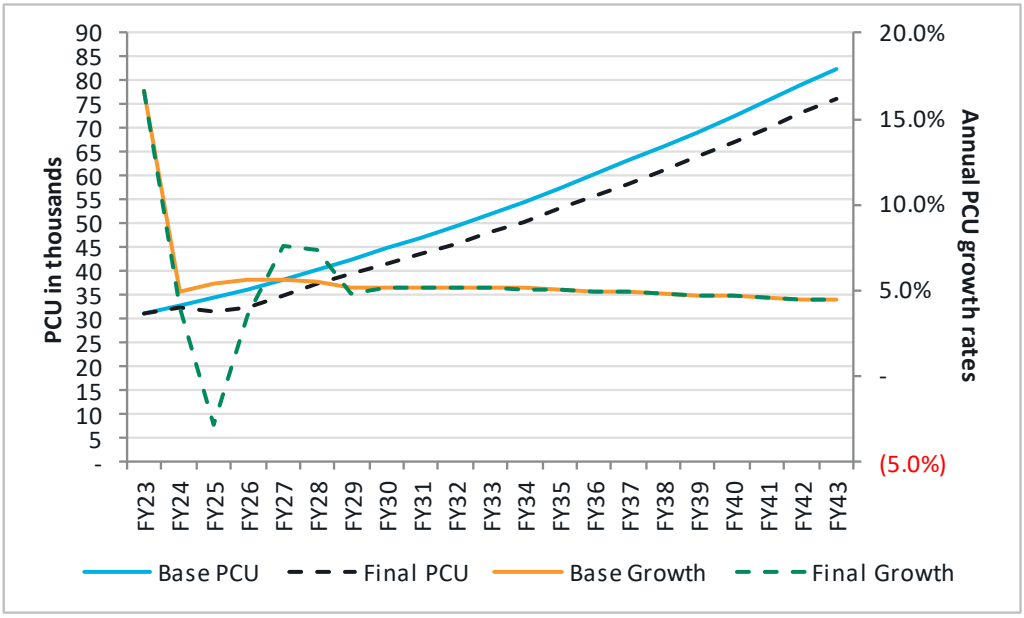
Table 6.15: Final (background plus impacts) revenue CAGR (%) – AB Raibha

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	11.0%	10.7%	10.5%	9.4%	9.4%	10.1%
Mini LCV	7.3%	6.9%	6.9%	6.1%	6.2%	6.6%
LCV	5.1%	5.9%	6.3%	6.4%	5.9%	6.1%
Bus	5.6%	5.9%	5.9%	5.9%	5.5%	5.8%
2A	4.5%	9.2%	7.7%	7.7%	7.1%	7.6%
3A	2.8%	9.1%	9.1%	8.6%	8.2%	8.2%
MAV	4.7%	10.8%	10.2%	9.8%	9.2%	9.5%
Total Revenue	**4.6%**	**10.0%**	**9.5%**	**9.1%**	**8.6%**	**8.9%**

Source: Steer analysis

6.42 The growth rates and PCU projections are presented in the chart below. The overall PCU traffic is estimated to grow at a CAGR of 4.6% from FY23 to FY43, where the CJV would grow by 5.6% and MAV by 5.2%.

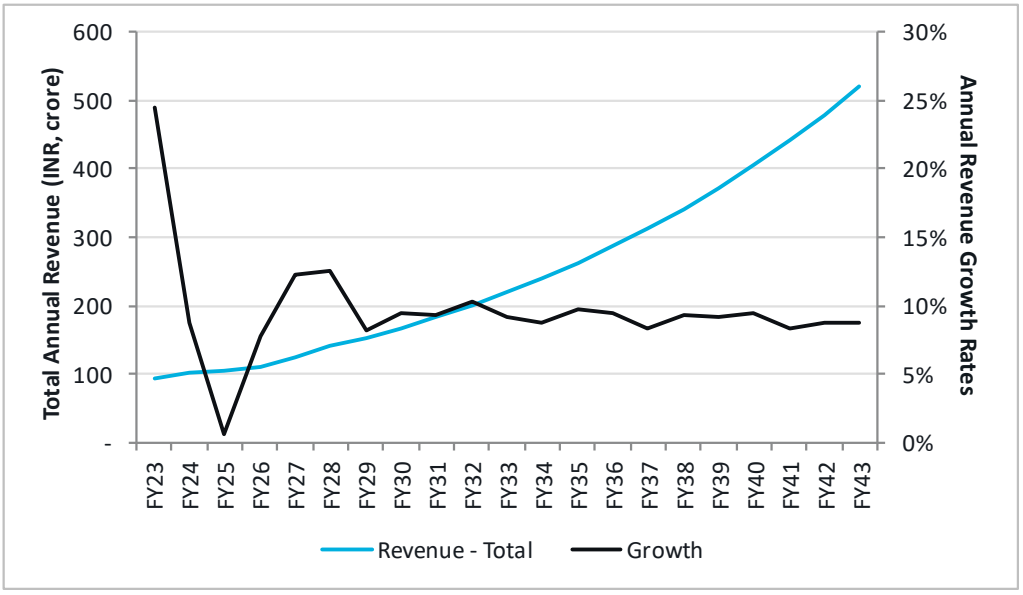
Figure 6.3: PCU growth rates (Base and Final)- AB: Raibha



Source: Steer analysis

6.43 Annual revenue and associated growth rates are presented in the chart below. The overall revenue is estimated to grow at a CAGR of 8.9% from FY23 to FY43, where over 72% of the revenues are contributed by 3A and MAVs through the forecasting period.

Figure 6.4: Revenue Estimates (INR Crore) and growth rates- AB: Raibha



Source: Steer analysis

Comparison with earlier study

Traffic and revenue forecasts

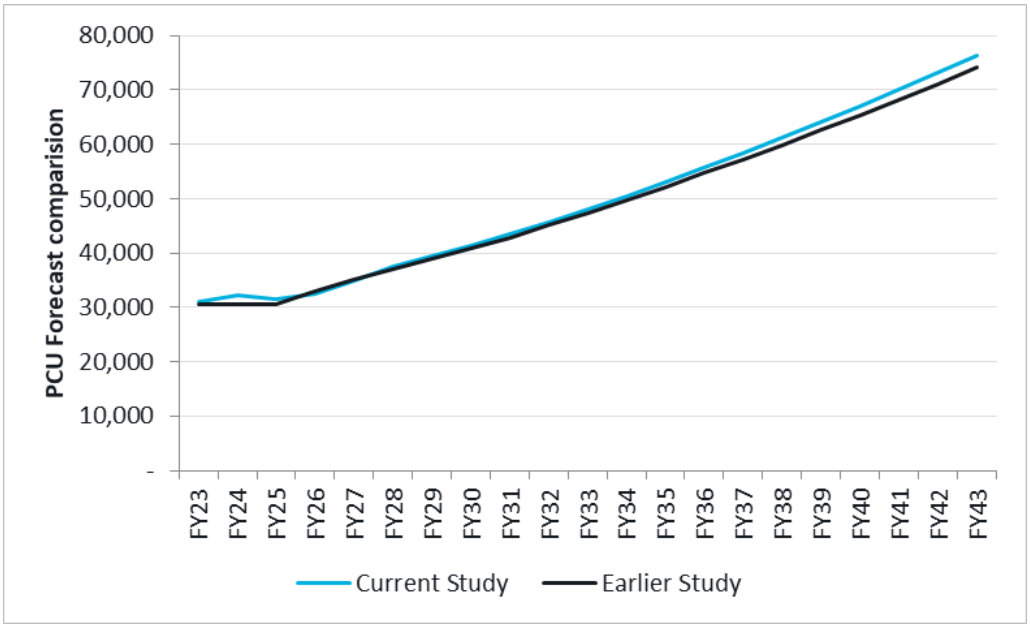
6.44 Presented below is the comparison of revised traffic forecasts vis-à-vis the earlier forecasts (from the study conducted in Aug-22)

Table 6.16: Traffic forecasts comparison

Vehicle Type	Current study		Earlier study	
	AADT (FY43)	Growth Rate (FY23-FY43)	AADT (FY43)	Growth Rate (FY23-FY43)
CJV	6,485	5.6%	6,897	5.7%
Mini LCV	355	2.2%	305	2.3%
LCV	696	1.9%	700	1.9%
Bus	76	1.7%	85	5.0%
2A	4,118	3.3%	3,923	3.1%
3A	4,019	3.9%	4,307	4.1%
MAV	9,735	5.2%	9,071	5.1%
Total	**25,491**	**4.6%**	**25,296**	**4.6%**
Total (PCUs)	**76,364**	**4.6%**	**74,055**	**4.5%**

Source: Steer analysis

Figure 7.5: PCU Forecast Comparison



Source: Steer Analysis

6.45 The total PCU growth rate is marginally higher as per the current study due to a combination of upward revision in base traffic and GDP estimates.

6.46 Presented below is the comparison of revised revenue forecasts vis-à-vis the earlier forecasts (from the study conducted in Aug-22)

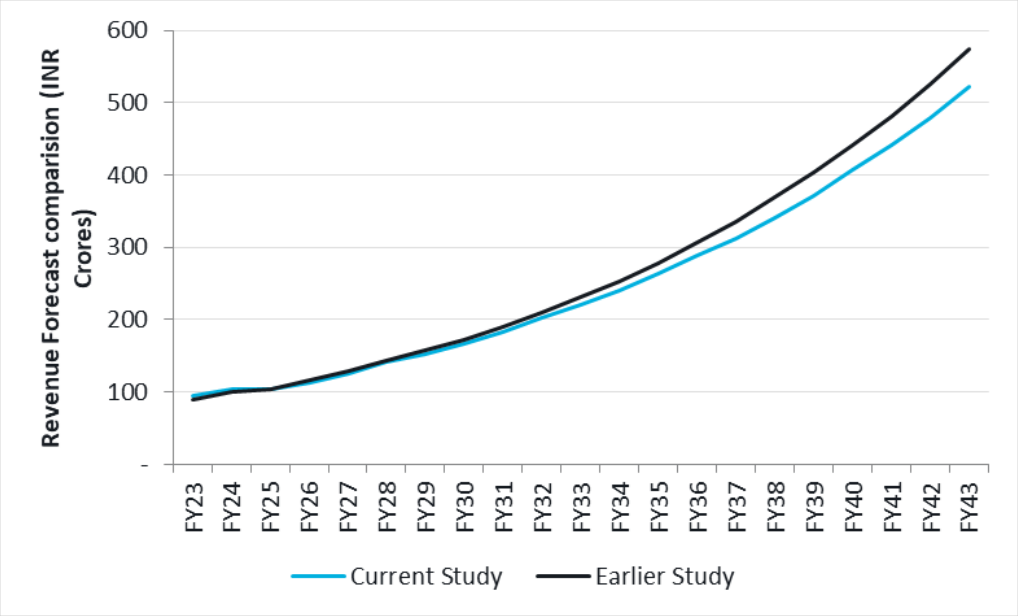
Table 6.17: Revenue forecasts comparison

Vehicle Type	Current study		Earlier study	
	Revenues (FY43) – INR Cr	Growth Rate (FY23-FY43)	Revenues (FY43) – INR Cr	Growth Rate (FY23-FY43)
CJV	32.9	10.1%	38.8	11.1%
Mini LCV	1.8	6.6%	1.8	7.8%

Vehicle Type	Current study		Earlier study	
	Revenues (FY43) – INR Cr	Growth Rate (FY23-FY43)	Revenues (FY43) – INR Cr	Growth Rate (FY23-FY43)
LCV	6.2	6.1%	6.9	7.1%
Bus	1.4	5.8%	1.8	10.2%
2A	79.5	7.6%	86.5	8.5%
3A	90.4	8.2%	110.6	9.2%
MAV	309.1	9.5%	327.4	10.2%
Total	**521.5**	**8.9%**	**574.2**	**9.7%**

Source: Steer analysis

Figure 6.5: Revenue Forecast Comparison



Source: Steer Analysis

6.47 The major reason causing the difference in the revenues is the toll rate induced by the change in WPI forecast assumptions. In the current study, a standard 3.5% WPI is considered from FY25 onwards based on the Client's input.

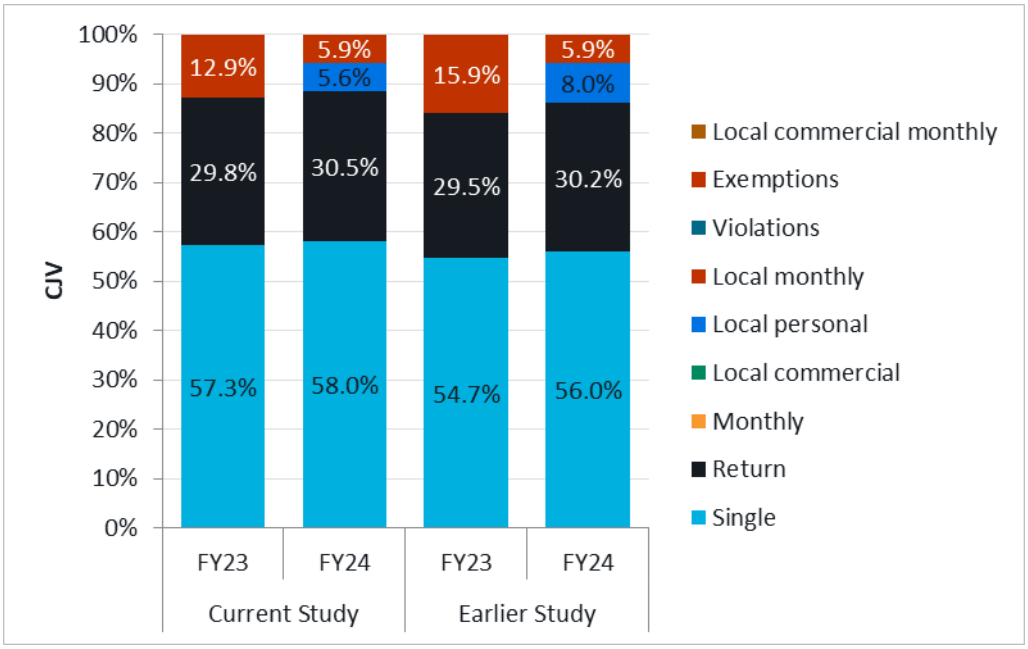
Revenue NPV analysis

6.48 We have performed a comparison between the NPV based on the forecasts made in earlier study (Aug-22) and the current assessment of the Asset. The variation in NPV is highlighted on account of following factors:

- **Traffic forecasts**: This includes the revised traffic forecasts due to updates in 'base year traffic' (FY23); 'impacts' due to change in inscopes as per the latest OD surveys, revised GJC analysis, and change in impact timelines; new 'network developments' such as 3A/ MAV correction in FY24, FY25; and update in 'GDP/ GSDP' values. The comparison in the traffic projections is provided in the previous section.
- **Segmentation**: The segmentation for FY23 in the current study is based on the actual segmentation observed over the entire year as compared to earlier study, where the segmentation for FY23 was available only for initial 4 months. More data has provided better clarity and on ground realities, which we have accordingly considered for FY23 in

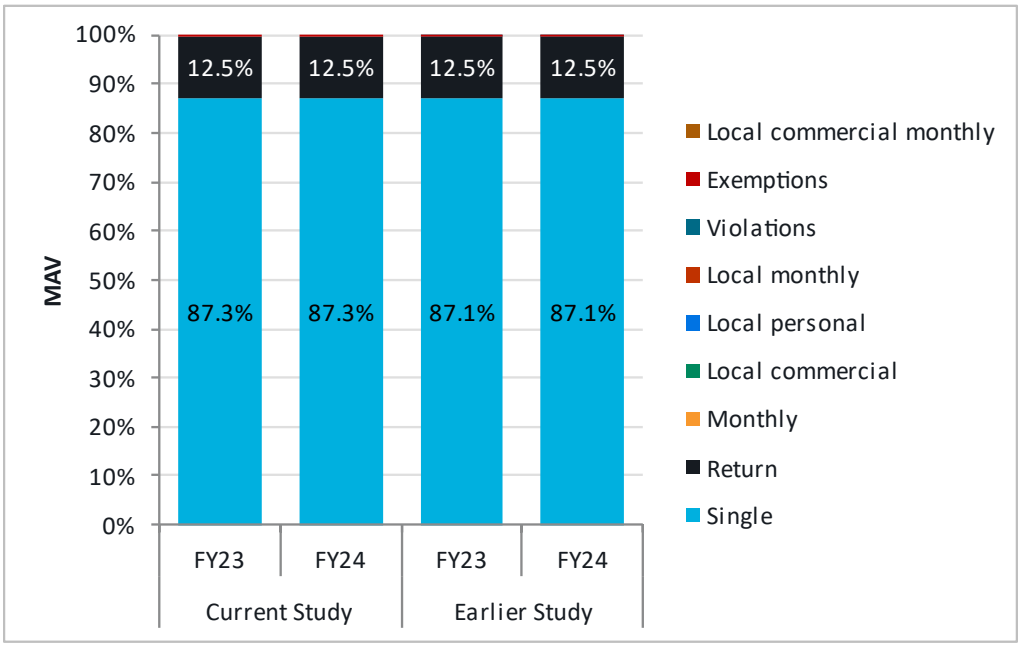
the current study. Provided below is the comparison of segmentation considered in both studies.

Figure 6.6: CJV Segmentation Comparison



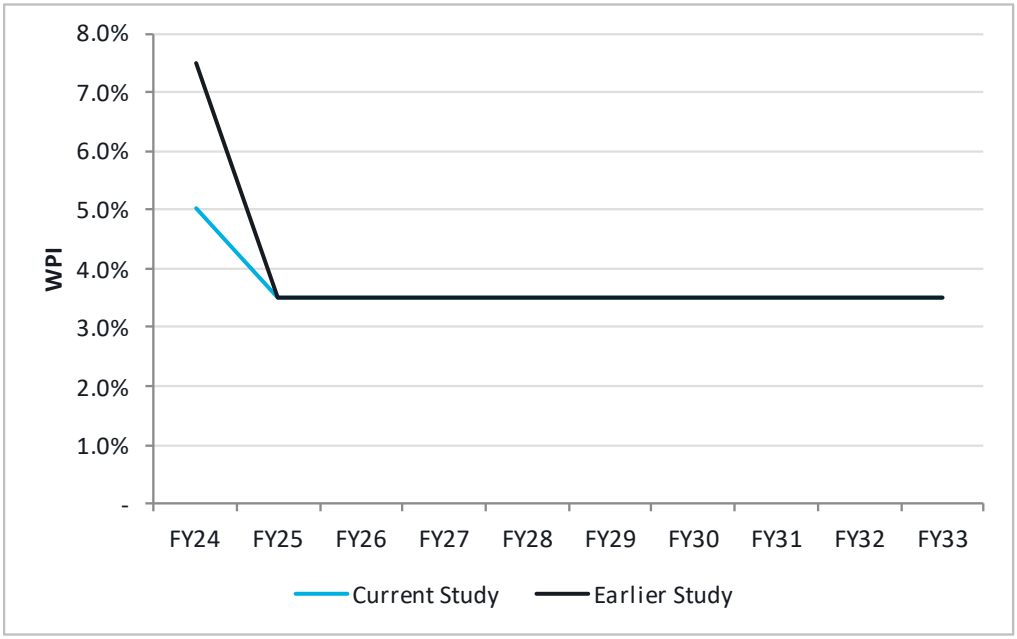
Source: Steer Analysis

Figure 6.7: MAV Segmentation Comparison



- **Toll rates + WPI**: At the time of earlier study in Aug-22, WPI of 7.5% was considered for FY24, which now has been considered as 5.02% based on actuals. WPI from FY25 is considered as 3.5% for all the years based on the recommendation of the Client. This has caused a variation in toll rates for FY24 and the subsequent years.

Figure 6.8: WPI Comparison



Source: Steer analysis, inputs from the Client on WPI forecasts

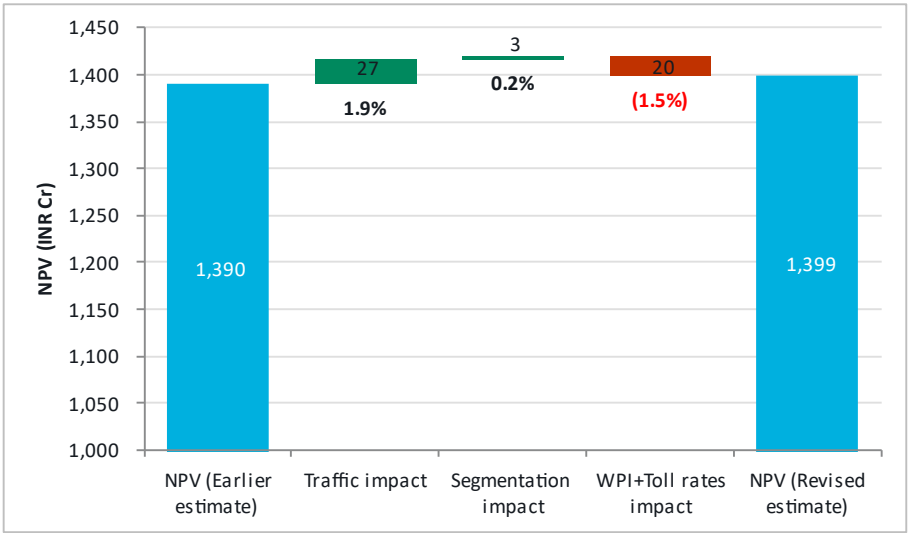
6.49 In addition to WPI, the tolling length hasn't change in the manner it was assumed in earlier study. This factor has also resulted in minor variation in toll rates.

Table 6.18: Tolling length comparison

Type of Vehicle	FY23	FY24 onwards
Earlier study	6.56 Km + 32.14 Km Bypass length	6.56 Km + 32.14 Km Bypass length
Current study	8.05 Km + 32.00 Km Bypass length	7.06 Km + 32.09 Km Bypass length

6.50 As a result of this, the NPV has increased by 0.7% as compared to the NPV based on earlier study. A discount factor of 12% has been assumed (as per client input). Accordingly, presented below is the waterfall chart which explains the NPV difference between the studies:

Figure 6.10: NPV Waterfall Chart



Source: Steer analysis

6.51 Please note that the NPV is estimated for revenue over the period FY24 - FY43 and considers a discount rate of 12%. The table below summarizes the impact of individual factors:

Table 6.19: Summary of NPV Revenue analysis

Particular	NPV (INR Cr)	Absolute impact	Remarks
NPV Earlier Estimate (Drone I)	~ 1,390		Based on WPI of 7.5% for FY24 and 3.5% from FY25 onwards. It also subsumes same trip factors, and tolling lengths for both earlier and revised studies
+ Revised traffic	~ 1,416	+ 1.9%	Including revised impacts and GDP/ GSDP factors
+ Revised Segmentation	~ 1,419	+ 0.2%	
+ Revised WPI + Toll rates	~ 1,399	(1.5%)	Due to the difference in the estimated and actual WPI for FY24.

Source: Steer analysis

Scenario Analysis

6.52 We have developed our base case scenario considering a balanced view on the risks associated with input assumptions around GDP growth and traffic growth elasticities. There is always a risk that the outturn values of these inputs will vary as compared to the assumptions taken due to exogenous impacts, e.g., GDP growth could be influenced both positively and negatively by the impact of monsoons, export-import balances, political changes etc.

6.53 Similarly, traffic growth elasticities could be influenced by increased efficiencies achieved by technology, large shifts in commodity prices globally, changes in local manufacturing practices. However, at this stage we consider that the base case represents a central case scenario given the risks of variation of input assumptions.

6.54 To account for the possible variations in the growth drivers, we are also presenting the forecasts for an Upside (optimistic) and a Downside (pessimistic) scenario.

6.55 These scenarios are defined by the following variations from the base assumptions:

Table 6.20 Summary of upside and downside scenario assumptions--AB: Raibha

Input	Steer scenarios		
	Base	Upside	Downside
Macro assumptions			
GDP/GSDP	As provided in report	+1% every year	-1% every year
Elasticities	As provided in report	+ 10%	- 10%
Impacts			
DME	As provided in earlier section of the report	2A: (7.6%) 3A: (8.4%) MAV: (6.1%)	2A: (12.7%) 3A: (14.1%) MAV: (10.2%)
WDFC	As provided in earlier section of the report	2A: (1.0%) 3A: (0.8%) MAV: (1.0%)	2A: (1.3%) 3A: (1.6%) MAV: (1.6%)
Agra Bypass Diversion	As provided in earlier section of the report	2A: (1.0%) 3A: (1.4%)	2A: (1.6%) 3A: (2.3%)

Input	Base	Steer scenarios	
		Upside	Downside
		MAV: (4.4%)	MAV: (7.3%)
Agra Bypass (city congestion)	As provided in earlier section of the report	2A:12.5% 3A: 6.3% MAV: 11.2%	2A:7.5% 3A: 3.8% MAV: 6.7%

Source: Steer Analysis

6.56 The traffic forecast and growth, and revenue incorporating the upside and downside assumptions are presented in the following sections.

Upside case

Table 6.21 Final traffic forecasts: Upside case-AB: Raibha

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	2,174	2,511	3,653	5,222	7,317	8,861
Mini LCV	228	241	281	326	374	404
LCV	480	494	562	650	746	807
Bus	55	57	64	71	79	84
2A	2,154	2,209	3,062	3,819	4,701	5,287
3A	1,854	1,908	2,670	3,576	4,709	5,503
MAV	3,505	3,784	5,831	8,382	11,796	14,313
OSV	3	3	5	6	9	11
AADT	**10,451**	**11,208**	**16,128**	**22,053**	**29,732**	**35,270**
PCU	**31,094**	**33,057**	**48,427**	**66,673**	**90,402**	**1,07,553**

Source: Steer Analysis

Table 6.22: Traffic growth rates (%): Upside case-AB: Raibha

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	7.5%	7.8%	7.4%	7.0%	6.6%	7.3%
Mini LCV	3.0%	3.1%	3.0%	2.8%	2.6%	2.9%
LCV	1.5%	2.6%	3.0%	2.8%	2.6%	2.6%
Bus	2.2%	2.3%	2.2%	2.1%	2.0%	2.2%
2A	1.3%	6.8%	4.5%	4.2%	4.0%	4.6%
3A	1.4%	7.0%	6.0%	5.7%	5.3%	5.6%
MAV	3.9%	9.0%	7.5%	7.1%	6.7%	7.3%
OSV	6.9%	7.1%	6.8%	6.4%	6.0%	6.7%
AADT	3.6%	7.6%	6.5%	6.2%	5.9%	6.3%
PCU's	3.1%	7.9%	6.6%	6.3%	6.0%	6.4%

Source: Steer Analysis

Table 6.23: Revenue (INR Crore): Upside case-AB: Raibha

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	4.77	6.06	10.89	19.38	32.80	44.90

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
Mini LCV	0.50	0.58	0.84	1.21	1.68	2.05
LCV	1.91	2.16	3.00	4.21	5.93	7.17
Bus	0.46	0.52	0.71	0.97	1.32	1.57
2A	18.23	20.75	34.96	53.24	80.72	102.04
3A	18.68	20.93	35.54	58.55	94.30	123.76
MAV	50.06	58.09	110.02	193.64	333.70	454.44
OSV	0.05	0.06	0.10	0.17	0.29	0.39
Total Revenue	**94.65**	**109.15**	**196.06**	**331.37**	**550.73**	**736.33**

Source: Steer Analysis

Table 6.24: Revenue growth rates (%): Upside case-AB: Raibha

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	12.7%	12.4%	12.2%	11.1%	11.0%	11.9%
Mini LCV	8.0%	7.6%	7.6%	6.8%	6.9%	7.3%
LCV	6.3%	6.8%	7.0%	7.1%	6.6%	6.9%
Bus	6.1%	6.4%	6.4%	6.4%	6.0%	6.3%
2A	6.7%	11.0%	8.8%	8.7%	8.1%	9.0%
3A	5.9%	11.2%	10.5%	10.0%	9.5%	9.9%
MAV	7.7%	13.6%	12.0%	11.5%	10.8%	11.7%
OSV	10.7%	11.6%	11.2%	10.7%	10.3%	11.0%
Total Revenue	**7.4%**	**12.4%**	**11.1%**	**10.7%**	**10.2%**	**10.8%**

Downside case

Table 6.25: Final traffic forecasts: Downside case-AB: Raibha

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	2,174	2,366	2,958	3,644	4,414	4,907
Mini LCV	228	236	258	281	303	316
LCV	480	473	496	540	583	609
Bus	55	56	60	64	68	70
2A	2,154	2,033	2,389	2,719	3,060	3,265
3A	1,854	1,698	1,986	2,357	2,758	3,006
MAV	3,505	3,379	4,061	5,027	6,112	6,805
OSV	3	3	4	5	6	6
AADT	**10,451**	**10,243**	**12,212**	**14,635**	**17,303**	**18,985**
PCU	**31,094**	**29,889**	**35,557**	**42,794**	**50,776**	**55,812**

Source: Steer Analysis

Table 6.26: Traffic growth rates (%): Downside case-AB: Raibha

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	4.3%	4.6%	4.3%	3.9%	3.6%	4.2%

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
Mini LCV	1.7%	1.8%	1.7%	1.6%	1.4%	1.7%
LCV	(0.7%)	1.0%	1.7%	1.6%	1.4%	1.2%
Bus	1.3%	1.4%	1.3%	1.2%	1.1%	1.2%
2A	(2.9%)	3.3%	2.6%	2.4%	2.2%	2.1%
3A	(4.3%)	3.2%	3.5%	3.2%	2.9%	2.4%
MAV	(1.8%)	3.7%	4.4%	4.0%	3.6%	3.4%
OSV	4.0%	4.2%	3.9%	3.6%	3.3%	3.8%
AADT	(1.0%)	3.6%	3.7%	3.4%	3.1%	3.0%
PCU's	(2.0%)	3.5%	3.8%	3.5%	3.2%	3.0%

Source: Steer Analysis

Table 6.27: Revenue (INR Crore): Downside case-AB: Raibha

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	4.77	5.71	8.82	13.52	19.79	24.87
Mini LCV	0.50	0.57	0.77	1.04	1.36	1.60
LCV	1.91	2.06	2.64	3.49	4.63	5.41
Bus	0.46	0.51	0.66	0.86	1.13	1.31
2A	18.23	19.10	27.28	37.90	52.54	63.01
3A	18.68	18.63	26.44	38.59	55.22	67.61
MAV	50.06	51.87	76.62	116.13	172.89	216.07
OSV	0.05	0.06	0.08	0.13	0.18	0.23
Total Revenue	**94.65**	**98.50**	**143.32**	**211.66**	**307.74**	**380.11**

Source: Steer Analysis

Table 6.28: Revenue growth rates (%): Downside case-AB: Raibha

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	9.4%	9.1%	8.9%	7.9%	7.9%	8.6%
Mini LCV	6.7%	6.2%	6.3%	5.5%	5.7%	6.0%
LCV	4.0%	5.1%	5.7%	5.8%	5.3%	5.4%
Bus	5.1%	5.4%	5.4%	5.5%	5.1%	5.3%
2A	2.4%	7.4%	6.8%	6.7%	6.2%	6.4%
3A	(0.1%)	7.2%	7.9%	7.4%	7.0%	6.6%
MAV	1.8%	8.1%	8.7%	8.3%	7.7%	7.6%
OSV	7.7%	8.6%	8.2%	7.9%	7.4%	8.0%
Total Revenue	**2.0%**	**7.8%**	**8.1%**	**7.8%**	**7.3%**	**7.2%**

Source: Steer Analysis

Summary outlook

6.57 The analysis presented in this report and the methodology followed adopted presents a custom approach compared to a standard traffic and revenue forecasting approach. We have utilised information from various sources, backed by our knowledge of toll roads in the

regional setting of the study Asset, in order to triangulate a robust base T&R position before presenting our views on other key topics, such as base year AADT and revenue, growth forecasts, and traffic segmentation.

6.58 Overall, we believe, we have tabled a robust set of forecast numbers underpinned by a rigorous base T&R position, background growth, exogenous impacts coupled with our unparallel market knowledge of the toll road industry in India.

6.59 Agra bypass benefits from its geographic and strategic location. The proximity to an upgraded network of expressways like Kundli Manesar Palwal (KMP) and Eastern Peripheral Expressway (EPE) provides seamless connectivity from Delhi NCR to travel to the west, east or south India. This is evident from the zonal influence observed on the Asset in form of

- North-South movements connecting Jammu and Kashmir, Punjab, Haryana, Delhi to Telangana, Andhra Pradesh, Karnataka and Tamil Nadu using NH7/44.
- North-West movements connecting Delhi NCR and north India to Gujarat and Maharashtra via NH3
- north to central / eastern movements originating from Delhi and northern parts of India to central (UP, Bihar) or eastern/ north-eastern parts of the country.

6.60 Delhi Mumbai Expressway is a key risk that has been identified which will impact the traffic on the corridor. As discussed in this chapter, a phased approach is taken to access the impact of DME, with 80% of estimated traffic loss in the first year of operation and the complete impact in the subsequent year. There is also uncertainty around the timeline of the Agra bypass link maybe constructed. As a base case, we believe FY26 is a reasonable timeline for the link to be completed as it is only an 8 km section, which could be constructed in 2 years once it is started.

6.61 Overall, we see a positive outlook for the region and the Agra by-pass Asset, given that it serves major urban centres of Delhi NCR, Faridabad, Palwal, Agra, Mathura, Vrindavan while also catering to long distance movement to/from Mumbai, Gujarat, Chennai, Bangalore, Hyderabad etc. The underlying growth drivers of the corridor are strong and are expected to deliver long term sustained growth.

Appendices

A Data collection exercise

A.1 Below you can find the Zone list used for OD Analysis for both Assets:

OD analysis

Zone list

Table A.1: Zone list used for OD analysis at AB Raibha

Zone No	Zone name	Description/State
1	Farah	Uttar Pradesh
2	Vrindavan	Uttar Pradesh
3	Kagrol	Uttar Pradesh
4	Raibha	Uttar Pradesh
5	Kuthawati	Uttar Pradesh
6	Mundhera	Uttar Pradesh
7	Mangura	Uttar Pradesh
8	Kasoti	Uttar Pradesh
9	Bharatpur	Uttar Pradesh
10	Fatehpur Sikri	Uttar Pradesh
11	Kiraoli	Uttar Pradesh
12	Raipura Jat	Uttar Pradesh
13	Karahara	Uttar Pradesh
14	Kakua	Uttar Pradesh
15	Dholpur	Rajasthan
16	Morena	Madhya Pradesh
17	Gwalior	Madhya Pradesh
18	Agra	Uttar Pradesh
19	Aligarh	Uttar Pradesh
20	Allahabad	Uttar Pradesh
21	Ambedkar Nagar	Uttar Pradesh
22	Amethi	Uttar Pradesh
23	Auraiya	Uttar Pradesh
24	Azamgarh	Uttar Pradesh
25	Baghpat	Uttar Pradesh
26	Bahraich	Uttar Pradesh
27	Ballia	Uttar Pradesh
28	Balrampur	Uttar Pradesh
29	Banda	Uttar Pradesh
30	Bara Banki	Uttar Pradesh
31	Bareilly	Uttar Pradesh
32	Basti	Uttar Pradesh
33	Bijnor	Uttar Pradesh
34	Budaun	Uttar Pradesh
35	Bulandshahr	Uttar Pradesh

Zone No	Zone name	Description/State
36	Chandauli	Uttar Pradesh
37	Chitrakoot	Uttar Pradesh
38	Deoria	Uttar Pradesh
39	Etah	Uttar Pradesh
40	Etawah	Uttar Pradesh
41	Faizabad	Uttar Pradesh
42	Farrukhabad	Uttar Pradesh
43	Fatehpur	Uttar Pradesh
44	Firozabad	Uttar Pradesh
45	Gautam Buddha Nagar	Uttar Pradesh
46	Ghaziabad	Uttar Pradesh
47	Ghazipur	Uttar Pradesh
48	Gonda	Uttar Pradesh
49	Gorakhpur	Uttar Pradesh
50	Hathras	Uttar Pradesh
51	Hapur	Uttar Pradesh
52	Hamirpur	Uttar Pradesh
53	Hardoi	Uttar Pradesh
54	Mahamaya Nagar	Uttar Pradesh
55	Jalaun	Uttar Pradesh
56	Jaunpur	Uttar Pradesh
57	Jhansi	Uttar Pradesh
58	Jyotiba Phule Nagar	Uttar Pradesh
59	Kannauj	Uttar Pradesh
60	Kanpur Dehat	Uttar Pradesh
61	Kanpur Nagar	Uttar Pradesh
62	Kansiram Nagar	Uttar Pradesh
63	Kaushambi	Uttar Pradesh
64	Kheri	Uttar Pradesh
65	Kushinagar	Uttar Pradesh
66	Lakhimpur Kheri	Uttar Pradesh
67	Lalitpur	Uttar Pradesh
68	Lucknow	Uttar Pradesh
69	Maharajganj	Uttar Pradesh
70	Mahoba	Uttar Pradesh
71	Mainpuri	Uttar Pradesh
72	Mathura	Uttar Pradesh
73	Mau	Uttar Pradesh
74	Meerut	Uttar Pradesh
75	Mirzapur	Uttar Pradesh
76	Moradabad	Uttar Pradesh
77	Muzaffarnagar	Uttar Pradesh
78	Pilibhit	Uttar Pradesh
79	Pratapgarh	Uttar Pradesh
80	Rae Bareli	Uttar Pradesh
81	Rampur	Uttar Pradesh
82	Shamli	Uttar Pradesh
83	Saharanpur	Uttar Pradesh
84	Sambhal	Uttar Pradesh
85	Sant Kabir Nagar	Uttar Pradesh

Zone No	Zone name	Description/State
86	Sant Ravi Das Nagar(bhadohi)	Uttar Pradesh
87	Shahjahanpur	Uttar Pradesh
88	Shrawasti	Uttar Pradesh
89	Siddharth Nagar	Uttar Pradesh
90	Sitapur	Uttar Pradesh
91	Sonbhadra	Uttar Pradesh
92	Sultanpur	Uttar Pradesh
93	Unnao	Uttar Pradesh
94	Varanasi	Uttar Pradesh
95	Central Delhi	NCT of Delhi
96	North Delhi	NCT of Delhi
97	West Delhi	NCT of Delhi
98	South West Delhi	NCT of Delhi
99	South East Delhi	NCT of Delhi
100	East Delhi	NCT of Delhi
101	North East Delhi	NCT of Delhi
102	North Haryana	Haryana
103	West Haryana	Haryana
104	Central Haryana	Haryana
105	Gurgaon SW Haryana	Haryana
106	Rewari SW Haryana	Haryana
107	Palwal City	Haryana
108	Faridabad	Haryana
109	Indore	Madhya Pradesh
110	Ratlam	Madhya Pradesh
111	North Madhya Pradesh	Madhya Pradesh
112	Central Madhya Pradesh	Madhya Pradesh
113	East Madhya Pradesh	Madhya Pradesh
114	West Madhya Pradesh	Madhya Pradesh
115	East Rajasthan	Rajasthan
116	South Rajasthan	Rajasthan
117	West Rajasthan	Rajasthan
118	North Rajasthan	Rajasthan
119	East Maharashtra	Maharashtra
120	West Maharashtra	Maharashtra
121	Punjab	Punjab
122	Himachal Pradesh	Himachal Pradesh
123	Uttarakhand	Uttarakhand
124	Jammu & Kashmir	Jammu & Kashmir
125	Gujarat	Gujarat
126	Hyderabad	Telangana
127	Rest of Telangana	Telangana
128	Chhattisgarh	Chhattisgarh
129	Odisha	Odisha
130	Bihar	Bihar
131	Jharkhand	Jharkhand
132	West Bengal Sikkim	West Bengal
133	Goa	Goa
134	Andhra Pradesh	Andhra Pradesh
135	Bengaluru	Karnataka

Zone No	Zone name	Description/State
136	Rest of Karnataka	Karnataka
137	Kerala	Kerala
138	Chennai	Tamil nadu
139	Rest of Tamil Nadu	Tamil nadu
140	Arunachal Pradesh	Arunachal Pradesh
141	Assam	Assam
142	Manipur	Manipur
143	Meghalaya	Meghalaya
144	Mizoram	Mizoram
145	Nagaland	Nagaland
146	Tripura	Tripura
147	Nepal	Nepal
148	Bangladesh	Bangladesh
149	Bhutan	Bhutan
150	Agra cantonment	Uttar Pradesh
151	Nashik	Maharashtra
152	Mumbai, Bhiwandi	Maharashtra
153	Pune	Maharashtra
154	Dhule	Maharashtra

Source: Steer representation

Top OD pairs

A.2 Further to the OD analysis presented in Chapter 3 this appendix presents the OD maps for 3A+MAVs along with top 10 OD pairs at each toll plaza.

Table A.2: AB Raibha: 3A/MAV top 10 OD pair shares

	OD Pair	Share
1	South East Delhi - Chennai	2.70%
2	South East Delhi - Bengaluru	2.55%
3	Gwalior - Mathura	2.48%
4	South East Delhi - Hyderabad	2.22%
5	Gwalior - South East Delhi	2.15%
6	South East Delhi - East Rajasthan	2.11%
7	South East Delhi - Rest of West Maharashtra	1.75%
8	Gwalior - Agra	1.68%
9	South East Delhi - Gujarat	1.49%
10	South East Delhi - Central Madhya Pradesh	1.35%

Source: Steer analysis

7 days TVC count

A.3 The TVC counts recorded at each toll plaza can be seen below. These counts form an important part of TVC-toll plaza data analysis which contributes significantly to our base estimation exercise:

Table A.3: AB Raibha: Daily TVC counts

Date	CJV	Mini LCV	LCV	Bus	2 Axle	3 Axle	MAV	OSV	Total
28-02-2023	2,033	271	993	46	1,944	1,886	3,927	2	11,102
01-03-2023	1,953	236	1,078	38	1,736	1,902	4,126	1	11,070
02-03-2023	1,962	245	925	37	2,049	1,957	3,928	1	11,104
03-03-2023	2,435	254	993	46	2,066	2,146	4,415	3	12,358
04-03-2023	3,310	320	974	54	1,891	2,111	3,998	1	12,659
05-03-2023	4,086	326	1,117	63	1,783	1,950	3,799	1	13,125
06-03-2023	3,290	303	782	43	1,436	1,898	3,274	1	11,027

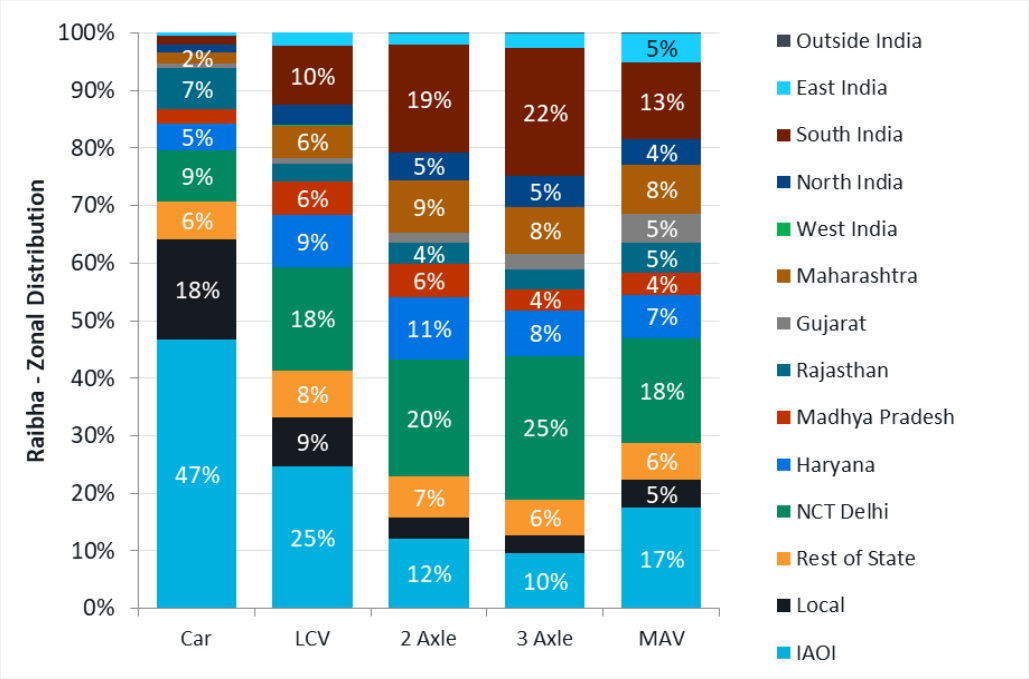
Source: Steer analysis

B Data collection (earlier study)

B.1 This section covers the outputs of OD analysis from the earlier study undertaken in Aug-22.

B.2 Zones that are located within Uttar Pradesh, collectively contribute to 20-30% in case of 3A and MAV. The remaining 80% is a diverse mix of other zones, including Delhi, Haryana, Rajasthan, South India, Maharashtra, among others. The long-distance nature of this Asset is evident from 15%-20% share of zonal influence of South India in case of 2 and 3 Axle vehicles, followed by major shares of Delhi, Haryana, and Maharashtra.

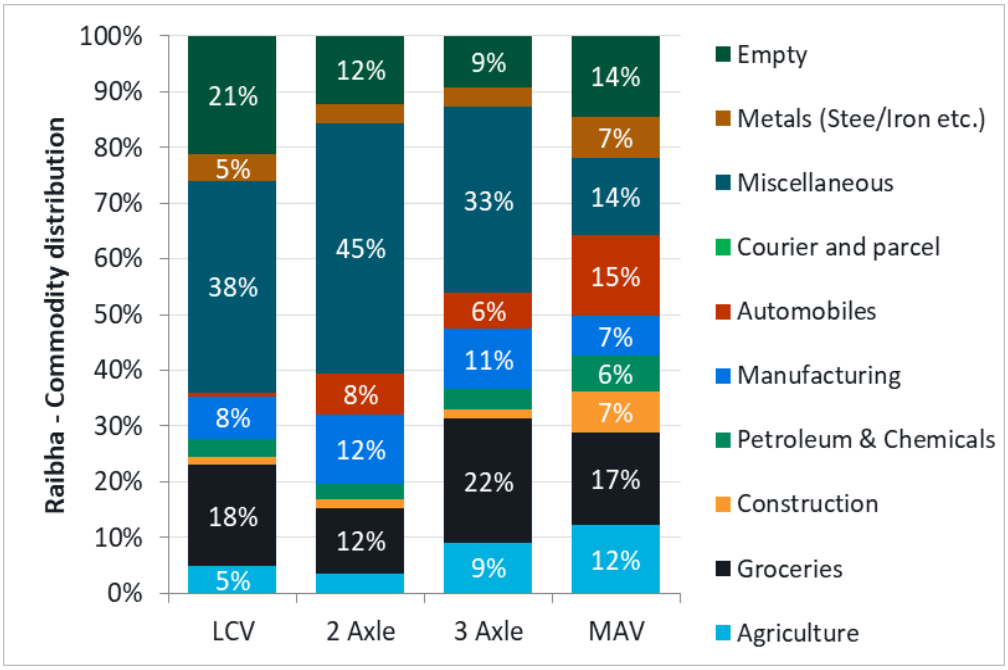
Figure B.1: Raibha - Zonal Distribution (Aug-22)



Source: Steer analysis

B.3 Among all the vehicle types, the largest proportion of goods being carried belong to the miscellaneous category, which includes parcels, couriers, and e-commerce deliveries that are mainly transported from warehouses in Agra, Indore, Hyderabad, Bengaluru, Maharashtra, Gujarat to local areas, Delhi NCR, Rajasthan, Haryana, and other North India regions. Followed by it are the groceries which are majorly being transported from Delhi and NCR regions to Hyderabad and Indore.

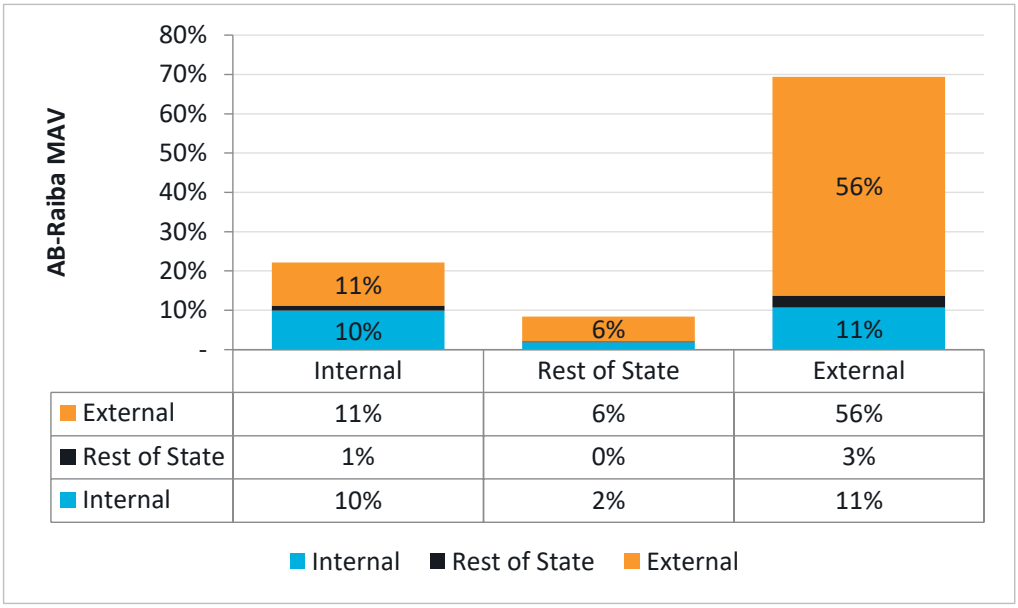
Figure B.2: Raibha - Commodity distribution (Aug-22)



Source: Steer analysis

B.4 The internal-external distribution further validates the strategic nature of the asset, with more than 70% influence pertaining to zones that are external. This is further to the zonal distribution that showed that Local and Rest of the State had relatively less influence on the Asset, while aggregate of the remaining zones categorized as External exert the significant proportion of influence on the traffic. This validates that the long-distance nature of the Asset, facilitating long distance through movement—that is trips that originate and end outside of Uttar Pradesh, traversing via the Asset.

Figure B.3: Raibha - Internal-External Analysis (Aug-22)



Source: Steer analysis

C IHMCL and Schedule-M Data

IHMCL Data

C.1 The converted AADTs and the corresponding long-term CAGR is shown below.

Table C.1: AADT based on from SCF Adjusted IHMCL counts-AB: Raibha

Vehicle Class	FY17	FY18	FY20	FY21	FY20-21	FY18-21
CJV	5,339	4,143	5,514	4,642		
LCV	498	369	421	361		
Bus	504	517	552	345		
3A	382	307	321	228		
MAV	306	270	355	318		
AADT	**7,029**	**5,607**	**7,163**	**5,893**	(17.7%)	1.7%
PCU	**10,120**	**8,387**	**10,362**	**8,329**		

Source: Steer analysis

Schedule-M Data

C.2 Schedule M data shared by the Client includes historical traffic data for FY20, as provided in the table below.

Table C.2: AADT from Schedule M data-AB: Raibha

Vehicle Class	Schedule M AADT
CJV	1,221
LCV	413
Bus	211
2A	781
3A	1,240
MAV	1,898
OSV	19
Total	**5,783**
PCU	**17,163**

Source: Steer analysis; To estimate AADT for FY20, we have only considered 25 days in March'20 to exclude the days for nationwide lockdown

D Traffic and revenue forecasts

D.1 Further to the summary of forecasts presented in Chapter 6, this appendix presents detailed forecasts.

Traffic forecasts

D.2 This section presents the detailed traffic forecasts for the forecast period until FY43, year of expected close of the concession. The following two tables show the traffic growth rates and AADT, respectively.

Table D.1: AB Raibha: Forecasts for final (background + impacts) AADT

Vehicle Category	FY23	FY24	FY25	FY26	FY27	FY28
CJV	2,174	2,296	2,434	2,588	2,752	2,921
Mini LCV	228	233	238	244	251	257
LCV	480	490	483	483	494	505
Bus	55	55	56	58	59	60
2A	2,154	2,229	2,117	2,234	2,377	2,525
3A	1,854	1,915	1,799	1,854	1,974	2,099
MAV	3,505	3,658	3,572	3,667	3,994	4,339
OSV	3	3	3	3	4	4
Total	**10,451**	**10,879**	**10,702**	**11,131**	**11,903**	**12,709**
PCU	**31,094**	**32,338**	**31,400**	**32,511**	**34,961**	**37,528**

Vehicle Category	FY29	FY30	FY31	FY32	FY33	FY34
CJV	3,090	3,268	3,457	3,657	3,869	4,089
Mini LCV	263	269	275	281	288	294
LCV	515	527	539	551	564	577
Bus	61	62	63	64	65	66
2A	2,607	2,700	2,795	2,894	2,997	3,101
3A	2,193	2,296	2,405	2,518	2,637	2,759
MAV	4,582	4,852	5,139	5,442	5,763	6,098
OSV	4	4	4	5	5	5
Total	**13,314**	**13,978**	**14,676**	**15,412**	**16,187**	**16,990**
PCU	**39,344**	**41,354**	**43,472**	**45,703**	**48,054**	**50,491**

Vehicle Category	FY35	FY36	FY37	FY38	FY39	FY40
CJV	4,319	4,557	4,805	5,062	5,328	5,603
Mini LCV	301	308	314	321	328	335
LCV	590	603	616	629	643	656

Vehicle Category	FY35	FY36	FY37	FY38	FY39	FY40
Bus	67	68	70	71	72	73
2A	3,207	3,315	3,425	3,537	3,650	3,765
3A	2,885	3,015	3,148	3,285	3,425	3,569
MAV	6,446	6,808	7,184	7,574	7,978	8,396
OSV	5	6	6	6	7	7
Total	**17,821**	**18,680**	**19,568**	**20,485**	**21,430**	**22,403**
PCU	**53,015**	**55,628**	**58,328**	**61,116**	**63,992**	**66,956**

Vehicle Category	FY41	FY42	FY43
CJV	5,888	6,181	6,485
Mini LCV	341	348	355
LCV	669	682	696
Bus	74	75	76
2A	3,881	3,999	4,118
3A	3,716	3,866	4,019
MAV	8,829	9,275	9,735
OSV	7	8	8
Total	**23,405**	**24,434**	**25,491**
PCU	**70,006**	**73,143**	**76,364**

Source: Steer analysis

Table D.2 AB Raibha: Forecasts for final (background + impacts) Revenue (in INR Crores)

Vehicle Category	FY23	FY24	FY25	FY26	FY27	FY28
CJV	4.77	5.49	5.87	6.59	7.38	8.25
Mini LCV	0.50	0.56	0.58	0.62	0.67	0.73
LCV	1.91	2.06	2.11	2.18	2.31	2.46
Bus	0.46	0.48	0.51	0.54	0.57	0.61
2A	18.23	19.90	19.89	21.75	23.96	26.76
3A	18.68	20.04	19.74	21.02	23.44	26.12
MAV	50.06	54.35	54.83	58.85	66.91	75.96
OSV	0.05	0.05	0.06	0.06	0.07	0.08
Total	**94.65**	**102.93**	**103.58**	**111.62**	**125.31**	**140.96**

Vehicle Category	FY29	FY30	FY31	FY32	FY33	FY34
CJV	8.79	9.74	10.77	12.02	13.21	14.51
Mini LCV	0.75	0.80	0.86	0.92	0.98	1.04

Vehicle Category	FY29	FY30	FY31	FY32	FY33	FY34
LCV	2.59	2.81	2.96	3.14	3.37	3.55
Bus	0.64	0.68	0.73	0.77	0.82	0.86
2A	28.47	30.82	33.29	36.05	38.71	41.64
3A	28.01	30.57	33.32	36.79	39.85	43.20
MAV	83.22	91.56	100.64	111.66	122.97	134.48
OSV	0.08	0.09	0.10	0.11	0.12	0.13
Total	**152.56**	**167.07**	**182.68**	**201.46**	**220.03**	**239.42**

Vehicle Category	FY35	FY36	FY37	FY38	FY39	FY40
CJV	16.03	17.58	19.26	21.12	22.95	25.12
Mini LCV	1.12	1.19	1.26	1.34	1.41	1.50
LCV	3.82	4.02	4.29	4.58	4.88	5.21
Bus	0.91	0.97	1.02	1.08	1.15	1.21
2A	44.71	48.53	51.75	55.81	60.05	64.64
3A	47.24	51.67	55.52	60.30	65.93	71.46
MAV	148.91	163.77	178.72	196.44	215.36	237.52
OSV	0.15	0.16	0.17	0.19	0.21	0.23
Total	**262.88**	**287.88**	**312.00**	**340.86**	**371.94**	**406.89**

Vehicle Category	FY41	FY42	FY43
CJV	27.29	30.31	32.86
Mini LCV	1.58	1.71	1.80
LCV	5.52	5.85	6.19
Bus	1.28	1.35	1.43
2A	69.06	73.84	79.46
3A	77.54	83.47	90.40
MAV	258.51	282.97	309.08
OSV	0.25	0.27	0.29
Total	**441.01**	**479.76**	**521.51**

Source: Steer analysis

E Vehicle Classification Chart

Table E.1: Vehicle Types

Vehicle Type	Description
2-Wheeler	
Auto-Rickshaw	
Car/Jeep/Van	
Taxi- shared/private	
Buses (govt/Pvt)	
Minibus	

Vehicle Type	Description
Mini LCV	
LCV 4 Tyre	
LCV 6 Tyre	
2 Axle Truck	
3 Axle Truck	
4 Axle Truck (MAV)	
5 Axle Truck (MAV)	

Vehicle Type	Description
6 Axle Truck (MAV)	
Oversized Vehicle/ Earth moving equipment (OSV)	

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Report
May 2023

Project Drone III: Traffic and Revenue due diligence – Borkhedi Kelapur: Darodha and Kelapur Toll Plazas

National Highway Infra Projects Private Limited (NHIPPL)
May 2023
Our ref: 24265605

steer

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Project Drone III: Traffic and Revenue due diligence – Borkhedi Kelapur: Darodha and Kelapur Toll Plazas

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Disclaimer

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Traffic Consultant developed the relationships in the models used to produce the forecasts for the projects based on data available through March 2023. Since March 2020, the outbreak of the virus known as COVID- 19 has spread throughout the world and has been defined by the World Health Organization as a "pandemic". The COVID-19 outbreak had a material impact on global economic and political affairs including having a significant impact on all the transportation industries, including toll road traffic, where in particular vehicle volumes fell in response to quarantine and self-care measures that governments imposed as a response to the different waves of infection rates in different parts of the country.

As of the date of distribution of this Report, the COVID-19 outbreak is continuing to have a material and uncertain impact on economic and political affairs in some jurisdictions, which may have a significant impact on the transportation sector including the actual usage of tolled highways. In such jurisdictions, these factors may introduce additional uncertainty into forward looking outputs included in our Report. Further, there are a wide range of views by authoritative sources concerning future travel patterns post-COVID, which adds uncertainty to forecasting in this regard.

As a result, no assurance can be provided by Traffic Consultant that the scenarios and assumptions Traffic Consultant has identified will prove to be accurate. Given the uncertainty inherent in this unprecedented pandemic, Traffic Consultant advises that all readers of the Reports consider the Reports in the context of their own assessment of the impact of COVID-19 on travel patterns post-COVID.

TO THE FULLEST EXTENT PERMITTED BY APPLICABLE LAW, THE LIABILITY OF THE TRAFFIC CONSULTANT FOR ANY LOSS, DAMAGE, COST OR EXPENSE SUFFERED OR INCURRED BY ALL PERSONS OR ENTITIES AND FOR ALL CLAIMS RESPECTING ITS WORK PERFORMED IN CONNECTION WITH THE ISSUE OR THE REPORTS IS HEREBY LIMITED IN THE AGGREGATE TO THE AMOUNT OF FEES ACTUALLY PAID BY THE CLIENT TO THE TRAFFIC CONSULTANT IN RESPECT OF THE REPORTS AND CONNECTED SERVICES.

Glossary Items

Acronym	Meaning
AADT	Annual Average Daily Traffic
ADT	Average Daily Traffic
BK	Borkhedi Kelapur
CAGR	Compound Annual Growth Rate
CAGR	Compound Annual Growth Rate
CJV	Cars / Jeeps / Vans
COD	Commercial Operations Date
DPR	Detailed Project Report
DME	Delhi Mumbai Expressway
EDFC	Eastern Dedicated Freight corridor
ETC	Electronic Toll Collection
FY	Financial Year
GDP	Gross Domestic Product
GJC	Generalised Journey Cost
GQ	Golden Quadrilateral
GSDP	Gross State Domestic Product
HCM	Heavy Commercial Vehicles
IAOI	Immediate Area of Influence
IHMCL	Indian Highways Management Company Limited
INR	Indian Rupee
LCV	Light Commercial Vehicles
LoS	Level of Service
MAV	Multi Axle Vehicle
MLCV	Mini LCV
NE	National Expressway
NH	National Highway
NHAI	National Highways Authority of India
NHDP	National Highways Development Project
NSDP	Net State Domestic Product
OD	Origin Destination
PCI	Per Capita Income
PCU	Passenger Car Unit

Acronym	Meaning
RNP	Registered Number Plate
RoS	Rest of State
SCF	Seasonality Correction Factors
SH	State Highway
T&R	Traffic and Revenue
TMS	Traffic Management System
TP	Toll plaza
TVC	Traffic Volume Count
VOC	Vehicle Operating Costs
VOT	Value of Time
WADT	Weekly Average Daily Traffic
YTD	Year to Date

Executive Summary for Borkhedi Kelapur – NH 44 ('Asset')

Project overview

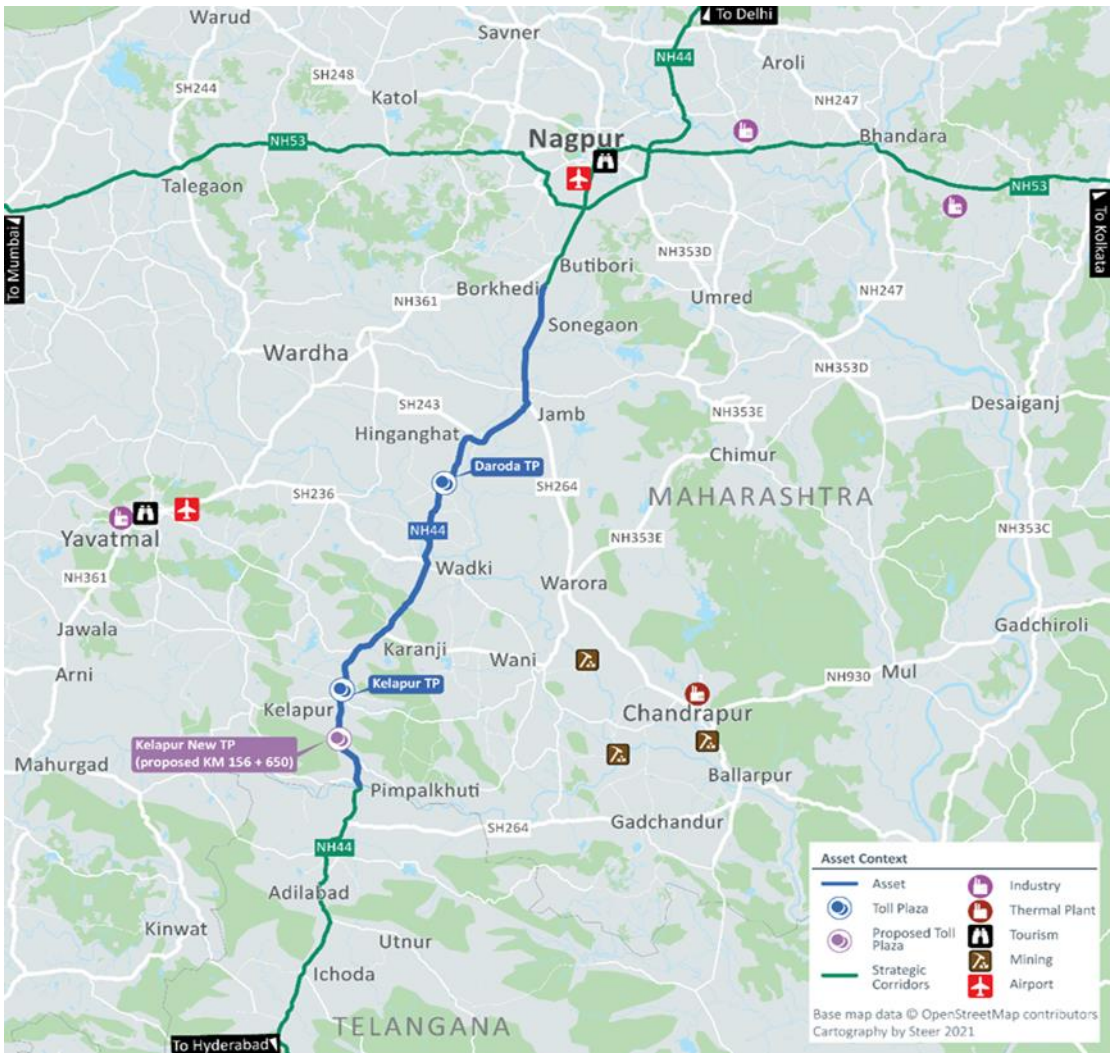
The Asset is located on NH 44 and is about 139 km four-laned section between Borkhedi and Maharashtra/Telangana Border stretching across Nagpur, Wardha, and Yavatmal districts in the state of Maharashtra.

There are two toll plazas on the asset and are located at and is shown in the map below:

- Darodha (KM 92.500)
- Kelapur (KM 150.000)

Kelapur toll plaza is proposed to be relocated to a new location, approximately 6 km south of the existing location in absence of adequate land to construct proper toll plaza at the present location. This is named as Kelapur New TP (KM 156.650) in the map below.

Figure: Asset context - BK



Source: Steer cartography using OpenStreetMap data

Salient growth features and traffic generators

The Asset is present in the state of Maharashtra, the second-most populous state in India with a population of nearly 124 million people. The Asset forms part of the strategic NH44 corridor catering to the north-south movement.

The Asset caters to the demands generated by the states connected through the above-mentioned highway. NH44 runs over 4,112 kms completing the north-south movement and connects some of the major states and industrial centres of northern states/UTs of Jammu and Kashmir, Punjab, Haryana, Delhi, Uttar Pradesh, Rajasthan, Madhya Pradesh, Maharashtra with the southern states of Telangana, Andhra Pradesh, Karnataka, and Tamil Nadu. The traffic profile is predominantly goods vehicles undertaking long distance movements between the locations mentioned.

The Asset lies on the outskirts of Nagpur which is the third largest city in Maharashtra. It is known for medium to large scale industries alongside agriculture. The key industries are manufacturing and food processing as described below.

- Manufacturing segment includes products ranging from agriculture equipment, aluminium products, castings, cement, chemicals, paper and packaging, electrical equipment and fittings, textile engineering goods, tools manufacturing, fabrication and machining, ferro alloys, paints, furniture, plastic and moulding products, etc.
- Food processing giants having presence at Nagpur includes Haldiram, Dinshaw, Patanjali and other medium scales orange and spices processing units, etc.

Apart from the above-mentioned industrial segments present in Nagpur, the following are some additional developments announced by the government for the region:

- Government of Maharashtra has set-up Multi-Modal International Passenger and Cargo Hub Airport at Nagpur (MIHAN). That will upgrade existing domestic airport along with a Special Economic Zone which is abutting to the boundary of the airport. MIHAN houses plant of Tata Aeronautics which manufactures parts for Boeing and Air India and Dassault's assembly plants.
- Container Corporations of India Limited (CONCOR) constructed Multi Modal Logistic Park along with a rail terminal connecting MIHAN with different ports in country.

Butibori industrial area established by Maharashtra Industrial Development Corporation (MIDC), north of the Asset, is one of the country's largest industrial hubs. It houses textile, machine and metal fabrication and manufacturing units and is home to industrial giants like KEC, Hyundai, and Unitech. Koradi Thermal Power Station and Khaparkheda Thermal Power Station are the two major thermal power stations located in vicinity of the hub. Yavatmal industrial area, in west of the Asset, has textile and cotton processing industries including Raymond India's garment plant. The industrial hub is also home to export units of machineries, cement, medicines, limestones, and clothes.

Chandrapur is key coal mining centre in close vicinity of the Asset and has thermal plant, cement, paper and ferro alloy manufacturing industries.

The agricultural stretches present along the Asset as well as in Nagpur generate a considerable share of traffic on the Asset. Nagpur, also known as Orange City, is famous for the production of oranges in addition to being home to large number of paddy, jowar, cotton, tur and soyabean fields.

Long-distance goods traffic has seen an increase in proportion in recent years due to the shift of traffic from other corridors to NH44 as this is the shortest route between Hyderabad/Bengaluru and Delhi.

Traffic volume and composite of vehicles

Historical traffic data

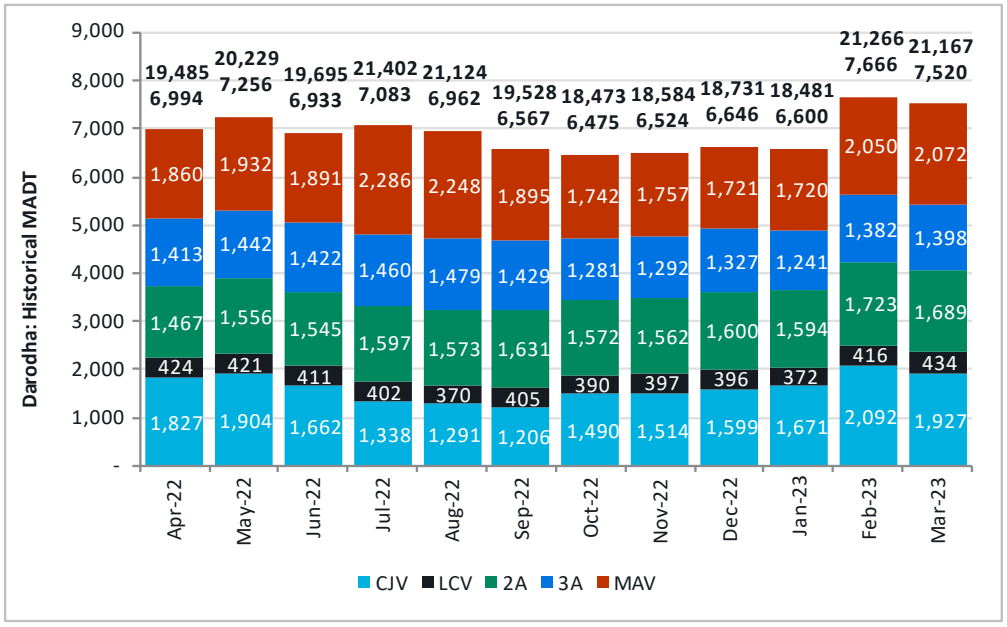
The toll plaza data, segmented with ticket categories, is available from 1st Apr-21 to 27th Mar-21, which has been used for FY23 base year estimation. For CJV and LCV, the number of exemptions/ violations traffic number is considerable. Therefore, due to unreliability of data, we have considered:

- For CJV and LCV: Cash + ETC data has been used; and for
- Remaining vehicle types (2A, 3A, and MAV): Cash + ETC + exemptions/ violations have been used for historical and base year traffic analysis.

The Asset trends at ~ 20,500 PCU levels in FY23 with robust truck performance continuing in Q4 FY23. Darodha till plaza observed an average of ~6,950 AADT and Kelapur ~6,450 AADT in FY23. ETC proportion of reported traffic exceeds 95% in the recent months of FY23. The Asset has performed well, recording a PCU growth of ~9% in FY23 with respect to FY22N at Darodha and ~6.5% at Kelapur. The traffic is dominated by 3A/MAVs.

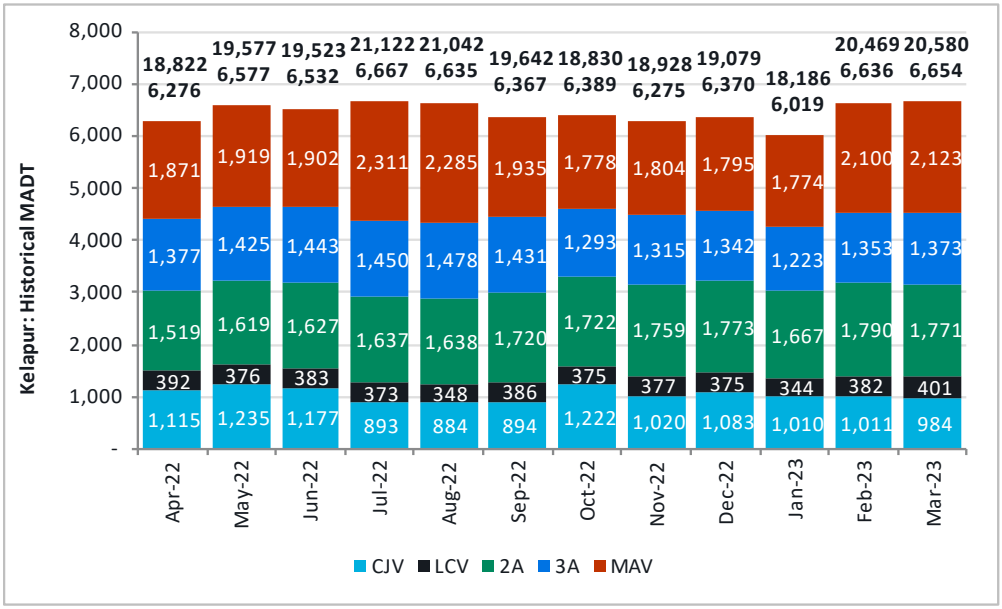
On an average, the daily revenue collection at Darodha and Kelapur are ~INR 23 lakhs and ~INR 22 lakhs respectively.

Figure: PCU and MADT for FY23 - BK: Darodha



Source: Steer analysis of client toll plaza data

Figure: PCU and MADT for FY23 - BK: Kelapur

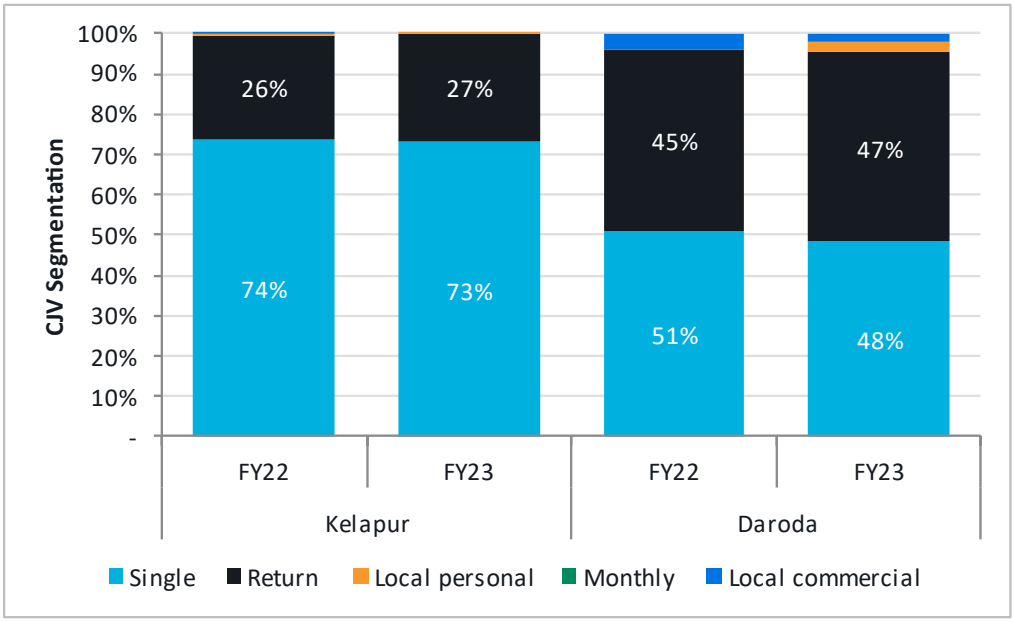


Source: Steer analysis of client toll plaza data

Toll segmentation

On the Asset, CJVs observe approximately equal split between single and return tickets on Darodha as the plaza caters to inter-urban movement influenced by Nagpur and sizeable split between single and return tickets at Kelapur given its proximity to Telangana.

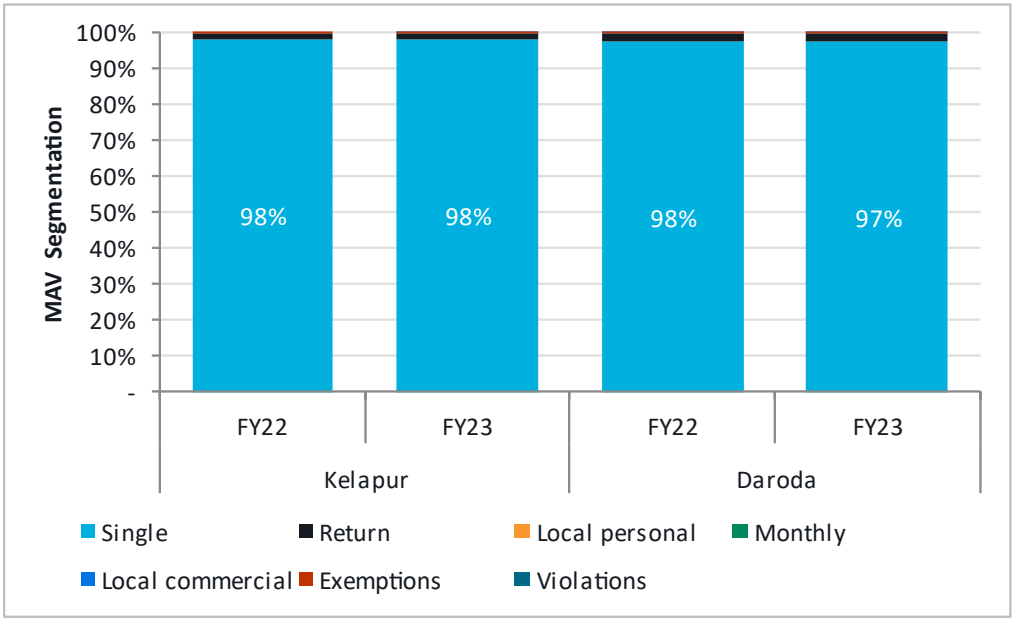
Figure: Segmentation CJV



Source: Steer analysis

~98% of the commercial vehicles (2A/3A/MAVs) plying on the Asset are observed to buy single tickets suggesting through-movement on the Asset. The observation is in line with the fact that the Asset is key connector for Delhi/NCR and Maharashtra/neighbouring zones and hence caters to long-distance traffic.

Figure: Segmentation MAV

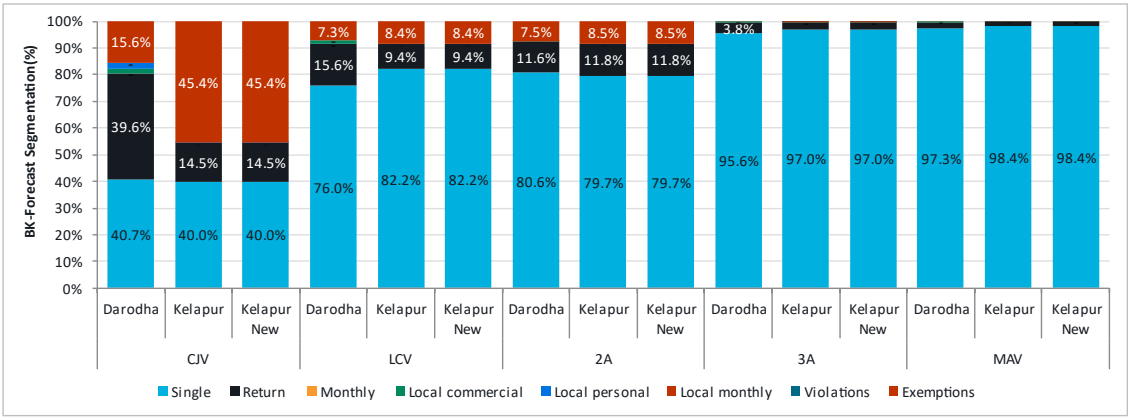


Source: Steer analysis

However, as the above-mentioned segmentation doesn't correctly reflect the share of non-toll paying traffic, i.e., violations and exemptions. The same has been assessed based on the difference between TMS and TVC dataset in the final adopted segmentation.

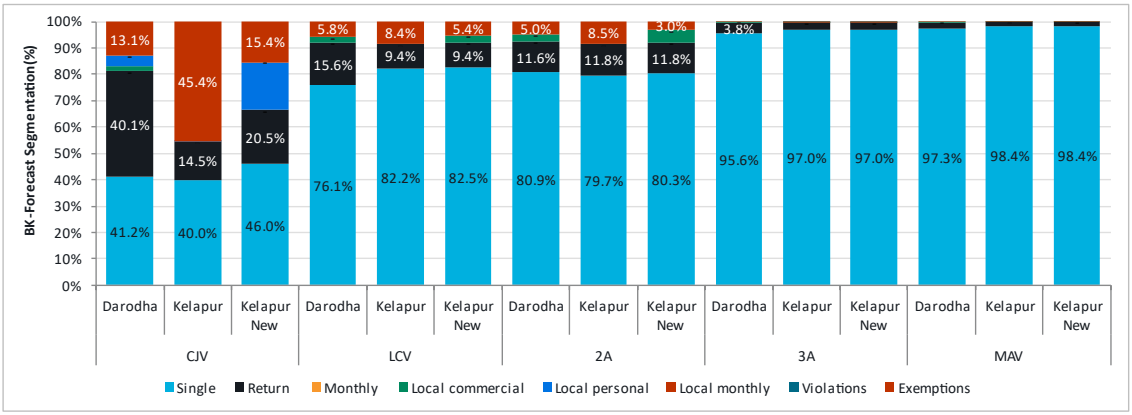
The final forecast segmentation is shown in the charts below. The changes in forecast toll segmentation observed on toll plaza is due to our understanding that once the Assets are taken over by the Client, the overall reporting practises will improve as the toll plaza will be operated by a reputed toll operator and may result in a decrease in total exemptions. Increasing compliance due to better operational efficiency in the next year will see the number of exemptions decrease further, with a subsequent increase in the Local passes, as well as the Single and Return ticket categories.

Figure: Toll segmentation (%) FY23



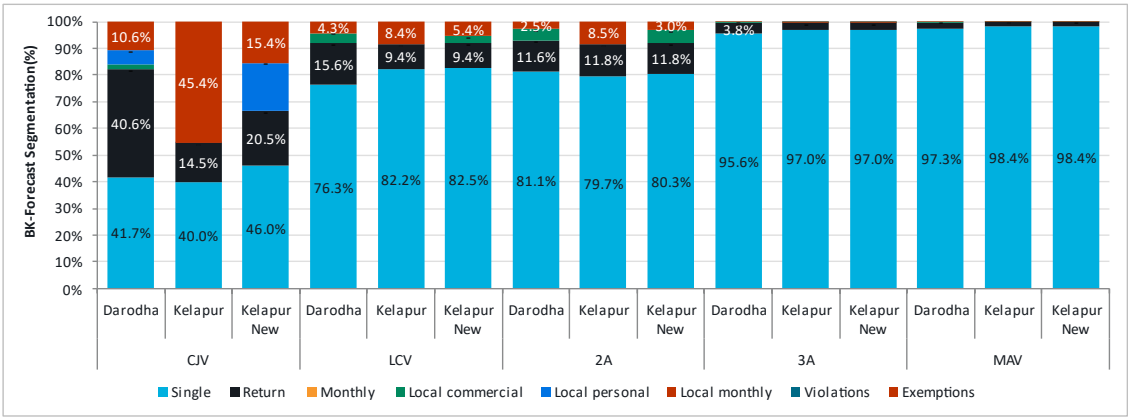
Source: Steer analysis

Figure: Toll segmentation (%) FY24



Source: Steer analysis

Figure: Toll segmentation (%) FY25



Source: Steer analysis

At Darodha, the installation of new systems and infrastructure components is in progress and is expected to complete by mid FY24. Accordingly, 50% of segmentation improvement is considered in FY24 and the remaining in FY25.

Additionally, for Kelapur the change in segmentation will be aided by the relocation of the toll plaza. Currently, the toll plaza is located within the city, once it shifts to its new location, the urban characteristic of the plaza will shrink resulting in lesser traffic exemptions.

Traffic forecast

The increase of traffic on any existing road alignment depends on how fast the background travel demand (background growth) will grow; and on how successfully the project road is in attracting that traffic (traffic capture). Background travel demand is driven by the prevalent socio-economic conditions in the region, which include:

- Changes in factors such as population, employment, and income distribution
- Economic growth (GSDP, and GDP).
- Growth of local industries near the Asset.

The model uses India GDP and GSDP of Maharashtra & Telangana as the two macro-economic inputs which operate as growth drivers on our base year forecasts.

The network developments near the Asset's alignment which Steer believes would affect traffic on the Asset during the concession period are Nagpur Vijayawada Expressway, Raipur-Hyderabad Economic Corridor and DME & SCE put together.

Steer has developed traffic and revenue forecasts for the Asset by taking into consideration all inputs discussed above – base year estimates, macro-economic assumptions, growth drivers, elasticities, and forecast ticket segmentation. The table below provides the final (background plus impacts) traffic growth on the Asset.

Table: Final (background plus impacts) AADT forecast – AB: Darodha

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	1,337	1,503	2,032	2,700	3,517	4,078
Mini LCV	583	623	736	857	983	1,061
LCV	434	463	524	609	698	753
Bus	221	230	254	279	303	317
2A	1,494	1,604	1,716	2,039	2,394	2,618
3A	1,380	1,499	1,723	2,106	2,537	2,816
MAV	1,929	2,168	2,612	3,470	4,520	5,241
OSV	1	2	2	3	3	4
AADT	**7,381**	**8,091**	**9,600**	**12,062**	**14,956**	**16,888**
PCUs	**20,548**	**22,582**	**26,401**	**33,369**	**41,606**	**47,123**

Table: Final (background plus impacts) AADT CAGR (%) – AB: Darodha

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	6.0%	6.2%	5.8%	5.4%	5.1%	5.7%
Mini LCV	3.4%	3.4%	3.1%	2.8%	2.6%	3.0%
LCV	3.3%	2.5%	3.1%	2.8%	2.6%	2.8%
Bus	2.0%	2.0%	1.9%	1.7%	1.5%	1.8%
2A	3.6%	1.4%	3.5%	3.3%	3.0%	2.8%
3A	4.2%	2.8%	4.1%	3.8%	3.5%	3.6%
MAV	6.0%	3.8%	5.8%	5.4%	5.1%	5.1%
OSV	5.4%	5.6%	5.3%	4.9%	4.5%	5.2%
AADT	**4.7%**	**3.5%**	**4.7%**	**4.4%**	**4.1%**	**4.2%**
PCU's	**4.8%**	**3.2%**	**4.8%**	**4.5%**	**4.2%**	**4.2%**

Source: Steer analysis

Table: Final (background plus impacts) AADT forecast – AB: Kelapur

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	1,361	1,529	2,068	2,748	3,580	4,150
Mini LCV	553	591	698	813	932	1,006
LCV	410	437	494	574	658	710
Bus	277	288	318	349	379	397
2A	1,563	1,678	1,808	2,148	2,521	2,758

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
3A	1,375	1,493	1,717	2,098	2,528	2,806
MAV	1,965	2,207	2,666	3,541	4,613	5,348
OSV	1	2	2	3	3	4
AADT	**7,505**	**8,226**	**9,771**	**12,273**	**15,215**	**17,179**
PCUs	**21,022**	**23,095**	**27,042**	**34,154**	**42,558**	**48,187**

Table: Final (background plus impacts) AADT CAGR (%) – AB: Kelapur

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	6.0%	6.2%	5.8%	5.4%	5.1%	5.7%
Mini LCV	3.4%	3.4%	3.1%	2.8%	2.6%	3.0%
LCV	3.3%	2.5%	3.1%	2.8%	2.6%	2.8%
Bus	2.0%	2.0%	1.9%	1.7%	1.5%	1.8%
2A	3.6%	1.5%	3.5%	3.3%	3.0%	2.9%
3A	4.2%	2.8%	4.1%	3.8%	3.5%	3.6%
MAV	6.0%	3.8%	5.8%	5.4%	5.1%	5.1%
OSV	5.4%	5.6%	5.3%	4.9%	4.5%	5.2%
AADT	**4.7%**	**3.5%**	**4.7%**	**4.4%**	**4.1%**	**4.2%**
PCU's	**4.8%**	**3.2%**	**4.8%**	**4.5%**	**4.2%**	**4.2%**

Source: Steer analysis

Table: Final (background plus impacts) AADT forecast – AB: Kelapur (New)

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	1,345	1,512	2,045	2,716	3,539	4,103
Mini LCV	569	608	718	835	959	1,034
LCV	410	437	494	574	658	710
Bus	223	232	256	281	305	319
2A	1,617	1,736	1,871	2,222	2,609	2,853
3A	1,263	1,372	1,577	1,927	2,322	2,577
MAV	1,953	2,195	2,650	3,521	4,586	5,317
OSV	1	2	2	3	3	4
AADT	**7,382**	**8,092**	**9,612**	**12,079**	**14,981**	**16,918**
PCUs	**20,635**	**22,677**	**26,550**	**33,559**	**41,845**	**47,396**

Table: Final (background plus impacts) AADT CAGR (%) – AB: Kelapur (New)

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	6.0%	6.2%	5.8%	5.4%	5.1%	5.7%
Mini LCV	3.4%	3.4%	3.1%	2.8%	2.6%	3.0%
LCV	3.3%	2.5%	3.1%	2.8%	2.6%	2.8%
Bus	2.0%	2.0%	1.9%	1.7%	1.5%	1.8%
2A	3.6%	1.5%	3.5%	3.3%	3.0%	2.9%

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
3A	4.2%	2.8%	4.1%	3.8%	3.5%	3.6%
MAV	6.0%	3.8%	5.8%	5.4%	5.1%	5.1%
OSV	5.4%	5.6%	5.3%	4.9%	4.5%	5.2%
AADT	**4.7%**	**3.5%**	**4.7%**	**4.4%**	**4.1%**	**4.2%**
PCU's	**4.8%**	**3.2%**	**4.8%**	**4.5%**	**4.2%**	**4.2%**

Source: Steer analysis

Tollable Length and Toll Rates

In terms of tollable length, Darodha currently (FY24) comprises 80.08 km and 80.18 km from FY25 onwards, whereas at Kelapur the tolling length is 75.16 km. In India, toll rates are as per notification by the Ministry of Road Transport and Highways in the National Gazette. The present toll rates are determined with reference to the published base toll rates and are adjusted annually at the beginning of each fiscal year equal to 40% of the movement in the wholesale price index in December of the preceding year plus a fixed 3%.

According to the NHAI's toll notification for FY24, i.e., April 1, 2023, onwards, the toll rates at the Raibha toll plaza for Asset are as follows:

Table: FY24 toll rates – BK: Darodha

Vehicle Type	Single	Return	Monthly
CJV	115	170	3815
LCV	185	275	6165
Bus/Truck	390	580	12920
3A	425	635	14095
MAV/ HCM/EME	610	910	20260
OSV	740	1110	24665

Table: FY24 toll rates – BK: Kelapur

Vehicle Type	Single	Return	Monthly
CJV	105	160	3585
LCV	175	260	5785
Bus/Truck	365	545	12125
3A	395	595	13230
MAV/ HCM/EME	570	855	19015
OSV	695	1040	23150

1 Introduction

1.1 National Highways Infra Projects Private Limited (**'NHIPPL'** or the '**Client'**) has commissioned Steer Davies Gleave India Private Limited (hereafter called '**Steer**') for a Annual review traffic assessment study for the following project road **('Asset').** This Asset includes a total of two toll plazas.

- **Asset:** Borkhedi-Kelapur-Maharashtra/Telangana border on NH44 (old NH7) in the state of Maharashtra with two toll plazas

1.2 Further, as part of this study, we have also covered a comparison with the estimates provided in the earlier traffic and revenue due diligence study performed in FY23 (Aug-22) by Steer.

1.3 The National Highways Authority of India ('**NHAI**') has set up an Infrastructure Investment Trust ('**InvIT**') namely National Highways Infra Trust and is acting as its Sponsor to the said InvIT. The National Highway Infrastructure Investment Managers Private Limited (NHIIMPL) has been incorporated and appointed as the Investment Manager for the proposed InvIT by NHAI and NHIPPL is the entity under NHIIMPL, which is responsible for the operation and maintenance of this Asset.

Table 1.1: Description of Assets

Asset ID	Asset: BK
Asset name	Borkhedi-Kelapur-MH/TS Border section of NH44
State	Maharashtra
NH	NH44
Length (km)	138.150 km
Chainage	km 36.600 to km 175.000
Nos. of toll plaza	2
Toll plaza locations	Darodha (km 92.500) Kelapur (km 150.000) which is to be relocated at proposed location of km 156.650
Operating since*	April 2011
Proposed concession period	20 years (taken over by NHIPPL in Feb/ Mar-23)
Tollable length (km)	**Darodha TP** • FY23: 80.08 Km (during construction) • FY25 onwards: 80.18 Km **Kelapur TP** • FY23: 75.16 Km • FY24 onwards: 75.16 Km

Source: NHAI

Scope of work

1.4 Our scope of work for carrying out a T&R due diligence exercise covered:

- Review of available data, and concession agreements.
- Primary traffic survey and analysis as per the schedule presented in the table below:
  - 7-days video based classified traffic volume count (TVC).
  - 24 hours origin-destination (OD) survey and commodity analysis
- Assembly of the toll plaza level base data from PIU, where available, and review of the recent growth trends.
- Identify appropriate benchmarks for historical performance, seasonality, ticket type segmentation for the asset.
- Estimate the base traffic and revenue position utilising the above information.
- Establishing traffic growth estimates based on key economic growth drivers such as GDP, GSDP, commodity, etc. and estimating underlying growth elasticities based on these growth drivers.
- Assessing impacts from exogenous factors, including network change impacts.
- Developing traffic forecasts by vehicle class and segmentation categories; and
- Toll revenue estimation for entire concession period.

Table 1.2: Data collection schedule

Survey	BK – Darodha	BK - Kelapur	BK – Kelapur New
TVC survey (7 x 24 hours)	27th Feb-23 to 5th Mar-23	27th Feb-23 to 5th Mar-23	(3 x 24 hours): 1st Mar – 3rd Mar-23
OD survey (1 x 24 hours)	1st Mar-23	2nd Mar-23	-

Source: Steer

Our approach

1.5 The approach employed by Steer in the preparation of the traffic and revenue forecasts was developed to take advantage of the existing knowledge of the Asset and of the available data. It follows normal practices well established in addressing the issue of forecasting on-going traffic growth on a brownfield project. The key difference in this exercise as compared to a typical secondary market transaction, where the vendor provides detailed information on the historical performance of their asset, is that the historical traffic and revenue information provided by the client is very limited (and had reporting variations) and therefore less reliable than what could be expected. Therefore, significant efforts had to be put into developing a credible base year position and growth expectations through benchmarking with other asset in close vicinity of the asset under consideration.

1.6 The analysis focused on two sets of issues:

- understanding and verifying the traffic which is, at present, using the Asset; and
- identifying how and why that traffic will change in the future.

1.7 Regarding the former (i.e., current traffic on the asset), independent primary data collection was commissioned as part of this study and then compared against the available traffic data from various sources.

1.8 To arrive at the base position, we have utilised information from various sources – including toll plaza data shared by NHAI and client, Steer independent primary surveys to validate the network understanding and ensure quality in the data collection process, and our context knowledge, to assess a reasonable demand on the corridor for the base year which formed the basis of future year forecasts.

1.9 Further base year revenue validation exercise has been undertaken to ensure both base traffic and segmentation assumptions are robust.

1.10 This approach is be-spoke for such projects where long time series consistent historical data is not available. Therefore, significant efforts had to be put into developing a credible base year position and growth expectations.

1.11 The estimation of future traffic demand on the Asset is driven by:

- Growth of 'background' traffic: this depends to a certain extent on the on-going socio-economic and demographic development of the area served by the Asset; and
- Change in the local and international industry: which drives heavy goods traffic on the Asset; and
- Change in the competitive position of the Asset: this reflects changes in highway capacity of competing roads and the relative changes in service levels (time, congestion, price, etc.) for the Asset, and their competitors.

1.12 The information related to the concession agreements, toll notifications, toll calculations and target revenue and designed capacity was provided as part of the commission.

1.13 We have analysed traffic data from multiple independent sources as well to understand the current traffic on the Asset. The list of data sources available and discussed in later chapters in detail are presented below:

Table 1.3: List of data sources available

Data sources	Provided by	Borkhedi Kelapur (BK)
Monthly toll plaza data sourced by Client (TMS)	Client	Monthly level traffic and revenue starting Apr'2021 upto 27 Mar'2023
ETC Daily Data	Client	ETC Daily data from 1 Feb 2023 to 15 Mar 2023.
Toll Notifications	Publicly sourced from NHAI website	Historical and latest toll notification detailing toll computations.
Steer TVC counts	Steer	Commissioned by Steer, 7 days TVC counts from 27 Feb-23 – 5 Mar-23 at Darodha and Kelapur and 3-days TVC counts from 1 Mar-23 to 3 Mar-23 at Kelapur New.
Origin-Destination (OD) survey	Steer	Commissioned by Steer, 24 hours surveys on 1 & 2 Mar-23

Source: Steer's review of data points

Evolution of Covid19 pandemic in India in FY21 and FY22

1.14 On 24th March 2020, the Central government announced a nationwide 21-day lockdown which was extended for another three weeks until May 3rd. Further extensions until May 17th and again until May 31 featured relaxations in 'green' and 'orange' zones. Starting 8th June 2020, 'Unlock' phases began. States have also taken their own measures, with Central guidelines being the minimum expected restrictions from States. The tolling across all national highways in India was stopped between 25th March 2020 and 20th April 2020. These lockdowns resulted in significant disruptions to traffic, with a reduction of both commuting trips to work (as people were required to work from home or stay at home) and leisure trips (due to the closure of various entertainment venues, places of worship, tourist destinations, etc.). Goods movements, while still impacted, continued to a lesser extent due to a need to supply essential goods such as food, etc.

1.15 The traffic volumes since then gradually started recovering on most Asset in India, with varying extent. By Q3 of FY21 traffic levels were already at par FY20 AADT numbers and even higher in some cases. The traffic trends observed on most of the India toll roads during Q4FY21, showed sustained traffic levels as were witnessed in Q3FY21, which reflected sustained demand revival in the Indian economy. These traffic levels reflected the longer-term trends of a strong economic recovery, in segments like auto manufacturing, road construction, energy consumption /production etc., are more stable and are driving the growth over and above FY20 levels and are expected to continue as more segments of the economy, like hospitality, tourism, etc., recover fully from the pandemic.

1.16 This second wave of Covid19 was accompanied by various local and state level night curfews and lockdowns starting from April until end of June. The second wave of Covid19, although had a higher infection rate, the movement of traffic and goods was not impacted by the same magnitude as the first wave when whole country went under strict lockdown for two quarters. This can be attributed to the fact that almost all the restrictions were localised or at state level. Moreover, there was no restriction on movement of goods vehicles and other services. As the industries and agricultural activities continued to operate, the truck traffic did not fall as steeply as it did in Q1 FY21. The second half of the year from October'21 showed sustained traffic levels due to the resumption in Economic activities and easing of restrictions.

1.17 Post which, there was a third wave of Covid19 in Jan-Feb-22. It lived for a short period and hence, the impact on traffic was observed only for these two period at some of the toll plazas in India. Since, then there hasn't been any material impact of Covid19 on traffic.

1.18 Therefore, FY23 is considered as normal year and has been considered for base estimation (without any Covid19 specific adjustments) for FY23 which is explained in detail in Chapter 6.

Contents of this Report

1.19 The report has been divided into 6 chapters, including:

- Chapter 2 describes the key features of the Asset.
- Chapter 3 provides a historic traffic and revenue overview of the Asset, and presents all the survey data collection, and analysis.
- Chapter 4 discusses the socio-economic context in the corridors containing the Asset.
- Chapter 5 presents our base year traffic estimates and forecasting assumptions.
- Chapter 6 summarises our key forecasting assumptions, assessment of network impacts, and presents our traffic and revenue forecasts for the Asset.

2 The Asset

Introduction

2.1 This chapter provides a description of the Assets, based on primary data (from site visits), our understanding of the region and network surrounding the Assets. We cover the strategic network context, followed by key economic activities and network developments around the Assets.

Figure 2.1: Asset location

Source: Steer cartography

Asset context

Context

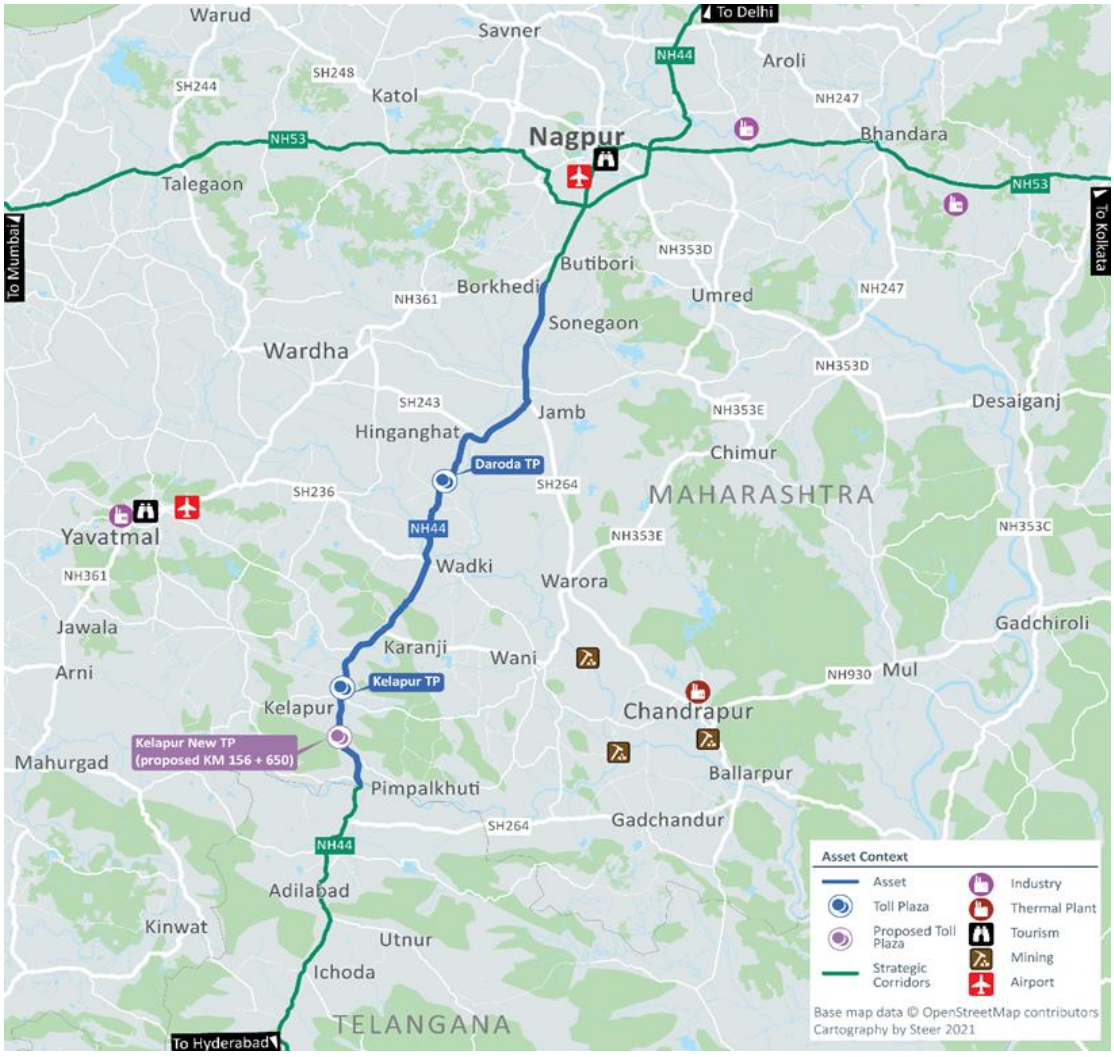
2.2 The Asset, Borkhedi – Kelapur (BK), is located on NH44 and is about 139 km long section between Borkhedi and Maharashtra/ Telangana Border (at Penganga River bridge) traversing through the districts of Nagpur, Wardha and Yavatmal in the state of Maharashtra.

2.3 There are two toll plazas on the Asset and are located at:

- Darodha (KM 92.500)
- Kelapur (KM 150.000, to be shifted to KM 156.650)

2.4 The Asset has two plazas located as shown in map below.

Figure 2.2: Asset context - BK



Source: Steer cartography using OpenStreetMap data

2.5 Kelapur toll plaza is proposed to be relocated to a new location, ~6 km south of the existing location in absence of adequate land to construct proper toll plaza at the present location. This is named as Kelpaur New TP (KM 156 +650) in the map above.

2.6 The Asset is in vicinity of Nagpur as the city is home to several manufacturing hubs, food processing units, and CONCOR's multi modal logistics logistic hub. Yavatmal (textile/cotton), Butibori (MIDC), and Chandrapur (coal) are some of key traffic generators for the Asset.

2.7 Steer team visited the Asset as part the site visit exercise to understand the traffic movement on the and its surrounding network and in addition spoke to the users of the road and undertook a detailed reconnaissance of the Asset, including identification of any micro-diversions. The images below show a typical cross-section of the Asset and its toll plazas as captured during site visit.

Figure 2.3: Typical cross-sections and toll plazas on the Asset

Source: Steer site visit

2.8 Darodha plaza has a 5+5 lane configuration, whereas the existing Kelapur plaza has a 2+2 lane configuration. Further, as observed during the site visit the Kelapur plaza is operating 1 lane on each side using manual hand-held device and the plaza is in generally poor condition. Land availability is citied as a key reason for this and therefore the requirement of the new toll plaza has been considered by NHAI.

2.9 The major commodities observed during surveys are manufacturing, courier/parcel, agricultural products, and groceries. Average trip lengths of more than 1,500 kms were observed on the toll plaza, this is validated by the analysis of the OD data as well presented in detail in later chapters.

2.10 The Asset location in the long-distance regional context is shown in map below.

Figure 2.4: Asset location in the regional network context- BK

Source: Steer cartography using OpenStreetMap data

2.11 The Asset caters to the following traffic movements:

- **Long-distance** traffic:
  - The Asset forms part of NH19/NH7 (new NH44) north-south long-distance strategic corridor connecting Srinagar in Kashmir (northernmost state) to Kanyakumari in Tamil Nadu (southernmost state).
  - It directly connects national capital Delhi and northern states with state capitals of Hyderabad (Telangana), Bengaluru (Karnataka) including other major cities/industrial nodes/ junctions along the way like Agra (Uttar Pradesh), Gwalior and Jhansi (Madhya Pradesh), Nagpur (Maharashtra), Selam, Madurai, Tirunelveli (Tamil Nadu).
  - The Asset also provides strategic linkage between Delhi and Chennai via Hyderabad-Kadapa and Hyderabad-Ongole routes.

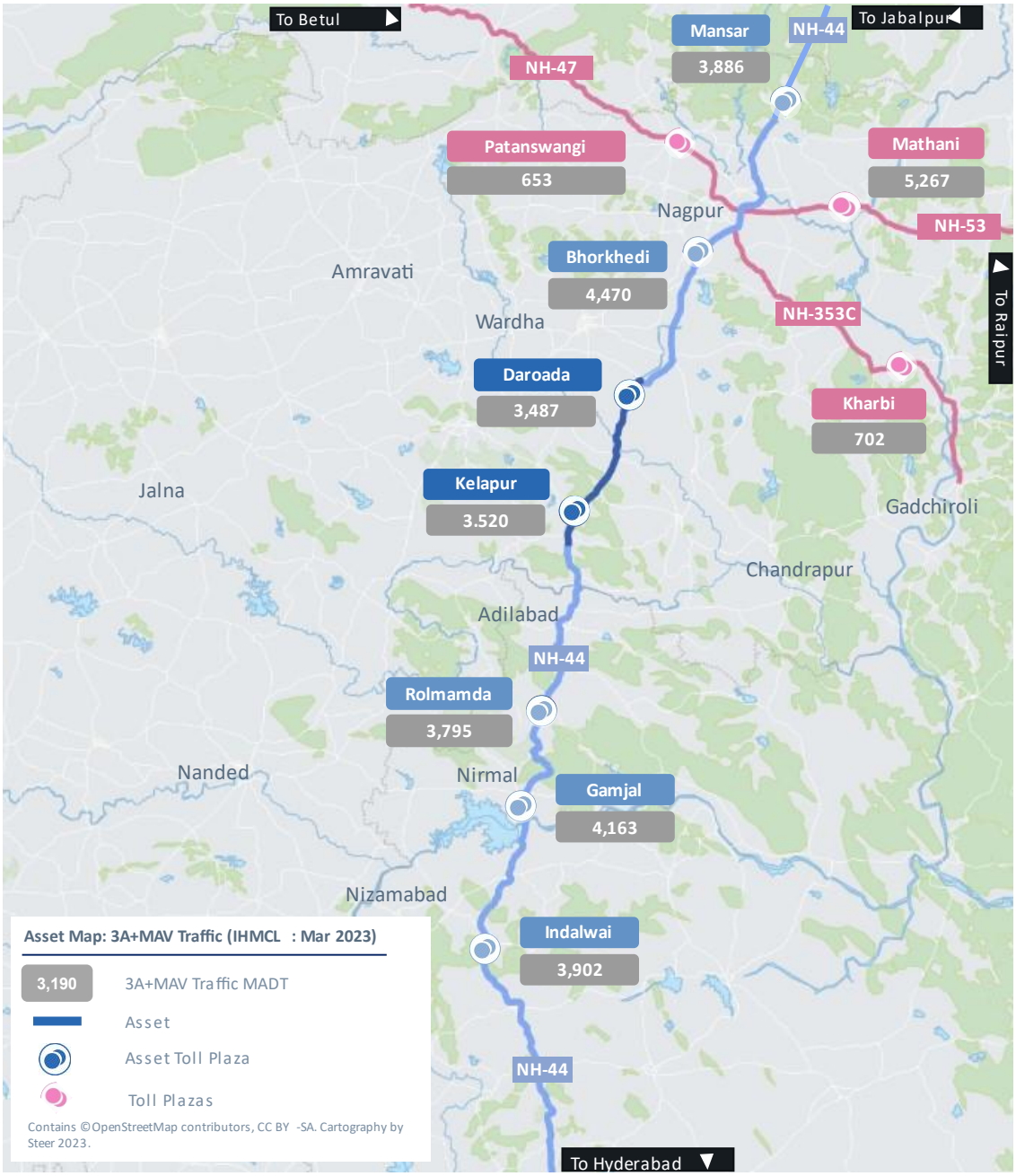
- **Medium-distance** traffic:
  - In addition to role as national connector, the Asset provides important regional connectivity between neighbouring states i.e., Maharashtra and Telangana.
- **Short-distance** traffic:
  - Nagpur, being centrally located in the country, acts as a strategic junction within immediate influence area in Maharashtra.
  - The Asset provides fair condition round the year connectivity to various urban/ semi-urban centres of eastern Maharashtra i.e., Chandrapur, Wadner, Padharkawada, Yavatmal among each other and with regional commercial centre of Nagpur.

2.12 The traffic profile is predominantly goods vehicles undertaking long distance movements between the locations discussed above. The commodity mix carried by the vehicles observed at the toll plaza during site visit was mix of manufacturing, courier/parcel, automobile, and agriculture confirming the long-distance nature of the traffic.

2.13 The Asset has seen an increase in proportion of the long-distance goods traffic in recent years as compared to past performance which may be attributed to shift of long-distance traffic from other corridors to NH44 (old NH7) corridor as NH44 observed continuous Level of Service (LoS) upgrades. Being the shortest route between Delhi and Hyderabad/Bengaluru, the increased LoS on the corridor attracted traffic on NH44 post improvement.

2.14 The Asset location in the context of traffic volumes on surrounding assets is shown in map below.

Figure 2.5 Traffic Volumes as per IHMCL ETC data for Mar-23



2.15 3A+MAV Traffic at Darodha and Kelapur essentially trends around the same range. Kelapur traffic is slightly higher on account of some traffic from Yavatmal plying on NH44 towards southern India.

2.16 Difference between Borkhedi and Darodha traffic volumes is mainly due to some of the traffic diverting at Jamb towards Chandrapur, Khammam, Warangal direction. Gamjal toll plaza observes higher 3A/ MAV traffic volumes due to addition of traffic from Nanded/ Ahmednagar playing from NH61 to NH44 at Nirmal.

Concession and tolling details

Table 2.1: Summary of concession

Asset ID	Asset: BK
Asset name	Borkhedi-Kelapur-MH/TS Border section of NH44
State	Maharashtra
NH	NH44
Length (km)	138.150 km
Chainage	km 36.600 to km 175.000
Nos. of toll plaza	2
Toll plaza locations	Darodha (km 92.500) Kelapur (km 150.000) which is to be relocated at proposed location of km 156.650
Operating since*	April 2011
Proposed concession period	20 years (taken over by NHIPPL in Feb/ Mar-23)
Tollable length (km)	**Darodha TP** • FY23: 80.08 Km (during construction) • FY25 onwards: 80.18 Km **Kelapur TP** • FY23: 75.16 Km • FY24 onwards: 75.16 Km

Source: NHAI

2.17 The Asset has been recently handed over full control to the client and they have started operating the toll plaza on 9th Mar-23 at Darodha and 20th Feb-23 at Kelapur. However, the tolling systems, the AVCC, and other software and hardware equipment being used is still not replaced. The client has informed that the new tolling systems are currently under procurement and will be installed and operational by end of Q2 FY24.

2.18 The change in Darodha's tolling length is due to reconstruction of a major bridge on the Asset. As per our discussion with the Client as well as our review of available documents, it was found out that the construction must be completed within 18 months of the appointed date. Hence, we have assumed the post-construction tolling length of 80.18 km for Darodha FY25 onwards.

Toll plazas and toll rates

2.19 As discussed earlier in section, the Asset has two toll plazas. Darodha toll plaza on the Asset has 5+5 lane configuration whereas Kelapur plaza has 2+2 configuration. FASTag is enabled on each side of the plaza for electronic collection of tolls.

2.20 The road users having valid FASTag installed on their respective vehicles approach the ETC lanes where the installed RFID readers detect the tag and deduct toll charges equalling single trip or for Local/monthly pass/discounts wherever applicable. In case, the RFID reader is not able to detect the FASTag, handheld devices are used to read the vehicle's tag. Further, in cases where FASTag is blacklisted or not working, the user can only buy single cash ticket and are charged

twice the single trip fare. The users crossing toll plaza twice within 24 hours automatically get return discount.

2.21 Like the other National Highway plazas, the Asset has Single, Return, Local Commercial, Local Personal, Monthly and Local Monthly tickets. Single toll rates and categories on each of the toll plaza are presented in the table below.

Table 2.2: Single toll rates on the Asset (INR), applicable for FY 23

Type of Vehicle	Darodha	Kelapur
CJV	110	100
LCV	175	165
Bus/Truck	370	345
3A	400	380
MAV/ HCM/EME	580	545
OSV	705	660

Source: NHAI Revision of User fee Rate w.e.f. 30.10.2022 for Darodha and 29.10.2022 for Kelapur

Table 2.3: Single toll rates on the Asset (INR), applicable for FY24

Type of Vehicle	Darodha	Kelapur
CJV	115	105
LCV	185	175
Bus/Truck	390	365
3A	425	395
MAV/ HCM/EME	610	570
OSV	740	695

2.22 The following table shows the change in tolling length.

Table 2.4: Tolling lengths for the Asset

Toll Plaza	FY23, FY 24	FY25 onwards
Darodha	80.08 Km	80.18 Km
Kelapur	75.16 Km	75.16 Km

Source: NHAI – User fee rate and Schedule-M, as shared by the Client

Key economic activities

Industrial Influence

2.23 The Asset is present in the state of Maharashtra, the second-most populous state in India with a population of nearly 124 million people. The Asset forms part of the strategic NH44 corridor catering to the north-south movement.

2.24 The Asset caters to the demands generated by the states connected through the above-mentioned highway. NH44 runs over 4,112 kms completing the north-south movement and connects some of the major states and industrial centres of northern states/UTs of Jammu and Kashmir, Punjab, Haryana, Delhi, Uttar Pradesh, Rajasthan, Madhya Pradesh, Maharashtra

with the southern states of Telangana, Andhra Pradesh, Karnataka, and Tamil Nadu. The strategic nature of the project corridor can be attributed as a reason behind average trip length of 1,500+ km of 3A/MAV as observed during the site visit and as validated by our survey data results.

2.25 The Asset lies on the outskirts of Nagpur which is the third largest city in Maharashtra. It is known for medium to large scale industries alongside agriculture. The key industries are manufacturing and food processing as described below.

- **Manufacturing** segment includes products ranging from agriculture equipment, aluminum products, castings, cement, chemicals, paper and packaging, electrical equipment and fittings, textile engineering goods, tools manufacturing, fabrication and machining, ferro alloys, paints, furniture, plastic and moulding products, etc.
- **Food processing** giants having presence at Nagpur includes Haldiram, Dinshaw, Patanjali and other medium scales orange and spices processing units, etc.

2.26 Apart from the above-mentioned industrial segments present in Nagpur, the following are some additional developments announced by the government for the region:

- Government of Maharashtra has set-up Multi-Modal International Passenger and Cargo Hub Airport at Nagpur (MIHAN). That will upgrade existing domestic airport along with a Special Economic Zone which is abutting to the boundary of the airport. MIHAN houses plant of Tata Aeronautics which manufactures parts for Boeing and Air India and Dassault's assembly plants.
- Container Corporations of India Limited (CONCOR) constructed Multi Modal Logistic Park along with a rail terminal connecting MIHAN with different ports in country.

2.27 **Butibori industrial area** established by Maharashtra Industrial Development Corporation (MIDC), north of the Asset, is one of the country's largest industrial hubs. It houses textile, machine and metal fabrication and manufacturing units and is home to industrial giants like KEC, Hyundai, and Unitech. Koradi Thermal Power Station and Khaparkheda Thermal Power Station are the two major thermal power stations located in vicinity of the hub.

2.28 **Yavatmal industrial area**, in west of the Asset, has textile and cotton processing industries including Raymond India's garment plant. The industrial hub is also home to export units of machineries, cement, medicines, limestones, and clothes.

2.29 **Chandrapur** is key coal mining centre in close vicinity of the Asset and has thermal plant, cement, paper and ferro alloy manufacturing industries.

Agricultural influence

2.30 The agricultural stretches present along the Asset as well as in Nagpur generate a considerable share of traffic on the Asset. Nagpur, also known as Orange City, is famous for the production of oranges in addition to being home to large number of paddy, jowar, cotton, tur and soyabean fields. The same is observed in our 'commodity analysis', a part of survey results, as well as ~13% of the MAVs were found to carry agricultural products.

Network developments

2.31 The section below details the impacts which we believe would influence the traffic levels on the Assets during the concession period.

Delhi Mumbai Expressway & Surat Chennai Expressway

2.32 Delhi Mumbai Expressway (DME) will connect Delhi to Mumbai with a dual carriageway with six lanes per direction. At 1,350km long, it will drastically reduce travel length and times. The section between Sohna (Haryana) to Dausa (Rajasthan) was made operational in Feb-23. The latest status[1] as posted by NHAI projects that by Mar-24 the section between Delhi and Ratlam-Indore will be operational. Similar to DME, 1,461 km long Surat Chennai Expressway will connect Surat and Chennai via Solapur, Kurnool, Kadappa, and Tirupati. Once both these expressways are constructed, traffic coming from Delhi/ north and travelling to Kurnool/south will have the option to use DME till Indore followed by NH52 till Solapur followed by SCE from Solapur to Kurnool and beyond. This new alternative will provide the option of using expressways for ~60% of the total journey distance and hence, a share of Delhi-Kurnool traffic is expected to have an alternate route choice.

2.33 Further, DME provides a faster access to Indore and post which the users can reach Solapur via Dhule – Aurangabad. After Solapur, the route to reach Bangalore can either be via Kurnool or via Vijaypura – Hospete section.

Nagpur Vijayawada Expressway

2.34 A 457 km long Nagpur – Vijayawada Expressway is being developed as Economic Corridor by National Highways Authority of India (NHAI) under Bharatmala Pariyojna. This development is mix of existing alignment to be widened and greenfield section between Warangal- Khammam and is expected to be completed by FY28.

2.35 The proposed expressway will establish new competing route for NH44 as the users will have the option to use the expressway from Nagpur to travel to Vijayawada and south. The existing distance between Nagpur and Vijayawada using Asset is 773 kms which will get reduced to 596 kms after the expressway is operational. The expressway is still in the planning phase, the exact status of the project has been raised as a query with NHAI and is pending clarification.

Raipur Hyderabad Expressway

2.36 A 568 km long Raipur-Hyderabad Economic Corridor by National Highways Authority of India (NHAI) is recently announced by the Government. This development is mix of existing alignment to be widened and greenfield section between Durg- Gadichroli- Bellampalli are expected to be completed by FY28.

2.37 The proposed greenfield alignment between Raipur and Bellampalli will establish new competing route as long-distance corridor for traffic moving between Raipur/Central Eastern parts and Hyderabad/south.

2.38 The existing distance between Raipur and Hyderabad using Asset is 766 kms which will get reduced to 568 kms after the economic corridor gets ready.

[1]DME status as on March'2023, **https://nhai.gov.in/nhai/sites/default/files/mix_file/Delhi-Mumbai-Award-Status-Mar-23_v1.pdf**

3 Traffic and revenue description

Introduction

3.1 This Chapter outlines the historical and current traffic and revenues on the Asset and how these are used to establish the current/base year demand (in terms of AADTs), which forms the basis of our forecasts. We then use our independent traffic volume counts (TVC) to validate the AADTs and estimate shares of toll violations and unreported exemptions.

3.2 For a traffic and revenue due diligence exercise, the data provided by the toll plaza is typically the primary source of establishing a road asset's base position, in terms of vehicle level AADT and PCU levels, as well as historical performance in terms of growth trends by vehicle type. However due to the unique nature of the asset under consideration in this assignment, being operated under different Operate Manage and Transfer (OMT) contracts, basically independent contractors, the toll plaza based historical data available was very limited for the Asset. Therefore, it was important to validate the toll plaza data against other independent data sources to entrust confidence in the data used for base position estimation.

3.3 An independent traffic count is often a good way to validate the toll plaza information which has been used in combination with data shared by the Client team. A fresh set forecasting approach was also developed using this independent data and benchmarks available from other studies. These data sources, described in detail below, were helpful in establishing the base position as well as the historical trends that could be relied upon for developing a robust set of forecasts.

Historical traffic and revenue analysis from various sources

3.4 This section below presents the sources from which the historical traffic and revenue of the Asset has been analysed. For this study, traffic data is made available from different sources shared by the Client, namely:

- IHMCL counts; and
- Schedule – M and/ or Schedule V; and
- Toll plaza data (ETC + Cash + Violations/ Exemptions) sourced from Client.

3.5 During the due diligence which was undertaken in Aug-2022, these data sources were analysed in addition to the independent primary survey data being collected by Steer. During that study it was established that Toll Plaza data along with primary survey data as mentioned above was the most reliable data source. Therefore, For the purposes of this study, we now have this dataset available for a longer time series i.e., from April'21 to 27th Mar'23. Therefore, for the purposes of historical analysis and FY23 base AADT estimation we have utilised only this data source (along with steer primary survey).

3.6 The following section outlines the current and historical traffic and revenue datasets available on the Asset, as well as our analysis of primary traffic count data, collected as a part of this project. In addition to the data available through secondary sources we have conducted our

own independent Traffic Volume Counts (TVC) counts to validate the AADT and estimate shares of vehicle classes, where data are not available or aggregated.

Historical traffic

IHMCL Data

3.7 During the earlier study undertaken by Steer in Aug-2022, the Client had provided the IHMCL data to us. IHMCL 7-day traffic counts are available on the Asset toll plaza for different months from Mar-15 (FY15) to Nov-20 (FY21) for Darodha and Sep-15 (FY16) to Sep-20 (FY21). The counts are classified by vehicle type and present a reasonable position of the traffic.

3.8 In order to observe the correct characteristics of the Asset, the IHMCL WADTs were corrected for seasonality using an SCF factor. In absence of reliable historical toll plaza data, the SCF were benchmarked from the toll plazas located in close vicinity of the Asset on NH44 which we have studied in the past and where a reasonable long-term historical data was available. The converted AADTs and the corresponding long-term CAGR is provided in Appendix – C.

3.9 Since, the IHMCL data had neither long-term historical monthly trends nor short-term FY22/ FY23 data, it isn't used to compute the base traffic position.

Schedule M Data

3.10 Schedule M data was shared by the Client during the earlier study, which included historical traffic data from Nov-17 (FY18) to Sep-20 (FY21) for Darodha and Feb-20 (FY21) to Jun-21 (FY22) for Kelapur.

3.11 As compared to Darodha plaza where the data was available from FY18-21, data from FY20-21 is available for Kelapur plaza. The data as obtained is provided in Appendix – C.

3.12 To validate the reliability of the Schedule M data, we had compared the traffic levels with the traffic levels provided in the toll plaza data for the months common in both the datasets. Data for the months common in both datasets was only available for Kelapur (Jan-21 to Jun-21). Based on the comparison, it was found that ETC was higher than Schedule M in Feb-21 and Jun-21. Therefore, this casted a doubt on Schedule M dataset and hence have not been included in our analysis for traffic volumes.

Toll plaza data (ETC + Cash + Violations/ Exemptions) as shared by Client

3.13 Based on our experience of studying toll roads across the country, tolling via FASTag has significantly improved the methods of reporting as the traffic, apart from getting recorded by the toll plaza, also gets recorded by centrally monitored bank servers. Therefore, we believe toll plaza (ETC+cash) dataset is reliable and has been used for our base traffic estimation. To further enhance the confidence on our base traffic position, we have compared the daily level toll plaza data traffic for each vehicle category with Steer's independent TVC counts for the same dates.

3.14 Toll plaza data from 01st Apr-21 to 27th Mar-23 for Darodha and Kelapur was shared by the Client. In this dataset, it was found that the Exemptions and violations data missing for Aug-22, Dec-22, and Jan-23 across all vehicle categories for both the toll plazas. For CJV and LCV, the number of exemptions/ violations traffic number is considerable (as was also observed in Aug-22 study). Therefore, due to unreliability of data, we have considered:

- For CJV and LCV: Cash + ETC data has been used; and

- For remaining vehicle types (2A, 3A, MAV): Cash + ETC + exemptions/ violations data for historical and base year traffic analysis.

3.15 The following table explains the quarterly recorded MADT by vehicle class, at the Asset's toll plaza over the period of 24 months from Apr-21 to Mar-23 (as provided by the client).

Table 3.1 Reported AADT at Darodha

Vehicle	FY22	FY22 N	FY23 YTD	Q1 FY23	Q2 FY23	Q3 FY23	Q4 FY23	FY23 vs FY22	FY23 vs FY22N
CJV	1,453	1,632	1,620	1,798	1,278	1,534	1,897	11.5%	(0.7%)
LCV	411	421	403	419	392	394	407	(2.0%)	(4.2%)
Bus/ 2A	1,310	1,412	1,591	1,523	1,600	1,578	1,669	21.5%	12.6%
3A	1,347	1,380	1,380	1,426	1,456	1,300	1,340	2.4%	(0.0%)
MAV	1,699	1,679	1,929	1,894	2,143	1,740	1,947	13.6%	14.9%
OSV	2	2	1	2	1	1	2	(14.1%)	(19.4%)
Total	**6,221**	**6,526**	**6,925**	**7,061**	**6,871**	**6,548**	**7,262**	**11.3%**	**6.1%**
Total PCUs	**17,693**	**18,206**	**19,827**	**19,803**	**20,685**	**18,596**	**20,305**	**12.1%**	**8.9%**

Source: Steer analysis of client data from 1st Apr-21 to 27th Mar-23, FY22N is H2FY22 traffic adjusted for seasonality. CJV, LCV do not include exemption + violation data, other categories do include all ticket type data.

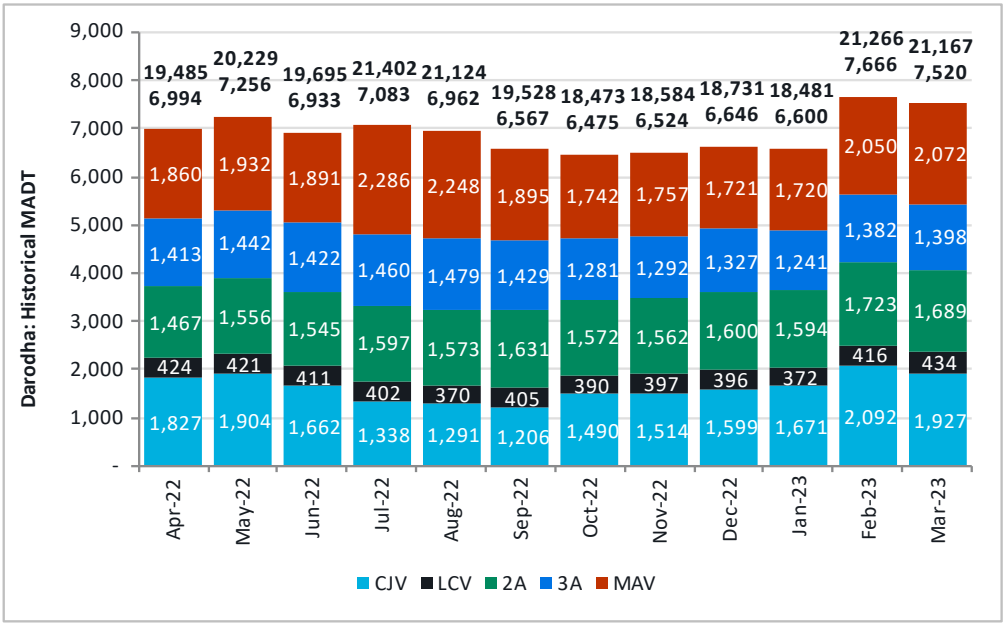
Table 3.2 Reported AADT at Kelapur

Vehicle	FY22	FY22 N	FY23 YTD	Q1 FY23	Q2 FY23	Q3 FY23	Q4 FY23	FY23 vs FY22	FY23 vs FY22N
CJV	887	1,033	1,045	1,176	890	1,108	1,001	17.9%	1.1%
LCV	441	409	376	384	369	376	375	(14.8%)	(8.1%)
Bus/ 2A	1,413	1,593	1,685	1,588	1,665	1,751	1,743	19.3%	5.8%
3A	1,340	1,390	1,375	1,415	1,453	1,316	1,316	2.6%	(1.0%)
MAV	1,740	1,742	1,965	1,897	2,177	1,792	1,999	12.9%	12.8%
OSV	2	2	1	2	1	1	2	(8.3%)	(19.1%)
Total	**5,822**	**6,168**	**6,447**	**6,462**	**6,556**	**6,345**	**6,437**	**10.7%**	**4.5%**
Total PCUs	**17,645**	**18,440**	**19,638**	**19,308**	**20,602**	**18,946**	**19,745**	**11.3%**	**6.5%**

Source: Steer analysis of client data from 1st Apr-21 to 27th Mar-23, FY22N is H2FY22 traffic adjusted for seasonality. CJV, LCV do not include exemption + violation data, other categories do include all ticket type data.

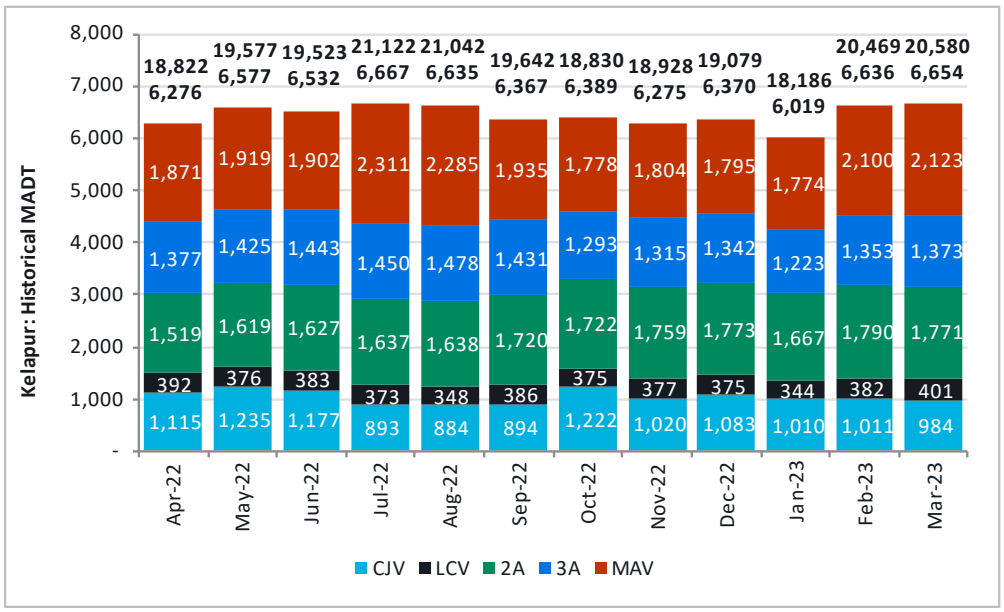
3.16 Figure below shows the PCU and MADT reported for the Asset in FY23.

Figure 3.1: BK: Darodha – MADT and PCU



Source: Steer analysis

Figure 3.2: BK: Kelapur – MADT and PCU



Source: Steer analysis

3.17 The Asset trends at 20,500 PCU levels in FY23 with robust truck performance continuing in Q4 FY23. Darodha plaza observed an average of ~6,950 AADT in FY23 as compared to ~6,450 AADT on Kelapur.

3.18 On both the plazas, traffic composition is majorly dominated by trucks (2A/3A/MAV) with over 2/3rd of total traffic on Darodha and Kelapur each, as they primarily serve long-distance north-south traffic movement. Due to long-distance nature of traffic, the plazas observe similar 3A/MAV volumes as the traffic traverses through movement. The difference in total traffic across the plazas is due to higher number of CJVs on Darodha due to the plaza's proximity to

urban centre of Nagpur. In FY23 YTD, Darodha witnessed ~1630 CJVs whereas Kelapur witnessed ~1050 CJVs per day.

3.19 Both the plazas observed ~400 LCVs per day in FY23 YTD. Kelapur observed ~1680 Bus/2As in FY23 YTD, slightly higher than ~1590 Bus/2As in FY23 YTD at Darodha. Buses and 2As are reported in a combined manner on the Asset as the toll rates are same for the categories. We have referred to the traffic reported in independent TVC counts for Bus/2A splits. The same has been explained in detail in later sections. This is further discussed in the data collection section.

3.20 The traffic in FY23 has witnessed growth at both Darodha & Kelapur toll plazas with the decline in Covid19 induced restrictions and resumptions in the economic activity. Darodha observed a higher PCU growth of ~9% as compared to 6.5% at Kelapur in FY23 as compared to FY22N. Further, both the assets have observed quarterly growth over the FY23, except from Q2 to Q3, which mainly caused by the slowdown in 3A/ MAVs. This could be attributed to heavy rainfall in Maharashtra in Q3.

3.21 The growth at both the toll plazas is mainly led by 2A and MAVs. CJV and 3As have observed to remain flattish, whereas LCVs have witnessed a slowdown.

3.22 The figures below show the category-wise share of traffic at the toll plazas for FY22 N and FY23 YTD. It can be seen that MAVs make up the highest proportion of vehicle share at both the toll plazas followed by CJVs at Darodha and 2A at Kelapur Toll Plaza. Accordingly, as expected, MAVs derive the highest proportion of revenue with an average of 45%-46% of total revenue in FY23, each for Darodha and Kelapur toll plazas.

Figure 3.3 Vehicle Share at Darodha

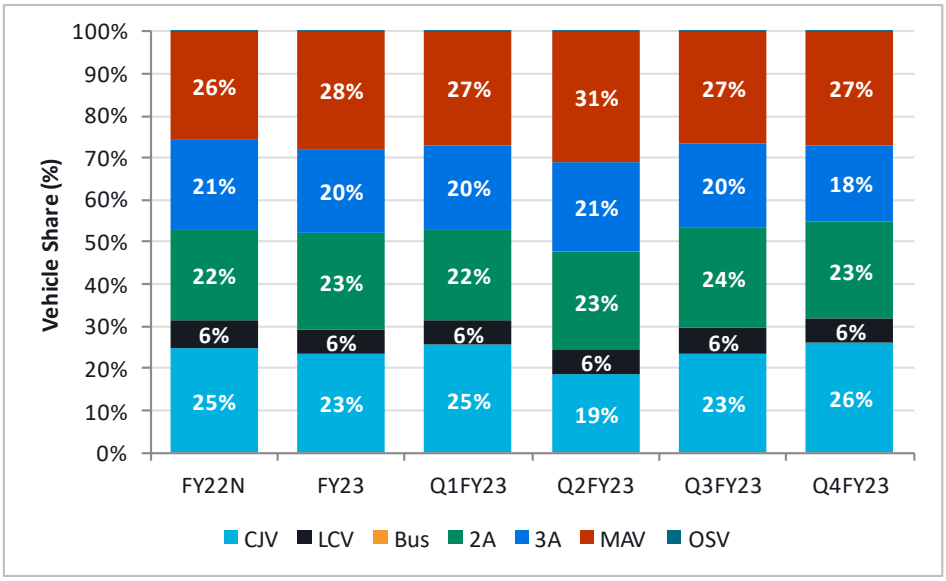
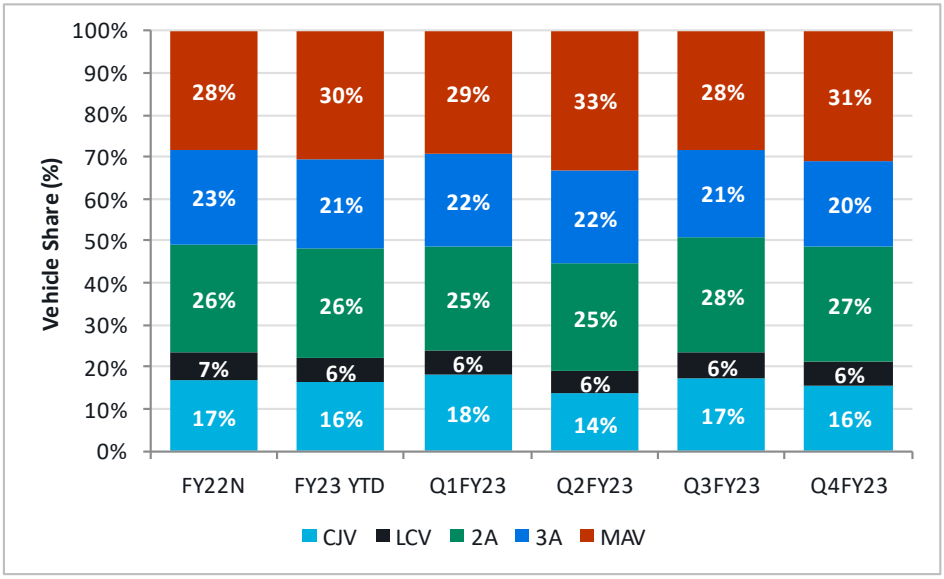


Figure 3.4 Vehicle Share at Kelapur



Source: Steer analysis of client data from 1st Apr-21 to 27th Mar-23

3.23 We have verified the traffic volumes by conducting our own independent TVC counts. The difference between TVC counts and the 'paying' traffic (cash + ETC) for CJV/ LCV and total traffic (cash + ETC + violations/ exemptions) for 2A/3A/ MAV/OSV and is being treated as unreported 'exemptions/violations' (non-paying traffic) in our forecasts explained in detail in TVC comparison section.

Historical Revenue

3.24 Revenue details were available split by vehicle category and ticket in the ETC+cash dataset. The ETC+cash dataset reported revenue on a daily level split by payment via FASTag and via cash. Over 99% of the total revenue is being collected via FASTag.

3.25 The revenue details from the datasets are shown in the charts below.

Table 3.3: BK: plaza wise annual revenue (INR Cr)

Vehicle Category	BK: Darodha			BK: Kelapur		
	FY22	FY23 YTD	Growth Rate	FY22	FY23 YTD	Growth Rate
CJV	4.15	5.21	25.5%	2.74	3.53	28.8%
LCV	2.12	2.34	10.4%	2.32	2.18	(6.0%)
2A	14.23	19.55	37.4%	15.54	20.13	29.5%
3A	16.46	18.93	15.0%	16.53	18.53	12.1%
MAV	29.78	38.21	28.3%	30.64	38.07	24.2%
Total	**66.78**	**84.28**	26.2%	**67.79**	**82.48**	21.7%

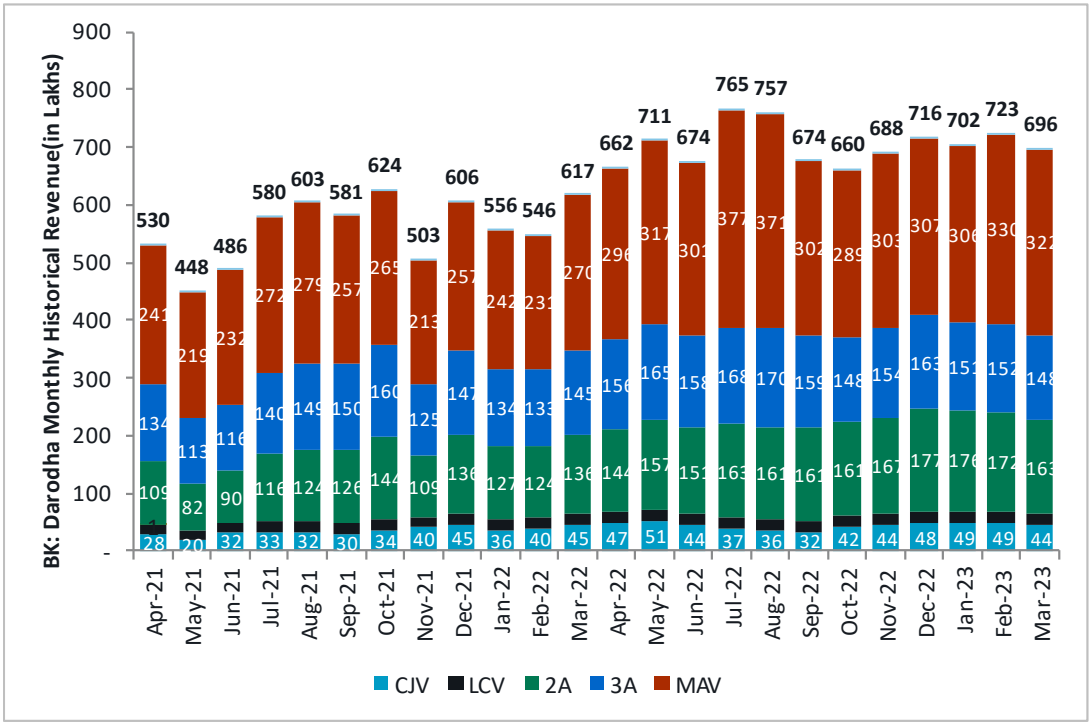
Source: Steer analysis of client data till 27th Mar'23

3.26 There has been an excellent growth (of ~24%) in the Asset revenues in FY23, led by 2A and MAVs.

3.27 Similar to commercial traffic volumes, both the plazas observe similar revenue levels as well. In FY23, the Darodha collected INR 84 crores whereas Kelapur collected INR 82 crores. On both the plazas, >90% of revenue is being collected from the commercial traffic where 3A/MAV alone accounts close to 70% of the total revenue.

3.28 The monthly revenue collection (ETC+cash) for the plazas is shown in the charts below.

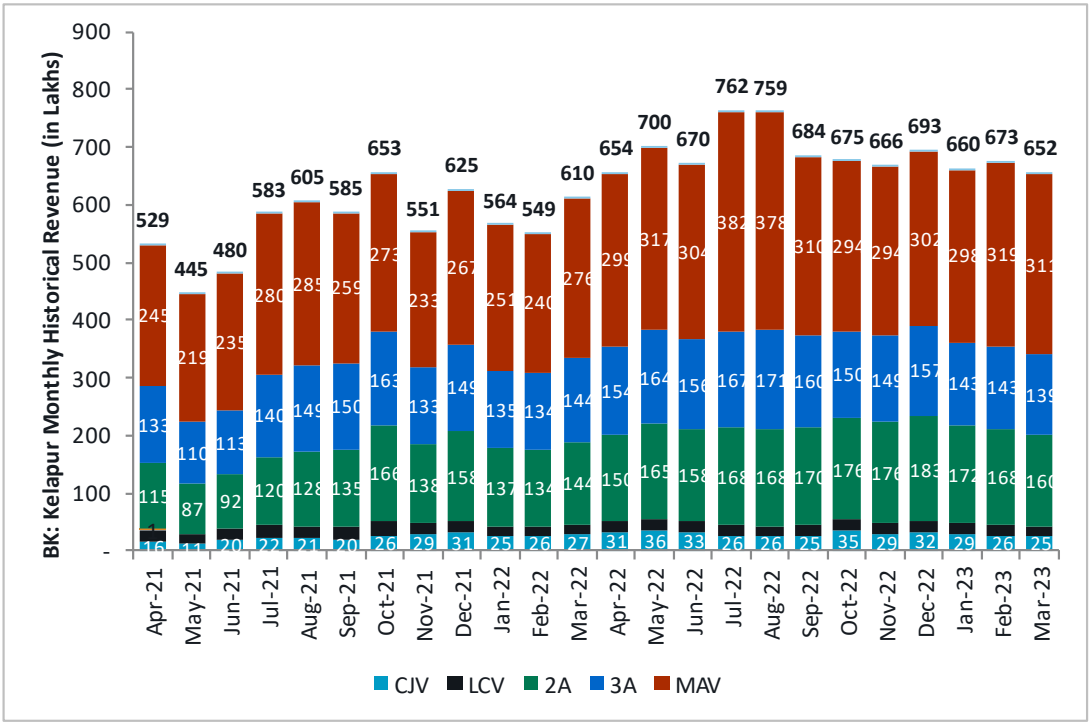
Figure 3.5: BK: Darodha – YTD Monthly revenue reported in toll plaza data (INR Lakhs)



Source: Steer analysis of client data till 27th Mar'23

3.29 The average monthly collection at Darodha and Kelapur plazas is ~ INR 7 Cr and ~ INR 6.6 Cr respectively in FY23 YTD. The daily collection in the same period was ~INR 23 lakhs and ~INR 22 lakhs respectively. Revenue collection is lower at Kelapur due to lower traffic volumes as well as lower tollable length than Darodha.

Figure 3.6: BK: Kelapur – YTD Monthly revenue reported in toll plaza data (INR Lakhs)



Source: Steer analysis of client data till 27th Mar'23

Toll Frequencies

3.30 Toll frequency or segmentation is typically the share of each ticket category recorded for a particular vehicle type. Each vehicle category has different segmentation. As a part of historical analysis, we calculate the toll frequency for each vehicle category from the monthly data shared by the client. The most common ticket categories observed on a typical national highway concession are: Single, Return, Monthly, Local and Exempt. Given the local nature of traffic, the Asset offers bespoke local passes to attract the local commuters to opt for these category passes instead of evading toll. Brief description of different ticket-types is given in table below.

3.31 Understanding the toll frequency gives insights into the nature of traffic. CJVs (Cars) generally have higher shares of return passes or monthly passes as the CJV users on Indian national highways tend to make shorter distance and more frequent trips. However heavy trucks mostly have single tickets since they travel long distance. This varies from asset to asset or even toll plaza to toll plaza. The asset catering to short distance local traffic generally observes high share of return or other local monthly passes while the asset catering to strategic long-distance traffic generally observes high share of single ticket traffic.

FASTag implementation

3.32 Generally, over the period the shares of single/return/monthly tickets tend to stabilise within 2-3 years from start of an asset operation. This is related to the stability of trip patterns are not expected to change significantly in absence of any major external events. During the last two years, two key events impacted the traffic patterns throughout the country: Covid19 and FASTag implementation.

3.33 With the FASTag implementation in December 2019, it was ensured that only FASTag users benefited from discounted tickets such as return/monthly and cash users were only allowed to buy single tickets, thus leading to a drastic increase in single ticket users between January 2020 till Feb- 2021. The removal of discounts for cash users and significant push by NHAI and toll plaza operators to promote use of FASTag has resulted in significant increase in %age transactions via FASTag. This in turn has resulted in ticket type use patterns have begun to return to their previous segmentation levels as observed prior to the FASTag implementation.

3.34 The following are the types of tickets are assumed to be sold at the plazas of both the Asset as per the concession agreement.

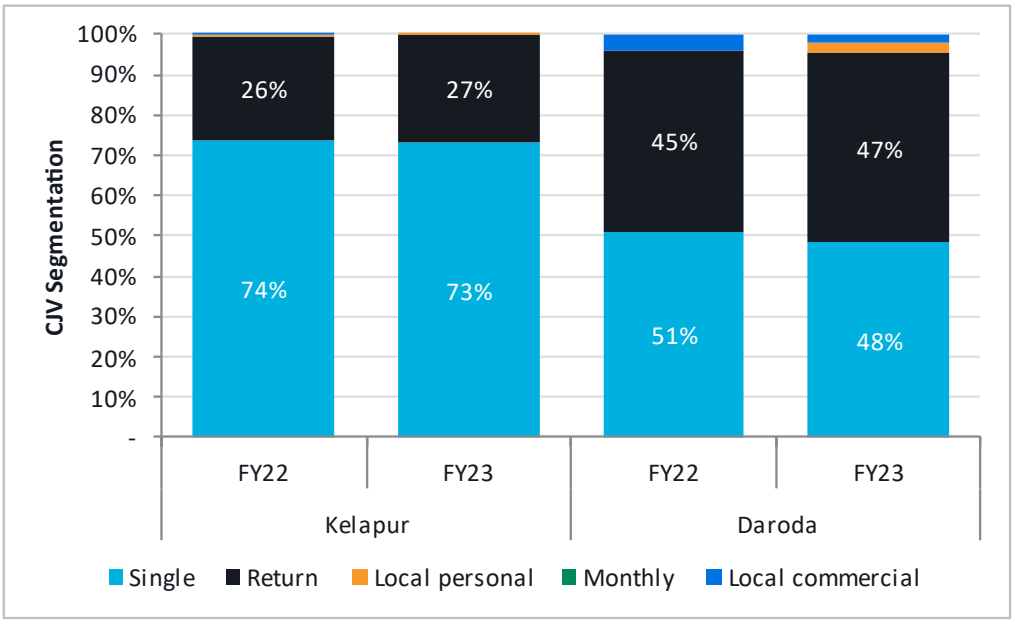
Table 3.4: Typical ticket types sold at NHAI plazas

Category	Description
Single	Allows the vehicle to cross the toll plaza once
Return	Daily pass for crossing the toll plaza multiple times within 24 hours. Charged 1.5 times the single toll
Monthly	Monthly pass
Local Personal	Discounted monthly pass only for private cars of residents within 20km radius of toll plaza
Local Commercial	50% discount on single trips for commercial vehicles registered in the local district
Exemptions	Officially exempted vehicles like ambulance, police cars, key political personnel etc.

Historical ticket segmentation

3.35 This section presents the toll segmentation used for Asset. As discussed in the earlier sections toll plaza data provided by the Client incudes traffic level at a ticket level for each of the transactions undertaken. The segmentation as per toll plaza data for 1st Apr'21– 27th Mar'23 is presented below for the Asset:

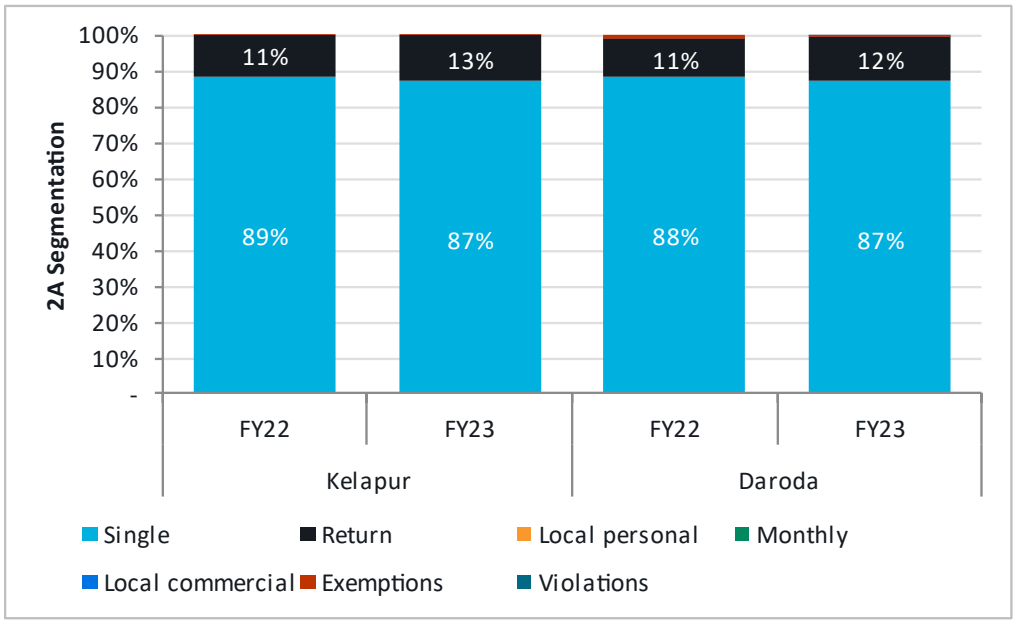
Figure 3.7: BK: Ticket segmentation (%) – CJV



Source: Steer analysis

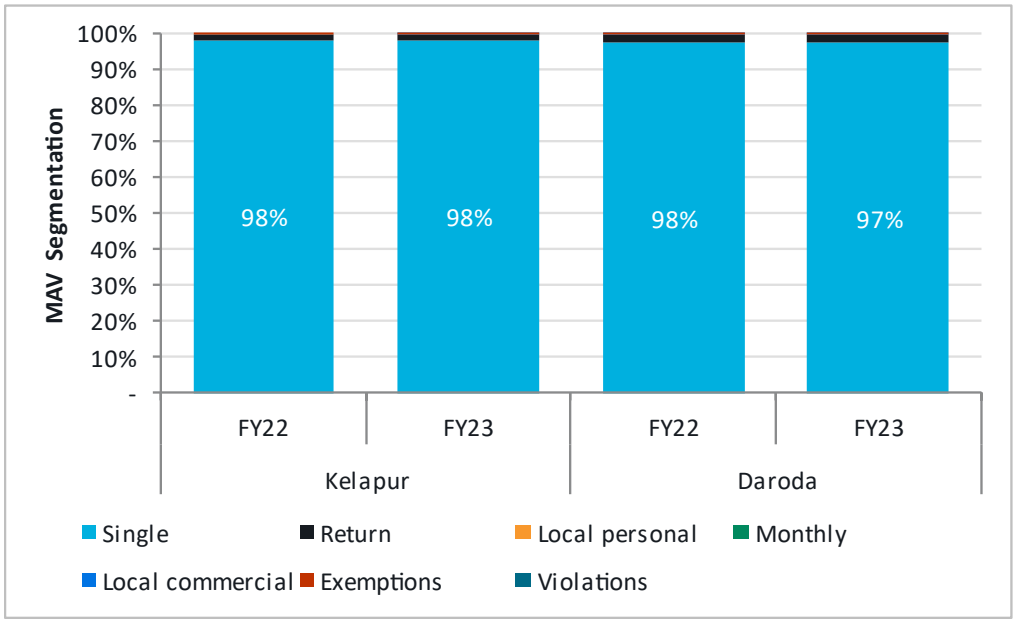
3.36 CJVs observe approximately equal split between single and return tickets on Darodha as the plaza caters to inter-urban movement influenced by Nagpur and sizeable split between single and return tickets at Kelapur given its proximity to Telangana. Due to presence of urban centres in the vicinity, CJV users presumably traverse more than one trip per day leading to high shares of return tickets.

Figure 3.8: BK: Ticket Segmentation (%) – 2A



Source: Steer analysis

Figure 3.9: BK: Ticket segmentation (%) – MAV



Source: Steer analysis

3.37 ~98% of the commercial vehicles (2A/3A/MAVs) plying on the Asset are observed to buy single tickets suggesting through-movement on the Asset. The observation is in line with the fact that the Asset is key connector for Delhi/NCR and Maharashtra/neighbouring zones and hence

caters to long-distance traffic. The same has been observed in the analysis of OD survey as well as trucks were seen to traverse an average distance more than 1000 kms. The Asset observed negligible level of exemptions and violations for trucks.

Conclusions – historical traffic and revenue analysis

3.38 The chapter outlined the current and historical traffic and revenue datasets available on the Asset, as well as our analysis of primary traffic count data, collected as a part of this project. Historical data records were obtained from several sources (PIU, ETC, DPR, etc.) and a review of all the sources was done to estimate the robust traffic and revenue numbers.

3.39 Multiple data sources including traffic data provided by the Client have been analysed and presented in detail in this chapter.

3.40 The analysis of these data sets confirms that the Asset carries high volumes of goods traffic which connect large urban centres and industrial clusters located in various parts of the country and facilitates long-distance strategic north-south movement.

3.41 Both traffic and revenue information are available for the toll plaza for a relatively short period. For the traffic data was available as reported in toll plaza (ETC+cash+violations/ exemptions) datasets. However, violations/ exemptions data was found to be unreliable for CJV and LCV, therefore, we have considered only ETC+cash for these two vehicle categories and entire data (ETC+cash+violations/ exemptions) for 2A, 3A, and MAV.

3.42 The Asset trends is trending at 20,500 PCU levels in FY23 with Darodha catering to slightly higher traffic volumes than Kelapur. Commercial volumes are similar across both the plazas as they cater to long-distance through movement. The traffic is dominated by 3A/MAVs. On an average, the daily revenue collection on the Asset is ~INR 45 lakhs.

3.43 Further, the Asset has observed strong traffic performance, recording a PCU CAGR of ~9.0% and ~6.5% at Darodha and Kelapur respectively in FY23 as compared to FY22N.

Survey data analysis

3.44 As mentioned earlier, to validate and inform various inputs used in our forecasting, we undertook primary data collection on the Asset, comprising the surveys listed below. OD survey data was collected on behalf of the Client, TVC surveys were commissioned by Steer with a third party. OD data collection typically involves manual data entry by enumerators based on oral surveys with road users crossing toll plazas, which Steer also commissioned with a third party. TVC data collection involves video-graphic capture of traffic passing crossing the toll plazas, followed by manual counting.

3.45 It should be noted that, in our experience, traffic on national highways shows variation across the week due to the economic activities surrounding each road. To derive a representative TVC count considering daily variation, three-day to seven-day traffic counts are generally recommended, and hence, in order to fully understand the impact of this weekly fluctuation on the Asset, we collected seven-day counts at each toll plaza.

3.46 Steer commissioned the following primary data collection at the Asset:

- 7-day 24-hour Traffic Volume Count (TVC)
- 24-hour Origin-Destination (OD) survey

3.47 This section presents the analysis of the primary data collected and its use thereof.

Key findings of the TVC data analysis

WADT estimates

3.48 As mentioned earlier, camera based Total Vehicle Counts (TVC) forms a key part of our primary data collection exercise. Using the TVC data and taking a simple average of the seven-day TVC counts, we obtained the Weekly Average Daily Traffic (WADT) for each toll plaza. The WADT excludes non-tollable vehicle such as tractors, two-wheelers, bullock-carts, etc., but includes officially exempt vehicles such as police cars, ambulances, emergency response vehicle, government vehicle and other vehicle types officially allowed as 'exempted' under the concession agreement.

3.49 During the site visits, our team makes sure that the cameras are located at a location where complete tollable traffic is captured. Additionally, emphasis is laid on positioning camera at such a location that the traffic from local leakages or bypass is also captured, if any.

3.50 In order to check the reliance of the TVC data, several checks are applied before using it in our analysis. Directional counts are verified by matching the sum of both the directions with the total counts. Our TVC data is directly used for validating our base year AADT and benchmarked with respect to traffic volumes on the sections in close vicinity of the Asset (discussed in Chapter 6).

3.51 The table below present the 7-day average (WADT) of independent counts undertaken by Steer.

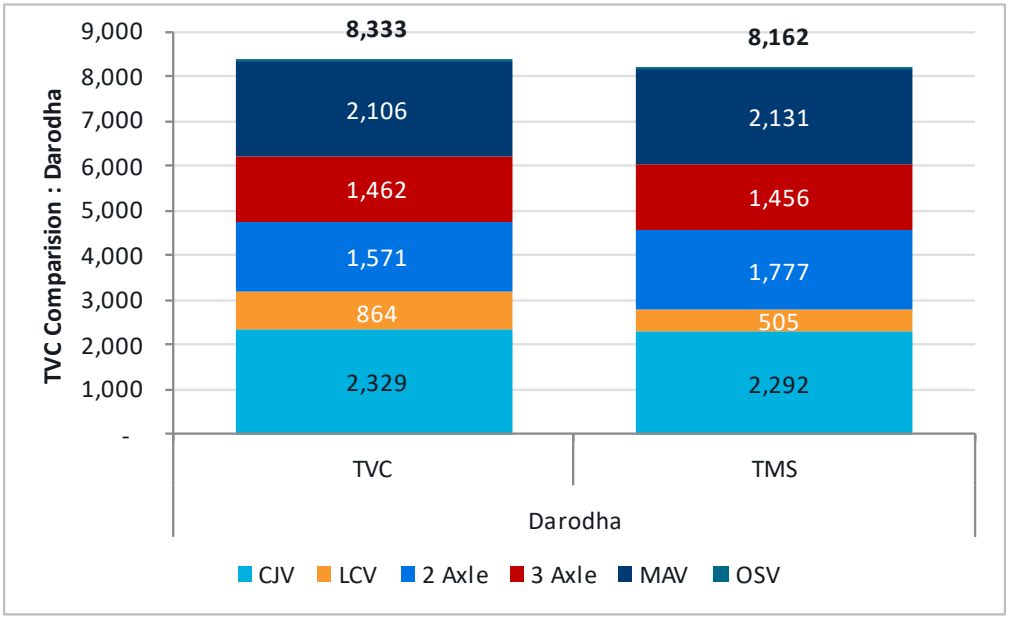
Table 3.5: WADT at Asset arrived using TVC

Vehicle Category	BK: Darodha	BK: Kelapur
CJV	2,329	1,968
LCV	864	794
2 Axle	1,571	1,729
3 Axle	1,462	1,495
MAV	2,106	2,233
OSV	2	1
Total	**8,333**	**8,221**

Source: Steer analysis of TVC data

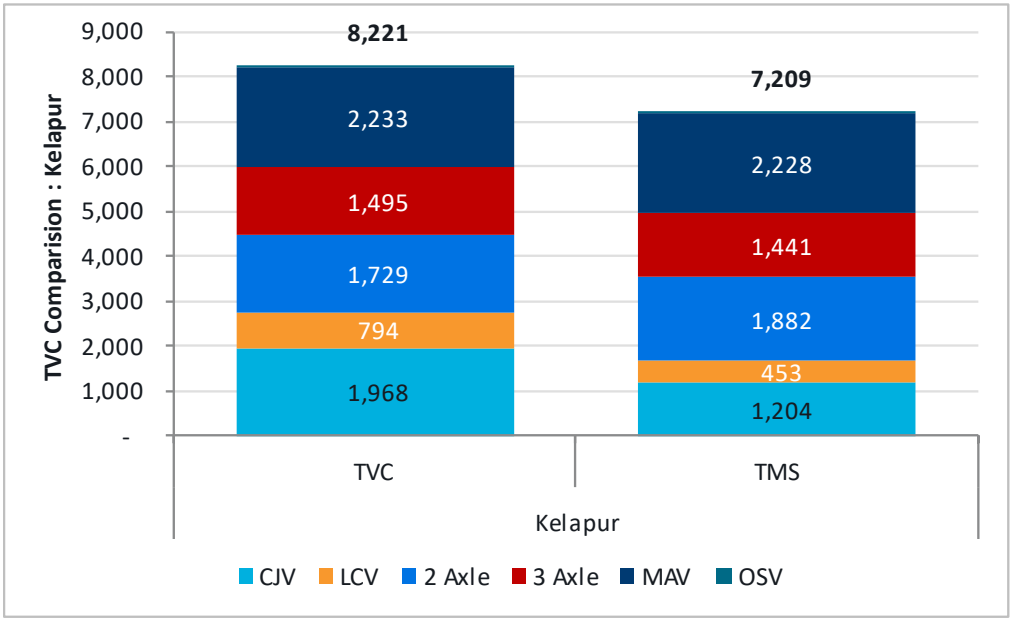
3.52 The figure below compares the vehicle wise shares as recorded by TVC.

Figure 3.10: BK Darodha: Vehicle TVC comparison



Source: Steer analysis of TVC counts, and TMS data

Figure 3.11: BK Kelapur: Vehicle TVC comparison

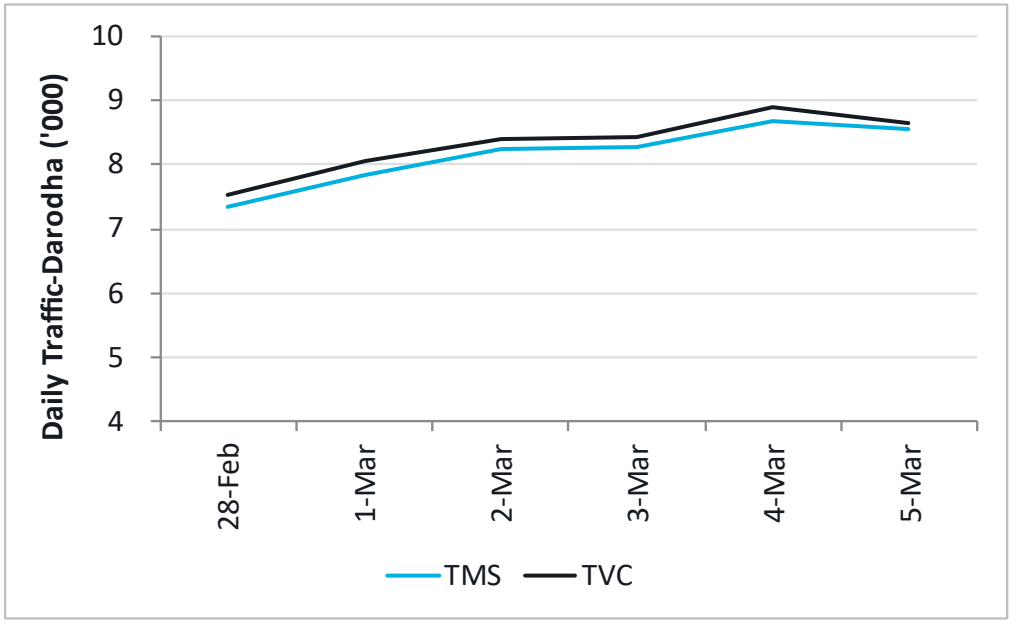


Source: Steer analysis of TVC counts, and TMS data

3.53 The TVC counts conducted in the month of Mar-23 were observed to be 8,333 WADT at Darodha, and 8,221 WADT at Kelapur. Moreover, the Asset was dominated by the traffic shares of CJVs followed by MAVs.

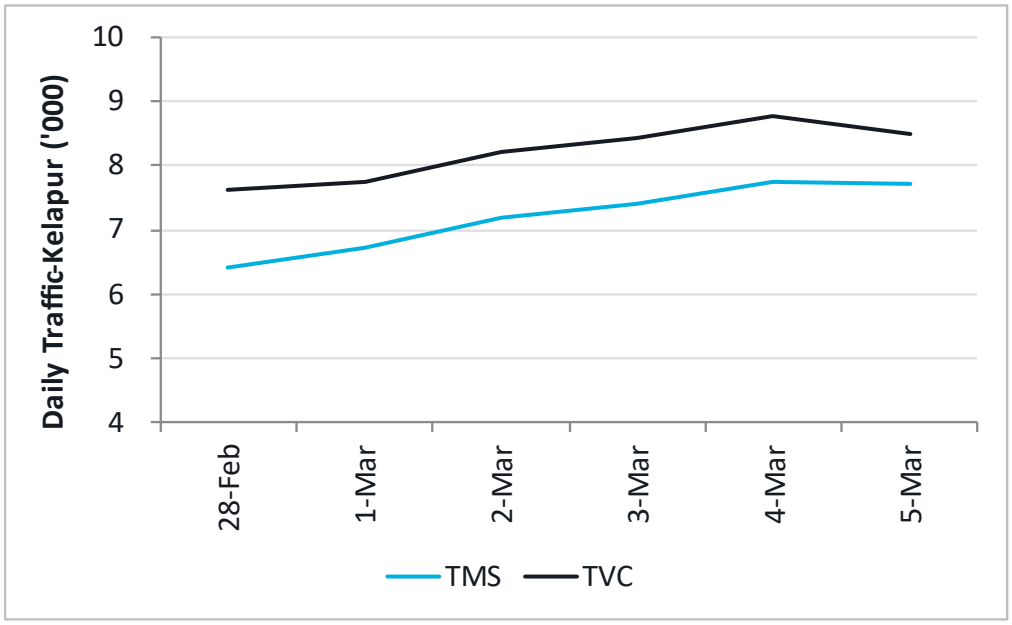
3.54 The following figure shows the daily traffic observed in our TVC-TMS counts for the toll plaza.

Figure 3.12: BK Darodha – Daily Traffic Counts



Source: Steer analysis of TVC counts, and TMS data

Figure 3.13: BK Kelapur – Daily Traffic Counts



Source: Steer analysis of TVC counts, and TMS (ETC only) data, cash data not available

3.55 TVC and TMS (ETC only) traffic data on the Asset follows similar trend on all days for Darodha, whereas for Kelapur, the difference in the two sources is much higher, which is due to some vehicles which pay in cash or are not paying at the toll plaza. This can be attributed to the fact the exemptions/violations aren't recorded on Kelpaur plaza.

3.56 On an overall level, Steer independent TVC has reported higher traffic volumes than the TMS data. The difference is primarily observed in CJV's 2As and LCVs. The trend is similar across all days, the difference in the two sources may be due to some vehicles which pay in cash or are not paying at the toll plaza.

3.57 TVC counts report lesser 2As, but higher LCVs as compared to TMS counts. This could be due to the error in categorization of LCVs and 2As post FASTag implementation. On the whole, TVC reports higher LCV+Bus+2A traffic which can be attributed to the fact that a share of this traffic crosses the plaza without paying and hence isn't getting recorded. The same is the reason for additional CJVs being counted in TVC counts. 3A+MAV traffic levels are similar in both the counts.

Outputs from TVC analysis

3.58 We have further analysed the TVC and TMS data at vehicular category level to ascertain the following outputs:

- **Base Correction:** As observed in the TVC-TMS analysis, the volume of traffic in CJV, LCV, and 2A categories saw a difference in the counts. While estimating the base, these differences were accounted for in the form of 'base correction factors'. The base correction factor is the % delta between TVC and toll plaza data counts (TMS) for each vehicle category. The delta is added on the base traffic of FY23 to account for the unreported traffic is crossing the plaza without paying. It is observed that the violations/exemptions historically have been around 300 MADT Units for CJV. Accordingly, the BCF is computed as 300/Base FY 23 AADT For CJV. The percentage of delta for 3A/MAVs is not being incorporated as the negligible delta can be attributed to the reconciliation of traffic numbers with the data received from the bank**.**
  This adjustment was necessary to understand the capacity at which the Asset is operating.

Table 3.6: Base Correction Factors

Vehicle Category	Darodha	Kelapur
CJV	18.5%	83.2%
LCV	7.8%	9.2%
2A	7.8%	9.2%

Source: Steer analysis of TVC/TMS data

- **Exemption adjustment:** The additional traffic being added to the base of our forecasts, as mentioned in the previous paragraph, is being treated as 'non-paying' traffic as the traffic isn't getting reported in the TMS counts as provided by the Client. Hence, in the ticket segmentation, the additional traffic in the corrected base traffic is assumed to be unreported 'exemptions'.
- **Traffic splits:** TVC WADT of each plaza was considered to derive the traffic splits for CJV, Mini LCV and Bus,2A as the split is not present in the data we have received. It is summarized for both the toll plazas in the table below:

Table 3.7: Traffic splits from TVC analysis

Vehicle Category	Darodha	Kelapur
CJV	69.6%	71.1%
Mini LCV	30.4%	28.9%

Source: Steer analysis of TVC/TMS data

Vehicle Category	Darodha	Kelapur
Bus	12.9%	15%

Vehicle Category	Darodha	Kelapur
2A	87.1%	85%

Source: Steer analysis of TVC/TMS data

The above traffic splits are applied back to TMS data prior to using it for arriving at base year estimates.

- **Kelapur (new) base traffic:** Steer TVC counts were conducted at the proposed new location of the Kelapur toll plaza, which is about 6 kms south of the existing location. The TVC-TMS analysis for the new location observed an adjustment in the base numbers of Kelapur toll plaza by (8.2%) in 3As and (0.6%) in MAVs to estimate the base position for Kelapur's new location. This is also explained in more detail in the later sections.

Table 3.8: Kelapur existing vs new TVC

	3A	MAV
Kelapur (existing)	1,476	2,253
Kelapur (new)	1,356	2,240
Delta	(8.2%)	(0.6%)

Source: Steer analysis of TVC data

Key findings of origin-destination analysis

Overview

3.71 OD surveys were conducted using on the toll plaza locations across the Asset, interviews for 24 hours at the toll location, typically starting at 8 AM and finishing at same time on the following day. The interviews began on 1st Mar'23on the Darodha toll plaza and on 2nd Mar'23 on the Kelapur Toll Plaza. Each toll lane had an interviewer filling OD records with supervisor monitoring them to minimise errors in data collected. This was accompanied by Steer staff visiting the toll plaza to ensure the data is being collected to quality and standards required to understand the traffic patterns on the Asset.

3.72 Data collected was segregated into vehicle types, origin area, origin zone, destination area, destination zones, commodity being carried, total load, and frequency of travel. The zones were further segmented into Internal, Rest of State, and External zones. The zones were also used to calculate the trip distances of the traffic plying on the Asset.

3.73 Before using the data for final analysis, the data is first cleaned, and numerous checks are applied. Some of these checks include verifying that the zones are physically apart as well as these zones are located within a reasonable distance and boundary. Reliability checks are also used which confirms that the sample rates are 30-50% for passenger and 50-70% for goods. Sanity checks includes verifying the sanctity of direction wise origin and destination as well as establishing that the share of empty vehicles is in line with the site visit observations (not more than 50% in any case). The final check includes matching the OD numbers with the TVC counts of the particular day and substantiating that the OD numbers aren't greater than the TVC counts.

3.74 Origin-destination (OD) analysis enables the understanding of the nature of traffic movement on the Asset. We have analysed the regional drivers of demand based on the following analysis:

- Zonal influence
- Commodity distribution
- Top OD pairs
- Trip length distribution

3.75 While zonal analysis and the list of top OD pairs help to understand 'where' people and goods travel, commodity distribution sheds light on 'what' goods get transported on this asset. Trip length distribution shows 'how far' vehicles and people travel, and goods get transported. This set of analysis is used to estimate key drivers of traffic and aid in making informed forecasting assumptions related to traffic demand elasticities, growth drivers and exogenous impacts.

Sample rates

3.76 Sample rates help understand the reliability of OD data. They are calculated by dividing OD samples by the TVC count observed on the same date for each vehicle category at the toll plaza. The table below presents the sample rates for key vehicle type aggregations at the toll plaza. We believe that the sample rates of the OD data are reasonable for the analysis required.

Table 3.9: Sample rates for OD data

Vehicle type	Darodha	Kelapur
CJV + MLCV	51%	29%
LCV	76%	26%
Bus + 2 Axle	75%	58%
3 Axle + MAV	89%	58%

Source: Steer analysis of OD data

3.77 Sample rates achieved on goods vehicles (Bus/2A and above) are very good and more than 50% in all categories. CJV users are traditionally difficult to interview primarily because their waiting times have reduced significantly due to FASTag implementation, and they are also reluctant to answer questions due to Covid19 related concerns.

Zone categories

3.78 To facilitate better interpretation of key regional drivers of traffic as determined by their OD zones, and influenced by various towns, cities, states, and regions in the vicinity of the Asset, we have aggregated zonal data as described in the table below.

Table 3.10: Zone aggregations for zonal influence analysis, BK

Aggregate Zone	Description
Local	Local zones are those that fall on or very close to the Asset.
IAOI	IAOI zones are the locations which generate traffic and lie within approximately 75-150 km distance from the Asset.
Rest of Telangana	Rest of the cities/Districts in the state that Asset lies in (other than Local/IAOI)

Aggregate Zone	Description
Rest of Maharashtra	Rest of the cities/Districts in the state that Asset lies in (other than Local/IAOI)
NCT Delhi	National Capital Territory of Delhi
Haryana	Haryana state
Madhya Pradesh	Madhya Pradesh state
Rajasthan	Rajasthan state
Maharashtra	Maharashtra state
Gujarat	Gujarat state
North India	Himachal Pradesh, Jammu and Kashmir, Punjab, Uttarakhand.
South India	Andhra Pradesh, Kerala, Tamil Nadu, Telangana, Karnataka
East India	Bihar, West Bengal, Arunachala Pradesh, Assam, Bihar, Jharkhand, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Tripura, Sikkim, Chhattisgarh
Outside India	Nepal, Bangladesh, Bhutan

Source: Steer analysis

Zonal influence

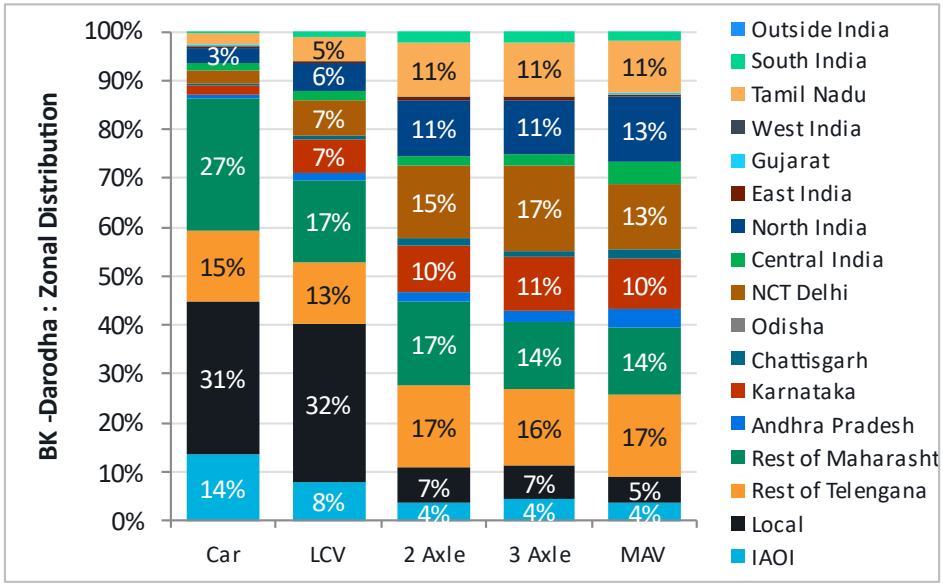
3.79 As the Asset is located on Maharashtra-Telangana border, the states influence 30%-40% of the truck trips on the Asset. Considerable share of influence is observed of Karnataka, Tamil Nadu, Delhi NCT, and northern Indian states since these zones are connected by the project highway NH44. The long-distance nature of trucks is validated by the zonal influence analysis as the trips are majorly influenced by southern and northern states of the country suggesting through movement on the Asset.

3.80 Car and bus trips are generally focused on catering to the local demands of the users and hence, the influence is dominated by local and rest of state movements. The local movement is typically observed between Hinganghat, Wadner, Badki, and Nagpur.

3.81 As both the plazas cater to the same movement of traffic, the zonal influence is also similar.

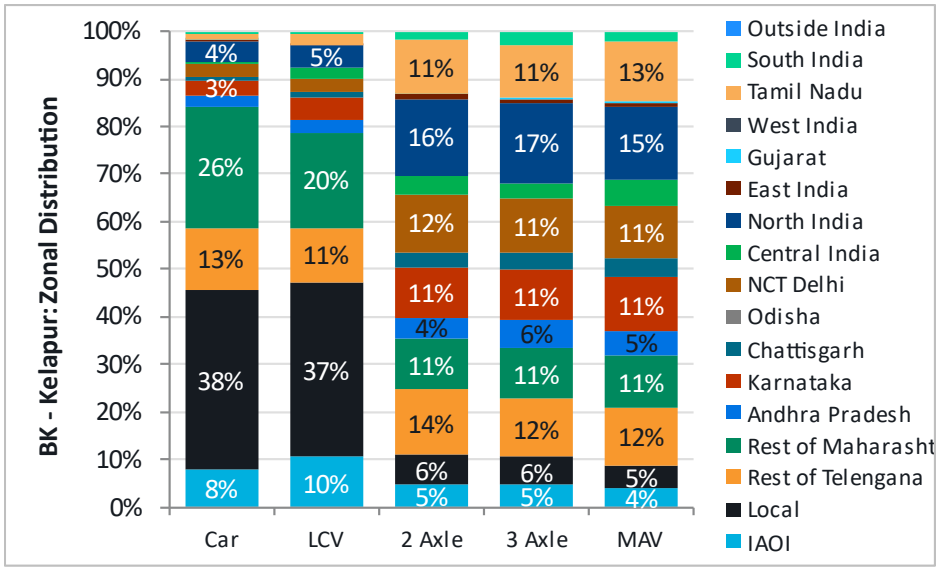
3.82 In comparison to the zonal influence observed based on the OD surveys (undertaken as part of earlier study in Aug-22), we found that the zonal influence largely remains unchanged, except for CJV, where the proposition of local trips has reduced, compensated by corresponding increase in trips to IAOI/ Rest of Maharashtra/ Telangana. Further, details are provided in Appendix-B.

Figure 3.14: BK Darodha: Zonal Distribution



Source: Steer analysis of OD data

Figure 3.9: BK Kelapur: Zonal Distribution

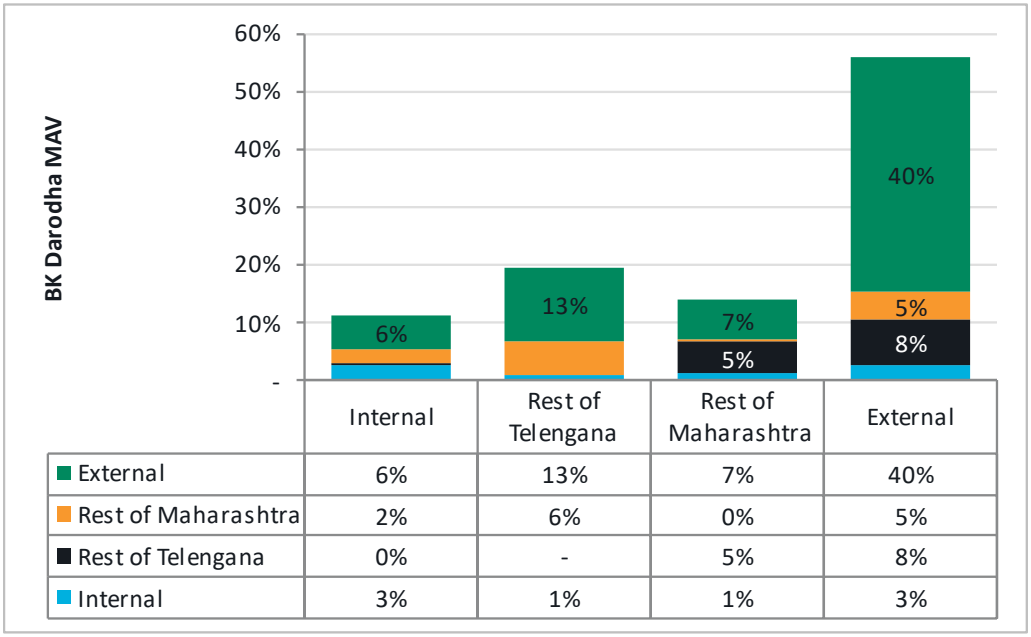


Source: Steer analysis of OD data

Internal External analysis

3.83 Internal-External analysis helps in identifying the trips which have both an origin and destination on or near the Asset i.e., local/IAOI zones (Internal-Internal or I-I), any one end on the Asset (Internal-External or I-E), or neither end on the Asset i.e., through trips (External-External or E-E). RoS here represents areas within the state which are neither local nor IAOI. 'Internal' zones are those that were analysed as 'local' and 'IAOI' in the zonal influence analysis, i.e., lying on the Asset, while 'External' zones are areas lying outside the state.

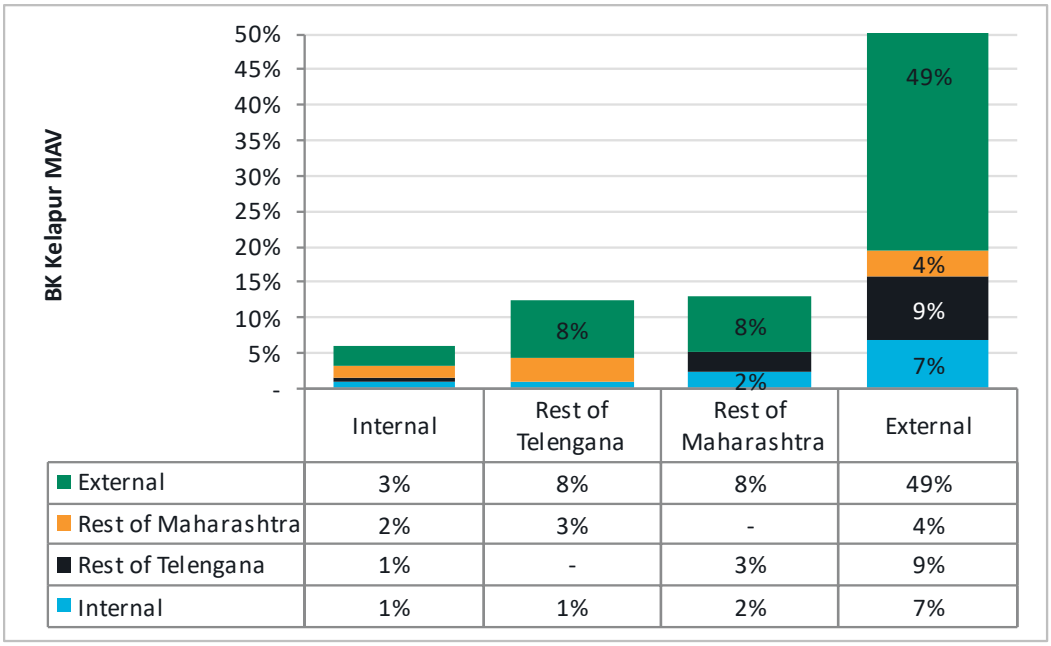
Figure 3.15: BK Darodha: Internal-External analysis



	Internal	Rest of Telengana	Rest of Maharashtra	External
External	6%	13%	7%	40%
Rest of Maharashtra	2%	6%	0%	5%
Rest of Telengana	0%	-	5%	8%
Internal	3%	1%	1%	3%

Source: Steer analysis of OD data

Figure 3.16: BK Kelapur: Internal-External Analysis



	Internal	Rest of Telengana	Rest of Maharashtra	External
External	3%	8%	8%	49%
Rest of Maharashtra	2%	3%	-	4%
Rest of Telengana	1%	-	3%	9%
Internal	1%	1%	2%	7%

Source: Steer analysis of OD data

3.84 Given strategic nature of the Asset, facilitating North-South movement across NH44, the zonal influence shows movements between Northern and Central India and southern states of the country like Haryana, Punjab, Delhi NCR, Telangana, Maharashtra, Karnataka, and Tamil Nadu

3.85 The internal-external distribution further validates the strategic nature of the Asset, with 65-70% influence pertaining to zones that are external. This is further to the zonal distribution that showed that Local and Rest of the State had relatively less influence on 2A/3A/MAVs on the Asset, while aggregate of the remaining zones categorized as External exert the significant

proportion of influence on the traffic. This validates that the long-distance nature of the Asset, facilitating long distance through movement—that is trips that originate and end outside of Maharashtra, traversing via the Asset.

3.86 Since the Asset is located on Maharashtra – Telangana border, the remaining trips are influenced by zones present in the mentioned states.

Commodity distribution

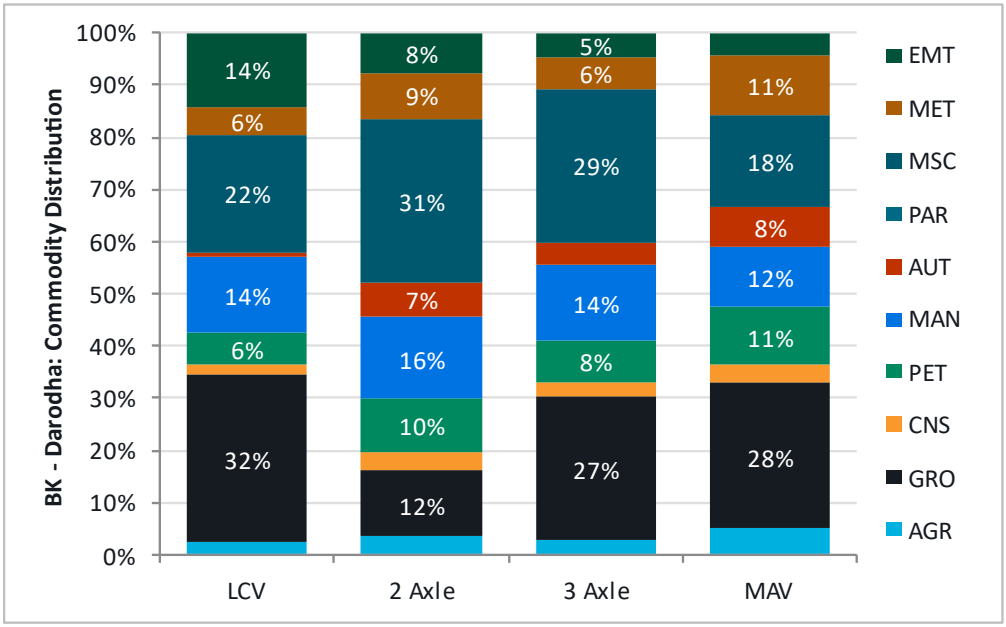
3.87 We have grouped various commodities into aggregate categories for ease of interpretation, as shown in the table below. The charts in the following sub-section present information in terms of aggregate commodity categories.

Table 3.11: Aggregate commodity categories

Commodity Description	Code	Combined codes used for charts
Agricultural Products / Cash crops (Wheat, Rice, Sugar cane, Maize etc.)	AGR	AGR
Perishable Items (Fruits, vegetables, milk, meat, fish etc.)	PER	
Cattle Food / Livestock (sheep, goat, cow, cattle food etc)	LIV	
Building Material / Construction (Cement, Lime, Brick etc)	CNS	CNS
Container	CTR	CTR
Empty	EMT	EMT
Groceries / Food items (Soap, Salt, Sugar, Pulses, Spices, Biscuits, bread, cool drinks, beer etc.)	GRO	GRO
Machinery / Spare parts	MAC	MAC
Steel / Metal (Iron, steel etc)	STL	MAN
Chemicals / Fertilizers (Acids, Fertilizers etc.)	CHM	
Manufacturing (Electronic items, Medicine, Leather, Wine, Rubber/ Tyre, Plastics, Cloth, Paper etc.)	MAN	
Automobiles (Finished products)	AUT	
Basic / Fabricated Metals (steel, iron)	MET	
Raw Wood, Cork & Wood Products, Fern	WUD	
Mining Minerals (Coal, Gypsum, Cobalt etc.)	MIN	MIN
Miscellaneous (Parcel, Courier, Household items etc.)	MSC	MSC
Passengers	PAS	
Petroleum Products (Oil, LPG, CNG, etc.)	PET	PET
Sand	SND	SND
Stone (Kota stone, marble, Granite, Aggregate stone etc.)	STN	STN
Cement	CMT	CMT

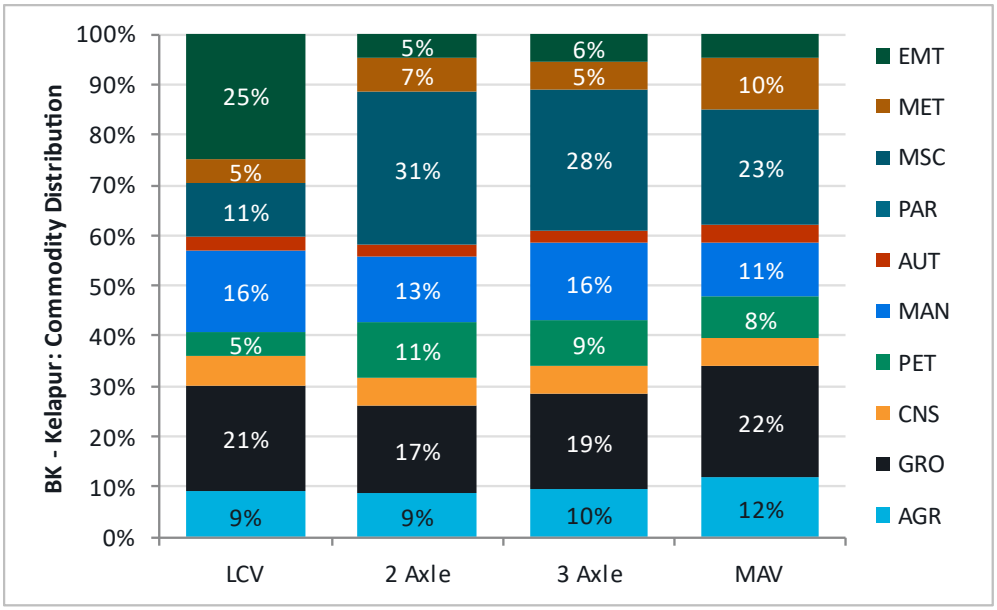
Source: Steer Analysis

Figure 3.17: BK Darodha: Commodity Distribution



Source: Steer OD analysis

Figure 3.18: BK Kelapur: Commodity Distribution



Source: Steer OD analysis

3.88 The commodities carried on the Asset are majorly groceries, miscellaneous goods, manufacturing. Miscellaneous goods (generally parcels and couriers) and groceries are being carried from warehouses in Delhi NCR, Agra, Nagpur to the zones connected by NH44. As mentioned earlier, presence of industrial hubs near the Asset (Yawatmal, Butibori) as well as along NH44 introduces manufacturing and metal related commodities on the Asset.

3.89 Direction wise commodity splits are given below:

Table 3.12: Directional commodity distribution – BK Darodha: Direction-wise commodity distribution

Nagpur to Hyderabad					Hyderabad to Nagpur			
LCV	2 Axle	3 Axle	MAV	Commodity	LCV	2 Axle	3 Axle	MAV
3.2%	4.0%	3.2%	6.8%	Agriculture	1.4%	3.1%	2.1%	2.5%
36.2%	13.7%	29.0%	29.5%	Groceries	26.5%	10.6%	25.5%	26.0%
1.9%	3.0%	3.5%	3.1%	Construction	1.6%	4.5%	2.2%	3.7%
5.3%	12.9%	9.5%	14.2%	Petroleum & Chemicals	7.2%	6.4%	5.8%	7.0%
7.4%	13.3%	13.7%	11.1%	Manufacturing	24.7%	18.9%	15.4%	12.3%
1.3%	7.2%	4.8%	6.0%	Automobiles	0.5%	6.1%	3.9%	9.8%
22.3%	30.7%	26.6%	13.6%	Miscellaneous	22.1%	32.0%	33.0%	23.1%
6.8%	8.7%	4.6%	11.2%	Metals (Steel/Iron etc.)	4.2%	8.9%	7.7%	11.5%
15.6%	6.5%	5.1%	4.5%	Empty	11.9%	9.5%	4.5%	4.2%

Source: Steer Analysis of OD Data

Table 3.13: Directional commodity distribution – BK Kelapur: Direction-wise commodity distribution

Nagpur to Hyderabad					Hyderabad to Nagpur			
LCV	2 Axle	3 Axle	MAV	Commodity	LCV	2 Axle	3 Axle	MAV
12.6%	11.0%	10.1%	19.5%	Agriculture	3.5%	7.2%	9.1%	6.8%
27.4%	10.1%	18.6%	22.9%	Groceries	11.8%	22.8%	19.2%	21.7%
9.4%	6.3%	6.4%	8.2%	Construction	0.7%	5.0%	5.0%	3.7%
4.9%	6.6%	8.3%	8.7%	Petroleum & Chemicals	4.2%	14.7%	9.5%	8.0%
5.4%	12.9%	15.1%	9.6%	Manufacturing	32.6%	13.0%	15.9%	11.9%
2.2%	2.7%	3.4%	4.0%	Automobiles	3.5%	1.7%	1.5%	2.9%
9.4%	39.2%	26.6%	14.4%	Miscellaneous	12.5%	24.0%	29.1%	28.7%
5.8%	4.1%	5.0%	8.4%	Metals (Steel/Iron etc.)	3.5%	8.5%	5.8%	11.6%
22.9%	7.1%	6.4%	4.4%	Empty	27.8%	3.1%	5.0%	4.8%

Source: Steer Analysis of OD Data

3.90 The direction wise distribution of commodities for each vehicle types helps to gauge a better understanding of the distribution as per the direction of goods movement. The profile of commodities being carried in both the directions is overall is somewhat similar.

3.91 The commodity distribution has largely remained unchanged (except some increase in proportion of construction commodities) based on the comparison of OD surveys from this and earlier study (Aug-22). The commodity share of Automobiles has decreased by over 20% for trucks at both Darodha and Kelapur in our current OD. The decrease is observed also for MAVs at Kelapur. This is because the growth in automobile industry was higher in Q2 FY23 vs now. Further, details are provided in Appendix-B.

3.92 For MAVs, there is a small change in the proportion of groceries, which could be attributed to difference in survey dates/ periods.

Trip length analysis

3.93 Trip-length distribution provides the distance-based profile of various vehicle categories. This aids in validating assumptions around the share of macro-economic drivers, inputs from zonal influence and toll segmentation. For ease of interpretation, we have categorised distances into 4 groups – local and short distance (0-250km), medium-distance (250-500 km), long-distance (500-1000 km) and very-long-distance (+1,000 km). The trip distances were derived as driving distances from Google Distance Matrix Tool based on zonal coordinates for OD pairs.[2]

3.94 The following table states the average trip lengths of traffic plying on the Asset across the toll plazas.

Table 3.14: Average trip lengths (Kms)

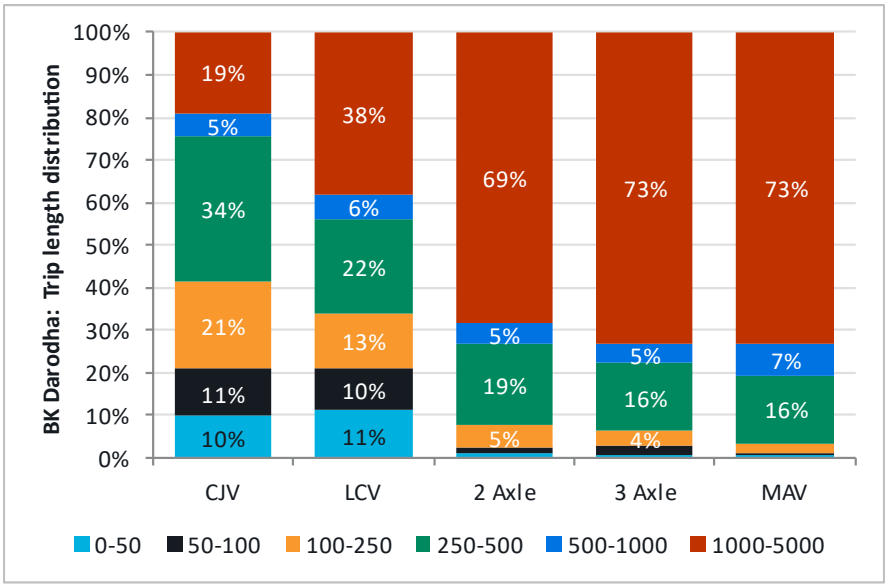
	CJV	LCV	2 Axle	3 Axle	MAV
BK Darodha	515	1,011	1,346	1,436	1,410
BK Kelapur	567	819	1,489	1,499	1,484

Source: Steer analysis of OD data

3.95 As discussed in the above sections, the Asset caters to the demands of long-distance strategic movements of mainly north – south movements. The same is validated by the average trip lengths observed in the table above where 2A/3A/MAV trucks are travelling nearly 1,500 kms per trip.

3.96 The trip length proportions for each vehicle type for each of the toll plaza is shown below.

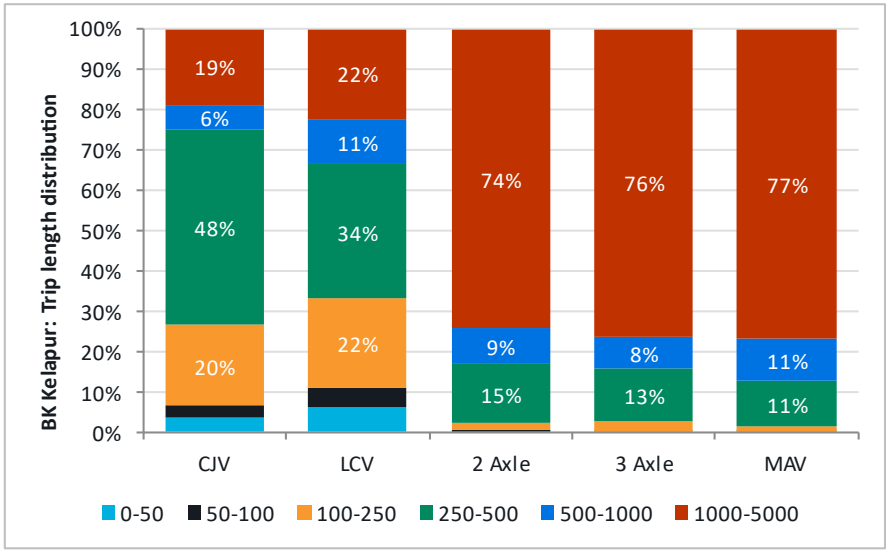
Figure 3.19: BK Darodha: Trip length distribution



Source: Steer analysis of OD data

[2] Google Distance API is a tool that is available on a chargeable basis from Google Maps Platform. Link: https://developers.google.com/maps/documentation/distance-matrix/start. Travel distance and time information for driving/transit under various congestion scenarios can be extracted through this tool by using macro-enabled Excel, R, etc.

Figure 3.20: BK Kelapur: Trip length distribution



Source: Steer analysis of OD data

3.97 Due to the strategic nature of this Asset, over 70% of the trip distances of 2 Axle, 3 Axle and MAV are traveling distances greater than 1,000 km. LCVs, also serving more local areas have a healthy mix of both short and long-distance trips.

3.98 The Asset acts as a facilitator between northern and southern India, connecting Haryana, Punjab, and Delhi NCR to states such as Telangana, Maharashtra, Karnataka and Tamil Nadu. Both Darodha and Kelapur exhibit similar traffic profiles, which observes more than 70% of the truck traffic traversing greater than 1000kms. External trips, which are long-distance trips, show origin/destination points near Delhi, Rajasthan, Uttar Pradesh in the north and Bangalore, Chennai, Hyderabad in the south.

3.99 As seen in the commodity distribution, these long-distance movements form a part of the through traffic on the asset which meets demand requirements of manufacturing, agriculture, and miscellaneous goods.

Conclusions – primary surveys

3.100 The chapter outlined the current and historical traffic and revenue datasets available on the Asset, as well as our analysis of primary traffic count data, collected as a part of this project. Historical data records were obtained from several sources and a review of all the sources was done to estimate the robust traffic and revenue numbers.

3.101 Steer survey results Asset have been analysed and presented in detail in this chapter. Independent TVC counts and OD surveys were undertaken by Steer to understand the primary traffic movements on each of the Asset. The analysis of these data sets confirms that the Asset carries high volumes of goods traffic which connect large urban centres and industrial clusters located in various parts of the country.

3.102 The analysis of the available data sets confirms that the Asset carries high volumes of goods traffic which connect large urban centres and industrial clusters located in various parts of the country, mainly moving along the corridor of NH-44 from north to south. In addition to role as national connector, the Asset provides important regional connectivity between neighbouring states i.e., Maharashtra and Telangana.

3.103 Key takeaways from the data analysis obtained from primary and secondary sources are:

- The strategic nature of traffic on the Asset was validated by the zonal distribution of the OD analysis as for MAVs, more than 80% of influence was from the states connected via NH44. The same was confirmed by the internal-external analysis too as the Asset was dominated by the share of External trips and hence, suggesting the presence of through traffic. In line with these observations, the trip length analysis saw that 3As and MAVs cover more than 1,300 kms per trip.
- The Asset observed a considerable share of agricultural and grocery-related commodities being transported. Furthermore, miscellaneous goods (parcels and couriers) also hold a considerable share as they are transported from the warehouses in the neighbouring states, along the strategic corridor of the Asset, towards the other states of the country. Other commodities observed on the Asset were manufacturing, metals, and automobile goods.
- Steer TVC counts when compared to the TMS data on the overlapping dates observed a difference in the traffic volumes for CJVs, LCVs and 2As. This difference can be attributed to relatively lower efficiency in reporting and management since the Asset is currently under an OMT contract.
- To account for the delta, we found in the TVC-TMS analysis, the observed unreported vehicle traffic has been added as 'Exemptions' during the calculation of our base position. This is necessary to identify the true traffic currently moving on the toll plazas. The same has been explained in detail in later sections.

4 Socio Economic Context

Introduction

4.1 The growth of traffic on existing (brownfield) roads depends on, firstly, how quickly the background travel demand grows (background growth); and secondly, how successful the Asset is in attracting that traffic (traffic capture). Background travel demand is driven by the socio-economic conditions of the region where the Asset is located and conditions at a national level. These include:

- Changes in macro-economic factors such as population, economic growth (regional and national) and industrial production; and
- Other local factors such as strategic port growth, and growth of industries in the vicinity of the Asset.

4.2 The change in the competitive position of the Asset (and thus of the traffic capture it will achieve) derives from the level of service and associated cost on the Asset in comparison to competing roads; and whether any new competing road facilities are available.

4.3 In this chapter, we assess the socio-economic indicators relevant to traffic growth on the Asset. The relevant growth drivers where reliable information was available have been selected for establishing growth trends in the traffic forecasts.

Population growth

National Level

4.4 The total population in India has grown at a Compound Annual Growth Rate (CAGR) of 1.5% since 2000, and have been showing decreasing trends over the years, as presented in the table below. The World Bank forecasts this growth to decrease to 0.6% CAGR by the 2030-45 period.

Table 4.1: CAGR of population in India

Years	CAGR		
	Total Population (m)	Rural Population (m)	Urban Population (m)
1970 - 1985	2.3%	1.9%	3.8%
1985 - 2000	2.0%	1.7%	2.9%
2000 - 2015	1.5%	1.0%	2.6%
2015 – 2030*	1.0%	0.3%	2.3%
2030 – 2045*	0.6%	-0.3%	1.9%

Source: World Bank Data on Health Nutrition and Population Statistics, *forecast population growth

4.5 The Asset lies in the state of Maharashtra. Maharashtra represents 9.3% of India's population, with the total state population of 112 million (2011 Census).

4.6 The growth rate of urban population in Maharashtra have been consistently higher than that of the national population estimates with urban population proportion being 31% for India and 45% for Maharashtra.

4.7 The table below shows population evolution in Maharashtra compared to that of the country.

Table 4.2: Population Growth in India (2001 – 2011)

State	2001 Population (m)			2011 Population (m)			CAGR (2001 – 2011)		
	Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban
Maharashtra	96.9	55.8	41.1	112.4	61.6	50.8	1.5%	1.0%	2.1%
India	1,028.7	742.6	286.1	1,210.9	833.7	377.1	1.6%	1.2%	2.8%

Source: Census 2011 Data

4.8 However, due to complexities in urbanisation trends, and the dynamic nature of local population migration (which are very difficult to forecast), we do not use population growth as a proxy for understanding future travel demand growth on the Asset. It has been included in this section to provide the overall context of the region in which the Assets are located.

Economic Indicators

GDP and GSDP Growth

4.9 The Indian economy has grown at a CAGR of 6.6% during FY12-20, aided by a strong growth in the services/tertiary sector. Maharashtra's (GSDP)[3] has been very similar to the India's GDP. Maharashtra approximately contributes 14% to the India's GDP. In terms of per capita income, Maharashtra higher per capita income than the country.

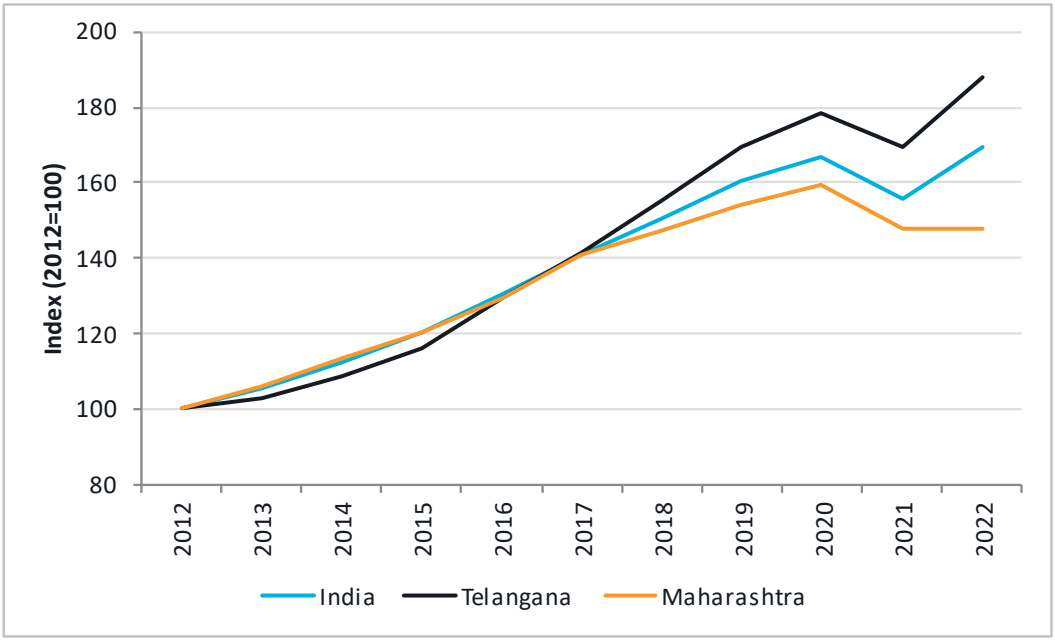
4.10 In the past decades, the state of Maharashtra has followed the same economic growth trend as observed at the national level. It is one of the most industrialised states and the financial capital of India-Mumbai is its state capital. Some of the other key cities which contribute towards the state's growth are Pune, Nasik, Aurangabad, Solapur, Kolhapur, and Nagpur. Of the 13 major ports in India, two major ports lie in the state, the largest container port of India, the Jawaharlal Nehru Port Trust (JNPT) and Mumbai Port along with 40+ minor ports. In terms of sectoral contribution, the services sector is the biggest contributor (61%), followed by secondary (26%) and primary sector (13%). The state has good presence of industrial clusters, especially in IT sector, automobile, gems and jewellery, textiles, chemicals, and heavy engineering industries along with agro-based and fishing sector. It is also the biggest onion, pomegranate and cotton producing state in the country.

4.11 Some of the key industrial clusters in the state are in Aurangabad (engineering and gems and jewellery), Mumbai (electronic and gems and jewellery), Nanded (chemicals and pharmaceuticals) and Pune (IT engineering and automobiles).

4.12 Maharashtra's GSDP CAGR was 6.6% between FY12-20 and its relative share to the national GDP was around 14% in FY20, highest amongst all the states.

[3] GSDP is the Gross State Domestic Product i.e., the GDP equivalent for a particular state, it is the final value of goods and services produced by a particular state

Table 4.3: GDP/GSDP index (2012=100)



Source: Central Statistical Organisation (CSO)

4.13 The official historical GDP and GSDP data for India are released by the Central Statistical Organisation (CSO). The GDP forecasts for India are available from various reliable sources such as Oxford and Consensus, but the state level GSDP forecasts are not published. However, using the long-term historical trends between GDP and GSDP, we have developed factors which are used to forecast GSDPs for each state.

4.14 Therefore, in our view, GDP is the best source to be used as a growth driver for long term forecasts of traffic.

Summary

4.15 For any indicator to be used as a growth driver to forecast traffic, a reliable source of historical and forecast available for that indicator is the key requirement. Of the key socioeconomic indicators discussed above GDP seems to be the only growth driver for which reliable data is available both in terms of historical and forecast data, therefore, to forecast traffic we would be using GDP/GSDP as our key growth drivers.

Indicator	Remarks
GDP/GSDP	Available annually ***National level reliable historical and forecast available***
Population/Urbanisation	Revised every 10 years, last available 2011. Population estimates are not available annually, making it difficult to run regressions. Also, the very dynamic nature of local population migration (which are very difficult to forecast with accuracy), we do not use population growth as a proxy for understanding future travel demand growth on the Asset. *Forecast available but historical data is a constraint*

Source: Steer analysis

5 Base traffic, revenue validation, and forecasting assumptions

5.1 In this chapter, we present our approach to arrive at the base pose position and assumptions for baseline (or background) traffic growth for each vehicle category on the Asset.

5.2 The two most important inputs that go into traffic and revenue forecasts are:

- The base position – both in terms of traffic and revenue levels currently being generated by an asset; and
- The future growth trends – which can be correlated to the various growth drivers and used to develop an informed view of the forecasts.

5.3 The following sections discuss our approach to arrive at each of these inputs for both the Assets.

FY23 Base year AADT estimates

5.4 The base year is the year on which long-term background forecast growth rates are applied to derive year-wise average annual daily traffic (AADT) estimates for forecast years. This is therefore an important aspect of our forecasting approach as baseline traffic and ultimately revenue forecasts for future years are built on top of the base year traffic estimate. We have used FY23 as the base year for AADT estimates for the forecast years.

5.5 As described previously in Chapter 3, to establish the base year (FY23) traffic position, we utilised information from provided by the Client and our context knowledge, to assess a reasonable demand on the corridor for the base year FY23 which formed the basis of future year forecasts.

5.6 FY23 has not been affected by any unexpected event(s) and can be considered as a normal year for the purposes of base year estimation. Toll plaza data is available for the Assets since 1st Apr'21 – 27sth Mar'2023 on Darodha and Kelapur toll plaza. 27 days data for Mar'23 was prorated to arrive at full month MADT. It should be noted that the exemptions and violations data isn't consistently available especially for CJV, LCV & 2A categories. Hence, the traffic doesn't include any exemptions and violations. The average traffic of actual traffic of FY23 is the base traffic (without correction) of our forecasts.

5.7 Base correction factors are then applied on FY23 base (without correction) to incorporate the unreported share of traffic. The corrected FY23 is the base of traffic forecasts.

5.8 The table provided below provides a comparison between the FY23 base year and FY22 normalized (FY22 N).

5.9 As discussed in initial chapters, the second wave of COVID-19 infections peaked in the country during April and May 2021. Therefore, the traffic volumes on the Assets were impacted during Q1FY22. In Q2FY22, the traffic gradually returned to normal as the impact of second wave

weaned away, including an element of residual (pent up) demand (from Q1 FY22) impacting traffic on the Asset. The period starting October 2021 up until March 2022 is devoid of any significant event, except Jan 2022 when the third wave of COVID-19 affected traffic volumes. However, the impact was short lived and had limited impact on the goods volumes of the Asset. Further, we believe that the traffic levels observed during the October 2021 to March 2022 period when seasonally adjusted, were representative of normalised traffic on the Asset and not a result of temporary shifts or impacts. H2 FY22 period is assumed to be 'normal' as the period.

5.10 FY22 second half is not affected by any external event(s) and provides a more suitable benchmark for growth observations in FY23. FY22 N is derived using the weighted average of SCF adjusted MADTs from Oct'21 to Mar'22 based on number of days in respective months.

Table 5.1: FY23 base year traffic

Vehicle Category	Darodha			Kelapur		
	FY22 N	FY23 base traffic	Growth rate	FY22 N	FY23 base traffic	Growth rate
CJV	1,627	1,620	(0.7%)	1,034	1,045	1.1%
LCV	420	403	(4.2%)	409	376	(8.1%)
Bus/2A	1,412	1,591	12.6%	1,595	1,685	5.8%
3A	1,381	1,380	(0.0%)	1,391	1,375	(1.0%)
MAV	1,678	1,929	14.9%	1,741	1.965	12.8%
OSV	2	1	(19.4%)	2	1	(19.1%)
Total	**6,520**	**6,925**	**6.1%**	**6,172**	**6,447**	**4.5%**
PCU	**18,195**	**19,827**	**8.9%**	**18,449**	**19,638**	**6.5%**

Source: Steer analysis

5.11 Reasonable to good growth is observed at an asset level in FY23. CJVs and 3A performance has been flattish, whereas LCVs have shown a negative growth. At the same time, an unusually higher growth in case of MAVs is observed at the Asset. This is due to the growth in the strategic north-south movement on NH44 as also observed on other toll plazas concerning this NH.

Base correction for FY23

5.12 To arrive at the true base traffic position, we have used a base correction factor to adjust the traffic volumes for CJVs, LCVs and 2As. The percentage of this correction has been calculated by comparing the toll plaza traffic volumes with TVC data as explained earlier in the report. As the base AADT of our forecasts is derived using the TMS data, it is imperative to validate the robustness of the reported traffic volumes with independent counts.

5.13 The difference between reported TMS data and the traffic in Steer independent TVC counts is added as part of the base to account for the vehicles which are crossing the plaza as 'unreported' traffic. The traffic observed in the independent counts conducted by Steer report ~5% higher on Darodha, and ~17% higher on Kelapur than the traffic reported in TMS in the same week. This difference is largely driven by CJVs and LCV/Bus/2A categories. The TMS data

is for the same dates as the TVC and an average of 7 days. The delta is higher at Kelapur as the toll plaza data/TMS doesn't include exemptions and violations details.

5.14 To correctly account for true traffic levels, we have added the difference between Steer TVC and TMS counts (as a % of TMS) on the FY23 normalised position. We believe that this share of additional and unreported traffic does not pay at the plaza and hence, we treat this share as 'Exemptions' in our forecasts, allowing us to estimate the correct capacity of operations at both the toll plazas.

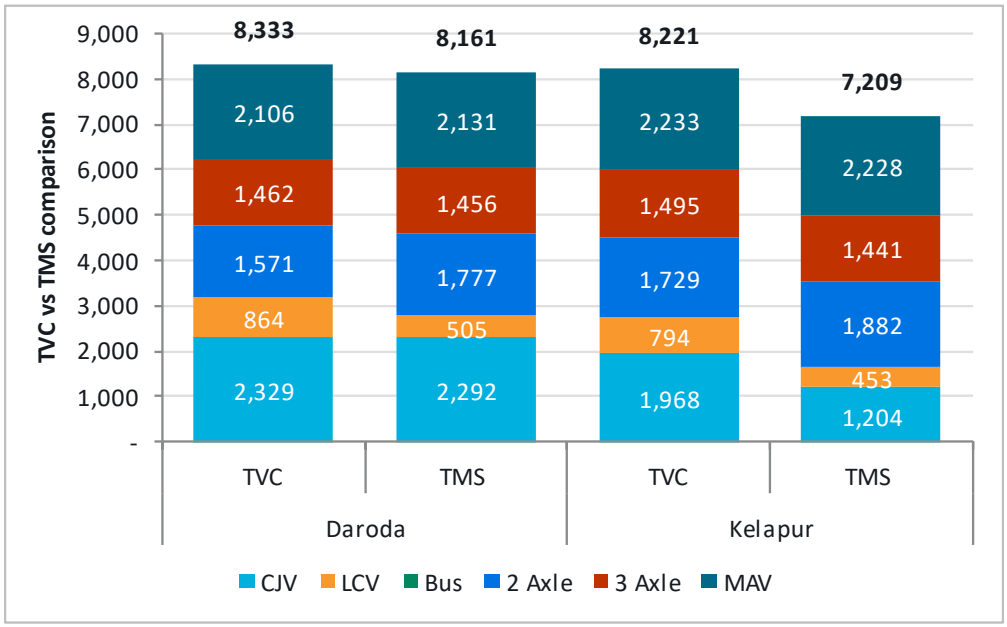
5.15 The table below illustrates the adjustment for the delta, and how it is factored into our base position:

Table 5.2: Base correction factor adjustment

	Darodha			Kelapur		
	FY23	**Base correction Factor**	**FY23 Base**	**FY23**	**Base correction Factor**	**FY23 Base**
CJV	1,620	18.5%	1,920	1,045	83.2%	1,914
LCV	403	7.8%	434	376	9.2%	410
2A	1,591	7.8%	1,715	1,685	9.2%	1,840
3A	1,380		1,380	1,375		1,375
MAV	1,929		1,929	1,965		1,965
OSV	1		1	1		1
Total	**6,925**		**7,381**	**6,44**		**7,505**

Source: Steer analysis

Figure 5.1: TVC vs TMS comparison



Source: Steer analysis

5.16 As discussed in Chapter 2, the location of the Kelapur toll plaza is being shifted approximately 6kms south of the existing location. Through Steer's independent TVC surveys we have observed a delta of (8.1%) in 3As and (0.6%) in MAVs on the new location as compared to the existing location. The adjusted base position for Kelapur New is shown in the table below.

Table 5.3: Kelapur New base traffic

	Existing location (FY23 Base traffic)	% Difference	New location (FY23 Base traffic)
CJV	1,914	-	1,914
LCV	410	-	410
2A	1,840	-	1,840
3A	1,375	(8.1%)	1,263
MAV	1,965	(0.6%)	1,953
OSV	1		1
Total	**7,505**		**7,382**
PCU	**20,725**		**20,635**

Source: Steer analysis

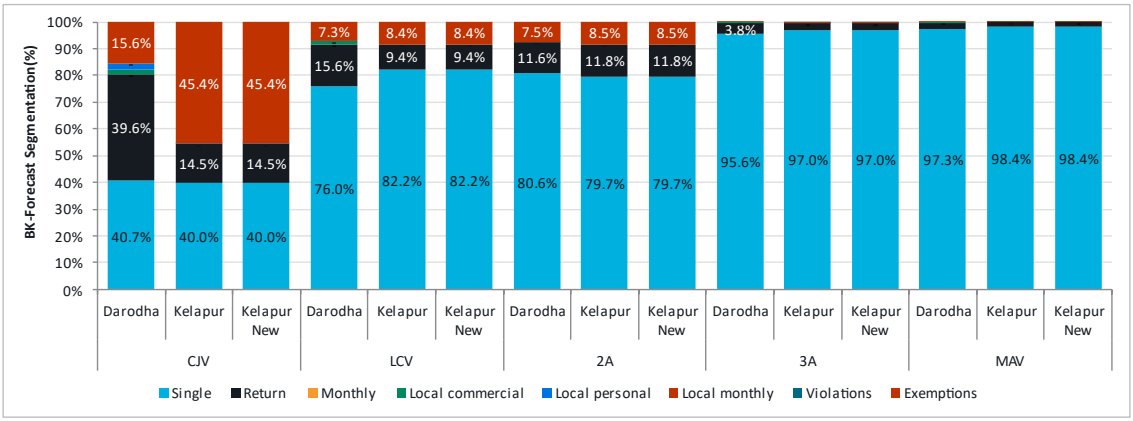
Revenue Estimates

5.17 To estimate the base revenue for the toll plaza, we used the estimated FY23 AADT, established as part of the analysis above, as the assumptions for base FY23 traffic. We then used the segmentation assumptions, discussed in chapter 3, as a starting point to arrive at the base year revenue. This is further discussed in the section below.

Toll Segmentation

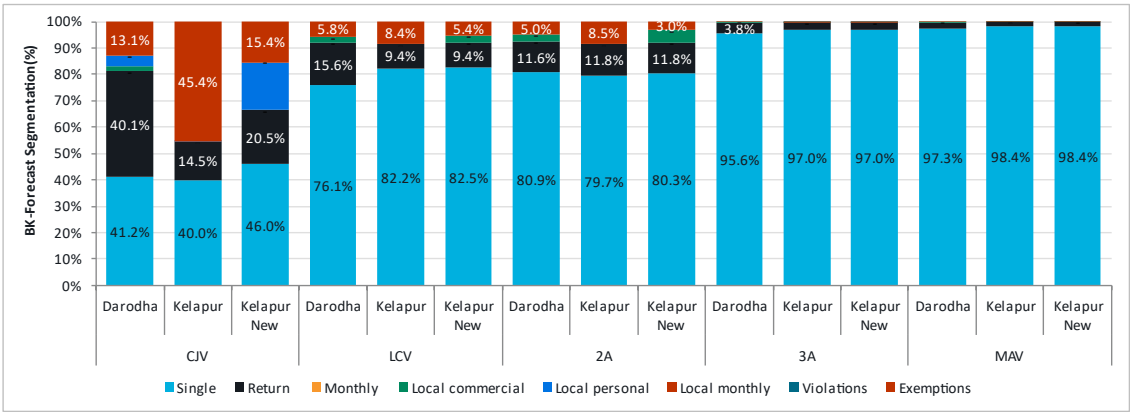
5.18 As discussed in chapter 3, segmentation trends have largely been stabilising over the last few months, with FASTag now being in a compulsory implementation since Feb'21 and more than 95% of transactions are via FASTag, it can be assumed that travel patterns have stabilised. Therefore, we believe the that average of the segmentation in actual traffic data for FY23 is representative of the travel patterns on the Asset. This is presented below:

Figure 5.2: Toll segmentation (%) for BK FY23



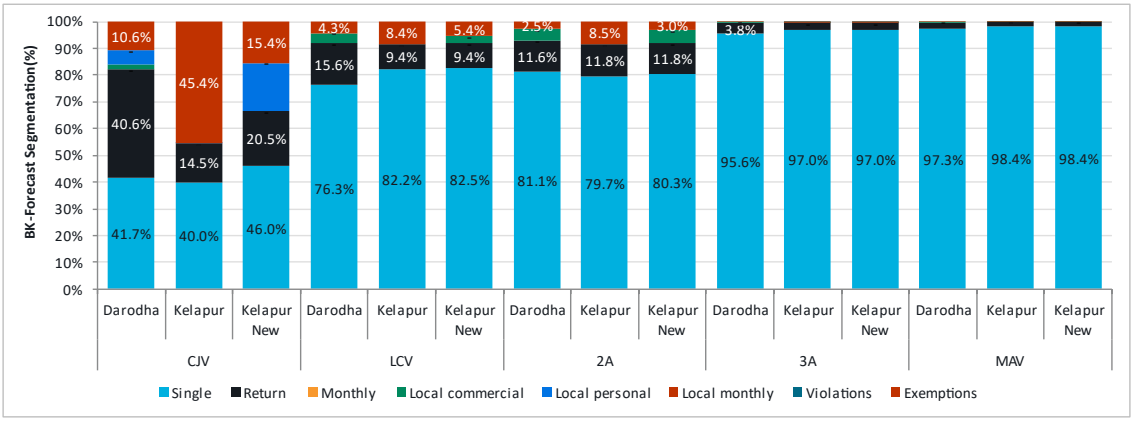
Source: Steer analysis

Figure 5.3: Toll segmentation (%) for BK FY24



Source: Steer analysis

Figure 5.4 Toll segmentation (%) for BK FY25 onwards



Source: Steer analysis

5.19 The changes in forecast toll segmentation observed on all three toll plazas is due to our understanding that once the Assets are taken over by the Client, the overall reporting practises will improve as the toll plaza will be operated by a reputed toll operator and may result in a decrease in total exemptions. Increasing compliance due to better operational efficiency in the next year will see the number of exemptions decrease further, with a subsequent increase in the Local passes, as well as the Single and Return ticket categories.

5.20 At Darodha, the installation of new systems and infrastructure components is in progress and is expected to complete by mid FY24. Accordingly, 50% of segmentation improvement is considered in FY24 and the remaining in FY25.

5.21 Additionally, for Kelapur the change in segmentation will be aided by the relocation of the toll plaza. Currently, the toll plaza is located within the city, once it shifts to its new location, the urban characteristic of the plaza will shrink resulting in lesser traffic exemptions.

Revenue reconciliation – validation of forecast segmentation

5.22 As part of validating the data provided by the Client, as well as our assumptions around toll calculations and forecast segmentation, we have reconciled the actual reported revenue on a monthly level for the Asset. To reconcile we have used our FY23 segmentation as mentioned

in the previous section, MADT of the month and compared it with the reported revenue for FY23.

5.23 The Steer revenue calculations have been built up from monthly raw traffic data files, containing monthly data and ticket type information; and the toll notifications – all shared by the Client. The comparison, as shown in the table below, depicts the difference between modelled revenue and the reported revenue is ~0.1% for both the Assets, this gives us the confidence on the assumptions around segmentation and trip factors used for estimating forecasting revenue. The slight difference is also contributed by unavailability of cash data from Jan-23 to Mar-23.

5.24 The table below shows the delta between our modelled revenue and the actual revenue reported in the toll plaza data:

Table 5.4: Revenue Reconciliation for BK

Revenue	Modelled	Reported	Delta
Kelapur	83.50	83.45	0.1%
Darodha	85.28	85.31	(0.04%)
Total	**168.77**	**168.76**	**0.01%**

Source: Steer analysis. 'Reported' is adjusted reported data for revenues till 31st Mar-23

Base year (FY23) Comparison

Traffic comparison

5.25 The table presented below is the comparison of FY23 corrected base traffic as assumed in the previous study in Aug-22 (2nd round of InVIT) and the FY23 base traffic as assumed in the present study.

Table 5.13: Base Year Traffic Comparison, Darodha Toll Plaza

Vehicle Category	Current Study	Earlier Study	Delta
CJV	1,920	2,436	(21.2%)
LCV	434	442	(1.7%)
2A	1,715	1,628	5.4%
3A	1,380	1,450	(4.8%)
MAV	1,929	1,892	2.0%
Total	**7,381**	**7,850**	(6.0%)
PCU	**20,548**	**20,856**	(1.5%)

Source: Steer Analysis, Earlier Study was carried in Aug-22.

Table 5.14: Base Year Traffic Comparison, Kelapur Toll Plaza

Vehicle Category	Current Study	Earlier Study	Delta
CJV	1,914	1,861	2.8%
LCV	410	408	0.5%
2A	1,840	1,716	7.2%
3A	1,375	1,454	(5.4%)
MAV	1,965	1,941	1.2%
Total	**7,505**	**7,382**	1.7%

Vehicle Category	Current Study	Earlier Study	Delta
PCU	**21,022**	**20,724**	1.4%

Source: Steer Analysis, Earlier Study was carried in Aug-22.

5.26 Growth at Darodha and Kelapur is led by 2A and MAVs. MAVs have observed a strong growth and 3As a slower growth across most of the toll plazas. Growth in MAVs has been derived from a strong performance across the NH44 corridor. The decrease in 3As can be said to be compensated by an increase in 2A category. For LCV category, the differences observed can be said to be in a reasonable range.

5.27 Difference in CJV volumes for Kelapur seems reasonable but for Darodha, it is observed to be significant. This is due to a correction required in exempted or non-paying traffic volumes in the FY23 base determined in the earlier study. There was uncertainty around reporting of CJV traffic data, and the reconciliation warranted an adjustment over the reported traffic. Hence, the adjustment resulted in over reporting of exemptions/ violations, which is necessary to be corrected now as there is more confidence on the reporting with the Client monitoring and now overtaking the operations of the toll plaza. Accordingly, the same has now been adjusted. Considering the adjusted volume for CJV, the PCU performance at Darodha TP is in line with the forecasts and at Kelapur TP, it has slightly outperformed the forecasted traffic volumes.

5.28 Therefore, barring the CJV traffic volumes, the overall, present and previous estimates fall within a delta of ~0.5% at a collective level for both the toll plazas, which gives us confidence that the earlier estimates still hold true.

Revenue comparison

5.29 The table provided below shows the comparison between the revenue estimated as part of current study vis-à-vis the earlier study.

Table 5.5 Revenue comparison (FY23) Darodha

Vehicle Category	Current Study	Earlier Study	Delta
CJV	5.22	5.86	(10.9%)
LCV	2.38	2.45	(2.8%)
2A	19.87	20.00	(0.6%)
3A	19.15	20.81	(8.0%)
MAV	38.78	39.68	(2.3%)
Total	**85.44**	**88.84**	**(3.8%)**

Table 5.6 Revenue comparison (FY23) Kelapur

Vehicle Category	Current Study	Earlier Study	Delta
CJV	3.58	3.74	(4.2%)
LCV	2.21	2.20	0.2%
2A	20.52	19.15	7.1%
3A	17.35	19.74	(12.1%)
MAV	38.69	37.71	2.6%
Total	**82.38**	**82.58**	**(0.2%)**

5.30 The difference in the revenue is on account of change in base year traffic, variation in tolling length vis-à-vis the one considered in the earlier study and a difference in the segmentation for FY23.

6 Traffic and Revenue forecasts

Introduction

6.1 Following the discussion on our forecast of background growth elasticity relationships in the previous chapter, this chapter first covers the forecasting assumptions around estimation of base year AADT and potential network impacts on traffic growth on the Asset. Thereafter, we present our assumptions around toll segmentations, trip factors and evolution of toll rates for the forecast period which are used to forecast revenues as derived from forecast traffic. In the final section, this chapter summarises traffic growth rates for the forecast years.

6.2 The following table lists key intermediate and final outputs that have presented in previous Chapters and in this chapter.

Table 6.1: Key intermediate and final outputs in the forecast

Forecast	Final outputs	Intermediate outputs	Inputs	Chapter
Traffic	Base year AADT	AADT	Historical and year-to-date AADT	Chapter 3, 5
	Background traffic growth	Background forecast elasticity	Background historical elasticities with respect to growth drivers	Chapter 3,4
		Forecasts for growth drivers	Historical performance of growth drivers along with Macro assumptions (GDP and GSDP)	Chapter 6
	Impact growth rates and staging	Impacts	Network analysis	Chapters 6
Revenue	Annual/daily revenue forecasts	Forecast toll segmentation: Trip frequencies and trip factors	Historical trip frequencies	Chapter 3
			Historical trip factors	Chapter 6
		Future toll rates	Toll evolution	Chapter 6

Source: Steer

Analysis of potential impacts

Summary of alternate routes and impact assessments

6.3 The section below details the impacts which we believe would affect traffic on the Asset during the concession period. As discussed in earlier Chapters, in order to assess the impacts on the Asset, whether positive or negative, we have studied developments (alternate roads, feeder roads and regulatory) in the surrounding road network.

6.4 The following table lists the impacts considered on the Asset.

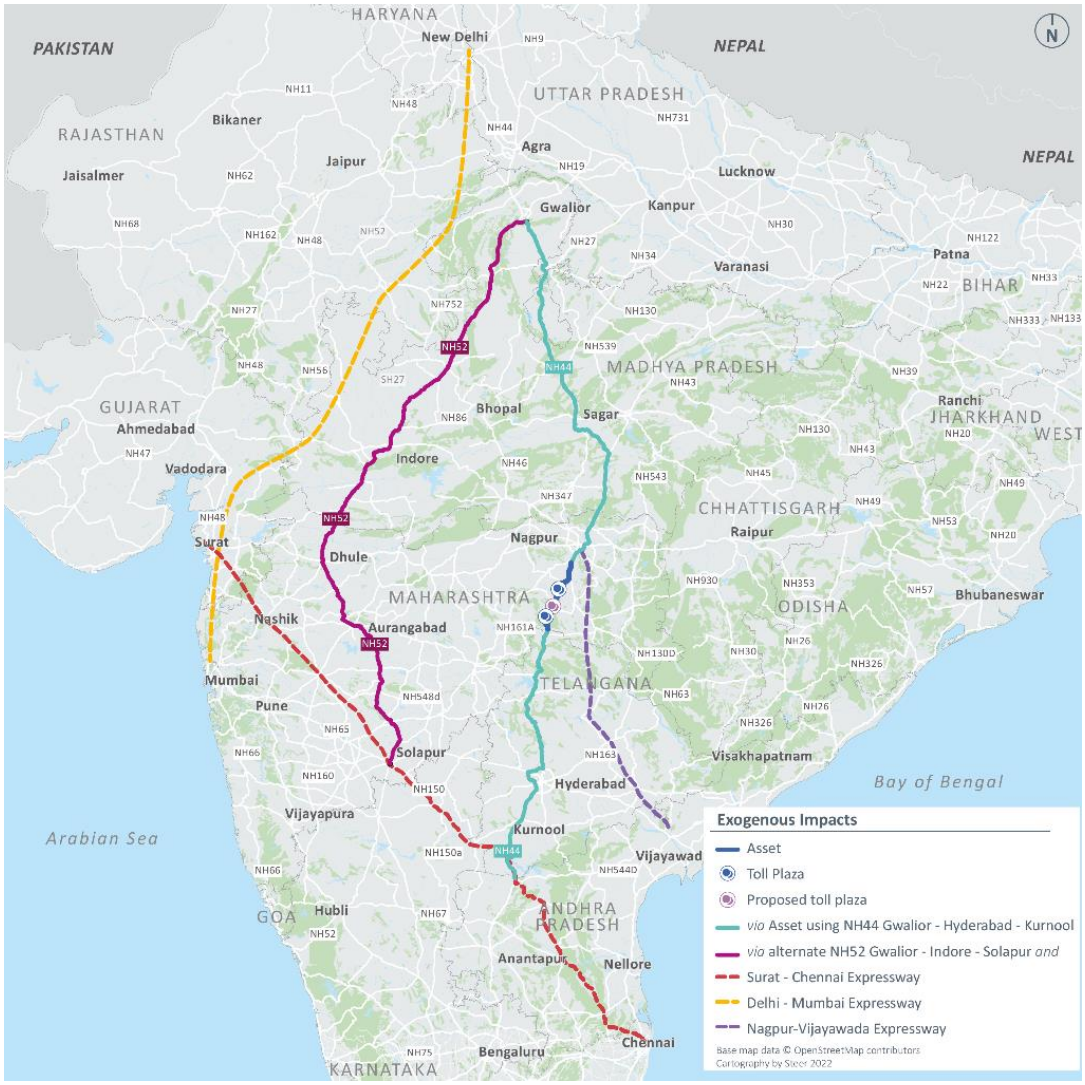
Table 6.2: Summary of impact

Impact	Toll plaza	Probability/Scale of impact	Year of impact	Impact (+/-)
Delhi Mumbai Expressway + Surat Chennai Expressway (long-distance alternate)	Darodha, Kelapur	High/low	FY27	-ve
Nagpur Vijayawada Expressway	Darodha, Kelapur	High/medium	FY27	-ve
Raipur-Hyderabad Economic Corridor	Darodha, Kelapur	High/medium	FY28	-ve

Source: Steer analysis of OD data

6.5 The network context in which these upgrades are planned can be analysed in conjunction with the network map below.

Figure 6.1: Asset route shown against the regional network context



Source: Steer analysis and cartography

6.6 The subsections below include a narrative of each of the improvements, and impacts associated from each of these on our traffic forecasts. Please note that all traffic volumes for impacts were estimated as impact rates applied on FY23 AADT.

Delhi Mumbai Expressway + Surat Chennai Expressway (DME +SCE)

6.7 There are currently two key options for north south traffic movement between Delhi/north and Kurnool/south via Gwalior:

- using NH19/NH44 via Delhi-Agra-Gwalior-Sagar-Nagpur-Hyderabad-asset-Kurnool-Karnataka/Chennai
- using NH19/NH44/NH52 via Delhi-Agra-Gwalior-Indore-Dhule-Aurangabad-Solapur-Kurnool-Karnataka/Chennai.

6.8 Currently, the trucks are using NH44 corridor as it is cheaper and shorter for north-south movement. The proposed upgrades on NH52 coupled with upcoming Delhi-Mumbai Expressway (DME) and Surat-Solapur-Chennai Expressway (SCE) will improve the alternate route's overall attractiveness as long-distance corridor for traffic moving north and south.

6.9 The in-scope traffic includes all the trips with origins and destinations in Gwalior/north and Kurnool/south currently moving on the Asset.

6.10 The following are the proposed road developments that will together act as a competing route for long distance traffic:

- Delhi-Mumbai Expressway (FY24)
- 4-laning of Dhule – Chalisgaon section (including Autram tunnel upgrade) + Solapur – Vijaypura upgradation (NH52) (FY27-FY28)
- Surat – Kurnool – Chennai Expressway (FY27)

6.11 The users travelling from Delhi/north to Kurnool/south will have the option to divert to DME at Delhi instead of taking NH44/NH52 route. The users can then exit from DME at Indore where they can travel till Solapur on an upgraded 4-lane highway (NH52). At Solapur, the users can divert on the upcoming SCE to reach Kurnool. Hence, the route via DME-NH52-SCE, which will be a mix of expressways and upgraded NH, will act as a competing route for the Asset.

6.12 The section between Sohna (Haryana) to Dausa (Rajasthan) was made operational in Feb-23. The latest status[4] as posted by NHAI projects that by Mar-24 the section between Delhi and Ratlam-Indore will be operational. Majority of the section between Vadodara to Virar is under construction/ award stage and is projected to be completed by Jun-24 (FY25). Similarly, the last section, which is, Virar to JNPT is also expected to be completed by Jun-24 (FY25).

6.13 The Chennai Surat expressway's alignment will pass through tier-II cities like Nashik, Ahmednagar, Solapur, Kalaburgi, Kurnool, Kadapa and Tirupati. There would be a six-lane greenfield between Surat and Solapur/Mehbubnagar. The rest of the corridor is expected to be a four-laned brownfield section, but not access-controlled. Tenders have been allotted in most packages (290 km) between Karnataka and Telangana borders.

6.14 We have assumed the diversion of traffic to being from FY27 in a phased manner.

[4]DME status as on March'2023, **https://nhai.gov.in/nhai/sites/default/files/mix_file/Delhi-Mumbai-Award-Status-Mar-23_v1.pdf**

Table 6.3: Impact of DME+SCE

Impact	2A	3A	MAV
Darodha	(2.5%)	(0.5%)	(2.5%)
Kelapur	(2.3%)	(0.5%)	(2.7%)

Source: Steer Analysis, overall impact, the impact will be phased over 2 years (FY27:80%, FY28 onwards:100%)

Nagpur Vijayawada Expressway

6.15 The existing distance between Nagpur and Vijayawada using Asset is 773 kms which will get reduced to 596 kms after the expressway is operational. Land acquisition is in progress between Vijayawada and Manchiryala while four-laning is ongoing between Manchiryala and Chandrapur. The traffic plying between Nagpur and Vijaywada will have the option to travel either via the Asset or via the Expressway.

6.16 The expressway will also provide an alternative option for traffic plying between Nagpur and Chennai. Presently, the traffic between Nagpur and Chennai either travels via Nagpur-Hyderabad-NAMEL-Ongole-Chennai route or via Nagpur-Hyderabad-Kurnool-Tirupati-Chennai route.

6.17 Surat Chennai expressway section (Nadyal-Chennai) coupled with upgradation on NH167 (Hyderabad – Nandyal) will result in an overall improvement in the attractiveness of the Nagpur-Hyderabad-Kurnool-Tirupati-Chennai route.

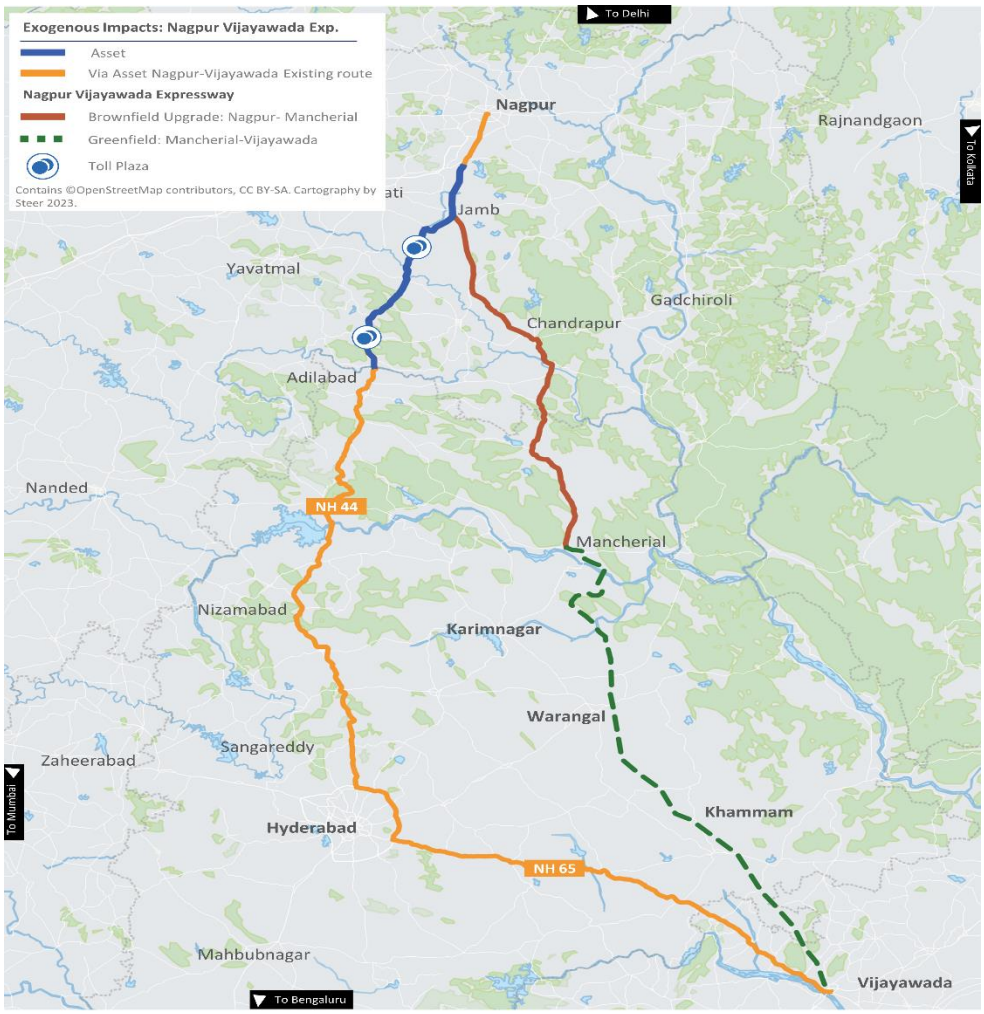
6.18 The proposed expressway between Nagpur and Vijayawada would establish another competing route for long-distance traffic moving between OD pairs Nagpur (/ north) and Chennai (/ south) via Guntur. The same OD pairs will be the in-scope traffic moving on the Asset. The staged impact for this has been assumed starting FY28.

Table 6.4: Impact of Nagpur Vijayawada Expressway

Impact	LCV	2A	3A	MAV
Darodha	(2.2%)	(6.0%)	(4.7%)	(5.4%)
Kelapur	(2.3%)	(5.7%)	(4.8%)	(5.3%)

Source: Steer Analysis, overall impact, the impact will be phased over 2 years (FY27:50%, FY28:100%)

Figure 6.2: Nagpur Vijayawada Expressway alignment



Source: Steer cartography

Raipur Hyderabad Economic Corridor

6.19 A 568 km long Raipur-Hyderabad Economic Corridor by National Highways Authority of India (NHAI). This development is mix of existing alignment getting widened and an upcoming greenfield section between Durg- Gadichroli- Bellampalli. The expressway is expected to be completed by FY28.

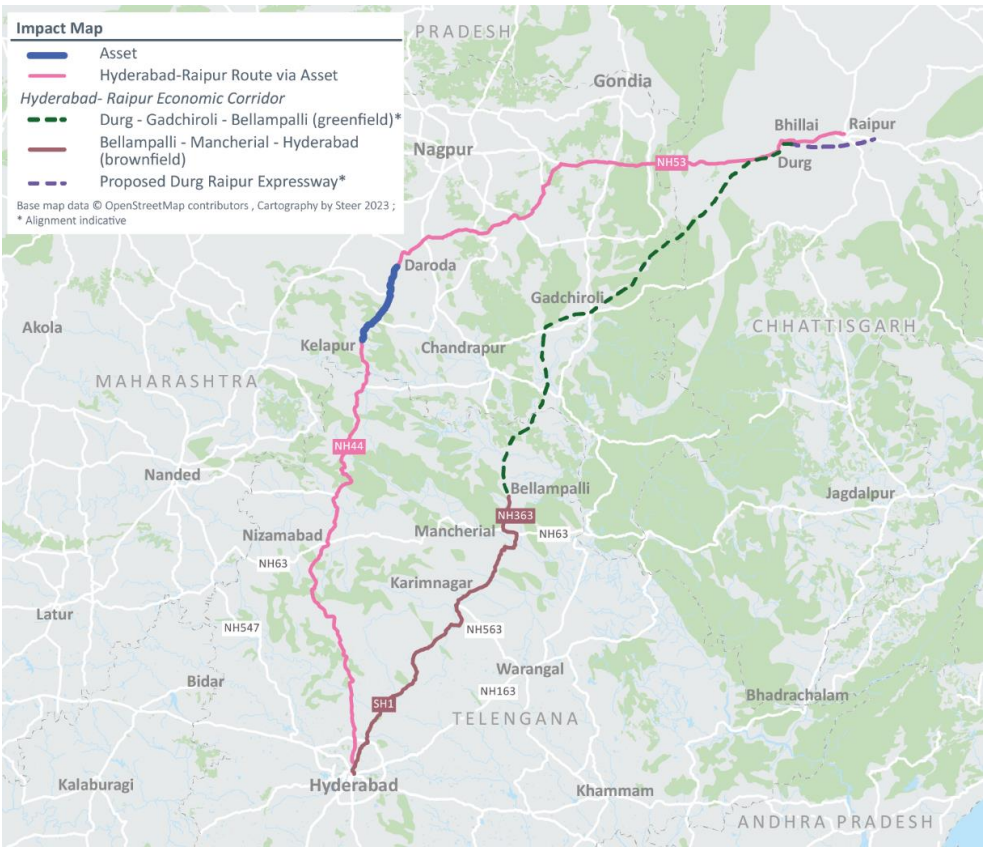
6.20 The proposed greenfield alignment between Raipur and Bellampalli will establish new competing route as long-distance corridor for traffic moving between Raipur/Central Eastern parts and Hyderabad/south and the same will be the in-scope traffic moving on the Asset. The staged impact for this has been assumed starting FY28.

6.21 The existing distance between Raipur and Hyderabad using Asset is 766 kms which will get reduced to 568 kms after the economic corridor gets ready.

Table 6.10: Impact of Raipur Hyderabad Economic Corridor

Impact	LCV	2A	3A	MAV
Darodha	(1.8%)	(2.4%)	(1.8%)	(3.0%)
Kelapur	(1.8%)	(2.3%)	(1.8%)	(3.0%)

Source: Steer Analysis, overall impact, the impact will be phased over 2 years (FY28:50%, FY29:100%)



Source: Steer Cartography

Forecasts for growth drivers

6.22 In this section, we have described our assumptions in relation to forecasts of the key macro-economic drivers of traffic growth. India's GDP and the relevant state GSDPs are the primary macroeconomic variables that have been used to drive our traffic growth forecasts.

Macro assumptions: GDP, GSDP and WPI

National GDP

6.23 For the past 2 decades, the Indian economy has grown at an average of about 7% annually. Between 2014-2018, India was the fastest growing major economy globally. In the year 2019-20, there was a trend of economic downturn observed in the country, nevertheless, with government initiatives such as Make in India, and Production-Linked Incentive (PLI) scheme, the national economy was expected to improve.

6.24 The Input assumptions on GDP, GSDP and WPI are presented below. GDP is sourced from Consensus forecasts. For UP state GSDP, there are significant investments expected to take place as part of the state's plan and Uttar Pradesh is expected to receive a significant proportion of these investments, given its leading position in industrial investments. The higher-than-expected GSDP growth rate across the concession period could be achieved if

such investments were realised as they are expected to give an additional boost to Uttar Pradesh's state economy.

6.25 In the long term, we believe that as other smaller state economies of India catch up with the national economic growth, the gap between growth rates of larger state economies, such as Gujarat, Maharashtra and Karnataka, and the national GDP growth rate will start reducing.

Table 6.5: GDP, GSDP UP, and WPI assumptions

	GDP	GSDP Telangana	GSDP Maharashtra	WPI
FY24*	5.8%	7.4%	6.1%	5.02%
FY25	6.2%	7.4%	6.2%	3.5%
FY26	6.5%	7.5%	6.4%	3.5%
FY27	6.5%	7.2%	6.2%	3.5%
FY28	6.3%	7.2%	6.2%	3.5%
FY29	5.9%	6.6%	5.8%	3.5%
FY30	5.9%	6.6%	5.8%	3.5%
FY31	5.9%	6.5%	5.8%	3.5%
FY32	5.9%	6.5%	5.8%	3.5%
FY33	5.9%	6.4%	5.8%	3.5%
FY34	5.8%	6.3%	5.7%	3.5%
FY35	5.7%	6.1%	5.6%	3.5%
FY36	5.6%	5.9%	5.5%	3.5%
FY37	5.5%	5.7%	5.4%	3.5%
FY38	5.4%	5.5%	5.2%	3.5%
FY39	5.3%	5.3%	5.1%	3.5%
FY40	5.2%	5.2%	5.0%	3.5%
FY41	5.1%	5.1%	4.9%	3.5%
FY42	5.1%	4.9%	4.8%	3.5%
FY43	5.0%	4.8%	4.7%	3.5%

Source: Projections from Consensus, *RBI Estimates, https://www.rbi.org.in/Scripts/PublicationsView.aspx?id=20931, WPI future input is provided by client

6.26 WPI for FY24 is sourced from the Dec'22 release of RBI estimates. According to the concession agreement, the RBI release of December is to be referred to vehicle incorporating WPI in the toll rate revision. We have assumed 3.5% WPI growth each year FY25 onwards based on the inputs provided by the Client.

Elasticity and growth drivers

6.27 In this section, we present our approach, and assumptions around estimation of elasticities and forecast assumptions of macro parameters for each vehicle category on the Asset.

6.28 Traffic growth is commonly related to a variety of macro-economic and industry- or commodity-specific factors (hereafter referred to as 'traffic growth drivers'). These growth drivers are typically identified from the results of the OD data analysis and the site visits that help us appreciate the nature of traffic movement – 'what' travels 'where' and 'why'.

6.29 On Asset where long time series historical data is available, to understand the historical traffic trends in relation to these growth drivers, we typically carry out regression analysis, to determine the historical relationship between traffic belonging to each major vehicle category and its macroeconomic growth driver at the toll plaza. The dynamics of traffic demand is the dependent variable while the dynamics of one or more identified growth drivers are the independent or explanatory variables. This is the primary approach to determine the elasticity relationships. However, for Assets under consideration where only limited historical data is available, we have adopted a benchmark approach to finalise our elasticity estimates.

6.30 While working on several Asset across the country where historical data is available, it has been observed that typically, growth of passenger and light commercial vehicles like cars, buses and LCVs which have relatively shorter trip lengths (<200-250 km) is more closely linked to the local economic growth drivers where the Asset is located. These categories are generally driven by the demand of local production/consumption centres and are in most cases captive to the Asset. Local factors coupled with tourism driven demand is often seen as the key driver for consumption of goods and services in the areas. Therefore, we typically link the growth rate of these vehicle categories with GSDP growth rates of the state where the asset is located as that is closest proxy of the local economic activity in the region.

6.31 Whereas heavy vehicle traffic like 3A trucks (sometimes 2A trucks as well) and MAVs tend to have a much longer average trip lengths (>350-500 km) and serve multiple economic activity centres located along an Asset as well beyond the Asset across multiple states of the country. For these vehicle categories we therefore assume these vehicle categories to grow in line with the national GDP.

6.32 This is because most light goods vehicles tend to travel shorter distances within the state, whereas a significant proportion of heavy vehicles carry commodities for long - distances across the country and have much longer trip lengths. These commodities also tend to be part of industry ecosystems whose demand-supply relationships are scattered across the country and therefore relate more with GDP growth. Therefore, using the OD data trip lengths of various vehicle types and the commodity carried by these goods vehicles form the basis for estimating the elasticity relationships.

6.33 The forecast elasticities are assumed to remain constant over the concession period as the logistics sector in still in early stages of development in India (95% of trucks still owned by operators owning less than 5 trucks). Car ownership levels are still around 22 per 1000 people, and it is likely to take a few years before the market reaches maturity. These trends are based on a long-term understanding of historical relationships and an overall outlook on the growth of the region and the country.

6.34 The table below detail out the reasoning for selection of respective growth driver(s) and elasticity adopted for each vehicle category for Darodha and Kelapur toll plaza.

Table 6.6: Assumed Elasticities for the BK: Darodha and Kelapur toll plaza

Vehicle Category	Proposed	Growth Driver	Comments
CJV	1.0	100% GSDP of Maharashtra	Car traffic is largely driven by the local demand from Nagpur, Kelapur, Butibori and Yavatmal. The Asset is also influenced by Hyderabad bound traffic. CJVs are expected to grow with 1.0 elasticity on the Asset as the car ownership levels continue to increase in the region in future years.
Buses	0.3	50% GSDP of Maharashtra 50% GSDP of Telangana	Buses are primarily a mix of public and private inter-city buses. It seems that buses currently are serving local intercity demand with some share of long-distance movement. As these cities grow, the buses are also expected to respond to the increasing demand however only at a muted rate.
MLCV/LCV	0.5	50% GSDP of Maharashtra 50% GSDP of Telangana	LCV have been observed to carry a mix of commodities, doing short to medium distances mostly catering to local demand alongside Nagpur Hyderabad corridor including groceries, agricultural and perishable products. As the region grows, we expect the consumption of these to also increase, combined with an increase in demand due to manufacturing industry along the Asset corridor.
2A	0.6	GDP	2A,3A, MAVs are assumed to carry a mix of commodities over medium to long distance trips catering to national as well as local demand between Nagpur and Hyderabad. The demand for high value low tonnage products over long distances makes 2A trucks as preferred mode. 2A trucks in the region are observed to be carrying such materials including courier, parcel etc. on this corridor between Delhi and Hyderabad, Chennai and Karnataka and local areas in-between. Further both 2A and 3As have also serving the manufactured goods industry. Therefore, we believe that the 2A category will continue to grow in the future with 0.6 elasticity to GDP. 3A trucks are also influenced long distance courier, parcel, and agricultural commodities along with local commodity movement including construction, groceries and perishable items. Therefore, higher elasticity of 0.7 has been assumed.
3A	0.7	GDP	
MAV	1.0	GDP	The Asset is part of the strategic NH44 north south corridor with MAV traversing long distance movements catering to the New Delhi and north India towards Hyderabad and southern parts of India. The Assets benefit from agricultural, groceries and industrial movement from industries along the corridor and in the vicinity. Therefore, an assumption of 1.0 to GDP has been assumed for the forecasts expecting the long-distance traffic to grow more in line with the national GDP.

Source: Steer analysis

Revenue Forecasting Assumptions

6.35 To forecast the revenues for a particular financial year, the traffic forecast for each vehicle type is converted into tickets sold, which is then multiplied with the corresponding toll rate, which grows over the years as defined in the Concession Agreement. While "trip factors" provide the conversion factor to the former, i.e., traffic (trips) to tickets sold, "toll segmentation" provides the latter i.e., the breakup of trips paying each ticket type. This section discusses assumptions related to trip factors, and toll rates for the forecast period.

Trip factors

6.36 As discussed in chapter 3, a user can by different type of tickets to pay toll depending on the vehicle type. Apart from the single trips, trips such as return, monthly, local commercial, local personal, are discounted tickets that are offered to the users. The revenue realised from these discounted trips is lower than a single trip fare. Therefore, in order to calculate the revenue for the trips made on discounted tickets (or passes) a trip factor is applied to calculate revenue realised from that particular pass sold.

6.37 The following trip factors are assumed for both the Asset.

Table 6.7: Trip factors for the forecast years

Ticket category	CJV	LCV	Bus	2A	3A	MAV	OSV
Single	1	1	1	1	1	1	1
Return	2	2	2	2	2	2	2
Monthly	45	45	45	45	45	45	45
Local Commercial	1	1	1	1	1	1	1
Local Personal	30						

Source: Steer analysis of toll plaza data

Toll evolution

6.38 Based on the concession agreement and the gazetted toll notification, we see that base toll rates increase every year on 1st April based on WPI-linked inflation (December print of previous FY) to provide us unrounded toll rates. These are rounded up to the nearest five to estimate the rounded toll rates charged to the road user. We have used actual toll rates of FY23 toll notifications to validate the modelling of toll evolution. These toll lengths are presented in the table below:

Table 6.8: Tolling lengths for toll evolution assumed - BK

Length (km)	Darodha		Kelapur	
	During construction (FY23-24)	Post construction (FY25 onwards)	Existing location	New location
Road length excluding bypass	66.60260	66.5910	69.6494	69.6494
Structure on road	1.34740	1.3590	0.5506	0.5506
Converted length of structures	13.4740	13.5900	5.5060	5.5060
Net Tollable length	80.0766	80.1810	75.1554	75.1554

Source: Steer analysis of toll notifications and concession agreement (CA)

6.39 The change in Darodha's tolling length is due to reconstruction of a major bridge on the Asset. As per our discussion with the Client as well as our review of available documents, it was found out that the construction has to be completed within 18 months of the appointed date. Hence, we have assumed the post-construction tolling length of 80.1810 km for Darodha FY25 onwards.

Traffic and Revenue forecasts

PCU factor assumption for forecasts

6.40 The PCU factors considered are given in the table below. These are derived from IRC: 16-1990 code. The splits for the same have been derived from the TVC counts that we have undertaken.

Table 6.9: PCU factors

Vehicle Category	PCU Factor
CJV	1.0
LCV	1.5
Bus	3.0
2A	3.0
3A	3.0
MAV	4.5
OSV	4.5

Source: Steer analysis, IRC Codes

6.41 Based on the traffic and revenue-related forecast assumptions discussed above, we have modelled the traffic and revenue forecasts for the forecast period for the Asset. The table below presents the traffic and revenue forecast growth rates and CAGRs on this Asset. Further, Appendix B presents the AADT and revenues for the forecast period.

Traffic and revenue forecasts

BK - Darodha

Table 6.10: Final (background plus impacts) AADT forecast – BK - Darodha

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	1,337	1,503	2,032	2,700	3,517	4,078
Mini LCV	583	623	736	857	983	1,061
LCV	434	463	524	609	698	753
Bus	221	230	254	279	303	317
2A	1,494	1,604	1,716	2,039	2,394	2,618
3A	1,380	1,499	1,723	2,106	2,537	2,816
MAV	1,929	2,168	2,612	3,470	4,520	5,241
OSV	1	2	2	3	3	4
AADT	**7,381**	**8,091**	**9,600**	**12,062**	**14,956**	**16,888**
PCU	**20,548**	**22,582**	**26,401**	**33,369**	**41,606**	**47,123**

Source: Steer analysis

Table 6.11: Final (background plus impacts) AADT CAGR (%) – BK Darodha

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	6.0%	6.2%	5.8%	5.4%	5.1%	5.7%
Mini LCV	3.4%	3.4%	3.1%	2.8%	2.6%	3.0%
LCV	3.3%	2.5%	3.1%	2.8%	2.6%	2.8%
Bus	2.0%	2.0%	1.9%	1.7%	1.5%	1.8%
2A	3.6%	1.4%	3.5%	3.3%	3.0%	2.8%
3A	4.2%	2.8%	4.1%	3.8%	3.5%	3.6%
MAV	6.0%	3.8%	5.8%	5.4%	5.1%	5.1%
OSV	5.4%	5.6%	5.3%	4.9%	4.5%	5.2%
AADT	**4.7%**	**3.5%**	**4.7%**	**4.4%**	**4.1%**	**4.2%**
PCU's	**4.8%**	**3.2%**	**4.8%**	**4.5%**	**4.2%**	**4.2%**

Source: Steer analysis

Table 6.12: Final (background plus impacts) revenue (INR crores) forecast – BK Darodha

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	3.64	4.84	7.95	13.05	20.70	26.91
Mini LCV	1.59	2.01	2.88	4.14	5.79	7.00
LCV	2.38	2.96	4.05	5.80	8.15	9.88
Bus	2.56	3.04	4.11	5.50	7.34	8.64
2A	17.31	21.85	28.58	41.50	59.77	73.54
3A	19.15	23.75	33.52	50.06	73.79	92.32
MAV	38.78	49.86	73.34	119.41	190.45	247.73
OSV	0.04	0.04	0.07	0.11	0.18	0.23
Total Revenue	**85.45**	**108.36**	**154.49**	**239.58**	**366.16**	**466.25**

Source: Steer analysis

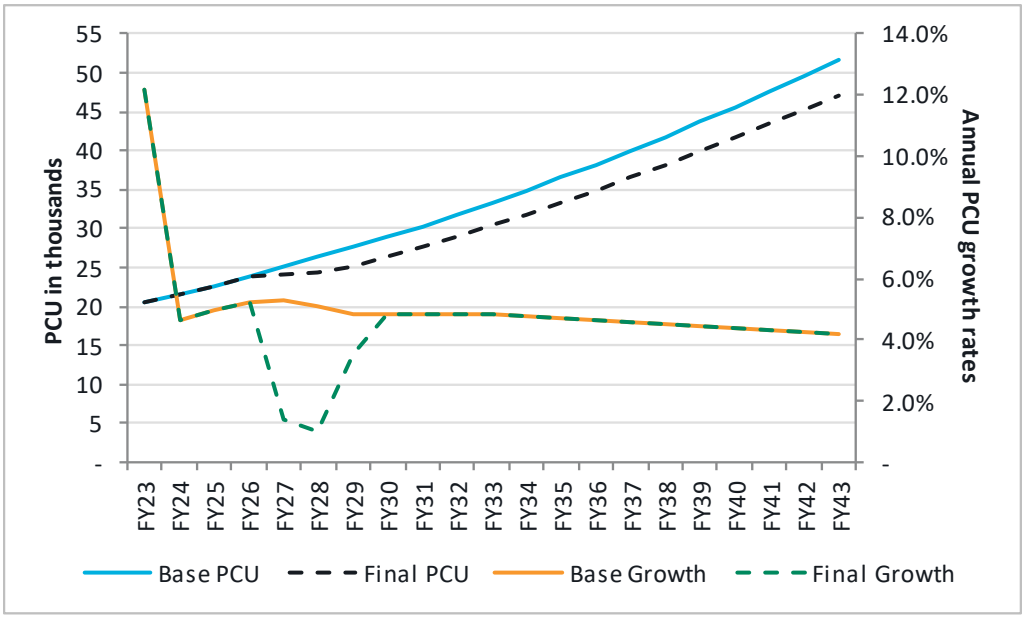
Table 6.13: Final (background plus impacts) revenue CAGR (%) – BK Darodha

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	15.3%	10.4%	10.4%	9.7%	9.1%	10.5%
Mini LCV	12.5%	7.5%	7.5%	6.9%	6.5%	7.7%
LCV	11.6%	6.4%	7.5%	7.1%	6.6%	7.4%
Bus	9.0%	6.2%	6.0%	5.9%	5.6%	6.3%
2A	12.3%	5.5%	7.7%	7.6%	7.2%	7.5%
3A	11.4%	7.1%	8.4%	8.1%	7.8%	8.2%
MAV	13.4%	8.0%	10.2%	9.8%	9.2%	9.7%
OSV	12.6%	10.0%	9.6%	9.2%	8.7%	9.8%
Total Revenue	**12.6%**	**7.4%**	**9.2%**	**8.9%**	**8.4%**	**8.9%**

Source: Steer analysis

6.42 The growth rates and PCU projections are presented in the chart below. The overall PCU traffic is estimated to grow at a CAGR of 4.2% from FY23 to FY43, where the CJV would grow by 5.7% and MAV by 5.1%.

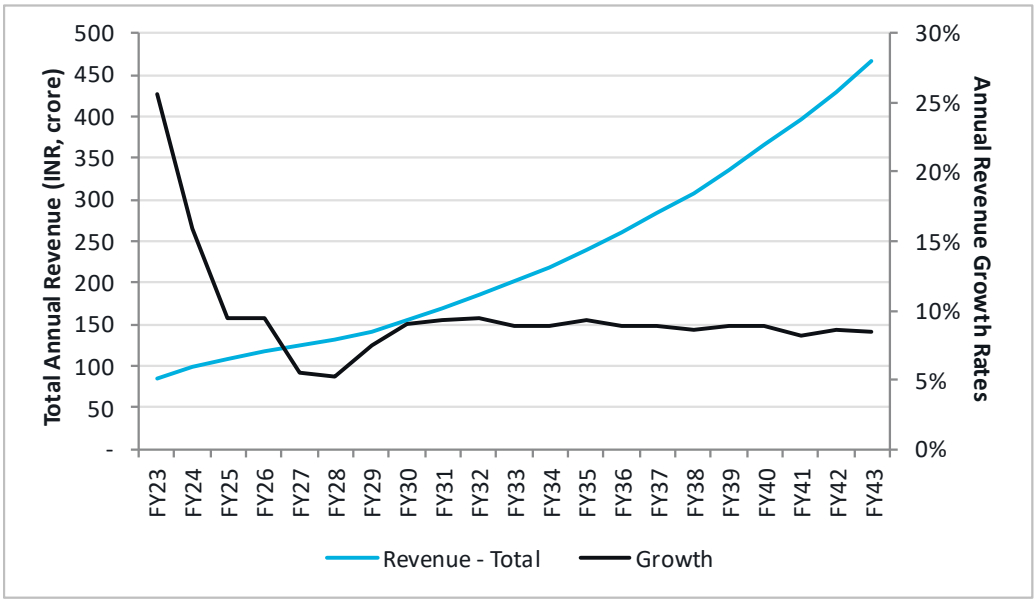
Figure 6.3: PCU growth rates (Base and Final)- BK: Darodha



Source: Steer analysis

6.43 Annual revenue and associated growth rates are presented in the chart below. The overall revenue is estimated to grow at a CAGR of 8.8% from FY23 to FY43, where over 68% of the revenues are contributed by 3A and MAVs throughout the forecasting period.

Figure 6.4: Revenue Estimates (INR Crore) and growth rates- BK: Darodha



Source: Steer analysis

BK – Kelapur (existing location)

Table 6.14: Final (background plus impacts) AADT forecast – BK - Kelapur

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	1,361	1,529	2,068	2,748	3,580	4,150
Mini LCV	553	591	698	813	932	1,006
LCV	410	437	494	574	658	710
Bus	277	288	318	349	379	397
2A	1,563	1,678	1,808	2,148	2,521	2,758
3A	1,375	1,493	1,717	2,098	2,528	2,806
MAV	1,965	2,207	2,666	3,541	4,613	5,348
OSV	1	2	2	3	3	4
AADT	**7,505**	**8,226**	**9,771**	**12,273**	**15,215**	**17,179**
PCU	**21,022**	**23,095**	**27,042**	**34,154**	**42,558**	**48,187**

Source: Steer analysis

Table 6.15: Final (background plus impacts) AADT CAGR (%) – BK Kelapur

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	6.0%	6.2%	5.8%	5.4%	5.1%	5.7%
Mini LCV	3.4%	3.4%	3.1%	2.8%	2.6%	3.0%
LCV	3.3%	2.5%	3.1%	2.8%	2.6%	2.8%
Bus	2.0%	2.0%	1.9%	1.7%	1.5%	1.8%
2A	3.6%	1.5%	3.5%	3.3%	3.0%	2.9%
3A	4.2%	2.8%	4.1%	3.8%	3.5%	3.6%
MAV	6.0%	3.8%	5.8%	5.4%	5.1%	5.1%
OSV	5.4%	5.6%	5.3%	4.9%	4.5%	5.2%
AADT	**4.7%**	**3.5%**	**4.7%**	**4.4%**	**4.1%**	**4.2%**
PCU's	**4.8%**	**3.2%**	**4.8%**	**4.5%**	**4.2%**	**4.2%**

Source: Steer analysis

Table 6.16: Final (background plus impacts) revenue (INR crores) forecast – BK Kelapur

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	2.53	3.14	5.20	8.44	13.64	17.73
Mini LCV	1.03	1.22	1.75	2.50	3.55	4.30
LCV	2.20	2.57	3.54	5.05	7.09	8.67
Bus	3.08	3.54	4.78	6.37	8.54	10.01
2A	17.42	20.60	27.16	39.23	56.76	69.50
3A	18.64	22.40	31.34	47.01	69.18	86.21
MAV	38.56	47.74	70.25	114.56	182.42	238.12
OSV	0.03	0.04	0.07	0.11	0.17	0.22
Total Revenue	**83.50**	**101.24**	**144.09**	**223.26**	**341.35**	**434.75**

Source: Steer analysis

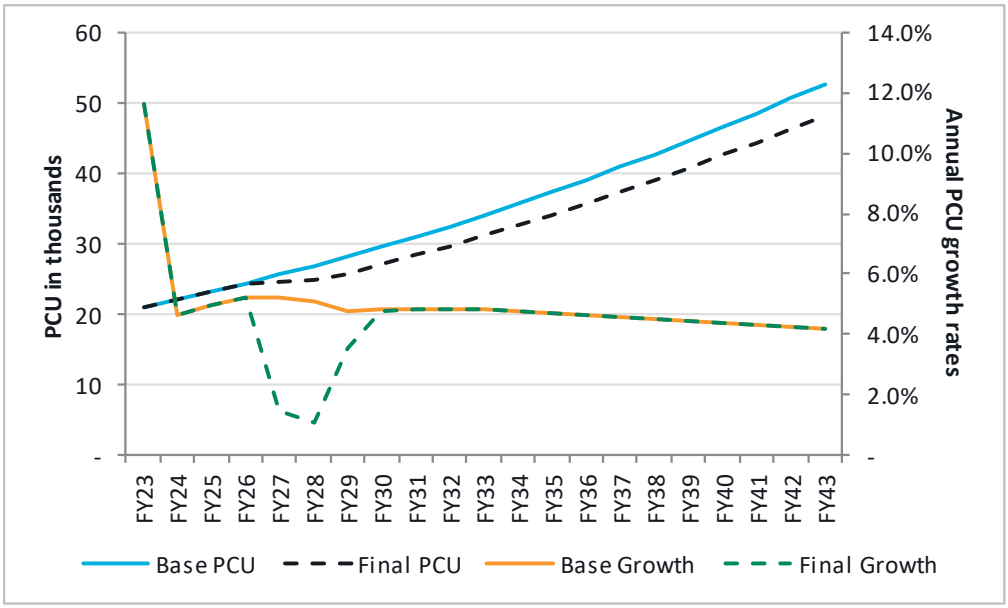
Table 6.17: Final (background plus impacts) revenue CAGR (%) – BK Kelapur

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	11.5%	10.6%	10.2%	10.1%	9.1%	10.2%
Mini LCV	8.8%	7.6%	7.3%	7.3%	6.5%	7.4%
LCV	7.9%	6.6%	7.4%	7.0%	6.9%	7.1%
Bus	7.1%	6.2%	5.9%	6.0%	5.4%	6.1%
2A	8.8%	5.7%	7.6%	7.7%	7.0%	7.2%
3A	9.6%	6.9%	8.4%	8.0%	7.6%	8.0%
MAV	11.3%	8.0%	10.3%	9.8%	9.3%	9.5%
OSV	10.9%	9.9%	9.5%	9.2%	8.8%	9.6%
Total Revenue	**10.1%**	**7.3%**	**9.2%**	**8.9%**	**8.4%**	**8.6%**

Source: Steer analysis

6.44 The growth rates and PCU projections are presented in the chart below. The overall PCU traffic is estimated to grow at a CAGR of 4.2% from FY23 to FY43, where the CJV would grow by 5.7% and MAV by 5.1%.

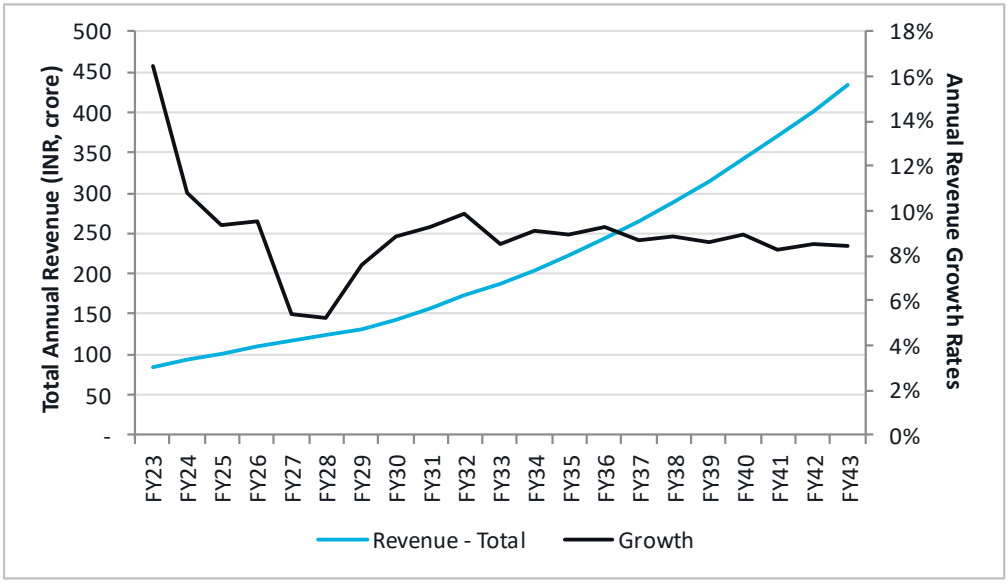
Figure 6.5: PCU growth rates (Base and Final)- BK: Kelapur



Source: Steer analysis

6.45 Annual revenue and associated growth rates are presented in the chart below. The overall revenue is estimated to grow at a CAGR of 8.6% from FY23 to FY43, where over 68% of the revenues are contributed by 3A and MAVs throughout the forecasting period.

Figure 6.6: Revenue Estimates (INR Crore) and growth rates- BK: Kelapur



Source: Steer analysis

BK – Kelapur (new location)

Table 6.18: Final (background plus impacts) AADT forecast – BK – Kelapur (new)

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	1,345	1,512	2,045	2,716	3,539	4,103
Mini LCV	569	608	718	835	959	1,034
LCV	410	437	494	574	658	710
Bus	223	232	256	281	305	319
2A	1,617	1,736	1,871	2,222	2,609	2,853
3A	1,263	1,372	1,577	1,927	2,322	2,577
MAV	1,953	2,195	2,650	3,521	4,586	5,317
OSV	1	2	2	3	3	4
AADT	**7,382**	**8,092**	**9,612**	**12,079**	**14,981**	**16,918**
PCU	**20,635**	**22,677**	**26,550**	**33,559**	**41,845**	**47,396**

Source: Steer analysis

Table 6.19: Final (background plus impacts) AADT CAGR (%) – BK Kelapur (new)

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	6.0%	6.2%	5.8%	5.4%	5.1%	5.7%
Mini LCV	3.4%	3.4%	3.1%	2.8%	2.6%	3.0%
LCV	3.3%	2.5%	3.1%	2.8%	2.6%	2.8%
Bus	2.0%	2.0%	1.9%	1.7%	1.5%	1.8%
2A	3.6%	1.5%	3.5%	3.3%	3.0%	2.9%
3A	4.2%	2.8%	4.1%	3.8%	3.5%	3.6%
MAV	6.0%	3.8%	5.8%	5.4%	5.1%	5.1%

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
OSV	5.4%	5.6%	5.3%	4.9%	4.5%	5.2%
AADT	**4.7%**	**3.5%**	**4.7%**	**4.4%**	**4.1%**	**4.2%**
PCU's	**4.8%**	**3.2%**	**4.8%**	**4.5%**	**4.2%**	**4.2%**

Source: Steer analysis

Table 6.20: Final (background plus impacts) revenue (INR crores) forecast – BK Kelapur (new)

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	2.52	3.87	6.39	10.37	16.76	21.78
Mini LCV	1.06	1.55	2.24	3.19	4.54	5.49
LCV	2.21	2.61	3.60	5.14	7.23	8.83
Bus	2.48	2.91	3.93	5.24	7.02	8.22
2A	18.04	22.04	29.05	41.98	60.72	74.37
3A	17.35	20.57	28.78	43.18	63.54	79.18
MAV	38.69	47.46	69.85	113.90	181.36	236.74
OSV	0.04	0.04	0.07	0.11	0.17	0.22
Total Revenue	**82.38**	**101.06**	**143.92**	**223.11**	**341.33**	**434.83**

Source: Steer analysis

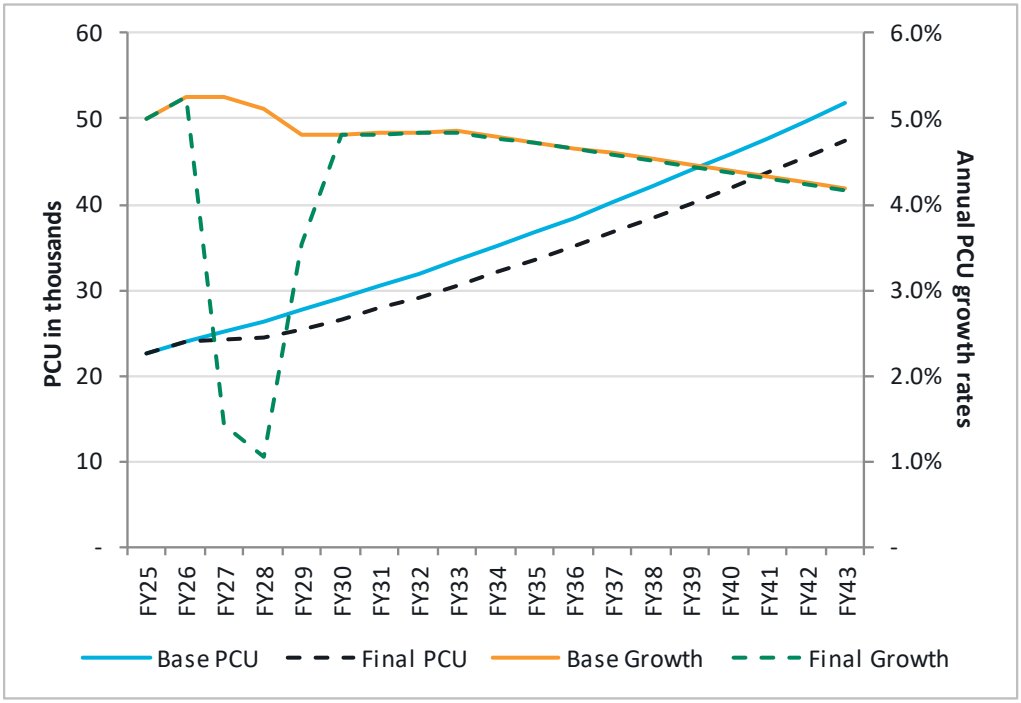
Table 6.21: Final (background plus impacts) revenue CAGR (%) – BK Kelapur (new)

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	24.0%	10.6%	10.2%	10.1%	9.1%	11.4%
Mini LCV	20.9%	7.6%	7.3%	7.3%	6.6%	8.6%
LCV	8.8%	6.6%	7.4%	7.0%	6.9%	7.2%
Bus	8.2%	6.2%	5.9%	6.0%	5.4%	6.2%
2A	10.5%	5.7%	7.6%	7.7%	7.0%	7.3%
3A	8.9%	6.9%	8.4%	8.0%	7.6%	7.9%
MAV	10.8%	8.0%	10.3%	9.8%	9.3%	9.5%
OSV	10.5%	9.9%	9.5%	9.2%	8.8%	9.5%
Total Revenue	**10.8%**	**7.3%**	**9.2%**	**8.9%**	**8.4%**	**8.7%**

Source: Steer analysis

6.46 The growth rates and PCU projections are presented in the chart below. The overall PCU traffic is estimated to grow at a CAGR of 4.2% from FY23 to FY43, where the CJV would grow by 5.7% and MAV by 5.1%.

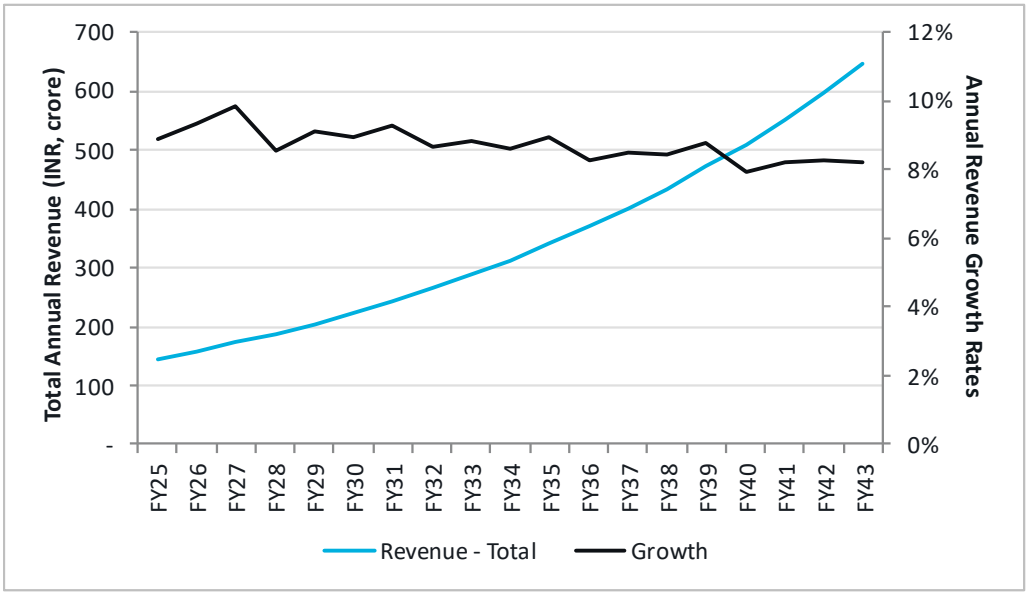
Figure 6.7: PCU growth rates (Base and Final)- BK: Kelapur (new)



Source: Steer analysis

6.47 Annual revenue and associated growth rates are presented in the chart below. The overall revenue is estimated to grow at a CAGR of 8.7% from FY23 to FY43, where more than 68% of the revenues are contributed by 3A and MAVs throughout the forecasting period.

Figure 6.8: Revenue Estimates (INR Crore) and growth rates- BK: Kelapur (new)



Source: Steer analysis

6.48 The traffic and revenue forecast presented above are our base case scenario considering a balanced view on the risks associated with input assumptions around GDP growth and traffic growth elasticities. There is always a risk that the outturn values of these inputs will vary as

compared to the assumptions taken due to exogenous impacts, e.g., GDP growth could be influenced both positively and negatively by the impact of monsoons, export-import balances, political changes etc.

6.49 Similarly, traffic growth elasticities could be influenced by increased efficiencies achieved by technology, large shifts in commodity prices globally, changes in local manufacturing practices. However, at this stage we consider that the base case represents a central case scenario given the risks of variation of input assumptions.

Comparison with Earlier Study

Traffic & Revenue Forecasts

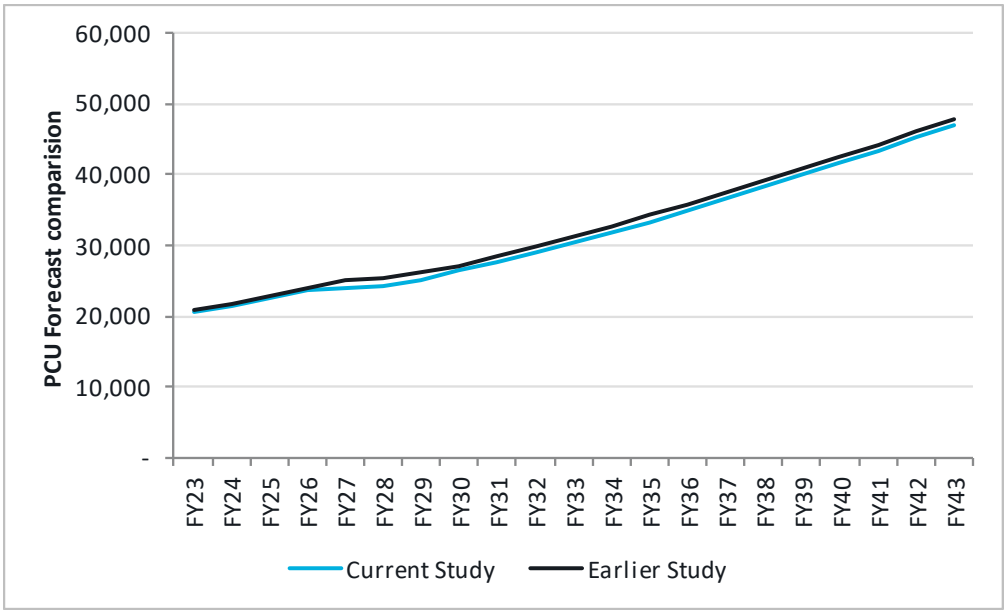
6.50 Presented below is the comparison of revised traffic forecasts vis-à-vis the earlier forecasts (from the study conducted in Aug-22)

Table 6.22 Traffic Forecasts Comparison at Darodha

Vehicle Type	Current study		Earlier study	
	AADT (FY43)	Growth Rate (FY23-FY43)	AADT (FY43)	Growth Rate (FY23-FY43)
CJV	4,078	5.7%	5,824	5.6%
Mini LCV	1,061	3.0%	832	2.9%
LCV	753	2.8%	755	2.7%
Bus	317	1.8%	275	1.8%
2A	2,618	2.8%	2,478	2.8%
3A	2,816	3.6%	2,929	3.6%
MAV	5,241	5.1%	5,126	5.1%
Total	**16,888**	**4.2%**	**18,223**	**4.3%**
Total (PCUs)	**47,123**	**4.2%**	**47,918**	**4.2%**

Source: Steer analysis

Figure 6.9 PCU forecast comparison at Darodha



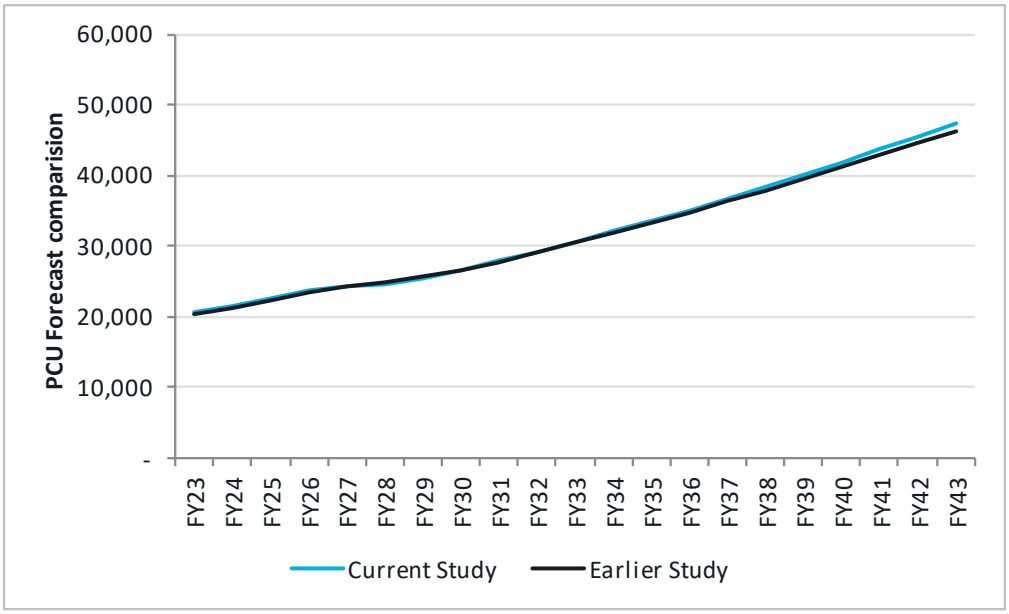
Source: Steer analysis

Table 6.23 Traffic Forecasts Comparison at Kelapur (New)

Vehicle Type	Current study		Earlier study	
	AADT (FY43)	Growth Rate (FY23-FY43)	AADT (FY43)	Growth Rate (FY23-FY43)
CJV	4,103	5.7%	4,037	5.6%
Mini LCV	1,034	3.0%	885	2.9%
LCV	710	2.8%	695	2.7%
Bus	319	1.8%	349	1.8%
2A	2,853	2.9%	2,557	2.8%
3A	2,577	3.6%	2,899	3.6%
MAV	5,317	5.1%	5,104	5.1%
Total	**16,918**	**4.2%**	**16,529**	**4.2%**
Total (PCUs)	**47,396**	**4.2%**	**46,362**	**4.2%**

Source: Steer analysis

Figure 6.10 forecast comparison at Kelapur (New)



Source: Steer analysis

6.51 The total PCU growth rate is marginally higher as per the current study.

6.52 Presented below is the comparison of revised revenue forecasts vis-à-vis the earlier forecasts (from the study conducted in Aug-22)

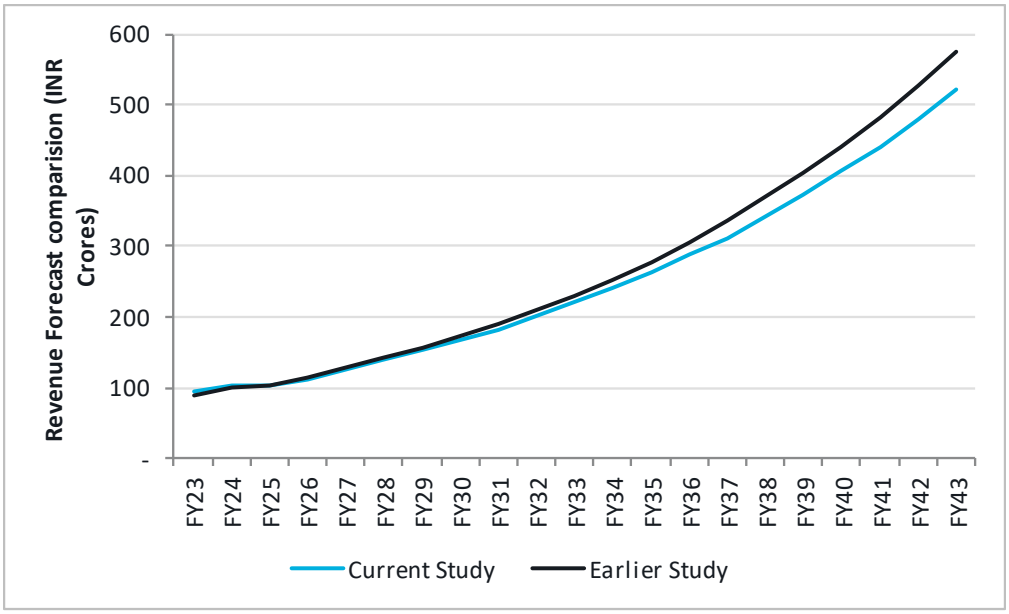
Table 6.24 Revenue Forecasts Comparison at Darodha

Vehicle Type	Current study		Earlier study	
	Revenues (FY43) – INR Cr	Growth Rate (FY23-FY43)	Revenues (FY43) – INR Cr	Growth Rate (FY23-FY43)
CJV	26.9	10.5%	39.2	11.1%

Vehicle Type	Current study		Earlier study	
	Revenues (FY43) – INR Cr	Growth Rate (FY23-FY43)	Revenues (FY43) – INR Cr	Growth Rate (FY23-FY43)
Mini LCV	7.0	7.7%	5.6	8.4%
LCV	9.9	7.4%	11.2	7.9%
Bus	8.6	6.3%	8.8	6.7%
2A	73.5	7.5%	81.2	7.9%
3A	92.3	8.2%	109.7	8.7%
MAV	247.7	9.7%	278.0	10.2%
Total	**466.2**	**8.9%**	**534**	**9.4%**

Source: Steer analysis

Figure 6.11 Revenue Forecast Comparison at Darodha



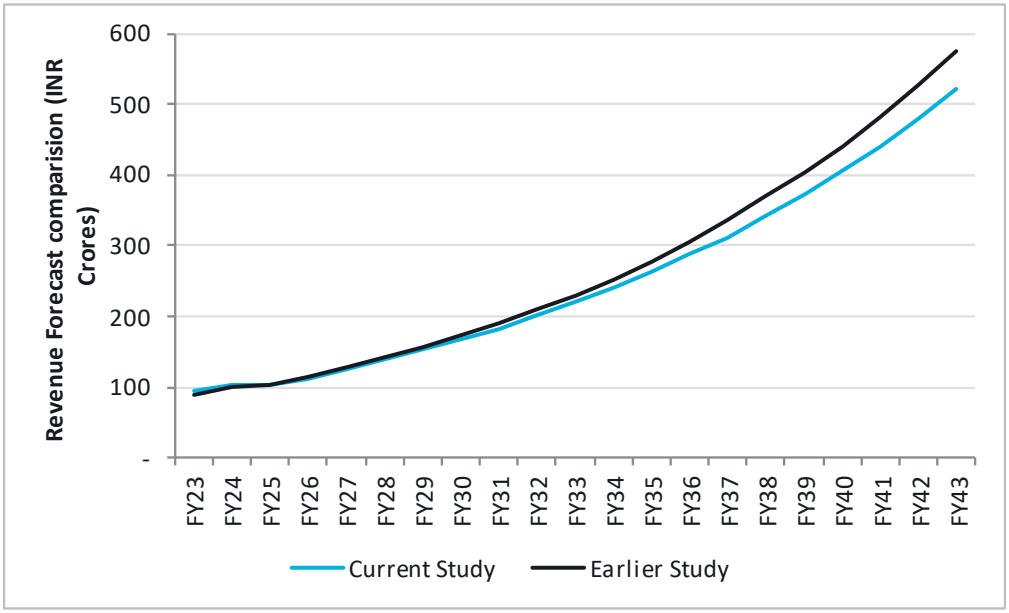
Source: Steer analysis

Table 6.25 Revenue Forecasts Comparison at Kelapur (New)

Vehicle Type	Current study		Earlier study	
	Revenues (FY43) – INR Cr	Growth Rate (FY23-FY43)	Revenues (FY43) – INR Cr	Growth Rate (FY23-FY43)
CJV	21.8	11.4%	23.8	10.8%
Mini LCV	5.5	8.6%	5.2	8.0%
LCV	8.8	7.2%	10.0	7.7%
Bus	8.2	6.2%	10.3	6.8%
2A	74.4	7.3%	78.3	7.8%
3A	79.2	7.9%	102.9	8.6%
MAV	236.7	9.5%	261.3	10.2%
Total	**434.8**	**8.7%**	**492**	**9.3%**

Source: Steer analysis

Figure 6.12 Revenue Forecast Comparison at Kelapur



Source: Steer analysis

6.53 The major reason causing the difference in the revenues is the toll rate induced by the change in WPI forecast assumptions. In the current study, a standard 3.5% WPI is considered from FY25 onwards based on the Client's recommendation.

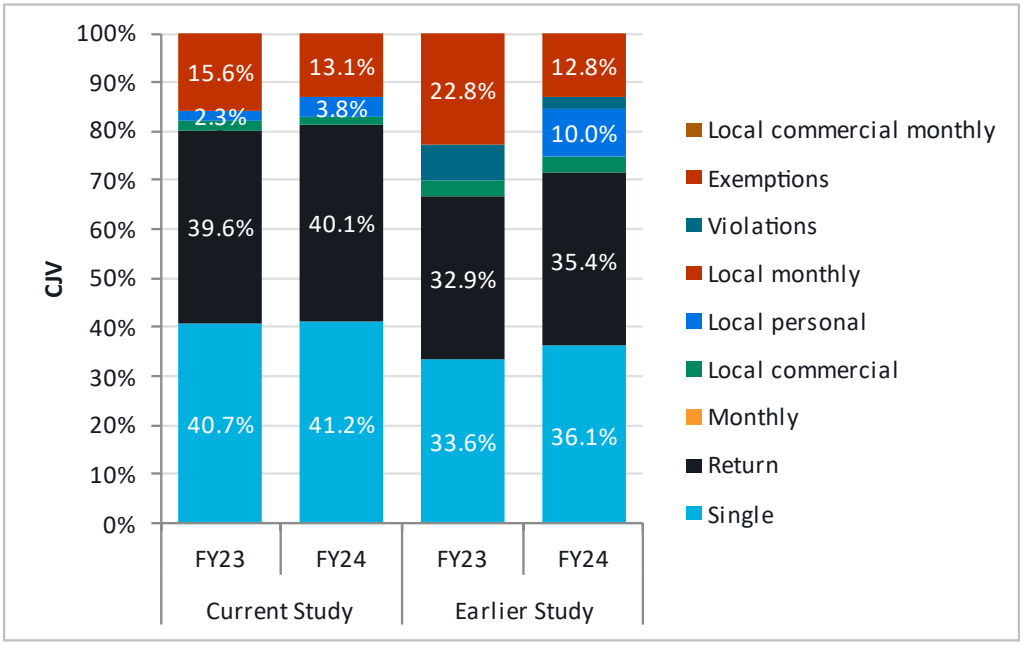
Revenue NPV analysis

6.54 We have performed a comparison between the NPV based on the forecasts made in earlier study (Aug-22) and the current assessment of the Asset. The variation in NPV is highlighted on account of following factors:

6.55 Traffic forecasts: This includes the revised traffic forecasts due to updates in 'base year traffic' (FY23); 'impacts' due to change in inscopes as per the latest OD surveys, revised GJC analysis, and change in impact timelines; new 'network developments' such as 3A/ MAV correction in FY24, FY25; and update in 'GDP/ GSDP' values. The comparison in the traffic projections is provided in the previous section.

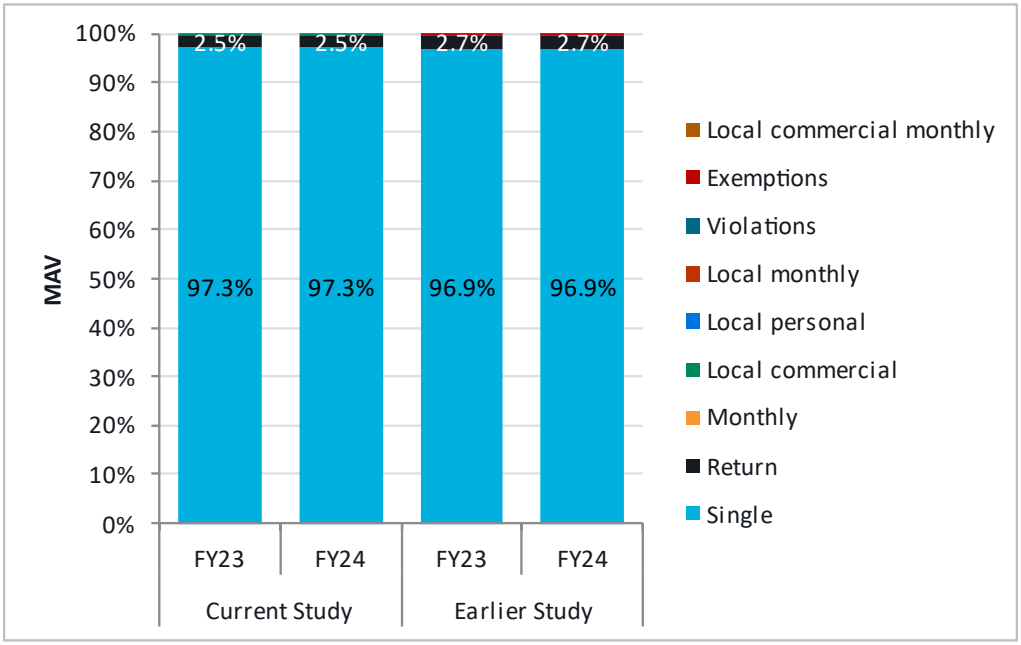
6.56 Segmentation: The segmentation for FY23 in the current study is based on the actual segmentation observed over the entire year as compared to earlier study, where the segmentation for FY23 was available only for initial 4 months. More data has provided better clarity and on ground realities, which we have accordingly considered for FY23 in the current study. Provided below is the comparison of segmentation considered in both studies.

Figure 6.13 CJV Segmentation Comparison at Darodha



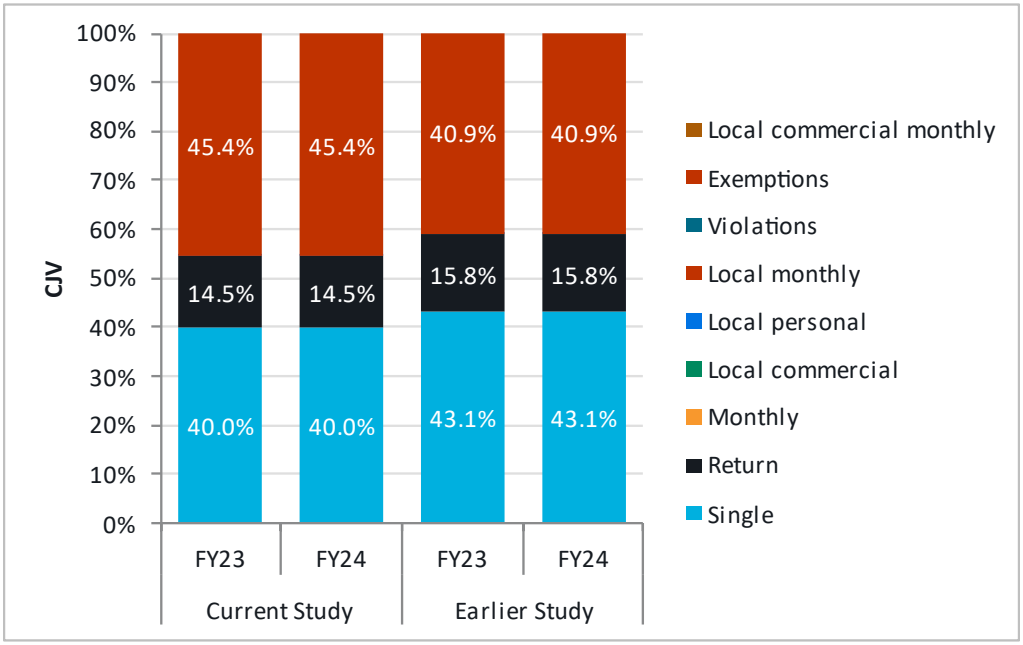
Source: Steer analysis

Figure 6.14 MAV Segmentation Comparison at Darodha



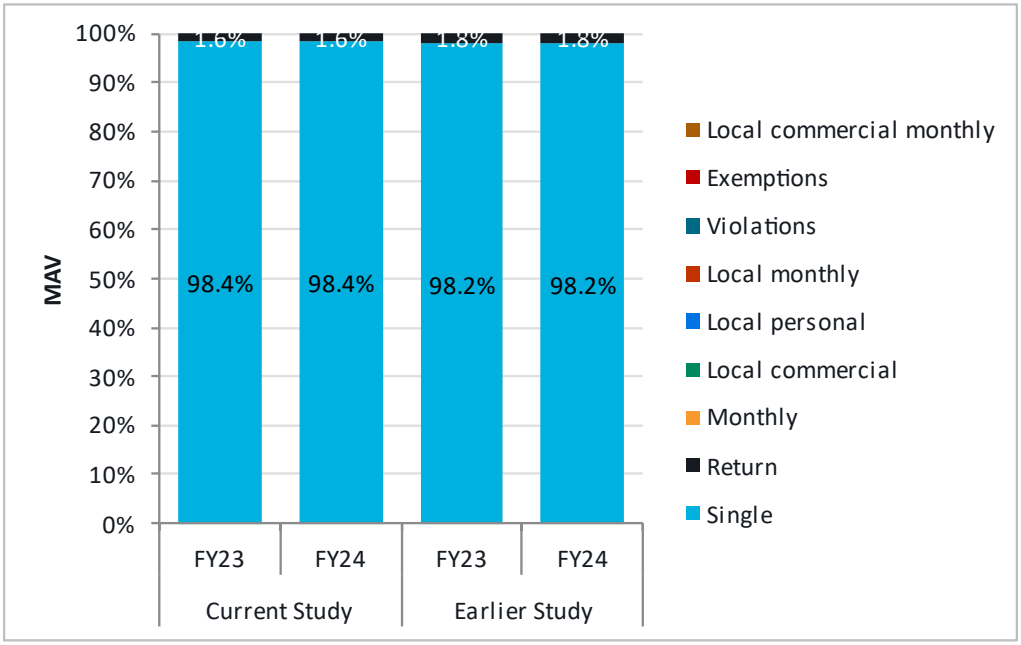
Source: Steer analysis

Figure 6.15 CJV Segmentation Comparison at Kelapur



Source: Steer analysis

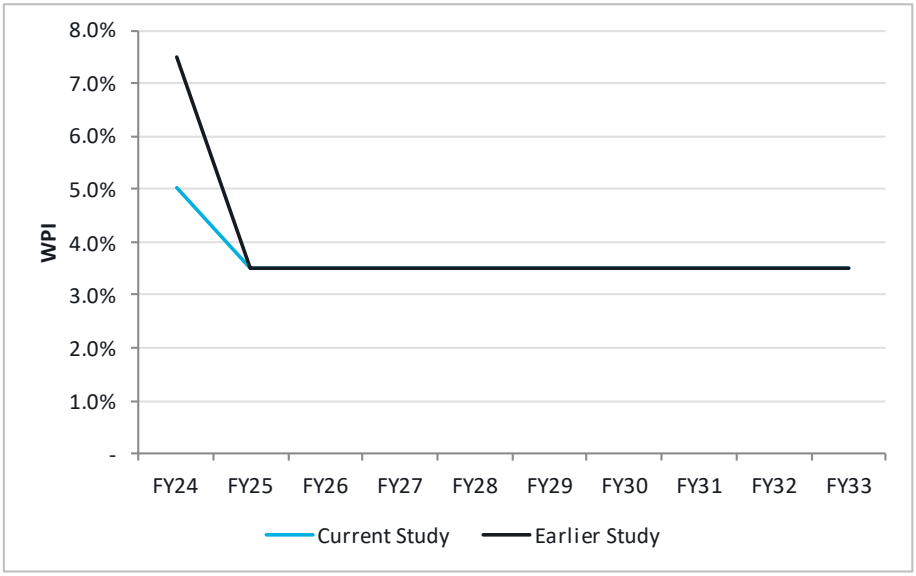
Figure 6.16 MAV Segmentation Comparison at Kelapur



Source: Steer analysis

6.57 Toll rates + WPI: At the time of earlier study in Aug-22, WPI of 7.5% was considered for FY24, which now has been considered as 5.02% based on actuals. WPI from FY25 is considered as 3.5% for all the years based on the recommendation of the Client. This has caused a variation in toll rates for FY24 and the subsequent years.

Figure 6.17 WPI Comparison



Source: Steer analysis, inputs from the Client on WPI forecasts

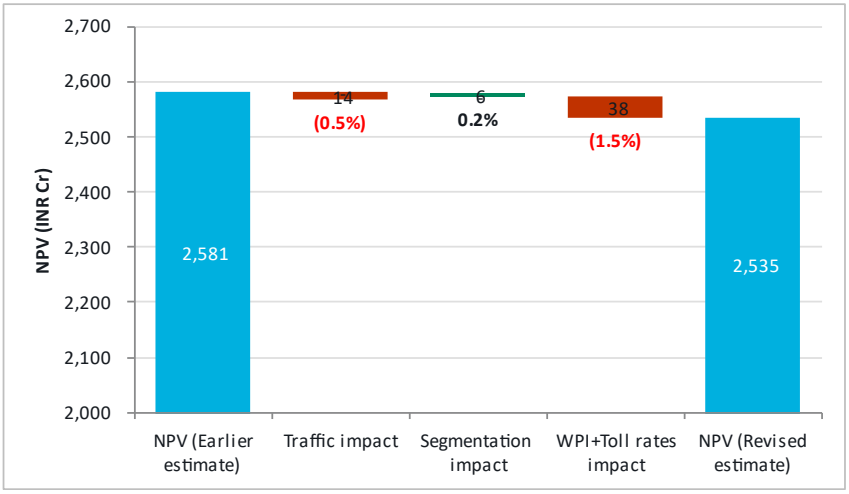
6.58 In addition to WPI, the tolling length hasn't varied (for Darodha) in the manner it was assumed in earlier study. This factor has also resulted in minor variation in toll rates.

Table 6.26: Tolling length comparison: BK - Darodha

Type of Vehicle	FY23	FY24	FY25 onwards
Earlier study	80.08 Km	80.08 Km	80.18 Km
Current study	74.30 Km till Oct-22 80.08 Km Nov-22 to Mar-23	80.08 Km	80.18 Km

6.59 As a result of this, the NPV has decreased by 1.8% (majorly due to variation in WPI factor) as compared to the NPV based on earlier study. A discount factor of 12% has been assumed (as per client input). Accordingly, presented below is the waterfall chart which explains the NPV difference between the studies:

Figure 6.18 NPV Waterfall Chart



Source: Steer analysis

6.60 Please note that the NPV is estimated for revenue over the period FY24 - FY43 and considers a discount rate of 12%. The table below summarizes the impact of individual factors:

Table 6.27 Summary of NPV Revenue analysis

Particular	NPV (INR Cr)	Absolute impact	Remarks
NPV Earlier Estimate (Drone I)	~ 2,581		Based on WPI of 7.5% for FY24 and 3.5% from FY25 onwards. It also subsumes same trip factors and tolling lengths for both earlier and revised studies
+ Revised traffic	~ 2,567	(0.5%)	Including revised impacts and GDP/ GSDP factors
+ Revised Segmentation	~ 2,573	+ 0.2%	
+ Revised WPI + Toll rates	~ 2,535	(1.5%)	Due to the difference in the estimated and actual WPI for FY24.

Source: Steer analysis

Scenario analysis

6.61 We have developed our base case scenario considering a balanced view on the risks associated with input assumptions around GDP growth and traffic growth elasticities. There is always a risk that the outturn values of these inputs will vary as compared to the assumptions taken due to exogenous impacts, e.g., GDP growth could be influenced both positively and negatively by the impact of monsoons, export-import balances, political changes etc.

6.62 Similarly, traffic growth elasticities could be influenced by increased efficiencies achieved by technology, large shifts in commodity prices globally, changes in local manufacturing practices. However, at this stage we consider that the base case represents a central case scenario given the risks of variation of input assumptions.

6.63 To account for the possible variations in the growth drivers, we are also presenting the forecasts for an Upside (optimistic) and a Downside (pessimistic) scenario.

Table 6.28 Summary of upside and downside scenario assumptions: BK: Darodha

Input	Base	Steer scenarios	
		Upside	Downside
Macro assumptions			
GDP/GSDP	As provided in report	+1% every year	-1% every year
Elasticities	As provided in report	+ 10%	- 10%
Impacts			
DME + SCE	As provided in report	2A: (1.9%) 3A: (0.4%) MAV: (1.9%)	2A: (3.1%) 3A: (0.7%) MAV: (3.1%)
Nagpur Vijayawada expressway	As provided in report	2A: (4.5%) 3A: (3.6%) MAV:(4.0%)	2A: (7.6%) 3A: (5.9%) MAV:(6.7%)
Raipur Hyderabad Economic Corridor	As provided in report	2A: (1.8%) 3A: (1.3%)	2A: (3.0%) 3A: (2.2%)

Input	Base	Steer scenarios	
		Upside	Downside
		MAV:(2.3%)	MAV:(3.8%)

Source: Steer Analysis

Table 6.29 Summary of upside and downside scenario assumptions: BK: Kelapur and Kelapur (new)

Input	Base	Steer scenarios	
		Upside	Downside
Macro assumptions			
GDP/GSDP	As provided in report	+1% every year	-1% every year
Elasticities	As provided in report	+ 10%	- 10%
Impacts			
DME + SCE	As provided in report	2A: (1.7%) 3A: (0.4%) MAV: (1.8%)	2A: (2.9%) 3A: (0.7%) MAV: (3.1%)
Nagpur Vijayawada expressway	As provided in report	2A: (4.3%) 3A: (3.6%) MAV:(4.0%)	2A: (7.1%) 3A: (5.9%) MAV:(6.6%)
Raipur Hyderabad Economic Corridor	As provided in report	2A: (1.7%) 3A: (1.3%) MAV:(2.2%)	2A: (2.8%) 3A: (2.2%) MAV:(3.7%)

Source: Steer Analysis

BK: Darodha

Upside case

Table 6.30 Final traffic forecasts: Upside case- BK Darodha

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	1,337	1,551	2,274	3,269	4,601	5,582
Mini LCV	583	634	781	948	1,133	1,251
LCV	434	471	562	681	812	897
Bus	221	232	264	296	330	351
2A	1,494	1,636	1,896	2,364	2,910	3,273
3A	1,380	1,533	1,903	2,459	3,132	3,590
MAV	1,929	2,238	3,012	4,330	6,093	7,393
OSV	1	2	2	3	4	5
AADT	**7,381**	**8,297**	**10,693**	**14,351**	**19,015**	**22,342**
PCU	**20,548**	**23,174**	**29,647**	**40,096**	**53,506**	**63,112**

Source: Steer Analysis

Table 6.31: Traffic growth rates (%): Upside case- BK Darodha

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	7.7%	7.9%	7.5%	7.1%	6.7%	7.4%

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
Mini LCV	4.2%	4.3%	3.9%	3.6%	3.4%	3.9%
LCV	4.2%	3.6%	3.9%	3.6%	3.4%	3.7%
Bus	2.5%	2.6%	2.4%	2.2%	2.0%	2.3%
2A	4.6%	3.0%	4.5%	4.2%	4.0%	4.0%
3A	5.4%	4.4%	5.3%	5.0%	4.7%	4.9%
MAV	7.7%	6.1%	7.5%	7.1%	6.7%	6.9%
OSV	6.9%	7.1%	6.8%	6.4%	6.0%	6.7%
AADT	**6.0%**	**5.2%**	**6.1%**	**5.8%**	**5.5%**	**5.7%**
PCU's	**6.2%**	**5.0%**	**6.2%**	**5.9%**	**5.7%**	**5.8%**

Source: Steer Analysis

Table 6.32: Revenue (INR Crore): Upside case- BK Darodha

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	3.64	5.00	8.90	15.80	27.08	36.84
Mini LCV	1.59	2.04	3.06	4.58	6.67	8.26
LCV	2.38	3.01	4.34	6.48	9.48	11.76
Bus	2.56	3.07	4.26	5.85	8.00	9.55
2A	17.31	22.28	31.56	48.11	72.67	91.94
3A	19.15	24.30	37.01	58.47	91.07	117.69
MAV	38.78	51.47	84.55	148.98	256.70	349.45
OSV	0.04	0.05	0.08	0.13	0.22	0.30
Total Revenue	**85.45**	**111.22**	**173.75**	**288.42**	**471.90**	**625.80**

Source: Steer Analysis

Table 6.33: Revenue growth rates (%): Upside case- BK Darodha

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	17.2%	12.2%	12.2%	11.4%	10.8%	12.3%
Mini LCV	13.4%	8.4%	8.4%	7.8%	7.4%	8.6%
LCV	12.5%	7.6%	8.3%	7.9%	7.5%	8.3%
Bus	9.5%	6.8%	6.6%	6.4%	6.1%	6.8%
2A	13.4%	7.2%	8.8%	8.6%	8.2%	8.7%
3A	12.7%	8.8%	9.6%	9.3%	8.9%	9.5%
MAV	15.2%	10.4%	12.0%	11.5%	10.8%	11.6%
OSV	14.2%	11.6%	11.1%	10.8%	10.2%	11.3%
Total Revenue	**14.1%**	**9.3%**	**10.7%**	**10.3%**	**9.9%**	**10.5%**

Source: Steer Analysis

Downside case

Table 6.34: Final traffic forecasts: Downside case- BK Darodha

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	1,337	1,460	1,838	2,275	2,766	3,080
Mini LCV	583	614	698	783	867	916
LCV	434	456	491	551	609	644
Bus	221	228	246	264	281	290
2A	1,494	1,576	1,564	1,780	2,003	2,138
3A	1,380	1,469	1,574	1,829	2,099	2,263
MAV	1,929	2,107	2,290	2,835	3,447	3,838
OSV	1	2	2	2	3	3
AADT	**7,381**	**7,912**	**8,703**	**10,318**	**12,074**	**13,172**
PCU	**20,548**	**22,065**	**23,739**	**28,268**	**33,216**	**36,319**

Table 6.35: Traffic growth rates (%): Downside case- BK Darodha

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	4.5%	4.7%	4.4%	4.0%	3.6%	4.3%
Mini LCV	2.6%	2.6%	2.3%	2.1%	1.9%	2.3%
LCV	2.5%	1.5%	2.3%	2.0%	1.9%	2.0%
Bus	1.5%	1.6%	1.4%	1.2%	1.1%	1.4%
2A	2.7%	(0.2%)	2.6%	2.4%	2.2%	1.8%
3A	3.1%	1.4%	3.1%	2.8%	2.6%	2.5%
MAV	4.5%	1.7%	4.4%	4.0%	3.6%	3.5%
OSV	4.0%	4.2%	3.9%	3.6%	3.3%	3.8%
AADT	**3.5%**	**1.9%**	**3.5%**	**3.2%**	**2.9%**	**2.9%**
PCU's	**3.6%**	**1.5%**	**3.6%**	**3.3%**	**3.0%**	**2.9%**

Table 6.36: Revenue (INR Crore): Downside case- BK Darodha

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	3.64	4.71	7.19	11.00	16.28	20.33
Mini LCV	1.59	1.98	2.73	3.78	5.10	6.05
LCV	2.38	2.92	3.80	5.24	7.11	8.44
Bus	2.56	3.01	3.98	5.21	6.80	7.91
2A	17.31	21.47	26.04	36.22	50.02	60.05
3A	19.15	23.28	30.61	43.48	61.03	74.20
MAV	38.78	48.46	64.29	97.54	145.21	181.41
OSV	0.04	0.04	0.07	0.10	0.14	0.18
Total Revenue	**85.45**	**105.86**	**138.71**	**202.57**	**291.70**	**358.55**

Source: Steer Analysis

Table 6.37: Revenue growth rates (%): Downside case- BK Darodha

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	13.7%	8.9%	8.9%	8.2%	7.7%	9.0%
Mini LCV	11.6%	6.7%	6.7%	6.2%	5.8%	6.9%
LCV	10.7%	5.4%	6.7%	6.3%	5.9%	6.5%
Bus	8.5%	5.7%	5.6%	5.5%	5.2%	5.8%
2A	11.4%	3.9%	6.8%	6.7%	6.3%	6.4%
3A	10.3%	5.6%	7.3%	7.0%	6.7%	7.0%
MAV	11.8%	5.8%	8.7%	8.3%	7.7%	8.0%
OSV	11.1%	8.6%	8.2%	7.9%	7.4%	8.4%
Total Revenue	**11.3%**	**5.6%**	**7.9%**	**7.6%**	**7.1%**	**7.4%**

Source: Steer Analysis

BK: Kelapur

Upside case

Table 6.38: Final traffic forecasts: Upside case- BK Kelapur

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	1,361	1,579	2,314	3,327	4,683	5,682
Mini LCV	553	601	741	899	1,074	1,186
LCV	410	445	530	642	766	846
Bus	277	291	330	371	413	439
2A	1,563	1,711	1,993	2,486	3,060	3,441
3A	1,375	1,528	1,896	2,451	3,120	3,577
MAV	1,965	2,279	3,072	4,415	6,214	7,539
OSV	1	2	2	3	4	5
AADT	**7,505**	**8,435**	**10,877**	**14,594**	**19,334**	**22,716**
PCU	**21,022**	**23,698**	**30,339**	**40,995**	**54,667**	**64,460**

Source: Steer Analysis

Table 6.39: Traffic growth rates (%): Upside case- BK Kelapur

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	7.7%	7.9%	7.5%	7.1%	6.7%	7.4%
Mini LCV	4.2%	4.3%	3.9%	3.6%	3.4%	3.9%
LCV	4.2%	3.6%	3.9%	3.6%	3.4%	3.7%
Bus	2.5%	2.6%	2.4%	2.2%	2.0%	2.3%
2A	4.6%	3.1%	4.5%	4.2%	4.0%	4.0%
3A	5.4%	4.4%	5.3%	5.0%	4.7%	4.9%
MAV	7.7%	6.2%	7.5%	7.1%	6.7%	7.0%
OSV	6.9%	7.1%	6.8%	6.4%	6.0%	6.7%
AADT	**6.0%**	**5.2%**	**6.1%**	**5.8%**	**5.5%**	**5.7%**

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
PCU's	**6.2%**	**5.1%**	**6.2%**	**5.9%**	**5.6%**	**5.8%**

Source: Steer Analysis

Table 6.40: Revenue (INR Crore) : Upside case-BK Kelapur

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	2.53	3.25	5.82	10.22	17.85	24.27
Mini LCV	1.03	1.24	1.86	2.76	4.09	5.07
LCV	2.20	2.61	3.80	5.64	8.26	10.33
Bus	3.08	3.57	4.96	6.78	9.31	11.06
2A	17.42	21.01	29.93	45.39	68.88	86.73
3A	18.64	22.91	34.60	54.91	85.38	109.90
MAV	38.56	49.28	80.95	142.84	245.73	335.70
OSV	0.03	0.04	0.08	0.13	0.21	0.29
Total Revenue	**83.50**	**103.91**	**161.99**	**268.67**	**439.71**	**583.35**

Source: Steer Analysis

Table 6.41: Revenue growth rates (%): Upside case-BK Kelapur

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	13.3%	12.4%	11.9%	11.8%	10.8%	12.0%
Mini LCV	9.7%	8.5%	8.2%	8.2%	7.4%	8.3%
LCV	8.8%	7.8%	8.3%	7.9%	7.8%	8.0%
Bus	7.7%	6.8%	6.4%	6.5%	5.9%	6.6%
2A	9.8%	7.3%	8.7%	8.7%	8.0%	8.4%
3A	10.9%	8.6%	9.7%	9.2%	8.8%	9.3%
MAV	13.0%	10.4%	12.0%	11.5%	11.0%	11.4%
OSV	12.5%	11.5%	11.1%	10.8%	10.3%	11.1%
Total Revenue	**11.6%**	**9.3%**	**10.6%**	**10.4%**	**9.9%**	**10.2%**

Source: Steer Analysis

Downside case

Table 6.42: Final traffic forecasts: Downside case-BK Kelapur

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	1,361	1,486	1,870	2,315	2,815	3,135
Mini LCV	553	582	661	742	822	868
LCV	410	431	463	519	574	607
Bus	277	285	308	330	351	363
2A	1,563	1,649	1,651	1,879	2,114	2,256
3A	1,375	1,463	1,568	1,822	2,091	2,255
MAV	1,965	2,145	2,338	2,894	3,519	3,919
OSV	1	2	2	2	3	3

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
AADT	**7,505**	**8,044**	**8,862**	**10,504**	**12,290**	**13,406**
PCU	**21,022**	**22,569**	**24,340**	**28,965**	**34,018**	**37,185**

Source: Steer Analysis

Table 6.43: Traffic growth rates (%): Downside case-BK Kelapur

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	4.5%	4.7%	4.4%	4.0%	3.6%	4.3%
Mini LCV	2.6%	2.6%	2.3%	2.1%	1.9%	2.3%
LCV	2.5%	1.5%	2.3%	2.0%	1.9%	2.0%
Bus	1.5%	1.6%	1.4%	1.2%	1.1%	1.4%
2A	2.7%	0.0%	2.6%	2.4%	2.2%	1.9%
3A	3.1%	1.4%	3.1%	2.8%	2.6%	2.5%
MAV	4.5%	1.7%	4.4%	4.0%	3.6%	3.5%
OSV	4.0%	4.2%	3.9%	3.6%	3.3%	3.8%
AADT	**3.5%**	**2.0%**	**3.5%**	**3.2%**	**2.9%**	**2.9%**
PCU's	**3.6%**	**1.5%**	**3.5%**	**3.3%**	**3.0%**	**2.9%**

Source: Steer Analysis

Table 6.44: Revenue (INR Crore) : Downside case- BK Kelapur

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	2.53	3.06	4.70	7.11	10.73	13.39
Mini LCV	1.03	1.20	1.66	2.28	3.13	3.71
LCV	2.20	2.53	3.32	4.56	6.19	7.41
Bus	3.08	3.50	4.63	6.03	7.91	9.15
2A	17.42	20.25	24.80	34.31	47.60	56.87
3A	18.64	21.95	28.62	40.83	57.21	69.28
MAV	38.56	46.40	61.62	93.64	139.18	174.48
OSV	0.03	0.04	0.06	0.09	0.14	0.17
Total Revenue	**83.50**	**98.91**	**129.42**	**188.85**	**272.09**	**334.46**

Source: Steer Analysis

Table 6.45: Revenue growth rates (%): Downside case- BK Kelapur

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	10.0%	9.0%	8.6%	8.6%	7.7%	8.7%
Mini LCV	7.9%	6.8%	6.5%	6.6%	5.8%	6.6%
LCV	7.1%	5.6%	6.6%	6.3%	6.2%	6.3%
Bus	6.6%	5.7%	5.4%	5.6%	5.0%	5.6%
2A	7.8%	4.1%	6.7%	6.8%	6.1%	6.1%
3A	8.5%	5.5%	7.4%	7.0%	6.6%	6.8%
MAV	9.7%	5.8%	8.7%	8.2%	7.8%	7.8%

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
OSV	9.5%	8.5%	8.1%	7.9%	7.4%	8.2%
Total Revenue	**8.8%**	**5.5%**	**7.9%**	**7.6%**	**7.1%**	**7.2%**

Source: Steer Analysis

BK: Kelapur (new)

Upside case

Table 6.46: Final traffic forecasts: Upside case- BK: Kelapur (new)

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	1,345	1,561	2,287	3,289	4,629	5,616
Mini LCV	569	618	762	925	1,104	1,220
LCV	410	445	530	642	766	846
Bus	223	234	266	299	333	353
2A	1,617	1,770	2,062	2,572	3,166	3,560
3A	1,263	1,403	1,741	2,251	2,866	3,286
MAV	1,953	2,266	3,054	4,390	6,178	7,496
OSV	1	2	2	3	4	5
AADT	**7,382**	**8,298**	**10,704**	**14,370**	**19,046**	**22,382**
PCU	**20,635**	**23,271**	**29,803**	**40,309**	**53,795**	**63,457**

Source: Steer Analysis

Table 6.47: Traffic growth rates (%): Upside case BK: Kelapur (new)

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	7.7%	7.9%	7.5%	7.1%	6.7%	7.4%
Mini LCV	4.2%	4.3%	3.9%	3.6%	3.4%	3.9%
LCV	4.2%	3.6%	3.9%	3.6%	3.4%	3.7%
Bus	2.5%	2.6%	2.4%	2.2%	2.0%	2.3%
2A	4.6%	3.1%	4.5%	4.2%	4.0%	4.0%
3A	5.4%	4.4%	5.3%	5.0%	4.7%	4.9%
MAV	7.7%	6.2%	7.5%	7.1%	6.7%	7.0%
OSV	6.9%	7.1%	6.8%	6.4%	6.0%	6.7%
AADT	**6.0%**	**5.2%**	**6.1%**	**5.8%**	**5.5%**	**5.7%**
PCU's	**6.2%**	**5.1%**	**6.2%**	**5.9%**	**5.7%**	**5.8%**

Source: Steer Analysis

Table 6.48: Revenue (INR Crore): Upside case BK: Kelapur (new)

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	2.52	3.99	7.15	12.56	21.92	29.82
Mini LCV	1.06	1.58	2.38	3.53	5.23	6.48
LCV	2.21	2.66	3.87	5.75	8.41	10.52
Bus	2.48	2.94	4.08	5.57	7.65	9.09

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
2A	18.04	22.48	32.02	48.58	73.69	92.80
3A	17.35	21.04	31.78	50.43	78.42	100.94
MAV	38.69	49.00	80.48	142.01	244.32	333.76
OSV	0.04	0.04	0.08	0.13	0.21	0.29
Total Revenue	**82.38**	**103.73**	**161.83**	**268.57**	**439.84**	**583.69**

Source: Steer Analysis

Table 6.49: Revenue growth rates (%): Upside case-BK: Kelapur (new)

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	26.0%	12.4%	11.9%	11.8%	10.8%	13.2%
Mini LCV	21.9%	8.5%	8.2%	8.2%	7.4%	9.5%
LCV	9.8%	7.8%	8.3%	7.9%	7.7%	8.1%
Bus	8.8%	6.8%	6.5%	6.5%	5.9%	6.7%
2A	11.6%	7.3%	8.7%	8.7%	8.0%	8.5%
3A	10.1%	8.6%	9.7%	9.2%	8.8%	9.2%
MAV	12.5%	10.4%	12.0%	11.5%	11.0%	11.4%
OSV	12.1%	11.5%	11.1%	10.8%	10.3%	11.1%
Total Revenue	**12.2%**	**9.3%**	**10.7%**	**10.4%**	**9.9%**	**10.3%**

Source: Steer Analysis

Downside case

Table 6.50: Final traffic forecasts: Downside case- BK: Kelapur (new)

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	1,345	1,469	1,849	2,289	2,783	3,099
Mini LCV	569	598	680	763	845	893
LCV	410	431	463	519	574	607
Bus	223	230	248	266	283	292
2A	1,617	1,706	1,708	1,944	2,188	2,334
3A	1,263	1,344	1,440	1,674	1,920	2,071
MAV	1,953	2,133	2,325	2,878	3,499	3,896
OSV	1	2	2	2	3	3
AADT	**7,382**	**7,913**	**8,715**	**10,334**	**12,095**	**13,195**
PCU	**20,635**	**22,158**	**23,883**	**28,440**	**33,419**	**36,541**

Source: Steer Analysis

Table 6.51: Traffic growth rates (%): Downside case-BK: Kelapur (new)

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	4.5%	4.7%	4.4%	4.0%	3.6%	4.3%
Mini LCV	2.6%	2.6%	2.3%	2.1%	1.9%	2.3%

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
LCV	2.5%	1.5%	2.3%	2.0%	1.9%	2.0%
Bus	1.5%	1.6%	1.4%	1.2%	1.1%	1.4%
2A	2.7%	0.0%	2.6%	2.4%	2.2%	1.9%
3A	3.1%	1.4%	3.1%	2.8%	2.6%	2.5%
MAV	4.5%	1.7%	4.4%	4.0%	3.6%	3.5%
OSV	4.0%	4.2%	3.9%	3.6%	3.3%	3.8%
AADT	**3.5%**	**2.0%**	**3.5%**	**3.2%**	**2.9%**	**2.9%**
PCU's	**3.6%**	**1.5%**	**3.6%**	**3.3%**	**3.0%**	**2.9%**

Source: Steer Analysis

Table 6.52: Revenue (INR Crore) : Downside case-BK: Kelapur (new)

Vehicle Type	FY23	FY25	FY30	FY35	FY40	FY43
CJV	2.52	3.76	5.78	8.74	13.18	16.45
Mini LCV	1.06	1.53	2.13	2.91	4.00	4.74
LCV	2.21	2.57	3.38	4.65	6.30	7.54
Bus	2.48	2.88	3.81	4.96	6.50	7.52
2A	18.04	21.66	26.53	36.72	50.92	60.84
3A	17.35	20.16	26.28	37.50	52.55	63.64
MAV	38.69	46.13	61.27	93.10	138.37	173.47
OSV	0.04	0.04	0.06	0.09	0.14	0.17
Total Revenue	**82.38**	**98.73**	**129.23**	**188.67**	**271.96**	**334.38**

Source: Steer Analysis

Table 6.53: Revenue growth rates (%): Downside case-BK: Kelapur (new)

Vehicle Type	FY23-FY25	FY25-FY30	FY30-FY35	FY35-FY40	FY40-FY43	FY23-FY43
CJV	22.2%	9.0%	8.6%	8.6%	7.7%	9.8%
Mini LCV	20.0%	6.8%	6.5%	6.5%	5.8%	7.8%
LCV	8.0%	5.6%	6.6%	6.3%	6.2%	6.3%
Bus	7.7%	5.7%	5.4%	5.6%	5.0%	5.7%
2A	9.6%	4.1%	6.7%	6.8%	6.1%	6.3%
3A	7.8%	5.5%	7.4%	7.0%	6.6%	6.7%
MAV	9.2%	5.8%	8.7%	8.2%	7.8%	7.8%
OSV	9.1%	8.5%	8.1%	7.9%	7.4%	8.1%
Total Revenue	**9.5%**	**5.5%**	**7.9%**	**7.6%**	**7.1%**	**7.3%**

Source: Steer Analysis

Summary outlook

6.64 The analysis presented in this report and the methodology followed adopted presents a custom approach compared to a standard traffic and revenue forecasting approach. We have utilised information from various sources, backed by our knowledge of toll roads in the regional setting of the study Asset, in order to triangulate a robust base T&R position before

presenting our views on other key topics, such as base year AADT and revenue, growth forecasts, and traffic segmentation.

6.65 Overall, we believe, we have tabled a robust set of forecast numbers underpinned by a rigorous base T&R position, background growth, exogenous impacts coupled with our unparallel market knowledge of the toll road industry in India.

6.66 The Asset lies on the NH44 which is the key corridor for long distance traffic movements between Delhi and North India to southern states such as Telangana, Karnataka and Tamil Nadu. The traffic movement on the Asset is also supported by industries near Nagpur, Hyderabad and Bengaluru.

6.67 Kelapur plaza is planned to be relocated 6km south from its existing location which is expected to improve the operational efficiency in tolling operations, hence improved compliance in CJV traffic is expected on the Kelapur New Plaza.

6.68 The proposed upgrades on NH52 coupled with Delhi Mumbai Expressway and development of Solapur Kurnool section of Surat-Kurnool-Chennai Expressway would improve the overall attractiveness of the route in comparison to NH7 for long-distance North-South traffic movements. Additionally, the development of Nagpur-Vijaywada expressway under the Bharatmala Pariyojana would act as an alternate for long-distance traffic moving between north of Nagpur to Vijawada and south. About 50% of the negative impact is expected in the first year of operations in FY28 and the rest is staggered in the next two subsequent years.

6.69 Overall, we believe that the Asset have a robust traffic profile as connects key centres of economic growth across the spinal cord of the country. As seen historically, all the industrial nodes along the corridor have grown in line with the country's economic growth. This along with salient features like shortest route among alternatives, local richness of agriculture and allied industry like cotton and food processing and established and growing trade relationship with neighbouring state, it is reasonable to believe that the underlying growth drivers of the corridor are strong and are expected to deliver long term sustained growth.

Appendices

A Data collection exercise

A.1 Below you can find the Zone list used for OD Analysis for both Assets:

OD analysis

Zone list

Table A.1: Zone list used for OD Analysis at BK

Zone No	Zone name	Description/State
1	Hinganghat	Maharashtra
2	Karanji	Maharashtra
3	Deodhari	Maharashtra
4	Wadner	Maharashtra
5	Nirmal	Telangana
6	Adilabad(U)	Telangana
7	Jamb	Maharashtra
8	Kandlakoya	Telangana
9	Chegunta	Telangana
10	Kamareddy	Telangana
11	Nadepalle	Telangana
12	Gudihathinur	Telangana
13	Pandharkawada	Telangana
14	Wadki	Maharashtra
15	Khatara	Maharashtra
16	Bori	Maharashtra
17	Ramayampet	Telangana
18	Kallakal	Maharashtra
19	Armur	Telangana
20	Ichoda	Telangana
21	Butibori	Maharashtra
22	Sonegaon	Maharashtra
23	Shedgaon Pati	Maharashtra
24	Borkhedi	Maharashtra
25	Darodha	Maharashtra
26	Kelapur	Maharashtra
27	Adilabad	Telangana
28	Komaram Bheem Asifabad	Telangana
29	Bhadradri Kothagudem	Telangana
30	Hyderabad	Telangana
31	Jagtial	Telangana
32	Jangaon	Telangana
33	Jayashankar Bhupalpally	Telangana
34	Jogulamba Gadwal	Telangana
35	Kamareddy	Telangana

Zone No	Zone name	Description/State
36	Karimnagar	Telangana
37	Khammam	Telangana
38	Mahabubabad	Telangana
39	Mahbubnagar	Telangana
40	Mancherial	Telangana
41	Medak	Telangana
42	Medchal	Telangana
43	Mulugu	Telangana
44	Narayanpet	Telangana
45	Nalgonda	Telangana
46	Nagarkurnool	Telangana
47	Nirmal	Telangana
48	Nizamabad	Telangana
49	Peddapalli	Telangana
50	Rajanna Sircilla	Telangana
51	Ranga Reddy	Telangana
52	Sangareddy	Telangana
53	Siddipet	Telangana
54	Suryapet	Telangana
55	Vikarabad	Telangana
56	Wanaparthy	Telangana
57	Warangal (Urban)	Telangana
58	Warangal (Rural)	Telangana
59	Yadadri Bhuvanagiri	Telangana
60	Ahmednagar	Maharashtra
61	Akola	Maharashtra
62	Amravati	Maharashtra
63	Aurangabad	Maharashtra
64	Beed	Maharashtra
65	Bhandara	Maharashtra
66	Buldhana	Maharashtra
67	Chandrapur	Maharashtra
68	Dhule	Maharashtra
69	Gadchiroli	Maharashtra
70	Gondia	Maharashtra
71	Hingoli	Maharashtra
72	Jalgaon	Maharashtra
73	Jalna	Maharashtra
74	Kolhapur	Maharashtra
75	Latur	Maharashtra
76	Mumbai City	Maharashtra
77	Mumbai Suburban	Maharashtra
78	Nanded	Maharashtra
79	Nandurbar	Maharashtra
80	Nagpur	Maharashtra
81	Nashik	Maharashtra
82	Osmanabad	Maharashtra
83	Palghar	Maharashtra
84	Parbhani	Maharashtra
85	Pune	Maharashtra

Zone No	Zone name	Description/State
86	Raigad	Maharashtra
87	Ratnagiri	Maharashtra
88	Sangli	Maharashtra
89	Satara	Maharashtra
90	Sindhudurg	Maharashtra
91	Solapur	Maharashtra
92	Thane	Maharashtra
93	Wardha	Maharashtra
94	Washim	Maharashtra
95	Yavatmal	Maharashtra
96	Ujjain region	Madhya Pradesh
97	Bhopal region	Madhya Pradesh
98	Narmadapuram region	Madhya Pradesh
99	Sagar region	Madhya Pradesh
100	Rewa region	Madhya Pradesh
101	Shahdol region	Madhya Pradesh
102	Gwalior and Chambal region	Madhya Pradesh
103	Chennai region	Tamil Nadu
104	Coimbatore region	Tamil Nadu
105	Madurai region	Tamil Nadu
106	Trichy region	Tamil Nadu
107	Bangalore	Karnataka
108	Anantapur	Andhra Pradesh
109	Chittoor	Andhra Pradesh
110	East Godavari	Andhra Pradesh
111	Guntur	Andhra Pradesh
112	Ysr Kadapa	Andhra Pradesh
113	Krishna	Andhra Pradesh
114	Kurnool	Andhra Pradesh
115	Prakasam	Andhra Pradesh
116	Nellore	Andhra Pradesh
117	Srikakulam	Andhra Pradesh
118	Vishakhapatnam	Andhra Pradesh
119	Vizianagaram	Andhra Pradesh
120	West Godavari	Andhra Pradesh
121	Delhi	Delhi (UT)
122	East Uttar Pradesh	Uttar Pradesh
123	West Uttar Pradesh	Uttar Pradesh
124	North Karnataka	Karnataka
125	South Karnataka	Karnataka
126	Andaman & Nicobar	Andaman & Nicobar
127	Sikkim	Sikkim
128	North eastern states	North eastern states
129	Bihar	Bihar
130	Chandigarh	Chandigarh
131	Rest of Chhattishgarh	Chhattishgarh
132	Daman and Diu and Dadra and Nagar Haveli	Daman and Diu and Dadra and Nagar Haveli
133	Goa	Goa
134	Rest of Gujarat	Gujarat
135	Himachal Pradesh	Himachal Pradesh

Zone No	Zone name	Description/State
136	Jammu and Kashmir	Jammu and Kashmir
137	Jharkhand	Jharkhand
138	Kerala	Kerala
139	Ladakh	Ladakh
140	Lakshadweep	Lakshadweep
141	Odisha	Odisha
142	Puducherry	Puducherry
143	Punjab	Punjab
144	Rajasthan	Rajasthan
145	Uttarakhand	Uttarakhand
146	West Bengal	West Bengal
147	Haryana	Haryana
148	Rest of Andhra Pradesh	Andhra Pradesh
149	Raipur	Chhattishgarh
150	NTR district, Vijaywada	Andhra Pradesh
151	Ongole	Andhra Pradesh
152	Guntur	Andhra Pradesh
153	Kavali	Andhra Pradesh
154	Nandyal	Andhra Pradesh
155	Tirupati	Andhra Pradesh
156	Ahmedabad	Gujarat
157	Vadodara	Gujarat
158	Gandhinagar	Gujarat
159	Rajkot	Gujarat
160	Surat	Gujarat

Source: Steer representation

Top OD pairs

A.2 Further to the OD analysis presented in Chapter 3 this appendix presents the OD maps for 3A+MAVs along with top 10 OD pairs at each toll plaza.

Table A.2: BK Darodha: 3A/MAV top 10 OD pair shares

	OD Pair	Share
1.	Hyderabad - Nagpur	10.68%
2.	Hyderabad - Delhi	8.97%
3.	Chennai region - Delhi	7.86%
4.	Bangalore - Delhi	7.59%
5.	Nagpur - Bangalore	4.03%
6.	Nagpur - Chennai region	3.49%
7.	Hyderabad - East Uttar Pradesh	2.28%
8.	Adilabad - Nagpur	1.78%
9.	Bangalore - East Uttar Pradesh	1.65%
10.	Hyderabad – Bhopal region	1.44%

Source: Steer analysis

Table A.3: BK Kelapur: 3A/MAV top 10 OD pair shares

	OD Pair	Share
1.	Chennai region - Delhi	6.38%
2.	Hyderabad - Nagpur	5.94%
3.	Hyderabad - Delhi	4.85%
4.	Bangalore - Delhi	4.15%
5.	Nagpur - Chennai region	3.49%
6.	Nagpur - Bangalore	2.53%
7.	Bangalore - East Uttar Pradesh	2.18%
8.	Adilabad - Nagpur	1.92%
9.	Chennai region – Rajasthan	1.88%
10.	Chennai region - Raipur	1.83%

Source: Steer analysis

TVC count

A.3 The TVC counts recorded at each toll plaza can be seen below. These counts form an important part of TVC-toll plaza data analysis which contributes significantly to our base estimation exercise:

Table A.4: BK Darodha: Daily TVC

Date	CJV	Mini LCV	LCV	Bus	2 Axle	3 Axle	MAV	OSV	Total
28-02-2023	1,473	752	804	207	1,162	1,288	1,845	3	7,534
01-03-2023	1,485	803	906	206	1,283	1,324	2,043	-	8,050
02-03-2023	1,456	828	863	194	1,440	1,469	2,167	2	8,419
03-03-2023	1,378	770	859	190	1,399	1,599	2,236	3	8,434
04-03-2023	1,893	708	931	207	1,414	1,592	2,158	-	8,903
05-03-2023	2,045	384	823	213	1,509	1,499	2,185	1	8,659

Source: Steer analysis

Table A.5: BK Kelapur: Daily TVC

Date	CJV	Mini LCV	LCV	Bus	2 Axle	3 Axle	MAV	OSV	Total
28-02-2023	1,324	667	771	256	1,215	1,348	2,042	3	7,626
01-03-2023	1,251	586	782	256	1,398	1,362	2,123	-	7,758
02-03-2023	1,205	595	810	267	1,592	1,443	2,312	2	8,226
03-03-2023	1,387	552	784	255	1,508	1,623	2,324	2	8,435
04-03-2023	1,690	593	857	270	1,501	1,622	2,254	1	8,788
05-03-2023	1,538	419	761	236	1,618	1,574	2,344	-	8,490

Source: Steer analysis

Table A.6: BK Kelapur New: Daily TVC for 3 days

Date	CJV	Mini LCV	LCV	Bus	2 Axle	3 Axle	MAV	OSV	Total
01-03-2023	1,433	639	810	214	1,436	1,213	2,118	-	7,863
02-03-2023	1,305	568	781	208	1,600	1,351	2,297	2	8,112
03-03-2023	1,534	599	819	211	1,542	1,503	2,305	2	8,515

Source: Steer analysis

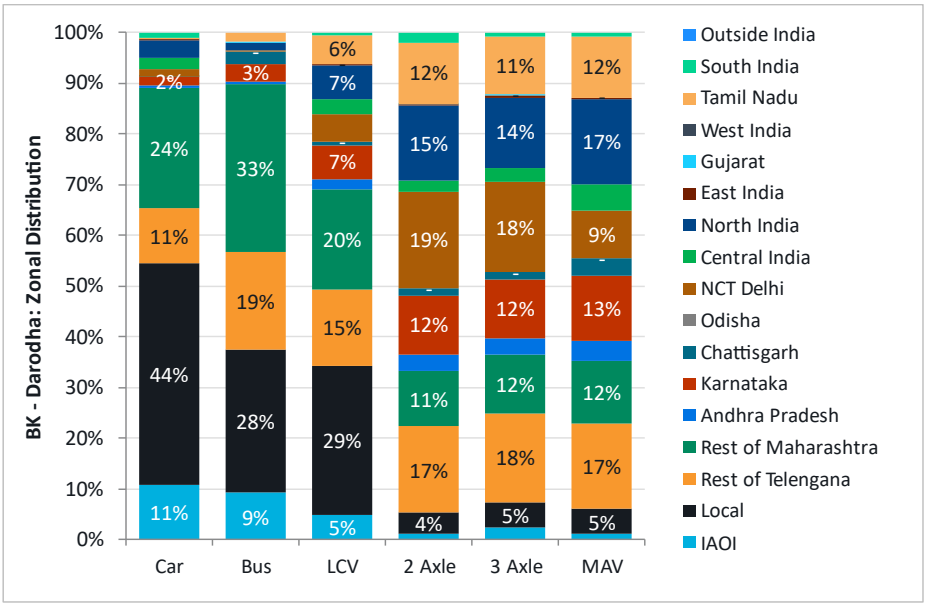
B Data collection (earlier study)

B.1 This section covers the outputs of OD analysis from the earlier study undertaken in Aug-22.

B.2 Car and bus trips are generally focused on catering to the local demands of the users and hence, the influence is dominated by local and rest of state movements. The local movement is typically observed between Hinganghat, Wadner, Badki, and Nagpur.

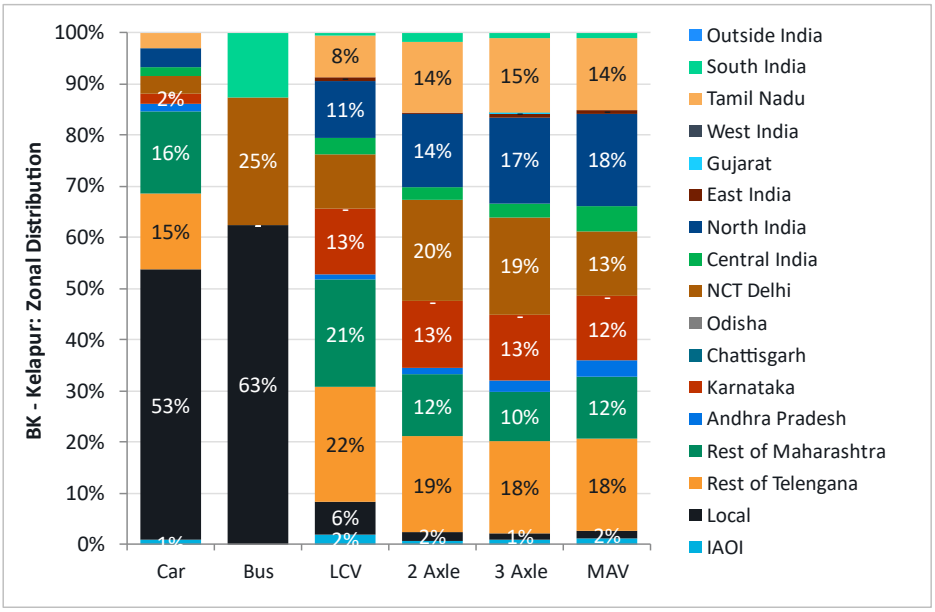
B.3 As both the plazas cater to the same movement of traffic, the zonal influence is also similar.

Figure B.1: Darodha: Zonal Distribution



Source: Steer analysis of OD data

Figure B.2: BK Kelapur: Zonal Distribution

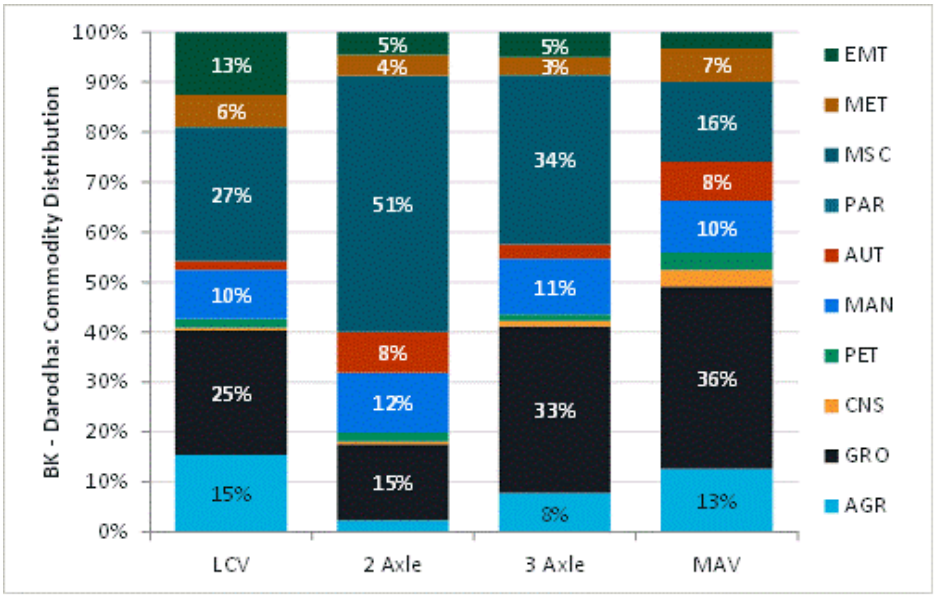


Source: Steer analysis of OD data

B.4 It was observed that, manufacturing goods have the next highest share in the commodities, which comprise of diversity of goods such as plastic, rubber, textiles, pipes, tyres, electronic goods, etc. These are being transported from industrial centres of Maharashtra, Gujarat, Hyderabad, Gwalior, Indore, parts of south India to Delhi NCR, Haridwar, Agra, Mathura, Punjab, Haryana, and other north India regions. Following this is agriculture, which is largely being carried long distance by bigger truck segment- 3A+MAV.

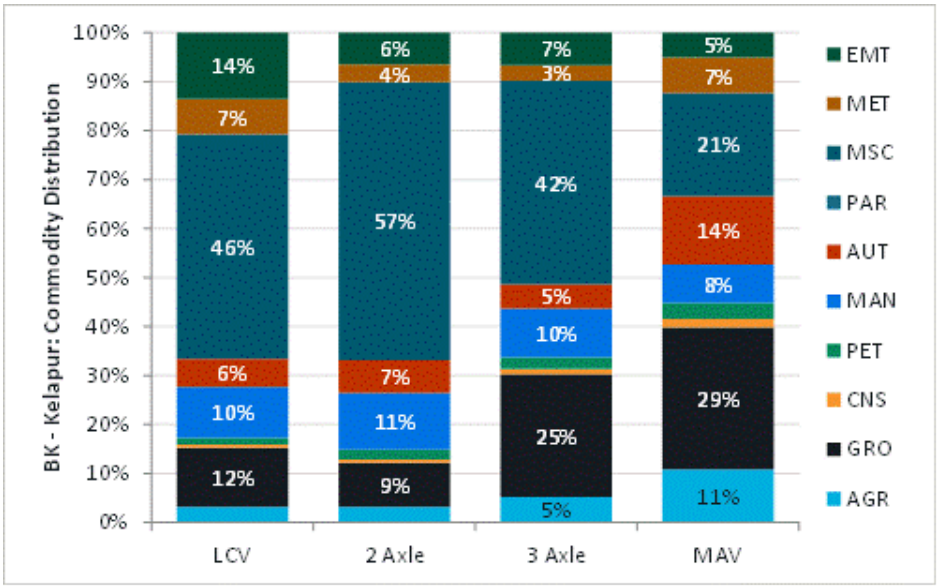
B.5 A mix of agricultural commodities such as lentils, cotton, spices, onions, wheat, etc is being carried across similar locations originating from south and West India regions to major vegetable wholesale markets of Delhi, Agra, Kolkata, Haryana and Punjab, among other regions.

Figure B.3: Commodity Distribution at Darodha



Source: Steer analysis of OD data

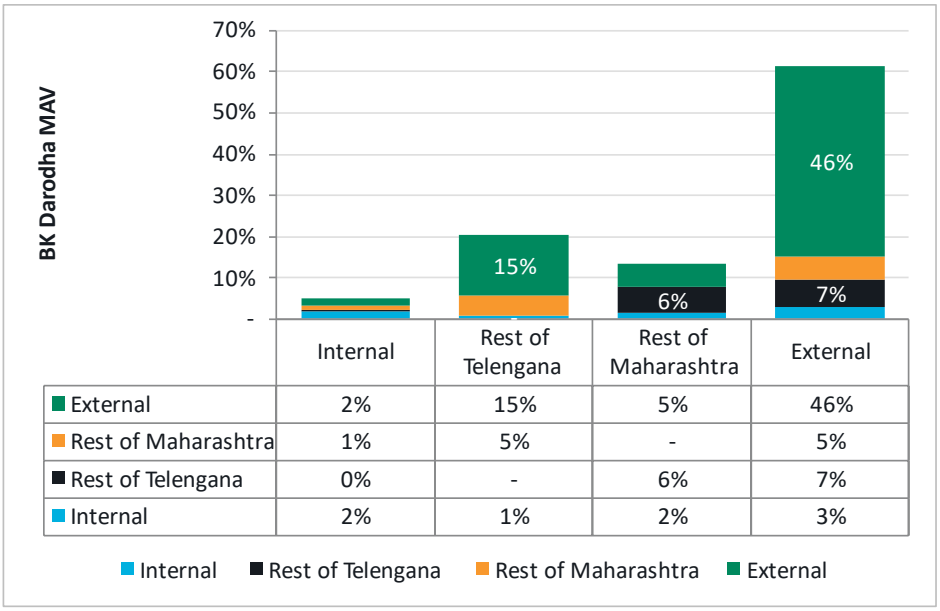
Figure B.4: Commodity Distribution at Kelapur



Source: Steer analysis of OD data

B.6 The internal-external distribution further validates the strategic nature of the asset, with more than 70% influence pertaining to zones that are external. This is further to the zonal distribution that showed that Local and Rest of the State had relatively less influence on the Asset, while aggregate of the remaining zones categorized as External exert the significant proportion of influence on the traffic. This validates that the long-distance nature of the Asset, facilitating long distance through movement—that is trips that originate and end outside of Uttar Pradesh, traversing via the Asset.

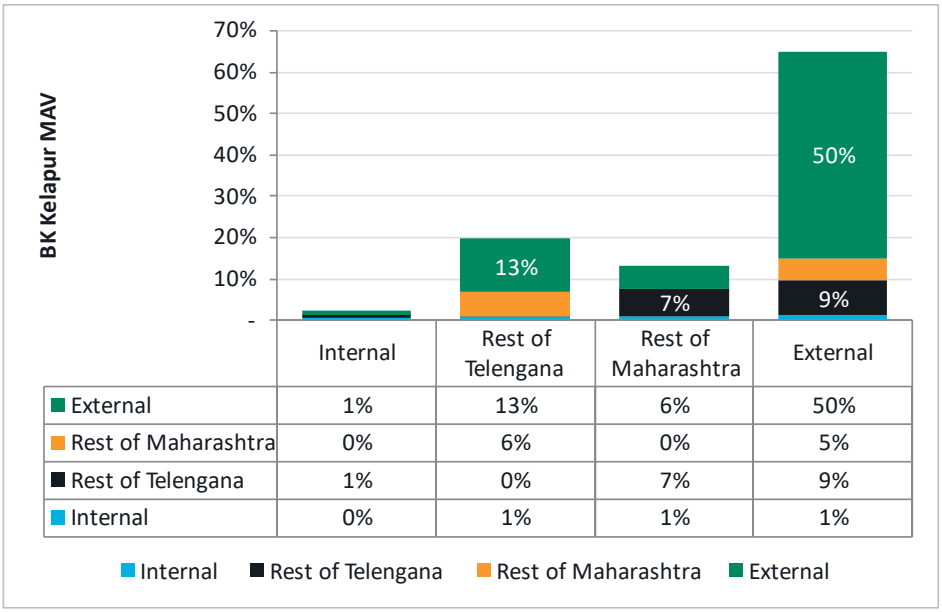
Figure B.5: BK Darodha: Internal-External analysis



	Internal	Rest of Telengana	Rest of Maharashtra	External
External	2%	15%	5%	46%
Rest of Maharashtra	1%	5%	-	5%
Rest of Telengana	0%	-	6%	7%
Internal	2%	1%	2%	3%

Source: Steer analysis of OD data

Figure B.6: BK Kelapur: Internal-External Analysis



	Internal	Rest of Telengana	Rest of Maharashtra	External
External	1%	13%	6%	50%
Rest of Maharashtra	0%	6%	0%	5%
Rest of Telengana	1%	0%	7%	9%
Internal	0%	1%	1%	1%

Source: Steer analysis of OD data

B.7 The internal-external distribution further validates the strategic nature of the Asset, with more than 70% influence pertaining to zones that are external. This is further to the zonal distribution that showed that Local and Rest of the State had relatively less influence on 2A/3A/MAVs on the Asset, while aggregate of the remaining zones categorized as External exert the significant proportion of influence on the traffic. This validates that the long-distance nature of the Asset, facilitating long distance through movement—that is trips that originate and end outside of Maharashtra, traversing via the Asset.

B.8 Since the Asset is located on Maharashtra – Telangana border, the remaining trips are influenced by zones present in the mentioned states.

C IHMCL and Schedule-M Data

IHMCL Data

C.1 The converted AADTs and the corresponding long-term CAGR is shown below.

Table C.1: Adjusted IHMCL counts-BK: Darodha

Vehicle	FY16	FY17	FY18	FY19	FY20	FY21	FY16-18	FY18-20
CJV	840	982	945	1,194	1,299	2,101	6.0%	17.2%
LCV	282	359	462	615	646	802	28.0%	18.2%
Bus/2A	432	402	473	605	713	907	4.6%	22.8%
3A	934	788	933	1,212	1,394	1,547	(0.0%)	22.3%
MAV	456	582	825	1,129	1,349	1,273	34.6%	27.9%
Total	**2,943**	**3,113**	**3,638**	**4,755**	**5,401**	**6,630**	**11.2%**	**21.8%**
PCU	**7,409**	**7,709**	**9,569**	**12,647**	**14,660**	**16,394**	**13.6%**	**23.8%**

Source: Steer analysis

Table C.2: Adjusted IHMCL counts-BK: Kelapur

Vehicle	FY15	FY17	FY18	FY19	FY21	FY15-18	FY19-21	FY15-21
CJV	1,140	1,424	1,447	1,523	1,806	8.3%	8.9%	8.0%
LCV	391	509	411	635	772	1.7%	10.2%	12.0%
Bus/2A	580	691	584	736	1,380	0.3%	37.0%	15.6%
3A	1,103	1,065	851	1,235	1,640	(8.3%)	15.3%	6.8%
MAV	443	741	640	1,205	1,694	13.0%	18.6%	25.0%
Total	**3,657**	**4,430**	**3,933**	**5,334**	**7,293**	**2.5%**	**16.9%**	**12.2%**
PCU	**8,770**	**10,789**	**9,249**	**13,809**	**19,649**	**1.8%**	**19.3%**	**14.4%**

Source: Steer analysis

Schedule-M Data

C.2 Schedule M data is available on monthly basis starting November 2017 till September 2020 for Darodha plaza and from February 2020 till June 2021 for Kelapur plaza. The data is presented in the figure below.

Table C.3: AADT from Schedule M data-BK: Darodha

Vehicle	FY18	FY19	FY20	FY21	FY18-19	FY19-20	FY20-21	FY18-20
CJV	847	1,032	1,042	746	21.7%	1.0%	(28.4%)	10.9%
LCV	531	546	516	364	2.9%	(5.4%)	(29.5%)	(1.4%)

Vehicle	FY18	FY19	FY20	FY21	FY18-19	FY19-20	FY20-21	FY18-20
Bus/2A	629	843	888	528	34.0%	5.4%	(40.5%)	18.8%
3A	752	952	1,118	750	26.5%	17.4%	(32.9%)	21.9%
MAV	703	997	1,338	1,067	41.9%	34.2%	(20.3%)	38.0%
Total	**3,462**	**4,370**	**4,902**	**3,455**	**26.2%**	**12.2%**	**(29.5%)**	**19.0%**
PCU	**8,950**	**11,723**	**13,856**	**9,927**	**31.0%**	**18.2%**	**(28.4%)**	**24.4%**

Table C.4: AADT from Schedule M data-BK: Kelapur

Vehicle	FY20	FY21	FY20-21
CJV	704	645	(8.4%)
LCV	513	428	(16.6%)
Bus/2A	1,143	1,053	(7.8%)
3A	1,157	1,107	(4.3%)
MAV	1,303	1,372	5.3%
Total	**4,819**	**4,604**	(4.5%)
PCU	**14,235**	**13,939**	(2.1%)

Source: Client data

D Traffic and revenue forecasts

D.1 Further to the summary of forecasts presented in Chapter 6, this appendix presents detailed forecasts.

Traffic forecasts

D.2 This section presents the detailed traffic forecasts for the forecast period until FY43, year of expected close of the concession. The following two tables show the traffic growth rates and AADT, respectively.

Table D.1: BK Darodha: Forecasts for final (background + impacts) AADT

Vehicle Category	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30
CJV	1,337	1,415	1,503	1,600	1,704	1,812	1,919	2,032
Mini LCV	583	602	623	645	668	691	713	736
LCV	434	448	463	480	491	497	508	524
Bus	221	225	230	235	240	245	250	254
2A	1,494	1,546	1,604	1,667	1,645	1,622	1,658	1,716
3A	1,380	1,436	1,499	1,567	1,592	1,605	1,655	1,723
MAV	1,929	2,041	2,168	2,309	2,344	2,369	2,467	2,612
OSV	1	2	2	2	2	2	2	2
Total	**7,381**	**7,716**	**8,091**	**8,504**	**8,686**	**8,843**	**9,171**	**9,600**
PCU	**20,548**	**21,507**	**22,582**	**23,768**	**24,095**	**24,333**	**25,190**	**26,401**

Vehicle Category	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38
CJV	2,152	2,279	2,414	2,554	2,700	2,852	3,009	3,173
Mini LCV	759	783	807	832	857	882	907	932
LCV	540	557	574	591	609	627	644	662
Bus	259	264	269	274	279	284	288	293
2A	1,777	1,840	1,905	1,972	2,039	2,108	2,178	2,249
3A	1,794	1,868	1,946	2,025	2,106	2,188	2,273	2,359
MAV	2,767	2,930	3,103	3,283	3,470	3,665	3,868	4,078
OSV	2	2	2	3	3	3	3	3
Total	**10,051**	**10,524**	**11,020**	**11,533**	**12,062**	**12,608**	**13,171**	**13,749**
PCU	**27,673**	**29,010**	**30,414**	**31,868**	**33,369**	**34,920**	**36,519**	**38,166**

Vehicle Category	FY39	FY40	FY41	FY42	FY43
CJV	3,342	3,517	3,698	3,885	4,078
Mini LCV	958	983	1,009	1,035	1,061
LCV	680	698	716	735	753
Bus	298	303	308	312	317
2A	2,321	2,394	2,467	2,542	2,618
3A	2,448	2,537	2,629	2,722	2,816
MAV	4,295	4,520	4,753	4,993	5,241
OSV	3	3	4	4	4
Total	**14,345**	**14,956**	**15,584**	**16,228**	**16,888**
PCU	**39,862**	**41,606**	**43,398**	**45,238**	**47,123**

Source: Steer analysis

Table D.2: BK Kelapur: Forecasts for final (background + impacts) AADT

Vehicle Category	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30
CJV	1,361	1,440	1,529	1,629	1,735	1,844	1,953	2,068
Mini LCV	553	571	591	612	634	655	676	698
LCV	410	423	437	453	463	469	479	494
Bus	277	282	288	294	300	307	313	318
2A	1,563	1,618	1,678	1,743	1,726	1,708	1,746	1,808
3A	1,375	1,431	1,493	1,561	1,586	1,599	1,649	1,717
MAV	1,965	2,079	2,207	2,351	2,389	2,416	2,517	2,666
OSV	1	2	2	2	2	2	2	2
Total	**7,505**	**7,845**	**8,226**	**8,645**	**8,835**	**8,999**	**9,335**	**9,771**
PCU	**21,022**	**21,999**	**23,095**	**24,303**	**24,658**	**24,924**	**25,807**	**27,042**

Vehicle Category	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38
CJV	2,190	2,320	2,457	2,599	2,748	2,902	3,063	3,229
Mini LCV	720	742	766	789	813	836	860	884
LCV	509	525	541	557	574	591	607	624
Bus	324	331	337	343	349	355	361	367
2A	1,872	1,938	2,007	2,077	2,148	2,220	2,294	2,369
3A	1,788	1,862	1,939	2,017	2,098	2,180	2,265	2,351
MAV	2,823	2,990	3,166	3,350	3,541	3,740	3,947	4,161
OSV	2	2	2	3	3	3	3	3
Total	**10,229**	**10,710**	**11,214**	**11,735**	**12,273**	**12,828**	**13,400**	**13,988**
PCU	**28,341**	**29,705**	**31,139**	**32,622**	**34,154**	**35,736**	**37,368**	**39,049**

Vehicle Category	FY39	FY40	FY41	FY42	FY43
CJV	3,402	3,580	3,764	3,954	4,150
Mini LCV	908	932	957	981	1,006
LCV	641	658	675	693	710
Bus	373	379	385	391	397
2A	2,445	2,521	2,599	2,678	2,758
3A	2,439	2,528	2,619	2,712	2,806
MAV	4,383	4,613	4,850	5,095	5,348
OSV	3	3	4	4	4
Total	**14,593**	**15,215**	**15,853**	**16,508**	**17,179**
PCU	**40,779**	**42,558**	**44,387**	**46,263**	**48,187**

Source: Steer analysis

Table D.3: BK Kelapur New: Forecasts for final (background + impacts) AADT

Vehicle Category	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30
CJV	1,345	1,423	1,512	1,610	1,715	1,823	1,931	2,045
Mini LCV	569	587	608	629	652	674	695	718
LCV	410	423	437	453	463	469	479	494
Bus	223	227	232	237	242	247	251	256
2A	1,617	1,674	1,736	1,804	1,786	1,767	1,807	1,871
3A	1,263	1,315	1,372	1,434	1,457	1,468	1,514	1,577
MAV	1,953	2,067	2,195	2,337	2,375	2,402	2,503	2,650
OSV	1	2	2	2	2	2	2	2
Total	**7,382**	**7,717**	**8,092**	**8,506**	**8,691**	**8,852**	**9,182**	**9,612**
PCU	**20,635**	**21,597**	**22,677**	**23,867**	**24,209**	**24,465**	**25,333**	**26,550**

Vehicle Category	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38
CJV	2,165	2,293	2,429	2,570	2,716	2,869	3,028	3,192
Mini LCV	740	763	787	811	835	860	884	909
LCV	509	525	541	557	574	591	607	624
Bus	261	266	271	276	281	286	291	295
2A	1,937	2,005	2,076	2,149	2,222	2,297	2,373	2,451
3A	1,642	1,710	1,780	1,853	1,927	2,003	2,080	2,159
MAV	2,807	2,972	3,148	3,331	3,521	3,719	3,924	4,137
OSV	2	2	2	3	3	3	3	3
Total	**10,064**	**10,537**	**11,035**	**11,549**	**12,079**	**12,627**	**13,190**	**13,771**
PCU	**27,829**	**29,174**	**30,587**	**32,048**	**33,559**	**35,118**	**36,727**	**38,384**

Vehicle Category	FY39	FY40	FY41	FY42	FY43
CJV	3,362	3,539	3,721	3,909	4,103
Mini LCV	934	959	984	1,009	1,034
LCV	641	658	675	693	710
Bus	300	305	310	315	319
2A	2,529	2,609	2,689	2,771	2,853
3A	2,240	2,322	2,406	2,491	2,577
MAV	4,358	4,586	4,822	5,066	5,317
OSV	3	3	4	4	4
Total	**14,367**	**14,981**	**15,610**	**16,256**	**16,918**
PCU	**40,090**	**41,845**	**43,648**	**45,498**	**47,396**

Source: Steer analysis

Revenue forecasts

D.3 This section presents the detailed revenue forecasts in INR Cr for the forecast period until FY43, year of expected close of the concession. The following tables show the revenue forecasts.

Table D.4: BK Darodha: Revenue forecasts (INR Cr)

Vehicle Category	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30
CJV	3.64	4.29	4.84	5.34	5.95	6.55	7.21	7.95
Mini LCV	1.59	1.83	2.01	2.15	2.33	2.50	2.68	2.88
LCV	2.38	2.70	2.96	3.15	3.38	3.59	3.76	4.05
Bus	2.56	2.87	3.04	3.22	3.45	3.65	3.87	4.11
2A	17.31	20.03	21.85	23.56	24.36	24.93	26.51	28.58
3A	19.15	22.05	23.75	25.96	27.52	28.97	31.00	33.52
MAV	38.78	45.22	49.86	55.19	58.15	61.52	66.57	73.34
OSV	0.04	0.04	0.04	0.05	0.05	0.06	0.07	0.07
Total	**85.45**	**99.04**	**108.36**	**118.63**	**125.20**	**131.77**	**141.67**	**154.49**

Vehicle Category	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38
CJV	8.75	9.82	10.65	11.75	13.05	14.26	15.70	17.04
Mini LCV	3.09	3.37	3.56	3.83	4.14	4.41	4.73	5.01
LCV	4.35	4.68	5.00	5.34	5.80	6.19	6.65	7.07
Bus	4.36	4.63	4.91	5.19	5.50	5.85	6.17	6.51
2A	30.82	33.24	35.89	38.48	41.50	44.81	48.02	51.48
3A	36.20	39.48	42.75	46.31	50.06	54.15	58.54	63.32
MAV	81.16	89.38	98.34	108.20	119.41	131.13	144.28	158.03
OSV	0.08	0.09	0.09	0.10	0.11	0.12	0.14	0.15
Total	**168.80**	**184.68**	**201.19**	**219.21**	**239.58**	**260.93**	**284.24**	**308.61**

Vehicle Category	FY39	FY40	FY41	FY42	FY43
CJV	18.85	20.70	22.42	24.60	26.91
Mini LCV	5.40	5.79	6.12	6.55	7.00
LCV	7.59	8.15	8.59	9.17	9.88
Bus	6.91	7.34	7.73	8.16	8.64
2A	55.45	59.77	63.94	68.45	73.54
3A	68.33	73.79	79.55	85.78	92.32
MAV	173.46	190.45	207.45	226.98	247.73
OSV	0.16	0.18	0.19	0.21	0.23
Total	**336.14**	**366.16**	**395.99**	**429.90**	**466.25**

Source: Steer analysis

Table D.5: BK Kelapur: Revenue forecasts (INR Cr)

Vehicle Category	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30
CJV	2.53	2.83	3.14	3.49	3.87	4.31	4.72	5.20
Mini LCV	1.03	1.12	1.22	1.31	1.41	1.53	1.63	1.75
LCV	2.20	2.42	2.57	2.80	2.94	3.14	3.35	3.54
Bus	3.08	3.34	3.54	3.75	3.98	4.27	4.50	4.78
2A	17.42	19.12	20.60	22.24	22.87	23.77	25.12	27.16
3A	18.64	20.49	22.40	24.26	25.80	26.94	28.90	31.34
MAV	38.56	43.18	47.74	52.98	56.00	59.01	64.05	70.25
OSV	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.07
Total	**83.50**	**92.53**	**101.24**	**110.88**	**116.91**	**123.02**	**132.33**	**144.09**

Vehicle Category	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38
CJV	5.88	6.48	7.06	7.72	8.44	9.44	10.24	11.40
Mini LCV	1.93	2.07	2.20	2.34	2.50	2.72	2.88	3.12
LCV	3.81	4.12	4.41	4.72	5.05	5.40	5.83	6.20
Bus	5.08	5.41	5.71	6.04	6.37	6.79	7.18	7.60
2A	29.33	31.70	34.03	36.56	39.23	42.45	45.57	48.98
3A	33.92	37.10	39.93	43.38	47.01	50.97	54.84	59.05
MAV	77.48	86.08	94.37	104.10	114.56	126.10	138.43	152.00
OSV	0.08	0.08	0.09	0.10	0.11	0.12	0.13	0.14
Total	**157.52**	**173.04**	**187.80**	**204.97**	**223.26**	**243.98**	**265.10**	**288.49**

Vehicle Category	FY39	FY40	FY41	FY42	FY43
CJV	12.34	13.64	15.01	16.21	17.73
Mini LCV	3.29	3.55	3.81	4.02	4.30

Vehicle Category	FY39	FY40	FY41	FY42	FY43
LCV	6.68	7.09	7.59	8.12	8.67
Bus	8.02	8.54	8.96	9.48	10.01
2A	52.54	56.76	60.47	64.90	69.50
3A	63.90	69.18	74.31	80.37	86.21
MAV	166.48	182.42	199.21	217.62	238.12
OSV	0.15	0.17	0.18	0.20	0.22
Total	**313.41**	**341.35**	**369.55**	**400.91**	**434.75**

Source: Steer analysis

Table D.6: BK Kelapur New: Revenue forecasts (INR Cr)

Vehicle Category	FY25	FY26	FY27	FY28	FY29	FY30
CJV	3.87	4.29	4.75	5.29	5.79	6.39
Mini LCV	1.55	1.68	1.81	1.96	2.09	2.24
LCV	2.61	2.85	3.00	3.19	3.41	3.60
Bus	2.91	3.09	3.27	3.51	3.69	3.93
2A	22.04	23.79	24.47	25.44	26.88	29.05
3A	20.57	22.29	23.69	24.75	26.55	28.78
MAV	47.46	52.67	55.67	58.67	63.68	69.85
OSV	0.04	0.05	0.05	0.06	0.06	0.07
Total	**101.06**	**110.70**	**116.71**	**122.86**	**132.16**	**143.92**

Vehicle Category	FY31	FY32	FY33	FY34	FY35	FY36
CJV	7.22	7.96	8.66	9.49	10.37	11.59
Mini LCV	2.47	2.65	2.81	3.00	3.19	3.47
LCV	3.89	4.19	4.49	4.81	5.14	5.50
Bus	4.18	4.44	4.69	4.96	5.24	5.58
2A	31.37	33.91	36.41	39.11	41.98	45.42
3A	31.16	34.08	36.68	39.84	43.18	46.81
MAV	77.03	85.58	93.82	103.50	113.90	125.37
OSV	0.08	0.08	0.09	0.10	0.11	0.12
Total	**157.39**	**172.90**	**187.65**	**204.81**	**223.11**	**243.86**

Vehicle Category	FY37	FY38	FY39	FY40	FY41	FY42	FY43
CJV	12.58	13.99	15.17	16.76	18.42	19.92	21.78
Mini LCV	3.67	3.99	4.21	4.54	4.87	5.14	5.49
LCV	5.94	6.32	6.80	7.23	7.73	8.27	8.83
Bus	5.90	6.24	6.59	7.02	7.37	7.79	8.22
2A	48.75	52.41	56.23	60.72	64.70	69.44	74.37

3A	50.37	54.24	58.69	63.54	68.25	73.82	79.18
MAV	137.63	151.12	165.52	181.36	198.06	216.36	236.74
OSV	0.13	0.14	0.15	0.17	0.18	0.20	0.22
Total	**264.98**	**288.45**	**313.37**	**341.33**	**369.59**	**400.94**	**434.83**

Source: Steer analysis

E Vehicle Classification Chart

Vehicle Type	Description
2-Wheeler	
Auto-Rickshaw	
Car/Jeep/Van	
Taxi- shared/private	
Buses (govt/Pvt)	
Minibus	

Vehicle Type	Description
Mini LCV	
LCV 4 Tyre	
LCV 6 Tyre	
2 Axle Truck	
3 Axle Truck	
4 Axle Truck (MAV)	
5 Axle Truck (MAV)	

Vehicle Type	Description
6 Axle Truck (MAV)	
Oversized Vehicle/ Earth moving equipment (OSV)	

Control Information

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Assessment and projection of traffic and revenue for Shivpuri-Jhansi section of NH-27

May 2023

Consulting

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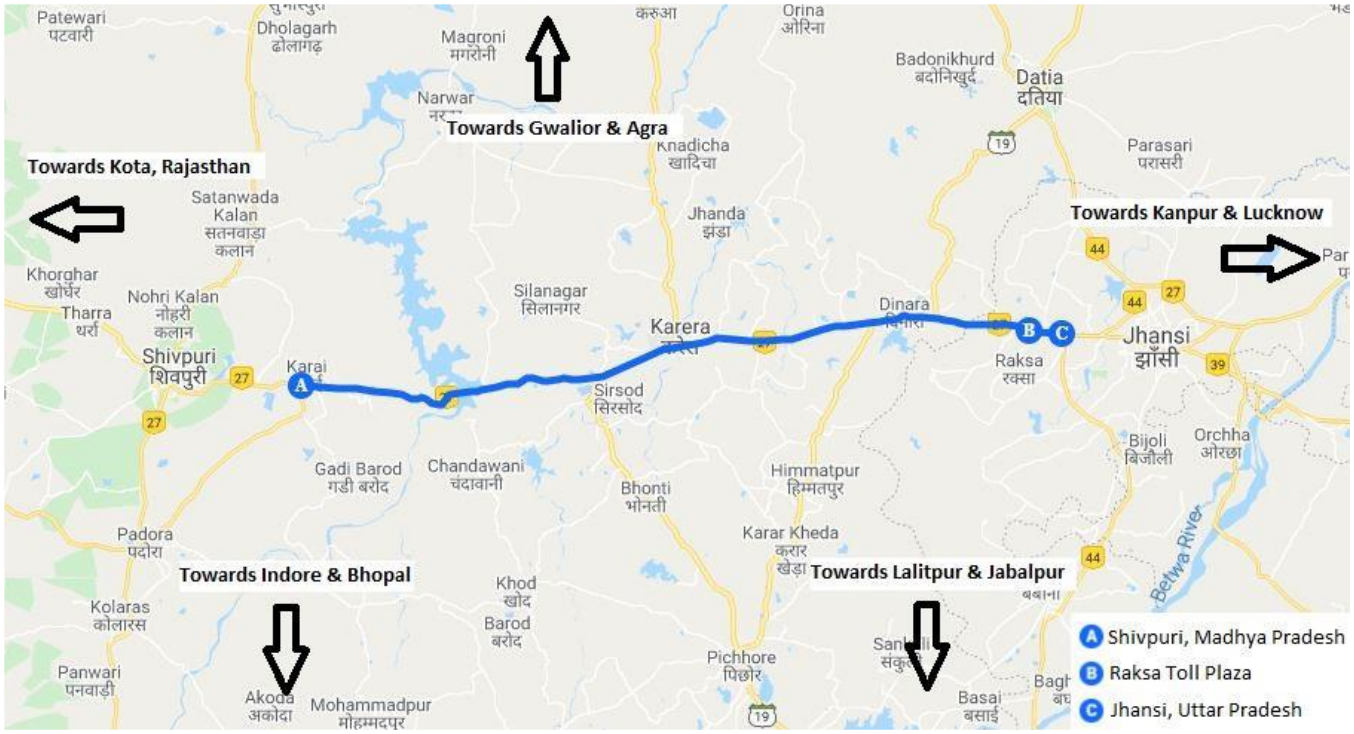
1 Executive Summary

Project overview

Asset is a 4-lane, 75.3 kms long stretch, on national highways (NH) 27 which connects the districts of Jhansi and Shivpuri in the state of Uttar Pradesh and Madhya Pradesh, respectively. The two states Uttar Pradesh and Madhya Pradesh form the two key project stretch influence states. The project stretch has one toll plaza by the name of Raksha toll plaza which lies at the chainage of km 1374+650 near Jhansi. In the larger road network, the project stretch is a part of East-West corridor (NH-27) which connects Porbandar in Gujarat to Silchar in Assam. Hence, the project stretch witnesses higher proportion of long route traffic between the eastern and western regions.



Source: CRISIL MI&A

Salient growth features and traffic generators

The project stretch is used by the traffic originating and destined in regions such as Kanpur-Lucknow cluster, Indore cluster, Maharashtra and Gujarat. Lucknow and Indore are the key regions where the east-west traffic converges. Currently, the traffic between Indore-Lucknow uses the project stretch which takes them 13-14 hours and travels ~793 km. There exists an alternate route between Lucknow and Indore which passes through Chhatarpur and Sagar. This route takes 16-17 hours and the distance is 801 km. The key reason for this longer travel time is that the alternate route is a mix of 2 lane and 4 lanes. Kanpur to Bhopal section of the alternate route which is nearly 527 km is 2 lanes. Under the Bharatmala program, the section from Lucknow to Sagar and Sagar to Kandla are proposed for augmentation. Hence, the Traffic Consultant has assumed FY33 to be start year for the alternate road stretch.

Further, there is a greenfield expressway coming up in the region. The 4-lane access-controlled Atal progress-way (Chambal expressway) will connect Etawah (UP) to Kota (Rajasthan). The connection point is likely to be the Agra-Lucknow expressway on one end and the Delhi-Mumbai expressway on the Kota side. Thus, the traffic from

eastern region converging at Lucknow will have an alternative to the project stretch. The traffic can travel on the Agra-Lucknow expressway and Atal progress-way to reach Rajasthan. They also have Delhi-Mumbai expressway connectivity to Gujarat and Maharashtra. The Delhi-Mumbai expressway is expected to begin operations in mid-2024 and for the Atal progress-way, the Traffic Consultant has assumed FY29 to be start year for the road stretch.

Agri produce forms the key commodity travelling on the project stretch, followed by courier & parcels, construction material, consumer items, and iron and steel. Kanpur, Lucknow, Jhansi, Indore, Mumbai and Rajkot are the major contributors to the goods traffic on the project stretch. Project stretch and its vicinity regions such as Kanpur, Lucknow, Indore etc. are the key origin-destination for the passenger traffic.

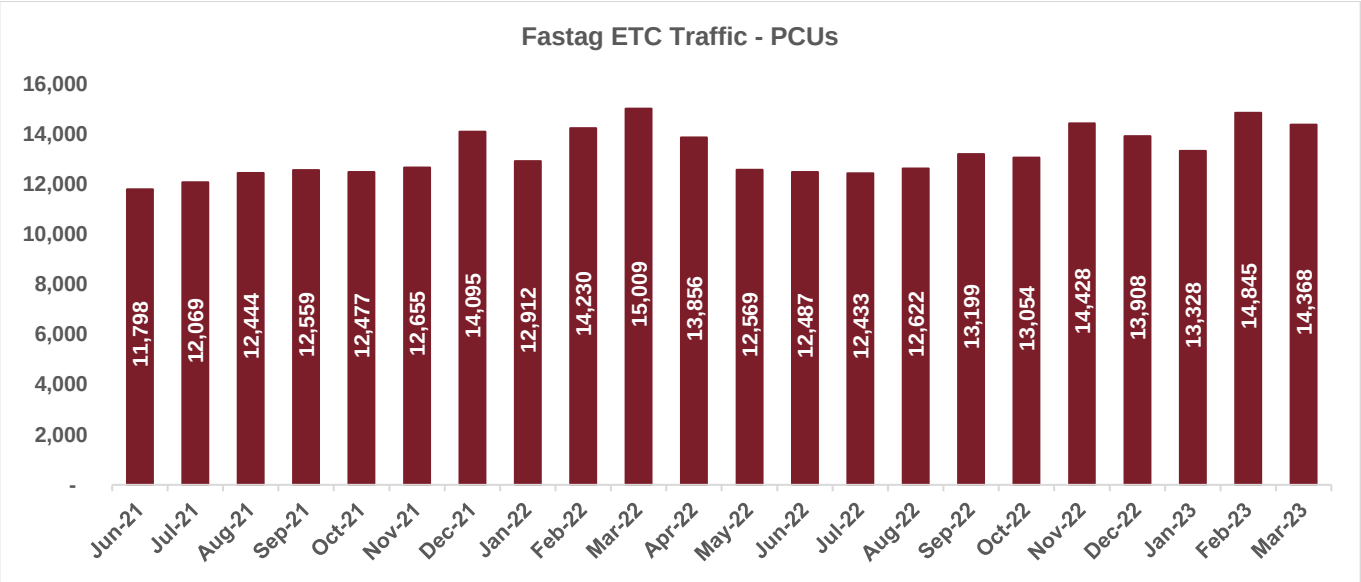
The Shivpuri-Jhansi Project is a part of the East-West Corridor, which includes industrialised districts such as Kanpur and Lucknow. These districts form the origination and destination points of the traffic. Other key consumption/industrial centres include Indore, Jhansi, Ahmedabad, Mumbai, and Pune. These are also catered by the stretch. Shivpuri and Jhansi districts, immediately adjacent to the stretch, have witnessed an economic growth greater than the national average.

Traffic volume and composite of vehicles

Historical traffic data

The following table shows the historical ETC traffic stretch according to the Traffic Consultant:

Figure 1: Total ADT (PCUs) on project stretch over June 2021-March 2023



Source: Toll Plaza data, CRISIL MI&A

Toll Segmentation

Trip segmentation has been derived based on the average share of a single journey, return journey and categories over April 2022 to March 2023. For revenue calculation, the trip factor used for a return journey is two, and for a monthly pass it is 50. The trip segmentation has been assumed to remain constant throughout the projection period i.e., over fiscals 2023 to 2043.

Table 1: Details of trip segmentation across vehicle categories

	Single	Return	Monthly Pass	Local Non-commercial	Local commercial	Exemption	Total
CJV	47.1%	40.3%	0.0%	9.5%	0.0%	3.1%	100.0%
LCV	86.3%	11.1%	0.7%	0.0%	0.5%	1.4%	100.0%
2A	83.5%	15.2%	0.0%	0.0%	0.0%	1.2%	100.0%
3A	91.4%	7.6%	0.0%	0.0%	0.0%	1.0%	100.0%
MAV	95.0%	4.5%	0.0%	0.0%	0.0%	0.5%	100.0%
OSV	92.1%	7.9%	0.0%	0.0%	0.0%	0.0%	100.0%

Note: The trip segmentation provided in the table is as per the values recorded in ETC data.
Local non-commercial is local monthly pass. Toll rate for cars is Rs 315 in fiscal 2023.
Source: Toll plaza data, CRISIL MI&A

Growth Rates

The table below provides the traffic growth rates considering diversions to expressway and other alternative routes, as provided by the Traffic Consultant:

Table 2: Traffic growth rates considering diversions to expressway and other alternative routes

CAGR	FY23-25	FY25-30	FY30-35	FY35-42	FY23-43
Car	7.8%	6.5%	5.1%	3.7%	5.1%
Bus	3.9%	3.3%	2.5%	1.9%	2.6%
Minibus	3.9%	3.3%	2.5%	1.9%	2.6%
LCV	4.8%	-0.4%	4.7%	4.7%	3.4%
2-axle	5.0%	1.2%	4.9%	4.8%	3.9%
3-axle	5.8%	1.6%	5.6%	5.4%	4.5%
MAV	5.4%	1.6%	5.2%	5.1%	4.2%
Total PCU	5.7%	2.4%	5.1%	4.7%	4.3%

Source: CRISIL MI&A

Projected Traffic Data: Growth in Passenger Car Unit (PCU)

Table below shows traffic projections for the forecast period from FY2023-43.

Table 3: Projected AADT, FY23-43

Year	FY23	FY25	FY30	FY35	FY40	FY43
Cars	2,296	2,668	3,661	4,684	5,675	6,234
Bus	113	122	143	162	179	187
Mini Bus	4	5	6	6	7	7
LCV	170	187	183	231	290	332
2A	743	819	868	1,100	1,390	1,597

Year	FY23	FY25	FY30	FY35	FY40	FY43
3A	507	568	616	809	1,055	1,234
MAV	1,704	1,892	2,045	2,641	3,385	3,917
Total	5,538	6,260	7,521	9,634	11,981	13,509
PCU	14,317	15,995	18,026	23,138	29,225	33,427

Source: CRISIL MI&A

Tollable Length and Toll Rates

In terms of tollable length, the Jhansi – Shivpuri Project comprises 89.5794 kms of roads. In India, toll rates are as per notification by the Ministry of Road Transport and Highways in the National Gazette. The present toll rates are determined with reference to the published base toll rates and are adjusted annually at the beginning of each fiscal year equal to 40% of the movement in the wholesale price index in December of the preceding year plus a fixed 3%. Single toll rates in INR at the Raksha toll plaza, applicable from April 2022 until March 2023 are as provided below:

Table 4: Toll Rates, FY2023

Type of Vehicle	SJ: Raksha
CJV	120
LCV	195
Bus/Truck	415
3A	450
MAV/ HCM/EME	645
OSV	790

Source: NHAI-TIS

2 Objective and background

National Highways Infra Investment Managers Pvt Ltd (NHIIMPL), referred as client, appointed CRISIL MI&A to undertake a study to analyse the present traffic patterns and growth prospects of the Shivpuri-Jhansi Road stretch (NH-27). In this regard, CRISIL MI&A conducted a detailed traffic study and provided traffic and revenue projections for the road stretch under consideration for fiscals 2023-43. CRISIL also conducted a 7-day total volume count and 1-day origin-destination (O-D) traffic survey to understand traffic movement on the national highway road stretch.

CRISIL MI&A also conducted a detailed traffic study in June 2022 when the client was acquiring the asset. The current study is done as an annual review of asset, where CRISIL MI&A's report intends to facilitate understanding current traffic pattern, growth prospect, potential threat to traffic and revenue growth based on a detailed assessment of the road stretch for entire projection period.

Table 5: Details of the road stretch

Project stretch	State	Toll plaza	Length (km)
Four-lane Shivpuri-Jhansi km 1305.000 to km 1380.387 of NH-27 in Madhya Pradesh and Uttar Pradesh	Madhya Pradesh and Uttar Pradesh	Raksha	75.3

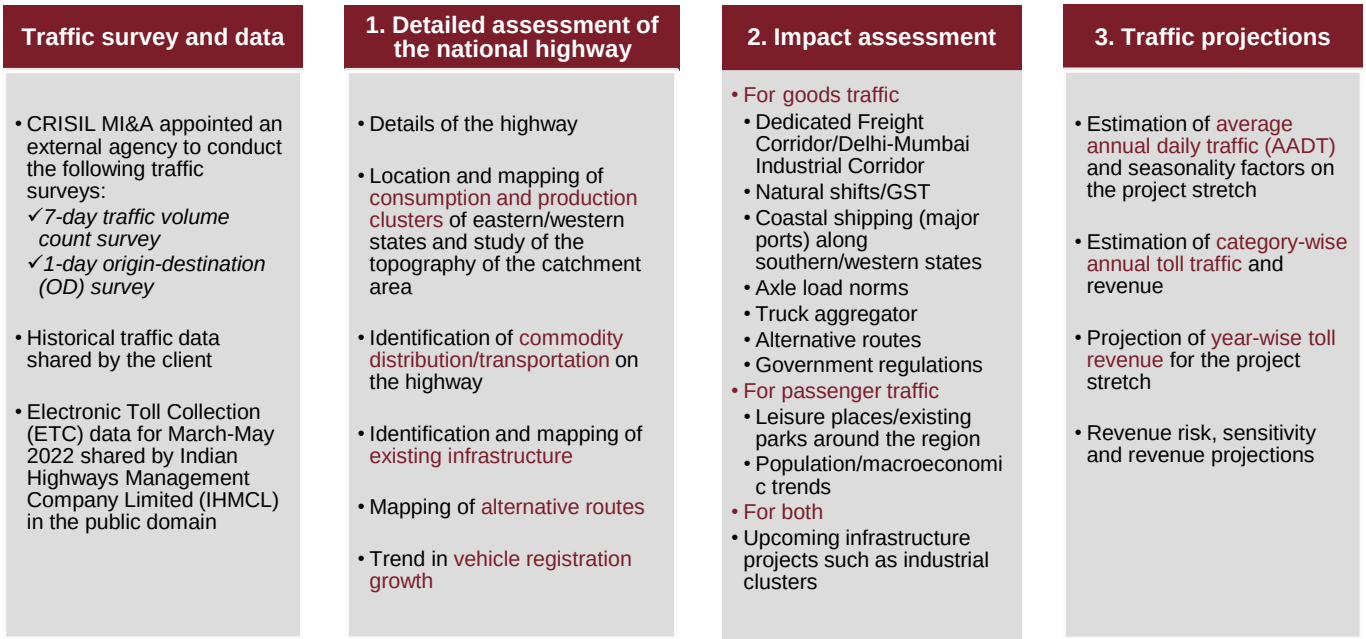
The report is divided into the following sections:

- Section I: Detailed assessment of the project stretch
- Section II: Growth and impact factor assessment
- Section III: Traffic and revenue projections for the project stretch

3 Approach and methodology

CRISIL MI&A conducted a detailed traffic assessment to understand the composition of current traffic for the stretch and various growth drivers and impact factors for this traffic, and arrive at traffic projections. Traffic for the stretch has been projected by factoring in traffic composition (vehicle category share, commodity carried by freight traffic vehicle categories, and origin-destination locations), outlook on production and consumption centres, alternative routes, and other factors impacting road traffic. This study helped us assess the project's traffic growth against key macro- and socio-economic parameters, and thus comment on the future prospects of the stretch.

Figure 2: Overview of approach and methodology for the study



Source: CRISIL MI&A

CRISIL has used its proprietary traffic projection methodology to project traffic using regional industry growth assumptions, macroeconomic developments, infra development and consumption centre growth factors of the catchment area and adjacent regions.

CRISIL, based on its coverage of 80+ sectors and the MSME industry, has developed a knowledge base to understand the growth of industries and demand across various regions and clusters. The growth expectations for various industries are applied to each vehicle category based on the commodity composition of the vehicle category. For example, the share of light commercial vehicles (LCVs) carrying agricultural commodities is expected to grow as per agricultural output growth; the share of LCVs carrying consumer products is expected to grow as per the volume growth of durables; and the share of Multi axle vehicles (MAVs) carrying steel commodities is expected to grow as per demand/supply volume of steel products based on regional dynamics. This approach helps CRISIL provide a more accurate growth rate of commercial traffic in the region.

For passenger traffic, CRISIL assesses the sale of passenger cars in the region, growth of vehicular population, purpose and frequency of passenger travel, population growth, expansion of the city, and infrastructure development in the catchment area.

Further, CRISIL also examines the various factors that will impact traffic over the concession period, such as upcoming alternative road routes, truck aggregation by logistics players, dedicated freight corridors and other transportation options. Thus, the analysis considers the impact of central and state policies, growth in production and consumption centres along the stretch, and infrastructure in the adjoining regions. The report covers both growth drivers and restraints for the traffic along the stretch. CRISIL has enumerated and detailed the parameters that will positively/negatively impact the traffic on the stretch in the future.

CRISIL's methodology is appropriate for the traffic study of Jhansi-Shivpuri stretch

Agri produce commodity accounts for nearly ~20% of the total traffic on the project stretch

Agri produce is the largest commodity observed on the project stretch. The commodity is composed of food grains, fruits, and vegetables. As per the survey conducted during this traffic study, in terms of vehicle wise composition, the category is made up of 26.9% LCVs, 39.9% of 2-axle, 14.9% of 3-axle and 16.9% of MAVs. In total, the agri produce accounts for 20.4% of the traffic on the stretch. The share noticed in DPR of TOT bundle-6 is even higher. DPR data shows, 23.2% MAVs account for food grains and cash crops traffic and 20.5% of MAVs account for fruits & vegetables traffic. Such higher share is noticed across vehicle categories in the DPR.

CRISIL's methodology considers the growth of the agri produce commodity at the regional level to derive the traffic growth of each vehicle category. Growth in agri produce is highly volatile as it depends on the positive outcome of the monsoon season. Hence on a long term period, it grows at low rate compared to the aggregate GDP. Given the high proportion of the agri produce on the stretch, it's imperative to assess it at a regional and commodity level, compared to a macroeconomic level. This is evident, considering only the macro level growth. The India GVA (constant prices) from agriculture, forestry & fishing has grown at a CAGR of 3.5% over FY12-22 while the GDP growth of India during the same period has been 5.4% CAGR. For this reason, CRISIL's method is more appropriate for the road stretch.

Origin-destination of the freight traffic of the stretch is limited to few specific states

The freight traffic is largely concentrated across Uttar Pradesh, Madhya Pradesh, Gujarat, and Maharashtra. In the direction of Shivpuri, nearly 91% of the freight traffic originates in Uttar Pradesh. This traffic is largely destined for Madhya Pradesh (53%), Gujarat (18%) and Maharashtra (18%). In the opposite direction, the shares remain similar with ~92% of the traffic destined for Uttar Pradesh having origin across Madhya Pradesh, Gujarat and Maharashtra.

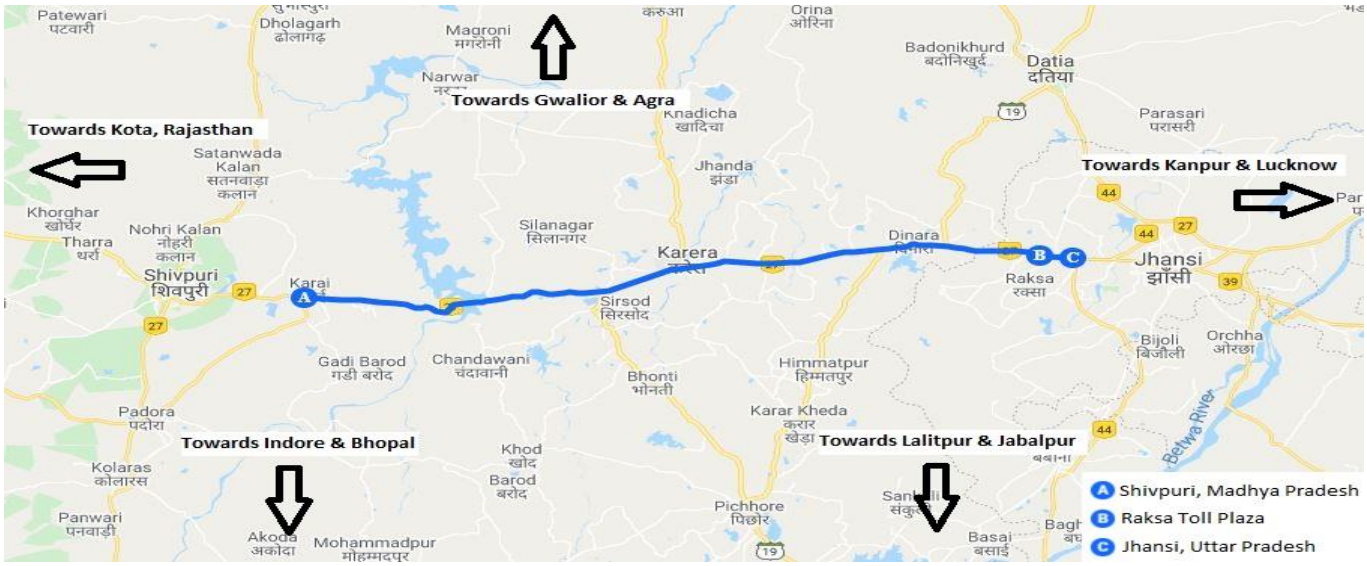
It is evident for the project stretch that the growth of the freight traffic is highly influenced by the regional and state-level growth drivers as against national level factors. As mentioned earlier, CRISIL's traffic forecasting method incorporates its coverage of 80+ sectors and the MSME industry. This knowledge base is used to understand the growth of industries and demand across various regions and clusters which influences the traffic growth. Hence, CRISIL's method is appropriate for this stretch as the growth drivers are concentrated in terms of region and commodities.

4 Overview of project stretch

Project stretch delineation

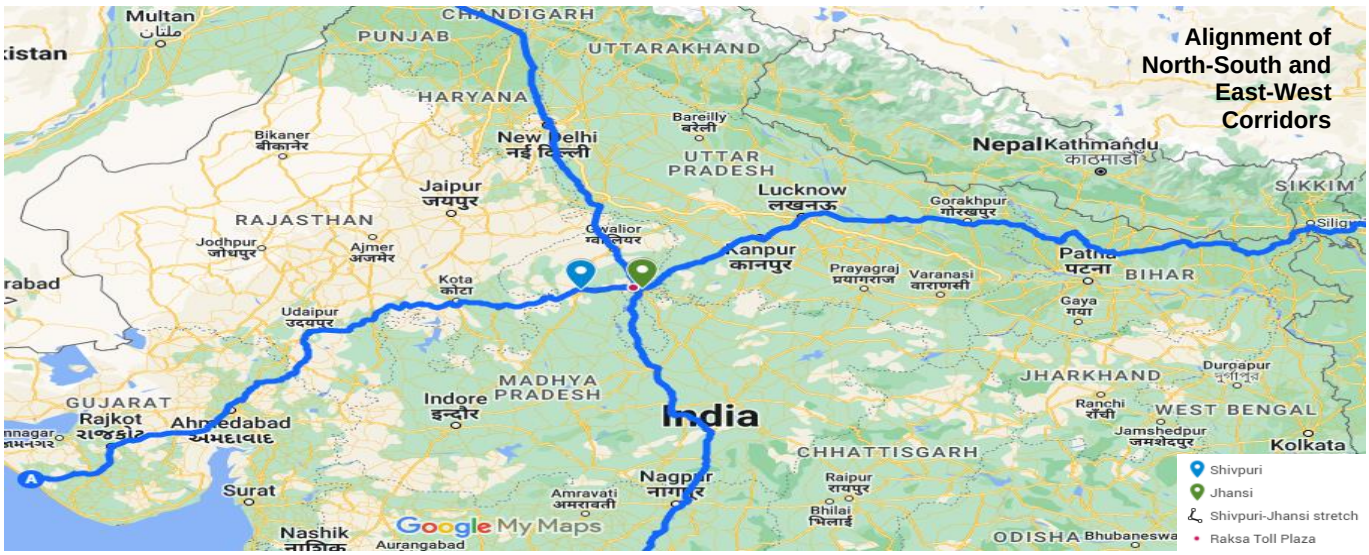
The Jhansi-Shivpuri section of NH-27 connects the districts of Jhansi and Shivpuri in Uttar Pradesh and Madhya Pradesh, respectively. These are the two key project stretch influence states. The project stretch has one toll plaza — Raksha — that lies at the chainage of km 1374+650 near Jhansi. In the larger road network, the project stretch is a part of East-West Corridor (NH-27), which connects Porbandar in Gujarat to Silchar in Assam. Hence, the project stretch witnesses high long-route traffic between the eastern and western regions.

Figure 3: Project stretch alignment



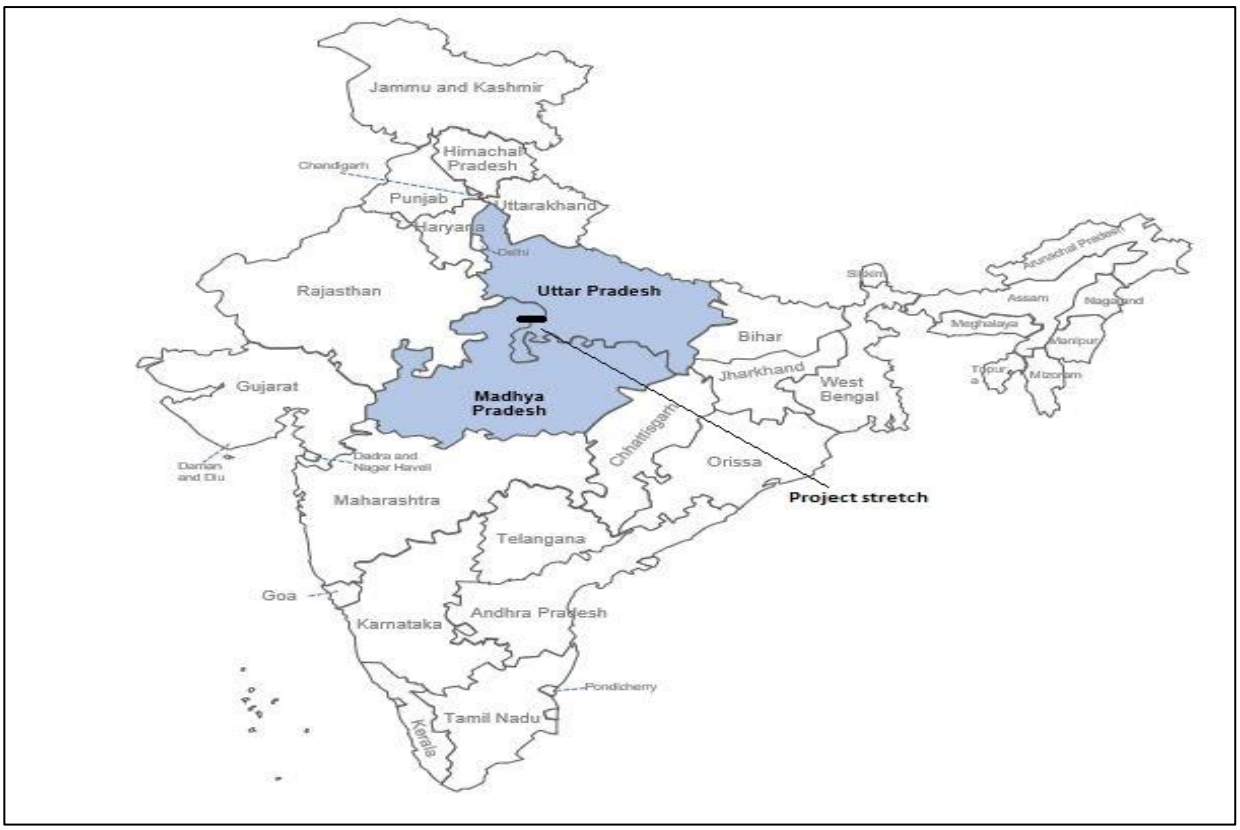
Source: NHAI, Google Maps, CRISIL MI&A

Figure 4: Project stretch alignment with regard to key freight corridors



Source: NHAI, Google Maps, CRISIL MI&A

Figure 5: Key project stretch influence states



Source: CRISIL MI&A

Table 6: Key details of project stretch

Project stretch	NH-27 - km 1305+000 to km 1380+300
Authority	National Highways Authority of India
No. of lanes	4-lane configuration
Length of project stretch	75.30 km
No. of toll plazas	01
Name of toll plaza(s)	Raksha (km 1374+650)
Commercial operation date	July 21, 2009
Current tolling agency	National Highway Infra Trust (from 10th March'2023)

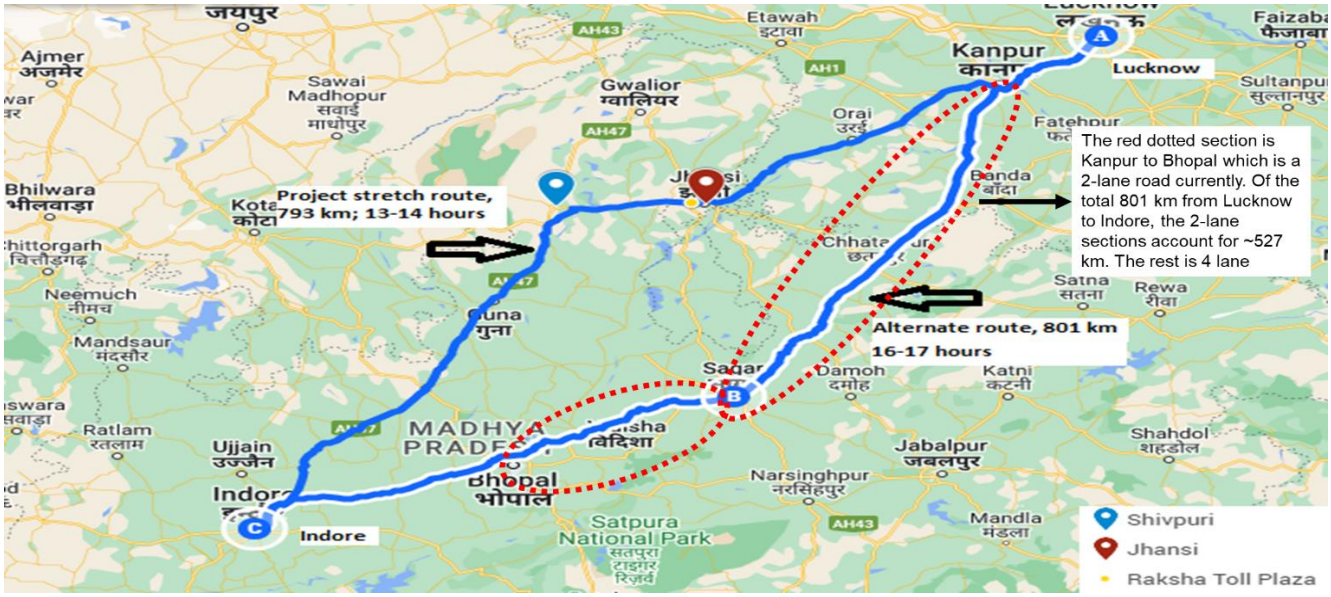
Source: NHAI, CRISIL MI&A

Current alternative routes to project stretch

The project stretch is used by the traffic originating and destined in regions such as the Kanpur-Lucknow cluster, the Indore cluster, Maharashtra and Gujarat. Lucknow/Kanpur and Indore are the key regions where the east-west traffic converges. Currently, the traffic travelling between Indore cluster and Lucknow/Kanpur cluster uses the project stretch which takes them 13-14 hours and travels ~793 km. There exists an alternative route between Lucknow and Indore that passes through Chhatarpur and Sagar. This route takes 16-17 hours, and the distance is 801 km. The key reason for this longer travel time is that the alternative route is a mix of two and four lanes. The

Kanpur-Bhopal section of the alternative route, which is nearly 527 km, is 2-lane. Hence currently, the route is not a feasible alternative against the project stretch.

Figure 6: Alignment of current alternative routes and project stretch

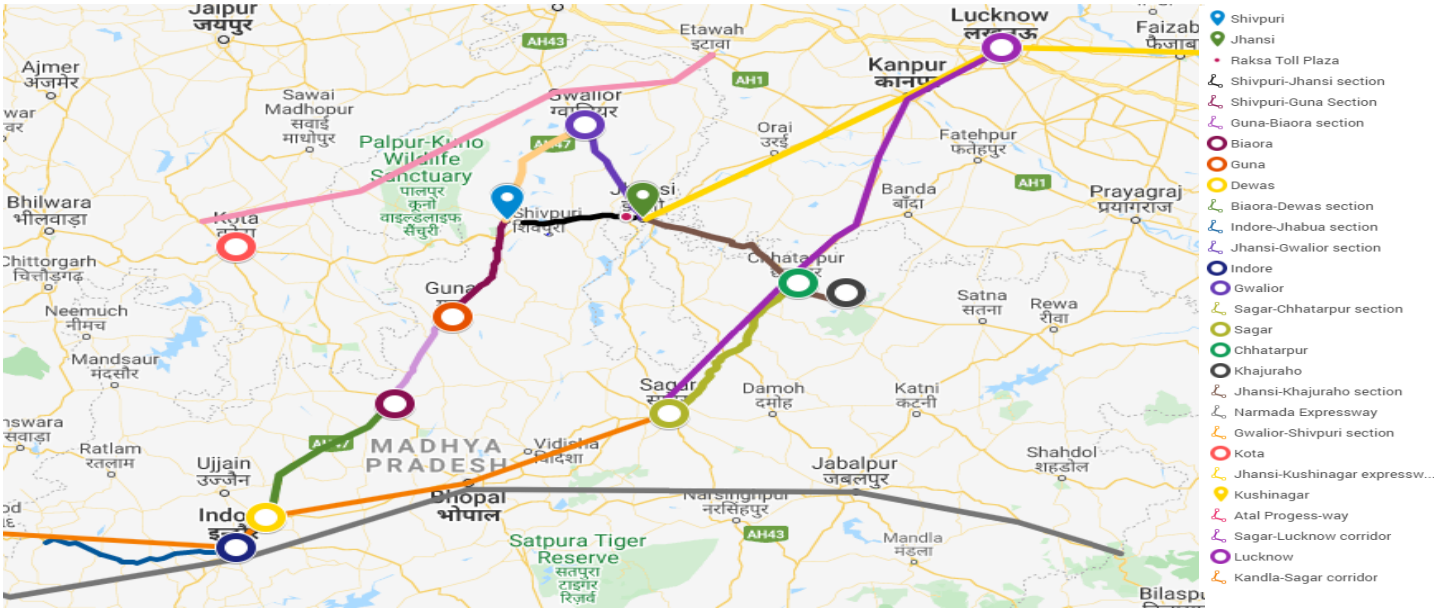


Source: NHAI, Google Maps, CRISIL MI&A

Network in the vicinity of project stretch

Stretches in the vicinity of the Shivpuri-Jhansi stretch are 4-lane, brownfield-upgraded. The stretches include Shivpuri-Gwalior, Gwalior-Jhansi, Jhansi-Khajuraho, Shivpuri-Guna, Guna-Biaora, and Biaora-Dewas. The region's better connectivity will lead to stronger traffic growth in the area, and this has been incorporated in the study's traffic projection.

Figure 7: Road network in the vicinity of project stretch



Source: NHAI, Google Maps, CRISIL MI&A

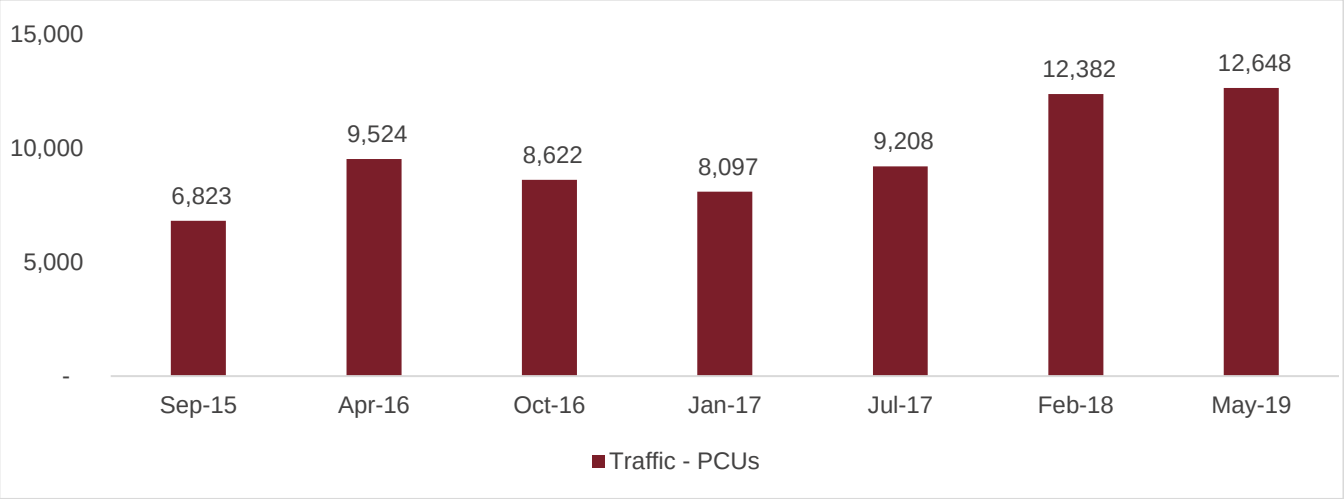
5 Traffic assessment of project stretch

Review of traffic at Raksha toll plaza

Project stretch saw strong traffic volume growth over 2015-19, as per IHMCL 7-day survey, driven by diverted traffic

The 7-day survey conducted by Indian Highways Management Company Ltd (IHMCL) indicated strong growth in traffic volume at the project stretch over calendar year 2015-19. This growth is expected to have been driven by diverted traffic from the adjoining Gwalior-Shivpuri section, which was under construction during 2014-19. The traffic from North used Gwalior-Jhansi and then the project stretch to go towards Indore, avoiding Gwalior-Shivpuri.

Figure 8: ADT from IHMCL 7-day traffic volume survey over 2015-19 (total PCUs)



Source: IHMCL, CRISIL MI&A

Table 7: ADT from IHMCL 7-day traffic volume survey over 2015-19

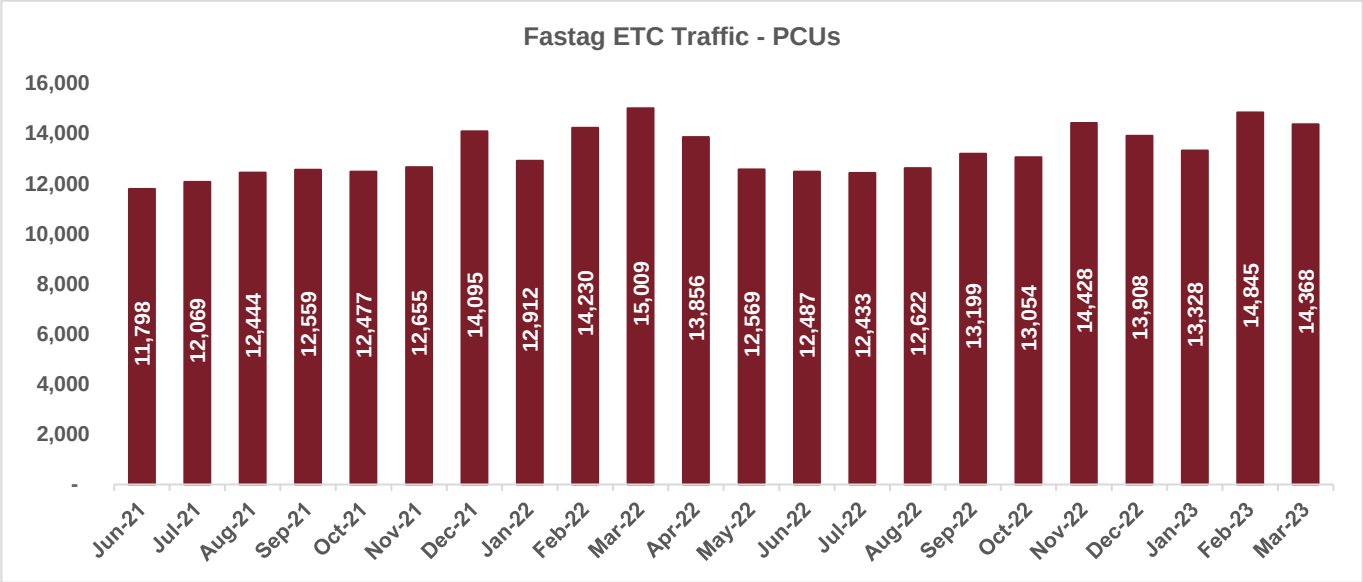
From	To	Car/jeep/van	LCV	2-axle	3-axle	MAV	OSV	Total	Total (PCUs)
Sep 26, 2015	Oct 2, 2015	1,249	188	275	400	726	0	2,838	6,823
Apr 5, 2016	Apr 11, 2016	1,413	228	332	667	1,059	1	3,701	9,524
Oct 2, 2016	Oct 8, 2016	1,406	246	298	466	1,012	0	3,428	8,622
Jan 27, 2017	Feb 2, 2017	1,325	186	270	423	981	0	3,184	8,097
Jul 22, 2017	Jul 28, 2017	1,289	255	281	402	1,217	2	3,447	9,208
Feb 9, 2018	Feb 15, 2018	1,861	305	373	533	1,632	1	4,704	12,382
May 26, 2019	Jun 1, 2019	2,028	296	410	554	1,619	1	4,907	12,648

Source: IHMCL, CRISIL MI&A

MAVs contribute ~55% to the stretch's traffic in PCUs; ETC is the dominant payment method across vehicle categories

The project stretch recorded 14,368 PCUs in March 2023. In terms of PCUs, the traffic mainly comprised MAVs (~55%), followed by 2- and 3-axle vehicles (17% and 11%, respectively in CV segment). Cars accounted for 13% of the traffic PCUs. Traffic data before June 2021 was not available for the toll plaza.

Figure 9: Total ADT (PCUs) on project stretch over June 2021-March 2023



Source: Toll Plaza data, CRISIL MI&A

Average daily ETC traffic for Jun-Mar 2023 vis-à-vis Jun-Mar 2022 grew by 3.3% on overall PCU level. Among vehicle categories, CJV traffic grew by 9.2% and MAV traffic grew by 3.2%. Traffic growth for LCV, 2 Axle and 3 Axle was observed at 2.9%, 1.2% and 0.6% respectively.

Table 8: ADT volume recorded on project stretch in March 2023

Vehicle category	Traffic volume (vehicles)	Traffic volume (PCUs)	Share (%) - PCUs
Car/jeep/van	1,865	1,865	**13%**
LCV	180	270	**2%**
2-axle	919	2,757	**19%**
3-axle	532	1,595	**11%**
MAV	1,766	7,945	**55%**
OSV	2	11	**0%**
Total	**5,263**	**14,442**	**100%**

Source: Toll Plaza data, CRISIL MI&A

As per the available data, cash (and exemption) recording has been inconsistent post May 2022. The available data for later months of fiscal 2023 are at a variance with the average cash paying traffic over June 2021 to May 2022 period. Particularly for 2 Axle vehicle category, a sizeable difference is observed between the two periods.

Available data for June 2021 to May 2022 stated that around ~200 Two-Axle vehicles paid in cash, while the corresponding number for Oct 2022 to Mar 2023, is less than 5.

So, for fiscal 2023, on one hand, cash paying traffic for Two-Axle vehicles, for first two months (April and May) of fiscal 2023, is ~200, while cash paying traffic for second half of the fiscal (Oct to Mar), is less than 5. The data for June to September period of the fiscal is not available. The toll collection management system (TCMS) operators for these periods are also different. From 1st October 2022 onwards, Intelliroute is providing the TCMS services, while PATH was TCMS operator prior to October 2022.

Anomalies were observed in estimation of cash (and exemption) traffic for fiscal 2023, in terms of different TCMS operators recording data, data being not available for entire fiscal 2023, and variations observed in cash (and exemption) traffic for available time periods. To remove these anomalies in estimating the cash and exemptions for fiscal 2023, the cash (and exemption) traffic for Oct 2022 to Mar 2023 period has been averaged with cash and exemption traffic considered for earlier study. The comparison of cash and exemptions for June 2021 to May 2022 (earlier study) and Oct 2022 to Mar 2023 is provided below:

Table 9: Share (%) of vehicles using various payment methods

	June 2021 – May 2022		Oct 2022 – Mar 2023	
Vehicle category	Cash	Exemption	Cash	Exemption
Car/jeep/van	3.2%	5.9%	1.3%	0.3%
LCV	7.4%	2.0%	1.2%	0.6%
2-axle	20.2%	1.9%	0.9%	0.2%
3-axle	1.0%	1.4%	0.2%	0.4%
MAV	0.3%	0.7%	0.1%	0.1%

Note: The percentages are the average of each month's share (%) of vehicles using ETC, cash and are exempted over months across vehicle categories

Source: Toll plaza data, CRISIL MI&A

Additionally, client has mentioned that they have taken over the tolling operations at the plaza from 10th March and currently they are in process of integrating toll management system. It is mutually decided that the estimated cash and exemption levels in this study will be reviewed in next update as tolling system at the plaza matures and a larger sample of 3-4 months is available.

Project stretch collected Rs 1.95 million on average per day in March 2023, with MAVs as the largest contributor

Based on data available for revenue collected during FY23, the project stretch collected Rs 667.6 million (excluding cash) for the April 2022 to March 2023 period. The annual revenue is calculated by estimated by pro rating the July 2022 (21 days) and Mar 2023 (27 days) data.

For March 2023, average per day collection was Rs 1.95 million. The toll collection was largely driven by commercial vehicles; MAVs formed ~59% of the toll collection, followed by two- and three-axle vehicles, with ~16% and ~12% share for the period Jun-2021 to Mar-2023.

Table 10: Per day total toll collection of the project stretch from June 2021 to March 2023

Month-Year	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22
Per day toll collection (Rs million)	1.46	1.50	1.55	1.57	1.55	1.56	1.74	1.60	1.76	1.87	1.90

Month-Year	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23
Per day toll collection (Rs million)	1.71	1.70	1.69	1.74	1.82	1.79	1.97	1.89	1.80	2.00	1.95

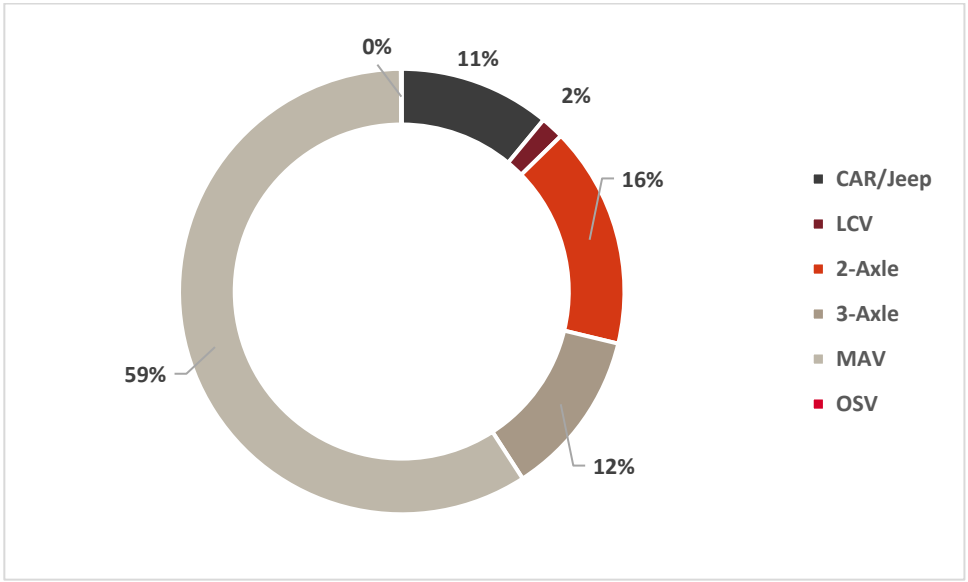
Source: Toll plaza data, CRISIL MI&A

Table 11: Remittance collection for the project stretch for the years available

Fiscal	Sept '17 to Oct '18	Oct '18 to Jan '20	Jan '20 to Jan '21	FY22	FY23	Per day remittance in period* Sept '17 to Oct '18	Per day remittance in FY23
Toll remittance (Rs million)	360.2	466.4	463.5	608.9	669.9	0.92	1.83

Note: *The period has 393 days; Source: NHAI, CRISIL MI&A

Figure 10: Share (%) of vehicle categories in the toll collection of the project stretch



Note: The percentages are the average of revenue share of vehicles over June 2021 to March 2023;
Source: Toll plaza data, CRISIL MI&A

As per ETC data, MAVs contribute ~55% to the stretch's traffic in PCUs; per day ETC collection in March 2023 was Rs 1.95 million

The project stretch collected an average Rs 1.46 million per day in June 2021, which increased ~34% to Rs 1.95 million in March 2023. This was largely driven by the strong increase in the WPI, which led to a rise in the toll rates.

As per IHMCL data, ETC traffic for the stretch is estimated as 14,397 PCU during March 2023. MAVs were the largest contributor to the traffic, with ~55% share, followed by 2- and 3-axles at 17% and 11%, respectively. Some 14% of the traffic was composed of passenger vehicles. i.e., cars and buses as per IHMCL March 2023 data.

Table 12: Per day ETC toll collection of the project stretch for the months available

Month-Year	May-21	Jun-21	Aug-21	Sep-21	Mar-22	Apr-22	May-22	Jun-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23
ETC collection (Rs million/Day)	1.19	1.46	1.55	1.57	1.87	1.90	1.71	1.71	1.82	1.79	1.97	1.89	1.79	2.00	1.95

Source: IHMCL, Toll Plaza Data, CRISIL MI&A

Table 13: Average daily traffic (ETC) recorded on the project stretch for Apr 2022- Mar 2023

Average daily traffic (ETC) volume (Apr 2022 to Mar 2023)			
Vehicle category	**Traffic volume (vehicles)**	**Traffic volume (PCUs)**	**Share (%) - PCUs**
Car/jeep/van	1,824	1,824	**14%**
LCV	164	246	**2%**
2-axle	742	2,227	**17%**
3-axle	500	1,499	**11%**
MAV	1,691	7,609	**57%**
OSV	2	10	**0%**
Total	**4,923**	**13,414**	**100%**

Source: Toll Plaza Data, CRISIL MI&A

Review of traffic survey results

CRISIL MI&A appointed a traffic consultant who conducted traffic surveys on the following dates,

Table 14: Details of traffic surveys conducted for the assessment

Survey details			
Survey name	**Survey location**	**Duration**	**Date**
Traffic volume count survey	Raksha toll plaza	7 days	March 11-17, 2023

Survey details			
Survey name	**Survey location**	**Duration**	**Date**
Origin-destination survey	Raksha toll plaza	1 day	March 14, 2022

Source: CRISIL MI&A

Traffic volume count (TVC) survey recorded 6,392 vehicles in total; recorded survey traffic volume shows discrepancy with the actual data

The ADT numbers were obtained by taking the average of the volume count numbers of seven days of the traffic survey. For the period, the actual traffic has been compared.

Table 15: Details of traffic recorded in the TVC survey conducted for the assessment

Date	Day	CJV	MLCV	LCV	MB	B	2A	3A	MAV	OSV	Total
3/11/2023	Saturday	3,065	256	664	15	160	308	501	1,745	5	6,719
3/12/2023	Sunday	3,150	307	718	12	178	347	553	1,894	1	7,160
3/13/2023	Monday	2,393	227	633	12	154	321	449	1,622	7	5,818
3/14/2023	Tuesday	2,203	283	689	15	190	311	498	1,802	3	5,994
3/15/2023	Wednesday	2,333	308	789	15	163	297	531	2,054	5	6,495
3/16/2023	Thursday	2,167	265	797	12	161	358	587	1,943	4	6,294
3/17/2023	Friday	1,968	323	711	12	167	376	602	2,098	4	6,261
ADT		2,468	281	714	13	168	331	532	1,880	4	6,392
ADT PCU		2,468	281	1,072	20	503	993	1,595	8,459	19	15,410

Source: CRISIL MI&A

TVC survey data is compared with the recorded traffic at plaza, comprising of ETC traffic (from ETC data), and cash and exemption traffic available through separate data shared by the client.

The TVC survey data and the actual traffic are largely similar, except for the Cars/Jeep/Van (CJV) category. The LCV and 2-axles are to be looked at together since the survey data has a classification error between the two vehicle categories. The ADT of the LCV and 2-axle category in the survey is 1,226, compared with the actuals recorded of 1,181 vehicles.

There is a substantial difference in the car traffic. To analyse this difference, we compared the daily car traffic for the days on which the survey was conducted, and the difference was noted across all days. Survey data was also validated by cross-checking the survey video for random hours of random days. Through this analysis, it appears the difference in the cars traffic volume is not getting recorded in the toll plaza system.

Table 16: Comparison of actual traffic and the TVC survey recoded traffic

ETC, Cash and Exemptions	CJV	LCV	2-Axle +Bus	3-Axle	MAV +OSV	Total	PCU	LCV+2A
ETC (Toll Plaza data)	2034	176	929	501	1816	5456	14760	1105
7D Cash ADT-Hourly Data	29	3	18	1	2	53	100	21
7D Exempt ADT-Hourly Data	257	17	37	11	44	366	625	54
Total 7D ADT	2319	196	985	514	1861	5875	15485	1181
7D TVC	**CJV**	**LCV+MB**	**2-Axle +Bus**	**3-Axle**	**MAV +OSV**	**Total**	**PCU**	**LCV+2A**
7D TVC-ADT	2750	728	499	532	1884	6392	15410	1226
Difference	430	532	-486	18	22	516	-76	46

Note: 7D refers to 7 Days. Hourly data refers to the traffic data shared by client compiled on a hourly basis.
Source: CRISIL MI&A

A noticeable difference across the LCV/minibus and 2-axles between the TVC and toll plaza data, which can be attributed to the difference in the vehicle classification methodology since the survey video was manually counted. Except for the cars category, in terms of the total daily traffic, the difference was small across the vehicle categories.

Annual average daily traffic for fiscal 2023 estimated based on actual traffic volume data for April 2022 to Mar 2023

In order to derive the annual average daily traffic (AADT) for fiscal 2023, we have considered actual 12-month traffic volume (April 2022 to March 2023) as the base for estimation. The segregation of buses from 2-axles and minibuses from LCVs was derived based on the share of these vehicles as per March 2022-Feb 2023 IHMCL traffic volume data.

Average cash and exemption traffic for fiscal 2023 is considered by analysing the data from October 2022 to March 2023. Average of cash and exemption data derived from October 2023 to March 2023 data with the cash and exemption traffic estimated during earlier study has been considered for fiscal 2023 AADT estimation. Additionally, to accommodate for the difference between cars volume recorded in the toll plaza data and the TVC survey data, we have added 350 cars to derive the final AADT for the fiscal. These estimates are added to the ETC data of April 2022 to March 2022 to arrive at full year AADT.

As discussed with client, the cash and exemption levels will be again reviewed in the next update, as the tolling systems installed by the client record data for 3-4 months and larger sample set is available.

Table 17: Projected FY23 AADT for the project stretch

Vehicle	ETC*	Cash	Exemption	FY23 AADT
CJV	2,174	50	72	2,296
LCV	164	8	2	175
2A	742	103	10	856
3A	500	3	5	507
MAV	1,691	3	8	1,702
OSV	2	0	0	2
Total	5,273	167	97	5,538
PCU	13,764	394	156	14,315

**Including 350 Cars to accommodate for the difference between TVC and toll plaza data*
Note: Cash and exemption are average of cash and exemption for June 2021 to May 2022 and Oct 2022 to Mar 2023.
Source: CRISIL MI&A

Origin-destination survey

CRISIL MI&A appointed a traffic consultant to conduct a 24-hour (O-D) survey at Raksha toll plaza. The survey was undertaken on March 14, 2023. The total size of the sample collected is a minimum of 70% across each vehicles category

Table 18: Details of sample collected in the O-D survey conducted for the assessment

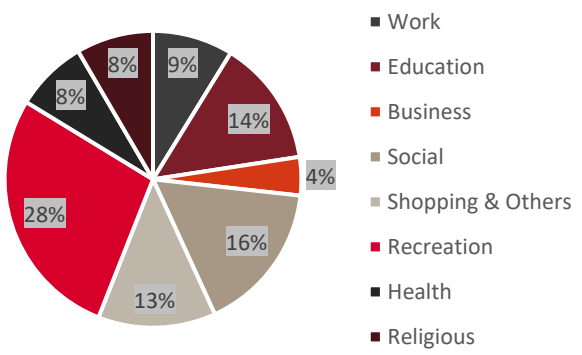
O-D survey sample							
Vehicle Category	**CJV**	**Bus + Mini Bus**	**LCV**	**2A**	**3A**	**MAV**	**Total**
Traffic Count	2,148	191	1,003	294	487	1,884	6,007
OD Sample	1522	130	723	233	389	1338	4,335
% Sample	71%	68%	72%	79%	80%	71%	72%

Source: CRISIL MI&A

Project stretch and its vicinity such as Kanpur, Lucknow and Indore are the key origin-destination for the passenger traffic

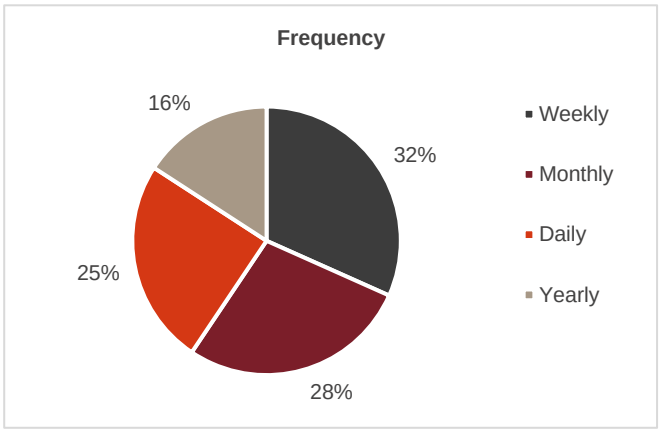
The O-D survey noted responses of the passengers on the traffic plying on the project stretch. These queries included purpose of the visit, frequency of travelling, origin point, and destination point. In terms of the purpose of travelling, passengers of 16% of the vehicles cited social reasons, followed by business (4%) and recreation (28%). In terms of frequency, 19% cited weekly travel, 26% monthly travel, 17% daily travel, and the rest cited yearly travel (39%).

Figure 11: Trip purpose of the passenger traffic at toll plaza as per O-D survey



Source: CRISIL MI&A

Figure 12: Trip frequency of the passenger traffic at toll plaza as per O-D survey



Source: CRISIL MI&A

The O-D survey revealed the key origin point and destination points for the passenger traffic are Shivpuri, Jhansi, Kanpur, Lucknow, Indore, and regions such as Raksha, which lie on the project stretch. The same pattern is noted in both directions, i.e., towards Shivpuri and towards Jhansi.

Table 19: Key O-D regions for passenger traffic at toll plaza in Jhansi to Shivpuri direction

Origin	%	Destination	%
Jhansi	53%	Shivpuri	33%
Kanpur	12%	Karera	14%
Lucknow	7%	Pichhore	9%
Raksa	4%	Indore	7%
Orai	3%	Dinara	6%
Orchha	2%	Kota	5%
Bageshwar Dham Sarkar	2%	Guna	3%
Varanasi	2%	Ujjain	3%
Prayagraj	1%	Anta	2%
Harpalpur	1%	Bhonti	2%
Others	14%	Others	17%

Source: CRISIL MI&A

Table 20: Key O-D regions for passenger traffic at toll plaza in Shivpuri to Jhansi direction

Origin	%	Destination	%
Shivpuri	29%	Jhansi	54%
Karera	14%	Kanpur	12%
Indore	10%	Lucknow	9%
Pichhore	8%	Raksa	5%
Anta	5%	Orai	2%
Kota	5%	Orchha	2%
Ujjain	5%	Banda	1%
Dinara	4%	Prayagraj	1%
Guna	3%	Basti	1%
Ahmedabad	2%	Harpalpur	1%
Others	16%	Others	12%

Source: CRISIL MI&A

Kanpur, Lucknow, Jhansi, Indore, Mumbai, and Rajkot are the major contributors to the goods traffic on the project stretch

The Jhansi-Shivpuri section is a part of the NH-27, which is the East-West Corridor. Hence, the traffic here largely plies between the eastern and western regions of the country. The key O-D region is Uttar Pradesh. Within the state, Kanpur, Lucknow and Jhansi are the key locations. Other key regions include Madhya Pradesh, Gujarat and Maharashtra. Within these states, the key cities noted in the survey are Indore, Mumbai, and Rajkot, among others.

Table 21: Key O-D regions for goods traffic at toll plaza in Jhansi to Shivpuri direction

Origin	%	Destination	%
Uttar Pradesh	**91%**	**Madhya Pradesh**	**53%**
Jhansi	26%	Shivpuri	20%
Kanpur	26%	Indore	18%
Lucknow	15%	Karera	3%
Prayagraj	4%	Bhopal	2%
Orai	2%	Ujjain	2%
West Bengal	**5%**	**Maharashtra**	**18%**
Bihar	**2%**	Mumbai	9%
Jharkhand	**1%**	Pune	3%
Madhya Pradesh	**1%**	Nashik	3%
Assam	**1%**	**Gujarat**	**18%**
Others	**0%**	Ahmedabad	8%
		Surat	3%
		Rajasthan	**10%**
		Others	**1%**

Source: CRISIL MI&A

Table 22: Key O-D regions for goods traffic at toll plaza in Shivpuri to Jhansi direction

Origin	%	Destination	%
Madhya Pradesh	**44%**	**Uttar Pradesh**	**92%**
Indore	16%	Kanpur	28%
Shivpuri	12%	Jhansi	24%
Dinara	2%	Lucknow	17%
Guna	2%	Prayagraj	3%
Bhopal	2%	Orai	2%
Maharashtra	**23%**	**West Bengal**	**4%**
Mumbai	10%	**Bihar**	**1%**
Nashik	4%	**Jharkhand**	**1%**
Pune	4%	**Madhya Pradesh**	**1%**
Gujarat	**17%**	**Others**	**1%**
Ahmedabad	8%		
Surat	3%		
Rajkot	2%		
Rajasthan	**15%**		
Kota	5%		
Ajmer	4%		
Tonk	3%		
Others	**2%**		

Source: CRISIL MI&A

Agri produce and Courier parcel form the key commodity travelling on the project stretch, followed by construction material, consumer items, and iron and steel

The O-D survey recorded the key commodities travelling the road stretch. The survey provides the share of vehicles for each commodity. The largest commodities are Courier parcel (20.5%) & Agri produce (20.4%) as per the survey, accounting for ~41% of the goods vehicles (LCV, 2-axle, 3-axle, and MAV) travelling the project stretch. Agri traffic comprises of food grain, fruits, vegetables, and other cash crops. Apart from these two commodities, other key commodities are consumer products at 8.4%, construction material and iron & steel at 8.2% each. Empty vehicles are only 11.4% of the total goods vehicles.

Table 23: Commodity share (%) based on O-D survey

Commodity	LCV	2 AXLE	3 AXLE	MAV	Grand Total
Agri Produce	26.9%	39.9%	14.9%	16.9%	20.4%
Iron & Steel Products	5.3%	1.7%	14.7%	9.0%	8.2%
Courier & parcel	15.4%	13.7%	30.3%	18.8%	20.5%
Empty	17.8%	9.0%	11.6%	10.0%	11.4%
Consumer Products	12.1%	4.7%	4.1%	6.5%	8.4%
Construction materials	3.7%	2.1%	6.2%	12.2%	8.2%
Plastic products	3.6%	9.9%	4.4%	5.1%	4.7%
Consumer Foods	3.6%	5.2%	3.6%	2.5%	3.2%
Textile & Footwear	2.0%	0.4%	0.5%	0.5%	0.9%
Automobiles	0.7%	0.4%	0.8%	2.9%	1.8%
Petroleum Products	0.0%	3.0%	1.8%	3.7%	2.4%
Chemical products	0.5%	0.9%	0.3%	1.3%	0.9%
Tiles & Ceramic products	1.0%	1.3%	0.5%	2.2%	1.5%
Plywood & Timber products	0.5%	0.4%	1.8%	0.4%	0.7%
Machinery	0.6%	0.9%	1.5%	1.2%	1.1%
Paper products	1.9%	2.1%	1.0%	1.3%	1.3%
Pharmaceuticals	0.7%	1.7%	1.0%	1.1%	1.1%
Coal	0.2%	0.4%	0.3%	2.0%	1.2%
Others	2.1%	1.3%	0.5%	0.4%	0.8%
Milk & Animal Food	1.2%	0.0%	0.3%	1.7%	1.2%
Rubber products	0.0%	0.9%	0.0%	0.2%	0.2%
Grand Total	100.0%	100.0%	100.0%	100.0%	100.0%

Source: CRISIL MI&A

Project stretch being a part of east west corridor, provides long distance connectivity and also passes through agri clusters and warehousing clusters and hence making the project stretch very ideal for commodities like vegetables, wheat, courier and parcels etc. The stretch also has a high proportion of seasonal agri-produce traffic. The region's harvest cycle begins in March and April.

Among key commodities, share of courier parcel, specifically, has a variance vis-à-vis the O-D survey conducted in June 2022. Demand led by festive season can be attributed for the same. A higher traffic from key transit and manufacturing hubs as Indore, Mumbai and Ahmedabad to consumption clusters of UP.

To normalise the commodity mix, an average was taken across data from two surveys, i.e., June 2022 and March 2023. The following shares have been considered for the traffic projections.

Table 24: Estimated commodity share (%) based on O-D survey conducted in June 2022 and March 2023

Commodity	LCV	2 AXLE	3 AXLE	MAV	Total
Agri Produce	26.4%	29.3%	14.4%	17.8%	19.8%
Iron & Steel Products	3.7%	2.5%	17.3%	14.0%	11.1%
Courier & parcel	13.7%	19.7%	22.2%	12.5%	15.7%
Empty	17.7%	8.1%	8.5%	9.2%	10.4%
Consumer Products	15.1%	5.7%	5.3%	6.1%	8.3%
Construction materials	3.1%	3.4%	6.6%	9.9%	7.2%
Plastic products	4.7%	8.3%	5.3%	5.6%	5.4%
Consumer Foods	4.0%	6.1%	5.2%	3.3%	4.1%
Textile & Footwear	2.4%	1.2%	2.2%	1.9%	2.1%
Automobiles	1.0%	1.4%	2.3%	3.3%	2.5%
Petroleum Products	0.0%	3.7%	1.2%	4.1%	2.7%
Chemical products	0.6%	0.6%	1.4%	2.2%	1.5%
Tiles & Ceramic products	1.1%	0.8%	1.0%	2.6%	1.8%
Plywood & Timber products	0.6%	2.6%	1.6%	1.1%	1.3%
Machinery	0.6%	1.4%	1.8%	1.5%	1.4%
Paper products	2.0%	1.9%	0.7%	0.9%	1.2%
Pharmaceuticals	1.0%	1.3%	1.1%	0.9%	0.9%
Coal	0.1%	0.4%	0.7%	1.5%	0.9%
Others	1.1%	0.8%	1.2%	0.3%	0.8%
Milk & Animal Food	1.2%	0.0%	0.3%	1.2%	0.9%
Rubber products	0.0%	0.9%	0.0%	0.2%	0.0%
Grand Total	100.0%	100.0%	100.0%	100.0%	100.0%

Source: CRISIL MI&A

Review of commodity growth rate assumptions

CRISIL MI&A's traffic projections are based on volume growth of commodities being transported on the road stretch. The below listed growth rates are assumed for the traffic study. These growth rates are applied to the traffic volume of vehicle categories based on the share of each vehicle category across various commodity categories. Based on the growth rates for fiscal 2024, traffic AADT growth in fiscal 2024 over fiscal 2023 is 4.7% for LCV, 4.9% for 2-axle, 5.7% for 3-axle, and 5.3% for MAVs.

Agri produce is the largest category on the stretch, comprising mostly vegetables (including onions). The origin states are Uttar Pradesh, Madhya Pradesh, Gujarat, and Maharashtra. Wheat and paddy are the next largest commodities originating from Uttar Pradesh, Madhya Pradesh, and Maharashtra. The key destination for these commodities is Uttar Pradesh – specifically Jhansi, Kanpur, and Lucknow districts.

The courier and parcel category largely originates in Gujarat (Ahmedabad) and Maharashtra (Mumbai) and is largely bound for Uttar Pradesh. Smaller warehousing hubs that have a fair amount of origination on the stretch include Vadodara and Indore. The proximity of large clusters and connectivity of consumption centres will lead to strong growth for this category.

The consumer product and foods category largely comprise processed food, FMCG and other grocery items, driven by consumption demand across Uttar Pradesh and Madhya Pradesh. Other key destinations are Gujarat, and Maharashtra.

Construction materials constitute bricks, cement, stone, and tiles. The origin points for these commodities are Uttar Pradesh, Rajasthan, and Gujarat. Kota and its nearby regions have cement clusters. Gujarat has a major tiles cluster in Morbi. Uttar Pradesh has grinding cement plants. The destinations are Uttar Pradesh and Madhya Pradesh owing to strong growth in housing development under Pradhan Mantri Awas Yojana (PMAY) – Urban and Rural. Iron and steel demand is also driven by the strong infra project pipeline and housing demand in the region. Kolkata is the largest origin point, while destination centres are Indore, Jhansi, Lucknow, and Mumbai. The key sub-commodity is iron as noticed in the survey.

Table 25: Growth rates of key commodities (volume terms) – excluding diversion impacts

Commodity	Share (%)	FY24	FY25-29	FY30-42
Agri Produce	19.8%	3.0%	3.0%	2.7%
Iron & Steel Products	11.1%	6.5%	6.9%	6.3%
Courier & parcel	15.7%	9.1%	7.9%	7.2%
Consumer Products	8.3%	3.5%	4.0%	3.6%
Construction materials	7.2%	6.1%	5.9%	5.4%
Plastic products	5.4%	5.0%	5.2%	4.5%
Consumer Foods	4.1%	4.0%	4.0%	3.6%
Textile & Footwear	2.1%	4.5%	4.9%	4.5%
Automobiles	2.5%	6.1%	6.9%	6.3%
Petroleum Products	2.7%	3.0%	2.7%	1.0%
Chemical products	1.5%	4.0%	4.2%	3.6%

Commodity	Share (%)	FY24	FY25-29	FY30-42
Tiles & Ceramic products	1.8%	6.1%	6.9%	6.3%
Plywood & Timber products	1.3%	5.0%	5.2%	4.5%
Machinery	1.4%	3.0%	3.2%	2.7%
Paper products	1.2%	6.1%	6.2%	5.4%
Pharmaceuticals	0.9%	6.1%	7.2%	6.3%
Coal	0.9%	3.5%	4.0%	3.6%
Others	0.8%	5.0%	5.9%	5.4%
Rubber products	0.0%	6.1%	6.2%	5.4%
Milk & Animal Food	0.9%	4.0%	4.2%	3.6%

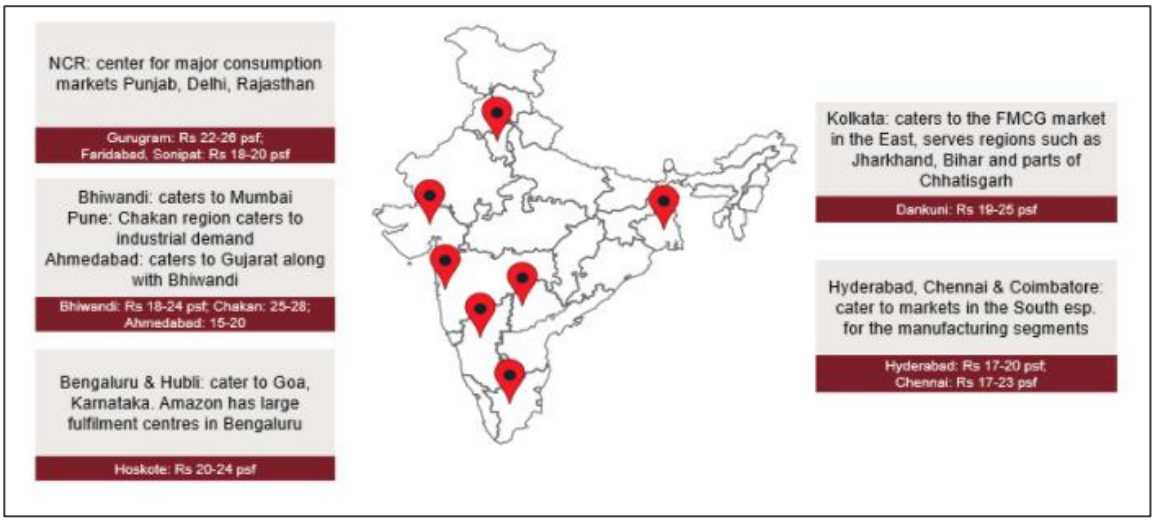
Source: Census data, CRISIL MI&A

Key warehousing cluster and connectivity to key cities drive courier and parcel traffic

In parity with % proportion of agri produce, Courier Parcel forms one of the major commodity plying on project stretch as per current study's OD data. Maharashtra, Gujarat, and Madhya Pradesh are the key origination states for the courier and parcel category. The key destination is Uttar Pradesh, followed by West Bengal and Madhya Pradesh. Outlook for the courier and parcel category is associated with the established presence of its origination points as key warehousing clusters. Bhiwandi, Pune, and Ahmedabad are the key warehousing clusters catering to the respective states and the neighbouring regions. Demand is driven by the key consumption centres of Kanpur, Lucknow, Jhansi, and eastern states of West Bengal and Bihar. We expect traffic to grow 8% over the short term and at ~7% CAGR over the long term.

Demand will be driven by robust consumption demand potential in Uttar Pradesh, Gujarat, and Maharashtra, along with the optimistic outlook for Kanpur, Lucknow, Ahmedabad, Mumbai, Pune, Indore, and Jhansi.

Figure 13: Key hubs of warehousing in India



Source: CRISIL MI&A

Figure 14: Emerging small warehousing hubs in India

Source: CRISIL MI&A

Agri produce largely constitutes vegetables and food grains

Agri produce dominates the project stretch with ~20% share as per the OD survey conducted during the course of this study. The key sub-category is vegetables (including onion), originating from Madhya Pradesh, Maharashtra, and Gujarat. The stretch also has a big proportion of food grains such as wheat and paddy from Uttar Pradesh and Madhya Pradesh.

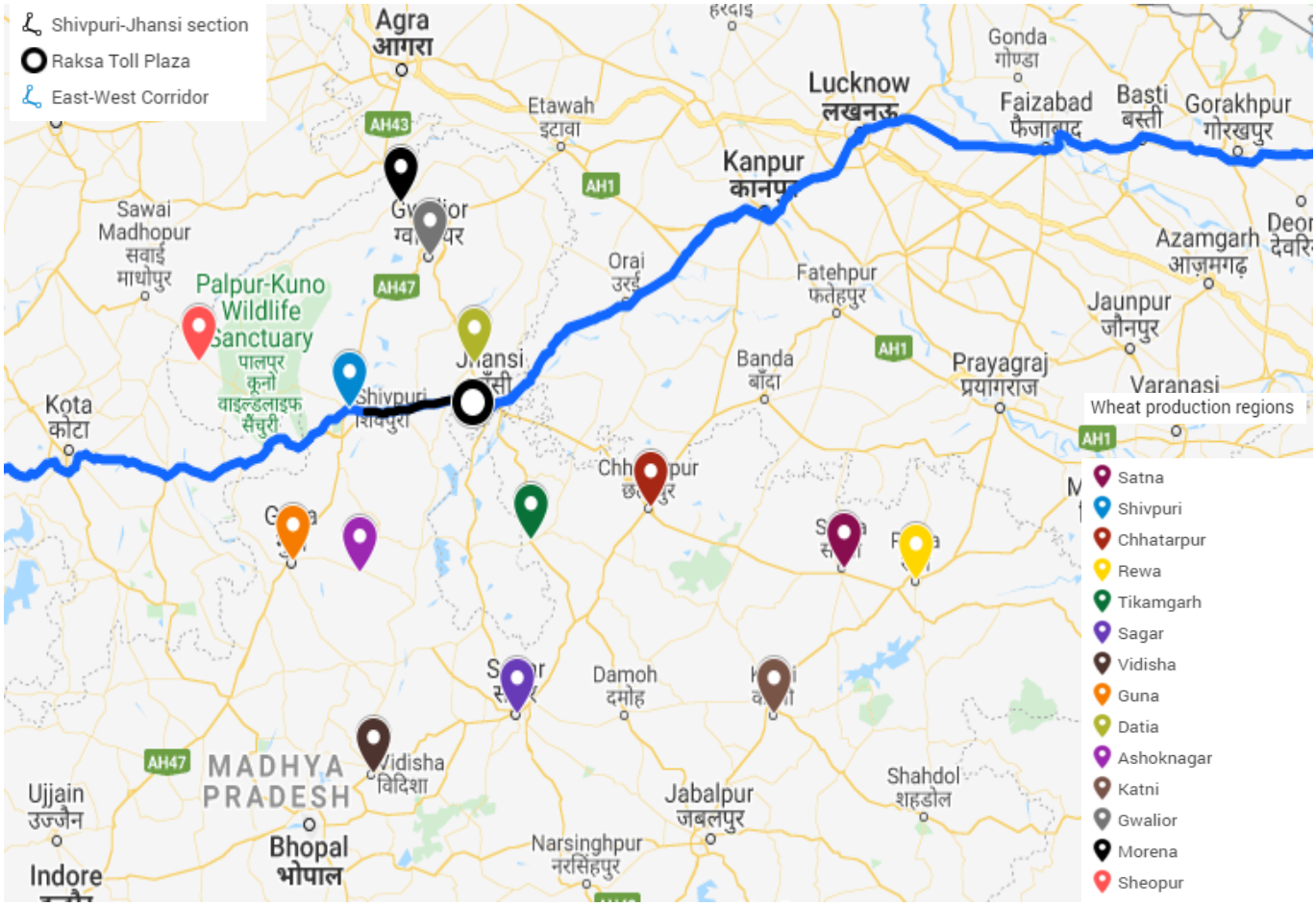
The major kharif horticulture crops grown in Madhya Pradesh are tomato, chilli, onion, okra, and brinjal. Vegetable production (volume) increased at 6% CAGR between fiscals 2015 and 2020 in Madhya Pradesh. Indore, Ujjain, Chhindwara, Sagar, and Dewas clusters grow onions. Dewas, Ujjain, Indore, and Sagar are the key regions for potato production. Shivpuri, Sagar, Chhindwara, and Jhabua are the key tomato producing regions.

Tomato, onion, okra, and banana are the key crops of Maharashtra. In Gujarat, the key vegetable crops are tomato, brinjal, banana, and okra. Gujarat and Maharashtra saw vegetable production volume increase CAGR of 1% and 11%, respectively, during fiscals 2015-20.

Madhya Pradesh and Uttar Pradesh are major wheat producers in the country. Wheat production in Madhya Pradesh and Uttar Pradesh increased at 4% and 10% CAGR between fiscals 2014 and 2019, respectively. The top five vegetable growing states, as of fiscal 2019, are Uttar Pradesh (26 MMT), West Bengal (12.8 MMT), Madhya Pradesh (15.6 MMT), Bihar (14.4 MMT), and Gujarat (13.4 MMT).

Madhya Pradesh accounts for 20-25% of India's wheat production. In marketing year (January to December) (MY) 22, it produced 22% of the country's total wheat. In the same year, Uttar Pradesh produced 29%, while Gujarat and Rajasthan produced 4% and 8%, respectively. The wheat producing regions marked in the map account for 35-40% of total wheat production in Madhya Pradesh. Each region produces 2-4% of wheat in the state; Shivpuri ranked third in fiscal 2019. Paddy (kharif) is a prominent crop in Madhya Pradesh and Uttar Pradesh. In MY21, these states produced 5% and 15% of India's total paddy (kharif), respectively.

Figure 15: Key wheat producing regions in Madhya Pradesh close to the project stretch



Source: Google Maps, CRISIL MI&A

The Indian agriculture sector is highly volatile as it is still dependent on the monsoon. Historical trends across key states close to the project stretch (Uttar Pradesh and Madhya Pradesh) have shown volatile production of agri commodities. In order to account for such volatility, agri produce traffic is expected to grow 3% in fiscal 2024. In the long term, 2-3% growth is expected.

Consumer products and foods category comprises FMCG, groceries and processed food

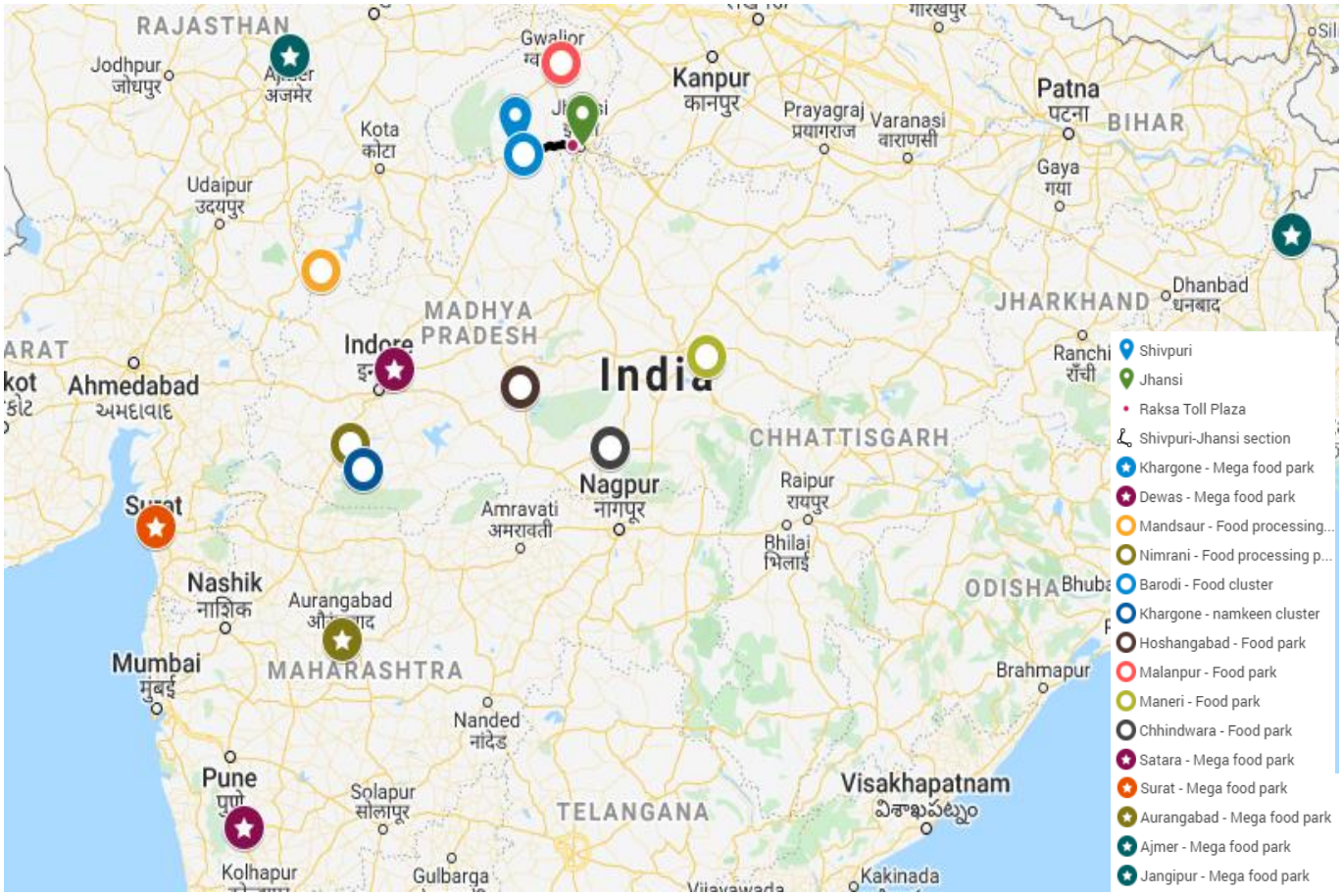
The consumer products and foods category transported on the project stretch constitutes grocery items, FMCG, and processed food. Uttar Pradesh, Madhya Pradesh, Maharashtra, Gujarat, and West Bengal are the key destinations for this category.

The consumer foods industry is set for healthy growth in the short term due to increased investments in the industry backed by favourable economic and demographic conditions in the key destination states. Madhya Pradesh, the main origin point, has several strong food processing clusters. Indore, Ujjain, and Bhopal have processing clusters of fruit, vegetables, spices, pulse, rice milling, flour milling, dairy, and ready-to-eat food. Several food parks exist in the vicinity of Indore and Bhopal that aid traffic on the stretch. We expect traffic of this commodity to grow 3-4% in the short term and sustain growth of ~3% CAGR over the long term.

The industry is witnessing an increase in household consumption of food items and higher demand for packaged foods. This will benefit the food processing cluster in Madhya Pradesh. The key destination states of Uttar Pradesh,

Madhya Pradesh, Maharashtra, Gujarat, and West Bengal are witnessing a rise in urbanisation, change in consumer lifestyles, and an increase in disposable incomes.

Figure 16: Alignment of operational and upcoming mega food parks along the key O-D regions



Source: Google Maps, CRISIL MI&A

Table 26: Upcoming mega food parks along the key O-D regions

Upcoming mega food park	State	Project cost (Rs million)
Pristine Mega Food Park	Bihar	1,201.3
BIADA, Muzaffarpur	Bihar	1,805.7
Fanidhar Mega Food Park, Mehsana	Gujarat	1,510.5
Wardha Mega Food Park, Wardha	Maharashtra	923.6
Shree Ram Mega Food Park, Bikaner	Rajasthan	1,328.1
Operational = 22; under implementation = 19		

Source: MOFPI, CRISIL MI&A

Housing, infrastructure push to goad transport of iron & steel and construction materials

The project stretch is used to transport iron and steel and construction materials such as bricks, cement, stone and tiles. The origin points for these commodities are Uttar Pradesh, Rajasthan, and Gujarat. Kolkata is the key origin point for iron and steel. Other key origin points are Kota in Rajasthan and regions in close proximity having clusters

of cement and stone manufacturing. Gujarat has a major tiles cluster in Morbi. Uttar Pradesh has grinding cement manufacturing units. Madhya Pradesh also has a strong cement manufacturing cluster.

In the past five years, the central (Uttar Pradesh and Madhya Pradesh) and eastern (Odisha, Bihar and West Bengal) regions exhibited strong demand led by a surge in infrastructure, construction, and rural housing. These two regions were less impacted by pandemic-induced demand disruptions in fiscal 2021, due to higher rural penetration. West Bengal, Madhya Pradesh, Bihar, Odisha, and Uttar Pradesh form almost 65% of under-construction houses under PMAY-Rural. We expect traffic to grow ~6% in the short term.

As seen in the past decade, the eastern and central regions are expected to continue to drive demand for construction materials in India in the medium term on the back of continued government thrust on infra and housing in the region. A plethora of infrastructure projects and pickup in urban housing in Uttar Pradesh, as well as healthy rural housing demand in Madhya Pradesh will aid traffic of construction materials. Key infrastructure projects in the region such as metro projects in Bhopal, Meerut, Agra and Indore; smart city-related development in Madhya Pradesh (Bhopal, Indore, and Jabalpur) and Uttar Pradesh (Lucknow); and several road and highway projects will boost demand.

During fiscals 2023-27, cement capacity additions in the central region (Uttar Pradesh and Madhya Pradesh) are projected at ~29 million tonne. Rising income levels and rural consumers' growing preference for ceramic tiles will drive long-term growth of construction material traffic on the stretch. Government initiatives such as 100 smart cities, Housing for All by 2022, increase in deduction limit for housing loan, and relaxed norms for issuing long-term bonds by banks for financing affordable housing will aid growth. We expect construction material traffic to increase 5-6% in the long term.

Strong pipeline of infrastructure projects to boost growth in the region

Top 100 projects across Indore, Shivpuri, Jhansi, Kanpur (Dehat), Kanpur (Nagar), and Lucknow have been considered at a total project cost of Rs 2,931 billion. Railways, coal-based power plants, real estate, roadways, and airways sectors account for nearly 78% of the project cost.

Table 27: Key upcoming infrastructure projects in the influence area of the project stretch

Key upcoming projects in Indore, Shivpuri, Jhansi, Kanpur, and Lucknow	Implementation stage	Project cost (Rs billion)
Light Metro Rail (Indore) Project	Under execution	222.8
Coal Based Power (Ghatampur) Project	Under execution	172.4
Metro Rail (Kanpur) Project	Under execution	137.2
Airport (Lucknow) Project – Modernisation	Planning	107.0
Indore-Manmad Railway Line Project	Planning	99.7
Anpara Coal Based Power (Bhognipur) Project – Phase II	Planning	71.9
Coal Based Power (Bhognipur) Project	Planning	71.9
Lucknow Metro Rail Project (Phase-IA)	Under execution	69.3
Mega Leather Park (Ramaipur)	Under execution	58.5

Key upcoming projects in Indore, Shivpuri, Jhansi, Kanpur, and Lucknow	Implementation stage	Project cost (Rs billion)
Panki Coal Based Power Project – Extension	Under execution	58.2
Outer Ring Road (Lucknow) Project	Planning	52.1
Smart City (Indore) Project	Under execution	51.1
Jhansi-Khairar-Manickpur Railway Line Project	Under execution	49.6
Dholpur-Jhansi 4th Railway Line Project	Nascent	48.7
Solar Park (Jalaun, Allahabad, Mirzapur and Kanpur)	Under execution	48.0
Prabandh Nagar Residential Scheme	Planning	47.9
Mathura-Jhansi 3rd Railway Line Project	Under execution	43.8
Indore-Jabalpur Railway Line Project	Planning	43.2
Residential Township (Lucknow) Project (Paarth Republic)	Under execution	40.0
Automotive Testing Facility (Multi State) Project	Under execution	38.3

Source: Projects Today, CRISIL MI&A

Table 28: Sectors in the influence area of the project stretch

Sectors of upcoming projects in Indore, Shivpuri, Jhansi, Kanpur, and Lucknow	Project cost (Rs billion)
Services and utilities	2,931
Electricity and non-conventional energy	2,300
Manufacturing	437
Irrigation	102
Mining	91

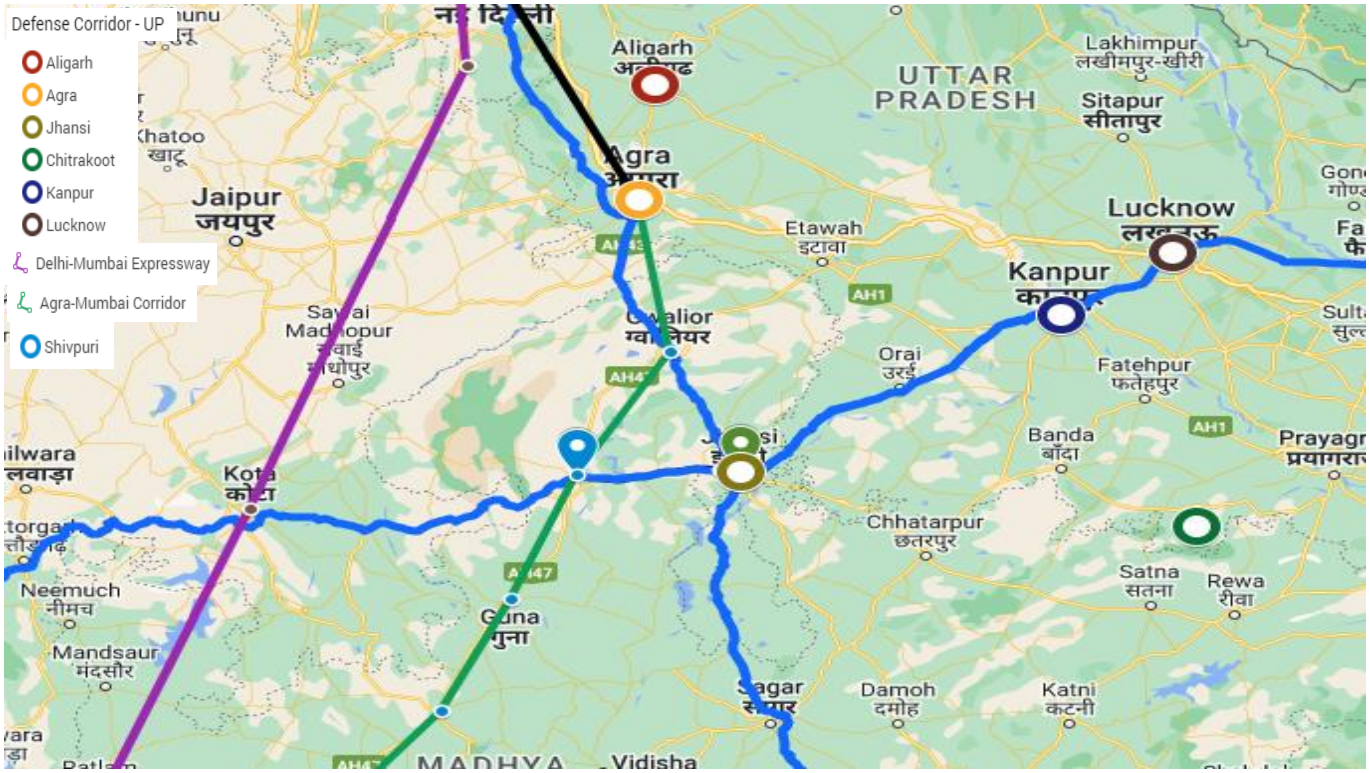
Source: Projects Today, CRISIL MI&A

Regional growth in infra projects and better connectivity positive for the project stretch

The region's connectivity is expected to improve with the upcoming Agra-Mumbai Economic Corridor and Delhi-Mumbai Expressway (DME). The project stretch will be a major feeder route to these upcoming road projects. The East-West Corridor will be named National Corridor and work on lane expansion and de-congestion of the East-West Corridor through rings roads, bypass, elevated corridors etc. is progressing under Bharatmala Pariyojana. The proposed Jhansi-Kanpur-Lucknow-Gorakhpur-Kushinagar Expressway, which will connect the two border points of Uttar Pradesh, will directly connect to the project stretch and boost traffic.

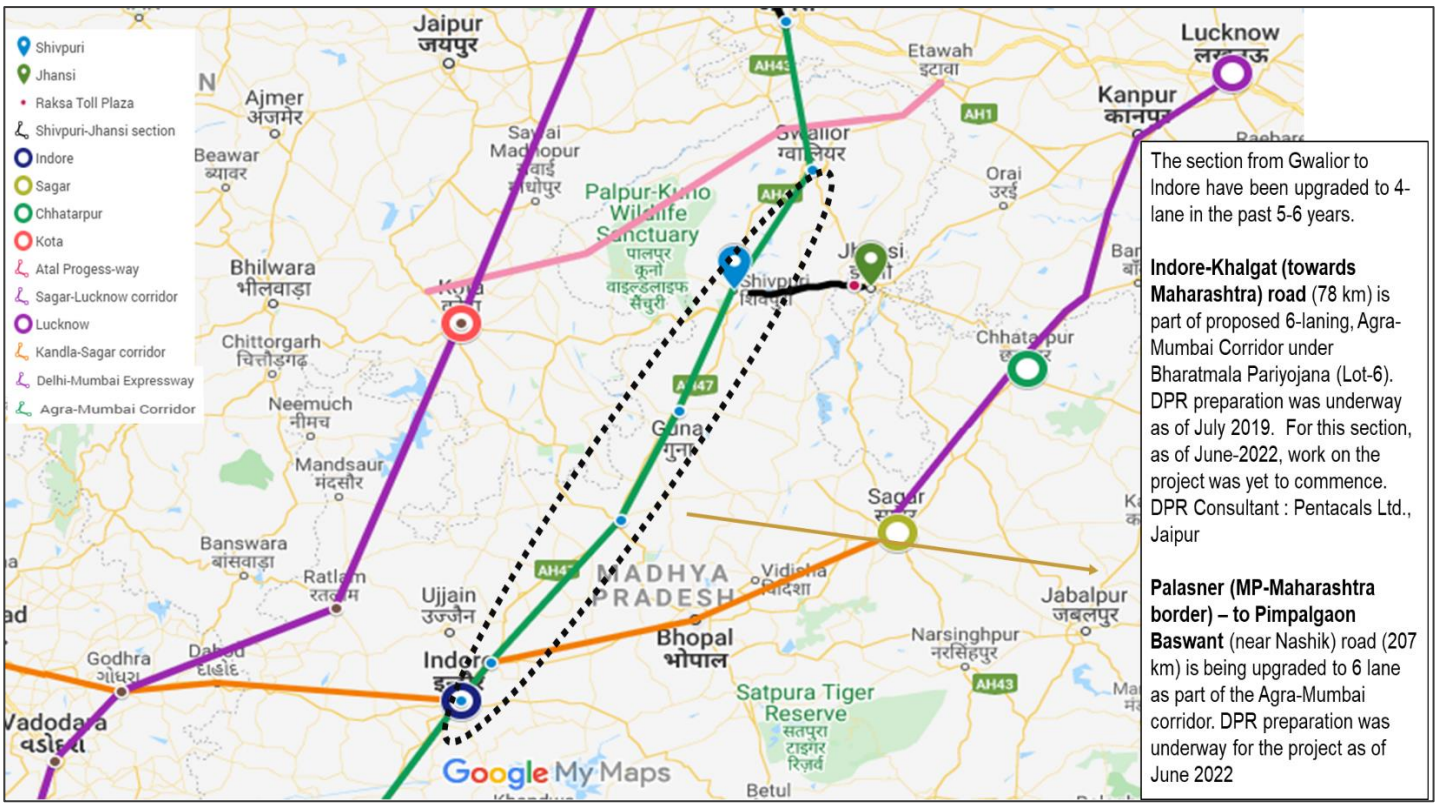
The upcoming Defence Industrial Corridor in Jhansi, Kanpur, Lucknow, Chitrakoot, Agra, and Aligarh will augment the region's industrial profile and boost traffic on the stretch. Uttar Pradesh Expressways Industrial Development Authority (UPEIDA) has been appointed as the key authority for project execution. The land acquisition process is currently underway. The authority created a land bank of 1,546 ha already and has a target of 5,000 ha. It has also signed 68 MOUs with various private players, as of date. The 2020 Uttar Pradesh Electronics Manufacturing Policy, proposes to establish a medical electronic manufacturing cluster in the Lucknow-Unnao-Kanpur zone.

Figure 17: Map of defence corridor and other key upcoming road stretches in the influence region of project stretch



Source: NHAI, UPEIDA, Google Maps, CRISIL MI&A

Figure 18: Alignment of and update on the Agra-Mumbai Corridor under the Bharatmala programme



Note: *Atal Progressway and the Lucknow-Kandla Corridor are under planning stage; Green coloured alignment from Gwalior to Indore is 4-lane; Proposed 6-laning of Agra-Mumbai Corridor under the Bharatmala project is under planning stage

Source: Projects Today, NHAI, Google Maps, CRISIL MI&A

6 Assessment of impact factors

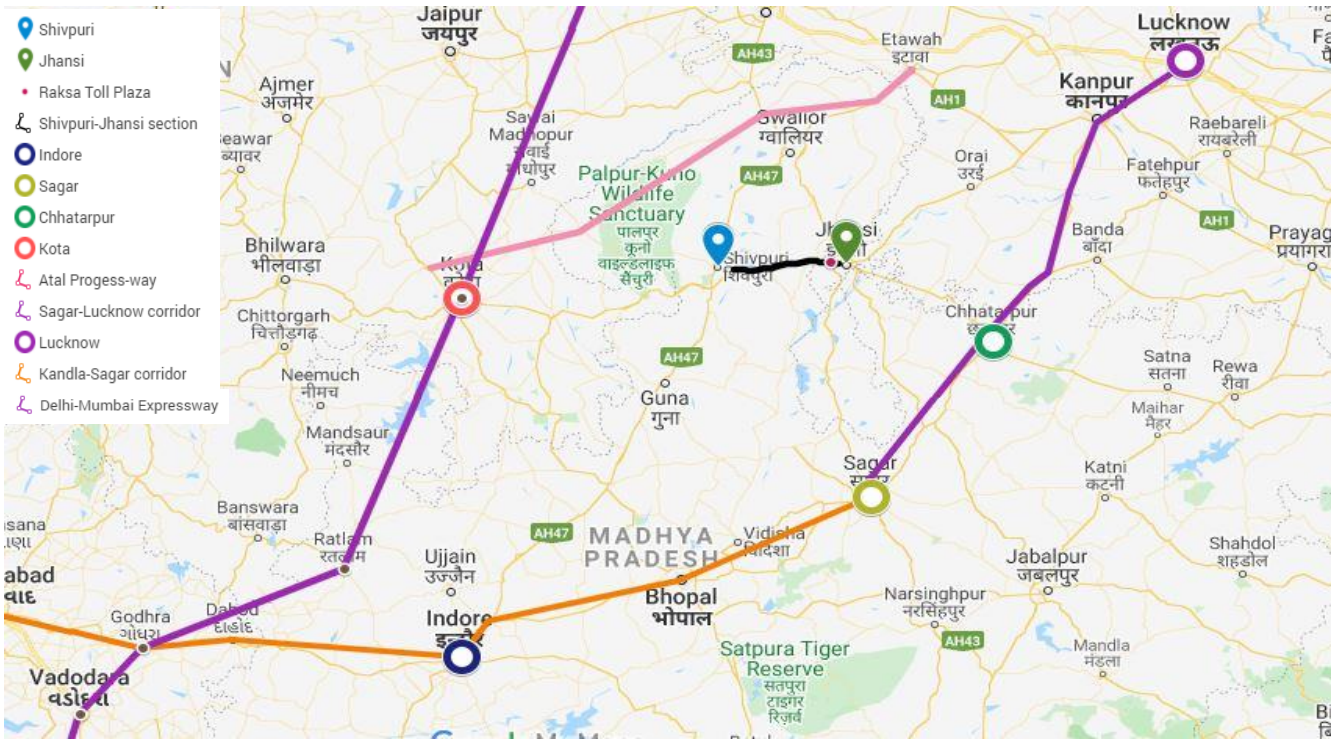
Atal Progressway and Lucknow-Kandla Economic Corridor pose long term risks to the project stretch, as they offer comparable speed and distance benefits

As discussed earlier, there exists an alternative route between Lucknow and Indore which passes through Chhatarpur and Sagar. This route takes 16-17 hours and the distance is 801 km. The key reason for this longer travel time is that the alternative route is a mix of two and four lanes. Kanpur to Bhopal section of the alternative route, of nearly 527 km, is 2-lane. The Maharashtra and Gujarat traffic can also use this road, as they converge at Indore, where they will have the option to go towards the project stretch or towards Sagar and use the alternative road.

Under the Bharatmala programme, the sections from Lucknow to Sagar and Sagar to Kandla are proposed for augmentation. Hence, in the future, when the augmentation gets completed, the alternative route will be a feasible route in competition to the project stretch. We have assumed the impact of this augmented road to begin in fiscal 2028.

Further, there is a greenfield expressway coming up in the region. The 4-lane access controlled Atal Progressway (Chambal Expressway) will connect Etawah (Uttar Pradesh) to Kota (Rajasthan). The connection point is likely to be the Agra-Lucknow Expressway on one end and the Delhi-Mumbai Expressway on the Kota side. Thus, the traffic from the eastern region converging at Lucknow will have an alternative to the project stretch. The traffic can travel on the Agra-Lucknow Expressway and Atal Progressway to reach Rajasthan. They also have the Delhi-Mumbai Expressway connectivity to Gujarat and Maharashtra, which is expected to begin operations in mid-2024. For the Atal Progressway, we have assumed fiscal 2029 to be start year for the road stretch.

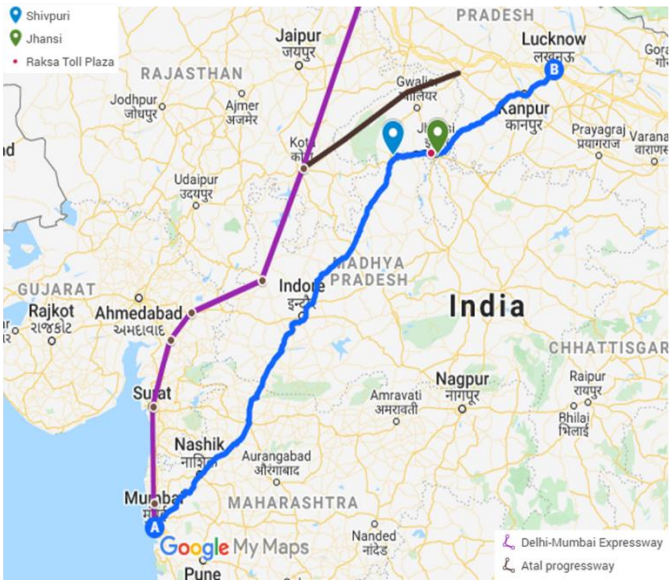
Figure 19: Alignment of key alternative routes to the project stretch



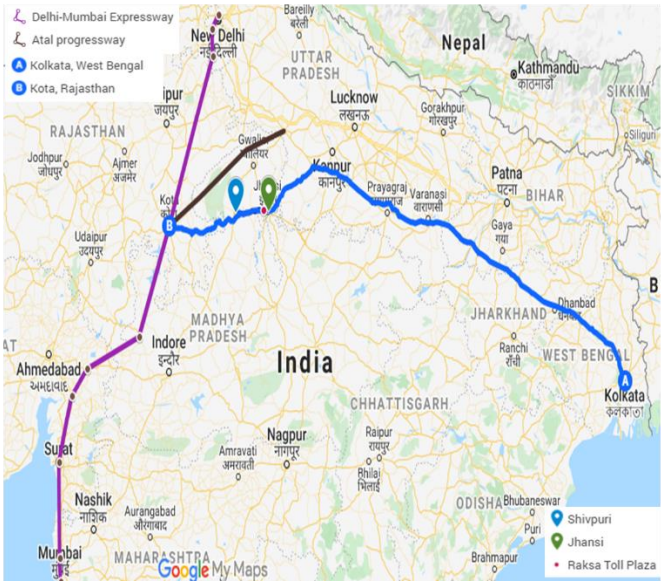
Source: NHAI, Google Maps, CRISIL MI&A

Figure 20: Traffic movement between east and west using the project stretch vs DME and Atal Progressway

Traffic from Gujarat-Maharashtra to Kanpur-Lucknow could divert to DME and Atal progress-way



Traffic from Kanpur-Lucknow and Eastern states to Rajasthan could divert to Atal progress-way



Source: NHAI, Google Maps, CRISIL MI&A

The generalised cost ratio has been defined by calculating the vehicle operating time cost, vehicle operating cost and toll rates. The toll rates considered for cost analysis are for fiscal 2023. Toll rates for the upcoming augmented Lucknow-Sagar Corridor and Sagar-Kandla Corridor are based on actual DME rates, after dividing by 1.25 as per NHAI rules. The toll rates for Atal Progressway are based on per km rates of DME. Based on the cost assessment, diversion percentages are derived as per IRC norms. A generalised cost ratio (GCR) greater than one indicates that the cost of travelling on the project stretch is cheaper than the alternative. A GCR of one denotes ~50% diversion to the alternative stretch.

The traffic at risk of diversion to Atal Progressway is calculated from the OD survey where traffic between 1) Rajasthan, and Uttar Pradesh, West Bengal, Assam, Bihar, Jharkhand and Delhi, 2) Maharashtra and Uttar Pradesh (selected regions), and 3) Gujarat and Uttar Pradesh (selected regions) have been considered.

To assess the at-risk traffic for Lucknow-Sagar and Sagar-Kandla corridors, traffic between 1) Madhya Pradesh (selected regions) and all states included in the OD survey, 2) Maharashtra, and Uttar Pradesh, Assam, Bihar, Jharkhand and West Bengal, and 3) Gujarat, and West Bengal, Assam, Bihar and Jharkhand have been considered. The at-risk traffic is then multiplied with the diversion percentage, which is defined based on IRC-defined formulae and considering that the project stretch as part of a national corridor. This process yields the percentage of diverted traffic. We have considered a lower diversion percentage than calculated, as the project stretch is part of the National Corridor i.e., the East-West Freight Corridor. For this reason, we believe the project stretch will continue to remain the preferred route for east-west traffic.

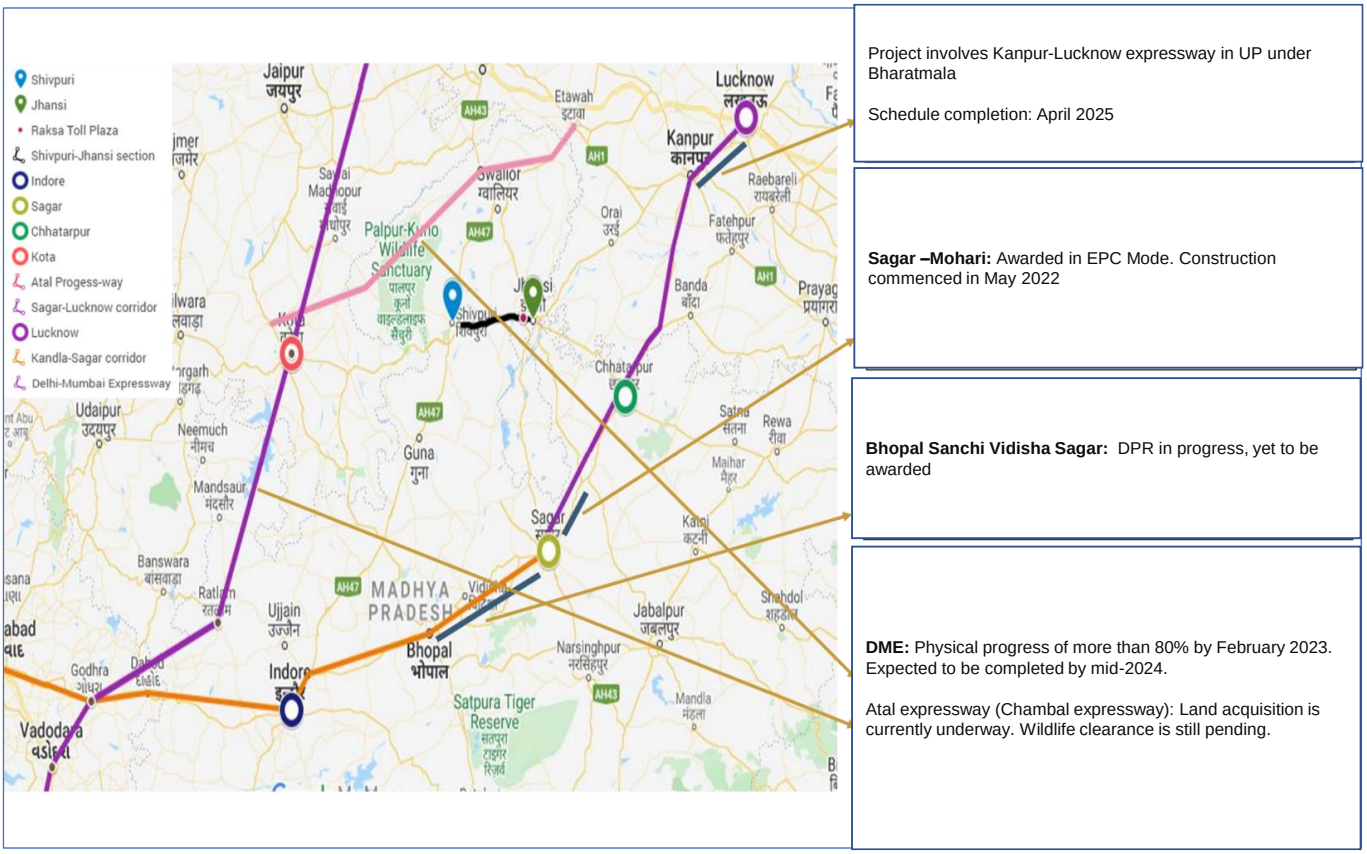
Table 29: GCR for the project stretch

Vehicle type	Post upgradation scenario Lucknow-Indore (via Sagar)	Post upgradation scenario Lucknow-Mumbai (via Sagar)	Post upgradation scenario Lucknow-Ahmedabad (via Sagar	Lucknow-Kota (via Atal Progress way)	Lucknow-Mumbai (via DME and Atal Progress way)	Lucknow-Ahmedabad (via DME and Atal Progress way)
Car	1.04	1.01	1.04	0.97	1.02	1.00
Bus	1.04	1.01	1.03	1.00	1.04	1.02
LCV	1.02	1.01	1.03	0.98	1.01	0.97
2-axle	1.04	1.02	1.04	1.00	1.02	1.00
3-axle	1.03	0.99	1.03	1.00	0.99	0.98
MAV	1.04	1.02	1.04	0.99	1.01	1.00

Note: GCR > 1 indicates cost of travelling on project stretch is cheaper than the alternative and the GCR = 1 denotes ~50% diversion to the alternative stretch

Source: NHAI, Google Maps, CRISIL MI&A

Figure 21: Alignment of and update on the alternative routes considered in the traffic assessment



Project involves Kanpur-Lucknow expressway in UP under Bharatmala

Schedule completion: April 2025

Sagar –Mohari: Awarded in EPC Mode. Construction commenced in May 2022

Bhopal Sanchi Vidisha Sagar: DPR in progress, yet to be awarded

DME: Physical progress of more than 80% by February 2023. Expected to be completed by mid-2024.

Atal expressway (Chambal expressway): Land acquisition is currently underway. Wildlife clearance is still pending.

Source: Projects today, NHAI, Google Maps, CRISIL MI&A

Project stretch will continue to be a preferred route on account of preference for industrial corridors and law and order issues on alternate routes

Project stretch vs Atal Progressway

Atal Progressway passes through the Chambal region and historically, the region has been known for law and order issues. Furthermore, it has been observed that expressways have lower preference across commercial traffic compared to national highways. Commercial traffic also prefer wider roads and on account of expected augmentation of Kanpur Jhansi stretch to 6 Lane (228Kms), Project stretch will continue to be preferred route as compared to Atal Progressway which is a 4 Lane route. With augmentation to 6L the preference of Atal Progressway will be lower. Project stretch is likely to be preferred over Atal Progressway on account of key industrial clusters present on project route stretch. Empty truck traffic prefers road stretches which pass through industrial corridors.

Commercial vehicles' preference of national highways

This preference is visible in the traffic composition of two parallel routes between Delhi and Agra i.e NH-2 and the Yamuna expressway. Yamuna expressway's traffic is composed of ~80% passenger vehicles. While ~70% of the traffic on NH-2 is commercial. NH-2 provides connectivity to key freight aggregation points such as ICD Tughlakabad and industrial regions such as Okhla, Badarpur, Saidabad, Faridabad, Ballabhgarh and Palwal. NH-2 is preferred over Yamuna Expressway as for travel time of 4-5 hours (saving of 1 hour), truckers prefer paying lower toll than paying higher toll rates on Yamuna expressway.

Detailed below is an example of traffic travelling between Delhi to Lucknow and have two options between Agra and Lucknow that is NH19 and Agra Lucknow expressway. Gurau toll plaza exists on NH-19, between Agra and Lucknow. Fatehabad toll plaza is located on the Agra Lucknow Expressway. The Delhi-Lucknow commercial traffic existing on both the plazas is as follows,

Table 30: Comparison of traffic between Agra and Lucknow on NH-19 and Agra-Lucknow expressway

Vehicle category	ADT at Gurau TP – NH19 (Delhi-Lucknow)	ADT at Fatehabad TP – AL expressway (Delhi-Lucknow)	Share (%) on AL exp	Diversion % per VOC-VOT cost analysis
LCV	48	32	40%	72%
2-axle	26	12	32%	65%
3- axle	4	5	53%	57%
MAV	28	23	46%	63%
Total MAV (ADT) – both toll plazas	51		As per the 63% diversion, the MAV traffic on AL Exp should be 32 vehicles	

Source: Projects today, NHAI, Google Maps, CRISIL MI&A

On Agra-Lucknow highway (NH-19) diversion to Agra-Lucknow expressway is lower than estimated diversion. The share of currently existing MAV traffic on the expressway is lower by ~28% than the calculated share as per the cost analysis.

Project stretch v/s Lucknow Indore Via Chhatarpur –Sagar

The project stretch is likely to be preferred over Lucknow –Indore via Chhatarpur on account of key industrial clusters present on project route stretch. Empty truck traffic prefers industrial corridors due to possibility of availing cargo. Also, the Kanpur Jhansi stretch (228 km) is likely to undergo capacity augmentation from 4 Lane to 6 Lane. Hence, project stretch will continue to be preferred routes as compared to Lucknow Indore Via Chhatarpur –Sagar route which will be 4 Lane. Wider routes are preferred by freight traffic.

Project stretch is part of Golden Quadrilateral

The project stretch forms part of the golden quadrilateral route connecting east and west region and provide connectivity to Delhi-Mumbai Expressway at Kota. The route is among the key national highway routes in the country and is considered preferred routes for road traffic on account of connectivity to other key highways while passing through high consumption centres in India. Going forward as well, on account of being key GQ routes, the project stretch will continue to remain a preferred route for road traffic.

NH-27 i.e the East-West corridor will see capacity augmentation under the Bharatmala program in the future. The road from Kanpur to Jhansi currently has ~30,000 PCUs and capacity augmentation (4-lane to 6-lane) is likely to happen over the medium term, considering 40,000 PCUs is the capacity augmentation threshold for the project stretch. Wider roads will be preferred by the freight traffic compared to the alternatives which will be 4 lane roads.

Under the Bharatmala program, the Golden-Quadrilateral and North South-East West, corridors would be declared as National corridors as they carry nearly 35% of India's freight. Lane expansion, and de-congestion of these National Corridors is proposed through Ring Roads and bypasses/ elevated corridors. Around 5,000 kms are being taken up under this category in Phase-I of the program.

Commercial traffic's preference of road stretch passing through Industrial clusters

To travel between Kanpur/Lucknow and Indore using the project stretch, traffic crosses Shivpuri, Datia, Guna, Ashoknagar, Shajapur, Rajgarh, Ujjain, Dewas and Indore districts. These districts together account for ~27% of MP state's net value added for secondary economic activities (manufacturing). Commercial traffic prefers to travel through industrial areas to ensure full truck load travel to pick-up and delivery goods on the way. Also while travelling back empty truck take the routes through industrial clusters to ensure they can pick up goods on way back. Given the presence of manufacturing industries, the project stretch offers strong freight aggregation centres along the route wherein the commercial vehicles can pick up freight.

The Atal Progressway passes through Sheopur, Bhind, and Morena districts form the Chambal region. These three districts account for only ~3% of MP state's net value added for secondary economic activities (manufacturing). Also, the Chambal region has lagged in terms of economic growth and historically law and order issues have been prevalent.

The other alternative road i.e Lucknow/Kanpur to Indore via Chhatarpur and Sagar passes through Hamirpur, Mahoba and Chhatarpur districts. Chhatarpur accounts for only 2% of MP state's net value added for secondary economic activities (manufacturing). Hamirpur and Mahoba districts together account for only ~0.4% of UP state's gross value added for secondary economic activities (manufacturing).

Thus, in both cases the lack of manufacturing activity, the alternate routes do not offer strong freight aggregation centres which commercial traffic prefers.

Upcoming industrial clusters and better connectivity near project stretch will led to lower diversion

The upcoming Defence Industrial Corridor in Jhansi, Kanpur, Lucknow, Chitrakoot, Agra, and Aligarh will augment the region's industrial profile and boost traffic on the stretch. Uttar Pradesh Expressways Industrial Development Authority (UPEIDA) has been appointed as the key authority for project execution. The land acquisition process is currently underway. The authority created a land bank of 1,546 hectares already and has a target of 5,000 hectares. It has also signed 68 MOUs with various private players, as of date. This will boost the industrial profile of the region and strengthen the preference for Kanpur-Jhansi route and the project stretch route .

The UPEIDA has proposed Jhansi-Kanpur-Lucknow-Gorakhpur-Kushinagar Expressway. This will connect the two border points of Uttar Pradesh and will directly connect to the project stretch, boosting traffic of the stretch. Under the 2020 UP Electronics Manufacturing policy, a medical electronic manufacturing cluster in the Lucknow-Unnao-Kanpur zone, is proposed to be established.

Service Road + access control is planned at Shivpuri to reduce congestion of traffic on the E-W corridor under the Bharatmala program. Shivpuri also has 2 proposed Ring Roads. Shivpuri also has a proposed logistics park which is under planning stage and will be located in Deherwara (Dist. Shivpuri). Kanpur is also a location for Multi-modal logistics park.

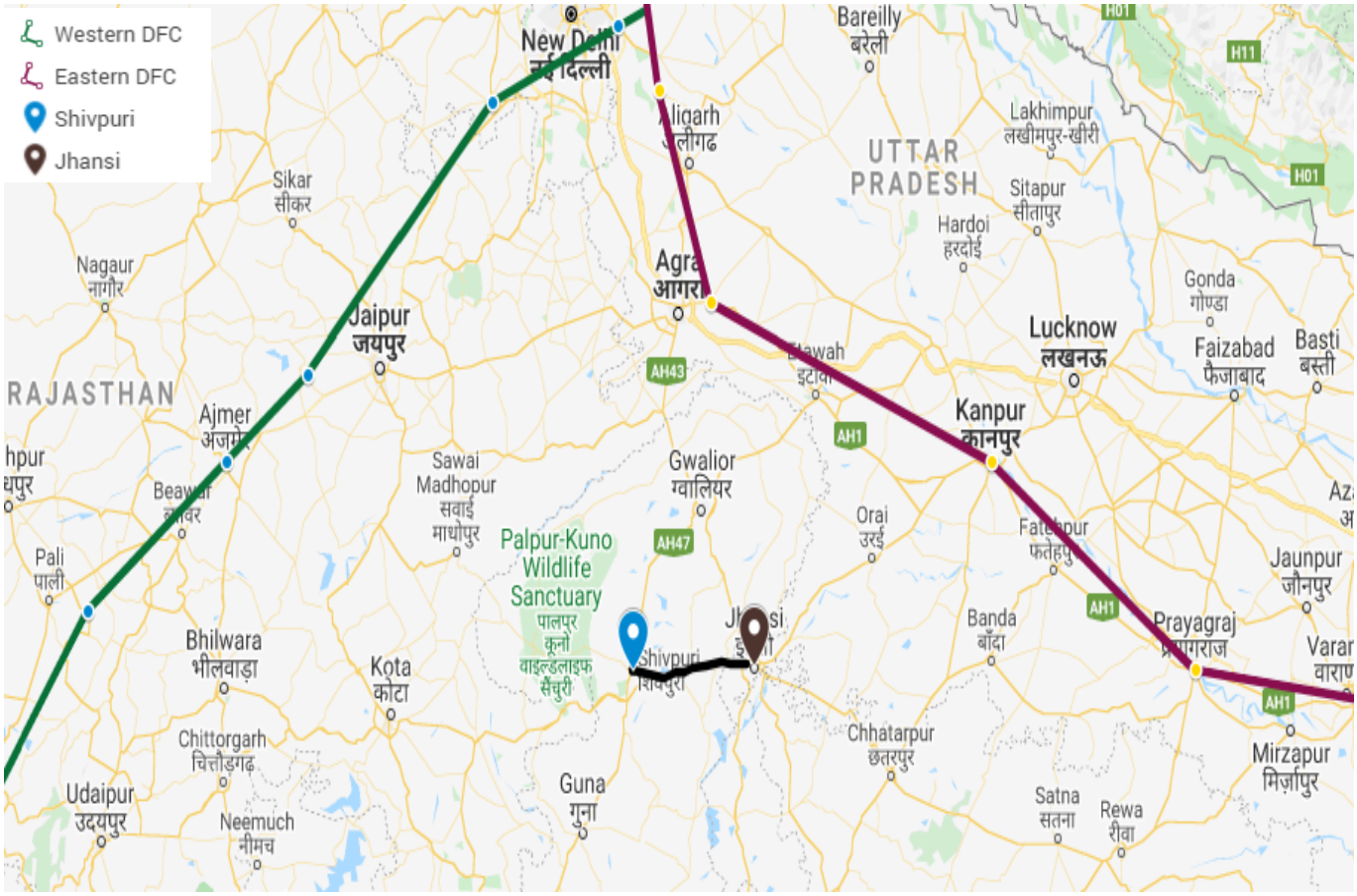
For the above reasons, the projects stretch will witness lower diversions to the alternate routes. CRISIL MI&A has assumed lower diversion rate by ~50% across commercial vehicle categories.

Shivpuri-Jhansi section traffic to remain unaffected by the DFCs

Dedicated freight corridors (DFCs) are constructed exclusively for movement of goods. The first phase of the project includes construction of the Western DFC from Mumbai to Dadri, near Delhi, and the Eastern DFC from Dankuni in West Bengal to Ludhiana in Punjab. The former will mainly cater to containers as 60% of container traffic originates from this region. The later will cater to dry bulk cargo. The DFCs aim to regain railway's lost share in handling of key commodities such as coal, steel, iron ore, cement, food grains, fertilisers, petroleum products, and containers.

The project stretch has a very small proportion of the aforementioned commodities, with none travelling on to the stretch from the northern region. Given the high proportion of agri produce on the stretch originating in Madhya Pradesh, the same could be transported to eastern parts of the country via DFCs. Thus, West Bengal and Bihar could benefit from this arrangement to a limited extent.

Figure 22: Alignment of DFCs with regard to the project stretch



Source: DFCCIL, Google Maps, CRISIL MI&A

Diversion to alternative routes could lead to ~17-18% loss in traffic

The impact of the alternative routes shown below represent a loss of traffic for the project stretch. We have calculated an impact of -17.9% PCUs, denoting that the traffic would have been higher by 17.9% in fiscal 2042, had there been zero diversions. The impact presented here is inclusive of the qualitative views given earlier on the preference of the project stretch corridor compared to the alternate routes.

The upcoming Atal Progressway and planned economic corridors pose a threat of traffic loss across major origin-destination regions. Atal Progressway is expected to take away ~7.5% of the overall PCU of the project stretch, and the Lucknow-Kandla Economic Corridor, 10.4%. We have assumed the Atal Progressway to impact the stretch starting fiscal 2029 (50% of the impact considered in fiscal 2029 and full impact in fiscal 2030) , and Kandla-Sagar and Lucknow-Sagar corridors from fiscal 2028 (50% of the impact in fiscal 2028, 75% impact in fiscal 2029 and 100% impact in fiscal 2030).

Table 31: Impact of various factors on the project stretch traffic

	Natural Shift	Truck Aggregation	Chambal	Lucknow-Sagar	AADT-Without Diversion	AADT-With Diversion
Vehicle Type	FY42	FY42	FY42	FY42	FY42	FY42
LCV	-1.0%	-0.3%	-10.0%	-14.0%	415	317
2-Axle	-1.5%	-0.2%	-7.2%	-10.2%	1,862	1,525
3- Axle	-1.3%	0.0%	-8.0%	-10.8%	1,446	1,171
MAV	0.5%	0.0%	-7.4%	-10.3%	4,469	3,731
Overall	-0.3%	-0.1%	-7.6%	-10.5%	8,192	6,744
Overall PCU	-0.1%	0.0%	-7.5%	-10.4%	30,657	25,353

*Note: The impact is based on traffic volume in vehicle terms

Source: CRISIL MI&A

Truck aggregation will majorly impact LCVs and 2-axle vehicles on the stretch. We do not expect MAV traffic to be impacted by truck aggregation. The share of LCVs in total PCU is low, and hence, it would also have a small impact overall. A natural shift towards heavy vehicle categories in the long term to meet higher demand as economy grows, could lead to increase in the proportion of heavy vehicles.

7 Traffic and revenue projection for the remaining concession

Traffic projections

The traffic (PCU) on the project stretch is expected to grow at 4.3% CAGR between fiscals 2023 and 2043. The traffic will be negatively impacted by the two upcoming road stretches — the Atal Progressway (impact from fiscal 2029), and the Sagar-Lucknow and Kandla-Sagar Corridor (Impact from fiscal 2028).

The stretch will undergo capacity augmentation when the traffic exceeds 40,000 PCU for three consecutive years. As per our projections, there is no risk of capacity augmentation till end of fiscal 2043.

Table 32: Projected AADT, FY23-43

Year	Cars	Bus	Mini Bus	LCV	2A	3A	MAV	Total	PCU	YOY
FY23	2,296	113	4	170	743	507	1,704	5,538	14,317	
FY24	2,479	117	5	178	780	536	1,795	5,890	15,130	5.7%
FY25	2,668	122	5	187	819	568	1,892	6,260	15,995	5.7%
FY26	2,861	126	5	196	861	601	1,997	6,647	16,915	5.8%
FY27	3,057	131	5	206	903	636	2,106	7,044	17,861	5.6%
FY28	3,256	135	5	201	900	636	2,107	7,239	18,057	1.1%
FY29	3,457	139	5	192	885	627	2,078	7,384	18,057	0.0%
FY30	3,661	143	6	183	868	616	2,045	7,521	18,026	-0.2%
FY31	3,865	147	6	192	910	650	2,153	7,923	18,970	5.2%
FY32	4,070	151	6	201	954	687	2,266	8,335	19,954	5.2%
FY33	4,276	155	6	210	1,001	725	2,385	8,758	20,977	5.1%
FY34	4,480	159	6	220	1,049	766	2,510	9,191	22,038	5.1%
FY35	4,684	162	6	231	1,100	809	2,641	9,634	23,138	5.0%
FY36	4,887	166	6	242	1,154	853	2,778	10,086	24,278	4.9%
FY37	5,088	169	7	253	1,209	900	2,921	10,547	25,458	4.9%
FY38	5,286	172	7	265	1,267	950	3,071	11,018	26,681	4.8%
FY39	5,482	176	7	277	1,327	1,001	3,225	11,495	27,931	4.7%
FY40	5,675	179	7	290	1,390	1,055	3,385	11,981	29,225	4.6%
FY41	5,865	182	7	303	1,456	1,112	3,553	12,477	30,566	4.6%
FY42	6,051	185	7	317	1,525	1,171	3,731	12,987	31,968	4.6%
FY43	6,234	187	7	332	1,597	1,234	3,917	13,509	33,427	4.6%
CAGR (FY23-43)	5.0%	2.5%	2.5%	3.3%	3.8%	4.5%	4.2%	4.5%	4.3%	

Source: CRISIL MI&A

Traffic volume CAGR for the projection period, excluding diversions, would have been higher by ~0.8%

Table 33: Traffic growth rates without considering diversions to expressway and other alternative routes

CAGR	FY23-25	FY25-30	FY30-35	FY35-42	FY23-43
Car	7.8%	6.5%	5.1%	3.7%	5.1%
Bus	3.9%	3.3%	2.5%	1.9%	2.6%
Minibus	3.9%	3.3%	2.5%	1.9%	2.6%
LCV	4.8%	4.8%	4.7%	4.7%	4.7%
2-axle	5.0%	4.9%	4.9%	4.8%	4.9%
3-axle	5.8%	5.7%	5.6%	5.4%	5.6%
MAV	5.4%	5.4%	5.2%	5.1%	5.2%
Total PCU	5.7%	5.5%	5.1%	4.8%	5.1%

Source: CRISIL MI&A

Table 34: Traffic growth rates considering diversions to expressway and other alternative routes

CAGR	FY23-25	FY25-30	FY30-35	FY35-42	FY23-43
Car	7.8%	6.5%	5.1%	3.7%	5.1%
Bus	3.9%	3.3%	2.5%	1.9%	2.6%
Minibus	3.9%	3.3%	2.5%	1.9%	2.6%
LCV	4.8%	-0.4%	4.7%	4.7%	3.4%
2-axle	5.0%	1.2%	4.9%	4.8%	3.9%
3-axle	5.8%	1.6%	5.6%	5.4%	4.5%
MAV	5.4%	1.6%	5.2%	5.1%	4.2%
Total PCU	5.7%	2.4%	5.1%	4.7%	4.3%

Source: CRISIL MI&A

Revenue assumptions

For revenue and traffic assessment, we have assumed the commercial operation date for the Atal Progressway to be in fiscal 2029. Further, we have assumed the augmentation of Kanpur-Chhatarpur-Sagar-Bhopal section gets completed by fiscal 2028. The traffic assessment has considered an additional volume of 350 cars in the base AADT. A comparison of TVC survey data and actual daily traffic data shared with us reveals that ~350 cars are not being recorded in the toll system daily. In the revenue calculations, we have assumed that the concessionaire will be able to convert this volume into toll-paying traffic. For these cars, we have assumed half under local monthly pass and the rest equally divided into single and return journey.

Trip segmentation

Trip segmentation has been derived based on the average share of a single journey, return journey and categories over April 2022 to March 2023. For revenue calculation, the trip factor used for a return journey is two, and for a monthly pass it is 50. The trip segmentation has been assumed to remain constant throughout the projection period i.e., over fiscals 2023 to 2043.

Table 35: Details of trip segmentation across vehicle categories

	Single	Return	Monthly Pass	Local Non-commercial	Local commercial	Exemption	Total
CJV	47.1%	40.3%	0.0%	9.5%	0.0%	3.1%	100.0%
LCV	86.3%	11.1%	0.7%	0.0%	0.5%	1.4%	100.0%
2A	83.5%	15.2%	0.0%	0.0%	0.0%	1.2%	100.0%

	Single	Return	Monthly Pass	Local Non-commercial	Local commercial	Exemption	Total
3A	91.4%	7.6%	0.0%	0.0%	0.0%	1.0%	100.0%
MAV	95.0%	4.5%	0.0%	0.0%	0.0%	0.5%	100.0%
OSV	92.1%	7.9%	0.0%	0.0%	0.0%	0.0%	100.0%

Note: The trip segmentation provided in the table is as per the values recorded in ETC data.
Local non-commercial is local monthly pass. Toll rate for cars is Rs 315 in fiscal 2023.
Source: Toll plaza data, CRISIL MI&A

Wholesale Price Index projections

The projected toll rates are dependent on Wholesale Price Index (WPI) assumptions for fiscals 2023 to 2043. For WPI projection, CRISIL MI&A has relied on inputs from client.

Table 36: WPI projections till December 2041

Month-year	WPI	Expected on-year growth
Dec-2020 (actual)	385.4	
Dec-2021 (actual)	440.4	14.3%
Dec-2022	462.6	5.02%
Dec-2023	478.7	3.5%
Dec-2024	495.5	3.5%
Dec-2025	512.8	3.5%
Dec-2026	530.8	3.5%
Dec-2027	549.4	3.5%
Dec-2028	568.6	3.5%
Dec-2029	588.5	3.5%
Dec-2030	609.1	3.5%
Dec-2031	630.4	3.5%
Dec-2032	652.5	3.5%
Dec-2033	675.3	3.5%
Dec-2034	699.0	3.5%
Dec-2035	723.4	3.5%
Dec-2036	748.7	3.5%
Dec-2037	774.9	3.5%
Dec-2038	802.1	3.5%

Month-year	WPI	Expected on-year growth
Dec-2039	830.1	3.5%
Dec-2040	859.2	3.5%
Dec-2041	889.3	3.5%

Source: CRISIL MI&A

Other details for revenue calculations

The following details have been used for the toll rate calculations which have been sourced from the toll rate calculation sheet.

Table 37: Base rates for toll calculation

Vehicle category	Base rate of fee per km (base year = FY08), in Rs
Car, jeep, van or LMV	0.65
LCV, light goods vehicle or minibus	1.05
Bus or truck (2-axle)	2.20
3-axle CV	2.40
HCM, EME or MAV (4-6 axles)	3.45
Oversized vehicles (seven or more axles)	4.20

Source: Technical schedules, CRISIL MI&A

Table 38: Details of toll rate calculation for multiple journeys

Amount payable	Maximum number of one-way journeys allowed	Period of validity
One-and-a-half times of the fee for one-way journey	Two	Twenty-four hours from the time of payment
Two-thirds of amount of the fee payable for 50 single journeys or more	50 or more	One month from date of payment
Rate of monthly pass for a person who owns a mechanical vehicle registered for non-commercial purposes and resides within a distance of 20 km from the toll plaza is Rs 315.00 for FY23, subject to revision as per NHAI rules		
Fee for CVs (excluding vehicles plying under national permit) registered in the district where the fee plaza falls will be 50% of the prescribed rate for that category of vehicle		

Source: Technical schedules, CRISIL MI&A

Table 39: Details of road length, structures and bypass on the project stretch

Location of toll plaza (chainage)	Length (in km) for which fee is payable	Length of bypass (in km) for which additional fee is payable	Length of structures (in km) converted into equivalent road length	Tollable length
Km 1374+650 near Raksha village	73.7134 km	Nil	15.8660 km	89.5794 km

Note: In the June 2022 assessment, tollable length was considered as 89.6554 Km, as per the available technical schedules, while the current tollable length is considered as per toll rate calculation sheet shared by the client

Source: Toll rate calculation sheet, CRISIL MI&A

Revenue projections

Table 40: Projected revenue (Rs million) for FY23-43

Year	Car	LCV	Bus	2A	3A	MAV	Yearly Revenues	Yearly Revenue Growth
Mar-23	79	12	16	107	81	395	690	
Mar-24	91	13	18	118	90	438	768	11.3%
Mar-25	102	14	19	128	100	482	845	10.1%
Mar-26	114	16	21	140	110	531	931	10.2%
Mar-27	125	17	22	153	121	582	1021	9.7%
Mar-28	139	18	24	159	125	605	1070	4.7%
Mar-29	153	18	26	163	129	623	1111	3.8%
Mar-30	171	17	28	167	132	635	1150	3.6%
Mar-31	187	19	29	181	145	696	1257	9.3%
Mar-32	203	21	31	199	159	765	1378	9.6%
Mar-33	224	23	34	217	175	840	1511	9.7%
Mar-34	243	24	36	236	193	920	1652	9.3%
Mar-35	266	27	38	258	211	1006	1805	9.2%
Mar-36	290	29	40	282	232	1103	1975	9.4%
Mar-37	312	32	43	306	255	1207	2154	9.1%
Mar-38	339	34	45	334	280	1318	2350	9.1%
Mar-39	365	38	48	366	307	1442	2566	9.2%
Mar-40	394	41	51	398	337	1575	2795	8.9%
Mar-41	424	44	54	434	369	1723	3047	9.0%
Mar-42	454	48	57	473	405	1883	3320	9.0%
Mar-43	488	53	60	515	444	2054	3614	8.9%
CAGR (FY23-43) %	9.5%	7.7%	6.8%	8.2%	8.9%	8.6%	8.6%	

Source: CRISIL MI&A

8 Annexure

Monthly traffic and revenue projection for Fiscal 2024

Fiscal 2023 – ETC estimates

Table 41: Monthly ETC data for fiscal 2023

Month	CJV	LCV	2A	3A	MAV	OSV	Total	PCU
Apr-23	1,647	165	862	556	1,711	2	4,943	13,856
May-23	2,037	151	675	499	1,506	1	4,870	12,569
Jun-23	1,797	154	693	488	1,535	2	4,669	12,487
Jul-23	1,625	164	658	474	1,591	2	4,514	12,437
Aug-23	1,533	154	671	466	1,653	2	4,479	12,624
Sep-23	1,297	168	713	489	1,786	2	4,454	13,199
Oct-23	1,812	159	692	453	1,680	2	4,798	13,056
Nov-23	2,128	169	744	512	1,839	2	5,395	14,437
Dec-23	2,115	174	720	494	1,752	3	5,258	13,914
Jan-23	1,926	155	697	479	1,696	3	4,955	13,328
Feb-23	2,146	182	895	563	1,787	2	5,575	14,845
Mar-23	1,839	178	906	529	1,766	2	5,220	14,368

Source: Toll Plaza data, CRISIL MI&A

Fiscal 2024 – Monthly Traffic

The monthly traffic for projected AADT of fiscal 2024 is estimated as per the seasonal variations observed for fiscal 2023. Month-wise traffic for fiscal 2024 is provided below:

Table 42: Seasonally adjusted monthly average daily traffic for fiscal 2024 (P)

Month	CJV	LCV	2A	3A	MAV	Total	PCU
Fiscal 2024 Traffic AADT - Projected	**2,479**	**183**	**897**	**536**	**1,795**	**5,890**	**15,130**
Apr-23	2,268	186	1,054	604	1,840	5,953	15,803
May-23	2,715	165	799	525	1,567	5,771	13,985
Jun-23	2,476	173	847	531	1,651	5,677	14,298
Jul-23	2,165	179	779	499	1,656	5,278	13,720
Aug-23	2,044	168	794	490	1,721	5,217	13,892
Sep-23	1,786	190	871	532	1,920	5,299	14,921
Oct-23	2,415	173	819	477	1,748	5,633	14,431
Nov-23	2,931	191	910	557	1,978	6,566	16,518
Dec-23	2,819	190	852	520	1,824	6,205	15,427

Month	CJV	LCV	2A	3A	MAV	Total	PCU
Jan-23	2,568	169	825	504	1,765	5,830	14,750
Feb-23	3,167	220	1,172	656	2,059	7,275	18,249
Mar-23	2,451	194	1,072	557	1,838	6,113	15,900

Source: Toll Plaza data, CRISIL MI&A

Fiscal 2024 – Monthly Revenue (in Rs. Million)

Table below contains seasonally adjusted month wise toll revenue for fiscal 2024. The monthly revenue is calculated by applying a similar trip segmentation on the monthly traffic for fiscal 2024.

Table 43: Seasonally adjusted monthly revenue for fiscal 2024 (P)

Month	CJV	LCV	2A	3A	MAV	Total
Fiscal 2024 Revenue (P)	90.6	13.1	135.2	90.3	438.3	767.6
Apr-23	6.8	1.1	13.1	8.4	36.9	66.3
May-23	8.4	1.0	10.2	7.5	32.5	59.7
Jun-23	7.4	1.0	10.5	7.3	33.1	59.4
Jul-23	6.7	1.1	10.0	7.1	34.4	59.3
Aug-23	6.3	1.0	10.2	7.0	35.7	60.2
Sep-23	5.4	1.1	10.8	7.4	38.5	63.2
Oct-23	7.5	1.1	10.5	6.8	36.3	62.1
Nov-23	8.8	1.1	11.3	7.7	39.7	68.6
Dec-23	8.8	1.1	10.9	7.4	37.8	66.1
Jan-24	8.0	1.0	10.6	7.2	36.6	63.4
Feb-24	8.9	1.2	13.6	8.5	38.6	70.7
Mar-24	7.6	1.2	13.7	8.0	38.1	68.6

Source: Toll Plaza data, CRISIL MI&A

Comparison vis-à-vis traffic assessment done in June 2022

Fiscal 2023 – AADT estimates

Fiscal 2023 AADT estimated in current study is compared with the AADT estimated in previous studies (provided below). ETC AADT is compared across the assessments, due to non-reliable data for cash and exemptions. ETC AADT based on Apr-Jun 2022 data was derived by removing the share of cash and exempted vehicles across vehicle categories.

The ETC AADT estimated based on actual data for the fiscal (Apr 2022 to Mar 2023), is 1.1% lower vis-à-vis the estimates based on Apr-Jun 2022 data. Variance in CJV growth is also due to the high domestic sales observed across the country, in addition to the higher than anticipated on year growth observed in COVID impacted months.

Cars and Utility vehicle sales growth was observed as ~27% on year in fiscal 2023, vis-à-vis 13% observed in fiscal 2022. The estimated sales growth for Uttar Pradesh and Madhya Pradesh also remained at similar levels. As per the state wise sales data available with CRISIL (for Apr-Dec period of fiscal 2023), growth for UP and MP, put together was 34%, similar to country's growth.

In case of other vehicle categories, agricultural produce is a major contributor. Untimely rains, particularly in UP, during the year have impacted the key kharif crops. For fiscal 2023, paddy, a key kharif crop for MP and UP, saw a decline in production. Maize production also remained flattish across both the states.

Additionally, Between March 1 and 21, 2023, cumulative rains have been 20% more than normal for India. Rains were 196% higher than normal for Central India, which is estimated to have impacted following crops – wheat (mature), gram (mature seed pods), onion (mature), mango (fruit), tomato (fruit), and grapes (fruit). This also held back the traffic volumes typically seen in March, leading to a marginal decline in actual fiscal 2023 AADT vis-à-vis projected AADT in June 2022.

Table 44: AADT comparison

AADT estimation	Cars	LCV/ Mini Bus	Bus/ 2Axle	3 Axle	MAV	PCU
FY23 (June 2022)						
AADT Total	2339	185	985	531	1722	14919
Cash %	3.2%	7.4%	20.2%	1.0%	0.3%	
Exemption %	5.9%	2.0%	1.9%	1.4%	0.7%	
AADT ETC	**2126**	**167**	**767**	**518**	**1705**	**13911**
FY23 (Mar 2023)						
AADT Total	2296	175	856	507	1702	14315
Cash	50	8	103	3	3	394
Exemption	72	2	10	5	8	97
AADT ETC	**2173**	**164**	**742**	**500**	**1693**	**13764**
Difference	*2.2%*	*-1.8%*	*-3.3%*	*-3.5%*	*-0.7%*	*-1.1%*

Note: AADT ETC includes 350 cars (added to accommodate the difference between the TVC survey and recorded traffic)
Source: CRISIL MI&A

Traffic and revenue projections

Traffic growth is projected as per the commodity shares across vehicle categories. The commodity share for current study is considered as an average of the shares arrived from OD surveys conducted in March 2023 and June 2023. Among the final commodity shares considered for projections across studies, the share of courier parcel is higher in the current study (~16%) vis-à-vis earlier study (~10%). Courier and parcel is typically a high growth commodity vis-à-vis other commodities, and with a larger share of high growth commodity, the commercial traffic growth for the stretch is pegged higher in the current study.

On overall PCU level, pre-diversion CAGR is projected at 5.1% CAGR during the concession period vis-à-vis 4.7% projected in earlier study. Similarly, current post diversion CAGR is 4.3% vis-à-vis 3.9% in earlier study.

Difference is observed in revenue projections as CRISIL has considered a WPI growth of 3.5% for the projection period, as per discussions with client. Earlier the same was projected based on CRISIL's view.

Table 45: Historical WPI data (December 2001 to December 2021)

Month-year	All commodities - WPI series (base: FY12)	On-year growth
Dec-2001	55.3	
Dec-2002	57.2	3.3%
Dec-2003	60.5	5.7%
Dec-2004	64.6	6.8%
Dec-2005	67.2	4.1%
Dec-2006	71.9	7.0%
Dec-2007	74.8	4.0%
Dec-2008	79.8	6.7%
Dec-2009	85.5	7.1%
Dec-2010	93.5	9.4%
Dec-2011	100.8	7.7%
Dec-2012	107.1	6.3%
Dec-2013	113.4	5.9%
Dec-2014	112.1	-1.1%
Dec-2015	109.4	-2.4%
Dec-2016	111.7	2.1%
Dec-2017	115.7	3.6%
Dec-2018	119.7	3.5%
Dec-2019	123.0	2.8%
Dec-2020	125.4	2.0%
Dec-2021	143.3	14.3%

Linking factor for WPI (base FY05 to FY12) is 1.561; linking factor for WPI (base FY94 to FY05) is 1.873

Source: Office of the Economic Adviser, CRISIL MI&A

Table 46: Pan-India historical growth rate of various industries

Commodity	Remark
Agri produce	Production (volume terms): CAGR (FY12-22), Rice: ~2.2%, Wheat: ~1.2%, Fruits: ~3.4%, Vegetables: ~2.7%
Iron and steel products	Steel domestic demand growth trend (volume-wise) CAGR (FY17-22) = ~5%

Commodity	Remark
Courier and parcel	Market size of Indian e-commerce industry (value-wise) CAGR (FY19-22) = ~7%
Consumer products	Organised retailing industry market size, value terms CAGR(FY17-22): ~8%
Construction materials	Cement demand in UP and MP (volume terms) CAGR (FY17-22) = ~5-6%
Plastic products	PVC demand (volume terms), CAGR(FY17-22) = ~0-1%
Consumer foods	Organised consumer food industry (value terms), CAGR(FY16-20) = ~14%
Textile and footwear	Domestic readymade garment (value terms), CAGR (FY16-20) = ~5-6%
Automobiles	• Cars & utility vehicles (volume terms), CAGR (FY12-22) = ~1-2% • Two-wheeler segment (volume-terms), CAGR (FY17-22) = ~(-5)%
Chemical products	Total chemicals industry (value-terms), CAGR (FY15-20) = ~4%
Tiles and ceramic products	Domestic ceramic tile market (volume terms), CAGR (FY18-21) = ~7%
Paper products	Paper demand (volume terms), CAGR (FY17-22) = ~4-5%
Pharmaceuticals	Domestic formulations (value terms), CAGR (FY17-22) = ~9%
Coal	Non-coking coal domestic consumption (volume terms), CAGR (FY17-22) = ~4%
Rubber products	Tyre demand (volume terms), CAGR (FY17-22) = ~2%
Milk and animal food	Milk production (volume terms), CAGR (FY18-22) = ~7%

Source: MOSPI, CRISIL MI&A

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Project Drone II: Revalidation study of InvIT R1 assets

National Highway Infra Projects Private Limited
October 2023
Our ref: 24265606

steer

Project Drone II: Revalidation study of InvIT R1 assets

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Traffic Consultant developed the relationships in the models used to produce the forecasts for this Project based on additional data provided for April to September 2023. Since March 2020, the outbreak of the virus known as COVID- 19 has spread throughout the world and has been defined by the World Health Organization as a "pandemic". As of the date of distribution of this Report, the COVID-19 outbreak is having a material impact on global economic and political affairs including having a significant impact on all the transportation industries, including toll road traffic, where in particular vehicle volumes have fallen in response to quarantine and self-care measures that governments have imposed. The situation remains dynamic and is subject to significant change. In this challenging context, Traffic Consultant has produced base forecasts (directly produced from models using a combination of pre-COVID-19 and post-COVID-19 views) with a view on a possible scenario for the traffic forecasts based on an assumption of recovery from the COVID-19-related traffic decrease. For the purposes of these forecasts, we have also incorporated other possible impacts of COVID-19 related scenarios. However, it is important to note that this is only one view, and there continues to remain uncertainty as to the short-term, intermediate or prolonged effects of and responses to the COVID-19 pandemic on the Project. All of these effects could impact the COVID-19-related aspects of the Report. As a result, no assurance can be provided by Traffic Consultant that the scenarios and assumptions Traffic Consultant has identified will prove to be accurate. Given the uncertainty inherent in this unprecedented pandemic, Traffic Consultant advises that all readers of the Report consider the Report in the context of their own assessment of the COVID-19 outbreak and its current and potential impacts before making final decisions related to this Project.

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IS HEREBY LIMITED IN THE AGGREGATE TO THE AMOUNT OF FEES ACTUALLY PAID BY THE CLIENT TO CONSULTANT IN CONNECTION WITH THE PROJECT

1 Introduction

Background

1.1 Steer was commissioned by National Highways Infra Projects Private Limited (NHIPPL or the Client) to carry out traffic and revenue (T&R) due diligence study in February 2023 for the following two Assets. The Assets included a total of two toll plazas.

- Abu Road – Swaroopganj section of NH27 from KM 646.00 to KM 677.00 (Undavariya Toll Plaza); and
- Palanpur – Abu Road section of NH 27 from KM 601.00 to KM 646.00 (Khemana Toll Plaza)

1.2 The Assets are a part of the National Highways Infra Trust (NHIT) InvIT (Round 1: concessioned in the 1st round of InvIT programme) whose sponsor is National Highways Authority of India (NHAI) with NHIPPL acting as the manager.

1.3 As part of the study, traffic and revenue forecasts were developed based on secondary analysis of the data provided by the Client, primary data collection and internal benchmarks available with Steer for similar Assets. The analysis of the traffic profile on the Asset was based on toll plaza data available for Apr 2021 – Mar 2023, and Steer's independent traffic count and primary surveys (24-hour OD and 7 days x 24-hour TVC) which were undertaken in March 2023. The final report on traffic and revenue forecasts was submitted to Client in May 2023.

The Assignment

1.4 NHIPPL intends to validate the forecasts for FY24 (FY24E[1]) for traffic and revenue due diligence for these Assets using desktop-based analysis considering the additional traffic data available for the period Apr to Sep 2023 (FY24A[2]), through a revalidation study. NHIPPL has commissioned Steer to undertake this revalidation for the said Assets.

[1] FY24E: Estimated for FY24 for the corresponding months: Apr-23 to Sep-23 (SCF applied).

[2] FY24A: Actual for FY24 based on Apr-23 to Sep-23 data.

2 Executive Summary

2.1 In the revalidation study for the Assets under consideration, the additional traffic data has been provided from 1st Apr-23 till 30th Sep-23 (henceforth referred to as year to date or YTD). This note summarises the traffic and revenue performance of the Assets till September 2023.

2.2 The traffic related observations are provided below:

Undavariya

- The outturn PCU performance for FY24A has been lower by 1.4% than the FY24E volumes. All the commercial vehicle categories except 2As observed lower traffic volumes as the outturn traffic was lower than the estimated volumes. This is majorly due to traffic impacted by excessive (significantly higher than expected) rainfalls during the months of Mar-May 2023, followed by the cyclone Biparjoy in Jun'23.
- As the month of June was affected by external events, therefore, on excluding the traffic volumes for the month of June, we observed that the outturn PCU performance for FY24A is lower by 0.3% than the FY24E volumes.
- The actual outturn of LCV traffic is lower by 7.7%, whereas Bus/2A traffic is 4.6% higher than the estimated volumes for the corresponding period. At a collective level, the difference between actual and estimated volumes is +2.2%, which shows the actual outturn is better/ in line with the forecasts.
- The performance of MAV traffic is better than estimated, but the performance of 3A traffic has been lower than the estimated volumes, to the tune of 9.3%. At a collective level, the outturn of 3A and MAV traffic is 0.1% higher than the expected volumes. The drop in 3A in H1FY23 has been observed in almost all Assets under the portfolio and needs to be monitored going forward. However, since the 2A+3A+MAV volumes are inline with forecasts hence we do not recommend any change in projections.
- CJVs have been lower by 6.1% as compared to the FY24E volumes. This is due to the traffic affected by rains and significant reductions in the exemptions reported by the toll plaza resulting in some of the local traffic diverting away from the Asset. This is shown in Appendix A (Table A.1), where it can be seen that PCU traffic on the Asset is gradually improving from 35,202 in July to 37,324 in August and 36,813 in September 2023.
- In terms of revenue, the actual revenue for FY24 (Apr to Sep) is 1.8% lower than the forecasted revenue.

Khemana

- The outturn PCU is lower by 7.3% than the estimated PCU on Khemana
- In addition, the cyclone rains also caused waterlogging/ drainage issues near Khemana toll plaza. Due to which, the traffic intended to Palanpur from the north of Khemana was forcibly diverted by the traffic police near Chitrasani village. The traffic primarily used two alternates passing though (i) Malana-Waghrol-Chandisar; or (ii) Deesa. The usage of diversion near Chitrasani, which bypasses Khemana toll plaza, appears to be a temporary phenomenon and should return to normalcy once the monsoons are over. However, it needs to be closely monitored and in case the traffic is still observed to use the alternate routes bypassing the Asset, the base position will require an adjustment.
- For the reasons mentioned above (traffic impacted by Cyclone Biparjoy in Jun, followed by forced diversion due to waterlogging issues), on excluding the traffic volumes for the month of June and July, we observed that the outturn PCU volume for FY24A is lower by 4.4% than the FY24E volumes.

- The actual outturn of LCV traffic is lower by 13%, whereas Bus/2A traffic is 3.3% higher than the estimated volumes for the corresponding months. At a collective level, the actual traffic turns out to be higher than the estimated volumes .
- The performance of MAV traffic has a delta of -1.8%, and the actual 3A traffic is significantly lower than the estimated volumes, to the tune of 12.1%. At a collective level, the outturn of 3A and MAV traffic is lower by 4.6% than the expected volumes. On similar lines, CJVs are lower by 12% as compared to the FY24E volumes.
- In terms of revenue, the actual revenue for FY24 (Apr to Sep) is 5.6% lower than the forecasted revenue for these two months.

2.3 For both the Assets, at an overall level, the trends for actual traffic outturn are largely in line with the estimated traffic, except for the disturbances causes by excessive rainfall and the cyclone in Q1 FY24. These variations were caused by temporary events and does not require any change in the overall outlook for the Assets based on two months (FY24) of additional data.

2.4 Largely, the segmentation is observed to be in line with the estimates for both the toll plazas. There are minor variations, which are due to the affected traffic movements on account of unseasonal excessive rainfalls.

2.5 The observed FY24 (Apr-Sep) revenue, at a portfolio level, is Rs. 80.0 Cr vs Rs. 83.4 Cr as forecasted, which is 4.0% lower than the revenue for the corresponding period in the previous study. This is despite being affected by excessive rainfall in the region. Further, the 2As have demonstrated a strong performance, which is likely to continue and the lower traffic for other vehicle categories should get back to normal levels.

2.6 The performance demonstrated by Undavariya toll plaza in Q2, FY24 is in line with the expected traffic volumes. On the other side, Khemana toll plaza, in addition, was impacted by waterlogging issues, causing diversion near Chitrasani. Due to which, there is a prolonged recovery from the impacts of rainfall and resulting forced traffic diversions. The month of August, which did not receive any rainfall, observed its performance in line with the expectations. Hence, this diversion appears to be a temporary phenomenon and should return to normalcy once the monsoons are over. The traffic for trucks has recovered to a large extent after the rainfall subsided in the months of August and September'23.

2.7 Therefore, considering this and the base traffic and ticket segmentation to be in line with the assumptions taken in the previous study, the observed revenue for the revalidation study can be considered within reasonable limits of the estimated revenue. However, it is suggested to observe the performance of Khemana toll plaza over the next few months and is reviewed in detail in Dec-23 to understand traffic performance and technical aspects concerning the Asset. Based of which, it is to be determined if the base position and forecasts need to be adjusted.

2.8 At this stage, the forecasts presented in the previous study (released in May-2023) can still be considered valid.

3 Revalidation assessment

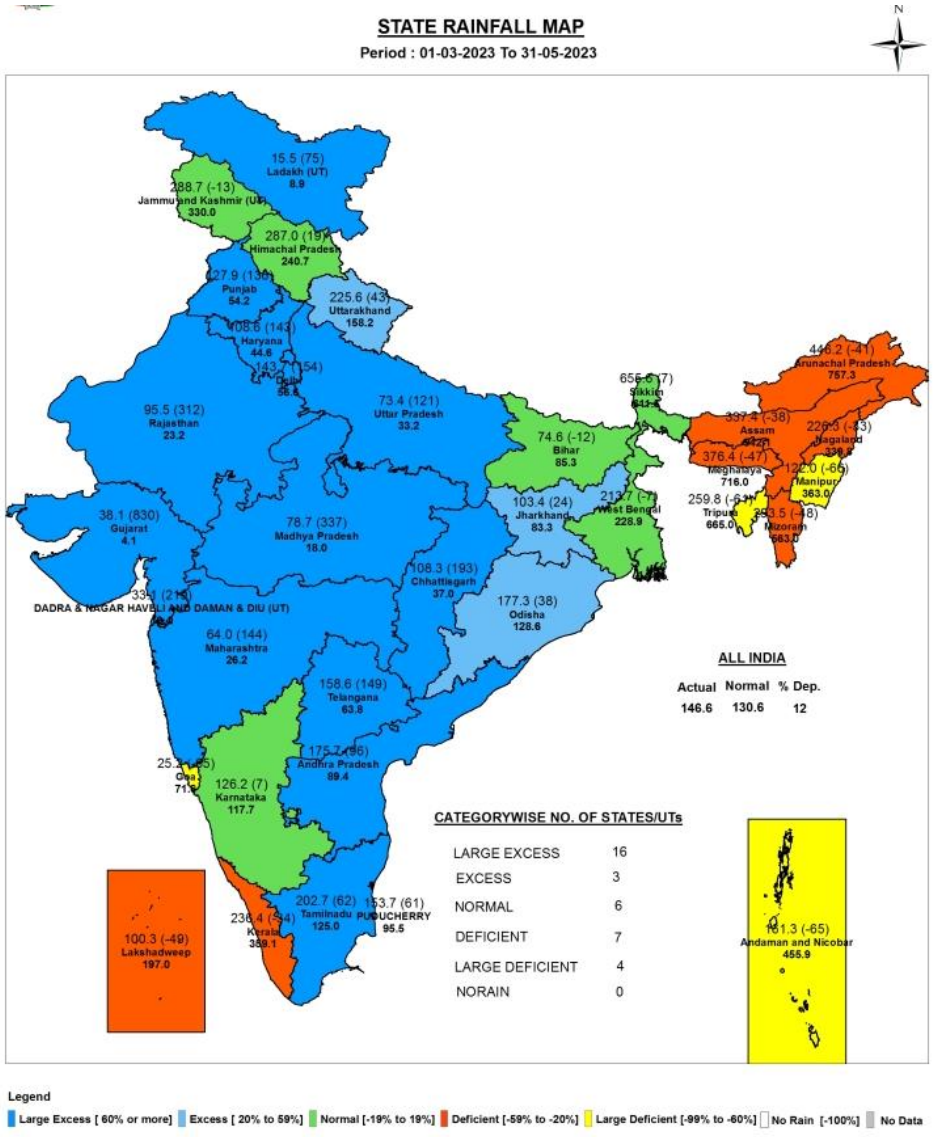
FY24 traffic comparison

3.1 There were a few unexpected events, which took place in the region and strongly affected the vehicle traffic on the Assets. The same have been detailed below:

Excessive rainfall in Gujarat and Rajasthan

- Both Gujarat and Rajasthan witnessed excess rainfall during the period Mar-May this year. As per the IMD, the excess rainfall Gujarat witnessed in Mar and Apr this year is the highest in those months over the past 15 years. Similarly, Rajasthan witnessed four times more rainfall than expected esp. during Mar and Apr-2023.
- The chart provided here shows rainfall in large excess in Gujarat, Rajasthan, and several other parts of the country for the period between 1st Mar – 31st May 2023, which has affected the traffic on the Asset.

Figure 3.1: State Rainfall Map (Mar-May 2023)



Source: India Meteorological Department

Cyclone Biparjoy

3.2 The Cyclone Biparjoy developed over the southeast Arabian Sea in early June (formed on 6th Jun 2023) and made a landfall between Saurashtra, Mandvi & Kutch in Gujarat towards the mid-month before heading to Rajasthan and dissipated on 19th Jun 2023. It caused severe rains and flash flooding to the coastal areas and widespread damage in Gujarat, including flooding, tree felling, power outages and damages to property/ infrastructure.

- It is considered as one of the longest-duration cyclonic storm in the northern Indian Ocean since 1977, according to IMD and its impact lasted almost for two weeks in the affected region.
- As a result, traffic on Assets in Gujarat was severely impacted for a large part of June'23.

3.3 The following section presents the comparison of FY24 traffic volumes between actual (FY24A YTD) and estimates (FY24E YTD)3 for the Apr to Sep 2023 period. FY24A YTD is arrived at by using the actual traffic volumes from Apr – Sep 2023 whereas FY24E YTD is arrived at by using synthesized traffic for April – September. The revalidation study aims to validate this profile against the actual traffic performance.

Undavariya

3.4 The outturn PCU performance for FY24A has been lower by 1.4% than the FY24E volumes. All the commercial vehicle categories except 2As observed lower traffic volumes as the outturn traffic was lower than the estimated volumes. The table below shows the comparison between FY24E and FY24A YTD traffic positions.

Table 3.1: Undavariya: FY24A Actual vs FY24E estimates (YTD)

FY24	FY24A YTD	FY24E YTD	FY24A vs FY24E
CJV	6,587	6,996	(5.8%)
LCV	361	400	(9.8%)
2A/Bus	1,691	1,617	4.6%
3A	711	786	(9.5%)
MAV	5,086	5,102	(0.3%)
Total	**14,436**	**14,900**	**(3.1%)**
PCU	**37,222**	**37,761**	**(1.4%)**
2A+3A+MAV	**7,488**	**7,504**	**(0.2%)**

Source: Steer analysis

3.5 The delta between actual estimated outturn PCU performance has seen a significant improvement between FY24 Q1 (April-June) and FY24 Q2 (July-September) at Undavariya. The table below compares FY24 Q1E and FY24 Q1A as well as FY24 Q2E and FY24 Q2A.

Table 3.2: Undavariya: Q1 and Q2 Actual vs estimates (YTD)

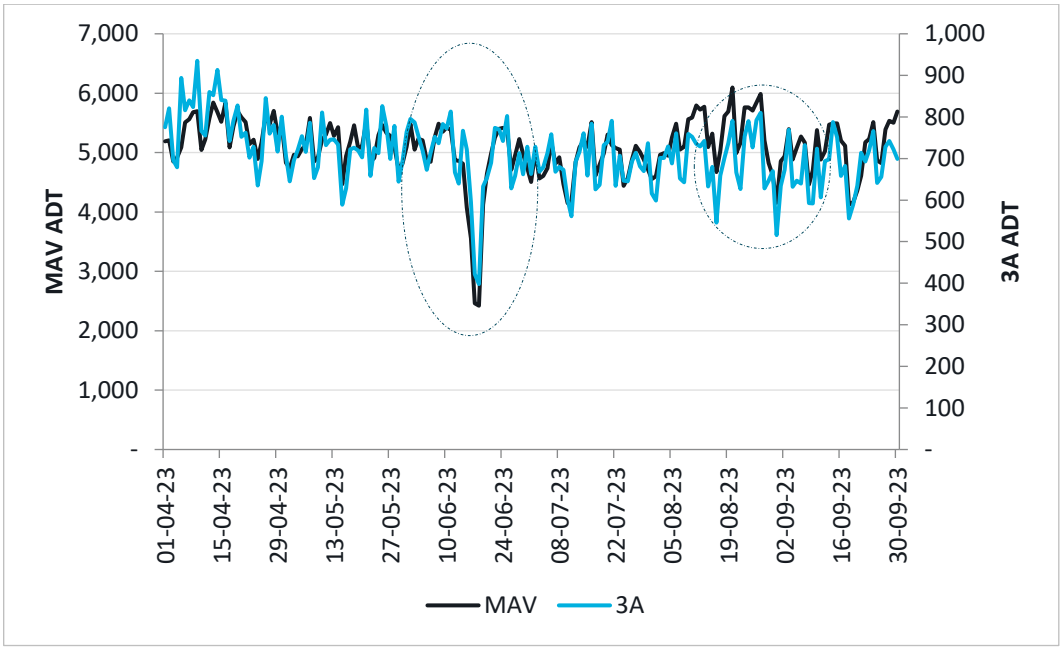
FY24	FY24 Q1A	FY24 Q1E	FY24 Q1A vs FY24 Q1E	FY24 Q2A	FY24 Q2E	FY24 Q2A vs FY24 Q2E
CJV	6,924	7,248	(4.5%)	6,253	6,747	(7.3%)
LCV	361	417	(13.3%)	360	383	(6.0%)
2A/Bus	1,743	1,680	3.7%	1,640	1,555	5.5%
3A	735	819	(10.3%)	687	753	(8.7%)
MAV	5,105	5,268	(3.1%)	5,067	4,937	2.6%

[3] 'YTD' represents Year-to-date (Apr-Sep).

FY24	FY24 Q1A	FY24 Q1E	FY24 Q1A vs FY24 Q1E	FY24 Q2A	FY24 Q2E	FY24 Q2A vs FY24 Q2E
Total	**14,869**	**15,432**	(3.6%)	**14,007**	**14,375**	(2.6%)
PCU	**37,874**	**39,076**	(3.1%)	**36,576**	**36,461**	0.3%
2A+3A +MAV	**7,583**	**7,767**	(2.4%)	**7,394**	**7,245**	2.1%

3.6 As discussed earlier, Biparjoy was responsible for significantly lower traffic on the Asset in Jun-2023. Its impact on the 3A and MAV volumes on the Asset is shown below:

Figure 3.2: ADT at Undavariya Toll Plaza



Source: Steer analysis

- The table below shows the average ADT for 3A and MAV over the Apr-Jun 2023 period on the Asset. The comparison between H2 and H1 for Jun-2023 represents an unseasonal and highly impacted traffic volumes.

Table 3.3: Average ADT volumes for 3A, MAV at Undavariya Toll Plaza

Period	3A	MAV	H2 vs H1		
			3A	MAV	Total
Apr (H1)	818	5,372			
Apr (H2)	758	5,413			
Apr	788	5,392	(7.3%)	0.8%	(0.3%)
May (H1)	714	5,080			
May (H2)	725	5,133			
May	720	5,108	1.5%	1.0%	1.1%
Jun (H1)	740	5,081			
Jun (H2)	658	4,551			
Jun	**699**	**4,816**	**(11.1%)**	**(10.4%)**	**(10.5%)**

Where, H1 represents first half of the month and H2 represents second half of the month.

- As the month of June 2023 (esp. 12th to 22nd Jun) was affected by unseasonal Cyclone/ one-off event, therefore, it cannot be considered as a normal month for the purposes of revalidation study. Hence, on excluding the traffic volumes for the Jun month, we observed that the outturn PCU performance for FY24A (Apr-Sep) is lower by 0.4% only than the FY24E volumes.

Traffic Comparisons excluding June'23

3.7 The table below shows the comparison between FY24E (Apr-Sep excluding June) and FY24A (Apr-Sep excluding June) traffic positions.

Table 3.4: Undavariya: FY24 Actual vs estimates (Apr-Sep 2023 excluding June)

FY24	FY24A (Apr-Sep excl. Jun)	FY24E (Apr-Sep excl. Jun)	FY24A vs FY24E
CJV	6,524	6,951	(6.1%)
LCV	366	397	(7.7%)
Bus/ 2A	1,705	1,630	4.6%
3A	713	786	(9.3%)
MAV	5,139	5,063	1.5%
Total	**14,448**	**14,828**	(2.6%)
PCU	**37,454**	**37,580**	(0.3%)
LCV+2A/Bus	2,071	2,028	2.2%
3A + MAV	5,852	5,849	0.1%

Steer analysis

3.8 The other reason for lower performance of the Asset than estimated during Apr-May is the higher-than-expected rainfall in the region concerning the Asset.

3.9 The actual outturn of LCV traffic is lower by almost 7.7%, whereas Bus/2A traffic is 4.6% higher than the estimated volumes for the corresponding period. The estimates volumes include the common 'Base Correction Factor' for LCV and Bus/2A, which was ascertained in the earlier study in Feb-23, based on difference between TVC and TMS volumes. At a collective level, the difference between actual and estimated volumes is +2.2%, which shows the actual outturn to be higher than the forecasts.

3.10 The performance of MAV traffic is found to be higher than estimated, but the performance of 3A traffic has been lower than the estimated volumes, to the tune of 9.3%. At a collective level, the outturn of 3A and MAV traffic is higher by 0.1%.

3.11 CJVs have been lower by 6.1% as compared to the FY24E volumes. This is due to the traffic affected by rains and significant reductions in the exemptions reported by the toll plaza. The average exempted traffic during Apr-Sep 2023 (excluding June) is about 80% of the average exempted traffic observed between Aug-22 to Feb-23.

Khemana

3.12 The outturn PCU is lower by 7.3% than the estimated PCU on Khemana. The table below shows the comparison between FY24E and FY24A YTD traffic positions.

Table 3.5: Khemana: FY24 Actual vs estimates (YTD)

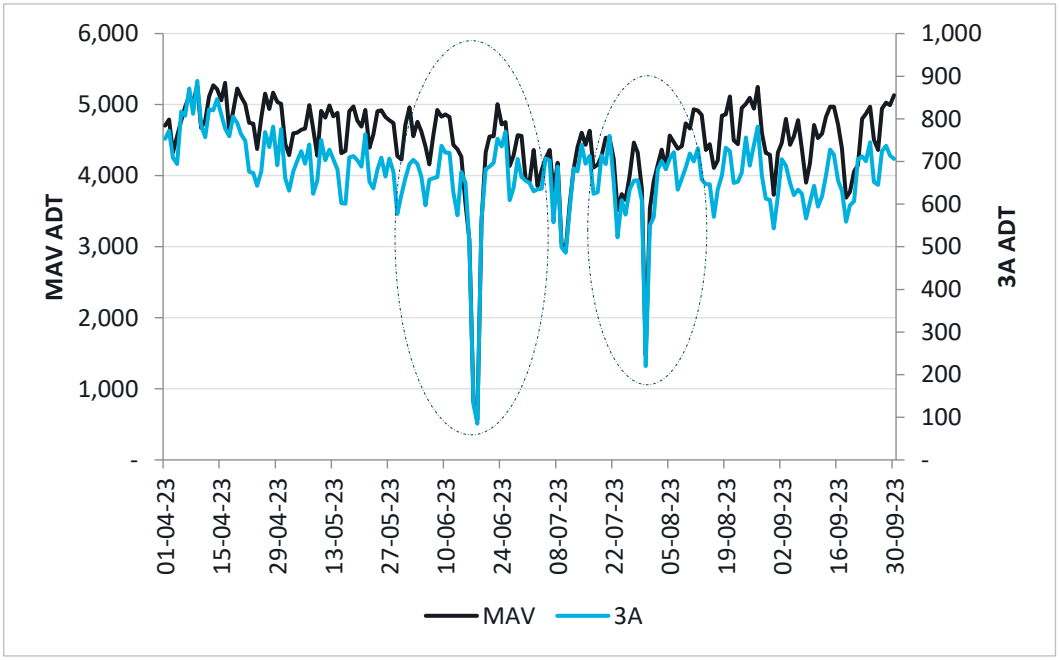
FY24	FY24A YTD	FY24E YTD	FY24A vs FY24E
CJV	7,365	8,646	(14.8%)

FY24	FY24A YTD	FY24E YTD	FY24A vs FY24E
LCV	327	385	(15.2%)
2A	1,487	1,450	2.6%
3A	672	767	(12.4%)
MAV	4,478	4,734	(5.4%)
Total	**14,328**	**15,983**	(10.4%)
PCU	**34,482**	**37,180**	(7.3%)

Steer analysis

3.13 At Khemana toll plaza also, the Cyclone Biparjoy has significantly impacted the traffic volumes. Its impact on the 3A and MAV volumes on the Asset is shown below:

Figure 3.3: ADT at Khemana Toll Plaza



Source: Steer analysis

- The table below shows the average ADT for 3A and MAV over the Apr-Jun 2023 period on the Asset. The comparison between H2 and H1 for Jun-2023 represents an unseasonal and highly impacted traffic volumes.

Table 3.6: Average ADT volumes for 3A, MAV at Khemana Toll Plaza

Period	3A	MAV	H2 vs H1		
			3A	MAV	Total
Apr (H1)	798	4,911			
Apr (H2)	738	4,944			
Apr	768	4,927	(7.5%)	0.7%	(0.5%)
May (H1)	685	4,663			
May (H2)	673	4,687			
May	679	4,675	(1.8%)	0.5%	0.2%

Period	3A	MAV	H2 vs H1		
			3A	MAV	Total
Jun (H1)	669	4,545			
Jun (H2)	592	3,817			
Jun	631	4,181	(11.5%)	(16.0%)	(15.4%)

- In addition, the cyclone **rains also caused waterlogging/ drainage issues** near Khemana toll plaza. Due to which, the **traffic intended to Palanpur from the north of Khemana was forcibly diverted by the traffic police near Chitrasani village.** The traffic primarily used two alternates passing though (i) Malana-Waghrol-Chandisar; or (ii) Deesa.
- For these reasons, we are not taking into consideration the traffic for Jun-2023. Further, there were heavy rains in July, which made the diversion to continue. Hence, on excluding the traffic volumes for the June and July months, we observed that the outturn PCU volume for FY24A is lower by 4.4% than the FY24E volumes.

Traffic Comparisons excluding June and July'23

3.14 The table below shows the comparison between FY24E (Apr-Sep excluding Jun and Jul) and FY24A (Apr-Sep excluding Jun and Jul) traffic positions.

Table 3.7: Khemana: FY24 Actual vs estimates (Apr-Sep excl. Jun and Jul 2023)

FY24	FY24A (Apr-Sep excl. Jun and Jul)	FY24E (Apr-Sep excl. Jun and Jul)	FY24A vs FY24E
CJV	7,670	8,718	(12.0%)
LCV	343	394	(13.0%)
Bus/2A	1,551	1,502	3.3%
3A	694	790	(12.1%)
MAV	4,681	4,766	(1.8%)
Total	**14,940**	**16,170**	(7.6%)
PCU	**35,986**	**37,630**	(4.4%)
LCV + Bus/2A	1,894	1,846	2.6%
3A + MAV	5,216	5,466	(4.6%)

Steer analysis

3.15 Further, the traffic in months Apr and May 2023 was impacted due to excessive rainfalls in the region.

3.16 The actual outturn of LCV traffic is lower by 13%, whereas Bus/2A traffic is 3.3% higher than the estimated volumes for the corresponding months. The estimates volumes include the common 'Base Correction Factor' for LCV and Bus/2A, as ascertained in the earlier study in Feb-23. At a collective level, the actual volumes are higher by 2.6% than the estimated volumes.

3.17 The performance of MAV traffic is largely in line with a delta of -1.8%, but the actual 3A traffic is significantly lower than the estimated volumes, almost to the tune of 12.1%. At a collective level, the outturn of 3A and MAV traffic is lower by 4.6% than the expected volumes. This can be attributed to the excessive rainfalls and continued diversions in the Asset region, which negatively impacted the traffic movements.

3.18 On similar lines, CJVs are lower by 12% as compared to the FY24E volumes. This is due to the traffic affected by rains and significant reductions in the exemptions reported by the toll plaza. The average exempted traffic during Apr-Sep 2023 is about half of the average exempted traffic observed between Aug-22 to Feb-23.

3.19 The tables below provide the comparison between FY23 and FY24 for the months of Apr and May. The LCV and Bus/ 2A numbers are not adjusted with BCF.

Table 3.8: Khemana: FY24 MADT for April to September

FY24 MADT	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
CJV	7,636	8,536	7,053	6,465	7,154	7,341
LCV	354	348	300	291	327	344
Bus/2A	1,619	1,591	1,399	1,318	1,451	1,547
3A	768	679	631	625	672	659
MAV	4,927	4,675	4,181	3,964	4,567	4,559
Total	**15,304**	**15,829**	**13,563**	**12,664**	**14,171**	**14,450**
PCU	**37,500**	**36,907**	**32,406**	**30,572**	**34,565**	**34,991**
LCV + Bus/2A	1,973	1,939	1,698	1,609	1,777	1,891
3A + MAV	5,695	5,354	4,812	4,590	5,239	5,218

Table 3.9: Khemana: FY23 MADT for April to September

FY23 MADT	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22
CJV	7,502	8,721	8,147	7,648	8,582	7,532
LCV	430	393	401	332	294	371
Bus/2A	1,505	1,438	1,398	1,334	1,351	1,510
3A	887	776	777	740	708	785
MAV	4,905	4,722	4,817	4,506	4,176	4,622
Total	**15,228**	**16,050**	**15,539**	**14,560**	**15,111**	**14,821**
PCU	**37,392**	**37,202**	**36,948**	**34,645**	**33,991**	**35,772**
LCV + Bus/2A	1,935	1,831	1,799	1,666	1,645	1,882
3A + MAV	5,791	5,498	5,594	5,246	4,884	5,407

Table 3.10: Khemana: FY24 and FY23 MADT comparison for April to September

FY24 vs FY23 (%)	Apr	May	Jun	Jul	Aug	Sep
CJV	1.8%	(2.1%)	(13.4%)	(15.5%)	(16.6%)	(2.5%)
LCV	(21.8%)	(15.7%)	(28.8%)	(16.6%)	5.6%	(11.8%)
Bus/2A	2.4%	5.3%	(4.8%)	(5.9%)	2.2%	(2.6%)
3A	(13.4%)	(12.6%)	(18.8%)	(15.5%)	(5.0%)	(16.1%)
MAV	0.5%	(1.0%)	(13.2%)	(12.0%)	9.4%	(1.3%)

FY24 vs FY23 (%)	Apr	May	Jun	Jul	Aug	Sep
Total	**(0.1%)**	**(2.0%)**	**(13.2%)**	**(13.6%)**	**(6.8%)**	**(3.1%)**
PCU	**(0.4%)**	**(1.5%)**	**(12.9%)**	**(12.4%)**	**1.0%**	**(2.9%)**
LCV + Bus/2A	(3.0%)	0.8%	(10.1%)	(8.1%)	2.8%	(4.4%)
3A + MAV	(1.7%)	(2.6%)	(14.0%)	(12.5%)	7.3%	(3.5%)

Steer analysis

3.20 It can be seen from the table above, that at a monthly level, the PCU traffic in FY24 is lower than FY23 by 0.4% and 1.5% in Apr and May respectively. However, in June and July 2023, the PCU traffic is lower than their corresponding PCU traffic in FY22 by 12.9% and 12.4% respectively, which can be attributed to external events. The performance in Aug and Sep is close to the estimated volumes.

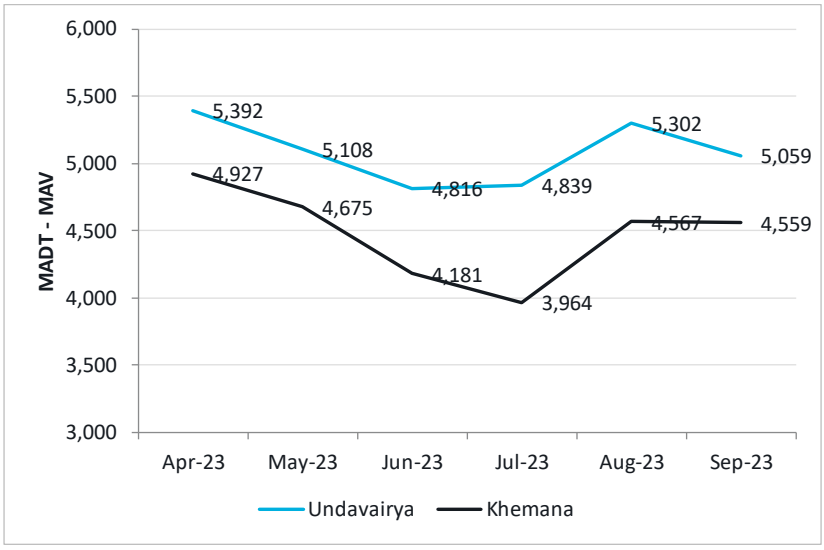
3.21 Therefore, excluding the months affected by external events, the performance of the Asset looks to be in line and does not require any adjustment at this stage based on the data observed for Apr-Sep months of FY24.

Conclusion

3.22 For both the Assets, at an overall level, the actual traffic outturn is in line with the estimated traffic. There is some variation but that is on account of temporary events and does not require any change in position.

3.23 As mentioned earlier, the traffic was forcibly diverted near Chitrasani due to the drainage and water logging issues near Khemana toll plaza, caused by cyclonic rains in Jun-23. As a result of which, it is found that the alternate route (which bypasses the toll plaza) has become known to many users in July 2023 and even now. The use of alternates bypassing the Asset appears to be a temporary phenomenon and should return to normalcy once the monsoons are over. There has been only one month, i.e., Aug-23, which was the driest month for India and during this month, the performance of Khemana month was found to be in line with the expected volumes. Further, the difference in the MAV volumes between the two toll plazas, is getting stabilized to initial levels.

Figure 3.4: MAV traffic comparison between Undavariya and Khemana toll plazas



Steer analysis

3.24 Hence, it is suggested that the performance of Khemana toll plaza is observed for next few months and a detailed assessment be taken up in Dec-23 to determine if the base position needs to be readjusted.

FY24 segmentation comparison

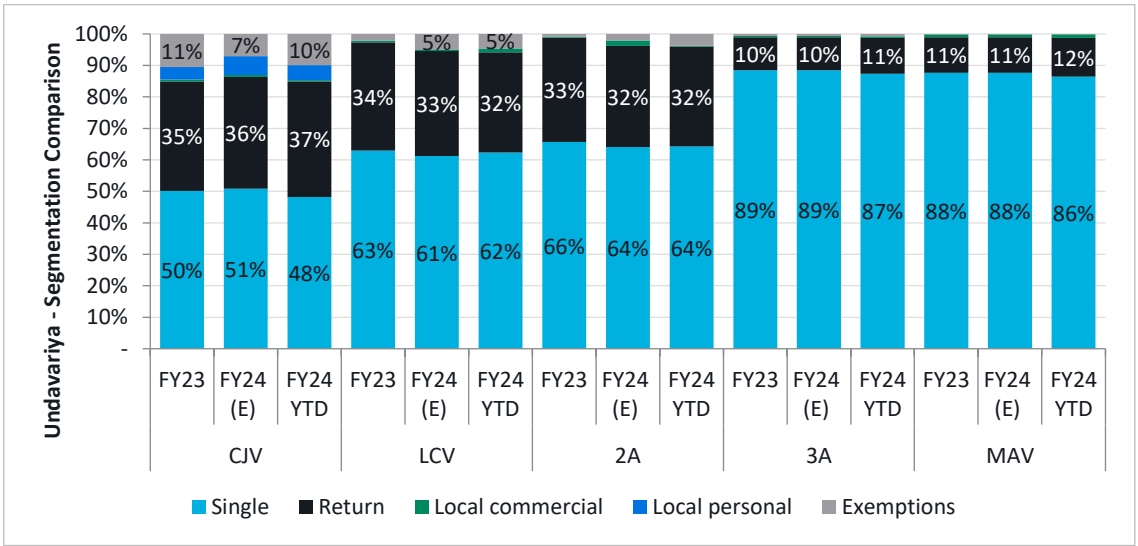
3.25 For the forecasts developed during the previous study, the average segmentation of the period in FY23 post takeover of operations by NHIPPL (FY23 N) with some additional improvements to take place in FY24, was considered as the representative of the FY24 base segmentation. The same, after adjusting for the traffic being added as 'base correction factor', wherever necessary, in form of exemptions for LCV and 2A (due to difference between TVC and ETC volumes), was used as the base year segmentation.

3.26 As the FY24 YTD traffic for both the plazas is available from Apr – Sep 2023, we have a longer history for the base year and therefore, the period can be relied upon on as a representation of the FY24 segmentation trends. However, as the month of Jun cannot be considered as it was severely affected by cyclone, therefore, the average segmentation between Apr – Sep 2023, with adjustment for BCF is shown below and is compared with the average FY24 segmentation adopted in the previous study. It should be noted that the same BCF is used while calculating both the segmentations, as derived in the previous study.

Undavariya

3.27 The ticket segmentation witnessed in FY24 (Apr-Sep) period is largely in line with the estimations taken in FY24E, as shown in the chart below:

Figure 3.5: Undavariya – ticket segmentation comparison



Source: Steer analysis

3.28 The FY24 E segmentation provided above is the average segmentation for FY24, whereas the FY24 YTD corresponds to the actual segmentation for Apr-Sep 2023 only.

3.29 In CJVs, there is already a significant improvement already observed in the exemptions between FY24 YTD and FY23. The same trend can be seen for LCVs as well. These improvements make us believe that the forecasted segmentation is realistic, and the Asset should be able to attain the same in FY24.

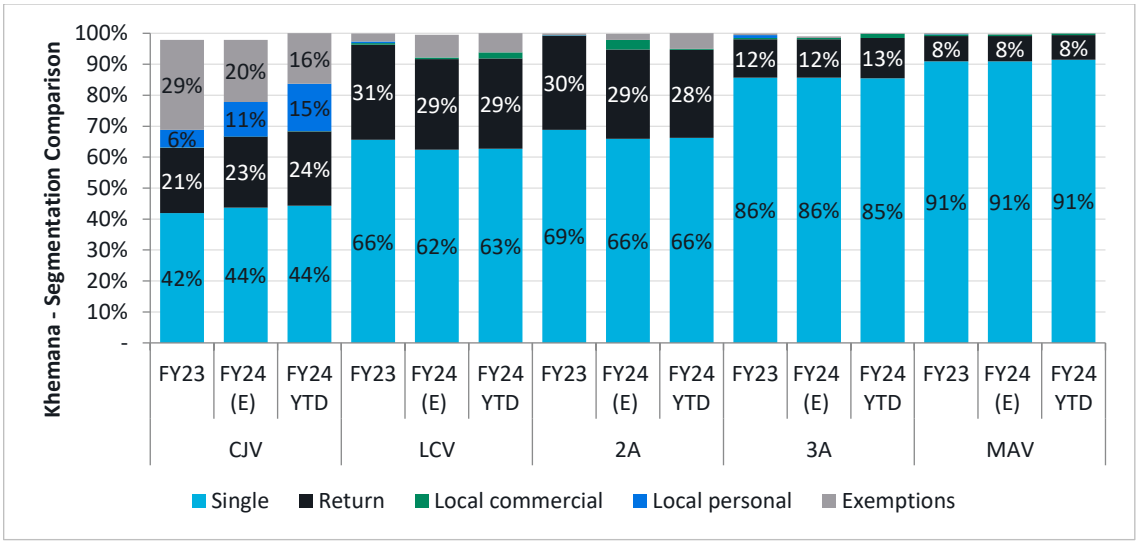
3.30 In trucks (2A, 3A, and MAV), the segmentation is largely in line, except for some shift in Return from Single ticket categories. This could be a temporary effect due to the heavy rainfall in the

concerned period. From the OD analysis undertaken during the previous study, we understand that 76%, 83%, and 86% of 2A, 3A, MAV movements respectively on the Asset are over 250 km, so, we think that the estimated segmentation is reasonable and achievable.

Khemana

3.31 The segmentation observed at Khemana is also largely in line despite the disruptions discussed earlier in this report.

Figure 3.6: Khemana – ticket segmentation comparison



Source: Steer analysis

3.32 For CJV, a significant improvement observed in the exemptions between FY24 YTD and FY23, compensated by an increase in share of Single and Local Personal. In LCVs as well, the performance is better than the estimated segmentation for FY24, which make us believe that the average estimated segmentation for the Asset is achievable in FY24.

3.33 In trucks (2A, 3A, and MAV), the segmentation is largely in line, except for some shift in Return from Single ticket categories, as observed at Undavariya toll plaza as well. Here's as well, 75%, 81%, and 90% of 2A, 3A, MAV movements respectively on the Asset are over 250 km Considering that the Asset caters to traffic with high average trip lengths and observed heavy rainfalls and damages in infrastructure during Apr-Sep 2023 (FY24 YTD), therefore, we don't envisage a need to adjust the segmentation based on additional months of data for FY24 at this stage.

FY24 base year revenue comparison

3.34 The comparison between estimated revenue and actual revenue (Apr-Sep 2023) is shown below. The estimated revenue for this period is computed using the estimated traffic for corresponding period and the average segmentation estimated for FY24.

Table 3.11: FY24 (Apr-Sep) revenue comparison (INR Cr)

	FY24E (Apr-Sep)	FY24A (Apr-Sep)	Absolute Delta	% Delta
Undavariya	33.70	33.10	(0.60)	(1.8%)
Khemana	49.69	46.92	(2.78)	(5.6%)

Total	**83.40**	**80.02**	**(3.37)**	**(4.0%)**

Source: steer analysis

3.35 Due to the factors mentioned earlier, for the purposes of revenue comparison, we have excluded June month in Undavariya and the months of June and July in Khemana. The comparison based on that is provided below:

Table 3.12: FY24 (Apr-Sep) revenue comparison (INR Cr)

Toll Plaza	FY24E (Apr-Sep)	FY24A (Apr-Sep)	Absolute Delta - Total	Absolute Delta (AADC) - Lakh	% Delta
Undavariya (excl. June)	28.05	28.11	0.06	0.04	0.2%
Khemana (excl. June and July)	33.72	32.92	(0.80)	(0.65)	(2.4%)
Total	**61.77**	**61.03**	**(0.74)**	**(0.62)**	**(1.2%)**

Source: steer analysis

3.36 The delta in the revenue is majorly contributed by lesser outturn of CJV, LCV and 3A vehicles at both the toll plazas, which has been considerably compensated by higher revenue contributed by 2A vehicles. This is due to excessive unseasonal rains in the Asset region, which impacted the traffic flow.

3.37 The observed FY24 (Apr-Sep) revenue, at a portfolio level, is 1.2% lower than the revenue for the corresponding period in the previous study. This is despite being affected by excessive rainfall in the region. Further, the 2As have demonstrated a strong performance, which is likely to continue and the lower traffic for other vehicle categories should get back to normal levels. Therefore, considering this and the base traffic and ticket segmentation to be in line with the assumptions taken in the previous study, the observed revenue for the revalidation study can be considered within reasonable limits of the estimated revenue.

Conclusions

3.38 Based on this assessment, the overall variation between actual and estimates is observed to majorly caused by the excessive rainfalls in the region and the cyclone Biparjoy. Considering these externalities/ temporary factors and the additional data only for few months of FY24, the traffic and revenue profile of the Asset are largely in line with the estimation and can be considered within the acceptable limits.

3.39 The usage of diversion near Chitrasani, which bypasses Khemana toll plaza, appears to be a temporary phenomenon and should return to normalcy once the monsoons are over. However, it needs to be closely monitored and in case the traffic is still observed to use the alternate routes bypassing the Asset, the base position will require an adjustment. Therefore, a detailed study is recommended to be undertaken in Dec-23.

3.40 Therefore, all underlying assumptions remain valid as considered in the previous study (released in May-2023). The traffic and revenue forecasts are updated only on account of updates in macro-economic assumptions (GDP, GSDP and WPI). The same have been provided in Appendix -2.

A Appendix

Historical traffic and revenue

A.1 Please find below the month-on-month traffic and revenue for Jan – Jun 2023:

Undavariya

Table A.1: Undavariya– Historical traffic MADT

	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
CJV	6,234	7,608	6,908	6,171	6,069	6,529
LCV	375	357	322	341	350	358
2A	1,763	1,741	1,577	1,557	1,588	1,640
3A	788	720	699	686	696	679
MAV	5,392	5,108	4,816	4,839	5,302	5,059
OSV	4	4	3	3	5	5
Total	**14,557**	**15,537**	**14,324**	**13,598**	**14,009**	**14,271**
PCU	**38,735**	**38,527**	**35,904**	**35,202**	**37,324**	**36,813**

Source: Steer Analysis

Table A.2: Undavariya – Historical monthly revenue (INR Cr)*

MADT	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
CJV	0.7	0.9	0.7	0.7	0.7	0.7
LCV	0.1	0.1	0.1	0.1	0.1	0.1
2A	0.8	0.8	0.7	0.7	0.7	0.7
3A	0.4	0.4	0.3	0.3	0.4	0.3
MAV	3.8	3.7	3.4	3.5	3.9	3.6
Total	**5.7**	**5.8**	**5.2**	**5.3**	**5.7**	**5.4**

Source: Steer Analysis

Khemana

Table A.3: Khemana – Historical traffic MADT

MADT	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
CJV	7,636	8,536	7,053	6,465	7,154	7,341
LCV	337	331	285	277	311	327
2A	1,541	1,514	1,331	1,255	1,381	1,472
3A	768	679	631	625	672	659
MAV	4,927	4,675	4,181	3,964	4,567	4,559
OSV	4	4	4	3	4	5
Total	**15,213**	**15,740**	**13,485**	**12,586**	**14,085**	**14,359**
PCU	**37,259**	**36,668**	**32,198**	**30,360**	**34,331**	**34,742**

Source: Steer Analysis

Table A.4: Khemana – Historical monthly revenue (INR Cr)

MADT	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
CJV	1.1	1.3	1.0	1.0	1.0	1.1
LCV	0.1	0.1	0.1	0.1	0.1	0.1
2A	1.0	1.1	0.9	0.9	1.0	1.0
3A	0.6	0.5	0.5	0.5	0.5	0.5
MAV	5.5	5.4	4.7	4.6	5.3	5.2
Total	**8.3**	**8.5**	**7.2**	**7.1**	**8.0**	**7.9**

Source: Steer Analysis

B Traffic and revenue forecasts

B.1 Further to the summary of forecasts, this appendix presents detailed traffic and revenue forecasts.

Traffic forecasts

B.2 This section presents the detailed traffic forecasts for the forecast period until FY52, year of expected close of the concession. The following two tables show the traffic growth rates and AADT, respectively.

Table B.1: Undavariya: Forecasts for final (background + impacts) AADT

Vehicle Category	FY25	FY26	FY27	FY28	FY29	FY30	FY31
CJV	6,790	7,277	7,778	8,300	8,825	9,354	9,913
Mini LCV	841	871	901	931	961	989	1,019
LCV	414	426	435	450	464	478	492
Bus	713	738	764	789	814	839	864
2A	1,036	1,049	1,053	1,074	1,094	1,114	1,134
3A	798	811	815	835	855	875	895
MAV	5,334	5,592	5,790	6,118	6,448	6,779	7,127
OSV	7	8	8	9	9	10	10
Total	**15,932**	**16,772**	**17,543**	**18,505**	**19,470**	**20,436**	**21,452**
PCU	**39,927**	**41,781**	**43,315**	**45,570**	**47,830**	**50,090**	**52,462**

Vehicle Category	FY32	FY33	FY34	FY35	FY36	FY37	FY38
CJV	10,483	11,106	11,813	12,502	13,217	13,959	14,729
Mini LCV	1,049	1,080	1,112	1,145	1,177	1,210	1,244
LCV	505	520	538	554	570	586	602
Bus	889	916	943	970	998	1,026	1,054
2A	1,152	1,172	1,206	1,227	1,248	1,269	1,290
3A	894	915	980	1,002	1,024	1,047	1,069
MAV	7,359	7,736	8,444	8,870	9,311	9,767	10,237
OSV	11	11	12	12	13	14	14
Total	**22,342**	**23,457**	**25,048**	**26,282**	**27,558**	**28,877**	**30,239**
PCU	**54,258**	**56,838**	**61,168**	**64,046**	**67,018**	**70,084**	**73,245**

Vehicle Category	FY39	FY40	FY41	FY42	FY43	FY44	FY45
CJV	15,525	16,328	17,159	18,017	18,902	19,814	20,753
Mini LCV	1,277	1,310	1,344	1,377	1,411	1,445	1,479
LCV	618	634	650	666	683	699	716

Vehicle Category	FY39	FY40	FY41	FY42	FY43	FY44	FY45
Bus	1,083	1,111	1,139	1,167	1,196	1,225	1,254
2A	1,311	1,331	1,351	1,372	1,392	1,412	1,432
3A	1,091	1,114	1,137	1,159	1,182	1,205	1,228
MAV	10,722	11,221	11,735	12,263	12,806	13,362	13,931
OSV	15	16	16	17	18	18	19
Total	**31,642**	**33,066**	**34,532**	**36,040**	**37,590**	**39,181**	**40,813**
PCU	**76,500**	**79,824**	**83,241**	**86,751**	**90,353**	**94,045**	**97,826**

Vehicle Category	FY46	FY47	FY48	FY49	FY50	FY51	FY52
CJV	21,718	22,709	23,725	24,766	25,831	26,942	28,100
Mini LCV	1,514	1,548	1,583	1,618	1,652	1,688	1,724
LCV	733	749	766	783	800	817	834
Bus	1,283	1,312	1,342	1,371	1,401	1,431	1,462
2A	1,452	1,472	1,492	1,511	1,531	1,551	1,571
3A	1,251	1,274	1,296	1,319	1,342	1,365	1,388
MAV	14,514	15,110	15,719	16,340	16,972	17,629	18,311
OSV	20	21	22	23	23	24	25
Total	**42,485**	**44,195**	**45,944**	**47,730**	**49,552**	**51,446**	**53,416**
PCU	**101,693**	**105,645**	**109,679**	**113,793**	**117,982**	**122,333**	**126,851**

Source: Steer analysis

Table B.2: Khemana: Forecasts for final (background + impacts) AADT

Vehicle Category	FY25	FY26	FY27	FY28	FY29	FY30	FY31
CJV	8,512	9,123	9,751	10,405	11,063	11,726	12,427
Mini LCV	703	728	753	778	803	827	852
LCV	399	411	420	434	447	461	475
Bus	548	567	587	607	626	644	664
2A	1,014	1,026	1,028	1,048	1,068	1,087	1,107
3A	785	797	800	820	840	859	879
MAV	5,010	5,249	5,427	5,735	6,045	6,355	6,681
OSV	7	7	8	8	8	9	9
Total	**16,977**	**17,909**	**18,773**	**19,835**	**20,900**	**21,968**	**23,092**
PCU	**39,429**	**41,293**	**42,835**	**45,103**	**47,378**	**49,654**	**52,044**

Vehicle Category	FY32	FY33	FY34	FY35	FY36	FY37	FY38
CJV	13,107	13,886	14,853	15,719	16,618	17,551	18,519
Mini LCV	877	903	930	957	984	1,012	1,040
LCV	485	500	522	537	553	568	584

Bus	683	704	725	746	767	788	810
2A	1,113	1,133	1,181	1,202	1,222	1,243	1,264
3A	884	905	956	978	999	1,021	1,043
MAV	6,948	7,304	7,855	8,252	8,662	9,086	9,524
OSV	10	10	11	11	12	13	13
Total	**24,108**	**25,345**	**27,033**	**28,401**	**29,818**	**31,283**	**32,796**
PCU	**54,064**	**56,677**	**60,550**	**63,443**	**66,432**	**69,518**	**72,700**

Vehicle Category	FY39	FY40	FY41	FY42	FY43	FY44	FY45
CJV	19,520	20,530	21,574	22,653	23,766	24,913	26,093
Mini LCV	1,068	1,095	1,123	1,151	1,180	1,208	1,237
LCV	600	615	631	647	663	679	695
Bus	832	854	875	897	919	941	964
2A	1,284	1,304	1,324	1,344	1,364	1,383	1,403
3A	1,065	1,087	1,109	1,131	1,153	1,175	1,198
MAV	9,975	10,440	10,918	11,409	11,913	12,431	12,961
OSV	14	14	15	16	16	17	18
Total	**34,357**	**35,939**	**37,569**	**39,248**	**40,974**	**42,747**	**44,567**
PCU	**75,979**	**79,324**	**82,765**	**86,301**	**89,931**	**93,654**	**97,468**

Vehicle Category	FY46	FY47	FY48	FY49	FY50	FY51	FY52
CJV	27,306	28,552	29,830	31,139	32,477	33,874	35,331
Mini LCV	1,265	1,294	1,323	1,352	1,381	1,411	1,441
LCV	711	727	743	760	776	793	810
Bus	986	1,009	1,031	1,054	1,076	1,100	1,123
2A	1,423	1,442	1,461	1,481	1,500	1,519	1,539
3A	1,220	1,242	1,265	1,287	1,309	1,331	1,354
MAV	13,503	14,058	14,624	15,201	15,789	16,400	17,035
OSV	19	19	20	21	22	23	23
Total	**46,433**	**48,343**	**50,297**	**52,294**	**54,331**	**56,451**	**58,656**
PCU	**101,371**	**105,362**	**109,436**	**113,593**	**117,828**	**122,228**	**126,799**

Source: Steer analysis

Revenue forecasts

B.3 This section presents the detailed revenue forecasts in INR Cr for the forecast period until FY52, year of expected close of the concession. The following tables show the revenue forecasts.

Table B.5: Undavariya: Revenue Forecasts (INR Cr)

Vehicle Category	FY25	FY26	FY27	FY28	FY29	FY30

CJV	9.6	10.5	12.2	13.1	14.2	16.2
Mini LCV	1.2	1.3	1.4	1.5	1.5	1.7
LCV	1.0	1.1	1.2	1.3	1.3	1.4
Bus	3.7	4.0	4.4	4.7	5.1	5.4
2A	5.4	5.8	6.1	6.5	6.9	7.2
3A	4.9	5.3	5.6	5.9	6.3	6.8
MAV	47.9	52.3	57.1	62.7	69.3	75.3
OSV	0.1	0.1	0.1	0.1	0.1	0.1
Total	**73.8**	**80.3**	**88.2**	**95.8**	**104.8**	**114.3**

Vehicle Category	FY31	FY32	FY33	FY34	FY35	FY36
CJV	17.5	14.9	15.8	20.6	26.9	29.0
Mini LCV	1.8	1.5	1.5	1.9	2.5	2.6
LCV	1.6	1.3	1.3	1.7	2.0	2.2
Bus	5.8	4.7	4.8	6.2	7.7	8.2
2A	7.7	6.2	6.3	8.0	9.8	10.4
3A	7.3	5.7	5.8	7.8	9.5	10.1
MAV	82.8	66.4	69.6	95.2	120.4	131.6
OSV	0.1	0.1	0.1	0.2	0.2	0.2
Total	**124.7**	**100.8**	**105.3**	**141.6**	**179.0**	**194.4**

Vehicle Category	FY37	FY38	FY39	FY40	FY41	FY42	FY43
CJV	32.3	34.6	38.4	42.6	45.2	49.8	54.7
Mini LCV	2.8	2.9	3.2	3.4	3.5	3.8	4.1
LCV	2.3	2.5	2.7	2.9	3.1	3.3	3.4
Bus	8.8	9.3	10.1	10.8	11.5	12.2	13.1
2A	11.0	11.6	12.4	13.0	13.8	14.5	15.4
3A	10.7	11.3	12.1	13.0	13.6	14.5	15.4
MAV	144.5	156.9	170.2	186.4	202.7	220.5	239.2
OSV	0.2	0.3	0.3	0.3	0.3	0.4	0.4
Total	**212.6**	**229.4**	**249.4**	**272.4**	**293.9**	**319.0**	**345.7**

Vehicle Category	FY44	FY45	FY46	FY47	FY48	FY49	FY50	FY51	FY52
CJV	60.0	66.0	71.8	75.9	83.4	90.0	100.4	108.2	117.7
Mini LCV	4.4	4.7	5.0	5.2	5.6	5.9	6.4	6.8	7.2
LCV	3.7	4.0	4.2	4.5	4.8	5.1	5.4	5.8	6.1
Bus	13.9	14.8	15.7	16.9	18.0	19.0	20.3	21.4	22.9
2A	16.2	17.0	18.0	19.1	20.2	21.1	22.4	23.5	24.9
3A	16.4	17.3	18.3	19.5	20.6	21.9	23.2	24.5	26.0

Vehicle Category	FY44	FY45	FY46	FY47	FY48	FY49	FY50	FY51	FY52
MAV	262.0	282.5	307.0	332.8	361.1	388.9	421.7	453.8	492.1
OSV	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8
Total	**377.0**	**406.7**	**440.5**	**474.4**	**514.2**	**552.4**	**600.5**	**644.8**	**697.7**

Source: Steer analysis

Table B.6: Khemana: Revenue Forecasts (INR Cr)

Vehicle Category	FY25	FY26	FY27	FY28	FY29	FY30
CJV	14.5	16.7	18.0	20.4	22.8	25.3
Mini LCV	1.2	1.3	1.4	1.5	1.7	1.8
LCV	1.5	1.6	1.7	1.9	2.0	2.1
Bus	4.4	4.8	5.2	5.6	6.0	6.5
2A	8.4	8.9	9.3	9.9	10.5	11.1
3A	7.5	8.0	8.5	9.0	9.6	10.3
MAV	70.3	77.4	83.9	92.9	102.0	111.7
OSV	0.1	0.1	0.1	0.2	0.2	0.2
Total	**108.0**	**118.8**	**128.3**	**141.4**	**154.7**	**169.1**

Vehicle Category	FY31	FY32	FY33	FY34	FY35	FY36
CJV	27.1	22.9	24.2	32.2	41.1	45.3
Mini LCV	1.9	1.5	1.6	2.0	2.5	2.7
LCV	2.3	1.8	1.9	2.4	3.1	3.3
Bus	6.9	5.6	5.7	7.4	9.1	9.8
2A	11.7	9.3	9.4	12.3	15.0	16.0
3A	10.9	8.6	8.8	11.6	14.3	15.2
MAV	122.2	99.0	103.8	139.6	176.0	192.9
OSV	0.2	0.2	0.2	0.2	0.3	0.3
Total	**183.2**	**148.9**	**155.6**	**207.8**	**261.4**	**285.4**

Vehicle Category	FY37	FY38	FY39	FY40	FY41	FY42	FY43
CJV	49.9	54.6	60.0	65.9	71.3	77.7	84.5
Mini LCV	2.9	3.1	3.3	3.5	3.7	3.9	4.2
LCV	3.5	3.7	4.0	4.3	4.6	4.9	5.1
Bus	10.4	11.2	11.9	12.8	13.6	14.5	15.5
2A	16.8	17.9	18.8	20.0	21.1	22.3	23.5
3A	16.2	17.1	18.2	19.3	20.6	21.8	23.1
MAV	209.9	230.1	249.9	273.4	296.8	322.3	351.3
OSV	0.4	0.4	0.4	0.5	0.5	0.5	0.6
Total	**310.0**	**338.0**	**366.5**	**399.7**	**432.2**	**468.0**	**507.8**

Vehicle Category	FY44	FY45	FY46	FY47	FY48	FY49	FY50	FY51	FY52
CJV	93.9	101.4	109.5	120.4	129.9	142.3	152.6	166.8	181.8
Mini LCV	4.6	4.8	5.1	5.5	5.8	6.2	6.5	6.9	7.4
LCV	5.6	5.9	6.3	6.6	7.1	7.5	8.0	8.6	9.1
Bus	16.5	17.6	18.7	19.9	21.3	22.6	24.0	25.6	27.3
2A	24.8	26.2	27.6	29.1	30.8	32.5	34.1	36.1	38.1
3A	24.6	26.0	27.6	29.4	31.1	32.9	34.8	36.8	39.2
MAV	383.0	414.4	448.6	486.9	528.8	569.9	617.1	667.1	722.2
OSV	0.6	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.2
Total	**553.7**	**597.1**	**644.1**	**698.6**	**755.6**	**814.9**	**878.2**	**949.0**	**1,026.3**

Source: Steer analysis

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NOTE ON TRAFFIC AND REVENUE ESTIMATES

Project name	**Traffic Study of Three NHAI InvIT Assets**
Client	**NATIONAL HIGHWAYS INFRA PROJECTS PRIVATE LIMITED**
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Note on Traffic and Revenue Estimates Based on Recent Data

National Highways Infra Projects Private Limited (NHIPPL) on behalf of National Highways Infra Trust has appointed Ramboll India Private Ltd as a traffic consultant to carry out a review of the earlier traffic and revenue forecasts pertaining to the report submitted in the month of May 2023 for three InvIT assets with respect to the latest traffic and revenue data. The earlier reports contained a comprehensive coverage of traffic levels, travel pattern and revenue estimation for the projects, duly considering the network characteristics and future economic perspective in the influence area of the projects containing traffic data till March 2023.

NHIPPL has provided latest 6 months of data from April 2023 to September 2023 and has requested to provide a note covering the impact of the following on traffic and revenue projections as presented in May 2023 report:

- recent traffic data of H1 of FY24
- revised GDP forecast by Consensus Economics
- RBI forecast of WPI for December 2023 and forecast for December 2024 & December 2025 based ongoing effect of El Niño and other geopolitical issues as updated in Q1 note.

This note presents the analysis based on the traffic data and revenue received from NHIPPL and the recommendations thereafter. The list of three InvIT assets is provided in **Table 1**.

Sl No	Projects/Assets	Toll Plazas
1	Chittorgarh – Kota (CK)	Bassi
		Aroli
		Dhaneshwar
2	Kagal – Belgaum (KB)	Kognoli
		Hattargi
3	Kothakota – Kurnool (KK)	Pullur

Table 1: List of NHAI InvIT Assets

For the present study, six months of additional data from April 2023 to September 2023 was provided. The month-on-month traffic profile from April 2022 to September 2023 based on the toll data for the three assets are presented in **Figure 1** to **Figure 3**.

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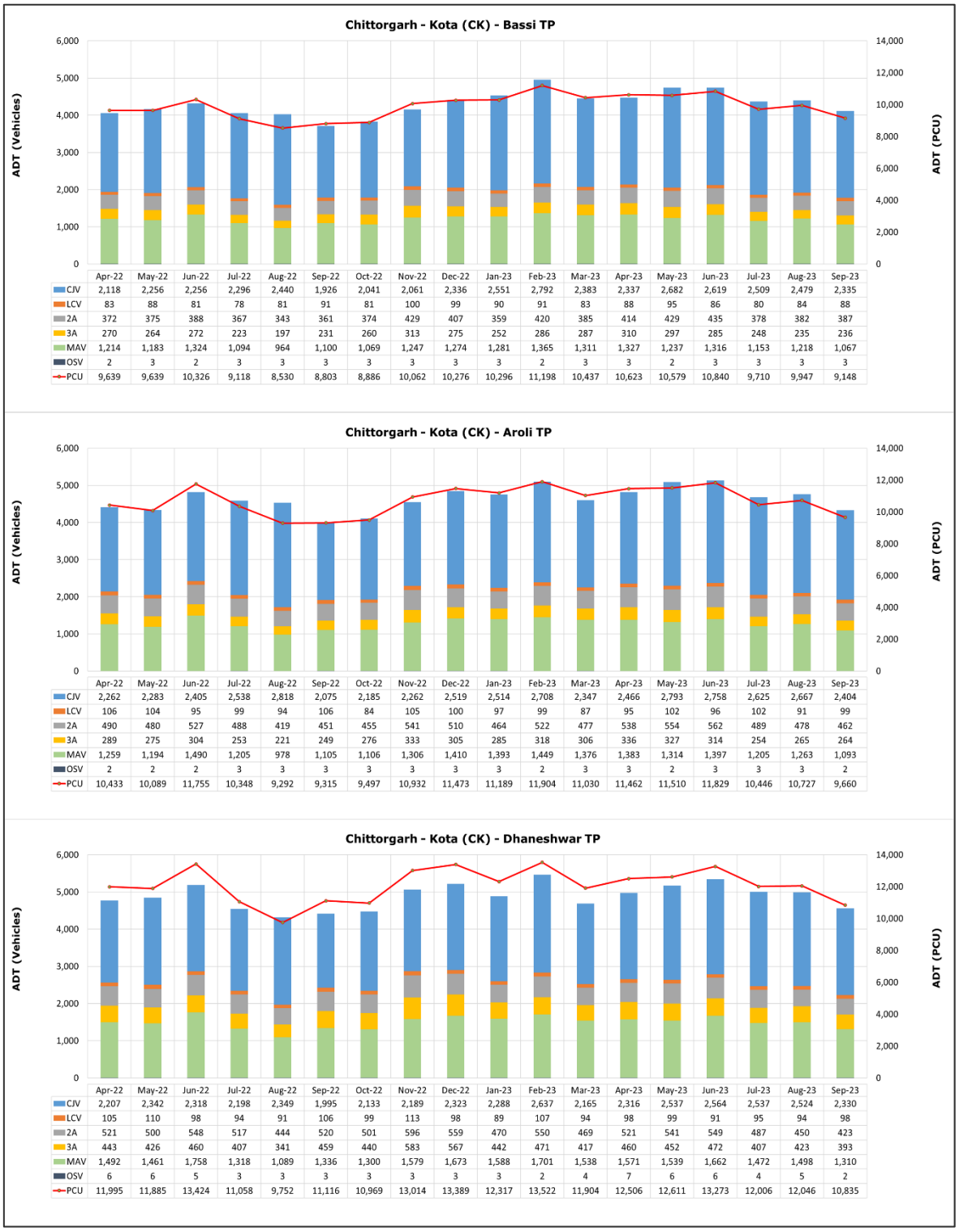

	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
CJV	2,118	2,256	2,256	2,296	2,440	1,926	2,041	2,061	2,336	2,551	2,792	2,383	2,337	2,682	2,619	2,509	2,479	2,335
LCV	83	88	81	78	81	91	81	100	99	90	91	83	88	95	86	80	84	88
2A	372	375	388	367	343	361	374	429	407	359	420	385	414	429	435	378	382	387
3A	270	264	272	223	197	231	260	313	275	252	286	287	310	297	285	248	235	236
MAV	1,214	1,183	1,324	1,094	964	1,100	1,069	1,247	1,274	1,281	1,365	1,311	1,327	1,237	1,316	1,153	1,218	1,067
OSV	2	3	2	3	3	3	3	3	3	3	2	3	3	2	3	3	3	3
PCU	9,639	9,639	10,326	9,118	8,530	8,803	8,886	10,062	10,276	10,296	11,198	10,437	10,623	10,579	10,840	9,710	9,947	9,148

	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
CJV	2,262	2,283	2,405	2,538	2,818	2,075	2,185	2,262	2,519	2,514	2,708	2,347	2,466	2,793	2,758	2,625	2,667	2,404
LCV	106	104	95	99	94	106	84	105	100	97	99	87	95	102	96	102	91	99
2A	490	480	527	488	419	451	455	541	510	464	522	477	538	554	562	489	478	462
3A	289	275	304	253	221	249	276	333	305	285	318	306	336	327	314	254	265	264
MAV	1,259	1,194	1,490	1,205	978	1,105	1,106	1,306	1,410	1,393	1,449	1,376	1,383	1,314	1,397	1,205	1,263	1,093
OSV	2	2	2	3	3	3	3	3	3	3	2	3	3	2	3	3	3	2
PCU	10,433	10,089	11,755	10,348	9,292	9,315	9,497	10,932	11,473	11,189	11,904	11,030	11,462	11,510	11,829	10,446	10,727	9,660

	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
CJV	2,207	2,342	2,318	2,198	2,349	1,995	2,133	2,189	2,323	2,288	2,637	2,165	2,316	2,537	2,564	2,537	2,524	2,330
LCV	105	110	98	94	91	106	99	113	98	89	107	94	98	99	91	95	94	98
2A	521	500	548	517	444	520	501	596	559	470	550	469	521	541	549	487	450	423
3A	443	426	460	407	341	459	440	583	567	442	471	417	460	452	472	407	423	393
MAV	1,492	1,461	1,758	1,318	1,089	1,336	1,300	1,579	1,673	1,588	1,701	1,538	1,571	1,539	1,662	1,472	1,498	1,310
OSV	6	6	5	3	3	3	3	3	3	3	2	4	7	6	6	4	5	2
PCU	11,995	11,885	13,424	11,058	9,752	11,116	10,969	13,014	13,389	12,317	13,522	11,904	12,506	12,611	13,273	12,006	12,046	10,835

Figure 1: Traffic Profile from April 2022 to September 2023 for CK

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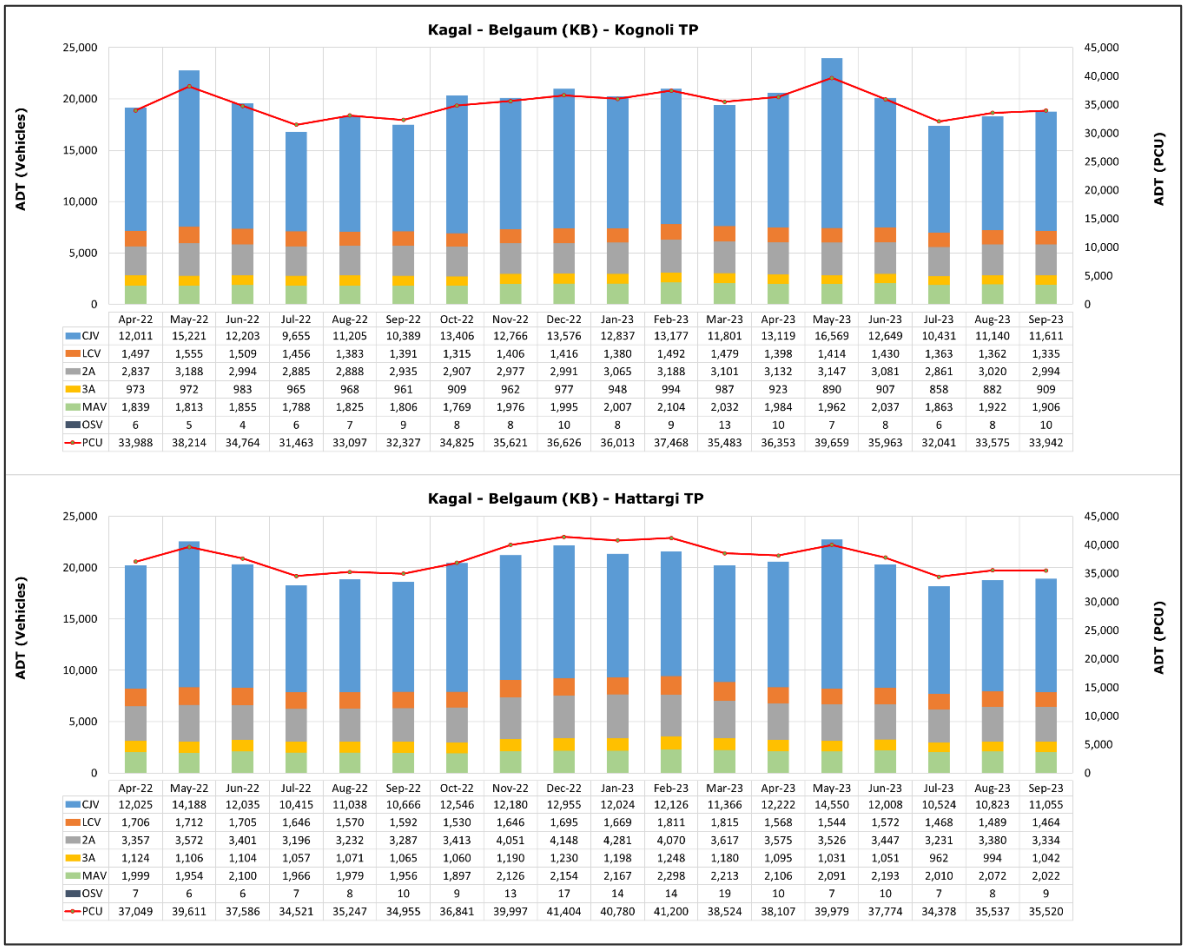
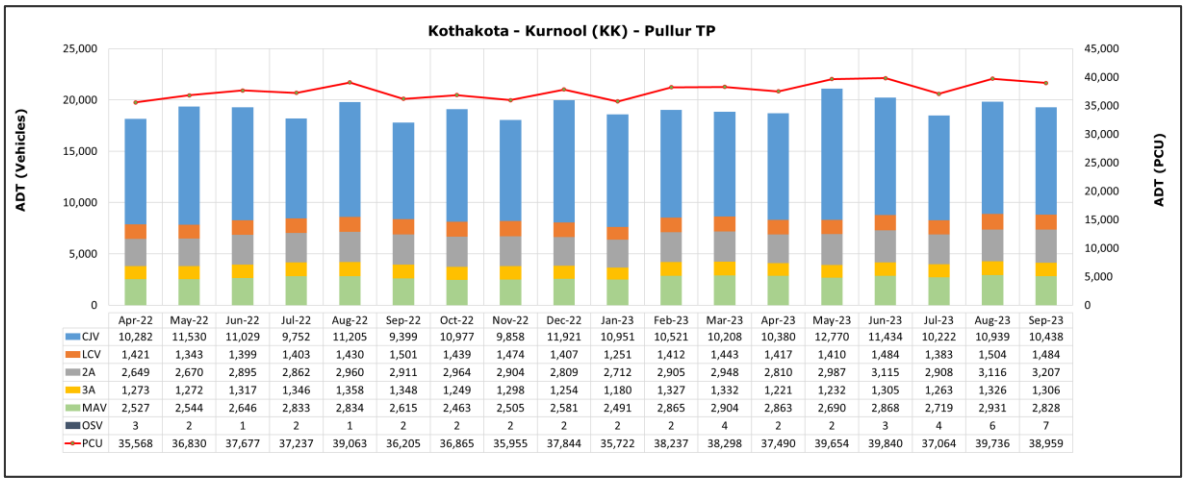


	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
CJV	12,011	15,221	12,203	9,655	11,205	10,389	13,406	12,766	13,576	12,837	13,177	11,801	13,119	16,569	12,649	10,431	11,140	11,611
LCV	1,497	1,555	1,509	1,456	1,383	1,391	1,315	1,406	1,416	1,380	1,492	1,479	1,398	1,414	1,430	1,363	1,362	1,335
2A	2,837	3,188	2,994	2,885	2,888	2,935	2,907	2,977	2,991	3,065	3,188	3,101	3,132	3,147	3,081	2,861	3,020	2,994
3A	973	972	983	965	968	961	909	962	977	948	994	987	923	890	907	858	882	909
MAV	1,839	1,813	1,855	1,788	1,825	1,806	1,769	1,976	1,995	2,007	2,104	2,032	1,984	1,962	2,037	1,863	1,922	1,906
OSV	6	5	4	6	7	9	8	8	10	8	9	13	10	7	8	6	8	10
PCU	33,988	38,214	34,764	31,463	33,097	32,327	34,825	35,621	36,626	36,013	37,468	35,483	36,353	39,659	35,963	32,041	33,575	33,942

	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
CJV	12,025	14,188	12,035	10,415	11,038	10,666	12,546	12,180	12,955	12,024	12,126	11,366	12,222	14,550	12,008	10,524	10,823	11,055
LCV	1,706	1,712	1,705	1,646	1,570	1,592	1,530	1,646	1,695	1,669	1,811	1,815	1,568	1,544	1,572	1,468	1,489	1,464
2A	3,357	3,572	3,401	3,196	3,232	3,287	3,413	4,051	4,148	4,281	4,070	3,617	3,575	3,526	3,447	3,231	3,380	3,334
3A	1,124	1,106	1,104	1,057	1,071	1,065	1,060	1,190	1,230	1,198	1,248	1,180	1,095	1,031	1,051	962	994	1,042
MAV	1,999	1,954	2,100	1,966	1,979	1,956	1,897	2,126	2,154	2,167	2,298	2,213	2,106	2,091	2,193	2,010	2,072	2,022
OSV	7	6	6	7	8	10	9	13	17	14	14	19	10	7	10	7	8	9
PCU	37,049	39,611	37,586	34,521	35,247	34,955	36,841	39,997	41,404	40,780	41,200	38,524	38,107	39,979	37,774	34,378	35,537	35,520

Figure 2: Traffic Profile from April 2022 to September 2023 for KB



	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
CJV	10,282	11,530	11,029	9,752	11,205	9,399	10,977	9,858	11,921	10,951	10,521	10,208	10,380	12,770	11,434	10,222	10,939	10,438
LCV	1,421	1,343	1,399	1,403	1,430	1,501	1,439	1,474	1,407	1,251	1,412	1,443	1,417	1,410	1,484	1,383	1,504	1,484
2A	2,649	2,670	2,895	2,862	2,960	2,911	2,964	2,904	2,809	2,712	2,905	2,948	2,810	2,987	3,115	2,908	3,116	3,207
3A	1,273	1,272	1,317	1,346	1,358	1,348	1,249	1,298	1,254	1,180	1,327	1,332	1,221	1,232	1,305	1,263	1,326	1,306
MAV	2,527	2,544	2,646	2,833	2,834	2,615	2,463	2,505	2,581	2,491	2,865	2,904	2,863	2,690	2,868	2,719	2,931	2,828
OSV	3	2	1	2	1	2	2	2	2	2	2	4	2	2	3	4	6	7
PCU	35,568	36,830	37,677	37,237	39,063	36,205	36,865	35,955	37,844	35,722	38,237	38,298	37,490	39,654	39,840	37,064	39,736	38,959

Figure 3: Traffic Profile from April 2022 to September 2023 for KK

The above graphs are presented after removing the duplication error in month-on-month profile for KK. Also, due to the construction work pertaining to 6-laning of project road for KB asset,

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vehicles carrying construction materials for the asset are exempted from tolling and hence high number of vehicles under exempt category can be found. This trend can be seen from November 2022 onwards in case of Hattargi TP and April 2023 onwards in case of Kognoli toll plaza. Hence, average exemption numbers from April 2022 to October 2022/March 2023 have been considered for relevant modes for respective toll plaza to arrive at the realistic traffic levels and the same has been presented in the graphs.

With the availability of six months of toll data from April 2023 to September 2023, an assessment of the applicability of the earlier forecast for FY24 (in May 2023 report) is carried out. For this purpose, seasonality profiles have been developed for each of these three assets using FY23 traffic data. Using this derived month-on-month seasonality profile on earlier forecasted FY24 AADT, monthly traffic for FY24 was estimated for all the assets.

An analysis was also conducted to assess the variation of traffic and revenue collected for H1 of FY24 vis-a-vis the forecasted H1 numbers (in May 2023 report). On an average, the actual observed traffic (average PCUs) for the three assets has shown positive variation of about 0.9 percent with respect to the forecasted numbers. In terms of revenue, 1-2 percent positive variation has been noticed across the three assets.

Revised FY24 AADT has been derived by considering six months of actual traffic and six months of forecasted traffic based on the seasonality profile. The comparison of revised FY24 AADT and the forecast for FY24 as in the earlier study is presented in **Table 2.**

Toll Plazas	Particulars	CJV	LCV	2-Axle	3-Axle	MAV	OSV	Total vehicles	PCUs
Chittorgarh – Kota (CK)									
Bassi	Earlier FY24 AADT	2,423	89	394	271	1,270	3	4,452	10,284
	Revised AADT	2,497	90	406	279	1,274	3	4,550	10,436
	% Variation	3.0%	0.4%	3.1%	2.9%	0.3%	-6.6%	2.2%	1.5%
Aroli	Earlier FY24 AADT	2,552	101	502	295	1,345	3	4,799	11,164
	Revised AADT	2,592	98	513	304	1,346	3	4,856	11,262
	% Variation	1.6%	-3.0%	2.2%	3.0%	0.1%	-6.5%	1.2%	0.9%
Dhaneshwar	Earlier FY24 AADT	2,396	103	533	473	1,570	4	5,079	12,654
	Revised AADT	2,446	99	518	471	1,580	4	5,119	12,691
	% Variation	2.1%	-3.5%	-2.8%	-0.6%	0.6%	0.0%	0.8%	0.3%
Kagal – Belgaum (KB)									
Kognoli	Earlier FY24 AADT	12,354	1,474	3,065	989	2,006	8	19,898	35,796

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Toll Plazas	Particulars	CJV	LCV	2-Axle	3-Axle	MAV	OSV	Total vehicles	PCUs
	Revised AADT	12,757	1,416	3,073	940	2,018	9	20,214	36,045
	% Variation	3.3%	-4.0%	0.3%	-5.0%	0.6%	7.9%	1.6%	0.7%
Hattargi	Earlier FY24 AADT	11,964	1,715	3,717	1,164	2,183	12	20,754	39,054
	Revised AADT	12,032	1,626	3,717	1,121	2,172	12	20,680	38,814
	% Variation	0.6%	-5.2%	0.0%	-3.6%	-0.5%	2.6%	-0.4%	-0.6%
Kothakota – Kurnool (KK)									
Pullur	Earlier FY24 AADT	11,376	1,459	2,907	1,322	2,806	2	19,872	38,889
	Revised AADT	11,259	1,450	2,978	1,287	2,803	3	19,779	38,855
	% Variation	-1.0%	-0.6%	2.4%	-2.6%	-0.1%	44.5%	-0.5%	-0.1%

Table 2: Comparison of Revised FY24 AADT with FY24 AADT in May 2023 Study

The above analysis indicates that revised AADT (in PCUs) are within +/- 1 percent of earlier forecasted AADTs for all the projects. In case of CK, positive variations (0.3%-1.5%) have been witnessed for all the plazas. Kognoli TP of KB has shown positive variation of 0.7 percent whereas Hattargi TP has shown negative variation of about 0.6 percent. Pullur TP of KK has shown negligible variation (-0.1%). At the portfolio level, on an average revised PCUs are higher by 0.4 percent as compared to the earlier forecasted FY24 PCUs. The month-on-month variations could be due to local influences, timely/delayed onset of monsoons in different parts of the country and seasonal fluctuations.

Based on this analysis, the previous estimates of traffic for these assets provided in May 2023 report for FY24 can still be considered as valid.

Tolling Segmentation

The average tolling segmentation for the six months of April 2023 to September 2023 are in line with the tolling segmentation considered for revenue estimation in May 2023 report. The average tolling segmentation for the six months of April 2023 to September 2023 are presented in **Annexure 1**.

Revision in GDP Forecast

The forecasts for FY24 onwards have been revised by Consensus Economics and the same has been considered for traffic growth estimation. A comparison between the GDP forecast adopted in earlier May 2023 study and present study is presented **Figure 4**.

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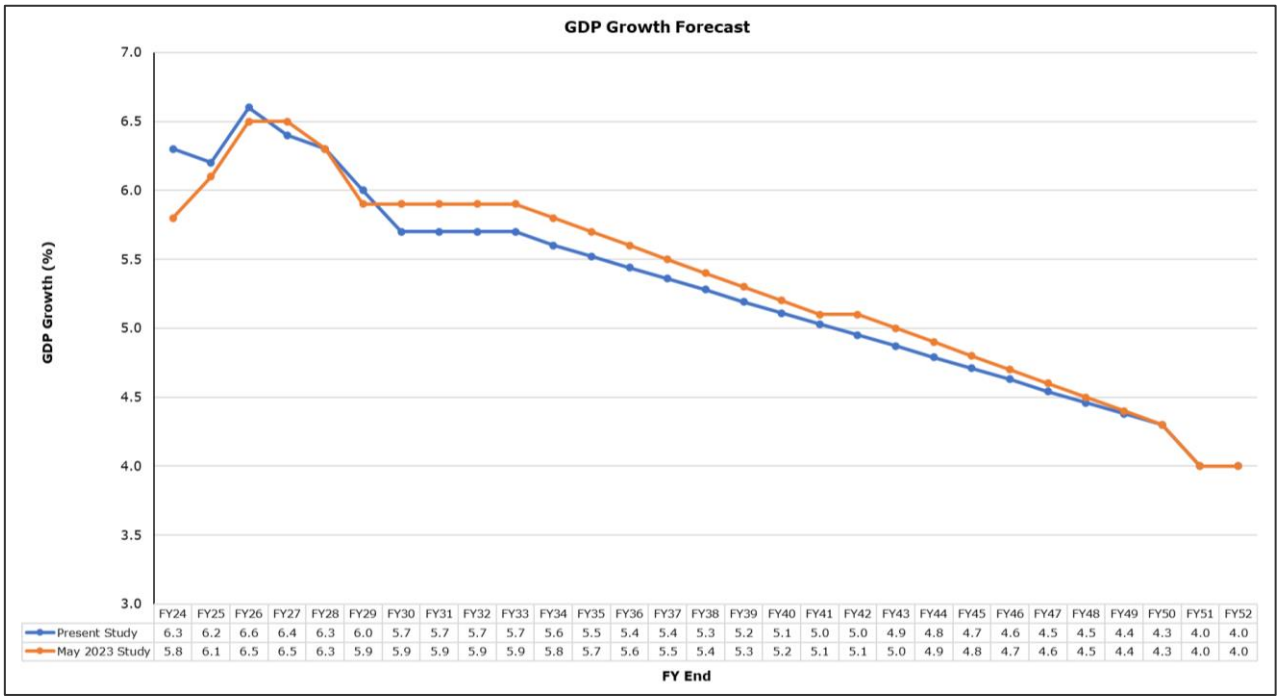

Figure 4: Comparison of GDP Forecast in Present Study and Earlier Study (May 2023)

The current forecast is about +/- 0.5 percent lower/higher than the adopted GDP forecast in May 2023 study.

The revised traffic estimates (in PCUs) for the three assets are presented in **Table 3**.

FY ending March	CK				KB			KK
	TP01	TP02	TP03	Average	TP01	TP02	Average	
2024	10,329	11,212	12,708	11,416	35,866	39,133	37,499	39,041
2025	11,050	11,975	13,549	12,191	36,768	40,149	38,458	41,043
2026	11,789	12,762	14,424	12,992	38,535	42,010	40,273	43,304
2027	12,557	13,579	15,330	13,822	40,343	43,912	42,128	42,794
2028	13,283	14,356	16,200	14,613	42,218	45,883	44,051	43,590
2029	14,016	15,140	17,078	15,411	44,099	47,856	45,977	44,262
2030	14,752	15,926	17,958	16,212	41,873	45,724	43,799	46,447
2031	15,461	16,686	18,809	16,985	41,495	45,434	43,464	48,535
2032	16,206	17,482	19,701	17,796	41,048	45,076	43,062	50,730
2033	16,987	18,317	20,636	18,647	42,806	46,924	44,865	53,039
2034	17,792	19,178	21,599	19,523	44,616	48,825	46,721	55,425
2035	18,623	20,067	22,594	20,428	46,486	50,786	48,636	57,898
2036	19,482	20,984	23,620	21,362	48,296	52,692	50,494	60,457
2037	20,367	21,930	24,679	22,325	50,155	54,647	52,401	63,105
2038	21,280	22,905	25,769	23,318	52,065	56,653	54,359	65,843
2039	22,218	23,907	26,889	24,338	54,020	58,705	56,363	68,665
2040	23,183	24,937	28,040	25,387	56,024	60,807	58,415	71,577
2041	24,175	25,996	29,223	26,465	58,076	62,957	60,517	74,580
2042	25,193	27,083	30,437	27,571	60,177	65,157	62,667	77,674
2043	26,238	28,198	31,683	28,706	62,325	67,403	64,864	80,858
2044	27,308	29,340	32,958	29,869	64,520	69,697	67,109	84,133

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FY ending March	CK				KB			KK
	TP01	TP02	TP03	Average	TP01	TP02	Average	
2045	28,405	30,510	34,264	31,060	66,761	72,038	69,399	87,498
2046	29,527	31,707	35,600	32,278	69,047	74,423	71,735	90,952
2047	30,671	32,927	36,961	33,520	71,373	76,847	74,110	94,487
2048	31,839	34,173	38,351	34,788	73,740	79,314	76,527	98,108
2049	33,031	35,443	39,768	36,081	76,148	81,821	78,985	101,815
2050	34,245	36,738	41,211	37,398	78,597	84,368	81,482	105,605
2051	35,417	37,987	42,603	38,669	80,953	86,818	83,885	109,274
2052	36,629	39,279	44,043	39,983	83,386	89,346	86,366	113,084

Table 3: Revised Traffic Estimates (in PCUs)

Revision in WPI Forecast

The growth forecast for WPI applicable for FY25 onwards was considered as 3.5 percent in the May 2023 study. However, the recent forecast of WPI by RBI indicates an inflation rate of 1 percent for December 2023 (applicable for FY25) and has been adopted for the Q1 study and present study. Also, WPI increase of 5.0 percent and 4.5 percent for December 2024 (applicable for FY26) and December 2025 (applicable for FY27) respectively has been considered for the Q1 study and present study to account for the low base in December 2023, the ongoing effect of El Niño and other geopolitical issues. The WPI growth forecast for remaining years beyond December 2025 has been kept unchanged at 3.5 percent.

Revenue Estimates

The revised revenue estimates have been worked out considering the updated traffic growth rates (due to change in GDP forecast) and WPI forecast (for December of 2023; 2024 and 2025). The projections of revenue under the present study for the project road have been presented till 15th December of FY52. Toll revenue streams have been calculated assuming that toll would be collected for all 365 days in a year and for 366 days in a leap year. The revised revenue estimates for all the three assets are presented in **Table 4**.

FY ending March	CK	KB	KK
2024	1,011.1	1,143.1	1,904.1
2025	1,105.9	1,172.4	1,537.1
2026	1,240.3	2,214.3	1,619.7
2027	1,383.7	2,885.0	1,989.2
2028	1,526.8	3,199.3	2,484.4
2029	1,667.3	3,471.6	2,611.6
2030	1,828.1	3,382.5	2,856.6
2031	1,991.5	3,467.0	3,099.5
2032	2,179.9	3,551.8	3,387.3
2033	2,372.5	3,839.8	3,661.0
2034	2,582.6	4,153.8	3,982.8
2035	2,819.3	4,493.5	4,320.2
2036	3,072.5	4,856.2	4,705.5

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FY ending March	CK	KB	KK
2037	3,327.6	5,217.9	5,101.3
2038	3,619.9	5,659.1	5,520.1
2039	3,936.9	6,100.6	5,990.1
2040	4,282.2	6,580.2	6,493.2
2041	4,631.8	7,078.4	7,026.9
2042	5,024.8	7,629.5	7,631.2
2043	5,442.2	8,217.6	8,251.9
2044	5,912.4	8,857.5	8,953.3
2045	6,384.2	9,501.4	9,625.1
2046	6,901.0	10,195.7	10,434.8
2047	7,469.8	10,954.7	11,288.4
2048	8,078.2	11,809.3	12,189.4
2049	8,700.1	12,655.1	13,123.8
2050	9,393.1	13,591.4	14,170.8
2051	10,090.8	14,518.1	15,233.7
2052	7,732.6	11,079.9	11,666.8
PV12 FY24 till 15th Dec in FY52	19,127.4	30,658.0	29,264.7

Table 4: Revised Revenue Estimates (₹ Million)

The year-on-year revenue estimates vary between -1.6 to 0.6 percent as compared to the earlier study across the three assets. In NPV terms, the revised revenue estimates are about 0.5-0.6 percent lower than the revenue estimates presented in May 2023 study for all the assets.

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ANNEXURES

ANNEXURE - 1
TOLLING SEGMENTATION

Traffic Study of Three NHAI InvIT Assets

Average Tolling Segmentation for April 2023 to September 2023 for Three Assets

Asset : **Chittorgarh – Kota (CK)**
Toll Plaza : **Bassi**

Ticket/ Mode	CJV	LCV	2-Axle	3-Axle	MAV	OSV
Single	40.9	61.9	47.6	60.6	76.0	87.9
Return	45.1	33.6	49.7	38.9	15.9	10.5
Monthly	0.0	0.0	0.0	0.0	0.0	0.0
Local Personal	1.4	0.0	0.0	0.0	0.0	0.0
Local Commercial	0.1	2.8	2.2	0.2	7.8	1.4
Exempt/ Violations	12.5	1.7	0.5	0.3	0.2	0.2
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Asset : **Chittorgarh – Kota (CK)**
Toll Plaza : **Aroli**

Ticket/ Mode	CJV	LCV	2-Axle	3-Axle	MAV	OSV
Single	43.9	58.2	42.4	58.5	71.9	93.1
Return	49.6	40.4	57.4	41.5	28.1	6.7
Monthly	0.0	0.0	0.0	0.0	0.0	0.0
Local Personal	3.0	0.0	0.0	0.0	0.0	0.0
Local Commercial	0.0	0.0	0.0	0.0	0.0	0.0
Exempt/ Violations	3.5	1.4	0.1	0.1	0.0	0.2
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Asset : **Chittorgarh – Kota (CK)**
Toll Plaza : **Dhaneshwar**

Ticket/ Mode	CJV	LCV	2-Axle	3-Axle	MAV	OSV
Single	38.6	53.1	39.7	40.7	54.4	51.7
Return	45.5	41.6	57.7	52.4	42.0	47.6
Monthly	0.0	3.5	0.0	0.0	0.0	0.0
Local Personal	10.9	0.0	0.0	0.0	0.0	0.0
Local Commercial	0.0	0.0	2.2	6.6	3.5	0.0
Exempt/ Violations	5.0	1.7	0.4	0.3	0.1	0.7
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Traffic Study of Three NHAI InvIT Assets

Average Tolling Segmentation for April 2023 to September 2023 for Three Assets

Asset : **Kagal – Belgaum (KB)**
Toll Plaza : **Kognoli**

Ticket/ Mode	CJV	LCV	2-Axle	3-Axle	MAV	OSV
Single	45.2	77.1	63.4	87.5	88.8	98.7
Return	44.4	21.6	36.0	11.8	10.7	1.2
Monthly	0.0	0.0	0.0	0.0	0.0	0.0
Local Personal	5.6	0.0	0.0	0.0	0.0	0.0
Local Commercial	0.0	0.0	0.0	0.0	0.0	0.0
Exempt/ Violations	4.8	1.3	0.6	0.7	0.5	0.1
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Asset : **Kagal – Belgaum (KB)**
Toll Plaza : **Hattargi**

Ticket/ Mode	CJV	LCV	2-Axle	3-Axle	MAV	OSV
Single	42.0	72.7	60.1	82.2	86.9	95.2
Return	52.5	24.3	33.8	17.4	12.8	0.1
Monthly	0.0	0.0	0.1	0.0	0.0	0.0
Local Personal	1.4	0.0	0.0	0.0	0.0	0.0
Local Commercial	0.1	0.6	5.6	0.0	0.0	0.0
Exempt/ Violations	4.1	2.4	0.4	0.4	0.3	4.7
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Asset : **Kothakota – Kurnool (KK)**
Toll Plaza : **Pullur**

Ticket/ Mode	CJV	LCV	2-Axle	3-Axle	MAV	OSV
Single	50.9	69.0	55.6	80.5	90.6	99.1
Return	39.7	30.6	43.2	19.2	9.3	0.3
Monthly	0.0	0.2	1.0	0.1	0.0	0.0
Local Personal	8.1	0.0	0.0	0.0	0.0	0.0
Local Commercial	0.0	0.0	0.0	0.0	0.0	0.0
Exempt/ Violations	1.3	0.2	0.2	0.1	0.1	0.6
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Project Drone VI: Revalidation study for InvIT R2 assets

National Highway Infra Projects Private Limited
October 2023
Our ref: 24265606

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Project Drone VI: Revalidation study for InvIT R2 assets

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Traffic Consultant developed the relationships in the models used to produce the forecasts for this Project based on additional data provided for Apr-Sep 2023. Since March 2020, the outbreak of the virus known as COVID- 19 has spread throughout the world and has been defined by the World Health Organization as a "pandemic". As of the date of distribution of this Report, the COVID-19 outbreak is having a material impact on global economic and political affairs including having a significant impact on all the transportation industries, including toll road traffic, where in particular vehicle volumes have fallen in response to quarantine and self-care measures that governments have imposed. The situation remains dynamic and is subject to significant change. In this challenging context, Traffic Consultant has produced base forecasts (directly produced from models using a combination of pre-COVID-19 and post-COVID-19 views) with a view on a possible scenario for the traffic forecasts based on an assumption of recovery from the COVID-19-related traffic decrease. For the purposes of these forecasts, we have also incorporated other possible impacts of COVID-19 related scenarios. However, it is important to note that this is only one view, and there continues to remain uncertainty as to the short-term, intermediate, or prolonged effects of and responses to the COVID-19 pandemic on the Project. All of these effects could impact the COVID-19-related aspects of the Report. As a result, no assurance can be provided by Traffic Consultant that the scenarios and assumptions Traffic Consultant has identified will prove to be accurate. Given the uncertainty inherent in this unprecedented pandemic, Traffic Consultant advises that all readers of the Report consider the Report in the context of their own assessment of the COVID-19 outbreak and its current and potential impacts before making final decisions related to this Project.

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1 Introduction

Background

1.1 Steer was commissioned by National Highways Infra Projects Private Limited (NHIPPL or the Client) to carry out traffic and revenue (T&R) due diligence study in February 2023 for the following two Assets. The Assets included a total of three toll plazas.

- **Agra Bypass (AB):** Agra Bypass section connecting NH19 (old NH2) to NH44 (old NH7) in Uttar Pradesh with one toll plaza (Raibha)
- **Borkhedi Kelapur (BK):** Borkhedi-Kelapur-Maharashtra/Telangana border on NH44 (old NH7) in the state of Maharashtra with two toll plazas (Daroda and Kelapur)

1.2 The Assets are a part of the National Highways Infra Trust (NHIT) InvIT (Round 2: concessioned in the 2nd round of InvIT programme) whose sponsor is National Highways Authority of India (NHAI) with NHIPPL acting as the manager.

1.3 As part of the study, traffic and revenue forecasts were developed based on secondary analysis of the data provided by the Client, primary data collection and internal benchmarks available with Steer for similar Assets. The analysis of the traffic profile on the Asset was based on toll plaza data available for April 2021 – March 2023 period and Steer's independent traffic count and primary surveys (24-hour OD and 7 days x 24-hour TVC) which were undertaken in Mar 2023. The final report on traffic and revenue forecasts was submitted to Client in May 2023.

The Assignment

1.4 NHIPPL intends to validate the forecasts for FY24 (FY24E[1]) for traffic and revenue due diligence for these Assets using desktop-based analysis considering the additional traffic data available for the period April to September 2023 (FY24A[2]), through a revalidation study. To this end, NHIPPL has commissioned Steer to undertake this revalidation for the said Assets.

[1] FY24E: Estimated for FY24 for the corresponding months: Apr-23 to Sep-23 (SCF applied).

[2] FY24A: Actual for FY24 based on Apr-23 to Sep-23 data.

2 Executive Summary

2.1 In the revalidation study for the Assets under consideration, the additional traffic data has been provided from 1st Apr-23 till 30th Sep-23. This note summarises the traffic and revenue performance of the Assets till September 2023.

2.2 For the purposes of this study, we have used the same Base Correction Factor (BCF) on actual traffic numbers, as identified during the previous T&R due diligence study. The actual traffic numbers adjusted with BCF (mainly for CJV, LCV and Bus/2A) have been compared with the estimated volumes as part of this study.

2.3 The traffic related observations are provided below:

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- The outturn PCU performance for FY24A is higher by 3.3% than the FY24E volumes. The outturn observed in FY24 YTD (April to September) has been higher than expected across all vehicle categories.
- CJVs have been higher by 19.7% as compared to the FY24E volumes. The toll plaza reported significantly high share of CJV volumes as exemptions and violations which was flagged as a reporting issue and corresponding adjustments were made to CJV volumes during the previous study. Based on the actual outturn, a significant improvement in reporting has been observed for CJV in the data provided for Apr – Sep '23 after the Asset has been taken over by NHIPPL in Mar-23. Therefore, this high increase in CJV is due to the BCF adjustment, which might not be required going forward. However, the same can be verified through a fresh video-based count survey (TVC).
- Overall, at an AADT level, the delta between actual and expected traffic is 6.2%, and at PCU level, it is 3.3%. The significant difference in total AADT is owing to the adjustments (BCF) made earlier to account for difference in reporting of CJVs, which seem to have been significantly controlled now.

Borkhedi Kelapur

- **Daroda**: The outturn PCU is higher by 5.5% than the estimated PCU on Daroda. The performance of 3A and MAV is higher than the estimates (1.4% and 2.3% higher than FY24E YTD respectively). The performance of LCV is 4.3% higher than the estimates for the same period. The delta is largely contributed by higher outturn of CJVs and 2As, which is 19.2% and 9.1%, respectively than the estimated volumes. This is due to an improvement in reporting after being taken over by NHIPPL and thus, requiring adjustment in the BCF factors considered for the comparison.
- **Kelapur**: The outturn PCU is higher by 3.5% on Kelapur. There was a significant share of unreported traffic observed for CJV, LCV and 2A vehicles during the site visit as part of the previous study. Moreover, the outturn of FY24 YTD is higher than the estimates across all vehicle categories. On looking at the performance of heavy commercial vehicles viz. 3A and MAVs together, the delta is about 65 vehicles, which signals robustness of estimates vis-à-vis actual outturn. However, the difference in CJV's performance between actual and

estimated volume is high. This seems to be on account of considerable improvement in the reporting of CJV traffic on the Asset.

2.4 It should be noted that the Client has been operating the Assets since Feb/ Mar 2023, but a systems upgrade is pending. Therefore, the reporting of exemptions and violations is being gradually improved. At Kelapur Toll Plaza, as the location is due for change, hence the traffic operations are yet to be upgraded. Due to improvement in reporting over the Q1 and Q2 of FY24, the CJV traffic outturn appears higher than the estimates. This is also validated through the comparison between actual and estimated revenues.

2.5 At a portfolio level, the actual revenue is INR 145.1 Cr vs INR 143.8 Cr forecasted for the Apr-Sep 2023 period. As the base year traffic and the base year ticket segmentation are in line and positive, the resultant FY24 revenue in the revalidation study for Round 2 Assets is observed to be+0.9% higher than the FY24 (Apr-Sep) revenue estimated in the previous study. Therefore, the forecasts presented in the previous study (released in May-2023) can still be considered valid.

3 Revalidation Assessment

FY24 traffic comparison

3.1 The following section presents the comparison of FY24 traffic volumes between actual (FY24A YTD) and estimates (FY24E YTD[3]) for the Apr to Sep 2023 period. FY24A YTD is arrived at by using the actual traffic volumes from Apr – Sep 2023 whereas FY24E YTD is arrived at by using synthesized traffic for Apr – Sep. The revalidation study aims to validate this profile against the actual traffic performance. For the purposes of this study, we have used the same Base Correction Factor (BCF) on actual traffic numbers, as identified during the previous T&R due diligence study.

Agra Bypass

3.2 The table below presents the FY24A vs FY24 E YTD traffic projections:

Table 3.1: Raibha: FY24 Actual vs estimates (YTD)

FY24*	FY24A YTD	FY24E YTD	FY24A vs FY24E
CJV	**2,937**	**2,453**	19.7%
LCV	**517**	**474**	9.0%
Bus/2A	**2,250**	**2,239**	0.5%
3A	**1,836**	**1,806**	1.6%
MAV	**3,528**	**3,450**	2.3%
Total	**11,067**	**10,422**	6.2%
PCU	**31,846**	**30,825**	3.3%
LCV + Bus/2A	**2,767**	**2,713**	2.0%
3A + MAV	**5,364**	**5,256**	2.1%
2A+3A+MAV	**7,614**	**7,495**	1.6%

Source: Steer analysis

3.3 The outturn PCU performance for FY24A has been higher by 3.3% than the FY24E volumes.

3.4 The toll plaza reported a significantly high share of CJV volumes as exemptions and violations which was flagged as a reporting issue and corresponding adjustments (to the tune of 15%) were made to CJV volumes, i.e., using the Base Correction Factor (BCF) based on the TVC and TMS difference. The BCF so considered was computed using TVC counts and TMS difference over a one-week period in Mar-23. Based on the actual outturn, a significant improvement in reporting has been observed for CJV in the data provided for Apr – Sep '23 after the Asset has been taken over by NHIPPL in Mar-23. Overall, CJVs have been higher by 19.7% as compared to the FY24E volumes.

[3] 'A' represents Actual; 'E' represents Estimated, 'YTD' represents Year-to-date (Apr-Sep).

3.5 Overall, at an AADT level, the delta between actual and expected traffic is 6.2%, and at PCU level, it is 3.3%, which does not represent a significant variation. The volume of traffic was also impacted due to heavy rains in Jun-23. Despite this, the traffic projections are higher than estimated volumes and MAVs have shown higher growth, which reinstates the fact that the Asset's performance is robust and should be able to be in line with the estimated number in the rest of the year.

Borkhedi Kelapur

3.6 **Daroda Toll Plaza**: The outturn PCU was higher by 5.5% than the estimated PCU on Daroda. The increase is majorly driven by CJVs and 2As. The differential is higher because CJVs and 2As grew by 19.2% and 9.1%, respectively. This is due to an improvement in reporting after being taken over by NHIPPL and thus, requiring adjustment in the BCF factors considered for the comparison.

3.7 The table below shows the comparison between FY24E and FY24A YTD traffic positions:

Table 3.2: Daroda: FY24 Actual vs estimates (YTD)

FY24*	FY24A YTD	FY24E YTD	FY24A vs FY24E
CJV	**2,333**	**1,957**	19.2%
LCV	**450**	**431**	4.3%
2A	**1,915**	**1,755**	9.1%
3A	**1,444**	**1,423**	1.4%
MAV	**2,070**	**2,023**	2.3%
Total	**8,211**	**7,590**	8.2%
PCU	**22,400**	**21,242**	5.5%
LCV + Bus/2A	**2,365**	**2,186**	8.2%
3A + MAV	**3,514**	**3,446**	2.0%
2A+3A+MAV	**5,429**	**5,201**	4.4%

Source: Steer analysis

3.8 There were adjustments of non-reported traffic was made in LCV, 2A vehicles, and accordingly, an adjustment was made using the BCF as part of the previous study. The actual outturn traffic in the table above is adjusted with the same BCF as determined during the previous T&R study, whereas now some improvements in reporting have already taken place; which is why it appears higher than the expected volumes.

3.9 The performance of 3A and MAV is in line with the estimates, where the delta is 1.4% and 2.3% respectively.

3.10 **Kelapur Toll Plaza**: The outturn PCU is higher by 3.5% on Kelapur. The performance of 3A+MAV and LCV+2A is better than the estimates, which signals robustness of estimates vis-à-vis actual outturn.

Table 3.3: Kelapur: FY24 Actual vs estimates (YTD)

FY24*	FY24A YTD	FY24E YTD	FY24A vs FY24E
CJV	**2,079**	**1,951**	6.6%
LCV	**425**	**407**	4.4%

FY24*	FY24A YTD	FY24E YTD	FY24A vs FY24E
2A	**1,990**	**1,881**	5.8%
3A	**1,427**	**1,418**	0.6%
MAV	**2,116**	**2,060**	2.7%
Total	**8,038**	**7,718**	4.1%
PCU	**22,491**	**21,730**	3.5%
LCV + Bus/2A	**2,416**	**2,289**	5.6%
3A + MAV	**3,543**	**3,478**	1.9%
2A+3A+MAV	**5,533**	**5,359**	3.2%

Source: Steer analysis

3.11 The outturn of CJV is higher by 6.6% from the estimates. It was seen during the site visits that a significant share of CJVs cross the plaza as unreported traffic. We believe that this is driving the delta of 4.1% between actual and estimated AADT on Kelapur. After the Client has taken over operations at the toll plaza, the reporting has been improved and exemptions have been controlled.

Conclusion

3.12 Overall, for the portfolio of Agra Bypass and Borkhedi – Kelapur Assets, the delta in PCU is 4%, which is mainly on account higher traffic for CJV and LCV+2A. This is on account of improvement in reporting after toll plazas being taken over by NHIPPL in Feb/ Mar this year. The BCF can be adjusted based on fresh TVC surveys to ascertain the current levels of underreporting in traffic.

3.13 The actual outturn of commercial traffic (collectively) is in line with the estimates. 3A and MAV's actual outturn traffic (collectively) shows a delta of 2% with the estimated numbers and LCV and 2A shows delta of 5%.

3.14 Therefore, the outturn traffic is largely in line with projections with small variations at an individual toll plaza level.

FY24 segmentation comparison

3.15 For the forecasts developed during the previous study, the average segmentation of the entire FY23 was considered as the representative of the FY24 base segmentation with some improvements due to operations being taken over by NHIPPL in Feb/ Mar 2023. The same, after adjusting for the traffic being added as BCF in form of exemptions (due to difference between TVC and ETC volumes), was used as the base year segmentation.

3.16 As the FY24 YTD traffic for all the three plazas is available from Apr – Sep 2023, we have a longer history for the base year and therefore, the period can be relied upon on as a representation of the FY24 segmentation trends. The average segmentation between Apr – Sep 2023, with adjustment for the BCF (for LCV and 2A only) is shown below and compared with the FY24 segmentation adopted in the previous study.

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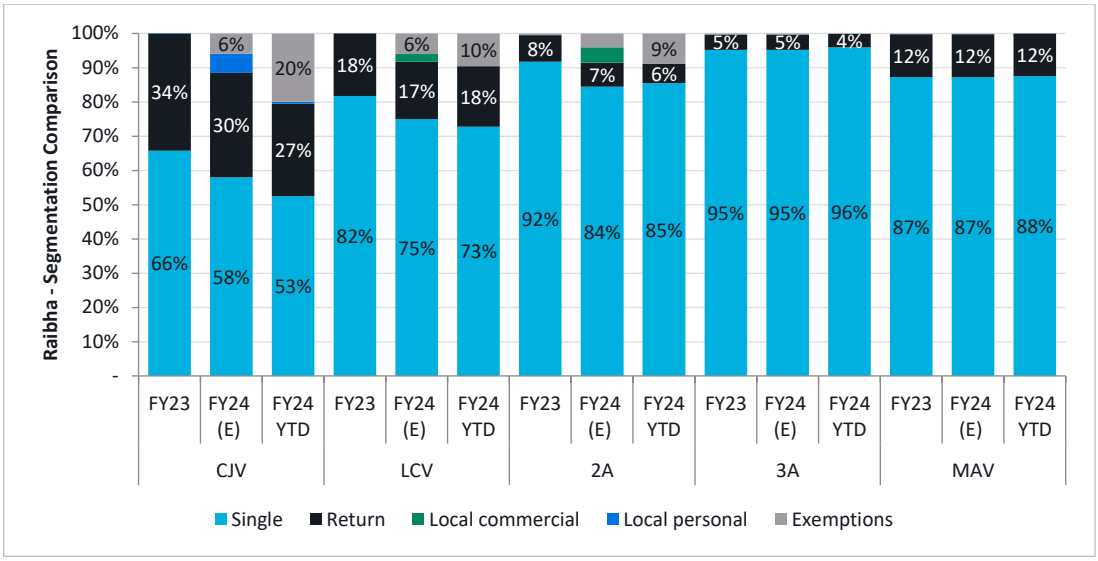
- The ticket segmentation witnessed in FY24 YTD period is in line with the estimations taken in FY24E for 3A and MAV, as shown in the chart below.

Figure 3.1: Raibha – ticket segmentation comparison

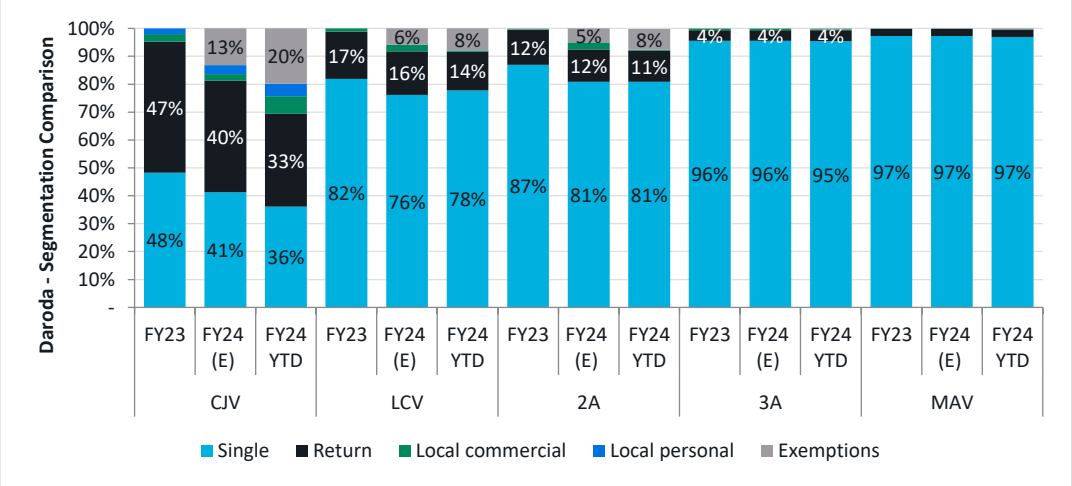


Source: Steer analysis

Borkhedi Kelapur

3.17 **Daroda Toll Plaza**: Across all the vehicle categories at Daroda toll plaza, the base year segmentation considered in the FY24E and the resultant segmentation after using traffic data for Apr – Sep 2023 (FY24 YTD) is largely in line. In fact, improvements, have been observed in the control of exemptions and conversion of such non-toll paying traffic into toll paying traffic.

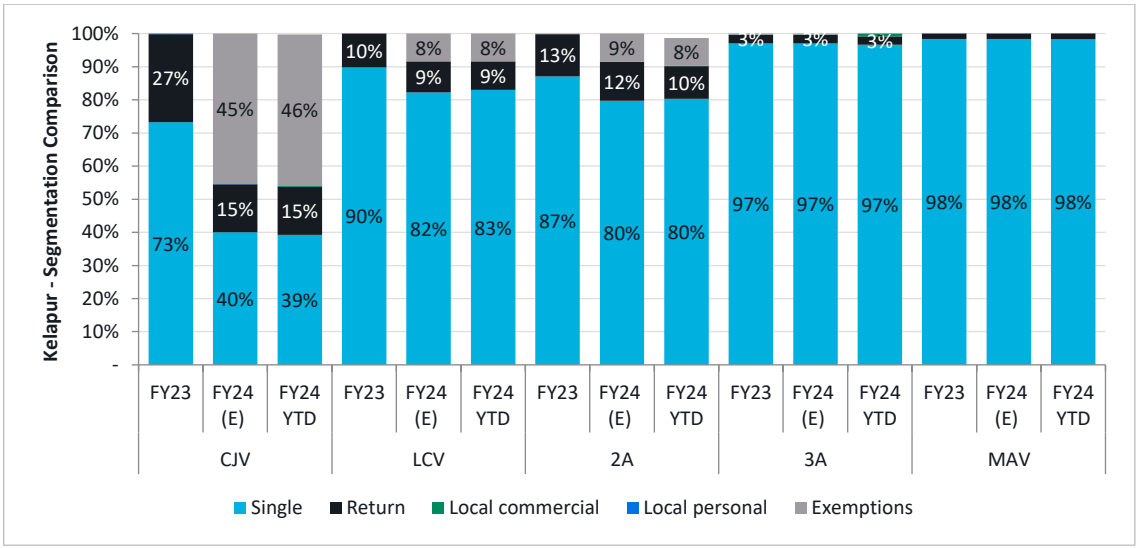
Figure 3.2: Daroda – ticket segmentation comparison



Source: Steer analysis

3.18 **Kelapur Toll Plaza**: The ticket segmentation witnessed in FY24 YTD period is in line with the estimations taken in FY24E for all vehicle categories, as shown in the chart below.

Figure 3.3: Kelapur – ticket segmentation comparison



Source: Steer analysis

3.19 The higher share in exemptions (in CJV, LCV, 2A) is due to the BCF factor used, which would need to be revisited on account of improved reporting at all the toll plazas.

FY24 base year revenue comparison

3.20 For the purposes of revenue comparison, the estimated revenue for Apr-Sep 2023 is computed using the Apr-Sep 2023 estimated traffic and the average segmentation estimated for FY24. The comparison between estimated revenue and actual revenue is shown below:

Table 3.4: FY24 revenue comparison (INR Cr)

	FY24E	FY24A	Absolute Delta	% Delta
Raibha	49.02	49.90	0.87	1.8%
Daroda	48.97	49.98	1.01	2.1%
Kelapur	45.77	45.22	(0.56)	(1.2%)
Total	143.77	145.09	1.33	0.9%

Source: steer analysis

3.21 The delta in revenue at Raibha is majorly due to stronger outturn in CJV and LCV traffic. At Daroda, it is due to strong performance of CJV and 2A, and at Kelapur it is due to weaker performance of 3A and MAV on the Asset.

3.22 The observed FY24 YTD revenue, at a portfolio level, is 0.9% higher than the estimated revenue for the corresponding period in the previous study. As both the inputs for revenue, i.e., the base traffic and ticket segmentation, are in line with the assumptions taken in previous study, the observed revenue for the revalidation study is within reasonable limits of the estimated revenue.

Conclusions

3.23 Based on this assessment, the overall variation between actual and estimates provided in previous study across the two Assets both in terms of traffic and revenue is found to be within the acceptable limits.

3.24 Therefore, all underlying assumptions remain valid as considered in the previous study (released in May-2023). The traffic and revenue forecasts are updated only on account of updates in macro-economic assumptions (GDP, GSDP and WPI). The same have been provided in Appendix -2.

A Appendix

Historical traffic and revenue

A.1 Please find below the month-on-month traffic and revenue for April – September 2023:

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Table A.1: Raibha – Historical traffic MADT

	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
CJV	2,443	2,665	2,930	2,523	2,491	2,299
LCV	438	446	466	494	483	509
2A	2,029	1,950	1,963	2,062	2,105	2,239
3A	1,880	1,815	1,764	1,780	1,856	1,922
MAV	3,643	3,645	3,493	3,404	3,427	3,561
Total	**10,434**	**10,521**	**10,615**	**10,263**	**10,362**	**10,530**
PCU	**31,223**	**31,032**	**30,526**	**30,108**	**30,521**	**31,569**

Source: Steer Analysis

Table A.2: Raibha – Historical monthly revenue (INR Cr)

	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
CJV	0.5	0.5	0.6	0.5	0.5	0.5
LCV	0.2	0.2	0.2	0.2	0.2	0.2
2A	1.6	1.6	1.5	1.7	1.7	1.7
3A	1.6	1.6	1.5	1.6	1.7	1.7
MAV	4.4	4.6	4.2	4.3	4.3	4.4
Total	**8.3**	**8.5**	**8.1**	**8.3**	**8.4**	**8.4**

Source: Steer Analysis

Borkhedi Kelapur

Table A.3: Daroda – Historical traffic MADT

MADT	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
CJV	2,160	2,454	2,188	1,725	1,724	1,560
LCV	431	436	420	408	405	403
2A	1,728	1,816	1,730	1,732	1,818	1,830
3A	1,449	1,507	1,423	1,413	1,456	1,414
MAV	2,100	2,124	1,973	2,011	2,134	2,077
Total	**7,868**	**8,339**	**7,734**	**7,288**	**7,536**	**7,284**
PCU	**21,789**	**22,635**	**21,155**	**20,820**	**21,754**	**21,245**

Source: Steer Analysis

Table A.4: Daroda – Historical monthly revenue (INR Cr)

	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
CJV	0.6	0.7	0.6	0.4	0.4	0.4
LCV	0.2	0.2	0.2	0.2	0.2	0.2

	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
2A	1.9	2.1	1.9	2.0	2.1	2.1
3A	1.8	1.9	1.8	1.8	1.8	1.8
MAV	3.8	4.0	3.6	3.7	3.9	3.8
Total	**8.3**	**8.9**	**8.1**	**8.0**	**8.4**	**8.2**

Source: Steer Analysis

Table A.5: Kelapur – Historical traffic MADT

MADT	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
CJV	1,252	1,393	1,262	979	1,013	913
LCV	397	388	392	384	387	390
2A	1,788	1,845	1,752	1,774	1,879	1,901
3A	1,417	1,472	1,399	1,398	1,457	1,416
MAV	2,141	2,143	2,010	2,075	2,196	2,128
Total	**6,994**	**7,240**	**6,814**	**6,611**	**6,933**	**6,748**
PCU	**21,094**	**21,569**	**20,345**	**20,410**	**21,486**	**21,027**

Source: Steer Analysis

Table A.6: Kelapur – Historical monthly revenue (INR Cr)

	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
CJV	0.4	0.4	0.4	0.3	0.3	0.3
LCV	0.2	0.2	0.2	0.2	0.2	0.2
2A	1.9	2.0	1.8	1.8	2.0	2.0
3A	1.7	1.8	1.6	1.6	1.7	1.7
MAV	3.6	3.8	3.4	3.5	3.7	3.6
OSV	0.0	0.0	0.0	0.0	0.0	0.0
Total	**7.8**	**8.2**	**7.5**	**7.6**	**7.9**	**7.8**

B Traffic and revenue forecasts

B.1 Further to the summary of forecasts, this appendix presents detailed traffic and revenue forecasts.

Traffic forecasts

B.2 This section presents the detailed traffic forecasts for the forecast period until FY43, year of expected close of the concession. The following two tables show the traffic growth rates and AADT, respectively.

Table B.1: AB Raibha: Forecasts for final (background + impacts) AADT

Vehicle Category	FY25	FY26	FY27	FY28	FY29	FY30
CJV	2,445	2,602	2,764	2,934	3,106	3,280
Mini LCV	239	245	251	257	263	269
LCV	484	484	495	505	516	528
Bus	57	58	59	60	61	62
2A	2,123	2,242	2,384	2,532	2,616	2,706
3A	1,806	1,863	1,982	2,107	2,203	2,303
MAV	3,589	3,689	4,013	4,360	4,609	4,871
OSV	3	3	4	4	4	4
Total	10,745	11,185	11,951	12,760	13,379	14,023
PCU	31,531	32,673	35,107	37,685	39,541	41,494

Vehicle Category	FY31	FY32	FY33	FY34	FY35	FY36
CJV	3,463	3,657	3,861	4,077	4,302	4,536
Mini LCV	275	281	288	294	300	307
LCV	539	551	564	576	589	602
Bus	63	64	65	66	67	68
2A	2,798	2,894	2,993	3,095	3,200	3,306
3A	2,408	2,518	2,633	2,753	2,877	3,004
MAV	5,149	5,443	5,753	6,081	6,422	6,777
OSV	4	5	5	5	5	6
Total	14,701	15,413	16,161	16,948	17,763	18,605
PCU	43,547	45,706	47,977	50,366	52,841	55,401

Vehicle Category	FY37	FY38	FY39	FY40	FY41	FY42	FY43
CJV	4,779	5,030	5,291	5,561	5,840	6,128	6,426
Mini LCV	314	320	327	333	340	347	354
LCV	615	628	641	654	667	680	693

Vehicle Category	FY37	FY38	FY39	FY40	FY41	FY42	FY43
Bus	69	71	72	73	74	75	76
2A	3,414	3,523	3,634	3,747	3,862	3,977	4,095
3A	3,135	3,269	3,406	3,547	3,692	3,839	3,990
MAV	7,145	7,528	7,924	8,334	8,758	9,196	9,647
OSV	6	6	7	7	7	8	8
Total	19,476	20,374	21,301	22,256	23,239	24,250	25,289
PCU	58,048	60,782	63,602	66,510	69,504	72,585	75,751

Source: Steer analysis

Table B.2: BK Daroda: Forecasts for final (background + impacts) AADT

Vehicle Category	FY25	FY26	FY27	FY28	FY29	FY30
CJV	1,510	1,609	1,712	1,820	1,930	2,040
Mini LCV	625	648	670	693	716	738
LCV	465	481	492	498	510	525
Bus	230	235	240	245	250	255
2A	1,609	1,672	1,650	1,627	1,663	1,720
3A	1,504	1,573	1,597	1,610	1,662	1,728
MAV	2,178	2,322	2,355	2,380	2,481	2,622
OSV	2	2	2	2	2	2
Total	8,122	8,543	8,719	8,876	9,213	9,630
PCU	22,669	23,878	24,188	24,427	25,308	26,483

Vehicle Category	FY31	FY32	FY33	FY34	FY35	FY36
CJV	2,156	2,279	2,409	2,547	2,690	2,838
Mini LCV	760	783	807	831	855	880
LCV	541	557	574	591	608	625
Bus	259	264	269	274	278	283
2A	1,779	1,840	1,903	1,968	2,034	2,102
3A	1,797	1,868	1,943	2,021	2,100	2,181
MAV	2,772	2,930	3,097	3,273	3,457	3,648
OSV	2	2	2	3	3	3
Total	10,066	10,524	11,003	11,506	12,025	12,560
PCU	27,716	29,010	30,367	31,791	33,263	34,783

Vehicle Category	FY37	FY38	FY39	FY40	FY41	FY42	FY43
CJV	2,993	3,153	3,319	3,491	3,668	3,852	4,041
Mini LCV	905	929	954	979	1,005	1,030	1,056
LCV	642	660	678	695	713	731	750

Vehicle Category	FY37	FY38	FY39	FY40	FY41	FY42	FY43
Bus	288	293	297	302	307	311	316
2A	2,170	2,240	2,311	2,382	2,455	2,529	2,603
3A	2,264	2,349	2,435	2,524	2,614	2,705	2,798
MAV	3,846	4,052	4,265	4,486	4,714	4,950	5,193
OSV	3	3	3	3	4	4	4
Total	13,111	13,679	14,263	14,863	15,480	16,112	16,761
PCU	36,350	37,966	39,629	41,341	43,100	44,907	46,761

Source: Steer analysis

Table B.3: BK Kelapur: Forecasts for final (background + impacts) AADT

Vehicle Category	FY25	FY26	FY27	FY28	FY29	FY30
CJV	1,536	1,638	1,743	1,853	1,964	2,076
Mini LCV	593	614	635	657	679	699
LCV	439	454	464	470	480	495
Bus	289	295	301	307	313	319
2A	1,683	1,749	1,731	1,713	1,752	1,812
3A	1,498	1,568	1,592	1,604	1,655	1,721
MAV	2,218	2,364	2,400	2,428	2,532	2,676
OSV	2	2	2	2	2	2
Total	8,257	8,684	8,868	9,034	9,377	9,801
PCU	23,183	24,415	24,753	25,020	25,927	27,126

Vehicle Category	FY31	FY32	FY33	FY34	FY35	FY36
CJV	2,195	2,320	2,452	2,592	2,737	2,889
Mini LCV	721	743	765	788	811	834
LCV	510	525	541	557	573	589
Bus	325	331	337	343	349	355
2A	1,874	1,938	2,005	2,073	2,143	2,214
3A	1,790	1,862	1,936	2,013	2,092	2,173
MAV	2,828	2,990	3,160	3,340	3,528	3,722
OSV	2	2	2	3	3	3
Total	10,245	10,710	11,197	11,708	12,235	12,779
PCU	28,385	29,705	31,090	32,544	34,046	35,596

Vehicle Category	FY37	FY38	FY39	FY40	FY41	FY42	FY43
CJV	3,046	3,209	3,378	3,553	3,733	3,920	4,113
Mini LCV	858	881	905	929	953	977	1,001
LCV	606	622	639	656	672	689	707

Vehicle Category	FY37	FY38	FY39	FY40	FY41	FY42	FY43
Bus	361	367	372	378	384	390	396
2A	2,286	2,360	2,434	2,510	2,586	2,664	2,742
3A	2,256	2,340	2,427	2,514	2,604	2,695	2,788
MAV	3,925	4,135	4,352	4,578	4,811	5,051	5,299
OSV	3	3	3	3	4	4	4
Total	13,340	13,917	14,510	15,121	15,747	16,390	17,050
PCU	37,196	38,844	40,541	42,287	44,082	45,926	47,817

Source: Steer analysis

Table B.4: BK Kelapur (New): Forecasts for final (background + impacts) AADT

Vehicle Category	FY25	FY26	FY27	FY28	FY29	FY30
CJV	1,519	1,619	1,723	1,832	1,942	2,052
Mini LCV	609	631	653	676	698	719
LCV	439	454	464	470	480	495
Bus	232	237	242	247	252	257
2A	1,741	1,810	1,791	1,772	1,813	1,875
3A	1,376	1,440	1,462	1,473	1,520	1,581
MAV	2,205	2,351	2,386	2,414	2,517	2,660
OSV	2	2	2	2	2	2
Total	8,123	8,544	8,723	8,885	9,224	9,641
PCU	22,764	23,978	24,303	24,560	25,451	26,633

Vehicle Category	FY31	FY32	FY33	FY34	FY35	FY36
CJV	2,169	2,293	2,424	2,562	2,706	2,856
Mini LCV	741	764	787	810	834	858
LCV	510	525	541	557	573	589
Bus	261	266	271	276	281	285
2A	1,939	2,005	2,074	2,145	2,217	2,291
3A	1,644	1,710	1,778	1,849	1,922	1,996
MAV	2,812	2,972	3,142	3,321	3,507	3,701
OSV	2	2	2	3	3	3
Total	10,079	10,537	11,018	11,522	12,042	12,578
PCU	27,873	29,174	30,539	31,971	33,452	34,980

Vehicle Category	FY37	FY38	FY39	FY40	FY41	FY42	FY43
CJV	3,011	3,172	3,339	3,512	3,691	3,875	4,065
Mini LCV	882	906	930	955	980	1,004	1,029
LCV	606	622	639	656	672	689	707

Vehicle Category	FY37	FY38	FY39	FY40	FY41	FY42	FY43
Bus	290	295	300	304	309	314	319
2A	2,365	2,441	2,518	2,597	2,676	2,756	2,837
3A	2,072	2,150	2,229	2,309	2,392	2,475	2,561
MAV	3,902	4,111	4,327	4,551	4,783	5,022	5,269
OSV	3	3	3	3	4	4	4
Total	13,131	13,700	14,286	14,887	15,506	16,140	16,790
PCU	36,557	38,182	39,856	41,578	43,348	45,166	47,031

Source: Steer analysis

Revenue forecasts

B.3 This section presents the detailed revenue forecasts in INR Cr for the forecast period until FY43, year of expected close of the concession. The following tables show the revenue forecasts.

Table B.5: AB Raibha: Revenue Forecasts (INR Cr)

Vehicle Category	FY25	FY26	FY27	FY28	FY29	FY30
CJV	5.8	6.6	7.4	8.3	8.8	9.8
Mini LCV	0.6	0.6	0.7	0.7	0.7	0.8
LCV	2.0	2.1	2.3	2.5	2.6	2.8
Bus	0.5	0.5	0.6	0.6	0.6	0.7
2A	19.6	21.8	24.0	26.8	28.6	30.9
3A	19.5	21.1	23.5	26.2	28.1	30.7
MAV	54.4	58.6	67.2	76.3	83.7	91.9
OSV	0.1	0.1	0.1	0.1	0.1	0.1
Total	102.5	111.5	125.8	141.6	153.3	167.6

Vehicle Category	FY31	FY32	FY33	FY34	FY35	FY36
CJV	10.8	12.0	13.2	14.5	16.0	17.5
Mini LCV	0.9	0.9	1.0	1.0	1.1	1.2
LCV	3.0	3.1	3.4	3.5	3.8	4.0
Bus	0.7	0.8	0.8	0.9	0.9	1.0
2A	33.3	36.1	38.7	41.6	44.6	48.4
3A	33.4	36.8	39.8	43.1	47.1	51.5
MAV	100.8	111.7	121.8	134.1	148.4	163.0
OSV	0.1	0.1	0.1	0.1	0.1	0.2
Total	183.0	201.5	218.8	238.8	262.0	286.7

Vehicle Category	FY37	FY38	FY39	FY40	FY41	FY42	FY43
CJV	19.2	21.0	22.8	24.9	27.1	30.1	32.6
Mini LCV	1.3	1.3	1.4	1.5	1.6	1.7	1.8

Vehicle Category	FY37	FY38	FY39	FY40	FY41	FY42	FY43
LCV	4.3	4.6	4.9	5.2	5.5	5.8	6.2
Bus	1.0	1.1	1.1	1.2	1.3	1.3	1.4
2A	51.6	55.6	59.8	64.3	68.7	73.4	79.0
3A	55.3	60.0	65.6	71.0	76.4	82.9	89.7
MAV	177.8	195.2	213.9	234.4	256.4	280.6	306.3
OSV	0.2	0.2	0.2	0.2	0.2	0.3	0.3
Total	310.5	339.0	369.7	402.8	437.2	476.1	517.3

Source: Steer analysis

Table B.6: BK Daroda: Revenue Forecasts (INR Cr)

Vehicle Category	FY25	FY26	FY27	FY28	FY29	FY30
CJV	4.8	5.4	6.0	6.6	7.3	8.0
Mini LCV	2.0	2.2	2.3	2.5	2.7	2.9
LCV	2.9	3.2	3.4	3.6	3.8	4.1
Bus	3.0	3.2	3.5	3.7	3.9	4.1
2A	21.6	23.6	24.4	25.0	26.6	28.6
3A	23.6	25.8	27.6	29.1	31.1	33.6
MAV	49.3	55.1	58.4	61.8	66.9	73.6
OSV	0.0	0.0	0.1	0.1	0.1	0.1
Total	107.2	118.5	125.7	132.3	142.3	155.0

Vehicle Category	FY31	FY32	FY33	FY34	FY35	FY36
CJV	8.8	9.8	10.6	11.6	13.0	14.2
Mini LCV	3.1	3.4	3.6	3.8	4.1	4.4
LCV	4.4	4.7	5.0	5.3	5.8	6.2
Bus	4.4	4.6	4.9	5.2	5.5	5.8
2A	30.8	33.2	35.8	38.4	41.4	44.7
3A	36.3	39.5	42.7	46.2	49.9	54.0
MAV	81.3	89.4	98.1	107.9	118.9	130.5
OSV	0.1	0.1	0.1	0.1	0.1	0.1
Total	169.0	184.7	200.9	218.6	238.8	259.9

Vehicle Category	FY37	FY38	FY39	FY40	FY41	FY42	FY43
CJV	15.6	16.9	18.7	20.5	22.2	24.4	26.7
Mini LCV	4.7	5.0	5.4	5.8	6.1	6.5	7.0
LCV	6.6	7.0	7.6	8.1	8.6	9.1	9.8
Bus	6.2	6.5	6.9	7.3	7.7	8.1	8.6
2A	47.9	51.3	55.2	59.5	63.6	68.1	73.1

Vehicle Category	FY37	FY38	FY39	FY40	FY41	FY42	FY43
3A	58.3	63.0	68.0	73.4	79.1	85.3	91.7
MAV	142.8	157.0	172.3	189.0	205.8	225.0	245.5
OSV	0.1	0.1	0.2	0.2	0.2	0.2	0.2
Total	282.2	307.0	334.2	363.8	393.3	426.7	462.6

Source: Steer analysis

Table B.7: BK Kelapur: Revenue Forecasts (INR Cr)

Vehicle Category	FY25	FY26	FY27	FY28	FY29	FY30
CJV	3.1	3.5	3.9	4.3	4.7	5.2
Mini LCV	1.2	1.3	1.4	1.5	1.6	1.8
LCV	2.6	2.7	3.0	3.1	3.4	3.5
Bus	3.5	3.7	4.0	4.3	4.5	4.8
2A	20.4	22.1	22.9	23.8	25.2	27.2
3A	21.9	24.4	25.9	27.0	29.0	31.4
MAV	47.2	52.8	56.3	59.3	64.4	70.5
OSV	0.0	0.0	0.1	0.1	0.1	0.1
Total	99.9	110.6	117.4	123.5	132.9	144.5

Vehicle Category	FY31	FY32	FY33	FY34	FY35	FY36
CJV	5.9	6.5	7.0	7.7	8.4	9.4
Mini LCV	1.9	2.1	2.2	2.3	2.5	2.7
LCV	3.8	4.1	4.4	4.7	5.0	5.4
Bus	5.1	5.4	5.7	6.0	6.4	6.8
2A	29.4	31.4	34.0	36.5	39.1	42.3
3A	34.0	37.1	39.9	43.3	46.9	50.8
MAV	77.6	86.1	94.2	103.8	114.1	125.5
OSV	0.1	0.1	0.1	0.1	0.1	0.1
Total	157.8	172.7	187.5	204.5	222.5	243.0

Vehicle Category	FY37	FY38	FY39	FY40	FY41	FY42	FY43
CJV	10.2	11.3	12.3	13.5	14.9	16.0	17.6
Mini LCV	2.9	3.1	3.3	3.5	3.8	4.0	4.3
LCV	5.8	6.2	6.6	7.1	7.6	8.1	8.6
Bus	7.2	7.6	8.0	8.5	8.9	9.5	10.0
2A	45.4	48.8	52.3	56.1	60.2	64.6	69.1
3A	54.6	58.8	63.6	68.8	73.9	79.9	85.6
MAV	137.7	150.3	165.3	181.0	197.6	215.7	236.0
OSV	0.1	0.1	0.2	0.2	0.2	0.2	0.2

Total	263.9	286.2	311.5	338.7	367.0	397.9	431.4

Source: Steer analysis

Table B.8: BK Kelapur (New): Revenue Forecasts (INR Cr)

Vehicle Category	FY25	FY26	FY27	FY28	FY29	FY30
CJV	3.9	4.3	4.8	5.3	5.8	6.4
Mini LCV	1.5	1.7	1.8	2.0	2.1	2.2
LCV	2.6	2.8	3.0	3.2	3.4	3.6
Bus	2.9	3.1	3.3	3.5	3.7	3.9
2A	21.8	23.6	24.5	25.5	27.0	29.1
3A	20.1	22.4	23.8	24.8	26.7	28.9
MAV	46.9	52.5	55.9	58.9	64.0	70.1
OSV	0.0	0.0	0.1	0.1	0.1	0.1
Total	99.8	110.4	117.2	123.3	132.8	144.4

Vehicle Category	FY31	FY32	FY33	FY34	FY35	FY36
CJV	7.2	8.0	8.6	9.5	10.3	11.5
Mini LCV	2.5	2.6	2.8	3.0	3.2	3.5
LCV	3.9	4.2	4.5	4.8	5.1	5.5
Bus	4.2	4.4	4.7	5.0	5.2	5.6
2A	31.4	33.6	36.4	39.0	41.9	45.3
3A	31.2	34.1	36.6	39.8	43.1	46.7
MAV	77.2	85.6	93.6	103.2	113.5	124.8
OSV	0.1	0.1	0.1	0.1	0.1	0.1
Total	157.6	172.6	187.4	204.3	222.4	242.9

Vehicle Category	FY37	FY38	FY39	FY40	FY41	FY42	FY43
CJV	12.5	13.9	15.1	16.6	18.3	19.7	21.6
Mini LCV	3.7	4.0	4.2	4.5	4.9	5.1	5.5
LCV	5.9	6.3	6.7	7.2	7.7	8.2	8.8
Bus	5.9	6.2	6.6	7.0	7.3	7.8	8.2
2A	48.6	52.2	56.0	60.1	64.4	69.1	74.0
3A	50.2	54.0	58.4	63.2	67.9	73.4	78.7
MAV	136.9	149.4	164.4	180.0	196.4	214.5	234.6
OSV	0.1	0.1	0.2	0.2	0.2	0.2	0.2
Total	263.7	286.2	311.4	338.7	367.0	397.9	431.5

Source: Steer analysis

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Note on traffic and revenue estimates for Jhansi-Shivpuri Road stretch

National Highways Infra Projects Private Limited

Final report

October 2023

Consulting

Traffic and revenue estimates based on recent data

National Highways Infra Projects Private Limited (NHIPPL), on behalf of National Highways Infra Trust, has appointed CRISIL Ltd as a traffic consultant to carry out a review of the earlier traffic and revenue forecasts pertaining to the report submitted in May 2023 for the Jhansi-Shivpuri Road stretch, with respect to the latest traffic and revenue data.

The earlier reports contained a comprehensive coverage of traffic quantum, travel pattern and revenue estimation for the asset, duly considering the network characteristics and future economic perspective in the influence area of the project asset containing traffic data till March 2023. NHIPPL has additionally provided the first two quarters data for fiscal 2024.

NHIPPL has requested CRISIL to provide a note covering the impact of these recent data points on the projections presented in the report.

This note presents the analysis based on traffic and revenue data received from NHIPPL.

Table 1: NHAI InvIT's Assets

S. No.	Project stretch	Toll plaza
1	Jhansi-Shivpuri (NH27)	Raksha Toll Plaza

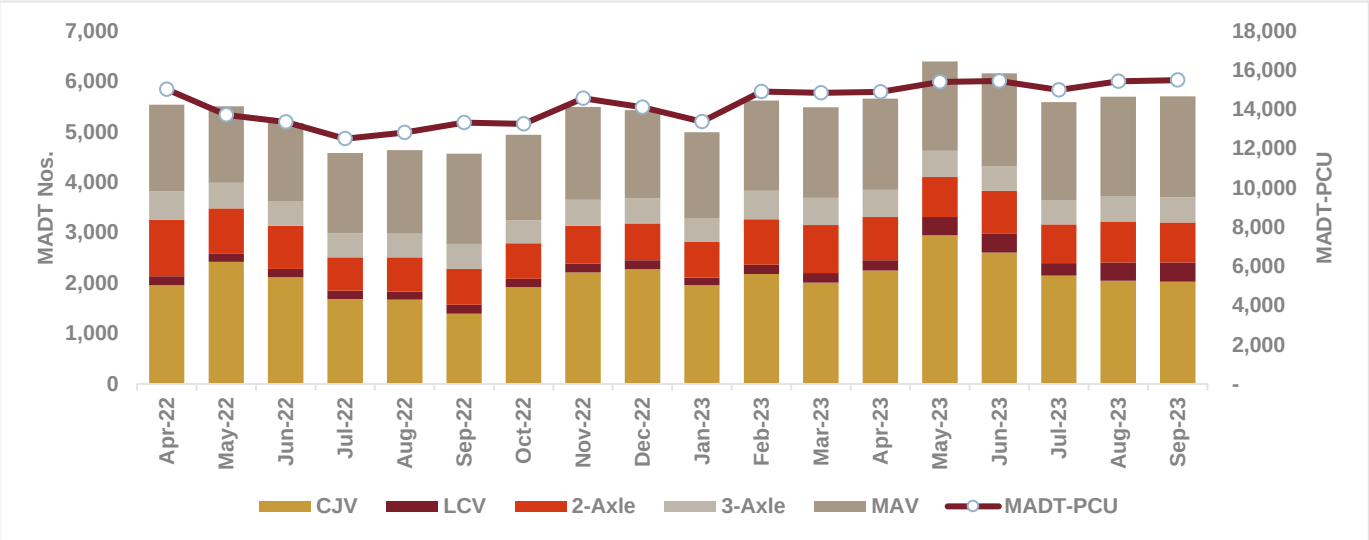
Source: Client data, CRISIL MI&A

For this study, complete fiscal 2023 traffic and revenue data along with first half yearly data of fiscal 2024 has been considered for assessment. Traffic data from April 2022 to September 2023, for the asset is presented in **Figure 1**.

Monthly traffic data from April 2022 to September 2023 for the asset has been presented in annexures. Data includes cash, exemptions, and violations along with FASTag data as well.

As OSVs were less than 10 in number, they have been excluded from the chart and added with MAV.

Figure 1: MADT profile of asset's fee plaza (Raksha TP)



Note: MADT for July-2022 is based on data for 21 days
Source: Client data, CRISIL MI&A

For the analysis of data, the actual traffic and revenue for first half yearly of fiscal 2024 is compared to the seasonally adjusted projected traffic (and revenue) of fiscal 2024.

CRISIL has considered the seasonality of fiscal 2023 for the asset. Seasonality of fiscal 2023 is considered as the long-term data for the asset is not available.

The comparison of actual and projected traffic for the first half yearly indicates a variance of (5.8%) on PCU level. The variance in CJV traffic is (5.9%), while for commercial traffic (PCU) variance is (5.7%). The variance in MAV traffic is higher vis-à-vis other vehicle categories.

Table 2: Actual vs Projected traffic for H1 FY24

Vehicle category	CJV	LCV	2-Axle	3-Axle	MAV	OSV	Total	PCU
FY24 AADT H1 – Actuals	2,377	285	809	503	1,891	2	5,867	15,259
FY24 AADT H1 – Projected	2,243	177	856	530	1,723	2	5,531	14,428
% Variation – Actuals/Projected	5.9%	61.3%	-5.6%	-5.0%	9.8%	-11.7%	6.1%	5.8%

Source: Client data, CRISIL MI&A

A comparison on a year-on-year basis also indicates that MAV traffic growth has remained higher vis-à-vis 2A and 3A traffic. Difference in rainfall profile of last fiscal vs. current fiscal, aggregate movement for construction projects, among others can be the potential reasons for the variance. Moreover, some additional traffic is also plying on the project stretch due to some construction work happening on NH-46.

In revenue terms, the variance is observed at 6.1%.

Table 3: Average daily revenue comparison for H1 FY24 (Rs Million)

Average Daily Revenue	Grand Total
H1 FY 24 Actual	2.13
H1 FY 24 Projected	2.01
Variation	6.1%

Note: H1 FY24 projected revenue is derived based on % proportion of seasonally adjusted traffic recorded in H1FY23.
Source: Client data, CRISIL MI&A

AADT for fiscal 2024, as projected in last study, is re-evaluated with the availability of traffic data for first half year of fiscal 2024.

AADT for fiscal 2024 is also estimated by applying *seasonality of fiscal 2023* on actual traffic of first half year of fiscal 2024 and comparison is made between the fiscal 2024 AADT projected in last study and fiscal 2024 AADT derived from first half yearly numbers.

The comparison is presented table below.

Table 4: Traffic - Projected FY24P (Based on H1FY24) vs. Projected FY24P (Last Study)

Traffic	CJV	LCV	2-Axle	3-Axle	MAV	OSV	Total	PCU
(1): FY24P (Based on H1FY24) actuals)	2,596	333	829	498	1,930	3	6,191	15,780
(2): FY24 P (Last Study)	2,601	292	839	505	1,951	2	6,192	15,865
% Variation (1) / (2)	4.9%	59.9%	-6.4%	-5.8%	8.9%	2.6%	5.1%	4.9%

Source: Client data, CRISIL MI&A

The above analysis shows that the difference in projected fiscal 2024 AADT, based on H1 actuals vs. projected fiscal 2024 AADT, as given in last study is 4.9% in PCU terms. CJV traffic is higher by 4.9%, while commercial PCU *(Total PCU less CJV PCU)* is higher by 4.8%. The 2 Axle and 3 Axle vehicles have shown a (-6.4%) and (-5.8%) variance, while MAV have shown a +8.9% variance.

Projected revenue for fiscal 2024, based on H1 actuals vs. value given in last study, also shows a variance of +3.8%.

Table 5: Revenue - Projected FY24P (Based on H1FY24) vs. Projected FY24P (Last Study) (Rs Million)

Average Daily Revenue	Grand Total
(1): FY24P (Based on H1FY24) actuals)	2.18
(2): FY24 P (Last Study)	2.10
Variation (1) / (2)	3.8%

Trip segmentation is considered same as fiscal 2023
Source: Client data, CRISIL MI&A

The variance can be attributed to limited seasonality data *(Data for a single financial year is available, where operations were maintained by multiple system integrators. Typically, a 5-6 year period is preferred to consider seasonality for a particular toll plaza),* a general trend of higher MAV traffic at road stretches around the plaza and other season-specific and region-specific factors. The traffic in Q2 is also higher on account of diverted traffic plying on the asset due to some construction work happening on NH-46 *(which is expected to be temporary based on primary interactions)*.

Keeping these factors in mind, we maintain the earlier estimates of traffic and revenue for the asset provided in May 2023 for fiscal 2024 and they can be still considered valid.

For traffic and revenue beyond fiscal 2024, the observations are as provided below:

- Traffic growth beyond fiscal 2024 till end of concession period same as last study, as CRISIL retains its growth outlook for the key commodities carried on the stretch.
- The diversions considered also remain same as last study.
- WPI growth is considered as 1% (Dec 2023), which will be applicable for FY25 toll rates. Based on inputs received from management, WPI increase for Dec 2024 and Dec 2025 is considered as 5% and 4.5% respectively. WPI for Dec 2026 and beyond is considered same at 3.5%. Revenue projections based on revised WPI growth are provided below:

Table 6: Revenue projections (with revised WPI) for Raksha Fee Plaza (Rs Million)

Year	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33
Total	690	768	831	924	1,021	1,073	1,107	1,150	1,257	1,382	1,511

Year	FY34	FY35	FY36	FY37	FY38	FY39	FY40	FY41	FY42	FY43*
Total	1,652	1,804	1,980	2,154	2,350	2,566	2,802	3,041	3,314	2,078

*Revenue for 210 days, 366 days in leap year has been considered for revenue estimation
Source: Client data, CRISIL MI&A

Annexures

Annexure 1: Actual traffic (Average daily traffic) for Raksha Fee Plaza from April 2022 to June 2023

MADT	CJV	LCV	2-Axle	3-Axle	MAV+OSV	MADT-PCU	MADT-Total
Apr-22	1,956	179	1,119	562	1,723	15,021	5,538
May-22	2,421	161	899	506	1,520	13,717	5,507
Jun-22	2,116	163	856	493	1,545	13,364	5,174
Jul-22	1,684	167	658	477	1,593	12,506	4,579
Aug-22	1,674	159	675	469	1,661	12,818	4,638
Sep-22	1,396	172	715	491	1,790	13,330	4,565
Oct-22	1,921	165	704	457	1,692	13,265	4,939
Nov-22	2,213	172	752	515	1,844	14,570	5,496
Dec-22	2,275	180	725	496	1,756	14,108	5,431
Jan-23	1,957	156	701	480	1,700	13,382	4,993
Feb-23	2,182	184	900	566	1,791	14,914	5,623
Mar-23	2,008	193	947	541	1,795	14,841	5,485
Apr-23	2,251	205	853	539	1,813	14,892	5,661
May-23	3,063	246	796	516	1,774	15,349	6,395
Jun-23	2,727	262	841	484	1,844	15,392	6,157
Jul-23	2,147	251	764	481	1,942	14,999	6,158
Aug-23	2,044	362	811	500	1,981	15,433	6,159
Sep-23	2,025	386	788	501	2,004	15,489	6,160

Source: Client data, CRISIL MI&A

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ANNEXURE D

TECHNICAL REPORTS

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National Highways Infra Projects Private Limited

FINAL REPORT

Tolling, Operation, Maintenance & Transfer of Four Lane section between Chichra to Kharagpur from km 185+150 (Design Km 16+130) to km 129+000 (Design Km 72+250) in the state of West Bengal

SAMARTH INFRAENGG Technocrats Private Limited

NOVEMBER 2023

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ABBREVIATIONS AND SYMBOLS

AADT	-Average Annual Daily Traffic
AE	-Authority Engineer
AMC	-Annual Maintenance Contract

ATMS	-Advanced Traffic Management System
BC	-Bituminous Concrete
BOQ	-Bill of Quantities
BOT	-Build, Operate & Transfer
CA	-Concession Agreement
CBR	-California Bearing Ratio
CCB	-Concrete Crash Barrier
CCR	-Cement Concrete Railing
COD	-Commercial Operation Date
COS	-Change of Scope
CPI	-Consumer Price Index
CUP	-Cattle Underpass
CVC	-Classified Volume Count
CVPD	-Commercial Vehicles per Day
DBM	-Dense Bituminous Concrete
DPR	-Detailed Project Report
ECB	-Emergency Call Box
EPC	-Engineering, Procurement and Construction
ESI	- Employees' State Insurance
FDD	-Filed Dry Density
FOB	-Foot Over Bridge
FRL	-Finished Road Level
FSI	-Free Swell Index
FWD	-Falling Weight Deflectometer
FY	-Financial Year
GOI	- Government of India
GR	-Growth Rates
GS	-Grade Separated
GSB	-Granular Sub Base
GST	-Goods and Services Tax
HCPT	-Half-cell Potential Test
HPC	-Hume Pipe Culvert
HR	- Human Resources
HTMS	-Highway Traffic Management Systems
IE	-Independent Engineer
IRC	- Indian Roads Congress
IRC SP	- Indian Roads Congress Special Publications
IRI	-International Roughness Index
Km	-kilometer

LHS	-Left Hand Side
LL	-Liquid Limit
LS	-Lumpsum
m	-Meter
MAV	-Multi Axle Vehicle
MBIU	-Mobile Bridge Inspection Unit
MCB	-Metal Beam Crash Barrier
MCS	-Micro Surfacing
MCW	-Main Carriageway
MDD	-Maximum Dry Density
MHR	-Metallic Hand Rail
MJB	-Major Bridge
mm	-Millimeter
MM	-Major Maintenance
MNB	-Minor Bridge
MoRTH	- Ministry of Road Transport & Highways
Mpa	-Mega Pascal
MR	-Resilient Modulus
MSA	-Million Standard Axle
NDT	-Non-Destructive Testing
NHAI	- National Highways Authority of India
NSV	-Network survey Vehicle
O&M	- Operation and Maintenance
OL	-Overlay
PF	-Provident Fund
PGR	-Pedestrian Guard Rail
PI	-Plasticity Index
PL	-Plastic Limit
PM	-Periodic Maintenance
PUP	-Pedestrian Underpass
R&R	-Repair and Rehabilitation
RCC	-Reinforced Cement Concrete
RE Wall	-Reinforced Earth Wall
RHS	-Right Hand Side
RHT	-Rebound Hammer Test
RM	-Routine Maintenance
ROB	-Road Over Bridge
RPO	-Route Patrol Officer
RUB	-Road Under Bridge

SDBC	-Semi-Dense Bituminous Concrete
SPV	-Special Purpose Vehicle
SR	-Service Road
SWB	-Static Weigh Bridge
TCS	-Typical cross Section
TDRT	-Transient Dynamic Response test
TMS	-Toll Management System
UI	-Unevenness Index
UPVT	-Ultra Pulse Velocity test
VDF	-Vehicle Damage Factor
VG	-Viscosity Grade
VUP	-Vehicular Underpass
WBM	-Water Bound Macadam
WMM	-Wet Mix Macadam
WPI	-Wholesale Price Index

CHAPTER 1. INTRODUCTION

1.1 INTRODUCTION

National Highways Authority of India ("NHAI"/ "Authority") is an autonomous body of the Government of India ("GoI") under the Ministry of Road Transport and Highways ("MoRTH") and was constituted on June 15, 1989 by an Act of Parliament titled - The National Highways Authority of India Act, 1988 ("NHAI Act"). NHAI was operationalized in February 1995 with the appointment of full time Chairman and other Members. The functioning of NHAI is governed by NHAI Act and rules, and regulations framed thereunder.

NHAI has set up an Infrastructure Investment Trust Namely **National Highways Infra Trust ("InvIT")** and is acting as its Sponsor to the said InvIT.

National Highways Infra Investment Managers Private Limited ("NHIIMPL") has been appointed as the Investment Manager to the InvIT

National Highways Infra Projects Private Limited ("NHIPPL"), a wholly owned subsidiary of InvIT is planning to enter into concession agreements with NHAI for "Tolling, Operation, Maintenance & Transfer of Four Lane section between Chichra to Kharagpur from km 185+150 (Design Km 16+130) to km 129+000 (Design Km 72+250) in the state of West Bengal".

M/s National Highways Infra Projects Private Limited ("NHIPPL) has engaged M/s SAMARTH INFRAENGG Technocrats Pvt Ltd as their Technical Consultants for undertaking technical due diligence study for the said project to estimate initial improvement cost (EPC) including immediate requirements for repair & rehabilitation of various elements and make an assessment of Operation & Maintenance costs for entire concession period.

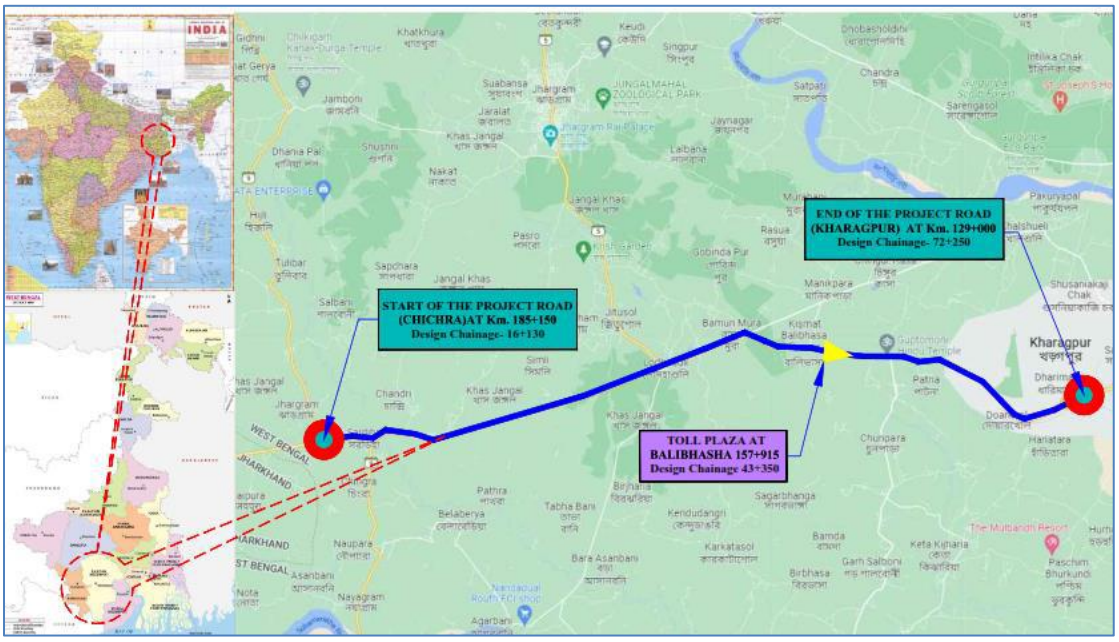
1.2 PROJECT AT A GLANCE

Project Corridor is a part of National Highway, new NH-49 (Old NH-6) having Four-lane divided highway with start point at Km 185.150 and ends at Km 129.000. The total length of the Project Highway is 56.150 Kms, in which 4-lane rigid pavement comprises of 50.720Kms from Km 185.150 to Km 134.430 and 4-lane Flexible Pavement of 5.430Kms from Km 134.430 to Km 129.000.

Four laning of project highway has been taken up by the Authority under Engineering Procurement and Construction (EPC) through Contractor M/s DilipBuildcon Limited and PCC of 4 laning has been achieved on 13 Feb 2020. Defect Liability Period is 48 months from PCC and a minimum period of 42 months after CC.

National Highway-49 begins from Bilaspur in the state of Chhattisgarh and ends at Kharagpur in West Bengal, Starting from NH 130 near Bilaspur and it terminates at NH 16 near Kharagpur, West Bengal. The Highway is combination of old NH-6 and old NH-200. The highway is part of AH46 network in India. The Highway passes through states Chhattisgarh, Odisha, Jharkhand & West Bengal.

The Highway connects several cities and towns such as Bilaspur, Saragaon, Sakti, Raigarh, kanakotra, Jharsuguda, Kuchinda, Pravasuni, Deogarh, Barakot, Pal Laharha, Kendujhargarh, Turumunga, Chadheibhol, Jashipur, Bangriposhi, Baharagora and Kharagpur. It is officially listed as running over 668 km from Bilaspur to Kharagpur.



Map Showing the Project Corridor

As per the Schedule, the design chainage at start point of the project road shall be km 16.130 and the design chainage at end point of the project road shall be km 72.250 with a total length of 56.120km.

Table 1: Project Corridor Chainage System

Referencing system	Rigid Pavement			Flexible Pavement			Total length of the project corridor
	Start Point (km)	End Point (km)	Length (km)	Start Point (km)	End Point (km)	Length (km)	
Existing Chainage	185.150	134.430	50.720	134.430	129.000	5.430	56.150
Design Chainage	16.130	66.850	50.720	66.850	72.250	5.400	56.120

The Project Corridor starts at State Boarder of West Bengal/Jharkhand near Chichra and ends at outs-skirts of Kharagpur town. Photograph showing the start and end point of the project road are presented below:

Start Point at km 185.150	End Point at km 129.000

1.3 OBJECTIVE AND SCOPE OF SERVICES

The main objective of the study is to review the current status of project corridor including details pertaining to its construction and maintenance and to provide requisite technical information for processing the acquisition of said project by client. Objective of the study can be broadly defined with following tasks:

- Study CA requirements for construction/maintenance requirements
- Undertake Detailed Reconnaissance to appreciate the project corridor characteristics
- Collection of relevant records and documents and review of same
- Undertake Engineering Studies to Establish:
    - Present Condition of Existing Road Assets
    - Quality of Executed Works/Quantity of Reutilization
    - Requirement of Immediate improvement costs as per Sch B (1st Year Capex)
    - Major Maintenance Strategies Over Concession Period
    - Routine Maintenance & Operations Requirements Over Concession Period
    - Prepare BOQ
    - Prepare Rate Analysis and finalize unit rates
    - EPC and O&M Cost

End Result is the finalization of:

- Initial improvement Works
- Major Maintenance Schedules/Cost
- Routine Maintenance Cost
- Operations Cost

The elaborate scope of services as defined in the “terms of reference” for consultants is as below:

i) Detailed reconnaissance.

ii) Video graphic survey of the entire Project corridor.

iii) Carrying out inventory and condition surveys for Project Road.

iv) Carrying out Inventory and detailed condition surveys for bridges & cross drainage structures (along with Photographs thereof) including recommendation for either strengthening/rehabilitation or reconstruction.

v) 24 hrs. Axle load survey along with axle load spectrum analysis for rigid pavement of the project corridor at two locations, wherever applicable (7-day traffic count to be provided by client)

vi) Test pits required @ every 10 km interval along the Project corridor.

vii) Carrying out necessary laboratory tests to determine the CBR value of the subgrade materials to be obtained from potential borrow pits and the quality of the aggregates from potential quarries for the pavement layers, concrete etc. The existing ground which will support the embankment and pavement must be tested for its adequacy, particularly in silty or clayey water-logged areas.

viii) Carrying out deflection test by Falling Weight Deflect meter (FWD) for existing pavement as per relevant IRC code at the rate of 5 points in km in each direction making it 10 points for both directions in the damaged stretches as well as fair stretches.

ix) Availability of construction materials as per required specification to be confirmed. Detailed Logistic plan showing the locations of the potential Borrow pits, Quarries, etc.

x) Report on existing condition of Toll Plaza and its associated facilities and proposal for their improvement.

xi) Preparation of Maintenance (Routine, Periodic and Major) costs to be incurred over the period of the concession keeping in mind the requirements of the draft Concession Agreement like adequate resources, maintenance of Cranes, Ambulance, ATMS, etc.,

xii) Independently develop a bottom-up forecast of Operating expenses for each project, with detailed break-up of each type of operating expense, along with underlying assumptions

1.4 DATA COLLECTION AND REVIEW

The following data has been reviewed to understand the project characteristics.

- ✓ Review of Concession Agreement & Schedules,
- ✓ Review of Detailed Project Report prepared by NHAI
- ✓ Review of As-built drawings, Plan and profiles, Structural drawings & Detailed Project Reports and Designs where available
- ✓ Review of O&M costs as presented in DPR reports
- ✓ Review of MPR provided by NHAI
- ✓ Review of Latest NSV and FWD data provided by PIU, NHAI

Key features of the project road are presented below.

Project Stretch	185+150 (Design Ch. 16+130) to 129+000 (Design Ch. 72+250) (Also includes the trumpet Interchange of Length 600m from Chainage 129+600 to 129+000)
NH No.(New/Old)	New-NH-49/Old-NH-6
Mode of the Execution	EPC
No. of Lanes/Configuration	Four Lanes
Length of the Project (in KM)	TOT Length 56.120 KM (4 Lane Length), EPC Contract length 55.520 (4 Lane Length)
No. of Toll Plazas	1
Letter of Award Date	14th October, 2016
Appointed Date	16th March, 2017
PCC Date	13th February, 2020 & DLP: 4 years from PCC i.e., 13 Feb 2024
EPC Contractor	M/s Dilip Buildcon Ltd.

1.5 PAVEMENT DESIGN REVIEW

As per Schedule-B

Flexible Pavement shall be provided for minimum design traffic of 246 MSA for main carriageway. Whereas, service road shall be designed for 10MSA and Flexible pavement on Bus Bay, Truck Lay bye and Junctions shall be designed for a minimum 20MSA.

Considering the DPR-AADT and obtained latest VDF, the following MSA are arrived and compared with DPR established MSAs are below.

Year	FY	Design Lane MSA on Existing Carriageway		MSA as established in DPR
		Km 157.850		
		UP	DN	
10th year	2032	188	92	101
15th year	2037	323	157	165
20th year	2042	494	241	246

DPR has suggested the following conventional thicknesses has been arrived as follows

S No	Layers	Main Carriageway	Service /Slip road	Junctions/bus-bays/ Truck lay-byes
1	BC +DBM in mm	220	80	110
2	WMM in mm	250	250	250
3	GSB in mm	200	200	200
5	Total in mm	670	530	560

Considering CTB+CTSB option for Main carriageway and CTSB option for Service roads & junctions, Consultants have suggested following thicknesses for quantification as follows.

CBR: 8%					
S No	Layers	Main Carriageway		Service roads	Bus Bay, Truck Lay bye and Junctions
		501 MSA on LHS	274 MSA on RHS	10 MSA	20 MSA
1	BC in mm	50	50	40	30
2	DBM in mm	100	75	-	50
3	WMM in mm	100	100	150	150
4	CTB in mm	175	175	-	-
5	CTSB in mm	200	200	200	200
	Total in mm	625	600	430	430

CHAPTER 2. SURVEY AND INVESTIGATION

2.1 INTRODUCTION

The main objective of undertaking Surveys and Investigations is to appreciate the existing engineering features along the project corridor and to understand the present condition of the various elements of the project road and to prepare required inputs for various rehabilitation and maintenance strategies.

Following Survey and Investigations have been undertaken as a part of study with an objective to understand the present condition of the road and there by access the quality of construction and as well to prepare requisite rehabilitation/corrective designs where necessary.

- Road Inventory Surveys
- Pavement Condition using NSV
- FWD Surveys
- Roughness Surveys using NSV
- Pavement Composition surveys (Test Pits)
- Subgrade Investigations & Laboratory testing
- Material Investigations
- Axle Load Survey
- Structure Inventory and Condition Surveys

2.2 ROAD INVENTORY

The project corridor is a Four-lane divided highway consisting of 50.720Km length of Rigid Pavement & Flexible pavement for a length of 5.400Kms, with 7.0m wide carriageway flanked by 1.5m paved shoulder plus 1.5 m earthen shoulder on either side of the median, expect at structure approach locations.

In general, the median width is 4.5m all along the project road except at Built-Up locations, where the median width is 1.5m.

The project corridor generally runs in plain terrain. The land use along the project road is forest, Industrial, Built-Up & Agricultural. It passes through urban settlements like Kharagpur, Sujatpur, Khemasuli, Lodhasuli & Chichra.

Road embankment heights are varying in the range of 0.5m-2.5m. Embankment heights higher than 2.5m are observed mainly in the approaches of CD structures and grade separator locations.

The Project Road has 1 Nos. of Major junction and 103 Nos. of Minor junctions. Photographs showing the Junctions are presented below:

Major Junction @ Km 132.900 LHS

Minor Junction at Km 172.250 RHS

Minor Junction @ Km 183.730 LHS

Minor Junction at km 132.680 LHS

High mast lighting is provided in 5 Nos. of locations along the project road, one at Major Junction & remaining four at Toll Plaza locations. Photos showing High mast lighting are presented below:

High mast lighting at Major Junction near Km 133.850

High mast lighting near Toll plaza at Km 158+100 LHS

There are 19 Nos. of Bus Bay with Bus shelter exists along the project Road. Few photos taken at the Bus Bay with Bus shelters are presented below:

Bus shelter Damaged @ Km 130.550 RHS

Bus Bay with Bus shelter @ Km 145.350 RHS

Bus Bay with Bus shelter @ Km 169.450 LHS

Bus Bay with Bus shelter @ Km 164.550 RHS

The Project Road has provision for 7 Nos. of Truck lay byes. In which, three truck lay byes are constructed with flexible pavement, three with rigid pavement and the remaining one is yet to be constructed. Pavement condition appears to be fair at all truck layby locations. All the existing six truck lay byes are provided with separators.

The photo depicting the truck lay bye portion is presented below:

Truck Lay bye @ Km 133.400 RHS

Truck lay bye lighting @ Km 165.050 LHS

The Project Road has 1 No. of Toll Plaza at Balibhasa village near km 157.900. Rigid pavement is provided at central and taper portions of Toll Plaza. The condition of toll plaza appears to be fair. The Toll Plaza has 4 lanes in each direction including 1 extra wide lane. 4 High mast lights and Single arm lights are present at Toll Plaza.

Few photos taken at toll plaza location are presented below:

Toll Plaza at km 157.900

Plaza Administrative Building at km 157+900

Extra Booths for future expansion at Toll Plaza at km 157+900 LHS

Extra Wide Lane at Toll Plaza at km 157+900 LHS

Static Weigh Bridge at Toll Plaza at km 157+900 LHS

Service road/slip roads having 7.5m wide carriageway with flexible pavement accumulating to a length (LHS+RHS) of 19.672 km are provided along the project road. Few photos depicting the service road pavement surface type, condition and the other associated feature like pedestrian guard railing are presented below.

7.5m Service Road Fair in Condition @ km 144.200 LHS

7.5m service Road with Ravelling @ km 177.000 LHS

7.5m Service Road requires Cleaning @ km 185.150 LHS

Service Road Fair in condition @ km 166.300 RHS

The collected Road Inventory Data is presented in **Appendix 1** of this Report.

2.3 PAVEMENT CONDITION SURVEY

In the majority length of the project corridor, pavement condition is fair except at few locations, the condition appears to be fair to poor. The surface distresses in rigid pavement are Raveling, Longitudinal, Transverse & Multiple Cracking, widened longitudinal joints, Patching, Corner breaking and Panel damages. Whereas, in Flexible Pavement noted distresses are raveling, rutting and shoving in majority length of either direction. The collected Pavement Condition Data is presented in **Appendix 2** of this Report.

Few photos taken during visual pavement condition Surveys are presented below:

Pot Holes @ 129+400 RHS

Rutting @ 132+000 RHS

Ravelling @ 133+000 RHS

Rutting @ 133+000 LHS

Wide Longitudinal Joint@ 137+600 RHS

Longitudinal Cracking @ 138+000 RHS

Transverse Cracking @ 138+300 RHS

Ravelling @ 140+400 RHS

Transverse Cracking @ 164+800 RHS

Longitudinal Cracking @ 166+600 LHS

Patching @ 184+200 RHS

Damaged Panel @ 182+000 LHS

Longitudinal wide Joint @ 178+800 LHS

Pot Hole @ 177+200 LHS

Longitudinal Cracking @ 167+800 LHS

Ravelling @ 144+100 LHS

✓ **Standards and Specifications of IRC:SP: 83-2018 (for Rigid Pavement)**

Pavement Condition Survey with various distresses like (cracking pop outs, raveling, settled panels damaged panels etc.) are identified. For identified distresses, based on the Severity and Extent of distress, suggested following various treatments as per IRC SP 83-2018 guidelines

Treatment Proposed	Distress Identified	Severity rating
Panel Replacement	Multiple cracks (>30)	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Alligator Cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Transverse Cracks	5 .>6mm wide
	Longitudinal Crack	5. >12mm wide
Partial Panel Replacement	Multiple cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Alligator Cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Transverse Cracks	4. 3mm-6mm wide
	Longitudinal Crack	4. 6mm-12mm wide
Stitching and stapling	Multiple cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Alligator Cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Transverse Cracks	3. 0.5mm-3 mm wide
	Longitudinal Crack	2. 0.5mm-3mm wide
		3. 3mm-6mm wide

2.4 ROUGHNESS SURVEYS

The Roughness data has been collected using **Network Survey Vehicle** and analyzed in terms of International Roughness Index (IRI), separately for each lane, for both direction of travel. Pavement Roughness report covering the data collection and methodology, computation of IRI for each km length in each direction is presented in **Appendix 4** of this Report.

As per Schedule-F of TOT, the desirable level of service for Roughness values for bituminous pavement surface is considered to less than 2000 mm/Km and the acceptable limits are less than 2400mm/Km.

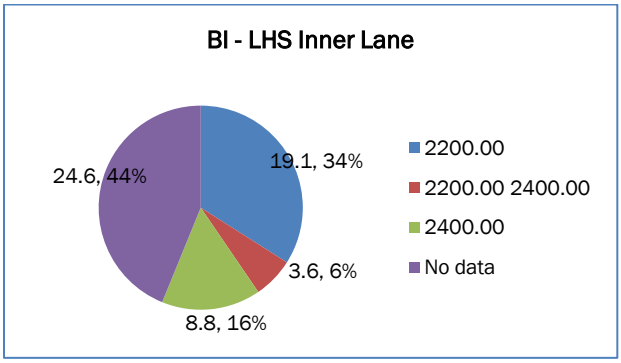
As per Schedule-F of TOT, the desirable level of service for Roughness values for rigid pavement surface is considered to less than 2200 mm/Km and the acceptable limits are less than 2400mm/Km.

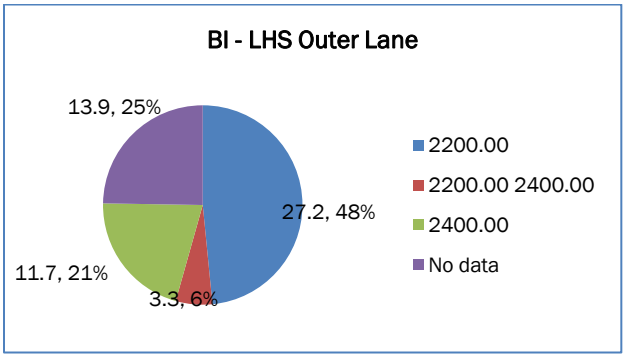
However, as per EPC Contract, Schedule-E, Roughness values should not exceed 2200mm/Km.

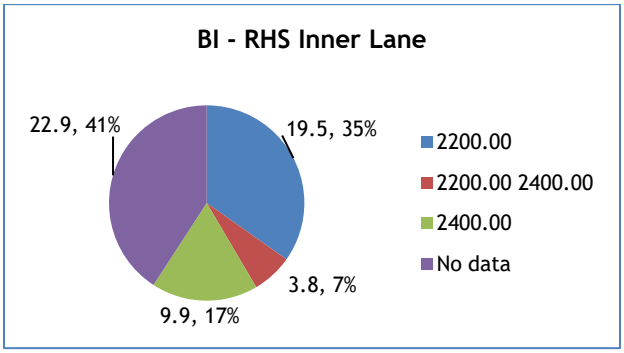
Roughness >2200 mm/km:

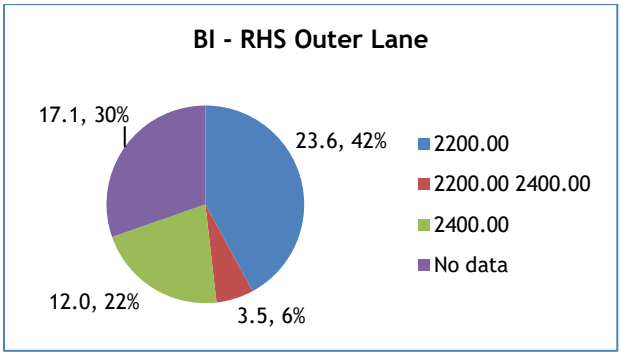
Rectification suggested based on moving average method for values >2200mm/km (based on EPC agreement)

The 10m point data captured has been summed upto 100 points so as to make 1km length in moving average method for consecutive points. The high values (10m points) of the captured data has be discarded so as maintain the roughness (<2200mm/km).The following pie chart shows the summed up individual 10m points data including deleted 10m point data are as presented below.









It can be seen from the above pie charts, that about 34% to 48% in LHS directions & 35% to 42% in RHS direction the Project Road carriageway has good riding quality (UI<2200 mm/km) in RHS carriageway

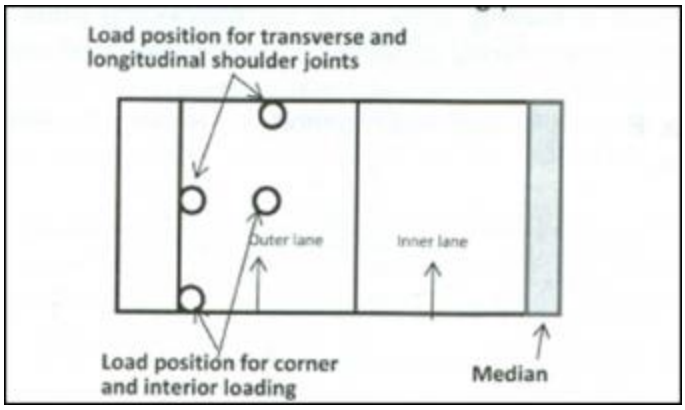
2.5 FALLING WEIGHT DEFLECTOMETER (FWD) SURVEYS

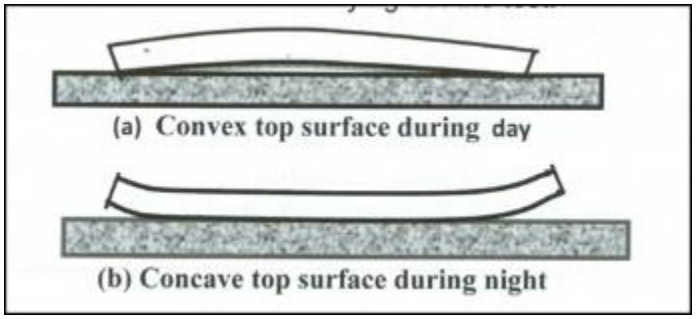
- **Pavement Evaluation Using FWD-RIGID Pavement**

Structural condition of in-service rigid pavement can be evaluated using Falling Weight Deflectometer as per IRC: 117 guidelines. FWD surveys are done at interior of panel to determine the Concrete Strength, Subgrade Support and to detect voids for loss of support FWD has been done in wheel path.

For evaluation of modulus of subgrade reaction and concrete strength i.e., "Interior" loading case is considered when temp gradient is zero or negative (top Surface is cooler than bottom), i.e., either in early morning or during night time has been done.

Corner loading has no indirect measure from the test, FWD test to be done when pavement is not in curled position and deflections measured along wheel paths to get void locations. Load position for various cases has been presented below:



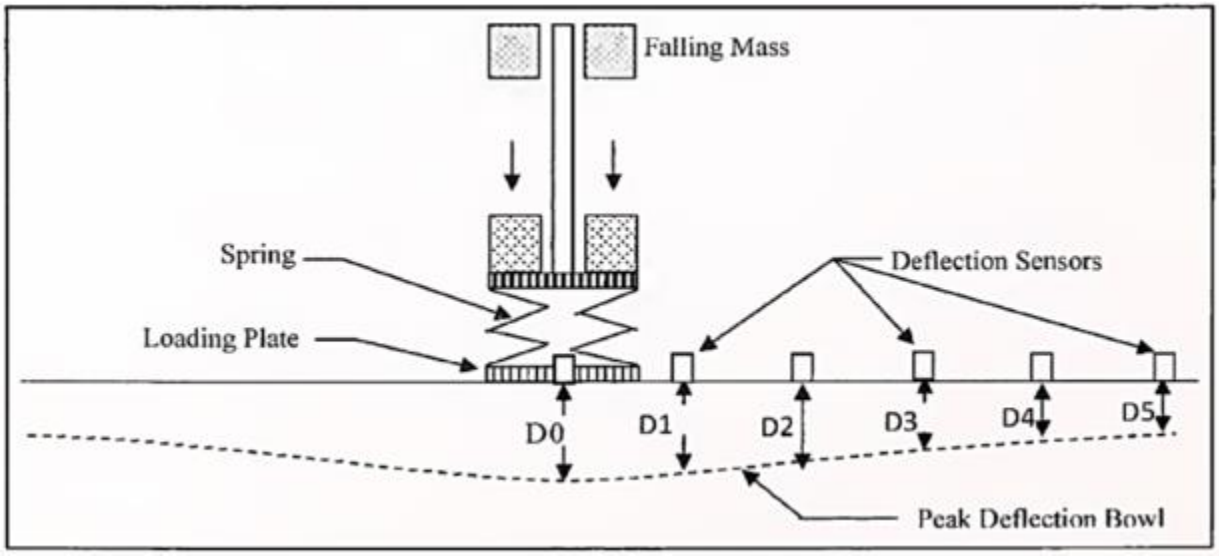


Among equipment available for structural evaluation of pavements, the Falling Weight Deflectometer (FWD) is extensively used world-wide because it simulates, to a large extent, the actual loading conditions of the pavement. When a moving wheel load passes over the pavement it produces load pulses. Normal stresses (vertical as well as horizontal) at a location in the pavement will increase in magnitude from zero to a peak value as the moving wheel load approaches the location. The time taken for the stress pulse to vary from zero to peak value is termed as 'rise time of the pulse'. As the wheel moves away from the location, magnitude of stress reduces from peak value to zero. The time period during which the magnitude of stress pulse varies from 'zero-to-peak-to-zero' is the pulse duration. Peak load and the corresponding pavement responses are of interest for pavement evaluation.

Working Principle of Falling Weight Deflectometer

Falling Weight Deflectometer (FWD) is an impulse-loading device in which a transient load is applied to the pavement and the deflected shape of the pavement surface is measured. The working principle of a typical FWD is illustrated in Figure below. D0, D1, etc., are surface deflections measured at different radial distances. Impulse load is applied by means of a falling mass, which is allowed to drop vertically on a system of springs placed over a circular loading plate. The deflected shape of the pavement surface is measured using displacement sensors which are placed at different radial distances starting with the center of the load plate.

A mass of weights is dropped from a pre-determined height onto a series of springs / buffers placed on top of a loading plate. The corresponding peak load and peak vertical surface deflections at different radial locations are measured and recorded.



Basically, the FWD generates a transient, of different magnitudes of impulse load by selection of a suitable mass and an appropriate height of fall. Under the application of the impulse load, the pavement deflects. Velocity transducers are placed on the pavement surface at different radial locations to measure surface deflections. Geophones or seismometers are used as displacement transducers. Load and deflection data are acquired with the help of a data acquisition system. The collected FWD Data and Analysis is presented in **Appendix 3** of this Report.

Few photos taken during the progress of FWD Surveys are presented below:

Deflection Measurement in progress on Flexible Pavement

Temperature Measurement in progress in Flexible pavement

Deflection Measurement in progress on Rigid Pavement

Deflection Measurement in progress on Rigid Pavement

FWD includes a circular loading plate of 300mm to 450mm diameter, in the present survey 300mm diameter load plate is used. A falling mass in the range of 50 to 350 kg is dropped from a height of fall in the range of 100 to 600mm to produce load pulses of desired peak load and duration. The target peak load in the range of 40KN to 60KN or Higher may be applied on Concrete Pavement to get a reasonable deflection of the order of 0.15 mm since pavements of major highways in India consisting of 150mm DLC and 300mm PQC are very stiff and a higher load may be required to get a deflection of about 0.15mm. In the present case target peak load as high as 150 KN is also used to get a reasonable deflection on concrete pavement.

In present study, Falling Weight Deflectometer (FWD) Test system has been used to generate the requisite NDT load-deflection data which was analyzed and is presented in this report. Surface deflections were measured at the center of the 300mm diameter loading plate and at the radial distances shown in the below table:

S No	Geophone Ref No	Radial distance measured from center of load plate (mm)
1	D0	0
2	D1	300
3	D2	600
4	D3	900

Methodology adopted for carrying the survey

- ✓ The FWD Surveys are carried out as per IRC:117-2014
- ✓ The project road has two longitudinal joints, i.e., one at center and other paved shoulder. Panel size is 4.5x4.0m & 4.5x3.5 in Inner and Outer lanes respectively.
- ✓ FWD test points were captured in every km considering three points in Inner Lane at 0m, 400m & 800m 200m & 400m and two points in Outer Lane at 200m & 400m to ascertain the strength/subgrade support.
- ✓ For Evaluation of Modulus of Subgrade reaction and Strength of Concrete i.e. "Interior" loading case is considered when temp gradient is zero or Negative (Top Surface is Cooler than Bottom), i.e. in the Early Morning or night time has to be done. Thus, the survey has been conducted during the night / early morning hours.

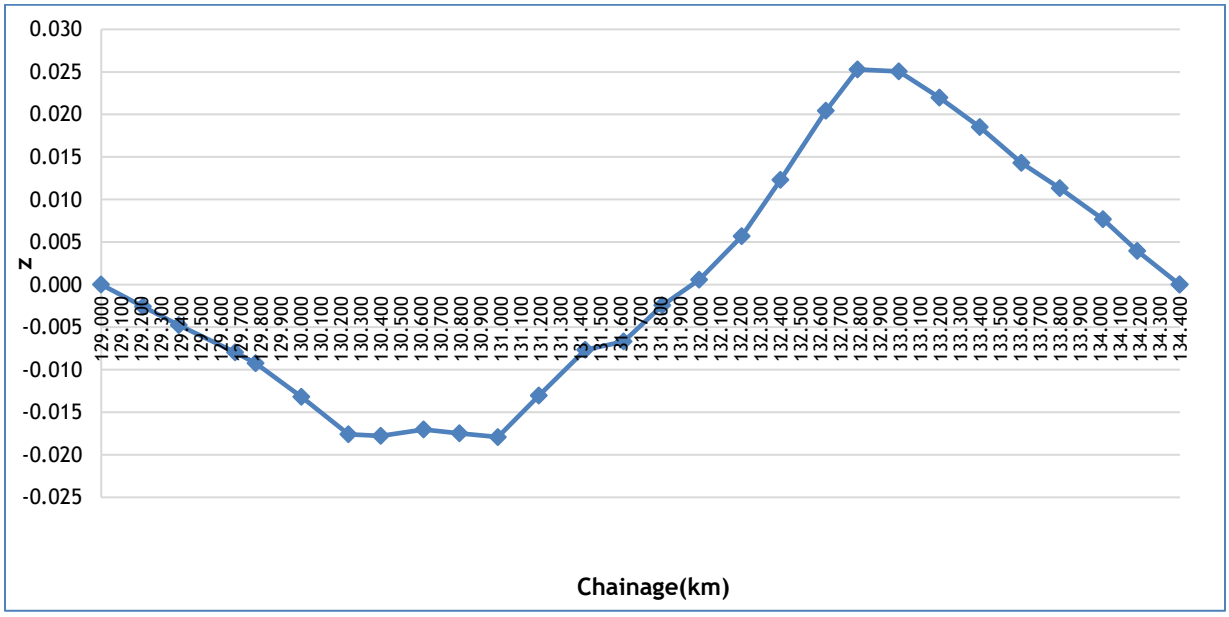
- **Pavement Evaluation Using FWD-Flexible Pavement**

In order to evaluate the structural strength of the existing flexible pavement, Falling Weight Deflectometer (FWD) survey has been carried out along the project road as per IRC: 115 guidelines on the Main carriageway. The collected FWD Data and Analysis is presented in **Appendix 3** of this Report.

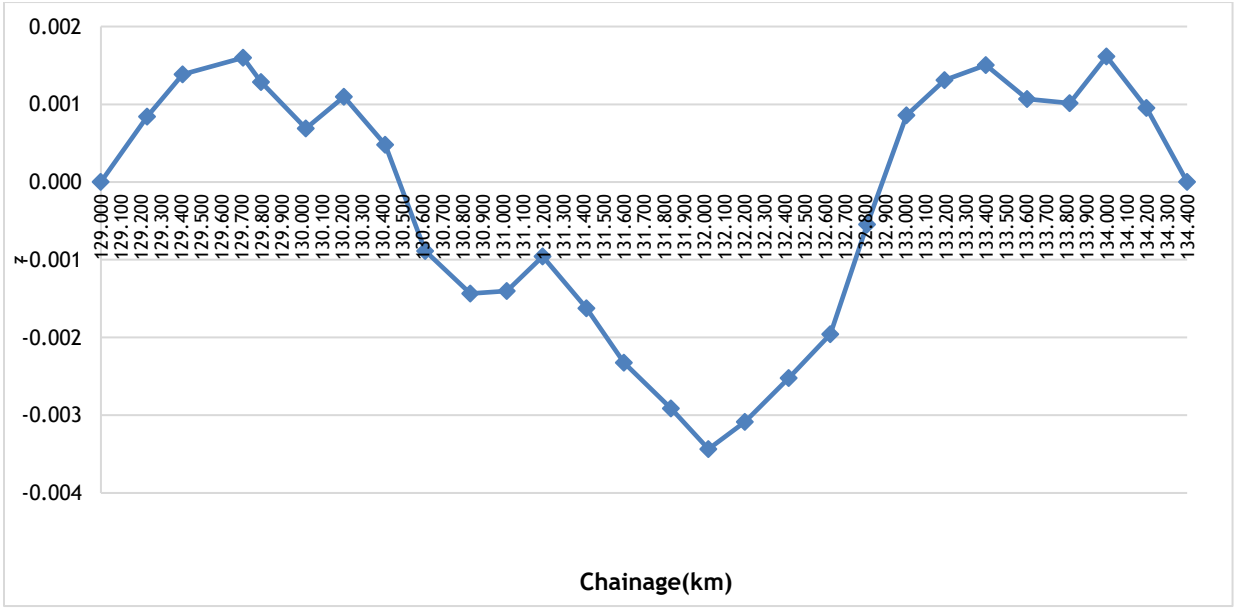
The homogeneous sections as identified in either direction (i.e., LHS & RHS) of the project stretch on flexible pavement were presented in the table below followed by graphical representation.

Table 2: Homogeneous Sections for FWD (Flexible Pavement)

S.No	From (Km)	To (Km)	Length (Km)
LHS			
1	134.40	131.42	3.0
2	131.42	129.00	2.4
RHS			
1	134.40	132.02	2.4
2	132.02	129.00	3.0



Delineation of Homogeneous Section – LHS (Flexible Pavement)



Delineation of Homogeneous Section – RHS (Flexible Pavement)

2.6 PAVEMENT COMPOSITION SURVEYS (TEST PITS)

The composition of the existing pavement crust has been noted from test pit surveys. Thus, a total of 12 pits have been dug along the corridor and the data on composition of pavement has been noted. All the 12 pits done on Main Carriageway edge, in which 11 Nos. of pits dug along Rigid Pavement edge and remaining 1 Nos. along the Flexible pavement edge.

Results of the test pit survey showing average thickness of pavement layers are presented in the Table below.

Table 3: Details of Pavement Composition along the Project Road

Sl No	Test Pit No	Existing Chainage (Km)	Direction	PQC (mm)	DLC (mm)	GSB (mm)	Total (mm)
1	CK-TP-1	138+760	RHS	280	150	160	**590**
2	CK-TP-2	149+050	RHS	280	150	170	**600**
3	CK-TP-3	159+950	RHS	280	150	150	**580**
4	CK-TP-4	168+100	RHS	300	130	150	**580**
5	CK-TP-5	178+350	RHS	280	180	140	**600**
6	CK-TP-6	184+700	LHS	300	180	170	**650**
7	CK-TP-7	173+950	LHS	270	150	180	**600**
8	CK-TP-8	164+450	LHS	300	150	140	**590**
9	CK-TP-9	155+720	LHS	280	120	150	**550**
10	CK-TP-10	145+900	LHS	280	170	150	**600**
11	CK-TP-11	135+700	LHS	300	140	160	**600**

S.no	Test Pit No	Existing Chainage(km)	Direction	BT (mm)	WMM	GSB	Total
1	CK-TP-12	132+500	LHS	350	230	300	**880**

Results of the test pit survey indicate varying thickness of crust layers. Pavement composition for rigid pavement consists of PQC (270mm to 300mm), DLC (120mm to 180mm) and granular base (140mm to 180mm). The Flexible pavement thicknesses for 5.43 km length can resemble the CK-TP-12 pavement composition.

2.7 SUBGRADE INVESTIGATIONS & LABORATORY TESTING

Sub-grade Investigations have been carried out to examine the subgrade soil characteristics along the project road. Test pits have been excavated at @ 5 km staggered along the road to carry out Field Density tests and to collect soil samples for laboratory tests. They have been carefully dug from the pavement surface up to sub-grade level, where these have been manually leveled and prepared for Field Density tests. Field Density tests on the sub-grade soils have been conducted at each test pit location after leveling the surface. A small quantity of sub-grade soil has also been collected in container for determining the Field Moisture Content. Upon completion of the Field

Density representative samples of sub-grade soils have been collected in bulk, in gunny bags, from each test pit for laboratory testing.

The samples collected from these Test pits have been tested for the following properties

- Grain size distribution test for each sample.
- Atterberg limits for each sample
- Moisture Verses density relationship (Heavy Compaction) for each sample.
- Four days soaked CBR at 97% of MDD.

Photographs have been taken at all test pit locations depicting the crust thickness and nature of material in the pavement. Photos showing Test Pits are presented below:

CK-TP-1

CK-TP-2

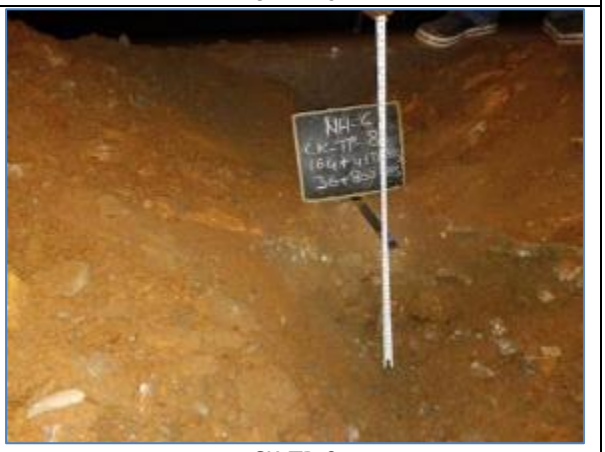
CK-TP-3

CK-TP-4

CK-TP-5

CK-TP-6

CK-TP-7



CK-TP-8

CK-TP-9

CK-TP-10

CK-TP-11

CK-TP-12

2.8 BORROW AREA

Potential borrow areas identified at 7 Nos. of locations within the vicinity of the project corridor for construction of embankment/subgrade within economic haulage leads. The sources identified as potential borrow sources and certain useful information such as distance from the project road, location, village name, etc., have also been presented in this table below.

Table 4: Borrow Area Details

Sl.No	Borrow Area No	Existing Chainage	Side	Offset	Village and contact person	Quantity	Rate	Remarks	Co-ordinates
1	CK-BP-1	146+500	RHS	5 km	Vill - Banspatri	20 Acres* 4 feet	Royality Only	Govt. Land	22.286628 87.206604
2	CK-BP-2	148+400	RHS	1 Km	Vill - Baghmari	5 Acres* 4 feet	Royality Only	Govt. Land	22.306277 87.205985
3	CK-BP-3	153+200	LHS	1.5 Km	Vill- Arjuni	10 Acres* 4 feet	Royality Only	Govt. Land	22.348566 87.182720
4	CK-BP-4	159+000	RHS	3.5 Km	Vill: Dhud Khund	3 Acres* 5 feet	Royality Only	Govt. Land	22.3277079 87.1195409
5	CK-BP-5	166+300	RHS	3 Km	Vill: Lodhasuli	6 Acres* 4 feet	Royality Only	Govt. Land	22.3161163 87.0530295
6	CK-BP-6	177+200	RHS	5 Km	Vill: Dhangri Contact Person: Sagar Contact no: 6296604244	2 Acres* 4 feet	Rate not told	Pvt. Land	22.2991678 86.9539990
7	CK-BP-7	182+800	RHS	100 M	Vill: Chichra	5 Acres* 4 feet	Royality Only	Govt. Land	22.306510 86.895855

Soil samples from these borrow sources have been collected in bulk by excavating test pits down up to 1.0m depth from the existing ground surface. The top organic soil layer of approximately 150mm thickness was removed before sampling. The samples collected from these identified

borrow pits/ gravel quarries have been tested for the suitability of utilizing them as embankment fill/ sub-grade.

Few photos showing borrow areas are presented below:

CK-BP-1

CK-BP-2

CK-BP-3

CK-BP-4

CK-BP-5

CK-BP-6

CK-BP-7

2.9 AGGREGATE AND SAND SAMPLES

A total of 6 Nos. aggregate samples have been identified and collected from different crushers and quarries falling within the vicinity of the project corridor to identify the suitability for sub base, base, surface courses and concrete works. The locations, estimated quantity and the approximate distance from each source to the nearest point on the Project Road are compiled and presented in the following table.

Table 5: Aggregate Samples Details

sample No.	Ex. Chainage (Km.)	Left/ Right	Name of Village	Name of Source/ Crusher	Lead from Nearest Ex.Chainage (Km.)	Approx. Quantity	Basic cost of the material (Rs.)	Remarks	Co-ordinate
CK-AQ-1	129+700	RHS	Haldipada	Crusher -Maa Laxmi Stone Crusher Name: Ananta Sahoo Mob no-8792431640	120 km	Plenty	20mm-Rs 1250/- per ton 10mm-Rs 650/- Per ton 6mm - Rs 600/- Per ton Dust - Rs 430/- Per ton Including Loading	Extra :GST 5%	21.576323 87.015513
CK-AQ-2	129+700	RHS	Naharpatna	Crusher - Chakrodhara stone Name: Arun Das Mob no-9937125301	120 km	Plenty	40 mm-Rs 930/- Per tom 20mm-Rs 1170/- per ton 16mm- RS 1150/- Per ton 10mm-Rs 600/- Per ton 6mm - Rs 550/- Per ton Dust - Rs 400/- Per ton Including Loading	Extra :GST 5%	21.542527 86.912859
CK-AQ-3	132+900	LHS	Pachami	National Stone Product Name: Md. Nasiruddin Mob: 7001157180	235 km	Plenty	40mm-Rs 520/- per ton 20mm-Rs 520/- per ton 10mm-Rs 75/- per ton 6mm-Rs 50/- per ton dust - Rs 20/- per ton including loading	Extra : Royalty (DCR) Rs-400/- Per 100 Cft & GST-5 %	24.071805 87.610234
CK-AQ-4	132+900	LHS	Pachami	Pachami Stone Quarry Name: Md. Nazir Hussain Malik Mob: 9434142297	235 km	Plenty	40mm-Rs 500/- per ton 20mm-Rs 600/- per ton 10mm-Rs 150/- per ton 6mm-Rs 100/- per ton dust - Rs 30/- per ton including loading	Extra : Royalty (DCR) Rs-100/- Per Ton & GST-5 %	24.075820 87.602010

sample No.	Ex. Chainage (Km.)	Left/ Right	Name of Village	Name of Source/ Crusher	Lead from Nearest Ex.Chainage (Km.)	Approx. Quantity	Basic cost of the material (Rs.)	Remarks	Co-ordinate
CK-AQ-5	132+900	LHS	Rampurhat	Kaba Stone Crusher Name: Kabir Shaikh Mob: 9064932709	235 km	Plenty	40mm-Rs 490/- per ton 20mm-Rs 480/- per ton 10mm-Rs 60/- per ton 6mm-Rs 80/- per ton dust - Rs 40/- per ton including loading	Extra : Royalty (DCR) Rs-100/- Per Ton & GST-5 %	24.183470 87.729747
CK-AQ-6	132+900	LHS	Rampurhat	Popular Stone Product Name-Sahid Shaikh Mob-9382436439	235 km	Plenty	40mm-Rs 510/- per ton 20mm-Rs 500/- per ton 10mm-Rs 145/- per ton 6mm-Rs 100/- per ton dust - Rs 60/- per ton including loading	Extra : Royalty (DCR) Rs-100/- Per Ton & GST-5 %	24.183686 87.726431

Photos depicting the quarry and crusher sources collected for Aggregate sampling are presented below:

CK-AQ-1

CK-AQ-2

CK-AQ-3

CK-AQ-4

CK-AQ-5

CK-AQ-6

One sand sample has been collected from river source within the project vicinity and its details are as given in the below table.

Table 6: Sand Samples Details

Sample ID no.	Village Name and Contact Details	River Name	Existing Chainage (km)	Side	Offset	Rate	Co-ordinate
CK-SQ-1	Village Name: Gopiballabpur Cont Person: Piyush Senapati Cont.no: 9933926095	Subarna Rekha	181+100	RHS	11 Km	Rs. 20/- per SFT	22.213963 86.902915

Photos depicting the Sand source is shown below:

CK-Sand-1

2.10 AXLE LOAD SURVEYS

Traffic loading has a significant impact on pavement performance and design. This is because the damage that vehicles create to a road depends very strongly on the axle loads of the vehicles. The exact relationship is influenced by the type of road structure and the way the road deteriorates but a "fourth power" damage law gives a good approximation.

Axle load study has been conducted using portable axle load pads at one location in the Project near Toll Plaza @ Km 157.850 on 4th December'2022 for 24 hrs. duration on either direction. The measurements have been made on random sampling basis. The collected axle load data and analysis is presented in **Appendix 5** of this Report.

The vehicle damage factors have been calculated using the standard axle loadings given in IRC: 37-2018. The standard axle loadings adopted have been presented in the following table

Table 7: Details of Standard Axle Used

Axle Configuration	Standard Axle load (Tonnes)/ KN	Remarks
Single Wheel, Single Axle	6.60/ 65	As per IRC 37-2018
Dual Wheel, Single Axle	8.16/ 80	As per IRC 37-2018
Dual Wheel, Tandem Axle group	15.10/ 148	As per IRC 37-2018
Dual Wheel, Tridem Axle group	22.90/ 224	As per IRC 37-2018

Few photographs illustrating the survey locations and axle load measurements are presented below.

Axle Load Survey @ Km 157.850 LHS

Axle Load Survey @ Km 157.850 RHS

Axle Load Survey @ Km 157.850 RHS

Axle Load Survey @ Km 157.850 LHS

Direction wise VDF for each mode of commercial traffic has been estimated. Results of axle load surveys have been presented in the following table.

Table 8: Estimated VDF at Toll Plaza, Km 157.850

Mode Type	Chichra to Kharagpur Carriageway	Kharagpur to Chichra Carriageway
LCV	1.29	2.52
2 Axle Truck	6.46	3.83
3 Axle Truck	8.85	4.75
MAV (4-6 Axle)	22.68	9.74
Buses	0.50	1.83

It is noted that trucks are carrying the heavy sand loads from Subharna Rekha River and travelling towards Kharagpur and thus, on LHS carriageway very high VDF are observed when compared to RHS direction.

CHAPTER 3. VALIDATION OF EXECUTED WORKS

3.1 ROAD WORKS

The project road has been closely inspected to verify the executed works on ground. The scope works to be executed by the Concessionaire/Contractor as envisaged in CA is compared with the executed work on the Ground. Each structure has been inspected to note down its structural configuration and condition. The following table highlights the scope comparison of the executed works on ground.

Table 9: Scope Comparison of Executed Works

Sl. No.	Particulars	Length/ Nos.	As per Site	Schedule-B	Remarks
1	Start Chainage (Km)	Km.	185.150		
2	End chainage (Km)	Km.	129.000		
3	Length of the Project Corridor	Kms	56.150		
4	Service Road / Slip Road	Kms	19.672	4.287	
5	Toll Plaza	Nr.	1		
6	No. of Lanes (Both side)	Nr.	4+4		4-Normal, 2-Extra Wide & 2-Revesible lanes
7	ROBs	Nr.	6		
8	RUB's	Nr.	1		
9	Interchange /Grade Separators	Nr.	1		
10	Flyovers	Nr.		1	
11	VUPs	Nr.	5		
12	PUP's/CUP's	Nr.	4/7		
13	EUPs	Nr.		1	
14	FOBs	Nr.		2	
15	Major Bridges	Nr.	1		
16	Minor Bridges	Nr.	9		
17	Culverts (Pipe)	Nr.	40		
18	Culvert (Slab/Box)	Nr.	27	3	
19	Major Junctions	Nr.	1		
20	Minor junctions	Nr.	103		
21	High Embankments	Kms	8.59		
22	RCC Wall	Kms	0.080		
23	RE Blocks/PANELS	Kms	12.00		
24	Bus Bays with Shelter	Nr.	19	3	
25	Truck Lay bye	Nr.	7		
26	High Mast Lights	Nr.	5		
27	Low Mast Lights	Nr.	5		
28	Highway Lighting (length only)	Kms	22.42	9.641	

Sl. No.	Particulars	Length/ Nos.	As per Site	Schedule-B	Remarks
29	Single Arm Lightings	Nr.	316		
30	Double Arm Lightings	Nr.	619		
31	Three Arm Lightings	Nr.	3		
32	Solar Blinkers	Nr.	40		
33	RCC Cover Drain	Kms	17.49	4.287	
34	Median drain	Kms	0.33		
35	Median Cuts	Nr.	798		
36	Chutes	Nr.	109		
37	Median Opening	Nr.	21		
38	Median kerb Damages	m	78		
39	Median Plantation Functional	Kms	33.86		
40	Median Plantation Non-Functional	Kms	5.37		
41	Road Markings	Sqm	44628		
42	W-Beam Safety Barriers	Kms	36.700		
43	Rigid Concrete Barriers	Kms	13.83		
44	Concrete Railing	Kms	4.37		
45	Steel Railing	Kms	0.59		
46	Pedestrian Guard Rails	Kms	7.2	2.987	
47	Delineators	Nr.	262		
48	Kilometre Stones	Nr.	104		
49	Hectometer Stones	Nr.	118		
50	Road Signs	Nr.	1154		
51	Gantry Sign Boards	Nr.	6		
52	Cantilever Sign Boards	Nr.	5		
53	Emergency Call Box	Nr.	8		
54	Anti-Glare	Nr.	4230		
55	separator Cuts	Nr.	418		

Service road/slip roads having 7.5m wide carriageway with flexible pavement accumulating to a length (LHS+RHS) of 19.672 km. Location of service roads and slip roads are provided in **Appendix 6** of this report.

Lined Covered drains are provided adjacent to service road locations in built-up areas. Length of lined Covered drain is about 17.490 Kms and open lined Median drain is about 0.33 km. Details of the Lined Covered and open lined Median drains are presented in **Appendix 6** of this report.

Table 10: Drains along the Project Road

RCC Cover Drains As per Site								
S. No.	Existing Km		Length (km)	Type	Direction	Cover Slab Missing (m)	Cover Slab Damage (m)	Remark
	From	To						
1	185.150	185.100	0.050	RCC Covered Drain	LHS	8		
2	184.400	183.400	1.000	RCC Covered Drain	LHS	8		
3	178.100	177.630	0.470	RCC Covered Drain	LHS			
4	177.600	177.050	0.550	RCC Covered Drain	LHS			
5	166.850	166.050	0.800	RCC Covered Drain	LHS	6		
6	166.030	165.560	0.470	RCC Covered Drain	LHS	2	2	
7	159.700	158.750	0.950	RCC Covered Drain	LHS	4	15	
8	152.400	151.750	0.650	RCC Covered Drain	LHS	4		
9	145.600	144.250	1.350	RCC Covered Drain	LHS			
10	142.400	140.415	1.985	RCC Covered Drain	LHS		5	
11	140.415	139.500	0.915	RCC Covered Drain	LHS	30	7	
12	133.950	133.300	0.650	RCC Covered Drain	LHS			Truck Lay Bye
13	129.200	129.530	0.330	RCC Open Drain	Median			Median Drain
14	133.400	133.850	0.450	RCC Covered Drain	RHS			Truck Lay Bye
15	139.450	140.470	1.020	RCC Covered Drain	RHS	10		
16	140.500	140.550	0.050	RCC Covered Drain	RHS	2		
17	144.250	144.400	0.150	RCC Covered Drain	RHS			
18	144.430	144.800	0.370	RCC Covered Drain	RHS			
19	144.820	144.920	0.100	RCC Covered Drain	RHS			
20	144.930	145.600	0.670	RCC Covered Drain	RHS	7		
21	151.750	152.400	0.650	RCC Covered Drain	RHS			
22	158.750	159.130	0.380	RCC Covered Drain	RHS			
23	159.140	159.700	0.560	RCC Covered Drain	RHS	5	1	
24	165.550	166.000	0.450	RCC Covered Drain	RHS			
25	166.030	166.300	0.270	RCC Covered Drain	RHS			
26	166.350	166.800	0.450	RCC Covered Drain	RHS			
27	177.050	177.270	0.220	RCC Covered Drain	RHS			
28	177.300	178.100	0.800	RCC Covered Drain	RHS			
29	181.110	181.140	0.030	RCC Covered Drain	RHS	30		Newly Constructed
30	183.400	184.380	0.980	RCC Covered Drain	RHS	4	1	
31	185.100	185.150	0.050	RCC Covered Drain	RHS			
Total			**17.820**			**120**	**31**	

RE/RCC walls and Soil embankments are found in approaches of some of the Grade-Separators/ ROB/ Major Bridges along the Project Corridor and are listed in the **Appendix 6** of this report**.** The Summary of those Slope protection works is given in following table.

Table 11: Embankment Slope Details

Approach Type	Length (Km)
Embankment	8.590
RCC Wall	0.080
RE Wall	12.000

In majority length of the project road has raised median of 4.0m-4.5m width, at urban settlements the width reduced to 2m and a depressed median of 9.0m wide is also observed near Km 140.000. There are 21 Nos. of Median openings found along the project corridor. Details of Median openings are presented in the **Appendix 6** of this report.

Safety barriers in the form of w-beam and concrete barriers have been provided along the project road at high embankments, sharp curve locations and at approaches to the grade-separator and cross drainage Structures.

Single-Face, w-beam barriers are observed for a length of 36.700 km. Details of Metal Beam Crash Barrier are provided in the **Appendix 6** of this report.

Concrete crash barrier/Concrete Railing are observed at Structure locations along the project corridor. Length of Concrete crash barrier is about 13.830 Kms and Concrete railings about 4.370 kms. Details of Concrete Crash Barrier and concert railing are provided in the **Appendix 6** of this report.

Pedestrian Guard Rails (PGR) are observed on separator between main carriageway and service road along the project corridor for a length of 7.200 km. Details of Pedestrian Guard Rails are presented in the **Annexure-6** of this report.

Table 12: Summary of Safety Barriers

Description	LHS (Km)	RHS (Km)	Median (Km)	**Total** (Km)	Damage (m)	Missing (m)
Metal beam crash Barrier	12.340	22.020	2.340	**36.700**	312	638
Concrete Crash Barrier(CCB)	7.000	5.920	0.910	**13.830**	-	-
Cement Concrete Railing (CCR)	1.400	2.560	0.410	**4.370**	-	-
Pedestrian Guard Railing (PGR)	4.130	3.070	0.000	**7.200**	40	104
Steel Railing	0.590	0.000	0.000	**0.590**	-	-

List of major and minor junctions developed are presented in the **Appendix 6** of this Report.

Road furniture in the form of Road Signage and Road Markings, Gantry signs and traffic safety blinkers, lighting, high mast lights have been provided along the project road.

Road Signages totaling to 1154 Nos. have been provided along the project corridor. Details of Road Signages are presented in the **Appendix 6** of this report.

Table 13: Summary of Road Signages

Description	LHS (Nos.)	RHS (Nos.)	Junction (Nos.)	Total (Nos.)
Octagonal	-	-	53	53
Circular	43	38	-	81
Triangular	87	101	240	428
Rectangular	39	38	13	90
Facility informatory	29	29	-	58
Chevron	105	107	-	212
Hazard	55	50	101	206
Route Marker	-	-	-	-
Safety Boards	-	-	-	-
Toll Boards	8	7	-	15
Cantilever Gantry	3	2	-	5
Over Head Gantry	3	3	-	6
Variable Message Sign	-	-	-	-
Project Descriptive	-	-	-	-
Total	**372**	**375**	**407**	**1154**

Total 262 nos of delineators are observed along the project corridor on both sides including median. Details of Delineators are presented in the **Appendix 6** of this report.

High mast lights of 5 Nos. are observed at toll plaza and major junction locations along the project corridor and are presented in the table below.

Table 14: Locations of High mast Lighting

High Mast Lighting as per Site					
S. No	**Chainage**	**Location**	**Facility, if any**	**As per site (Nos.)**	**Remark**
1	157.750	RHS	Toll Plaza	2	
2	157.750	LHS	Toll Plaza	2	
3	132.900		Round-About	1	
			Total	**5**	

Street lights in the form of Double arm lights are observed at built-up sections and Single arm are observed at Bus bays and truck Lay bye along the project corridor. Details of Street lights are presented in the table below.

Table 15: Locations of Street Lighting

Double Arm:

Double Arm Lightings								
S No.	Chainage (Km)		Length (Km)	Location	As per site (Nos.)	Poles Damaged (Nos.)	Bulbs Missing (Nos.)	Remarks
	From	To						
1	139.480	142.650	3.170	RHS	92		1	
2	144.280	145.570	1.290	RHS	44			
3	151.750	152.400	0.650	RHS	17		1	
4	157.450	157.750	0.300	Median	10			
5	158.100	158.440	0.340	Median	10	1		
6	158.740	159.700	0.960	RHS	31			
7	165.580	166.800	1.220	RHS	48			
8	177.040	178.080	1.040	RHS	34	1		
9	183.400	184.370	0.970	RHS	32			
10	185.060	185.170	0.110	RHS	3			
11	184.440	183.400	1.040	LHS	32		1	
12	178.100	177.080	1.020	LHS	34			
13	169.820	165.600	4.220	LHS	48			
14	159.730	158.770	0.960	LHS	31			
15	152.450	151.770	0.680	LHS	17		1	
16	145.600	144.280	1.320	LHS	44			
17	142.350	139.480	2.870	LHS	92			
		Total	**22.260**		**619**	**2**	**4**	

Single Arm:

Single Arm Lightings									
S. No	Chainage (Km)		Chainage (Km)	Location	Facility, if any	As per site (Nos.)	Poles Damaged (Nos.)	Bulbs Missing (Nos.)	Remark
	From	To							
1	136.600	137.720	1.120	RHS		33		1	
2	142.880	143.900	1.020	RHS		35	1	1	
3	146.680	146.800	0.120	RHS	Bus Bay	6			
4	153.240	153.500	0.260	RHS		11			
5	154.820	154.960	0.140	RHS	Bus Bay	6			
6	164.460	164.620	0.160	RHS	Bus Bay	6			
7	169.250	169.400	0.150	RHS	Bus Bay	6			
8	181.080	181.080	0.000	RHS		1			
9	181.080	181.080	0.000	RHS		1			
10	172.100	171.980	0.120	LHS	Bus Bay	6			
11	169.500	169.380	0.120	LHS	Bus Bay	6			

Single Arm Lightings									
S. No	Chainage (Km)		Chainage (Km)	Location	Facility, if any	As per site (Nos.)	Poles Damaged (Nos.)	Bulbs Missing (Nos.)	Remark
	From	To							
12	165.100	164.800	0.300	LHS	Truck Bay	7			
13	164.760	164.650	0.110	LHS	Bus Bay	6			
14	155.000	154.900	0.100	LHS	Bus Bay	6			
15	153.100	152.900	0.200	LHS	Truck Bay	11			
16	146.800	146.550	0.250	LHS	Bus Bay	6			
17	143.900	142.880	1.020	LHS		36			
18	137.720	136.600	1.120	LHS		34			
19	146.650	146.750	0.100	RHS	Bus Bay	7			
20	166.550	166.650	0.100	RHS	Bus Bay	6			
21	183.900	184.000	0.100	RHS	Bus Bay	6			
22	184.100	184.000	0.100	LHS	Bus Bay	6			
23	166.400	166.300	0.100	LHS	Bus Bay	6			
24	145.300	145.200	0.100	LHS	Bus Bay	6			
25	142.100	142.000	0.100	LHS	Bus Bay	6			
26	133.000	132.840	0.160	Round About	ROUND ABOUT	28	**2**		
27	133.000	132.840	0.160	BHS	ROUND ABOUT	9			
28	158.200	158.300	0.100	RHS	Weigh Bridge	5			
29	157.850	157.750	0.100	LHS	Weigh Bridge	5			
30	157.750	157.750	0.000	Toll Plaza		3			
			7.530		**Total**	**316**	**3**	**2**	

Triple Arm:

Three Arm As per Site					
S. No	Chainage (km)	Location	Facility, if any	As per site (Nos.)	Remark
1	179.400	BHS	Minor Junction	2	
2	133.000	Center	Round About	1	
			Total	3	

Road user facilities such as Bus Stops and Truck Laybys have been provided along the corridor. The project Road has total 19 Nos. of Bus bay with bus shelters and 7 numbers of truck laybys along the project Road. The details of the bus bay with bus shelters are presented in the **Appendix 6** of this report and truck laybys are presented in the table below.

Truck Lay-byes As per Site									
S. No.	Existing Km		Length	Width(m)	Side	Pavement Type	Toilet Blocks	Separator	Remarks
	From	To							
1	165.100	164.860	0.24	7.0	LHS	Rigid	Yes	Yes	
2	153.480	153.240	0.24	7.0	RHS	Rigid	Yes	Yes	
3	153.080	152.840	0.24	7.0	LHS	Rigid	Yes	Yes	
4	133.950	133.310	0.64	28.0	LHS	Flexible	Not Available	Yes	
5	133.890	133.370	0.52	28.0	RHS	Flexible	Not Available	Yes	
6	132.230	132.030	0.20	5.50	LHS	Earthen	Not Available	No	Not constructed
7	132.180	132.010	0.17	5.50	RHS	Flexible	Not Available	Yes	

3.2 STRUCTURES

List of Major Structures found during the inventory survey along the corridor are as follows:

Table 16: Details of Major Structures

S No.	Chainage	Type of Str	Side	Structure on	Age of Structure	Span Arrangement (No x Length, m)	Deck width, m	Remarks
1	143+962	RUB	LHS	MCW	New	1 x 11.0	12.00	
2	143+962	RUB	RHS	MCW	Old	2 x 6.2	6.00	
3	143+372	ROB	RHS	MCW	Old	1 x 10.8	11.30	
4	143+319	ROB	RHS	MCW	Old	2 x 8.2	11.30	
5	143+205	ROB	LHS	MCW	New	1x37.280+1x25.080+1x31.280 +1x15.840+1x31.280+1x31.28 0+1x22.800+1x37.280+1x28.0 80+1x37.280+1x37.280+1x37. 280+1x23.000+1x25.050+1x64 .010	12.30	
6	143+156	ROB	RHS	MCW	Old	1 x 10	11.40	
7	142+890	ROB	RHS	MCW	Old	2 x 7.5 + 1 x 25.7	11.50	
8	137+140	ROB	LHS	MCW	New	1 x 14.255 + 1 x 37.280 + 1 x 22.0	12.30	
9	137+140	ROB	RHS	MCW	Old	3 x 5.7	11.60	
10	180+605	MJB	LHS	MCW	New	1 x 12.0+ 5x33.0 + 1 x 12.0	12.50	
11	180+605	MJB	RHS	MCW	Old	1 x 12.0+ 5x33.0 + 1 x 12.0	8.50	
12	182+031	MNB	LHS	MCW	New	3 x 5.334	12.50	
13	182+031	MNB	RHS	MCW	New	3 x 5.334	12.50	
14	178+939	MNB	LHS	MCW	New	2 x 7.0	12.50	
15	178+939	MNB	RHS	MCW	Old	2 x 6.7	8.30	

S No.	Chainage	Type of Str	Side	Structure on	Age of Structure	Span Arrangement (No x Length, m)	Deck width, m	Remarks
16	178+535	MNB	LHS	MCW	Old	3 x 6.7	8.30	
17	178+535	MNB	RHS	MCW	New	3 x 6.6	12.50	
18	171+508	MNB	LHS	MCW	New	1 x 43.10	12.50	
19	171+508	MNB	RHS	MCW	Old	2 x 8.8+3 x 8.5	8.50	
20	165+966	MNB	LHS	MCW	New	2 x 8.0	12.25	
21	165+966	MNB	RHS	MCW	New	2 x 8.0	12.25	
22	165+966	MNB	LHS	SR	New	2 x 8.0	10.00	
23	165+966	MNB	RHS	SR	New	2 x 8.0	10.00	
24	165+362	MNB	LHS	MCW	New	2 x 8.0	12.50	
25	165+362	MNB	RHS	MCW	New	2 x 8.0	12.50	
26	161+491	MNB	LHS	MCW	Old	3 x 3.8	9.20	
27	161+491	MNB	RHS	MCW	New	1 x 11.0	12.50	
28	157+103	MNB	LHS	MCW	Old	1 x 3.7+2 x 4.2	9.50	
29	157+103	MNB	RHS	MCW	New	1 x 11.5	12.50	
30	151+061	MNB	LHS	MCW	New	2 x 7.0	12.50	
31	151+061	MNB	RHS	MCW	New	2 x 7.0	12.50	
32	129+685	Interchange	LHS	MCW	New	1 x 24.3 + 1 x 32.8 + 1x24.3	10.00	
33	129+685	Interchange	RHS	MCW	New	1 x 24.3 + 1 x 32.8 + 1x24.3	10.00	
34	181+046	VUP	LHS	MCW	New	1 x 12.0	14.75	
35	181+046	VUP	RHS	MCW	New	1 x 12.0	14.75	
36	166+457	VUP	LHS	MCW	New	2 x 12.0	14.75	
37	166+457	VUP	RHS	MCW	New	2 x 12.0	14.75	
38	144+706	VUP	LHS	MCW	New	1 x 12.691	14.75	
39	144+706	VUP	RHS	MCW	New	1 x 12.691	14.75	
40	142+122	VUP	LHS	MCW	New	1 x 12.484	14.75	
41	142+122	VUP	RHS	MCW	New	1 x 12.484	14.75	
42	139+897	VUP	LHS	MCW	New	1 x 16.971	14.75	
43	139+897	VUP	RHS	MCW	New	1 x 16.971	14.75	
44	183+218	PUP	LHS	MCW	New	1 x 7.017	14.75	
45	183+218	PUP	RHS	MCW	New	1 x 7.017	14.75	
46	177+235	PUP	LHS	MCW	New	1 x 7.320	14.75	
47	177+235	PUP	RHS	MCW	New	1 x 7.320	14.75	
48	165+811	PUP	LHS	MCW	New	1 x 7.0	14.75	
49	165+811	PUP	RHS	MCW	New	1 x 7.0	14.75	
50	159+010	PUP	LHS	MCW	New	1 x 7.087	14.75	
51	159+010	PUP	RHS	MCW	New	1 x 7.087	14.75	

S No.	Chainage	Type of Str	Side	Structure on	Age of Structure	Span Arrangement (No x Length, m)	Deck width, m	Remarks
52	174+838	CUP	LHS	MCW	New	1 x 7.0	14.50	
53	174+838	CUP	RHS	MCW	New	1 x 7.0	14.50	
54	172+614	CUP	LHS	MCW	New	1 x 7.0	14.50	
55	172+614	CUP	RHS	MCW	New	1 x 7.0	14.50	
56	168+963	CUP	LHS	MCW	New	1 x 7.0	14.50	
57	168+963	CUP	RHS	MCW	New	1 x 7.0	14.50	
58	167+437	CUP	LHS	MCW	New	1 x 7.0	14.50	
59	167+437	CUP	RHS	MCW	New	1 x 7.0	14.50	
60	162+891	CUP	LHS	MCW	New	1 x 7.0	14.50	
61	162+891	CUP	RHS	MCW	New	1 x 7.0	14.50	
62	160+843	CUP	LHS	MCW	New	1 x 7.0	14.50	
63	160+843	CUP	RHS	MCW	New	1 x 7.0	14.50	
64	148+830	CUP	LHS	MCW	New	1 x 7.0	14.50	
65	148+830	CUP	RHS	MCW	New	1 x 7.0	14.50	

4.1 EMBANKMENT & SUBGRADE

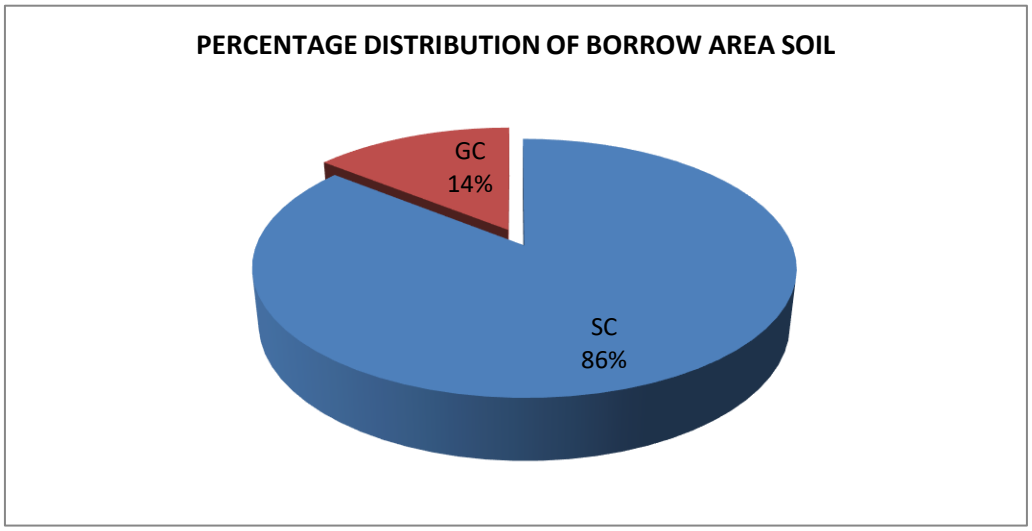
The embankment for project road has been constructed with available soils from nearby areas. No major settlements or depressions have been noted even at high embankment locations. There are no marshy/water logging areas along the length of project road.

Borrow pits sample reveal that the soil collected primarily belong to Coarse grain soil type. Out of 7 samples collected and tested, 6 samples belongs to SC type of soil and 1 samples belongs to GC type of soil. The testing results related to percentage distribution, soaked CBR and other details are as given below.

Table 17: Test Results of Borrow area Samples

Lab Sample No	Site Identification		Grain Size Analysis					Atterberg Limits (%)			Soil Class	MDD (gm/cc)	OMC (%)	Dry Density at 97% MDD	Soaked CBR 97% MDD	Free Swelling Index (%)
	Location (km)	Up/Dn	Percentage passing from					LL	PL	PI						
			4.75 mm IS Sieve	425 mic IS Sieve	75 mic IS Sieve	Gravel %	Sand %									
CK-BP-1	146+500	RHS	70.35	49.08	40.60	29.65	29.75	39	20	19	SC	2.04	11.80	1.98	13.87	8.33
CK-BP-2	148+400	RHS	43.47	29.17	25.75	56.53	17.72	43	21	22	GC	2.16	11.10	2.10	28.63	28.57
CK-BP-3	153+200	LHS	79.96	38.16	36.38	20.04	43.58	47	27	20	SC	2.17	9.80	2.10	13.43	15.38
CK-BP-4	159+000	RHS	66.06	27.89	22.03	33.94	44.03	36	16	20	SC	2.22	8.60	2.15		13.04
CK-BP-5	166+300	RHS	66.75	38.48	32.37	33.25	34.38	47	22	25	SC	2.12	11.40	2.06	16.23	27.27
CK-BP-6	177+200	RHS	97.20	69.54	35.43	2.8	61.77	20	14	6	SC	2.22	8.20	2.15		5.26
CK-BP-7	182+800	RHS	58.41	20.58	12.85	41.59	45.56	33	18	15	SC	2.20	8.00	2.13	34.16	8.70

Pie Chart showing the percentage distribution of soil classification of Borrow area sample is presented below.



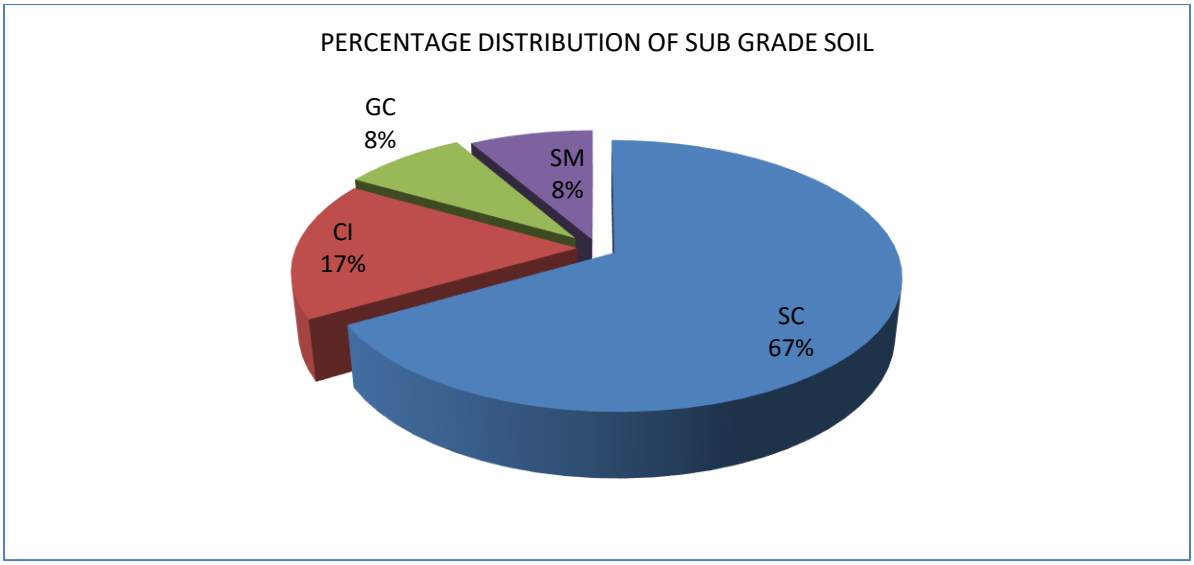
Test results of subgrade samples reveal that the soil collected belongs to Coarse grain soil type for subgrade. A Total of 12 sub grade samples collected and tested, 8 samples belongs to SC type of soil, 2 samples belongs to CI type of soil, 1 sample belongs to GC type of soil and 1 sample belongs to SM type of soil. The testing results are given below in the following table. The percentage distribution of existing subgrade soil and soaked CBR values are presented below.

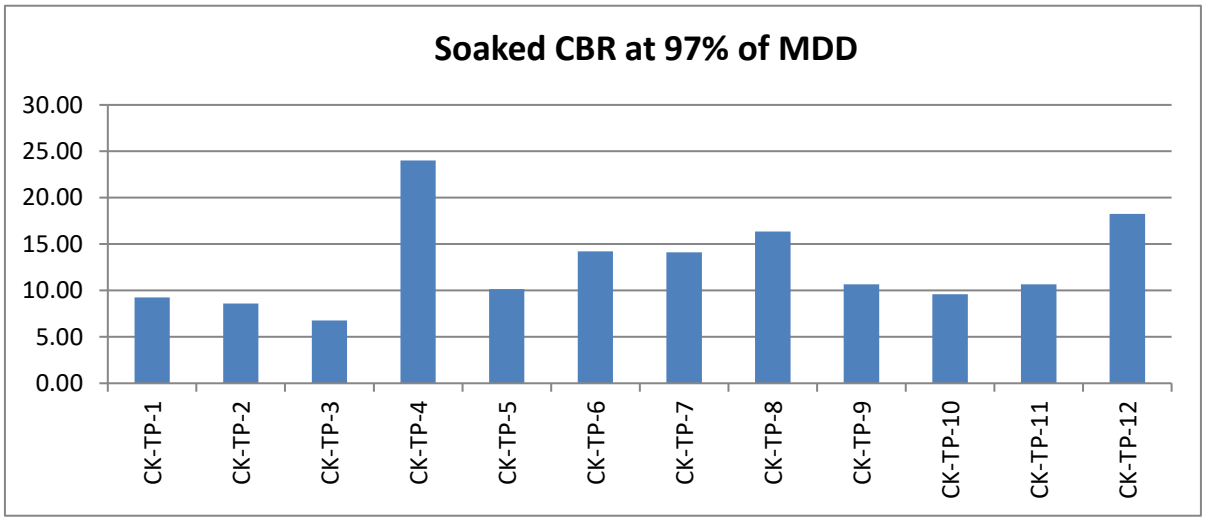
Table 18: Details of Soaked CBR Values of Existing Subgrade Soils

Lab Sample No	Site Identification		Grain Size Analysis					Atterberg Limits (%)			Soil Class	MDD (gm/cc)	OMC (%)	Dry Density at 97% MDD	Soaked CBR 97% MDD	FDD	COMPACTION	Free Swelling Index (%)
	Location (km)	Up/Dn	Percentage passing from					LL	PL	PI								
			4.75 mm IS Sieve	425 mic IS Sieve	75 mic IS Sieve	Gravel %	Sand %											
CK-TP-1	138+760	RHS	80.22	55.02	43.39	19.78	36.83	36	20	16	SC	1.93	12.20	1.87	9.25	1.90	98	30.43
CK-TP-2	149+050	RHS	92.26	67.16	54.29	7.74	37.97	44	18	26	CI	1.87	13.70	1.81	8.59	1.84	98	34.78
CK-TP-3	159+950	RHS	92.24	54.84	45.89	7.76	46.35	37	21	16	SC	2.03	12.75	1.97	6.76	1.98	98	16.67
CK-TP-4	168+100	RHS	57.25	27.90	22.69	42.75	34.56	34	19	15	GC	2.23	8.20	2.16	24.01	2.09	94	13.04
CK-TP-5	178+350	RHS	95.13	63.77	45.37	4.87	49.76	38	17	21	SC	2.06	9.60	2.00	10.15	1.90	92	31.82
CK-TP-6	184+700	LHS	86.94	40.76	30.11	13.06	56.83	35	17	18	SC	2.18	7.40	2.11	14.20	1.98	91	11.54
CK-TP-7	173+950	LHS	77.79	47.99	38.42	22.21	39.37	32	15	17	SC	2.09	9.40	2.03	14.10	1.93	92	30.43
CK-TP-8	164+450	LHS	78.36	25.51	6.37	21.64	71.99	33	18	15	SC	2.22	8.60	2.15	16.35	2.04	92	22.73
CK-TP-9	155+720	LHS	94.20	58.5	40.03	5.8	54.17	33	18	15	SC	2.00	10.80	1.94	10.65	1.98	99	11.54
CK-TP-10	145+900	LHS	89.60	65.73	52.75	10.4	36.85	49	24	25	CI	1.95	10.40	1.89	9.58	1.92	98	27.27
CK-TP-11	135+700	LHS	93.13	55.67	49.32	6.87	43.81	43	20	23	SC	2.02	10.60	1.96	10.65	1.88	93	32.00

Lab Sample No	Site Identification		Grain Size Analysis					Atterberg Limits (%)			Soil Class	MDD (gm/cc)	OMC (%)	Dry Density at 97% MDD	Soaked CBR 97% MDD	FDD	COMPACTION	Free Swelling Index (%)
	Location (km)	Up/Dn	Percentage passing from					LL	PL	PI								
			4.75 mm IS Sieve	425 mic IS Sieve	75 mic IS Sieve	Gravel %	Sand %											
CK-TP-12	132+500	LHS	88.13	69.33	37.95	11.87	50.18	-	NP	NP	SM	2.11	9.60	2.05	18.25	1.95	92	12.50

Pie Chart showing the percentage distribution of soil classification of existing subgrade sample is presented below:





The following observations can be made from the above test results conducted on of existing subgrade samples

- Maximum Dry Density for all subgrade samples varies between 1.81 and 2.16 gm/cc. One sample are not satisfying the MDD criterion (MDD>=1.75 gm/cc)
- OMC for existing subgrade samples varies between 7.4 to 13.70.
- Free Swelling Index for existing subgrade samples varies between 11.54 to 34.78. All the 12 samples are satisfying the FSI criterion (FSI<=50%).

The material test results are presented in **Appendix 7** of this report.

Aggregates to be used for sub-base, base, surface courses and concrete works have been collected from the crushers under operation from the existing quarries. The Table below represents the test results of the Aggregate and Sand Samples.

Table 19: Test Results of Aggregate Samples Details

S. No	Sample	Location (km)	Up/Dn	A.I.V (%)	Water Absorption (%)	Specific Gravity	Remark
1	CK-AQ-1	129+700	RHS	7.08	0.14	2.78	
2	CK-AQ-2	129+700	RHS	7.51	0.28	2.76	
3	CK-AQ-3	132+900	LHS	11.47	0.33	2.79	
4	CK-AQ-4	132+900	LHS	8.68	0.30	2.81	
5	CK-AQ-5	132+900	LHS	9.62	0.23	2.79	
6	CK-AQ-6	132+900	LHS	8.36	0.32	2.79	

Table 20: Test Results of Sand Samples Details

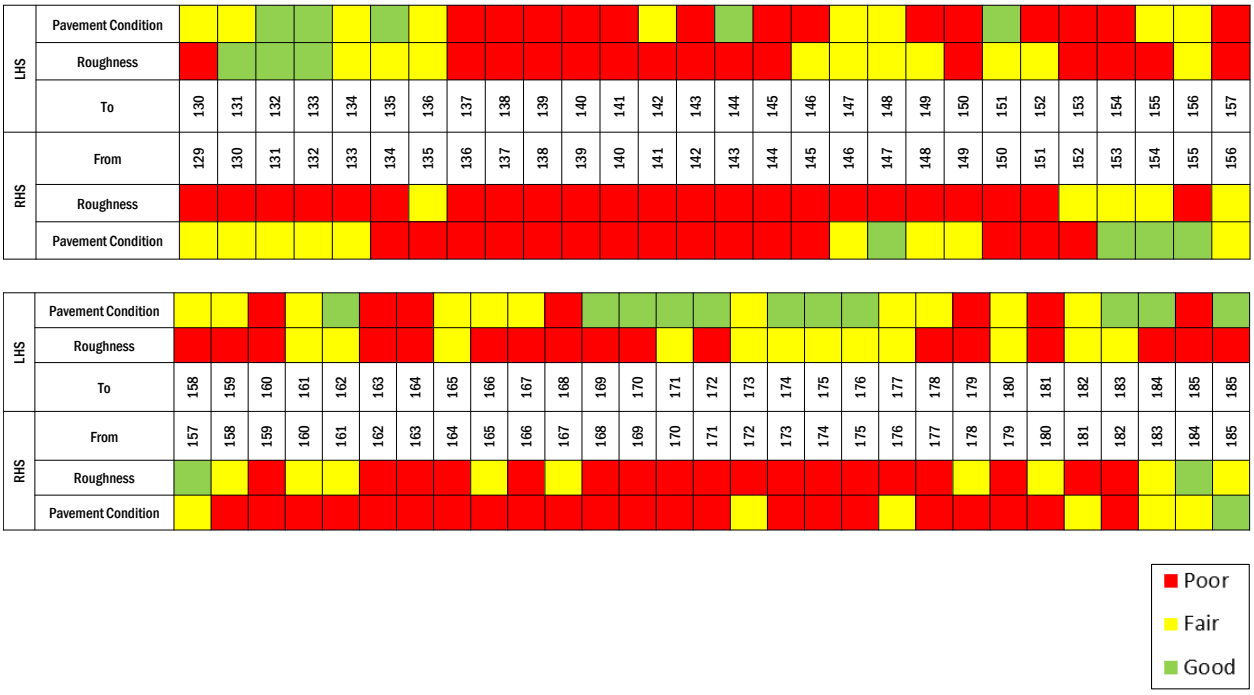
S No	Sample No	Chainage (km)	Side	10 mm Passing %	4.75 mm Passing %	2.36 mm Passing %	1.18mm Passing %	0.600mm Passing %	0.300mm Passing %	0.150mm Passing %	FM	ZONE
1	CK-SQ-1	181+100	RHS	100	96	92	84	63	14	1	**2.5**	**ZONE-III**

4.2 PAVEMENT CONDITION

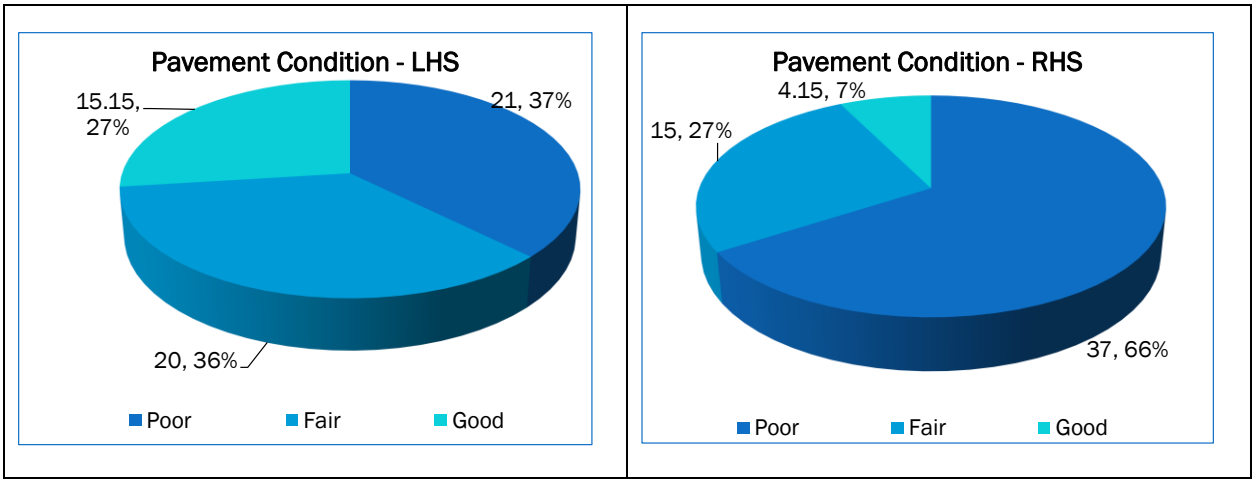
The distresses in bituminous surface have been captured on the project corridor for each lane separately by using the Network Survey Vehicle (NSV).

The project corridor has been provided with flexible pavement over a length of 5.430 Kms and remaining 50.720 Kms length it is rigid. Rutting is observed in inner and outer lanes on the both the side of the carriageway along the Flexible pavement where as in Rigid pavement longitudinal cracking, Transverse cracking and Raveling are observed. At few locations longitudinal wide joint and Transverse wide joint were observed.

The distresses in pavement surface have been captured on the project corridor by NSV survey. Pavement Condition report covering the data collection for each km length in each direction has been presented in the **Annexure-2**.



Pie-chart showing the Pavement condition rated as good, fair and poor condition are as



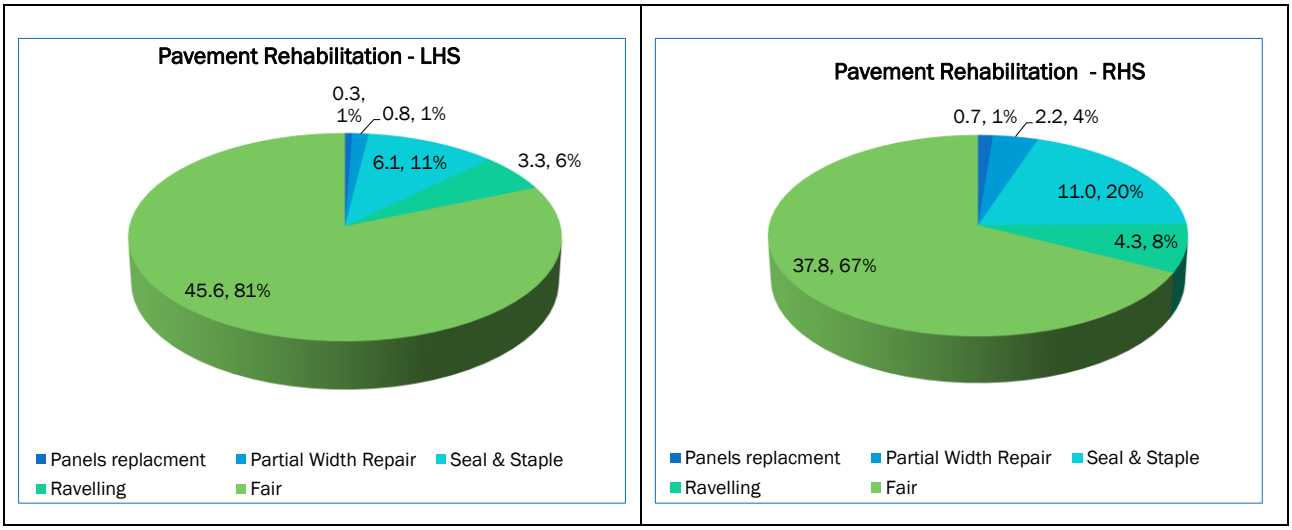
Based on IRC: SP: 83-2018 guidelines the summary of the pavement distresses the following rehabilitation measures for rigid panels have be considered.

The suggested Pavement rehabilitation in terms of No. of panels based on visual pavement condition are as:

LHS	Overall																									
	Ravelling	9	18	26	36	22	22	48	26	22	2	30	22	10	12	18	28	14	22	16	12	30	18	20	8	
	Seal & Staple	6.4	15	63	39	59	41	58	2.2	32	2.9	77	28	23	29	86	29	5.8	66	31	60	12	20	25	17	
	Partial Width Repair	1.4	2.7	5.5	10	29	9.4	14	0	0.7	0	1.4	0	2.2	0	5.5	5.2	0	0	2.2	0	0	0	0	3.5	
	Panels replacment	2	2	0	2	12	8	4	2	0	2	2	0	0	0	4	0	0	0	0	4	0	0	0	0	
	To	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	
RHS	From	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	
	Panels replacment	12	2	8	0	36	2	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Partial Width Repair	6.3	14	29	1.7	27	5.2	4.9	7.6	0	1.1	2.2	0	1.1	0	0	1.6	3.3	0	6.3	0	0	0	1.1	0.9	
	Seal & Staple	25	33	58	60	66	36	46	25	43	17	85	73	28	14	23	24	45	68	66	0	6.5	2.5	4.2	6.8	
	Ravelling	8	12	38	22	4	2	2	8	60	52	26	18	10	4	4	10	14	14	14	4	0	10	20	34	
	Overall																									

LHS	Overall																									
	Ravelling	8	4	26	4	10	8	8	10	2	4	2	0	0	4	0	0	0	0	16	14	22	12	24	20	8	4	28	2
	Seal & Staple	22	29	8	8.5	77	39	29	18	20	69	9.8	3.3	6.6	13	23	14	3.2	0	10	15	31	18	19	6.4	4.7	5.8	16	0.5
	Partial Width Repair	0	15	0	0	2.4	6.9	3	4.4	2.1	0.9	0	2.2	0	0	2.9	0	0	0.8	0.4	11	7.7	2.5	3.7	1.6	2.6	0	4.7	0
	Panels replacment	8	4	0	0	0	4	2	2	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	2	2	0
	To	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	185
RHS	From	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185
	Panels replacment	0	0	0	2	8	0	2	4	2	2	0	0	2	0	0	0	2	10	6	8	0	4	8	10	10	4	0	0
	Partial Width Repair	25	2.3	7	19	20	21	39	32	37	5.5	3.1	4.8	28	13	11	3.7	18	34	6.2	2.3	10	3.7	15	0.4	5.7	0.8	0	0
	Seal & Staple	60	33	57	122	54	135	190	75	34	69	65	101	105	27	30	41	73	104	9.8	18	40	62	36	19	19	12	9.9	0
	Ravelling	18	22	10	10	14	54	44	28	14	16	22	34	10	16	0	24	34	24	8	22	18	12	26	10	30	26	18	0
	Overall																												

Pie-chart showing the % distribution of various distress rectification measures are as presented below.

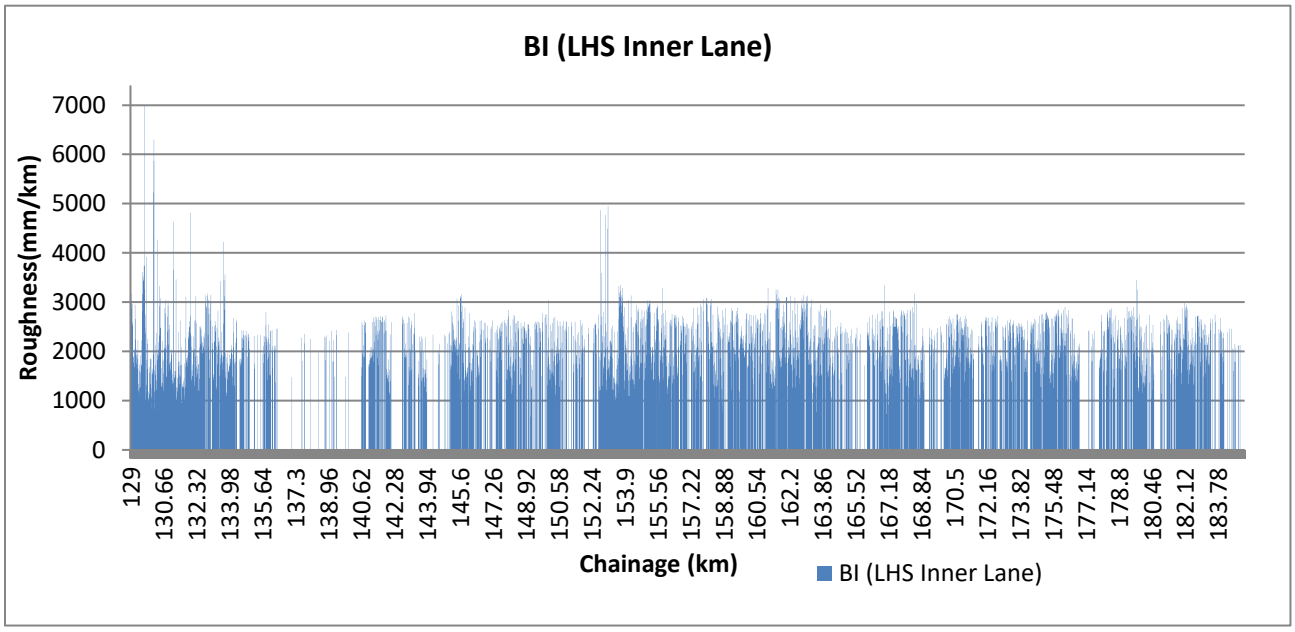


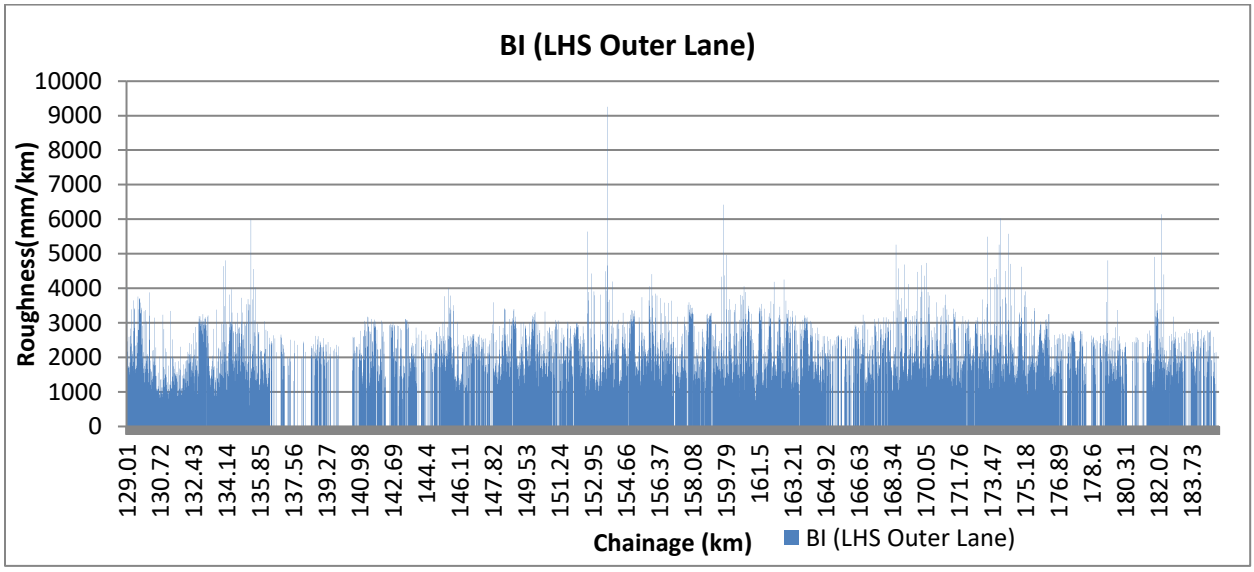
Overall, the following panel rectification measured are considered for the rigid pavement.

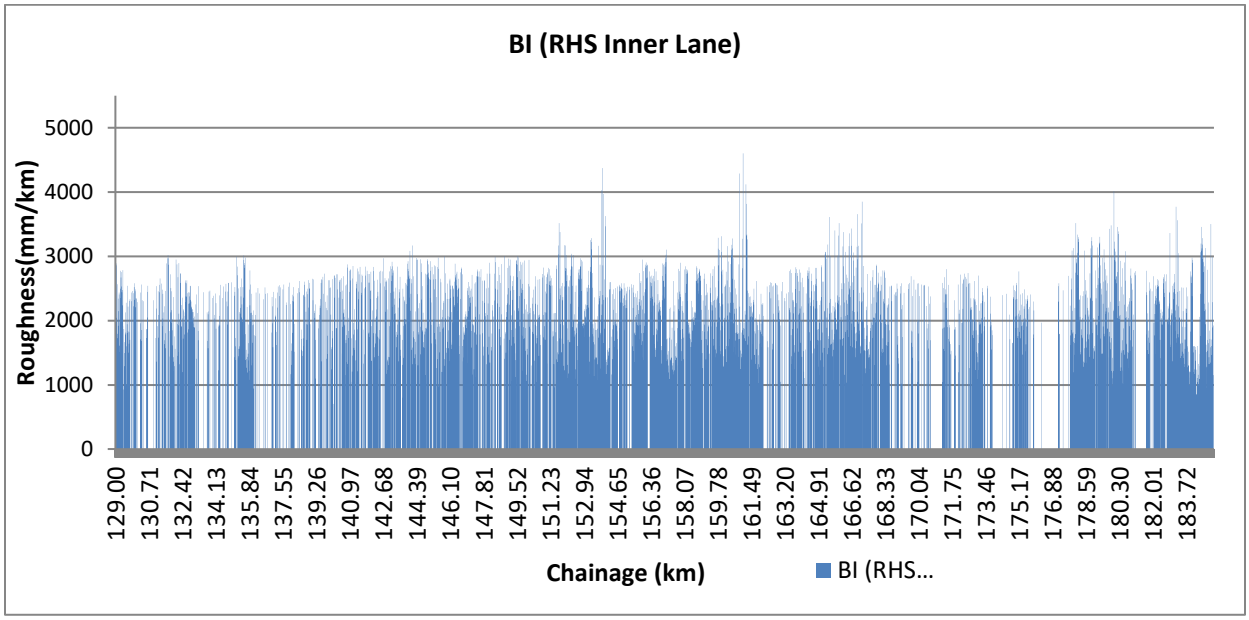
S No	Total Panels for replacement	Partial 1m Full Depth Repair	Stitch & Staple in mtrs	Raveling in sqm
1	243	649	17100	30330

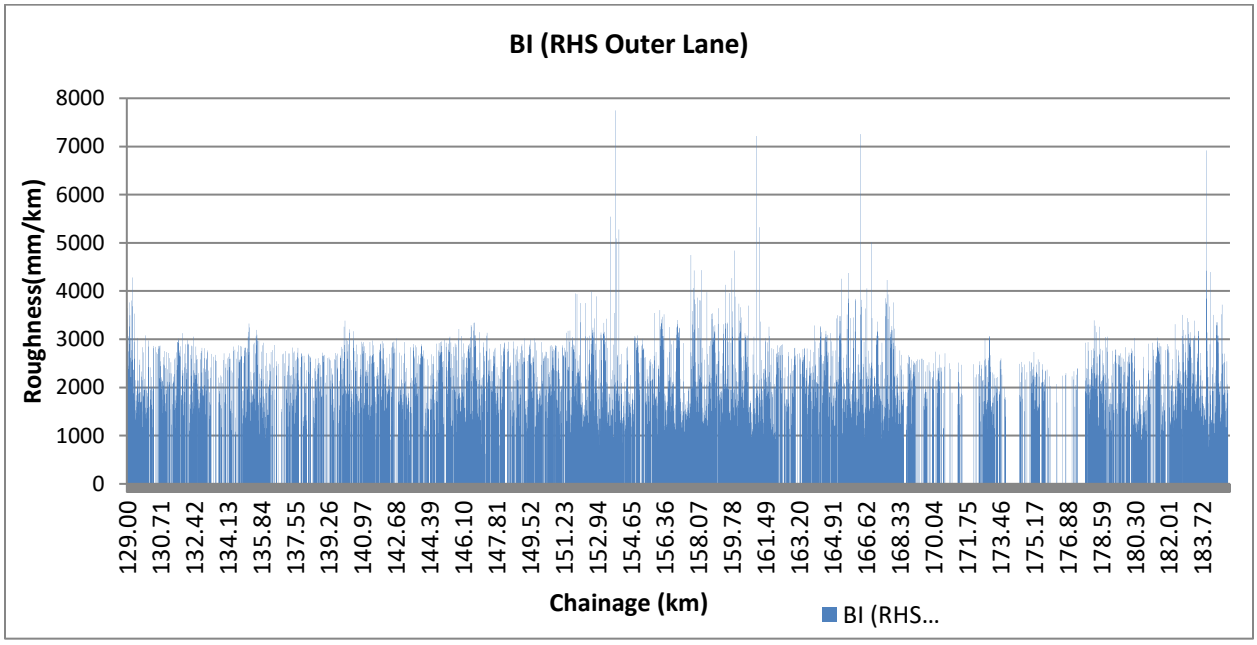
4.3 ROUGHNESS

The roughness surveys conducted along the corridor indicate good riding quality over the length of project corridor. Bar diagrams showing the Kilometer wise roughness along the project road are presented below:









Based on the above, Km-stone reference system the summary of Lane-km having varying roughness values are as presented below.

>=Roughness (mm/km)	<Roughness (mm/km)	LHS Inner (Lane Km)	LHS Outer (Lane Km)	RHS Inner (Lane Km)	RHS Outer (Lane Km)	TOTAL (Lane Km)
	2200	19.09	27.2	19.53	23.61	89.43
2200	2400	3.68	3.34	3.83	3.48	14.33
2400	3000	15.94	10.39	15.63	12.55	54.51
3000		17.39	15.19	17.14	16.49	66.21

An alternate exercise with moving average method has been adopted considering 10m point interval roughness data. With the moving average criteria, considering roughness threshold limit

(<2200mm/km), the combined lane-km lengths with varying roughness values are as presented below.

>=Roughness (mm/km)	<Roughness (mm/km)	LHS Inner & Outer (Lane Km)	RHS Inner & Outer (Lane Km)
	2200	46.3	43.1
2200	2400	6.9	7.3
2400		20.5	21.9
Lengths for rectification considered		38.5	40

By attending the rectification of 38.5 lane-km length in LHS, at identified locations, the roughness values can bring down to required threshold value(<2200m/km) by considering moving average method for consecutive 100 points data. However, still there will be accumulated length of 20.5 lane-km at scattered points having roughness value higher than threshold value (>2200m/km).

Similarly in RHS, by attending the rectification of 40 lane-km length at identified locations, the roughness values can bring down to required threshold value(<2200m/km) by considering moving average method for consecutive 100 points data. However, still there will be accumulated length of 21.9 lane-km at scattered points having roughness higher than threshold value (>2200m/km).

4.4 FWD ANALYSIS

4.4.1 Flexural strength of Concrete Rigid Pavement (Rigid)

FWD deflections shall be measured and recorded for radial distances at 0 mm, 300 mm, 600 mm and 900 mm from the centre of loading point.

The area parameter of deflection basin should be calculated using the equation 2 of IRC 117-2014.

From area of deflection basin, Radius of relative stiffness (l) can be evaluated from the charts. The excel sheet provided with the guidelines used to get the value of Radius of relative stiffness (l).

After finding the Radius of relative stiffness, normalized deflections (d) are calculated using various equations formed from the charts. The excel sheet directly gives the values of the normalized deflections.

Subgrade modulus values can be found by using the equation 3 of IRC 117-2014 for different normalized deflections and average of all should be taken as subgrade modulus.

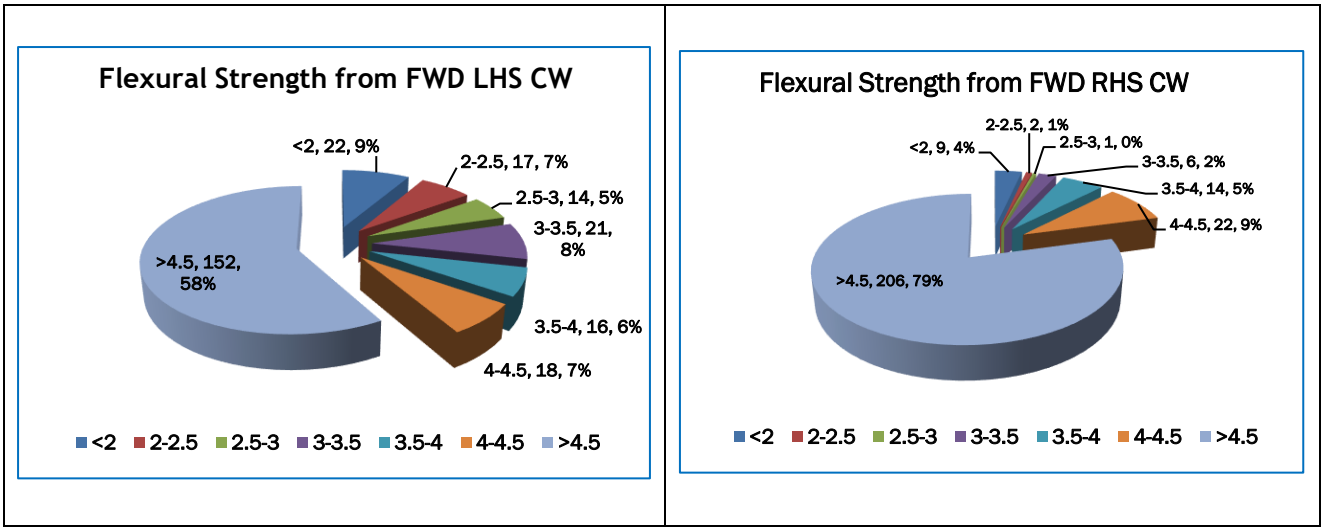
Elastic Modulus (MPa) of concrete can be found by using the equation 4 of IRC 117-2014.

Strength of the concrete and Flexural strength can be determined from the value of Ec from the equation 5 & 6 of IRC 117-2014.

The fck values calculated for the rigid pavement are presented in **Appendix-3** of the report:

Table 21: Distribution range of Fck values (Rigid Pavement)

Fck values Range (MPa)	Locations in LHS (Nos.)	Locations in RHS (Nos.)
<2.0	22	9
2.0-2.5	17	2
2.5-3.0	14	1
3.0-3.5	21	6
3.5-4.0	16	14
4.0-4.5	18	22
>4.5	152	206
Total	**260**	**260**



Flexural Strength of the PQC estimated from FWD Surveys indicates that:

a) More than 58% of samples in LHS Carriageway having values greater than 4.5 Mpa and 79% of samples in RHS Carriageway are having values greater than 4.5 Mpa.

b) 7% of samples in LHS Carriageway are having values between 4.0 – 4.5 Mpa and 9% of samples in RHS Carriageway are having values between 4.0 – 4.5 Mpa.

c) 6% of samples in LHS Carriageway are having values between 3.5 – 4.0 Mpa and 5% of samples in RHS Carriageway are having values between 3.5 – 4.0 Mpa.

d) 8% of samples in LHS Carriageway and 2% of samples in RHS Carriageway are having values between 3 – 3.5 Mpa.

e) 5% of samples in LHS Carriageway and 0% of samples in RHS Carriageway are having values between 2.5 – 3.0 Mpa.

f) 7% of samples in LHS Carriageway and 1% of samples in RHS Carriageway are having values between 2 – 2.5 Mpa

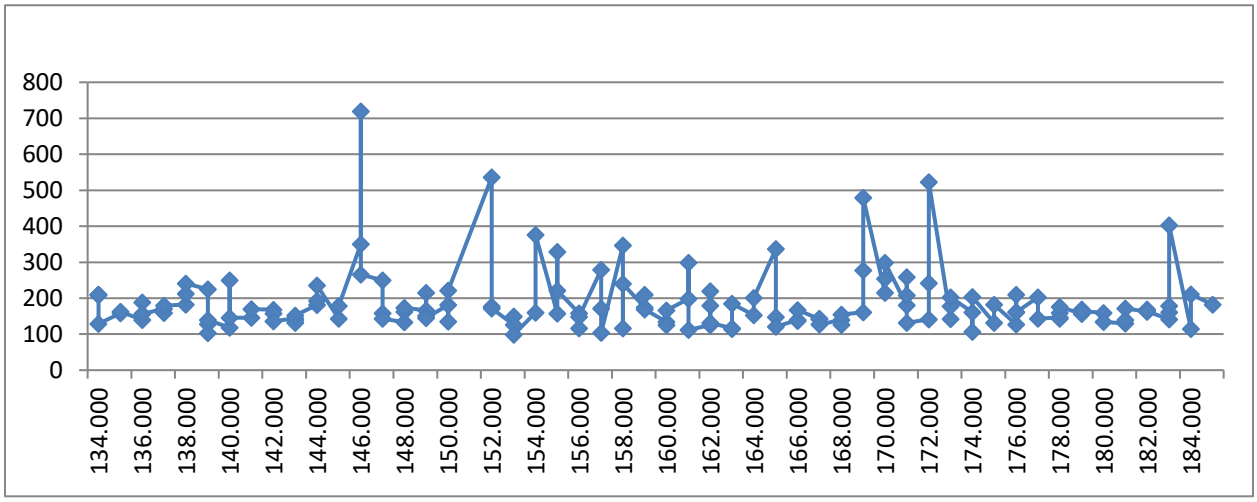
g) 9% of samples in LHS Carriageway and 4% of samples in RHS Carriageway are having values less than 2 Mpa.

Detection of Voids underneath the Rigid Pavement

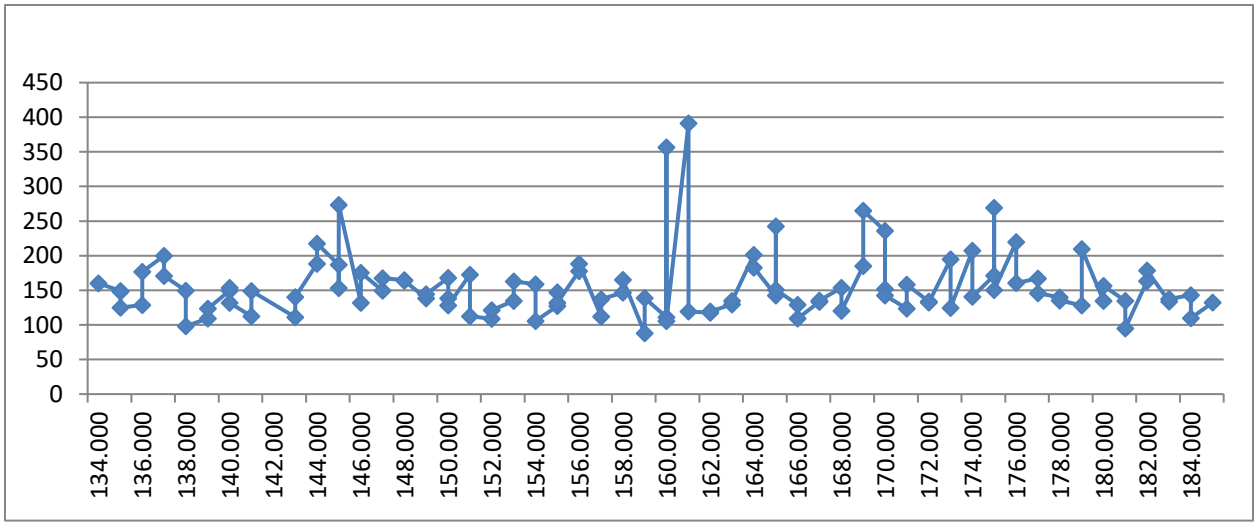
4.4.2 DETECTION OF VOIDS UNDERNEATH THE RIGID PAVEMENT

- Deflection of Voids below a pavement slab can be easily be done by a FWD. Deflections are measured along the wheel path and a plot of central deflections versus distance has to be made.
- The locations where the deflections are much higher than the normal may indicate presence of voids. Sample is shown in below

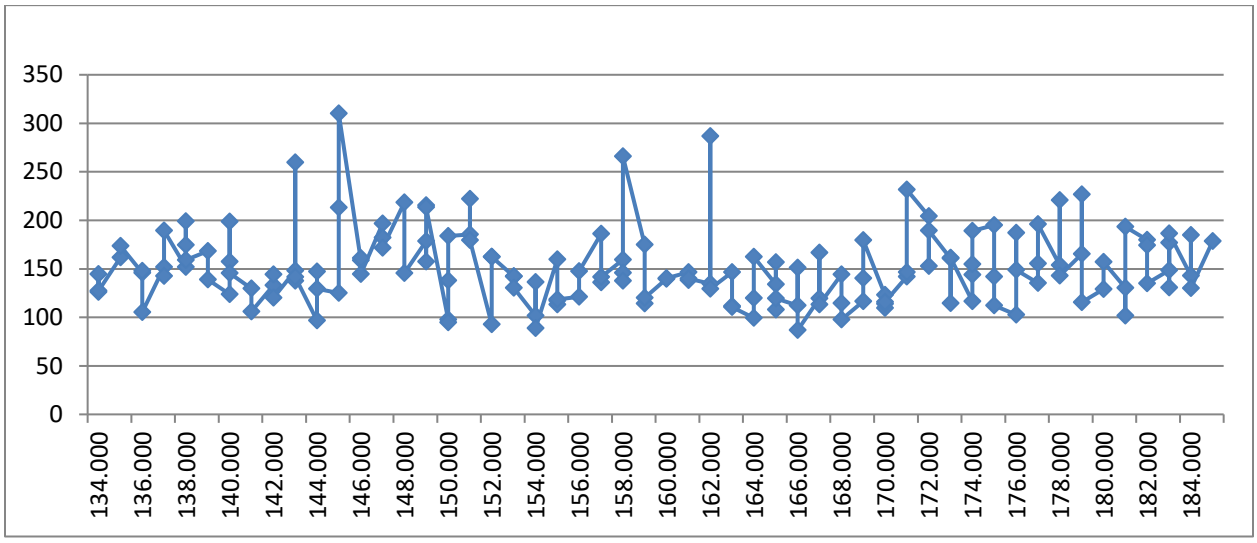
LHS-Inner Lane:



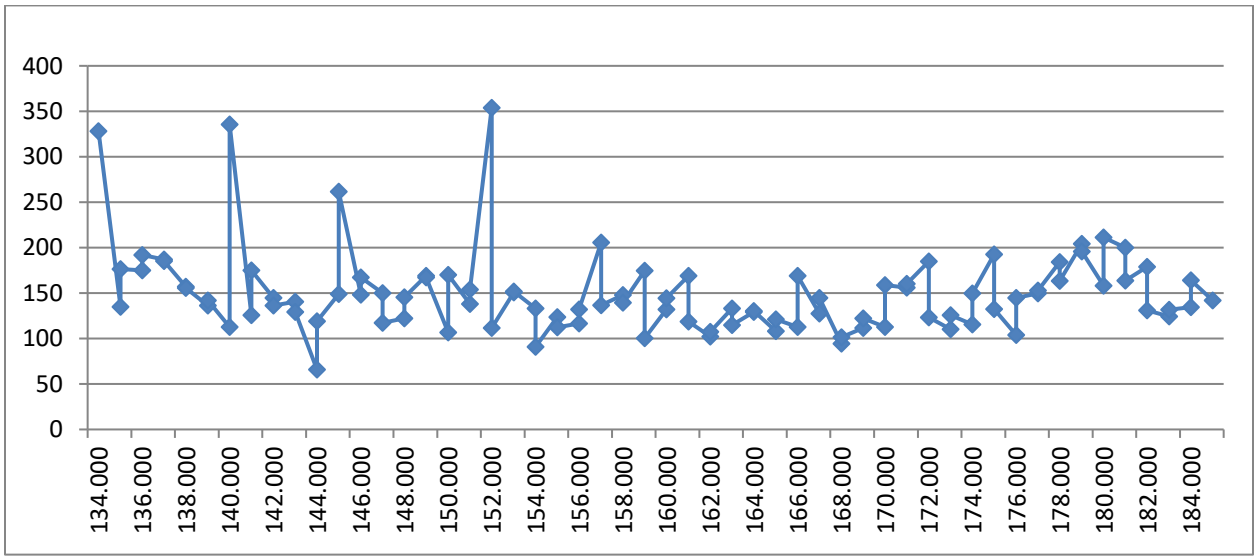
LHS- outer Lane:



RHS- Inner lane:



RHS-outer lane:



From the above graph, voids underneath the pavement are identified as 54 points in LHS, 44 points in RHS. For quantification, every point is considered for 150m length in lane width.

4.4.3 FWD Analysis and Assessment of Overlay Requirement (Flexible)

The FWD data collected has been analyzed as per IRC-115 guidelines with the suggested ranges for in-service pavements

- Subgrade Modulus---------- 5 CBR to 20 CBR
- Granular Layer Modulus---------- 100 Mpa to 500 MPa
- Bituminous Layers –Thick without distress--------- 750 Mpa to 3000 MPa
- Bituminous Layers in distressed condition--------- 400 Mpa to 1500 MPa

The above suggested ranges for guidance only and pavement engineer shall use his judgment based on available data while fixing the above ranges. By looking at the age and condition and performance of the pavement following different set of ranges have been used while finalizing the modulus values:

Layer	Bituminous Layers	Granular Layer Modulus	Subgrade
Modulus Value (MPa)	750-3000	100-500	50-100

Bituminous layer Moduli obtained from back calculations shall be corrected for a standard pavement temperature of 35°C using given equations. Whereas, for back calculated moduli values obtained for granular and subgrade layer shall be corrected for seasonal variations (using winter and summer equations). As FWD tests, performed, during the monsoon, no seasonal correction factor is applied for granular and subgrade layer. The design moduli (15th percentile moduli) of in-service layers for each homogenous section are given in table below.

Table 22: Summary of Design Moduli of different layers – LHS (Flexible Pavement)

Sl. No	Side	From	To	Length	15th Percentile MR values		
					MR for BT	MR for Granular	MR for Subgrade
1	LHS	134.40	131.42	3.0	2040	391	87
2	LHS	131.42	129.00	2.4	2062	393	86

Table 23: Summary of Design Moduli of different layers – RHS (Flexible Pavement)

Sl. No	Side	From	To	Length	15th Percentile MR values		
					MR for BT	MR for Granular	MR for Subgrade
1	RHS	134.40	132.02	2.4	2034	394	86
2	RHS	132.02	129.00	3.0	2051	393	86

Observations on FWD Results (Flexible Pavement)

It can be noticed from the above table that the layer moduli for the three layers are varying along the length and direction. The MR value for BT layer is 2040 Mpa to 2062 Mpa in LHS & 2034 Mpa to 2051 Mpa in RHS Carriageway, however, the MR value of BT layer restricted to 3000 Mpa. The MR value for Granular Layers is 391 Mpa to 393 Mpa in LHS & 394 Mpa to 393 Mpa in RHS Carriageway. Similarly, the MR value for Subgrade Layer is 87 Mpa to 86 Mpa in LHS Carriageway and 86 Mpa in RHS Carriageway.

4.5 PAVEMENT COMPOSITION

Results of the test pit survey indicate varying thickness of crust layers. Pavement composition consists of granular base, DLC and PQC. The average Crust thickness for PQC is 285 mm, for DLC 150 mm, for GSB 160 mm and the total crust average is 595 mm which is obtained from test-pits. Whereas, for flexible pavement has BT thickness 350mm, WMM of 230mm thickness, GSB of 300mm thick with overall thickness of 880mm.

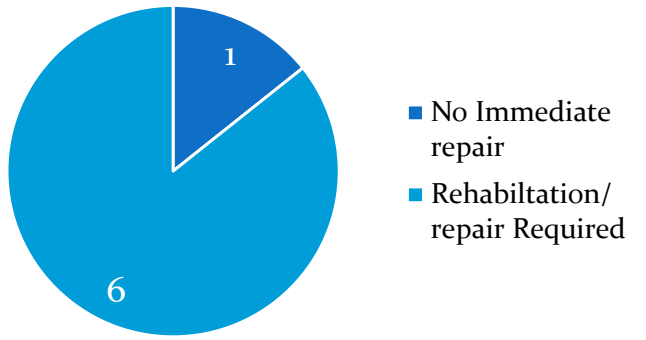
4.6 STRUCTURES

Inventory and asset condition of all the existing structures falling within project road have been verified as per IRC: SP-35 procedures and guidelines with following field surveys

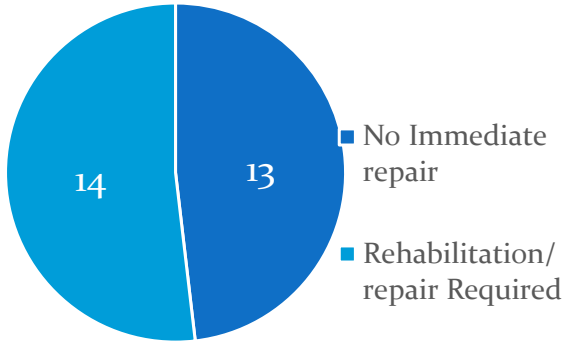
- Inventory of existing highway bridges / structures
- MBIU/Visual condition survey of existing highway bridges / structures

Inventory and condition survey of all the structures is presented in **Appendix 8** of this report.

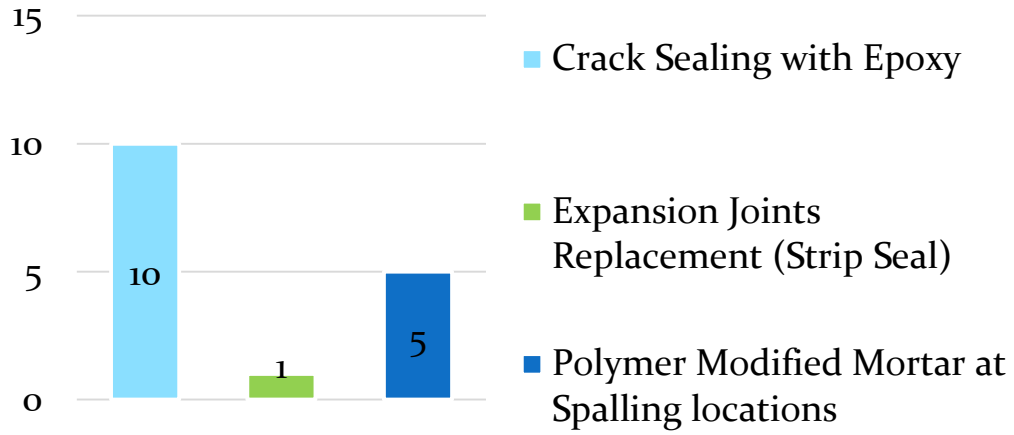
Structure distresses as identified under immediate repairs are as follows.



Major Structures



Minor Structures



Joint repairs with number of location

List of Structures found during the inventory surveys along the corridor are as follows:

Table 24: Summary of Structures

S. No	Type of Structure	No. of Structures			Total No. of Structures	Total No. of Locations
		LHS	RHS	BHS		
1	ROB	2	5	-	7	6
2	MJB	1	1	-	2	1
3	MNB	10	10	-	20	9
4	VUP	5	5	-	10	5
5	CUP	7	7	-	14	7
6	PUP	4	4	-	8	4
7	RUB	1	1	-	2	1
8	Interchange	1	1	-	2	1
9	BC	-	-	27	27	27
10	PC	-	-	40	40	40

Table 25: Details of ROB

S. No	Skew (Yes/No)	NH No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
												Abutment	Pier		
1	No	NH-6	137+140	ROB	LHS	MCW	New	1 x 14.255 + 1 x 37.280 + 1 x 22.0	12.3	9.5	Pile	RCC Wall type	RCC Wall type	Steel Girder	Elastomeric
2	No	NH-6	137+140	ROB	RHS	MCW	Old	3 x 5.7	11.6	7	Not Visible	Brick Wall type	Trestle type	T-Beam Girder	-
3	20	NH-6	142+890	ROB	RHS	MCW	Old	2 x 7.5 + 1 x 25.7	11.5	7	Not Visible	RCC Wall type	RCC Wall type	Steel Girder & RCC Solid slab	Pot PTFE
4	No	NH-6	143+156	ROB	RHS	MCW	Old	1 x 10	11.4	7	Not Visible	RCC Wall type	-	RCC Solid Slab	-
5	No	NH-6	143+205	ROB	LHS	MCW	New	1x37.280+1x25.080+1x31.280+1x15.840+1x31.280+1x31.280+1x22.800+1x37.280+1x28.080+1x37.280+1x37.280+1x37.280+1x23.000+1x25.050+1x64.010	12.3	9.5	Pile	RCC Wall type	RCC Wall type	Steel Girder & Bow String	Pot PTFE
6	30	NH-6	143+319	ROB	RHS	MCW	Old	2 x 8.2	11.3	7	Not Visible	RCC Wall type	Trestle type	RCC Solid Slab	-
7	10	NH-6	143+372	ROB	RHS	MCW	Old	1 x 10.8	11.3	7	Not Visible	RCC Wall type	-	RCC Solid Slab	-

Table 26: Details of RUB

S. No	Skew (Yes/No)	NH No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
												Abutment	Pier		
1	No	NH-6	143+962	RUB	LHS	MCW	New	1 x 11.0	12	10	Raft	RCC Box	RCC Box	RCC Box	-
2	No	NH-6	143+962	RUB	RHS	MCW	Old	2 x 6.2	6	7	Open	RCC Wall type	RCC Wall type	RCC Solid Slab	-

Table 27: Details of Major Bridges

S.No	Skew (Yes/No)	NH No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
												Abutment	Pier		
1	No	NH-6	180+605	MJB	LHS	MCW	New	1 x 12.0+ 5x33.0 + 1 x 12.0	12.5	9.5	Pile	RCC Wall type	RCC Wall type	PSC Girder & Solid slab	Elastomeric & Pot PTFE
2	No	NH-6	180+605	MJB	RHS	MCW	Old	1 x 12.0+ 5x33.0 + 1 x 12.0	8.5	7.5	Well	Trestle type	RCC Wall type	Balanced Cantilever	Rocker & Roller

Table 28: Details of Minor Bridges

S.No	Skew (Yes/No)	NH No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
												Abutment	Pier		
1	No	NH-6	151+061	MNB	LHS	MCW	New	2 x 7.0	12.5	9.5	Raft	RCC Box	RCC Box	RCC Box	-
2	No	NH-6	151+061	MNB	RHS	MCW	New	2 x 7.0	12.5	9.5	Raft	RCC Box	RCC Box	RCC Box	-
3	No	NH-6	157+103	MNB	LHS	MCW	Old	1 x 3.7+2 x 4.2	9.5	8.5	Open	RCC Wall type	RCC Wall type	RCC Solid Slab	-
4	No	NH-6	157+103	MNB	RHS	MCW	New	1 x 11.5	12.5	9.5	Raft	RCC Box	-	RCC Box	-
5	No	NH-6	161+491	MNB	LHS	MCW	Old	3 x 3.8	9.2	8	Open	RCC Wall type	RCC Wall type	RCC Solid Slab	-
6	No	NH-6	161+491	MNB	RHS	MCW	New	1 x 11.0	12.5	9.5	Raft	RCC Box	-	RCC Box	-
7	15	NH-6	165+362	MNB	LHS	MCW	New	2 x 8.0	12.5	9.5	Open	RCC Box	RCC Box	RCC Box	-
8	15	NH-6	165+362	MNB	RHS	MCW	New	2 x 8.0	12.5	9.5	Open	RCC Box	RCC Box	RCC Box	-
9	No	NH-6	165+966	MNB	LHS	MCW	New	2 x 8.0	12.25	9.5	Raft	RCC Box	RCC Box	RCC Box	-
10	No	NH-6	165+966	MNB	RHS	MCW	New	2 x 8.0	12.25	9.5	Raft	RCC Box	RCC Box	RCC Box	-
11	No	NH-6	165+966	MNB	LHS	SR	New	2 x 8.0	10	8.5	Raft	RCC Box	RCC Box	RCC Box	-
12	No	NH-6	165+966	MNB	RHS	SR	New	2 x 8.0	10	8.5	Raft	RCC Box	RCC Box	RCC Box	-
13	No	NH-6	171+508	MNB	LHS	MCW	New	1 x 43.10	12.5	9.5	Pile	RCC Wall type	-	PSC Girder	Pot PTFE

S.No	Skew (Yes/No)	NH No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
												Abutment	Pier		
14	No	NH-6	171+508	MNB	RHS	MCW	Old	2 x 8.8+3 x 8.5	8.5	7.5	-	RCC Wall type	RCC Wall type	RCC Solid Slab	-
15	No	NH-6	178+535	MNB	LHS	MCW	Old	3 x 6.7	8.3	7.5	Open	RCC Wall type	RCC Wall type	RCC Solid Slab	-
16	No	NH-6	178+535	MNB	RHS	MCW	New	3 x 6.6	12.5	9.5	Raft	RCC Box	RCC Box	RCC Box	-
17	No	NH-6	178+939	MNB	LHS	MCW	New	2 x 7.0	12.5	9.5	Raft	RCC Box	RCC Box	RCC Box	-
18	No	NH-6	178+939	MNB	RHS	MCW	Old	2 x 6.7	8.3	7.5	-	RCC Wall type	RCC Wall type	RCC Solid Slab	-
19	40	NH-6	182+031	MNB	LHS	MCW	New	3 x 5.334	12.5	9.5	Raft	RCC Box	RCC Box	RCC Box	-
20	40	NH-6	182+031	MNB	RHS	MCW	New	3 x 5.334	12.5	9.5	Raft	RCC Box	RCC Box	RCC Box	-

Table 29: Details of Interchanges

S.No	Skew (Yes/No)	NH No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
												Abutment	Pier		
1	No	NH-6	129+685	Interchange	LHS	MCW	New	1 x 24.3 + 1 x 32.8 + 1 x 24.3	10	7.5	Not Visible	RCC Wall type	RCC Wall type	PSC Box Girder & Voided slab	Pot PTFE
2	No	NH-6	129+685	Interchange	RHS	MCW	New	1 x 24.3 + 1 x 32.8 + 1 x 24.3	10	7.5	Not Visible	RCC Wall type	RCC Wall type	PSC Box Girder & Voided slab	Pot PTFE

Table 30: Details of VUP's

S.No	Skew (Yes/No)	NH No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure
												Abutment	Pier	
1	45	NH-6	139+897	VUP	LHS	MCW	New	1 x 16.971	14.75	13.5	Raft	RCC Box	-	RCC Box
2	45	NH-6	139+897	VUP	RHS	MCW	New	1 x 16.971	14.75	13.5	Raft	RCC Box	-	RCC Box
3	16	NH-6	142+122	VUP	LHS	MCW	New	1 x 12.484	14.75	13.5	Raft	RCC Box	-	RCC Box
4	16	NH-6	142+122	VUP	RHS	MCW	New	1 x 12.484	14.75	13.5	Raft	RCC Box	-	RCC Box
5	19	NH-6	144+706	VUP	LHS	MCW	New	1 x 12.691	14.75	13.5	Raft	RCC Box	-	RCC Box
6	19	NH-6	144+706	VUP	RHS	MCW	New	1 x 12.691	14.75	13.5	Raft	RCC Box	-	RCC Box
7	No	NH-6	166+457	VUP	LHS	MCW	New	2 x 12.0	14.75	13.5	Raft	RCC Box	RCC Box	RCC Box
8	No	NH-6	166+457	VUP	RHS	MCW	New	2 x 12.0	14.75	13.5	Raft	RCC Box	RCC Box	RCC Box
9	No	NH-6	181+046	VUP	LHS	MCW	New	1 x 12.0	14.75	13.5	Raft	RCC Box	-	RCC Box
10	No	NH-6	181+046	VUP	RHS	MCW	New	1 x 12.0	14.75	13.5	Raft	RCC Box	-	RCC Box

Table 31: Details of PUP's

S.No	Skew (Yes/No)	NH No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure
												Abutment	Pier	
1	9	NH-6	159+010	PUP	LHS	MCW	New	1 x 7.087	14.75	13.5	Raft	RCC Box	-	RCC Box
2	9	NH-6	159+010	PUP	RHS	MCW	New	1 x 7.087	14.75	13.5	Raft	RCC Box	-	RCC Box
3	No	NH-6	165+811	PUP	LHS	MCW	New	1 x 7.0	14.75	13.5	Raft	RCC Box	-	RCC Box
4	No	NH-6	165+811	PUP	RHS	MCW	New	1 x 7.0	14.75	13.5	Raft	RCC Box	-	RCC Box
5	17	NH-6	177+235	PUP	LHS	MCW	New	1 x 7.320	14.75	13.5	Raft	RCC Box	-	RCC Box
6	17	NH-6	177+235	PUP	RHS	MCW	New	1 x 7.320	14.75	13.5	Raft	RCC Box	-	RCC Box
7	4	NH-6	183+218	PUP	LHS	MCW	New	1 x 7.017	14.75	13.5	Raft	RCC Box	-	RCC Box
8	4	NH-6	183+218	PUP	RHS	MCW	New	1 x 7.017	14.75	13.5	Raft	RCC Box	-	RCC Box

Table 32: Details of Cattle Underpasses

S.No	Skew (Yes/No)	NH No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure
												Abutment	Pier	
1	No	NH-6	148+830	CUP	LHS	MCW	New	1 x 7.0	14.5	13.5	Raft	RCC Box	-	RCC Box
2	No	NH-6	148+830	CUP	RHS	MCW	New	1 x 7.0	14.5	13.5	Raft	RCC Box	-	RCC Box
3	No	NH-6	160+843	CUP	LHS	MCW	New	1 x 7.0	14.5	13.5	Raft	RCC Box	-	RCC Box
4	No	NH-6	160+843	CUP	RHS	MCW	New	1 x 7.0	14.5	13.5	Raft	RCC Box	-	RCC Box
5	No	NH-6	162+891	CUP	LHS	MCW	New	1 x 7.0	14.5	13.5	Raft	RCC Box	-	RCC Box
6	No	NH-6	162+891	CUP	RHS	MCW	New	1 x 7.0	14.5	13.5	Raft	RCC Box	-	RCC Box
7	No	NH-6	167+437	CUP	LHS	MCW	New	1 x 7.0	14.5	13.5	Raft	RCC Box	-	RCC Box
8	No	NH-6	167+437	CUP	RHS	MCW	New	1 x 7.0	14.5	13.5	Raft	RCC Box	-	RCC Box
9	No	NH-6	168+963	CUP	LHS	MCW	New	1 x 7.0	14.5	13.5	Raft	RCC Box	-	RCC Box
10	No	NH-6	168+963	CUP	RHS	MCW	New	1 x 7.0	14.5	13.5	Raft	RCC Box	-	RCC Box
11	No	NH-6	172+614	CUP	LHS	MCW	New	1 x 7.0	14.5	13.5	Raft	RCC Box	-	RCC Box
12	No	NH-6	172+614	CUP	RHS	MCW	New	1 x 7.0	14.5	13.5	Raft	RCC Box	-	RCC Box
13	No	NH-6	174+838	CUP	LHS	MCW	New	1 x 7.0	14.5	13.5	Raft	RCC Box	-	RCC Box
14	No	NH-6	174+838	CUP	RHS	MCW	New	1 x 7.0	14.5	13.5	Raft	RCC Box	-	RCC Box

Table 33: Details of Proposed Flyover

S. No	Existing Chainage		Design Chainage		Structure Type	Width (m)	Span (m)	Length (m)	Clear Span (m)	Vertical Clearance (m)
	From(Km)	To (km)	From(Km)	To (km)						
1	137+966	138+034	63+288	63+220	Flyover	2x15	1 x 17.3 + 1 x 33.3 + 1 x 17.3	67.9	1 x 14.87 + 1 x 30 + 1 x 14.87	5.5

Table 34: Details of Proposed Elephant Underpass

S. No	Existing Chainage		Design Chainage		Structure Type	Width (m)	Span (m)	Length (m)	Clear Span (m)	Vertical Clearance (m)
	From (km)	To (km)	From (km)	To (km)						
1	153+953	153+853	47+410	47+310	EUP	2 x 15	2 x 50	100	1 x 47.8 + 1 x 47.8	7

Table 35: Details of Proposed Foot over Bridges

S. No	Existing Chainage	Design Chainage	Span (m)	Vertical Clearance (m)
1	151+990	49+290	1 x 56	6
2	162+070	39+210	1 x 56	6

Table 36: Age of structures

S.No	Type of Str	LHS		RHS		BHS		Total (Nos)		Total no.of Str's
		Old	New	Old	New	Old	New	Old	New	
1	ROB	-	2	5	-	-	-	5	2	7
2	MJB	-	1	1	-	-	-	1	1	2
3	MNB	3	7	2	8	-	-	5	15	20
4	VUP	-	5	-	5	-	-	-	10	10
5	CUP	-	7	-	7	-	-	-	14	14
6	PUP	-	4	-	4	-	-	-	8	8
7	RUB	-	1	1	-	-	-	1	1	2
8	Interchange	-	1	-	1	-	-	-	2	2
9	BC	-	-	-	-	23	4	23	4	27
10	PC	-	-	-	-	1	39	1	39	40

Table 37: Summary of Expansion joints and bearings

S.No	Type of Str	Expansion joints		Bearings					
				Pot PTFE		Elastomeric		Rocker Roller	
		Old	New	Old	New	Old	New	Old	New
1	ROB	2	20	8	144	-	30	-	-
2	MJB	8	8	-	40	-	20	18	-
3	MNB	-	2	-	8	-	-	-	-
4	Interchange	-	8	-	36	-	-	-	-
Total No's		**10**	**38**	**8**	**228**	-	**50**	**18**	-
		48		**304**					

Table 38: Summary and combination of Super Structures

S.No	Type of Str	PSC Box Girder & Voided slab	T-Beam Girder	Balanced Cantilever	RCC Slab	PSC Girder & Solid slab	PSC Girder	RCC Box	Steel Girder	Steel Girder & RCC Solid slab	Steel Girder & Bowstring	Total no.of Structures
1	ROB	-	1	0	3	-	-	-	1	1	1	7
2	MJB	-	-	1	-	1	-	-	-	-	-	2
3	MNB	-	-	-	5	-	1	14	-	-	-	20
4	VUP	-	-	-	-	-	-	10	-	-	-	10
5	CUP	-	-	-	-	-	-	14	-	-	-	14
6	PUP	-	-	-	-	-	-	8	-	-	-	8
7	RUB	-	-	-	1	-	-	1	-	-	-	2
8	Interchange	2	-	-	-	-	-	-	-	-	-	2

Table 39: Summary of Sub Structures

S.No	Type of Str	ABUTMENT				PIER		
		RCC Box	RCC Wall type	Trestle type	Brick Wall type	RCC Box	RCC Wall type	Trestle type
1	ROB	-	6	-	1	-	3	2
2	MJB	-	1	1	-	-	2	-
3	MNB	14	6	-	-	12	5	-
4	VUP	10	-	-	-	2	-	-
5	CUP	14	-	-	-	-	-	-
6	PUP	8	-	-	-	-	-	-
7	RUB	1	1	-	-	-	1	-
8	Interchange	-	2	-	-	-	2	-

Details of Culvert

S No.	Design Chainage (Km)	Type of Culvert As per Site	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
					LHS	RHS	LHS	RHS	
1	132+394	PC	1 x 1.20	30	Not Visible	Not Visible	Not Visible	Not Visible	> Heavy vegetation observed.
2	133+343	PC	1 x 1.20	55	Not Visible	Not Visible	Not Visible	Not Visible	> Heavy vegetation observed.
3	133+505	PC	1 x 1.20	55	Not Visible	Not Visible	Not Visible	Not Visible	> Truck lay bay Location. > Culvert Not visible.
4	133+890	BC	1 x 3	26	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
5	133+910	BC	1 x 3	26	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
6	135+243	BC	1 x 1.5	36.19	Not Visible	Not Visible	Not Visible	Not Visible	> Heavy vegetation observed.
7	135+659	PC	1 x 1.20	30	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
8	136+416	PC	1 x 1.20	35	Not Visible	Not Visible	Not Visible	Not Visible	> Heavy vegetation observed.
9	137+159	BC	1 x 3	50.89	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
10	137+202	BC	1 x 3	50.64	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
11	137+761	BC	1 x 3	26	Not Visible	Not Visible	Yes	Yes	> Vegetation growth observed. > Structure condition is fair.
12	138+165	BC	1 x 2.1	29.53	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
13	138+663	BC	1 x 3	26	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
14	138+891	PC	1 x 0.90	30.85	Not Visible	Not Visible	Not Visible	Not Visible	> Heavy vegetation observed.
15	139+339	PC	1 x 1.20	41.25	Not Visible	Not Visible	Not Visible	Not Visible	> Heavy vegetation observed.
16	139+855	PC	1 x 1.20	52.5	Not Visible	Not Visible	Not Visible	Not Visible	> Connected to drains. > Structure is in fair condition.
17	139+996	PC	1 x 1.20	55	Not Visible	Not Visible	Not Visible	Not Visible	> Connected to drains.
18	140+218	PC	1 x 1.20	53.75	Not Visible	Not Visible	Not Visible	Not Visible	> Connected to drains.
19	140+634	BC	1 x 4.5	42.5	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
20	143+571	PC	2 x 0.90	73.75	Not Visible	Not Visible	Not Visible	Not Visible	> Heavy vegetation observed.

S No.	Design Chainage (Km)	Type of Culvert As per Site	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
					LHS	RHS	LHS	RHS	
21	144+678	PC	2 x 1.20	51.25	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
22	144+693	PC	2 x 0.90	61.1	Not Visible	Not Visible	Not Visible	Not Visible	> Connected to drains.
23	144+901	BC	1 x 3	42.5	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
24	145+794	PC	2 x 0.90	28.75	Yes	Yes	Yes	Yes	> Vegetation growth observed. > Structure condition is fair.
25	146+273	BC	1 x 5.8	26	Yes	Yes	Yes	Yes	> Structure condition is fair.
26	146+625	PC	1 x 1.20	41.25	Not Visible	Not Visible	Yes	Yes	> Vegetation growth observed. > Structure condition is fair.
27	146+650	PC	1 x 1.20	42.5	Not Visible	Not Visible	Not Visible	Not Visible	> Not found on the site.
28	148+020	PC	1 x 1.20	31.25	Not Visible	Not Visible	Not Visible	Not Visible	> Heavy vegetation observed.
29	148+496	PC	2 x 1.20	30	Yes	Yes	Yes	Yes	> Structure condition is fair.
30	149+226	PC	2 x 1.20	30	Yes	Yes	Yes	Yes	> Structure condition is fair.
31	149+682	PC	2 x 1.20	33.75	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
32	149+876	BC	1 x 2.7	26	Yes	Yes	Yes	Yes	> Structure condition is fair.
33	150+900	PC	2 x 1.20	31.25	Not Visible	Not Visible	Yes	Yes	> Vegetation growth observed. > Structure condition is fair.
34	151+422	PC	1 x 1.20	32.5	Yes	Yes	Yes	Yes	> Structure condition is fair.
35	151+595	BC	1 x 1.5	34	Not Visible	Not Visible	Yes	Yes	> Vegetation growth observed. > Structure condition is fair.
36	152+546	PC	1 x 1.20	36.162	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
37	152+687	BC	1 x 3	26	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
38	153+679	PC	1 x 1.20	37.5	Not Visible	Not Visible	Yes	Yes	> Canal type culvert. > Structure is in fair condition.

S No.	Design Chainage (Km)	Type of Culvert As per Site	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
					LHS	RHS	LHS	RHS	
39	153+946	BC	1 x 2.3	26	Not Visible	Not Visible	Yes	Yes	> Vegetation growth observed. > Structure condition is fair.
40	155+796	PC	1 x 1.20	28.75	Not Visible	Not Visible	Yes	Yes	> Vegetation growth observed. > Structure condition is fair.
41	156+015	PC	1 x 1.20	28.75	Yes	Yes	Yes	Yes	> Structure condition is fair.
42	156+209	BC	1 x 6	26	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
43	157+867	BC	1 x 3	85.73	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
44	158+435	BC	1 x 3	26	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
45	159+097	PC	1 x 0.90	46.25	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
46	159+646	BC	1 x 3	42.5	Not Visible	Not Visible	Yes	Yes	> Vegetation growth observed. > Structure condition is fair.
47	163+445	BC	1 x 3	26	Yes	Yes	Yes	Yes	> Structure condition is fair.
48	163+760	PC	1 x 1.20	32.5	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
49	164+719	PC	1 x 1.20	31.25	Not Visible	Not Visible	Not Visible	Yes	> Structure condition is fair. > LHS Buried.
50	166+301	PC	1 x 1.20	27.5	Not Visible	Not Visible	Not Visible	Not Visible	> Connected to Drains.
51	166+471	PC	1 x 1.20	27.5	Not Visible	Not Visible	Not Visible	Not Visible	> Connected to Drains.
52	168+831	PC	3 x 1.0	39.7	Not Visible	Not Visible	Yes	Yes	> Vegetation growth observed. > Structure condition is fair.
53	169+207	PC	4 x 1.20	30	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
54	169+735	PC	2 x 1.20	31.25	Yes	Yes	Yes	Yes	> Vegetation growth observed. > Structure condition is fair.
55	170+203	PC	2 x 1.20	32.5	Yes	Yes	Yes	Yes	> Structure condition is fair.

S No.	Design Chainage (Km)	Type of Culvert As per Site	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
					LHS	RHS	LHS	RHS	
56	172+290	PC	1 x 1.20	33.75	Not Visible	Not Visible	Yes	Yes	> Vegetation growth observed. > Structure condition is fair.
57	174+195	PC	2 x 1.20	28.75	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
58	174+460	BC	1 x 1.5	31.661	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
59	175+381	BC	1 x 3	26	Yes	Yes	Yes	Yes	> Structure condition is fair.
60	176+371	BC	1 x 3	26	Not Visible	Not Visible	Yes	Yes	> Vegetation growth observed. > Structure condition is fair.
61	177+600	PC	1 x 1.20	46.25	Not Visible	Not Visible	Yes	Yes	> Fully Covered with Debris.
62	178+258	PC	1 x 1.20	38.75	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
63	179+198	BC	1 x 4.5	26	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
64	180+357	BC	1 x 1.5	26	Yes	Yes	Yes	Yes	> Structure condition is fair.
65	180+997	BC	1 x 3	43.5	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
66	181+639	PC	1 x 1.20	33.75	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.
67	183+656	BC	1 x 3	43.1	Not Visible	Not Visible	Yes	Yes	> Structure condition is fair.

Photos of Box/Slab Culverts:

Box Culvert at CH: 133+890

Box Culvert at CH: 133+910

Box Culvert at CH: 138+165

Box Culvert at CH: 144+901

Box Culvert at CH: 151+595

Box Culvert at CH: 153+946

Photos of Box/Slab Culverts:

Box Culvert at CH: 158+435

Box Culvert at CH: 174+460

Box Culvert at CH: 175+381

Box Culvert at CH: 179+198

Box Culvert at CH: 180+357

Box Culvert at CH: 183+656

Photos of Pipe Culverts:

Pipe Culvert at CH: 138+891

Pipe Culvert at CH: 144+693

Pipe Culvert at CH: 146+625

Pipe Culvert at CH: 148+496

Pipe Culvert at CH: 150+900

Pipe Culvert at CH: 151+422

Photos of Pipe Culverts:

Pipe Culvert at CH: 155+796

Pipe Culvert at CH: 159+097

Pipe Culvert at CH: 164+719

Pipe Culvert at CH: 168+831

Pipe Culvert at CH: 174+195

Pipe Culvert at CH: 178+258

4.7 DRAINAGE AND SLOPE PROTECTION

RCC covered drains constructed along the corridor appear to be in good condition for most of length and functioning well.

Median drain provided at only one location and it is in good condition

Slope protection in the form of RE & RCC walls has been provided along the corridor and is mentioned in the tables above.

4.8 TRAFFIC SAFETY AND ROAD FURNITURE

Metal beam crash barriers provided along the project road appear to be fair over entire length except for few locations where it got damaged.

Pedestrian guard rails installed in between MCW & Service Road locations appear to be in fair condition. At some locations small length damaged and missing.

Median Opening locations appear to be in fair condition.

Traffic blinkers observed at median openings and these are in working condition

Roadway delineators installed along the length of corridor appear to be good condition at most of locations. Very few delineators got damaged.

4.9 ROAD USER FACILITITES

The Bus Bay with Bus Shelters and Truck lay bye provided along the corridor appear to be fair in condition.

CHAPTER 5. REHABILITATION PLANS AND DESIGNS

5.1 DESIGN TRAFFIC LOADING

Design Traffic loading has been estimated by considering the traffic data (given) and VDFs as estimated from the latest axle load survey data for all types of vehicles for the design period of 10 years, 15 years and 20 years as below:

Table 40: Traffic Volume (AADT)

Vehicle/Mode	AADT at 157.850 FY23 (Vehicles)
LCV	239
2A truck	2048
3A truck	1072
MAV truck	3171
BUS	146

Note: 50:50 directional distributions are considered.

Table 41: Estimated Design traffic loading

Year	FY	Design Lane MSA on Existing Carriageway	
		Km 157.850	
		UP	DN
10th year from Now	2032	188	92
15th year from Now	2037	323	157
20th year from Now	2042	494	241

Note: Growth rate with 5% has been considered in the analysis.

The computation of traffic loadings is presented in **Appendix 9** of this Report. The traffic loading appears more LHS direction when compare to RHS direction. Design traffic corresponding to 10 years period has been considered for overlay design.

5.2 PAVEMENT REHABILITATION AND STRENGTHENING

5.2.1 Rigid Pavement Strengthening

Based on the FWD survey and their results it appears that about 65% in LHS, 87% in RHS of the flexural strength values ranges from 4 MPa to more than 4.5 MPa. The rigid pavement design period has been checked with various flexural strength values by considering the existing PQC & DLC thickness.

Number of axle load repetitions for each year of operation is estimated and cumulated for entire operation period of 20 years from now. Using IRC 58-2015 design charts, stress ratios corresponding each Flexural strength values ranging from 4MPa-4.5MPa have been estimated and number repetitions that existing pavement serves is also established.

The summary of the Design period satisfies for various flexural strength values as given below:

Flexural Strength (Mpa)	Existing Rigid Pavement Thickness satisfies to the design period in Years	
Side	LHS	RHS
3.88 / 3.73	10 Years	10 Years
4.02 / 3.87	20 Years	20 Years
3.75	5 Years	11 Years
4.0	18 Years	30 Years
4.5	30 Years	30 Years

From the FWD data analysis it is found that nearly 79% points in on LHS & 90% points in RHS were having flexural strength values more than 3.75Mpa. These are considered to be fair condition and requires minimal maintenance. Similarly, flexural strength values less than 3.75mpa were considered to be average to poor condition and are estimated nearly 21% of samples in on LHS & 10% sample in RHS of project road may require major rehabilitation measures during operation period. Thus, the same has been considered in cost estimates apart from routine and periodic maintenance of rigid pavement

5.2.2 Flexible Pavement Strengthening

For Design the Overlay Thickness the following method as suggested in IRC: 115 has been used

- The existing pavement is considered as a 3-layer system consisting of subgrade, granular and bituminous layer. The remaining life of exiting pavement in terms of Fatigue and Rutting life (MSA) are estimated.
- The remaining life is compared with design traffic loading. An overlay with assumed thickness is considered on exiting pavement where required.
- The total system including the proposed Overlay (Trial thickness) is assumed as a four-layer system and considered the relevant MR values for all the four layers namely New BT layer, existing bituminous surface, total existing Granular layers and Subgrade layers.
- The MR value for the new BT is assumed as 3000 MPA (considering VG40 Bituminous grade) and for all the remaining three layers, the MR Values derived and finalized from the FWD Analysis are considered
- Critical tensile strains and Vertical strains are found out by using the IIT PAVE Software at the bottom of existing bituminous layer and at the top of the subgrade layer respectively.
- The Fatigue and Rutting equations (equation given in the IRC: 115) have been used to estimate the Fatigue and Rutting Life of the Pavement system.
- The obtained Fatigue and Rutting Life are compared with the required life for the assumed trial overlay thickness.

Remaining life of the existing pavement from the above analysis is presented in the following tables:

Table 42: Remaining life of the existing pavement on Both Carriageways

Sections	From (km)	To (km)	Length (km)	BT layer MR value, MPa	Granular Layer MR value, MPa	Subgrade MR value, MPa	Existing BT layer thickness (mm)	Existing Granular thickness (mm)	Total BT thickness (mm)	Total Crust (mm)	BT layer MR value, MPa	ver. Strain (Ev)x 10^6	tan. Strain (Et) x 10^6	Nf- Fatigue life, MSA	Rutting life, MSA
LHS															
1	134.40	131.42	3.0	2040	391	87	220	490	220	710	2040	163.6	108.7	278	2064
2	131.42	129.00	2.4	2062	393	86	220	490	220	710	2062	163.9	108	283	2047
RHS															
1	134.40	132.02	2.4	2034	394	86	200	540	200	740	2034	158.3	118	203	2397
2	132.02	129.00	3.0	2051	393	86	200	540	200	740	2051	158.2	117.8	203	2404

It can be seen from the above table, there is no requirement of strengthening overlay in both the carriageways as the remaining life of these sections is more than the 10th year Design traffic loading, 188 MSA in LHS & 92 MSA.

5.3 STRUCTURAL REHABILITATION

All the structure found to be in good condition except minor treatment like repair of stone pitching, cleaning of drainage spouts, cleaning of vegetation etc. may be required. Detailed structural rehabilitation quantities have been worked out based on the prevailing condition of existing structures. This methodology describes in detail the procedure for the execution of each item of rehabilitation work of the Existing Bridges of the project.

The scope of this methodology covers the items mentioned below for rehabilitation work of all the existing Bridges.

- Repair/ Replacement of Existing Bearings
- Repair / Replacement of Existing Expansion Joints
- Repair / Replacement of Existing Wearing Coat
- Profile Correction for Existing Deck Slab by Cement Concrete
- Sealing of Cracks for Bridges by Epoxy Resin
- Replacement of Spalled Concrete of ECW by Epoxy Mortar
- Cement Grouting for Repair of Existing Bridges
- Guniting / Shotcrete for Repair of Existing Bridges
- Providing & Fixing of Drainage Spouts
- Repair of Substructure Component

- Repair / Replacement of Railing & Crash Barrier
- Epoxy Bonding between New and Old Concrete

About 7 Nos. of locations, structures are closely monitored by use of Mobile Bridge Inspection Unit (MBIU). Details of these structures where MBIU is used are presented in the following table

Table 43: Locations of MBIU survey

S.No	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Remarks
1	143+205	ROB	LHS	MCW	New	1x37.280+1x25.080+1x31.280+ 1x15.840+1x31.280+1x31.280+ 1x22.800+1x37.280+1x28.080+ 1x37.280+1x37.280+1x37.280+ 1x23.000+1x25.050+1x64.010	
2	137+140	ROB	LHS	MCW	New	1 x 14.255 + 1 x 37.280 + 1 x 22.0	
3	180+605	MJB	LHS	MCW	New	1 x 12.0+ 5x33.0 + 1 x 12.0	
4	180+605	MJB	RHS	MCW	Old	1 x 12.0+ 5x33.0 + 1 x 12.0	
5	171+508	MNB	LHS	MCW	New	1 x 43.10	
6	129+685	Interchange	LHS	MCW	New	1 x 24.3 + 1 x 32.8 + 1 x 24.3	
7	129+685	Interchange	RHS	MCW	New	1 x 24.3 + 1 x 32.8 + 1 x 24.3	

Based on the Visual Inspection, as the structures are in fair condition there is no necessity of NDT tests to evolve rehabilitation strategies for the following structures.

5.4 DEVELOPMENT ZONES (SCHEDULE-B PROVISIONS)

5.4.1 Maintenance work

Schedule B stipulates the obligation of immediate maintenance which is to be done by the incoming Concessionaire. However, NHAI has represented to NHIT that they will undertake the immediate maintenance themselves, confirming to CA obligations, before handing over the asset to NHIT.

5.4.2 Project facilities

5.4.2.1 Truck lay-bye

Truck Lay bye shall be retained and maintained/ modified as per IRC: SP: 84-2019. The existing toilets (if available or when provided by the authority) shall be suitably modified (including ramp facility) to give an aesthetically pleasing look and shall gel with the surroundings. The Sewage disposal system shall be through Bio-digestible system (including Septic Tank & Soak pit). The drinking water facility shall be RO Treated Water.

5.4.2.2 Bus bay and shelter

Bus bay and Shelter bye shall be provided at the following locations as per IRC: SP:84- 2019 within the ROW. The bus bay location can be changed as per site conditions.

The existing toilets (if available or when provided by the authority) shall be suitably modified to give an aesthetically pleasing look and shall gel with the surroundings. The Sewage disposal system shall be through Bio-digestible system (including Septic Tank & Soak pit). The drinking water facility shall be RO Treated Water.

Table 44: New bus bay with bus shelter

S. No.	Chainage (km)	Side
1	130+550	LHS
2	134+000	Both side

Sample photographs showing the locations of proposed Bus bay with bus shelters are presented below:

Proposed Bus bay with bus shelter Location at Km 134.000 LHS

Proposed bay with bus shelter Location at Km 134.000 RHS

5.4.2.3 Highway lighting

The Concessionaire shall provide the lighting at the following locations as per the Manual for Four Laning IRC: SP: 84-2019.

I. Truck Lay byes

II. Toll Plaza Approach & Canopy (including existing lighting in the approaches of Toll Plaza shall be re-instated).

III. Grade Separated Structures: The Flyovers, ROB and service /slip roads shall have lighting with solar energy system, as per Manual.

Lighting shall be provided at top & underside of the Grade Separated structures.

The locations are given below:

Table 45: Lighting proposal

S. No.	Chainage (km)		Length (m)	Side	Location
	From	to			
1	130+000	130+490	490	Median	Double arm on Median
2	130+490	132+160	1670	Median	Double arm on Median
3	132+160	132+740	580	Median	Double arm on Median
4	132+980	133+375	395	Median	Double arm on Median
5	133+375	133+840	465	Both	Double arm on both separator
6	136+230	136+700	470	Median	Double arm on Median
7	137+500	139+300	1800	Median	Double arm on Median
8	155+000	155+250	250	Median	Double arm on Median
9	161+900	162+300	400	Median	Double arm on Median
10	181+000	181+400	400	Both	Single arm on SR on BHS

5.4.3 Completion Schedule for Improvement Proposals

Completion schedule for Scope mentioned in Schedule-B shall be as below.

S. No.	Description of Work	Date of Completion
1	Incident Management (Section 11.7, 11.8, 11.9)	From Appointed Date
2	Installation / Landscaping and Tree Plantation (Section 11.4)	6 months from Appointed Date
3	Maintenance and Rehabilitation (Section 4)	6 months from Appointed Date
4	Toll Plaza and other facilities at Toll Plaza (Section 11.1,11.11,11.12)	From Appointed Date
5	Other Improvements (Section 1,2,3,5,6,7,8,9,10,11.2,11.3,11.5,11.6,12)	12 months from Appointed Date

CHAPTER 6. OPERATION AND MAINTENANCE

6.1 INTRODUCTION

Looking at the contractual requirements of maintaining project road under specified level of roughness it is felt that roughness is the most important criterion for finalizing the O&M schedule for the project. Accordingly, the methodology adopted by present consultants includes predicting the roughness year by year under the traffic using a well acknowledged HDH-4 model developed for developing countries like India after lot of research by World Bank. The said model is widely prescribed by MORTH and NHAI during the preparation of detailed project reports for several projects in doing economic analysis for the projects. The economic analysis mainly consists of two parts:

1. Predicting the road deterioration and estimating VOC
2. Estimating Benefits

Considering its importance and present use in India, consultants felt prudent to use the first part, i.e., estimating road deterioration and predicting roughness in HDM 4 model to finalize the O&M schedule for the project. This approach is more scientific and includes main criterion of at 2400 mm/Km as per Schedule-F.

6.2 CA SPECIFICATIONS FOR MAJOR MAINTENANCE

Schedule F prescribe the maintenance standards to be adopted for project. Summary of same is presented below.

- Schedule F of CA specifies that Roughness values exceeds 2400 mm/km in a length of KM, needs to be corrected within 180 days.

Maintenance standards given under Schedule-F are given in table below:

Table 46: Maintenance Criteria for Pavements

Asset Type	Performance Parameter	Level of Service (LOS)		Frequency of Inspection	Tools / Equiment	Standards and References for Inspection and Data Analysis	Time limit for Rectification / Repair	Maintenance specifications
		Desirable	Acceptable					
Flexible Pavement Programmed Inspection	Rutting	<10mm for any 50 m section and/or, length of section <5m	<10mm for any 50 m section and/or, length of section <10m	Bi- Annually	(NSV) with all its module such as Laser Profilometer, Transverse profile logger, Laser crack measurement system, Video logging modules, high resolution Odometer etc.	measuring Longitudinal Profile of Travelled Surfaces with Accelerometer Established Inertial Profiling Reference and ASTM E1656 - 94:2000- Standard Guide for Classification of Automatic Pavement Condition Survey Equipment	15-30 days	IRC:82-2015
	Pavement rating based on distress per IRC 82 / Pavement Condition Index as per ASTM 6433-07	>3/85	>2.1/70	Bi- Annually			180 days	IRC:82-2015/ ASTM D 6433-07
	Other Pavement Distresses	-	-	Bi- Annually			2-7 days	IRC:82-2015
	Skid	60SN	50SN	Bi- Annually	SCRIM (Sideway force Coefficient Routine Investigation Machine or equivalent) British Pendulum Tester	IRC:82-2015	180 days	BS:7941-1:2006, IRC:82-2015/ ASTM 274

<table>
<tr><th rowspan="2">Asset Type</th><th rowspan="2">Performance Parameter</th><th colspan="2">Level of Service (LOS)</th><th rowspan="2">Frequency of Inspection</th><th rowspan="2">Tools / Equiment</th><th rowspan="2">Standards and References for Inspection and Data Analysis</th><th rowspan="2">Time limit for Rectification / Repair</th><th rowspan="2">Maintenance specifications</th></tr>
<tr><th>Desirable</th><th>Acceptable</th></tr>
<tr><td></td><td>Deflection/ Remaining Life</td><td></td><td>-</td><td>Annually</td><td>Falling Weight Deflectometer</td><td>IRC 115: 2014</td><td>180 days</td><td>IRC:115-2014</td></tr>
<tr><td rowspan="2">Rigid Pavement (Pavement of MCW, Service Road, Grade separated structure, approaches of connecting roads, slip roads, lay byes etc. as applicable.</td><td>Roughness BI</td><td><2200mm/km</td><td><2400mm/km</td><td>Bi- Annually</td><td>Class I Profilometer Mounted on NSV</td><td>ASTM E950 (98) :2004 and ASTM E1656 -94: 2000</td><td>180 days</td><td>IRC:SP:83-2018</td></tr>
<tr><td>Skid</td><td colspan="2">Skid Resistance No. at different speed of vehicles
<table><tr><th>Minimum SN</th><th>Traffic Speed</th></tr><tr><td>36</td><td>50</td></tr><tr><td>33</td><td>65</td></tr><tr><td>32</td><td>80</td></tr><tr><td>31</td><td>95</td></tr><tr><td>31</td><td>100</td></tr></table></td><td>Bi- Annually</td><td>SCRIM (Sideway force Coefficient Routine Investigation Machine or equivalent) British Pendulum Tester</td><td>IRC: SP:83-2018</td><td>180 days</td><td>IRC:SP:83-2018</td></tr>
<tr><td rowspan="4">Embankment /Slope</td><td>Edge drops at shoulders</td><td>Nil</td><td>40mm</td><td>Daily</td><td rowspan="3">Length Measurement Unit like Scale, Tape, odometer etc.</td><td rowspan="4">IRC</td><td>7-15 days</td><td>MORT&H Specification</td></tr>
<tr><td>Slope of camber/cross fall</td><td>Nil</td><td><2% variation in prescribed slope of camber /cross fall</td><td>Daily</td><td>7-15 days</td><td>MORT&H Specification</td></tr>
<tr><td>Embankment Slopes</td><td>Nil</td><td><15 % variation in prescribe side slope</td><td>Daily</td><td>7-15 days</td><td>MORT&H Specification</td></tr>
<tr><td>Embankment Protection</td><td>Nil</td><td>Nil</td><td>Daily</td><td>NA</td><td>7-15 days</td><td>MORT&H Specification</td></tr>
</table>

Asset Type	Performance Parameter	Level of Service (LOS)		Frequency of Inspection	Tools / Equiment	Standards and References for Inspection and Data Analysis	Time limit for Rectification / Repair	Maintenance specifications
		Desirable	Acceptable					
	Rain Cuts/Gullies in slope	Nil	Nil	Daily Specially During Rainy Season	NA	IRC	7-15 days	MORT&H Specification
Cut Section/ Slope	Unstable Slopes	Nil	-		NA	IRC	2-7 days	MORT&H Specification

Table 47: Maintenance Criteria for Rigid Pavements

S. No	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	For the case d > D/2
CRACKING						
1	Single Discrete Cracks Not intersecting with any joint Single Transverse (or Diagonal) Crack intersecting with one or more joints	w =width of crack, L =length of crack, d =depth of crack, D =depth of slab	0	Nil, not discernible	No Action	-
			1	w < 0.2 mm. hair cracks		
			2	w = 0.2-0.5 mm, discernible from slow- moving car	Seal without delay	Full Depth Repair Dismantle and reconstruct affected portion - See Para 5.4, within 15 days
			3	w =0.5-1.5 mm, discernible from fast- moving car		
			4	w =1.5-3.0 mm	Seal and stitch if L > l m. within 7 days	
			5	w>3 mm.		
2	Single Transverse (or Diagonal) Crack	w =width of crack, L =length of crack,	0	Nil, not discernible	No Action	

S. No	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	For the case d > D/2
	intersecting with one or more joints	d =depth of crack, D =depth of slab	1	w<0.2 mm. hair cracks	Route and seal with Epoxy within 7 days	Seal Staple within 15days & Cross stich
			2	w =0.2-0.5 mm, discernible from slow- moving car		
			3	w =0.5-3.0 mm, discernible from fast- moving car	Seal and stitch, if L > l m. within 7 days	Full Depth Repair Dismantle and reconstruct affected portion with norms & Specifications - See Para 5.5 &refer chapter 9 of IRC: SP:83-2018, within 15 days.
			4	w =3.0-6.0 mm	Not Applicable	Staple or Dowel Bar Retrofit within 15 days.
			5	w > 6 mm, usually associated with spalling, and/or slab rocking under traffic	Not Applicable, (full depth crack)	Staple or Dowel Bar Retrofit within 15 days
3	Single Longitudinal Crack intersecting with one or more joints	w = width of crack L = length of crack d = depth of crack D = depth of slab	0	Nil, not discernible	No Action	
			1	w < 0.5 mm, discernable from slow moving vehicle	Seal and stich if L >l m within 7 days	Seal and Cross-Stich or Staple within 15 days
			2	w =0.5-3.0 mm, discernible from fast vehicle		
			3	w =3.0-6.0 mm	Seal & Staple, within 15 days	Partial Depth Repair with or without dowel bar retrofit within 15 days or
			4	w =6.0-12.0 mm, usually associated with spalling	Not applicable	

S. No	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	For the case d > D/2
			5	w > 12 mm, usually associated with spalling, and/or slab rocking under traffic	Not Applicable, (Rocking/ Spalling indicates full depth crack)	Full Depth Repair Dismantle and reconstruct affected portion - See Fig 5.6 and Chapter 9 of IRC: SP:83-2018, within 15 days
4	Multiple Cracks intersecting with one or more joints	w = width of crack	0	Nil, not discernible	No Action	
			1	w<0.2 mm. hair cracks	Seal and stitch if L > l m. within 15 days	Dismantle and Reconstruct whole slab as per Specifications
			2	w =0.2-0.5 mm, discernible from slow- moving car		
			3	w =0.5–3.0 mm, discernible from fast- moving car	Full depth repair within 15 days	within 30days.
			4	w=3.0-6.0 mm panel broken into 2 or 3 pieces		
			5	w>6 mm and/or panel broken into more than 4 pieces		Reinstate sub- base, reconstruct whole slab within 30days.
5	Corner Break	w = width of crack, L = length of crack	0	Nil, not discernible	No Action	
			1	w<0.5 mm; only 1 corner broken	Seal with low viscosity epoxy to secure broken parts within 7 days	
			2	w<1.5 mm; L<0.6 m, only one corner broken		
			3	w<1.5 mm; L<0.6 m,	Partial Depth (Refer Figure 8.3 of IRC: SP:83-2018) within 15 days	Full depth repair within 30 days.
			4	w>1.5 mm; L>0.6 m or three corners broken		

S. No	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	For the case d > D/2
			5	three or four corners broken		Reinstate sub-base, and reconstruct the slab as per norms & Specifications within 30 days.
6	Punchout (Applicable to Continuous Reinforced Concrete Pavement CRCP only)	w = width of crack L = length (m/m2)	0	Nil, not discernible	No Action	
			1	w<0.5 mm; L<3 m/m2	Not Applicable, (Punch- out is full depth Distress)	Seal with low viscosity epoxy to secure broken parts Within 15 days
			2	either w>0.5 mm or L<3 m/m2		
			3	w>1.5 mm and L< 3 m/m2		
			4	w>3 mm, L<3 m/m2 and deformation		Full depth repair - Cut out and replace damaged area taking care not to damage reinforcement. Within 30 days.
			5	w>3 mm, L>3 m/m2 and deformation		
Surface Defects						
					Short Term	**Long Term**
7	Ravelling or Honeycomb type surface	r = area damaged surface/total surface of slab (%) h = maximum depth of damage	0	Nil, not discernible	No action.	Not Applicable
			1	r < 2 %	Local repair of areas damaged and liable to damage. Within 15 days	
			2	r = 2 - 10 %		
			3	r = 10-25%	Bonded Inlay, if affecting 2 or 3 slabs. Within 30 days	
			4	r = 25 - 50 %		
			5	r > 50% and h > 25 mm	Reconstruct slabs, if affecting 4 or more slabs. Within 30 days	
8	Scaling	r = area damaged surface/total	0	Nil, not discernible	No action.	Not Applicable

S. No	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	For the case d > D/2
		surface of slab (%) h = maximum depth of damage	1	r < 2 %	Local repair of areas damaged and liable to within 7 days	
			2	r = 2 - 10 %		
			3	r = 10 - 20%	Bonded Inlay within 15 days	
			4	r = 20 - 30 %		
			5	r > 30 % and h > 25 mm	Reconstruct slab within 30 days.	
9	Polished Surface/Glazing	t = texture depth, sand patch test	0		No action.	Not Applicable
			1	t > 1 mm		
			2	t = 1 - 0.6 mm	Monitor rate of deterioration	
			3	t = 0.6 - 0.3 mm		
			4			
			5	t<0.3 mm	Diamond Grinding if affecting 50% or more slabs in a continuous stretch of minimum 5 km. Within 30 days	
10	Popout (Small Hole), Pothole Refer Para 8.4	n = number/m2, d = diameter, h = maximum depth	0	d < 50 mm; h < 25mm; n < 1 per 5m2	No action.	Not Applicable
			1	d = 50 - 100 mm; h < 50 mm; n < 1 per 5 m2	Partial depth repair 65 mm deep. Within 15 days	
			2	d = 50 - 100 mm; h >50 mm; n < 1 per 5 m2		

S. No	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	For the case d > D/2
			3	d = 100 - 300 mm; h <100 mm n < 1 per 5 m2	Partial depth repair 110mm i.e.,10 mm more than the depth of the hole within 30 days	
			4	d = 100 - 300 mm; h >100 mm; n < 1 per 5 m2		
			5	d > 300 mm; h > 100 mm: n > 1per 5 m2	Full depth repair within 30 days.	
JOINT DEFECT						
					Short Term	**Long Term**
11	Joint Seal Defects	loss or damage L = Length as % total joint length	0	Difficult to discern.	No action.	
			1	Discernible, L< 25% but of little immediate consequence with regard to ingress of water or trapping incompressible material.	Clean joint, inspect later.	Not Applicable
			3	Notable. L > 25% insufficient protection against ingress of water and trapping incompressible material	Clean and reapply sealant in selected locations. Within 7 days.	
			5	Severe; w > 3 mm negligible protection against ingress of water and trapping incompressible material.	Clean, widen and reseal the joint following strict procedures within 7 days.	
12	Spalling of Joints	w = width on either side of the joint L = length of	0	Nil, not discernible	No action.	
			1	w < 10 mm	Apply low viscosity epoxy resin/mortar	

S. No	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	For the case d > D/2
		spalled portion (as % joint length)	2	w = 10 - 20 mm, L < 25%	in cracked portion within 7days	
			3	w = 20 - 40 mm, L > 25%	Partial Depth Repair, 30 - 50 mm deep, h = w+ 20% of w, within 30 days	
			4	w = 40 - 80 mm, L > 25%		
			5	w > 80 mm, and L > 25%	50 - 100 mm deep repair. H = w + 20% of w, within 30 days	
13	Faulting (or Stepping) in Cracks or Joints	f = difference of level	0	not discernible, < 1 mm	No action.	
			1	f < 3 mm		
			2	f = 3 - 6 mm	Determine cause and observe	
			3	f = 6 - 12 mm	Diamond Grinding within 15 days	
			4	f= 12 - 18 mm	Raise sunken slab within 15 days.	
			5	f> 18 mm	Strengthen subgrade and sub-base by grouting, within 30 days.	
14	Blowup or Buckling	h = vertical displacement from normal profile	0	Nil, not discernible	No action.	
			1	h < 6 mm		
			2	h = 6 - 12 mm	Install Signs to Warn Traffic, within 24 hours days	
			3	h = 12 - 25 mm		
			4	h > 25 mm	Full Depth Repair, within 30 days.	

S. No	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	For the case d > D/2
			5	shattered slabs, i.e. 4 or more pieces	Replace broken slabs, within 30 days.	
15	Depression	h = negative vertical displacement from normal profile. L = length	0	Not discernible. h < 5 mm	No action.	
			1	h = 5 - 15 mm		
			2	h = 15 - 30 mm, Nos <20% joints	Install Signs to Warn Traffic, within 24 hours	
			3	h = 30 - 50 mm		
			4	h > 50 mm or > 20% joints	Strengthen subgrade. Reinstate pavement at normal level, within 30 days.	
			5	h > 100 mm		
16	Heave	h = positive vertical displacement from normal profile. L = length	0	Not discernible. h < 5 mm	No action.	
			1	h = 5 - 15 mm	Follow up.	
			2	h = 15 - 30 mm, Nos<20% joints	Install Signs to Warn Traffic, within 24 hours	
			3	h = 30 - 50 mm		
			4	h > 50 mm or > 20% joints	Stabilize subgrade. Reinstate pavement at normal level, within 30 days	
			5	h > 100 mm		
17	Bump	h = vertical displacement from normal profile	0	h < 4 mm	No action.	
			1	h = 4 - 7 mm	Grind, in case of new construction. Within 7 days	
			3	h = 7 - 15 mm	Grind in case of Ongoing	
			5	h > 15 mm		

S. No	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	For the case d > D/2
					maintenance within 15 days	
18	Lane to Shoulder Drop- off	f = difference of level	0	Nil, not discernible < 3mm	No action.	
			1	f = 3 - 10 mm	Spot repair of shoulder. Within 3 days	
			2	f = 10 - 25 mm		
			3	f = 25 - 50 mm	Fill up shoulder within 7 days	
			4	f = 50 - 75 mm		For any 100 m segment, reconstruct shoulder, if affecting 25% or more of segment, within 30 days.
			5	f > 75 mm		
DRAINAGE						
					Short Term	**Long Term**
19	Pumping	quantity of fines and water expelled through open joints and cracks Nos/100 m stretch	0	not discernible	No action.	
			1 to 2	slight/occasional Nos< 10%	Repair cracks and joints without delay	Inspect and repair Sub-drainage at distressed sections and upstream
			3 to 4	appreciable/Frequent 10 - 25%	Lift or jack slab within 30 days.	
			5	Abundant crack development > 25%	Repair distressed pavement sections. Strengthen subgrade And sub-base. Replace slab. Within 30 days.	
20	Ponding		0-2	No discernible problem	No action.	

S. No	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	For the case d > D/2
		Ponding on slabs due to blockage of drains	3 to 4	Blockages observed in drains, but water flowing	Clean drains etc., follow up, deep groving in transverse direction to remove water, within 7 days	Action required to stop water damaging foundation within 15 days.
			5	Ponding, accumulation of water observed	Deep groving in transverse direction to remove water-hydro planning within 7 days	

Table 48: Maintenance Criteria for Safety Related Items and Other Furniture Items

Asset Type	Performance Parameter	Level of Service (LOS)			Frequency of Measurement	Testing Method	Recommended Remedial Measures	Time limit for Rectification	Specifications and Standards
		Design Speed (kmph)	Desirable Minimum Sight Distance (m)	Safe Stopping Sight Distance (m)					
Highway	Availability of Safe Sight Distance	As per IRC SP: 84-2019, a minimum of safe stopping sight distance shall be available throughout.			Monthly	Manual Measurements With Odometer along with	Removal of obstruction within 24 hours, in case of sight line affected by temporary objects such as trees, temporary encroachments.		IRC: SP:84-2019
		100	360	180					
		80	260	130		video/ image backup	In case of permanent structure or design deficiency: * Removal of obstruction/ improvement of deficiency at the earliest * Speed Restriction boards and		

Asset Type	Performance Parameter	Level of Service (LOS)			Frequency of Measurement	Testing Method	Recommended Remedial Measures	Time limit for Rectification	Specifications and Standards
		Design Speed (kmph)	Desirable Minimum Sight Distance (m)	Safe Stopping Sight Distance (m)					
							suitable traffic calming measures such as transverse bar marking, blinkers, etc. shall be applied during the period of rectification.		
Pavement Marking	Wear	<70% of marking remaining			Bi-Annually	Visual Assessment as per Annexure- F of IRC:35- 2015	Re-Painting	Cat-1 Defect - within 24 hours Cat-2 Defect – within 2 months	IRC:35-2015
	Day time Visibility	During expected life Service Time • Cement Road - 130mcd/m2/lux • Bituminous Road - 100mcd/m2/lux			Monthly	As per Annexure-D of IRC:35-2015	Re-Painting	Cat-1 Defect - within 24 hours Cat-2 Defect – within 2 months	IRC:35-2015
	Night Time Visibility	Initial and Minimum Performance for Dry Retro reflectivity during night time:			Bi-Annually	As per Annexure-E of IRC:35- 2015	Re-Painting	Cat-1 Defect - within 24 hours Cat-2	IRC:35-2015
		Design Speed	(RL) Retro-Reflectivity (mcd/m²/lux)						
			Initial (7Days)	Minimum Threshold Level (TL) and warranty period required up to 2 years				Defect – within 2 months	
		Up to 65	200	80					

Asset Type	Performance Parameter	Level of Service (LOS)			Frequency of Measurement	Testing Method	Recommended Remedial Measures	Time limit for Rectification	Specifications and Standards
		Design Speed (kmph)	Desirable Minimum Sight Distance (m)	Safe Stopping Sight Distance (m)					
		65 - 100	250	120					
		above 100	350	150					
		Initial and Minimum Performance for Night Visibility under wet condition (Retro reflectivity): • Initial 7days Retro reflectivity: 100mcd/m2/lux • Minimum Threshold Level: 50 mcd/m2/lux							
	Skid Resistance	Initial and Minimum performance for Skid Resistance • Initial (7days): 55BPN • Min. Threshold: 44BPN *Note: shall be considered under urban/city traffic condition encompassing the locations like pedestrian crossings, bus bay, bus stop, cycle track intersection delineation, transverse bar markings etc.			Bi-Annually	As per Annexure-G of IRC:35-2015		Within 24 hours	IRC:35-2015

Asset Type	Performance Parameter	Level of Service (LOS)			Frequency of Measurement	Testing Method	Recommended Remedial Measures	Time limit for Rectification	Specifications and Standards
		Design Speed (kmph)	Desirable Minimum Sight Distance (m)	Safe Stopping Sight Distance (m)					
Road Sign	Shape and Position	Shape and Position as per IRC:67-2012. Signboard should be clearly visible for the design speed of the section			Daily	Visual with video/image backup	Improvement of shape, in case if shape is damaged. Relocation as pe requirement	48 hours in case of Mandatory Signs, Cautionary and Informatory Signs (Single and Dual post signs), 15 Days in case of Gantry/ Cantilever Sign boards	IRC:67-2012
	Retro reflectivity	As per specifications in IRC:67-2012			Bi-Annually	Testing of each signboard using Retro Reflectivity Measuring Device. In accordance with ASTM D 4956-09	Change of signboard	48 hours in case of Mandatory Signs, Cautionary and Informatory Signs (Single and Dual post signs). 1 Month in case of Gantry/ Cantilever Sign boards	IRC:67-2012
Kerb	Kerb Height	As per IRC 86:2018 depending upon type of Kerb			Bi-Annually	Use of distance measuring tape	Raising Kerb Height	Within 1 Month	IRC 86:2018

Asset Type	Performance Parameter	Level of Service (LOS)			Frequency of Measurement	Testing Method	Recommended Remedial Measures	Time limit for Rectification	Specifications and Standards
		Design Speed (kmph)	Desirable Minimum Sight Distance (m)	Safe Stopping Sight Distance (m)					
	Kerb Painting	Functionality: Functioning of Kerb painting as intended			Daily	Visual with video/image backup	Kerb Repainting	Within 7-days	IRC 35:2015
Other Road Furniture	Reflective Pavement Markers (Road Studs)	Numbers and Functionality as per specifications in IRC: SP:84-2019 and IRC:35-2015, unless specified in Schedule-B.			Daily	Counting	New Installation	Within 2 months	IRC: SP:84-2019, IRC:35-2015
	Pedestrian Guardrail	Functionality: Functioning of guardrail as intended			Daily	Visual with video/image backup	Rectification	Within 15 days	IRC: SP:84-2019
	Traffic Safety Barriers	Functionality: Functioning of Safety Barriers as intended			Daily	Visual with video/image backup	Rectification	Within 7-days	IRC: SP:84-2019, IRC:119-2015
	End Treatment of Traffic Safety Barriers	Functionality: Functioning of End treatment as intended			Daily	Visual with video/image backup	Rectification	Within 7-days	IRC: SP:84-2019, IRC:119-2015
	Attenuators	Functionality: Functioning of Attenuators as intended			Daily	Visual with video/image backup	Rectification	Within 7-days	IRC: SP:84-2019, IRC:119-2015
	Guard Posts and Delineators	Functionality: Functioning of Guard Posts and Delineators as intended			Daily	Visual with video/image backup	Rectification	Within 15 days	IRC:79-2019
	Overhead Sign Structure	Overhead sign structure shall be structurally adequate			Daily	Visual with video/image backup	Rectification	Within 15 days	IRC:67-2012

Asset Type	Performance Parameter	Level of Service (LOS)			Frequency of Measurement	Testing Method	Recommended Remedial Measures	Time limit for Rectification	Specifications and Standards
		Design Speed (kmph)	Desirable Minimum Sight Distance (m)	Safe Stopping Sight Distance (m)					
	Traffic Blinkers	Functionality: Functioning of Traffic Blinkers as intended			Daily	Visual with video/image backup	Rectification	Within 7-days days	IRC: SP:84-2019
Highway Lighting System	Highway Lights	Illumination: Minimum 40 Lux illumination on the road surface			Daily	The illumination level shall be measured with lux- meter	Improvement in Lighting System	24 hours	IRC: SP:84-2019
		No major failure in the lighting system			Daily	-	Rectification of failure	24 hours	IRC: SP:84-2019
		No minor failure in the lighting system			Monthly	-	Rectification of failure		IRC: SP:84-2019
	Toll Plaza Canopy Lights	Minimum 40 Lux illumination on the road surface			Daily	The illumination level shall be measured with lux- meter	Improvement in Lighting System	24 hours	IRC: SP:84-2019
		No major/minor failure in the lighting system			Daily	-	Rectification of failure	8 hours	IRC: SP:84-2019
Trees and plantation including median plantation	Obstruction in a minimum head- room of 5.5 m above carriageway or obstruction in visibility of road signs				Monthly	Visual with video/image backup	Removal of trees	Immediate	IRC: SP:84-2019

Asset Type	Performance Parameter	Level of Service (LOS)			Frequency of Measurement	Testing Method	Recommended Remedial Measures	Time limit for Rectification	Specifications and Standards
		Design Speed (kmph)	Desirable Minimum Sight Distance (m)	Safe Stopping Sight Distance (m)					
	Deterioration in health of trees and bushes				Daily	Visual with video/image backup	Timely watering and treatment. Or Replacement of Trees and Bushes.	Within 90 days	IRC: SP:84-2019
	Vegetation affecting sight line and road structures				Daily	Visual with video/image backup	Removal of trees	Immediate	IRC: SP:84-2019
Rest Area	Cleaning of toilets				Daily	-	-	Every 4 hours	-
	Defects in electrical, water and sanitary installations				Daily	-	Rectification	24 hours	-
Other Project Facilities and Approach roads	Damage or deterioration in Approach Roads, pedestrian facilities, truck lay-bys, bus-bays, bus-shelters, cattle crossings, Traffic Aid Posts, Medical Aid Posts, and other works				Daily	-	Rectification	15 Day	IRC: SP:84-2019

Table 49: Maintenance Criteria for Structures and Culverts

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
Pipe/box /slab culverts	Free waterway/ unobstructed flow section	85% of culvert normal flow area to available.	2 times in a year (before and after rainy season)	Inspection by Bridge Engineer as per IRC SP: 35-1990 and recording of depth of silting and area of vegetation	Cleaning silt up soils and debris in culvert barrel after rainy season, removal of bushes and vegetation, U/s of barrel, under barrel and D/s of barrel before rainy season.	15 days before onset of monsoon and within 30 days after end of rainy season.	IRC 5-2015, IRC SP:40-2019 and IRC SP:13-2004
	Leak-proof expansion joints if any	No leakage through expansion joints	Bi-Annually	Physical inspection of expansion joints as per IRC SP: 35-1990 if any, for leakage strains on walls at joints.	Fixing with sealant suitably	30 days or before onset of rains whichever comes earlier	IRC SP:40-2019 and IRC SP:69-2011
	Structurally sound	Spalling of concrete not more than 0.25 sq.m. Delamination of concrete not more than 0.25 sq.m. Cracks wider than 0.3 mm not more than 1m aggregate length	Bi-Annually	Detailed inspection of all components of culvert as per IRC SP:35-1990 and recording the defects	Repairs to spalling, cracking, delamination, rusting shall be followed as per IRC: SP: 40-2019.	15 days	IRC SP 40-2019 and MORTH Specifications clause 2800
	Protection works in good condition	Damaged of rough stone apron or bank revetment not more than 3 sq.m, damage to solid apron (concrete apron) not more than 1 sq.m	2 times in a year (before and after rainy season)	Condition survey as per IRC SP:35-1990	Repairs to damaged aprons and pitching	30 days after defect observation or 2 weeks before onset of rainy season whichever is earlier.	IRC: SP 40-2019 and IRC: SP: 13-2004.

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
Bridges including ROB"s, Flyover and Viaducts etc. as applicable	Riding quality or user comfort No pothole in wearing coat on	No pothole in wearing coat on bridge deck	Daily	Visual inspection as per IRC SP:35-1990	Repairs to BC or wearing coat	15 days	MORT&H Specification 2811
Bridges including ROB"s, Flyover and Viaducts etc. -Super Structure	Bumps	No bump at expansion joint	Daily	Visual inspection as per IRC SP:35-1990	Repairs to BC on either side of expansion joints, profile correction course on approach slab in case of settlement to approach embankment	15 days	MORT&H Specification 3004.2 & 2811
	User safety (condition of crash barrier and guard rail)	No damaged or missing stretch of crash barrier or pedestrian hand railing	Daily	Visual inspection and detailed condition survey as per IRC SP: 35- 1990	Repairs and replacement of safety barriers as the case may be	3days	IRC: 5-2015, IRC SP: 84-2019 and IRC SP:40- 2019
	Rusted reinforcement	Not more than 0.25 sq.m	Bi-Annually	Detailed condition survey as per IRC SP: 35-1990 using Mobile Bridge Inspection unit.	All the corroded reinforcement shall portion with epoxy mortar/concrete. need to be thoroughly cleaned from rusting and applied with anti-corrosive coating before carrying out the repairs to affected concrete	15 days	IRC SP: 40-2019 and MORTH Specification 1600 IRC SP: 40-2019 and MORTH Specification
	Spalling of concrete	Not more than 0.50 sq.m					
	Delamination	Not more than 0.50 sq.m					
	Cracks wider than 0.30 mm	Not more than 1m total length	Bi-Annually	Detailed condition survey as per IRC SP: 35-1990using Mobile Bridge Inspection Unit.	Grouting with epoxy mortar, investigating causes for cracks or other defects development and carry	48 Hours	IRC SP: 40-2019 and MORTH Specification2800

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
					out necessary rehabilitation.		
	Rainwater seepage through deck slab	Leakage - nil	Quarterly	Detailed condition survey as per IRC SP: 35-1990using Mobile Bridge Inspection Unit.	Grouting of deck slab at leakage areas, waterproofing, repairs to drainage spouts	1 month	MORTH specifications 2600 & 2700.
	Deflection due to permanent loads and live loads	Within design limits.	Once in every 10 years for spans more than 40 m	Load test method	Carry out major rehabilitation works on bridge to retain original design loads capacity	6 months	IRC SP: 51-2015
	Vibrations in bridge deck due to moving trucks	Frequency of vibrations shall not be more than 5 Hz	Once in every 5 years for spans more than 30m and every 10 years for spans between 15 to 30	Laser displacement sensors or laser vibro- meters	Strengthening of super structure	4 months	AASHTO, LRFD specifications
	Leakage in Expansion joints	No damage to elastomeric sealant compound in strip seal expansion joint, no leakage of rainwater through expansion joint in case of buried and asphalt plug and copper strip joint.	Bi-Annually	Detailed condition survey as per IRC SP:35-1990. using Mobile Bridge Inspection Unit.	Replacement of seal in expansion joint. Replacement of Sealing compound in case of leakage I copper strip type joint.	15 days	MORTH specifications 2600 and IRC SP: 40- 2019.
	Debris and dust in strip seal expansion joint	No dust or debris in expansion joint gap.	Monthly	Detailed condition survey as per IRC SP: 35-1990. using Mobile Bridge Inspection Unit.	Cleaning of expansion joint gaps thoroughly	3 days	MORTH specifications 2600, IRC SP: 40-2019 and IRC: SP:69-2011
	Drainage spouts	No down take Pipe missing/ broken below	Monthly	Detailed condition survey as per IRC	Cleaning of drainage spouts thoroughly.	3 days	MORTH specification 2700

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
		soffit of the deck slab. No silt, debris, clogging of drainage spout collection chamber.		SP: 35-1990. using Mobile Bridge Inspection Unit.	Replacement of missing/broken down take pipes with a minimum pipe extension of 500mm below soffit of slab. Providing sealant around the drainage spout if any leakages observed.		
Bridges including ROB"s, Flyover and Viaducts etc.- Bridge Substructure	Cracks/ spalling of concrete /rusted steel	No cracks, spalling of concrete and rusted steel	Bi-Annually	Detailed condition survey as per IRC SP: 35-1990 using Mobile Bridge Inspection Unit.	All the corroded reinforcement shall need to be thoroughly cleaned from rusting and applied with anti-corrosive coating before carrying out repairs to substructure by grouting/guiniting and micro concreting depending on type of defect noticed	30 days	IRC SP: 40-2019 and MORTH specification 2800
	Elastomeric Bearings	Delamination of bearing reinforcement not more than 5%, cracking or tearing of rubber not more than 2 locations per side, no rupture of reinforcement or rubber	Bi-Annually	Detailed condition survey as per IRC SP: 35-1990 using Mobile Bridge Inspection Unit.	In case of failure of even one bearing on any pier/abutment, all the bearings on that pier/ abutment shall be replaced, in order to get uniform load transfer on to bearings.	3 months	MORTH specification 2810, IRC SP: 40-2019 and IRC:83 (Part-II)-2018
	POT/PFFE and Spherical Bearings	No locking of movable and rotational parts, No Corrosion, Cleanliness	Bi-Annually	Detailed condition survey as per IRC SP: 35-1990 using Mobile Bridge Inspection Unit.	Unlocking of affected parts, Cleaning of Rust and repainting. General Cleaning of bearings.	30 days	IRC:83 (Part-III)-2018 IRC:83 (Part-IV)-2014

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
Bridges including ROB"s, Flyover and Viaducts etc.- Bridge Foundations	Scouring around Foundations	Scouring shall not be lower than maximum scour level for the bridge	Bi-Annually	Condition survey and visual inspection as per IRC SP:35-1990 using Mobile Bridge Inspection Unit. In case of doubt Underwater camera for Inspection of deep wells in Major Rivers.	Suitable protection works around pier/abutment	1 month	IRC SP: 40-2019, IRC: 89-2019, IRC:78-2014, MORTH specification 2500
	Protection works in good condition	Damaged of rough stone apron or bank revetment not more than 3 sq.m, damage to solid apron (concrete apron) not more than 1 sq.m	2 times in a year (before and after rainy season)	Condition survey as per IRC SP:35-1990	Repairs to damaged aprons and pitching	30 days after Defect observation or 2 weeks before onset of rainy Season whichever is earlier.	IRC: SP 40-2019, IRC: SP:13- 2004 and IRC:89-2019

6.3 INPUTS FOR M&M SCHEDULE

6.3.1 PROJECT SECTIONS

Since roughness is the main criterion for major maintenance, Project Corridor has been divided in to various sections depending the present roughness values:

- Section 1: Roughness value <2000 mm/Km
- Section 2: Roughness values >2000<2200 mm/Km
- Section 3: Roughness values >2200<2400 mm/Km
- Section 4: Roughness value >2400 mm/Km

6.3.2 TRAFFIC (AADT)

The following traffic data has been used in the analysis is as below:

Vehicle/Mode	AADT at 157.850 FY23 (Vehicles)
LCV	239
2A truck	2048
3A truck	1072
MAV truck	3171
BUS	146

Note: 50:50 directional distributions are considered.

6.3.3 VECHILE DAMAGE FACTORS (VDF)

VDF values as obtained from axle load surveys are used for various sections are as given below:

VDF Values Estimated at the Toll Plaza Location-km 157.850

Mode Type	Chichra to Kharagpur Carriageway	Kharagpur to Chichra Carriageway
LCV	1.29	2.52
2 Axle Truck	6.46	3.83
3 Axle Truck	8.85	4.75
MAV (4-6 Axle)	22.68	9.74
Buses	0.5	1.83

6.3.4 HDM INPUTS

FWD and Roughness values are used as obtained from surveys and investigations as below:

Section-1	LHS				RHS			
	<2000	>=2000 and <2200	>=2200 and <2400	>2400	<2000	>=2000 and <2200	>=2200 and <2400	>2400
Length, km	2	3	0	0	2	1	1	1.4
Roughness, mm/km	1523	2121	0	0	1910	2059	2262	2776
IRI	2.20	2.96	0.00	0.00	2.69	2.88	3.13	3.76
Deflection, mm	0.21	0.18	0.00	0.00	0.14	0.16	0.13	0.11
Cracking, %	1.0%	1.5%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%
Raveling, %	1.0%	1.5%	0.0%	0.0%	25.0%	0.0%	0.0%	10.0%
Patching, %	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Rut Depth, mm	20.00	17.00	0.00	0.00	12.00	20.00	20.00	16.00
BT Crust, mm	220	220	0	0	200	200	200.0	200.0
Granular Crust, mm	490	490	0.00	0.00	540	540	540.0	540.0

6.3.5 OPTIONS FOR MM SCHEDULE

Based on the requirements of CA, various options have been considered to be used as responsive overlays triggered at specified level of roughness of 2400mm/km. Micro surfacing has also been considered to examine its feasibility for major maintenance.

For LHS & RHS directions, following options were considered in the analysis:

- ✓ Base Case: MCS at Roughness of 2400mm/Km with regular maintenance
- ✓ Opt-1: Responsive Overlay of 30mm BC whenever roughness is >2400mm/KM with regular maintenance
- ✓ Opt-2: Responsive Overlay of 40mm BC whenever roughness is >2400mm/KM with regular maintenance

6.4 ROUGHNESS PROGRESSION

Roughness progression for each section under each alternative maintenance option has been done using the deterioration models in HDM-4. Following few graphs represents the roughness progression for each alternative:

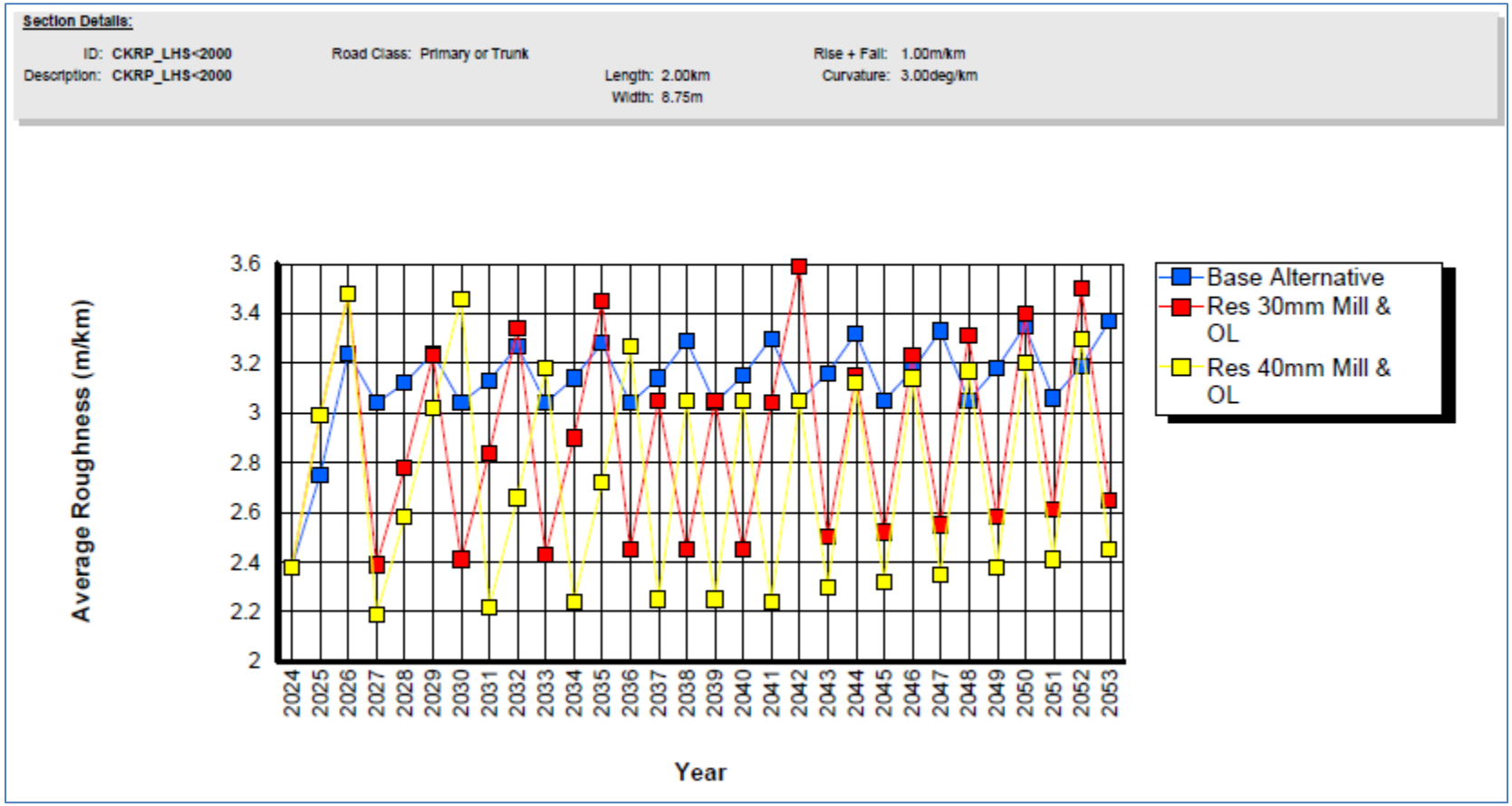


Figure 1: Average Roughness in LHS (<2000mm/Km)

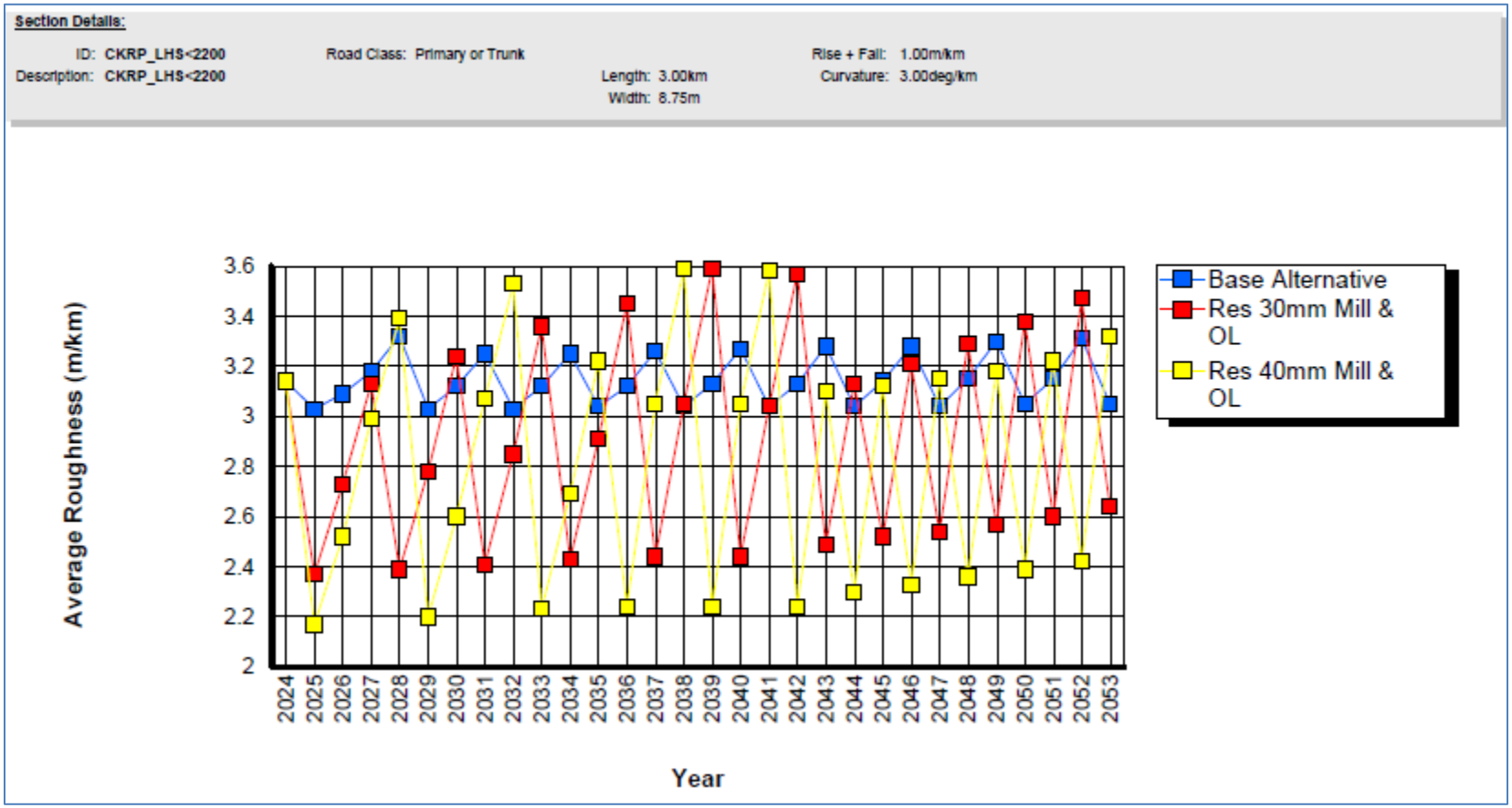


Figure 2: Average Roughness in LHS (<2200mm/Km)

6.5 M&M SCHEDULE

Based on the forgoing discussions and inputs, the O&M schedule for the project for various options considered above for individual sections have been prepared for varying overlay thickness and Option with 40mm BC as overlay has been recommended for final application. Obtained & Adopted MM schedule for project is as below:

Table 50: Adopted MM schedule for the project for LHS & RHS

: LHS

Base Year	Criteria:	(DD 40mm mill & OL)									Remarks
		Obtained MM schedule for LHS					Adjusted MM schedule for LHS				
		IRI<2000	>=2000 and <2200	>=2200 and <2400	>2400		IRI<2000	>=2000 and <2200	>=2200 and <2400	>2400	
	Length:	3000	2000	0	0		3000	2000	0	0	
	Financial Year	Case-1	Case-2	Case-3	Case-4		Case-1	Case-2	Case-3	Case-4	
	2023										
1	2024		40								
2	2025										
3	2026	40									
4	2027										
5	2028		40								
6	2029										
7	2030	40					40	40			
8	2031										
9	2032		40								
10	2033	40									
11	2034										
12	2035		40								Capacity Augmentation
13	2036	40									Capacity Augmentation
14	2037										DLP
15	2038	40	40								DLP
16	2039										DLP
17	2040	40									DLP
18	2041		40								DLP
19	2042	40					40	40			DLP

Base Year	Criteria:	(DD 40mm mill & OL)									Remarks
		Obtained MM schedule for LHS					Adjusted MM schedule for LHS				
		IRI<2000	>=2000 and <2200	>=2200 and <2400	>2400		IRI<2000	>=2000 and <2200	>=2200 and <2400	>2400	
	Length:	3000	2000	0	0		3000	2000	0	0	
	Financial Year	Case-1	Case-2	Case-3	Case-4		Case-1	Case-2	Case-3	Case-4	
20	2043		40								DLP
21	2044	Concession Ends in FY44									DLP

Section-1: RHS

Base Year	Criteria:	(DD 40mm mill & OL)									Remarks
		Obtained MM schedule for LHS					Adjusted MM schedule for LHS				
		IRI<2000	>=2000 and <2200	>=2200 and <2400mm	>=2400		IRI<2000	>=2000 and <2200	>=2200 and <2400mm	>=2400	
	Length:	**2000**	**1000**	**1000**	**1400**		**2000**	**1000**	**1000**	**1400**	
	Financial Year	Case-1	Case-2	Case-3	Case-4		Case-1	Case-2	Case-3	Case-4	
	2023										
1	2024										
2	2025										
3	2026			40	40						
4	2027		40								
5	2028	40									
6	2029										
7	2030						40	40	40	40	
8	2031										
9	2032			40	40						
10	2033		40								
11	2034	40									
12	2035										Capacity Augmentation
13	2036										Capacity Augmentation
14	2037			40	40						DLP
15	2038		40								DLP
16	2039	40									DLP
17	2040										DLP

Base Year	Criteria:	(DD 40mm mill & OL)									Remarks
		Obtained MM schedule for LHS					Adjusted MM schedule for LHS				
		IRI<2000	>=2000 and <2200	>=2200 and <2400mm	>=2400		IRI<2000	>=2000 and <2200	>=2200 and <2400mm	>=2400	
	Length:	**2000**	**1000**	**1000**	**1400**		**2000**	**1000**	**1000**	**1400**	
	Financial Year	Case-1	Case-2	Case-3	Case-4		Case-1	Case-2	Case-3	Case-4	
18	2041			40	40						DLP
19	2042		40				40	40	40	40	DLP
20	2043	40									DLP
21	2044	Concession Ends in FY44									DLP

6.6 STRUCTURAL PERIODIC MAINTENANCE STRATEGY

Expansion joints:

- Visual inspection is carried out to check for seal breakages, Armor angle, Weld failures, cracks between deck & Expansion joints concrete and Joints filled with debris. Such joints replaced immediately.
- Joint buried with debris shall be inspected for any distress, if any distress is shown it shall be replays immediately.
- During visual inspection it is seen that some Expansion joints are bad where as some are not showing any defects.
- Due to this it is considered provident to change the Expansion joints which are visibly damaged in initial stage.
- In the absence of records pertaining to Expansion joint replacements it is highly difficult to predict the date of replacement needed for compliance to IRC codal requirements. Balance joints which are not replaced initially will be replaced as on when defects are shown in the joints. This aspect is considered in BOQ.

Bearings:

- In order to identify the bearings requiring immediate replacement, the following strategy is adopted.
    1. Girder Bridges showing diagonal cracks at support, distress in the Pedestals and any form of distress in support location is regarded as a candidate for replacement. By visual inspection there are only a handful of such situations.
    2. Wherever pedestals are damaged either by cracking or spalling poisons confinement is proposed by Jacketing/MS plate bonding such procedure is very effective and common.
    3. All Metallic Bearings need to be taken up for servicing.

Wearing Coat:

It is necessary to replace the Wearing coat at every 15years interval, as wearing coat is a very weak component of the bridge structure which is subjected to severe deterioration due to Loading,

Environment etc. As of now, we have considered sealing of cracks by Fog Seal and for which does not show any distress other than cracking by viz. Pot holes, abrading etc. Based on this aspect, this cost has been considered in highway O&M cost.

Periodic Maintenance strategy for Replacement of Bearings & Expansion joint:

Below strategy has been considered for periodic major maintenance of the structures.

Sl.no	Description		Bridge components
1	Old structure	Structures which are older than 15years as of now	Periodic Replacement of bearings, Expansion joint
2	New Structure	Structures which are Not older than 15years as of now	

The year on year assumption for replacement of bearings and expansion joints are as follows:

Age	Description	Item	structures-Assumption-MMR							
			% of Replacement of Major components							
			2024	2028	2033	2038	2043	2048	2053	2052
New	Super structure lifting with Pot bearings	Pot	0%	10%	50%	25%	50%	25%	25%	0%
New	Super structure lifting with Elastomeric bearings	Ela	0%	10%	75%	50%	50%	25%	50%	0%
New	Super structure lifting with Rocker bearings	Rocker	0%	0%	0%	0%	0%	0%	0%	0%
Old	Super structure lifting with Pot bearings	Pot	50%	25%	50%	25%	25%	25%	50%	0%
Old	Super structure lifting with Elastomeric bearings	Ela	50%	25%	50%	25%	25%	25%	50%	0%
Old	Super structure lifting with Rocker bearings	Rocker	25%	10%	25%	10%	25%	25%	25%	0%
New	Pot bearing cost	Pot	0%	10%	50%	25%	50%	25%	25%	0%
New	Elastomeric bearing cost	Ela	0%	10%	75%	50%	50%	25%	50%	0%
New	Rocker bearing cost	Rocker	0%	0%	0%	0%	0%	0%	0%	0%
Old	Pot bearing cost	Pot	50%	25%	50%	25%	25%	25%	50%	0%
Old	Elastomeric bearing cost	Ela	50%	25%	50%	25%	25%	25%	50%	0%
Old	Rocker bearing cost	Rocker	25%	10%	25%	10%	25%	25%	25%	0%
New	Expansion joint Replacement	EJ	0%	20%	50%	50%	50%	25%	50%	0%
Old	Expansion joint Replacement	EJ	75%	25%	25%	25%	50%	25%	50%	0%
New	Others	-	0%	20%	50%	25%	25%	25%	50%	0%
Old	Others	-	75%	25%	25%	25%	25%	25%	50%	0%

CHAPTER 7. COST

Cost Component for various items and activities have been worked out by considering the Best Industry practice and most appropriate methods. Detailed quantities for work items have been estimated based on the details presented in previous chapters for various heads.

The gist of the cost components considered are presented below:

- Initial Improvement Works
- Routine Maintenance Cost
- Incident Management Cost
- Periodic Maintenance Cost
- Operations Cost
- Year by Year total O&M Costs

7.1 RATE ANALYSIS

Detailed rate analysis has been carried out based on MORTH guidelines to arrive at the unit rates of various items. Material rates and their leads from the project corridor are considered as per the material investigations done on the project road. Summary of unit rates arrived at are presented in table below:

Table 51: Basic Material Rates excluding GST

S no	Description	Units	Source	Basic rate excluding Transportation & GST	Lead in Kms
1	Good earth	Cum	BA	19	10.40
2	40 mm	Cum	Crusher	1575	164.43
3	20 mm	Cum	Crusher	1875	164.43
4	12 mm	Cum	Crusher	1425	164.43
5	6 mm	Cum	Crusher	900	164.43
6	Dust	Cum	Crusher	750	164.43
7	M sand	Cum	Crusher	825	164.43
8	Flyash	Cum	Nearest Plant	0	157.58
9	Boulders	Cum	Quarry	669	1.00
10	Sand source to Plant	Cum	River	711	36.00
11	Sand source to working site	Cum	Stock yard	711	12.00
12	Bitumen 60/70	MT	Haldia	48993	152.00
13	Bitumen 80/100	MT	Haldia	47272	152.00
14	VG-40	MT	Haldia	48000	152.00
15	CRMB-55	MT	Haldia	49943	152.00
16	PMB	MT	Haldia	53200	152.00
17	SS1	MT	Haldia	50000	152.00
18	Steel	MT	Kharagpur	63630	47.00
19	HTS Strands	MT	Kharagpur	70000	168.00
20	Cement	MT	Kharagpur	6875	0.00
21	Structural Steel	MT	Kharagpur	65630	47.00
22	RCC Pipe NP 4 heavy duty non pressure pipe 1000 mm dia	RM	Kharagpur	5500	150.00

S no	Description	Units	Source	Basic rate excluding Transportation & GST	Lead in Kms
23	RCC Pipe NP 4 heavy duty non pressure pipe 1200 mm dia	RM	Kharagpur	6500	150.00
24	RCC Pipe NP 4 heavy duty non pressure pipe 900 mm dia	RM	Kharagpur	3500	150.00

Table 52: Major Material Rates excluding GST

Sl.no	Item	Unit	Rate (INR) Excluding GST
1	Embankment - borrow	Cum	285
2	Embankment - Excavation	Cum	74
3	SG	Cum	293
4	GSB G-2	Cum	3346
5	WMM	Cum	3541
6	Prime Coat	Sqm	40
7	Tack coat on granular	Sqm	14
8	DBM G-1	Cum	9938
9	Tack coat on bituminous surface	Sqm	13
10	BC - G1	Cum	11433
11	Road Marking	Sqm	531
12	RE wall	Sqm	4810
13	Select Fill	Cum	322
14	Filter Media	Cum	3063
15	M15	Cum	7489
16	M20	Cum	8229
17	M25	Cum	8811
18	M30	Cum	8741
19	M35	Cum	9020
20	M40	Cum	9156
21	PSC M45	Cum	11043
22	HYSD	MT	91764
23	HT strand	MT	139611

7.2 INITIAL IMPROVEMENT WORKS (SCHEDULE-B)

Costs associated with initial improvements are estimated based on the detailed asset inventory and condition assessment surveys, Pavement condition and structural condition assessment surveys. Items which are not executed as part of scope or in damaged condition have been considered for immediate costs as a part of 1-year capex. Following items are mainly considered for Initial Improvement costs:

- Scope given in schedule-B
- Scope which is not executed
- Road work items
- Bridge Work Items
- Pavement Rehabilitation works
- Structural Rehabilitation works
- Drainage Works
- Slope Protection works
- Safety Works

Summary of Initial Improvement Costs are included in table below:

Table 53: Summary of Initial Improvement Cost

S.no	Description	Unit	Quantity	Rate (Rs.)	Amount (Rs.)
1	Immediate Repair's - Structures	LS	1	26,53,200	26,53,200
2	EPC (Highway & Str)	LS	1	7,20,53,632	7,20,53,632
3	TMS	LS	1	2,15,53,444	2,15,53,444
4	Revalidation surveys	LS	1	54,77,219	54,77,219
5	Pavement Rehabilitation void fill	LS	1	1,69,05,000	1,69,05,000
Total Cost excluding GST					11,86,42,495
GST at 18%					2,13,55,649
Total Cost including GST					13,99,98,145
Total Cost including GST In Crores					**14.00**

Note: This above cost arrived is with due consideration of reply to pre-bid queries dtd 27.09.2023

- **Flyover@ Km 63.288, Approach length**

  The new Flyover approach is near to ROB location and as per Schedule-B its approach length is 680m. The location of flyover is provided at the entrance of Steel Factory. Practically, this length is insufficient for maneuvering of vehicles. Hence, entry & exist lengths are provided accounting to a total approach length of 1.27km. This length has been considered in the initial capex cost.

7.3 ROUTINE MAINTENANCE & INCIDENT MANAGEMENT COSTS

Routine maintenance costs include general maintenance costs of road elements, bridge elements and road furniture and appurtenances. This can be mainly divided into two parts as:

- ✓ General Maintenance of Works
- ✓ Repairs to Highway & Bridge Elements

7.3.1 GENERAL ROUTINE MAINTENANCE

General Routine Maintenance of Roads generally include following items:

- Cleaning of Project facilities
- Structures cleaning,
- Cleaning of ROW
- Cleaning and Maintenance of Toll Plaza
- Unlined Drain Maintenance
- Lined Drain Maintenance
- Maintenance of Highway Lighting at Toll Plaza and other project locations
- Median Plantation maintenance & Avenue plantation maintenance:
- Maintenance of Road Furniture
- Maintenance of Road Safety Items

The above items are estimated by considering the detailed break-up of following items:

- Manpower including Managers/Labour etc
- Vehicles for Labour Transport/Water Tankers/Sweeping Machines Etc
- Resources/Equipment's such as grass cutters, tools, jet sprayers, hydraulic trimmers etc

7.3.2 REPAIRS TO HIGHWAY & BRIDGE WORKS

Repairs to highway and bridge works have been estimated based on the assumed quantities (Percentage basis) of execution for every year.

These items include the following:

A. Roads

1	Providing treatment for sealing of road surface / isolated cracks at scattered locations
	i) covered with 6.7 mm size stone chipping @ 0.1 cum/ 10 sqm.
	ii) covered with dry coarse sand passing through 2.36 mm sieve and retained on 180-micron sieve @ 0.03 cum/10 sqm heated to 600 C
	iii) filling discrete cracks with slow curing bitumen emulsion as per Technical Specification Clause 3004.3.3
2	Providing treatment to bleeding bituminous surface at scattered locations
3	Providing localized repair to rutted portion and edge breaking of bituminous surface
4	Providing treatment and repair to pot-holes and patch work
5	Providing and laying dense bituminous macadam using bitumen grade 60/70 complete as per Technical Specification Clause 507
6	Proving and laying bituminous concrete (asphaltic concrete)
	(a) Using bitumen (VG-40) as per IRC: SP: 53
7	Road Roughness survey
8	Turfing on embankment slopes and at all other Project Facilities
9	Providing repair to stone pitching/apron at scattered locations
10	Rain Cuts Maintenance: Restoration of rain cuts soil, moorum, gravel or a mixture of these
11	Cleaning of Lined Drain
12	Repair of damaged lined drain
13	Unlined drain cleaning
14	Filling in median island with approved materials with all leads and lifts complete as per TS Clause No. 407
15	Replacing damaged / broken railing with new pre-cast / cast-in-situ, concrete railing to match with existing design and pattern.
24	Carrying out repair to road signs including strengthening resetting or otherwise repairing signs and delineators
	a) Road sign board mounted on single post
	b) Road sign board mounted on double post
	c) Overhead/ Gantry Sign boards
	d) Delineator
25	Supplying and fixing at site retro-reflectorized type sign boards/signs

	90cm Equilateral triangle
	60cm circular
	90 cm circular
	90cm high octagon
	80cm x 60cm rectangle
	Chevron signs 60cm x 45cm
	Place identification signs (Fig 15.7 of IRC 67)
	Providing and fixing Object Markers
	Providing and fixing of retro-reflectorized Route Marker signs (size 450mm x 600mm)
26	Hazard Marker Sign:
	a) size 90 x 30 cm
	b) size 30cm triangular side cluster of red reflectors (screen printed)
27	Cats Eyes/Raised pavement marker (NMC Nails Less)
28	Painting two coats on old surface after minor repairs to give an even and smooth surface and printing letters and figures with synthetic enamel paint
	a) Hectometer stones
	b) Kilometer Stone
	c) 5 Kilometer stone
	d) Boundary stone
	e) Guard stone
29	Providing painting lettering and fixing of distance measurement stones including dismantling of old damaged/ broken ones, confirming to TS Clause 804
	a) Hectometer stones
	b) Kilometer Stone
	c) 5 Kilometer stone
	d) Boundary stone
	e) Guard stone
30	Providing and fixing road delineators conforming to TS Clause No. 805 as directed by the Engineer.
31	Repainting the Kerb stones and separation barrier with first quality synthetic enamel paint of approved brand
32	Painting all types of pavement markings including lines, dashes, arrows etc. on roads as per relevant IRC/MOST standards after cleaning the surface complete in all respects as directed by the Engineer.
	a) Hot applied Thermoplastic compound
	(i) Lane / Centre Line / Edge Line
	(ii) Direction Arrows, Diagonal Chevrons Markings, PC etc.,
	(iii) Transverse bar Marking
33	Supplying and laying cast-in-situ cement concrete Kerb without channel section
	a) by Manual/machine including formwork
34	Major repair / replacement of metal beam crash barrier (W profile guard rails)

35	Providing and fixing chain link/ welded mesh fencing / square bars fencing
36	Dismantling the old damaged chain link/welded mesh / square bars fencing and replacing it with new chain link/ welded mesh/square bars fencing
37	Provision of rumble strips
38	Shoulder Maintenance
39	synthetic enamel paint of approved brand on metal pedestrian guard rail
40	Dismantling of wearing course
41	Toll Plaza building repairs, booths, canopy and also maintenance of TP buildings
42	Median plantation maintenance
43	RE wall Maintenance

B. Structures

1. Wearing coat comprising of 53 mm thick BC including water proofing material.
2. Cleaning and adding rubber sealant near expansion joints.
3. Modular Expansion joints.
4. Replacement of Damaged Concrete Railing all complete as per Technical specifications and as directed by the Engineer
5. Provision of an RCC crash barrier (0.35sqm cross sectional area) constructed with M-40 grade concrete including reinforcement
6. Cleaning of rocker & roller bearing using high pressure water jet, free from rust scales, re-setting & greasing the bearings using graphite grease including cost of materials, labour etc., complete.
7. POT PTF Bearings greasing and maintaining (sand plastering).
8. Elastomeric Bearings and maintaining.
9. Cutting of groove of 15 mm x 15 mm along crack and sealing the same with epoxy putty including cost of material, labour etc.
10. Carrying out 50 to 60 mm thick shortcreting using a mix proportion of 1:2:2 (cement: sand:6 mm down aggregate) added with Polypropylene fibers at a dosage rate of 125 gms/bag of cement including cost of labour, material, scaffolding, equipment etc complete.
11. Repair of Floor Aprons, pitching and other protection works
12. Cleaning of Drainage Spouts
13. M-25-M-35 Concrete
14. Providing and filling joint sealing compound as per drawings of pourable grade, (Bitumastic sealant in the gap b/w Abutment & Approach slab. As per Technical specifications
15. Providing and laying Filter material underneath pitching in slopes.
16. Providing and laying Pitching on slopes laid over prepared filter media including boulder apron laid dry in front of toe of embankments.
17. Test s UPV, RHT and Load test for span 15m and above as per Schedule I.
18. Vegetation cleaning before and after monsoon.
19. Repair of damaged structure portion due accidents and any others.
20. Level of Service if applicable.

7.3.3 INCIDENT MANAGEMENT COST

Incident Management & Safety items include the following:

- ✓ ATMS control room operations,
- ✓ Regular patrolling & reaching accident/incident site,
- ✓ providing relief to injured persons including taking them to nearest hospital and attending to the safety requirements at the location (putting cones, safely guide & manage the traffic using signs, safety barricades, etc.),
- ✓ removal of accident /breakdown vehicles, removing of dead animals/birds lying on the highway and loading, unloading, transportation & disposal of surplus material left over by accidental vehicle or otherwise lying on road (on carriageway) and
- ✓ Encroachment prevention & removal with all lead & lifts complete with proper communication equipment,
- ✓ consumables, materials, suitable Towing vehicles, Ambulance, patrolling vehicles and manpower like drivers, helpers, para-medical staff, labours including deployment of crane and all works shall be done as per requirement and as directed by Client representative and as per Relevant Specifications as applicable.

7.4 OPERATIONS COSTS

Cost towards Operations include the following:

- Electricity Bill of lighting
- Toll Plaza Operation cost
- Operation and management costs of rest areas and lay byes
- Operation and management costs of Traffic & medical aid posts
- SPV Costs
- Survey Costs
- Insurance
- IE Fee
- Audit Charges
- Administrative Cost

Table 54: 1st year O&M Cost

S. no	Description	Amount with GST (INR CR)
A1.1	Tolling Operations	5.01
A1.2	Incident Management	2.22
A2.1	Routine Maintenance	3.88
A2.2	Repairs	1.83
A2.3	ATMS	-
B	Admin Expenses	4.26
-	Insurance	1.11
C	Power (Excluding Toll Plaza)	-
	TOTAL OPERATIONS COST (FY 2024)	**18.32**
	For FY 2027, Additional cost towards special repairs is to be added	**5**
	TOTAL OPERATIONS COST(FY 2027)	**23.32**

7.5 PERIODIC MAINTENANCE COSTS

Cost towards major maintenance include following:

- ✓ Cost of Periodic maintenance of Pavement based on Finalized MM schedule
- ✓ Cost of Periodic Maintenance of Structures
- ✓ Cost of Periodic replacement of Toll Equipment's & Software

Accordingly, following items are considered as below

- o Major maintenance of Flexible pavement for either carriageway is considered with 3 cycles of 40mm BC + 1 cycles of DBM for 50% length.
- o Major maintenance of Rigid pavement for either carriageway is considered with 2 cycles. The cost includes such as repair of cracks, joints, repair, removal and replacement of panels, retexturing and grinding etc.
- o Road marking (50% of actual) at every 3rd year is considered based on market observations and latest test requirement.
- o Structure Periodic Cost towards replacement of Bearings, Expansion joints and any structural distress are considered under this item considering the age of items.
- o Replacement of TMS is considered as periodic maintenance.

Table 55: Periodic Maintenance Cost

Year	Periodic Maintenance				
	Functional +Structural overlay MCW+ S/R	Major Maintenance of Rigid Pavement	Replacement of **ATMS**	Replacement of **TMS**	Structure specified repairs
2023-2024	-	-	-	-	-
2024-2025	-	-	-	-	-
2025-2026	-	-	-	-	-
2026-2027	0.26	1.69	-	-	-
2027-2028	-	-	-	-	0.69
2028-2029	-	-	-	-	-
2029-2030	19.93	21.45	-	-	1.53
2030-2031	-	-	-	1.27	-
2031-2032	-	-	-	-	-
2032-2033	0.26	1.69	-	-	1.02
2033-2034	-	-	-	-	-
2034-2035	-	-	-	-	-
2035-2036	-	-	-	-	-
2036-2037	-	-	-	-	-
2037-2038	-	-	-	2.53	
2038-2039	-	-	-	-	-
2039-2040	-	-	-	-	-
2040-2041	-	-	-	-	-
2041-2042	49.26	-	-	-	-
2042-2043	-	-	-	-	-
2043-2044	0.89	-	-	-	-
Total	**70.60**	**24.84**	**0.00**	**3.80**	**3.24**
Periodic Maintenance Cost	**102.47**				

Note: All the amounts are in Rs. Cr based on FY24 price and is inclusive of GST, without escalation

7.6 TOTAL OPERATION & MAINTENANCE COSTS

Year on year operation cost is summation of following:

- ✓ Immediate Costs
- ✓ Routine Maintenance & Incident Management
- ✓ Periodic Maintenance
- ✓ Operations Cost

Following table presents the summary of Operations & Maintenance cost for the project

Table 56: Cost Abstract

O & M COSTS SUMMARY	All costs at 2023-24 price					Additional Cost (For special repair) -Already included in routine maintenance expenses
Calendar Year	SUMMARY OF VARIOUS EXPENSES in Rs. Crs					
	Immediate Repair's Cost	Toll Operation expenses	Routine Maintenance Expenses	Periodic Maintenanace (Functional +Struc Overlay+ Toll collectio system)	Total Cost (Rs. Cr.)	
2023-2024		-	-	-	-	
2023-2024	14.00	5.01	5.37	-	24.38	-
2024-2025		5.01	13.31	-	18.32	-
2025-2026		5.01	13.31	-	18.32	-
2026-2027		5.01	18.31	1.95	25.27	5.00
2027-2028		5.01	13.31	0.69	19.01	-
2028-2029		5.01	13.31	-	18.32	-
2029-2030		5.01	13.31	42.91	61.23	-
2030-2031		5.01	13.31	1.27	19.59	-
2031-2032		5.01	13.31	-	18.32	-
2032-2033		5.01	13.31	2.97	21.29	-
2033-2034		5.01	13.31	-	18.32	-
2034-2035		5.01	7.59	-	12.60	-
2035-2036		5.01	7.59	-	12.60	-
2036-2037		5.01	8.04	-	13.05	-
2037-2038		5.01	8.04	2.53	15.58	-
2038-2039		5.01	8.04	-	13.05	-
2039-2040		5.01	8.04	-	13.05	-
2040-2041		5.01	8.04	-	13.05	-
2041-2042		5.01	8.04	49.26	62.31	-
2042-2043		5.01	8.04	-	13.05	-
2043-2044		5.01	8.04	0.89	13.94	-
Total Cost:	***14.00***	***105.23***	***222.95***	***102.47***	**444.65**	**-**

Note: All the amounts are in Rs. Cr based on FY24 price and is inclusive of GST, without escalation

CHAPTER 8. TMS & ATMS

8.1 DATA COLLECTION AND REVIEW TMS WORKS

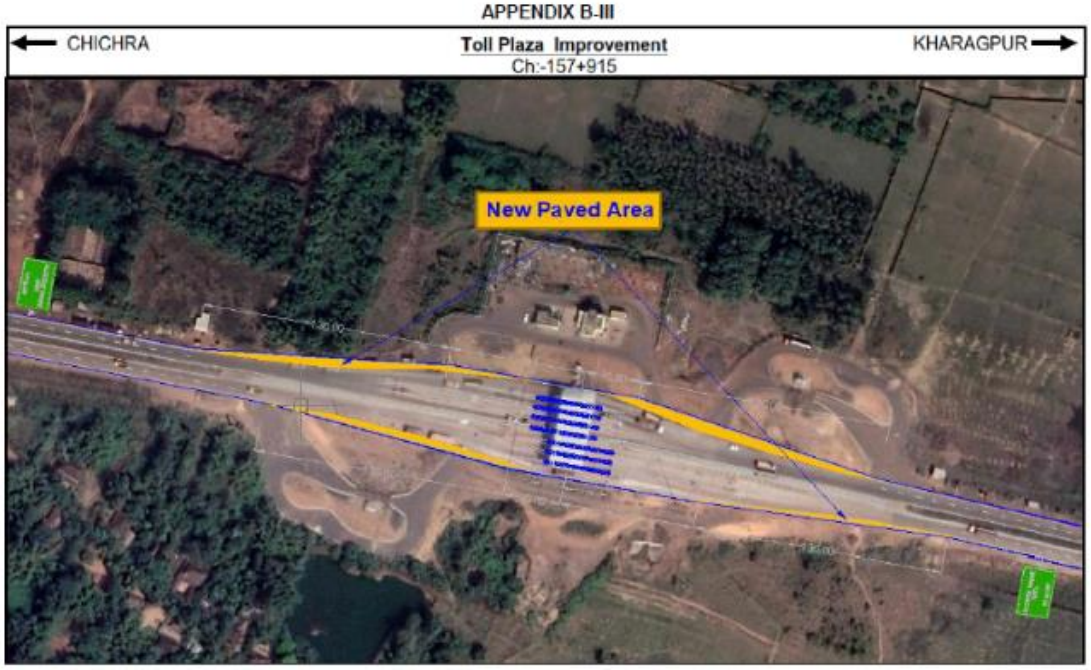
1) Provisions as per CA and other documents are as below.

(a) Clause 21.7 of Schedule A - Existing toll plaza with 8 physical lanes at Km. 43+350 i.e. 10 toll lanes with 2 reversible lanes with Hybrid ETC system is under operation

(b) **Clause 11.1 of Schedule B** – Balibhasha toll plaza at Km. 157.900. The Existing toll plaza is proposed to be retained. The following improvement proposal shall be constructed.

- Improvement of Tapering of toll plaza shall be done as per Drawing attached in APPENDIX B-III.
- The Existing Toll Booths, Toll Plaza premises including all facilities, parking etc. shall be re- instated and maintained.
- The Concessionaire shall restore and maintain the administrative buildings.
- NHAI/Policy Guidelines/management of toll plaza/2021 Policy circular No. 17.5.82 dated 24th May 2021 shall be followed.
- Toilet blocks at toll plaza on main carriageway shall be operated and maintained to desired level of cleanliness. If not maintained and for lack of proper upkeep, facilities etc. fine up to Rs. 10000/- will be imposed on every occurrence on Concessionaire.
- Concessionaire shall also make arrangements for the water supply, electricity etc. for Toilet blocks and Water ATM.

APPENDIX B-III



(c) **Schedule C states as below:**

- Engineering and safety improvements along the project highway shall conform to the IRC: SP: 84:2019, Manual of specifications & Standards for Four laning of Highways through Public Private Partnership published by IRC.
- Clause 2 – Deviations from the manual - Section 10.

S.No.	Clause referred in the Manual	Item as per Manual	Modified provision
9	Section - 10 Clause - 10.3	**Number of Toll Lane: -** Adequate land for Toll Plaza shall be acquired to permit the provision of toll lanes for a projected peak hour's traffic of 20 years' subject to a minimum number of 16 toll lanes including all, other buildings and structures to be accommodated at the Toll Plaza location.	Existing Toll Plaza shall be retained with same nos. of toll lanes as present at site.
10	Section-10 Clause-10.4.5	**Tunnel at Toll Plaza** For movement between Toll office and Toll Booth of each toll lane, an underground tunnel across all toll lanes shall be provided.	Existing Tunnel shall be retained.
11	Section-10 Clause: - 10.5.1	**Electronic Toll Collection -** To carry out, as per defined technical specifications, installation, testing, commissioning, operations and maintenance of Hybrid ETC System in all the lanes of Toll Plaza including but not limited to: i) Installation, integration, testing, commissioning, operations and maintenance of ETC RFID transceiver in all the lanes of Toll Plaza. ii) Installation, integration, testing, commissioning, operations and maintenance of Medium Speed Weigh in Motion in all lanes of Toll Plaza and one Static Weigh Bridge in each direction of traffic at Toll Plaza. Integration, testing, operations and maintenance of ETC RFID transceiver, Medium Speed Weigh in Motion, Static Weigh Bridge and other associated peripheral hardware into single Hybrid Toll Management System/Software.	All toll lanes shall be provided with the system of payment through Hybrid Electronic Toll Collection along with additional items (Medium Speed Weigh in Motion, Static Weigh Bridge, Network Printer and 55" LED Display for CCTV monitoring) as per NHAI extent policy. Specifications are provided in Annexure- III.

S.No.	Clause referred in the Manual	Item as per Manual	Modified provision
12	Section-10 Clause-10.12	**Toll Plaza Complex** The size of Toll Plaza office complex depends on the minimum requirements as mentioned in Clause 10.12.	Existing Toll Plaza office complex is to be retained. Facilities as mentioned in Clause 10.12 are to be provided with in the existing Toll Plaza Office Complex.

(d) IRC SP: 84:2019 clause 10.6.2 – Not less than 2 middle toll lanes shall be capable of being used as reversible lane to meet the demand of tidal flow.

8.2 DATA COLLECTION AND REVIEW ATMS WORKS

✓ **Nil-**

Pre-bid reply dtd 11.10.2023, annexure-2, S.No3: Installation, operation and maintenance of the ATMS shall be done by NHAI.

8.3 CAPACITY AUGMENTATION

The following factors have been considered for the capacity augmentation.

O&M activity	Before Construction	During Construction	Post 6 Laning
Tolling Operations	1	1	1
Incident Management	1	0	1
Routine Maintenance	1	0	1.58
Repairs	1	0	1.58
Insurance	1	1	1.4
Admin Expenses	1	1	1
ATMS	1	0	1

CHAPTER 9. CONCLUSIONS

1. The Project Highway is a part of NH-49 with a starting chainage at Chichra, near km 185.150 and ends at Kharagpur, near km 129.000 in the state of West Bengal with total length of 56.150 km.

2. The Project Corridor Starts at km 185.150 in Chichra and ends at km 129+000 in Kharagpur with the total length of 56.150 Km's.

3. Capacity augmentation is envisaged for the year 2032-2034 (2Yrs-Construction+ 10Yrs- DLP). Accordingly, Routine & Major Maintenance cost not considered between 2033-2044.

4. The Project is a four-lane divided carriageway with Rigid Pavement for the length of 50.750 km and Flexible pavement for the length of 5.4 km.

5. MCW width at flexible pavement appear to be 8.75m, at rigid pavement it is 9.0m and at structure approach location it is 9.5m.

6. In regard to Roughness, the 10m point data captured has been summed upto 100 points so as to make 1km length in moving average method for consecutive points. The high values (10m points) of the captured data has be discarded so as maintain the roughness (<2200mm/km). Thus, in LHS for 38.5 lane-km and in RHS for 21.9 lane-km at scattered points having roughness higher than threshold values needs the rectification

7. The Pavement Condition of the project appears to be fair in condition for most of the length. However, in rigid pavement longitudinal cracks, Raveling, Transverse Cracks and longitudinal wide joints are observed at few locations. Overall, total pane replacement suggested for 243 Nos., partial 1m full depth repair for 649 Nos., staple and stich for 17.1km and raveling for 30330 sqm.

8. In flexible pavement Rutting is observed for most of the locations in the inner lane and few locations in the outer lane in both the carriageways, at some locations shoving is also observed.

9. From Km 134+000 to Km 144+000 industrial areas are observed in those areas rigid pavement appears to be fair to poor in condition.

10. All the service roads are provided with flexible pavement. At some service road locations distress in the form of rutting, potholes, patching and raveling are observed.

11. Condition at Bus-bays with bus shelter appears to be fair. At some locations seating arrangements in the bus shelter are damaged and at Km 130.550 RHS side Bus Shelter shed got damaged.

12. Slope Protection in approach locations are provided with RE Walls all along the project corridor and all the RE Wall approaches appear to be fair in condition.

13. Metal beam crash barriers provided at high embankment and appear to be fair in condition. At some locations MCB damages are observed.

14. Anti-glare treatment provided in the narrow median appears to be damaged at most of the locations.

15. Pavement marking appears to be poor in most of the MCW locations in rigid pavement.

16. Pavement marking in almost all of the service roads appear to be poor in condition.

17. Kerb painting appears to be fair to poor in most of the locations. In industrial areas from Km 135+000 to 143+000 it appears to be poor.

18. Pedestrian cross markings provided at median opening and bus bay location appear to be poor in condition.

19. PGR provided between MCW and SR appear to be fair in Condition. At some locations PGR damages are observed.

20. CCBs Provided along the Approach locations are fair in condition and at one location between Km 129.260 to Km 129.600, CCB paint has faded.

21. Concrete railings are provided at some CD structure locations and are found to be in good condition.

22. Median cuts provided at curve locations appear to be fair in condition. In some locations median cuts cleaning is required.

23. Median drain observed only at one location from Km 129.200 to Km 129.530.

24. RCC covered drains are observed only in service road locations. condition of the RCC drains appear to be fair in condition except at some locations Drain cover slabs are missing and at few location damages are observed.

25. 9.5m wide median is observed between Km 139.400 to Km 140.400

26. Border Check post exist between Km 175.900 and 176.500.

27. One damaged Overhead gantry observed at Km 130.400.

28. Most of the Service Road locations are deposited with soil and requires cleaning.

29. The Project Road has variety of Superstructure types for various structures such as PSC Box Girder, PSC Girder, T-Beam Girder, and Balanced Cantilever Box Girder, Voided slab, RCC Solid slab & RCC Box.

30. As per site inventory it is understand from the structures, there are 12 No's of Structures are found as Old. In that 5- ROB's, 1- MJB, 5-MNB & 1-RUB are old in one Side.

31. Pot PTFE, Elastomeric & Rocker Roller Bearings are observed in Girder type Structures.

32. Structures are having 48 No's of Expansion joints, in that 10 No's of Exp. joints on Old Structures & 38 No's of Exp. joints on New Structures.
33. Vegetation growth observed on quadrant pitching at few locations, Cleaning of expansion joints, drainage spouts need to be done regularly.
34. All the structures appear to be in good condition. Few locations cracks have been noticed on Soffit of deck slab & Abutment Walls. May require to undertake NDT to assess the actual structural condition.
35. As Built Drawings not available for ROB's, Interchange at Km 129+685 and Box Culverts at Km 133+890,133+910 & 158+635 and Pipe culverts at km 132+394, 133+343 & 133+505.
36. There are 2 New Foot over Bridges,1 Flyover and 1 Elephant Underpass proposed in Schedule-B.
37. 3 No. of Culverts which are falling in new proposed Structure Approaches are proposed for Reconstruction.
38. All the Costs presented in this report are inclusive of applicable GST.

SAMARTH INFRAENGG Technocrats Pvt. Ltd

SIT/PJRP/2411610/15
12th February 2024

Chief Operating Officer
National Highways Infra Investment Managers Pvt. Ltd.
G-5&6, Sector 10, Dwarka,
New Delhi – 110075

Sub: Submission of Supplementary Report for Final Reports for CKRP project

Ref: Our letter reference SIT/PJRP/223607/067 dated 03.06.2023

K/A Mr. Shubhra Bhattacharya

In continuation to above reference, we are pleased to submit hereby the "Supplementary Report for Final Reports" in hard/soft copies for the following asset.

- ✓ Tolling, Operation, Maintenance & Transfer of Four Lane section between Chichra to Kharagpur from km 185+150 (Design Km 16+130) to km 129+000 (Design Km 72+250) in the state of West Bengal

✓

Thanking you and assuring you best services all the time.

Yours Sincerely,
SAMARTH Infraengg Technocrats Pvt. Ltd.

D V Sridhar Murthy
Managing Director

Encl.: "Supplementary Report for Final Reports" for the above project in hard/soft copy.

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SUPPLEMENTARY REPORT FOR FINAL REPORT

1.1 INTRODUCTION

The Final Report was submitted on 14th Day of November 2023. Subsequent to this submission, the Operation Cost has been revised in due consultation with the Competent Authority. The following changes were made.

1. Operation Costs particularly Toll Operation Cost has been revised for Year FY 2027, FY 2028 and FY 2029 considering the reduction in Manpower. The same Operation Cost pertaining to FY2029 has been considered for rest of the Concession Period.
2. Abstract Cost has been updated in line with the above changes made in Operation Cost.
3. The updated Table-54 (O&M Cost) and Table-56 (Cost Abstract) have been presented below.
4. The Cost numbers presented in the following table supersedes cost numbers presented in the respective tables of the earlier submitted report

1.2 OPERATIONS COSTS

Table 54: O&M Cost

S.No	Particulars	FY-25	FY-26	FY-27	FY-28	FY-29
A1.1	**Tolling Operations**	5.011	5.011	4.387	4.387	4.056
A1.2	**Incident Management**	2.220	2.220	2.220	2.220	2.220
A2.1	**Routine Maintenance**	3.884	3.884	3.884	3.884	3.884
A2.2	**Repairs**	1.833	1.833	1.833	1.833	1.833
A2.3	**ATMS**	0.000	0.000	0.000	0.000	0.000
B	**Admin Expenses**	4.513	4.513	4.513	4.513	4.513
		17.460	**17.460**	**16.836**	**16.836**	**16.505**
	For FY 2027, Additional cost towards special repairs	**-**	**-**	**5.000**	**-**	**-**
	Total Operation Cost	**17.460**	**17.460**	**21.836**	**16.836**	**16.505**

Note: All the amounts are in Rs. Cr and is inclusive of GST, without escalation

1.3 TOTAL COSTS

Year on year operation cost is summation of following:

- ✓ Immediate Costs
- ✓ Routine Maintenance & Incident Management
- ✓ Periodic Maintenance
- ✓ Operations Cost

Following table presents the Cost Abstract for the project

Table 56: Cost Abstract

Project Years	Calendar Year	SUMMARY OF VARIOUS EXPENSES in Rs. Crs					Remarks
		Immediate Repair's Cost	Toll Collection Expenses and Patrolling expenses	Routine Maintenance Expenses	Periodic Maintenance (Functional +Struc Overlay+ Toll collection system)	Total Cost (Rs. Cr.)	
1	2023-2024	14.00	5.01	4.51	-	23.52	
2	2024-2025		5.01	12.45	-	17.46	
3	2025-2026		5.01	12.45	-	17.46	
4	2026-2027		4.39	17.45	1.95	23.79	5.0 Cr. Additional Cost in FY2027
5	2027-2028		4.39	12.45	0.69	17.53	
6	2028-2029		4.06	12.45	-	16.50	
7	2029-2030		4.06	12.45	42.91	59.41	
8	2030-2031		4.06	12.45	1.27	17.77	
9	2031-2032		4.06	12.45	-	16.50	
10	2032-2033		4.06	12.45	2.97	19.48	
11	2033-2034		4.06	4.51	-	8.57	Capacity Augmentation
12	2034-2035		4.06	4.51	-	8.57	
13	2035-2036		4.06	4.96	-	9.01	
14	2036-2037		4.06	4.96	-	9.01	
15	2037-2038		4.06	4.96	2.53	11.54	
16	2038-2039		4.06	4.96	-	9.01	
17	2039-2040		4.06	4.96	-	9.01	
18	2040-2041		4.06	4.96	-	9.01	
19	2041-2042		4.06	4.96	49.26	58.27	
20	2042-2043		4.06	4.96	-	9.01	
21	2043-2044		4.06	4.96	0.89	9.90	
	Total Cost:	***14.00***	***88.70***	***175.20***	***102.47***	**380.37**	

Note: All the Costs are in Crores, inclusive of GST, without escalation considering FY 2024 price

National Highways Infra Projects Private Limited

FINAL REPORT

Tolling, Operation, Maintenance & Transfer of Rewa to Katni (Km 656+000 to Km 725+125 of NH-30 (old NH 7) in the State of Madhya Pradesh (MP), Package-1

SAMARTH INFRAENGG Technocrats Private Limited

NOVEMBER 2023

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LIST OF ABBREVIATIONS AND SYMBOLS

AADT	-Average Annual Daily Traffic
AE	-Authority Engineer
AMC	-Annual Maintenance Contract
ATMS	-Advanced Traffic Management System
BC	-Bituminous Concrete
BOQ	-Bill of Quantities
BOT	-Build, Operate & Transfer
CA	-Concession Agreement
CBR	-California Bearing Ratio
CCB	-Concrete Crash Barrier
CCR	-Cement Concrete Railing
COD	-Commercial Operation Date
COS	-Change of scope
CPI	-Consumer Price Index
CUP	-Cattle Under pass
CVC	-Classified Volume Count
CVPD	-Commercial Vehicles per Day
DBM	-Dense Bituminous Concrete
DPR	-Detailed Project Report
ECB	-Emergency Call Box
EPC	-Engineering, Procurement and Construction
ESI	- Employees' State Insurance
FDD	-Filed Dry Density
FOB	-Foot Over Bridge
FRL	-Finished Road Level
FSI	-Free Swell Index
FWD	-Falling Weight Deflectometer
FY	-Financial Year
GOI	- Government of India
GR	-Growth Rates
GS	-Grade Separated
GSB	-Granular Sub Base
GST	-Goods and Services Tax
HCPT	-Half cell Potential Test
HPC	-Hume Pipe Culvert
HR	- Human Resources
HTMS	-Highway Traffic Management Systems

IE	-Independent Engineer
IRC	- Indian Roads Congress
IRC SP	- Indian Roads Congress Special Publications
IRI	-International Roughness Index
Km	-kilometer
LHS	-Left Hand Side
LL	-Liquid Limit
LS	-Lumpsum
m	-Meter
MBIU	-Mobile Bridge Inspection Unit
MCB	-Metal Beam Crash Barrier
MCS	-Micro Surfacing
MCW	-Main Carriageway
MDD	-Maximum Dry Density
MHR	-Metallic Hand Rail
MJB	-Major Bridge
mm	-Millimeter
MM	-Major Maintenance
MNB	-Minor Bridge
MoRTH	- Ministry of Road Transport & Highways
Mpa	-Mega Pascal
MR	-Resilient Modulus
MSA	-Million Standard Axle
NDT	-Non-Destructive Testing
NHAI	- National Highways Authority of India
NSV	-Network survey Vehicle
O&M	- Operation and Maintenance
OL	-Overlay
PF	-Provident Fund
PGR	-Pedestrian Guard Rail
PI	-Plasticity Index
PL	-Plastic Limit
PM	-Periodic Maintenance
PUP	-Pedestrian Underpass
R&R	-Repair and Rehabilitation
RCC	-Reinforced Cement Concrete
RE Wall	-Reinforced Earth Wall
RHS	-Right Hand Side
RHT	-Rebound Hammer Test
RM	-Routine Maintenance

ROB	-Road Over Bridge
RPO	-Route Patrol Officer
RUB	-Road Under Bridge
SDBC	-Semi-Dense Bituminous Concrete
SPV	-Special Purpose Vehicle
SR	-Service Road
SWB	-Static Weigh Bridge
TCS	-Typical cross Section
TDRT	-Transient Dynamic Response test
TMS	-Toll Management System
UI	-Unevenness Index
UPVT	-Ultra Pulse Velocity test
VDF	-Vehicle Damage Factor
VG	-Viscosity Grade
VUP	-Vehicular Underpass
WBM	-Water Bound Macadam
WMM	-Wet Mix Macadam
WPI	-Wholesale Price Index

CHAPTER 1. INTRODUCTION

1.1 INTRODUCTION

National Highways Authority of India ("NHAI"/ "Authority") is an autonomous body of the Government of India ("GoI") under the Ministry of Road Transport and Highways ("MoRTH") and was constituted on June 15, 1989 by an Act of Parliament titled - The National Highways Authority of India Act, 1988 ("NHAI Act"). NHAI was operationalized in February 1995 with the appointment of full time Chairman and other Members. The functioning of NHAI is governed by NHAI Act and rules, and regulations framed thereunder.

NHAI has set up an Infrastructure Investment Trust namely National Highways Infra Trust ("InvIT") and is acting as its Sponsor to the said InvIT.

National Highways Infra Investment Managers Private Limited ("NHIIMPL") has been appointed as the Investment Manager to the InvIT.

National Highways Infra Projects Private Limited ("NHIPPL"), a wholly owned subsidiary of InvIT is planning to enter into concession agreements with NHAI for "Tolling, Operation, Maintenance & Transfer of Rewa to Katni Pkg 1 (Km 656+000 to Km 725+125 of NH-30 (old NH 7) in the State of Madhya Pradesh (MP).

M/ National Highways Infra Projects Private Limited ("NHIPPL") has engaged M/s SAMARTH INFRAENGG Technocrats Pvt Ltd as their Technical Consultants for undertaking technical due diligence study for the said project to estimate initial improvement cost (EPC) including immediate requirements for repair & rehabilitation of various elements and make an assessment of Operation & Maintenance costs for entire concession period.

1.2 PROJECT AT A GLANCE

Project road is a four-lane divided Project Highway starts at Km 656+000 (old NH-7) New NH-30 and ends at Km 725+125. The total length of the project highway is 69.185 Km.

The project corridor is constructed by Larsen & Toubro Limited and is under Defect Liability Period (DLP) up to 29th Oct 2023.

The NH-30, runs between Sitarganj, Uttarakhand and Vijayawada, Andhra Pradesh. The total length of the Highway is 1984.3Kms. It starts at the junction of NH 9 at Sitarganj and ends at the junction of NH 65 at Ibrahimpatnam, Vijayawada. It starts at the city of Sitarganj and passes through towns such as Pilibhit, Bareilly, Tilhar, Shahjahanpur, Sitapur, Lucknow, Raebareli, Allahabad, Rewa, Jabalpur, Mandla, Raipur, Dhamtari, Charama, Kanker, Kondagaon, Jagdalpur, Sukma, Konta, Nellipaka, Bhadrachalam, Paloncha, Kothagudem, Tiruvuru and terminates at Ibrahimpatnam, Vijayawada.

Major towns/settlements along the project road are Chorhata, Agdaal, Khutha, Mohari Katra, Baarikala, Semari, Sarbaka, Karhee & Kakraa, Paraswahi, Rigara, Nadan Sharda Prasad, Reusa Poundi.

Map Showing the Project Corridor

Table 1: Project Corridor Chainage System

Referencing system	Project Corridor Start Point (km)	Project Corridor End Point (km)	Length (km)
As per CA Chainage	656.000	725.185	69.185
As per Site	656.000	725.185	69.185

Photograph showing the start and end point of the project road are presented below

A view of the Start Point of Project Road at km 656.000

A view of the End Point of Project Road at km 725.185

1.3 OBJECTIVE AND SCOPE OF SERVICES

The main objective of the study is to review the current status of project corridor including details pertaining to its construction and maintenance and to provide requisite technical information for processing the acquisition of said project by client. Objective of the study can be broadly defined with following tasks:

- Study CA requirements for construction/maintenance requirements
- Undertake Detailed Reconnaissance to appreciate the project corridor characteristics
- Collection of relevant records and documents and review of same
- Undertake Engineering Studies to Establish:
    - Present Condition of Existing Road Assets
    - Quality of Executed Works/Quantity of Reutilization
    - Requirement of Immediate improvement costs as per Sch B (1st Year Capex)
    - Major Maintenance Strategies Over Concession Period
    - Routine Maintenance & Operations Requirements Over Concession Period
    - Prepare BOQ
    - Prepare Rate Analysis and finalize unit rates
    - EPC and O&M Cost

End Result is the finalization of:

- Initial improvement Works
- Major Maintenance Schedules/Cost
- Routine Maintenance Cost
- Operations Cost

The elaborate scope of services as defined in the “terms of reference” for consultants is as below:

i) Detailed reconnaissance.

ii) Video graphic survey of the entire Project corridor.

iii) Carrying out inventory and condition surveys for Project Road.

iv) Carrying out Inventory and detailed condition surveys for bridges & cross drainage structures (along with Photographs thereof) including recommendation for either strengthening/rehabilitation or reconstruction.

v) 24 hrs. Axle load survey along with axle load spectrum analysis for rigid pavement of the project corridor at one locations, wherever applicable (7-day traffic count to be provided by client)

vi) Test pits required @ every 10 km interval along the Project corridor.

vii) Carrying out necessary laboratory tests to determine the CBR value of the subgrade materials to be obtained from potential borrow pits and the quality of the aggregates from potential quarries for the pavement layers, concrete etc. The existing ground which will support the embankment and pavement must be tested for its adequacy, particularly in silty or clayey water-logged areas.

viii) Carrying out deflection test by Falling Weight Deflect meter (FWD) for existing pavement as per relevant IRC code at the rate of 5 points in km in each direction making it 10 points for both directions in the damaged stretches as well as fair stretches.

ix) Availability of construction materials as per required specification to be confirmed. Detailed Logistic plan showing the locations of the potential Borrow pits, Quarries, etc.

x) Report on existing condition of Toll Plazas and its associated facilities and proposal for their improvement.

xi) Preparation of Maintenance (Routine, Periodic and Major) costs to be incurred over the period of the concession keeping in mind the requirements of the draft Concession Agreement like adequate resources, maintenance of Cranes, Ambulance, etc.,

xii) Independently develop a bottom-up forecast of Operating expenses for each project, with detailed break-up of each type of operating expense, along with underlying assumptions

1.4 DATA COLLECTION AND REVIEW

In brief, following were covered

- ✓Review of Concession Agreement & Schedules,
- ✓Review of Detailed Project Report prepared by NHAI
- ✓ Review of As-built drawings, Plan and profiles, Structural drawings & Detailed Project Reports and Designs where available
- ✓Review of O&M costs as presented in DPR reports
- ✓Review of MPR provided by NHAI
- ✓Review of Latest NSV and FWD data provided by PIU, NHAI

1.5 PAVEMENT DESIGN REVIEW

As per Schedule-B

Flexible Pavement shall be provided for minimum design traffic of 115 MSA or 20 years design traffic whichever is maximum for main carriageway. Whereas, service road shall be designed for 10MSA and 30MSA.

Considering CTSB, Consultants have suggested as an option the following thicknesses has been arrived as follows.

CBR: 8%					
S No	**Layers**	**10 MSA**	**30 MSA**		**115 MSA**
1	**BC in mm**	40	40		**40**
2	**DBM in mm**	-	50		**110**
3	**WMM in mm**	150	150		**150**
4	**CTSB in mm**	200	200		**200**
	Total in mm	**390**	**440**		**500**

However, as TCS cross section drawings are showing conventional layers so an attempt has been made with design of conventional layers thicknesses as below.

Sl.No	Layers	Conventional - Option		
		CBR-10%		
		10 MSA	30 MSA	115 MSA
		Va-4.5 & Vb-10.5	Va-3.5 & Vb-10.6	Va-3.2 & Vb-10.6
1	BC in mm	30	40	50
2	DBM in mm	50	95	130
3	WMM in mm	250	250	250
4	GSB in mm	200	200	200
	Total in mm	**530**	**585**	**630**

DPR has suggested the following conventional thicknesses has been arrived as follows

MSA	**115**	**30**	**10**
	MCW	**SR-30MSA**	**SR-10MSA**
BC	50	40	30
DBM	95	85	50
WMM	150	250	250
GSB		200	200
CTSB	200		

CHAPTER 2. SURVEYS AND INVESTIGATIONS

2.1 INTRODUCTION

The main objective of undertaking Surveys and Investigations is to appreciate the existing engineering features along the project corridor and to understand the present condition of the various elements of the project road and to prepare required inputs for various rehabilitation and maintenance strategies.

Following Survey and Investigations have been undertaken as a part of study with an objective to understand the present condition of the road and there by access the quality of construction and as well to prepare requisite rehabilitation/corrective designs where necessary.

- Road Inventory Surveys
- Pavement Condition using NSV
- FWD Surveys
- Roughness Surveys using NSV
- Pavement Composition surveys (Test Pits)
- Subgrade Investigations & Laboratory testing
- Material Investigations
- Core Cutting Investigation
- Axle Load Survey
- Structure Inventory and Condition Surveys

2.2 ROAD INVENTORY

The project corridor has rigid pavement with 7.5m wide carriageway including shyness flanked by 1.5m paved shoulder plus 1.0 m to 1.5 m earthen shoulder on each side expect at Structure Approach locations flexible pavement has been provided to correct the approach settlements. The length of Rigid and flexible pavement is presented below.

Description	LHS (km)	RHS (km)
Before Improvement Works		
Rigid Pavement	67.495	64.895
Flexible Pavement	1.690	4.290
Project Length	69.185	69.185
After Improvement Works		
Rigid Pavement	65.785	63.655
Flexible Pavement	3.400	5.530
Project Length	69.185	69.185

In general, the project road has depressed median of 10.8m width and at built-up sections it has narrow median of 2m.

The project corridor generally runs in plain terrain. The land use along the project road is mostly Agricultural. It passes through urban settlements like, Bela, Paraswati, Amarpattan,Khudara and Goshianganj, Mihar.

In general, road embankments are in the range of 0.5-2.5m height. Embankments higher than 2.5m are observed mainly in the approaches of CD-Structures and Underpass locations.

Typical View of Project Road is shown below:

A view of the Project Road at km 657.020

A view of the Project Road at km 658.000

A view of the Project Road at km 685.010

A view of the Project Road at km 689.100

A view of the Project Road at km 704.050

A view of the Project Road at km 714.900

The Project Road has 7 Nos. of major junctions and 59 Nos. of minor junctions. Photographs showing the Major Junctions and minor junctions are presented below:

Major Junction at km 660.200 BHS

Major Junction at km 717.215-RHS

Minor Junction at km 664.900-LHS

Minor Junction at km 705.400-RHS

Minor Junction at km 709.950-LHS	**Minor Junction at km 719.745-RHS**

High mast lighting of 8 Nos. are provided near Toll plaza location and Major junction locations. Single arm (1021 Nos.) and double arm lighting (390 Nos.) have been provided in overall 62.410 Kms length of highway lighting at urban locations. Few photos showing High mast lighting are presented below:

A view of High Mast Lighting at km 694.160 Median	**A view of Single Arm lighting at km 700.000 Median**
A view of Double Arm lighting at km 696.050 Median	**A view of Single Arm lighting at km 672.000 LHS**

All together the Project Road has about 26 Nos. of Bus bays with shelters & 2 Bus shelters are observed along the project road. Few photos taken at the Bus Bays and Bus Shelters are presented below:

Bus Bay with Shelter at km 664.750-LHS

Bus Bay with Shelter at km 708.700 -RHS

The Project Road has 3 Nos. of Truck lay byes along the project corridor with rigid pavement and its condition appears to be fair. Temporary Toilet blocks were provided in the container due to the land acquisition issue. Separator is available in between main carriageway and Truck lay bye portion. Lighting in the form of single arm poles have been provided on the shoulder side of the truck lay bye counting to 11 Nos. and are found to be in good condition.

Few photos depicting the truck lay bye portion are presented below:

A view Truck Lay Bye at Km 665.100-LHS

A view Truck Lay Bye at Km 677.610-RHS

1-arm lighting @ Km 665.100 LHS

A

view Truck Lay Bye at Km 712.700-LHS

The Project Road has 1 Nos. Toll Plaza at Km 675.700. Rigid pavement exists at toll plaza location and its pavement condition appears to be fair. It has 3+1 lanes on each side. 4 numbers of High mast lighting have been provided at Toll Plaza location and on the approach to Toll Plaza, double arm lighting has been provided in central median portion.

A

view of the Existing Toll Plaza near km 675.700

A view of the Admin building near Toll plaza

A view of the Ambulance Toll plaza

A view of the Static Weigh Bridge near Toll plaza

Service road/slip roads having carriageway width of 7m have been observed along the Project Corridor for overall length of 29.94km. Service road pavement condition appears to be in fair. Photos depicting the pavement surface type, Condition and the other associated features like drain, pedestrian guard rails and metal Beam crash barriers on the separator are presented below. Few photos taken at service road locations are presented below:

Service road at km 660.180 RHS

Service road at km 680.900 LHS

Service road at km 691.150 RHS

Service road at km 720.200 LHS

The collected Road Inventory Data is presented in **Appendix 1** of this Report

2.3 PAVEMENT CONDITION SURVEYS

The present Pavement condition data has been collected using **Network Survey Vehicle (NSV).** The Pavement Condition report covering the data collection for each km length in each direction has been presented in **Appendix 2** of this Report. However, by visual inspection the pavement condition appears to be fair.

The photographs showing the pavement condition of the Project Road is presented below.

Longitudinal crack@ km 666.100 LHS	Longitudinal crack@ km 669.800 LHS	Delamination @ km 686.030 LHS
Raveling @ Km 718.100 LHS	Rutting @ Km 690.880 on RHS	Rutting @ Km 709.880 on RHS
Multiple Crack @ km 717.200 RHS	Longitudinal W.J @ Km 724.010 RHS	Corner break @ Km 667.010 LHS
Panel replacement @ km 672.700 RHS	Pop-outs @ Km 686.010 RHS	Tranverse crack @ Km 707.050 LHS

✓ **Standards and Specifications of IRC:82-2015 (for Flexible Pavement)**

The Pavement condition survey may be undertaken by the visual assessment of the surface by identifying the type, location and magnitude of the distress and the rating of the Pavement may be assignment as per the criteria given in Table 5.1 of IRC: 82-2015 as below:

Defects (type)	**Ranges of Distress**		
Cracking (%)	>10	5 to 10	<5
Ravelling (%)	>10	1 to 10	<1
Potholes (%)	>1	0.1 to 1	<0.1
Shoving (%)	>1	0.1 to 1	<0.1
Patching (%)	>10	1 to 10	<1
Settlement and Depression (%)	>5	1 to 5	<1
Rut depth (mm) using 3m straight edge	>10	5 to 10	<5
Rating	1	1.1 - 2	2.1 - 3
Condition	**Poor**	**Fair**	**Good**

For the calculation of the Weighted Rating Value of each individual parameter, the following fixed weightages have been assigned.

S.No.	**Parameter**	**Weightage (Fixed) (Multiplier Factor)**
1	Cracking	1.00
2	Raveling	0.75
3	Potholes	0.50
4	Shoving	1.00
5	Patching	0.75
6	Settlement	0.75
7	Rut depth	1.00

The Final Rating Value is calculated by taking the average of the Weighted Rating Values of all parameters viz: cracking, raveling, potholes, shoving, patching, settlement and rut depth.

It may be noted the acceptable/desirable level of service mentioned under IRC 82-2015 indicates at condition rating in terms of 1-3, <=1 being the poor and >2.1-3 being the good condition.

✓ **Standards and Specifications of IRC:SP: 83-2018 (for Rigid Pavement)**

Pavement Condition Survey with various distresses like (cracking pop outs, raveling, settled panels damaged panels etc.) are identified. For identified distresses, based on the Severity and Extent of distress, suggested following various treatments as per IRC SP 83-2018 guidelines.

Treatment Proposed	Distress Identified	Severity and
Panel Replacement	Multiple cracks (>30)	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Alligator Cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Transverse Cracks	5 .>6mm wide
	Longitudinal Crack	5. >12mm wide
Partial Panel Replacement	Multiple cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Alligator Cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Transverse Cracks	4. 3mm-6mm wide
	Longitudinal Crack	4. 6mm-12mm wide
Stitching and stapling	Multiple cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Alligator Cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Transverse Cracks	3. 0.5mm-3 mm wide
	Longitudinal Crack	2. 0.5mm-3mm wide
		3. 3mm-6mm wide

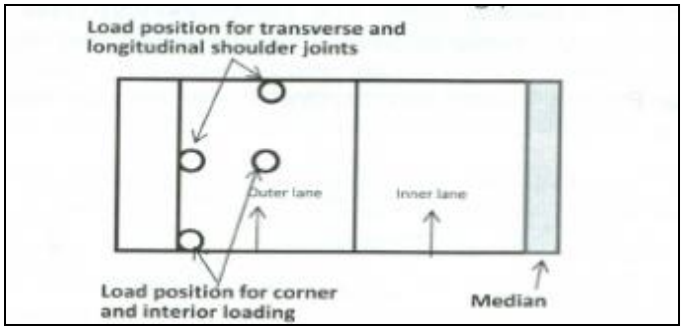
2.4 FALLING WEIGHT DEFLECTOMETER (FWD) SURVEYS

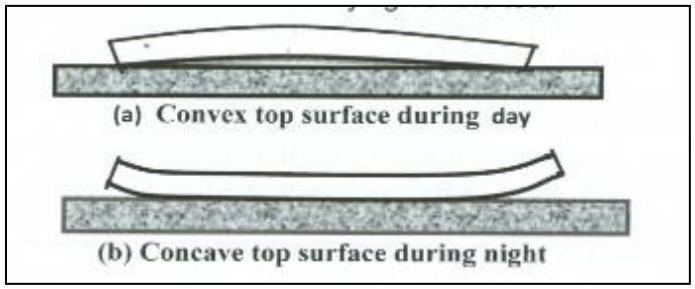
2.4.1 Pavement Evaluation Using FWD-RIGID Pavement

Structural condition of in-service rigid pavement can be evaluated using Falling Weight Deflectometer. FWD surveys are done at interior of panel to determine the Strength of Concrete and Subgrade Support and to Detect voids for loss of support FWD has been done in Wheel path.

For Evaluation of Modulus of Subgrade reaction and Strength of Concrete i.e., “Interior” loading case is done when temp gradient is zero or Negative (Top Surface is Cooler than Bottom), i.e., in the Early Morning or night time has been dine.

Corner loading has no indirect measure from the test, FWD test to be done when pavement is not in curled position and Deflections measured along wheel paths to get void locations. Load position for various cases has been presented below:



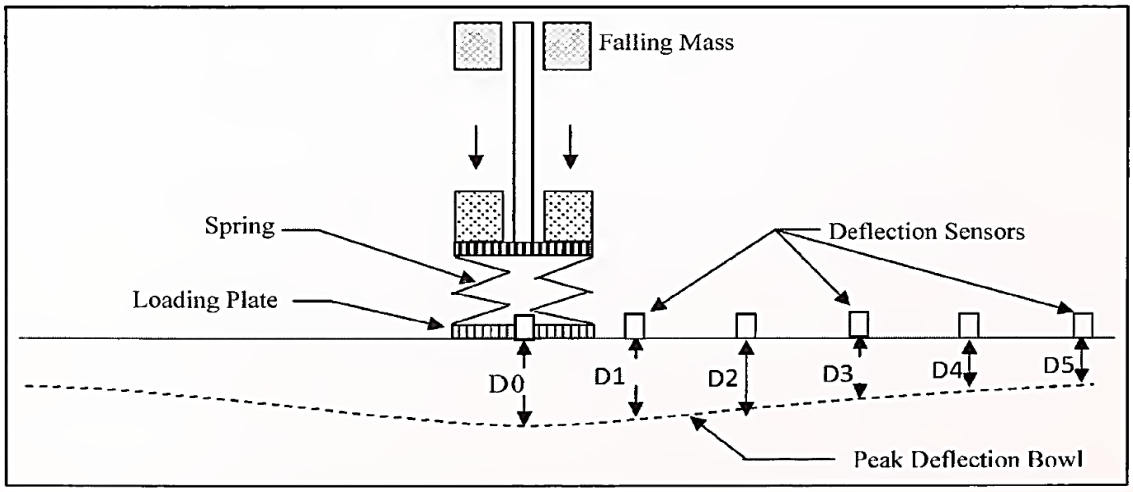


Among equipment available for structural evaluation of pavements, the Falling Weight Deflectometer (FWD) is extensively used world-wide because it simulates, to a large extent, the actual loading conditions of the pavement. When a moving wheel load passes over the pavement it produces load pulses. Normal stresses (vertical as well as horizontal) at a location in the pavement will increase in magnitude from zero to a peak value as the moving wheel load approaches the location. The time taken for the stress pulse to vary from zero to peak value is termed as 'rise time of the pulse'. As the wheel moves away from the location, magnitude of stress reduces from peak value to zero. The time period during which the magnitude of stress pulse varies from 'zero-to-peak-to-zero' is the pulse duration. Peak load and the corresponding pavement responses are of interest for pavement evaluation.

- ✓ **Working Principle of Falling Weight Deflectometer**

Falling Weight Deflectometer (FWD) is an impulse-loading device in which a transient load is applied to the pavement and the deflected shape of the pavement surface is measured. The working principle of a typical FWD is illustrated in Fig below. D0, D1, etc., are surface deflections measured at different radial distances. Impulse load is applied by means of a falling mass, which is allowed to drop vertically on a system of springs placed over a circular loading plate. The deflected shape of the pavement surface is measured using displacement sensors which are placed at different radial distances starting with the center of the load plate.

A mass of weights is dropped from a pre-determined height onto a series of springs / buffers placed on top of a loading plate. The corresponding peak load and peak vertical surface deflections at different radial locations are measured and recorded.



Basically, the FWD generates a transient, of different magnitudes of impulse load by selection of a suitable mass and an appropriate height of fall. Under the application of the impulse load, the pavement deflects. Velocity transducers are placed on the pavement surface at different radial locations to measure surface deflections. Geophones or seismometers are used as displacement transducers. Load and deflection data are acquired with the help of a data acquisition system.

FWD includes a circular loading plate of 300 to 450mm diameter, in the present survey 300mm diameter load plate is used. A falling mass in the range of 50 to 350 kg is dropped from a height of fall in the range of 100mm to 600mm to produce load pulses of desired peak load and duration. The target peak load in the range of 40KN to 60KN or Higher may be applied on Concrete Pavement to get a reasonable deflection of the order of 0.15 mm since pavements of major highways in India consisting of 150mm DLC and 300mm PQC are very stiff and a higher load may be required to get a deflection of about 0.15mm. In the present case target peak load as high as 150 KN is also used to get a reasonable deflection on concrete pavement.

In present study, Falling Weight Deflectometer (FWD) Test system has been used to generate the requisite NDT load-deflection data which was analyzed and is presented in this report. Surface deflections were measured at the center of the 300mm diameter loading plate and at the radial distances shown in the below table:

Sl.No	Geophone Ref No	Radial distance measured from center of load plate (mm)
1	D0	0
2	D1	300
3	D2	600
4	D3	900

Methodology adopted for carrying the survey

1. The FWD Surveys are carried out as per IRC:117-2014
2. The project road has two longitudinal joint one at center and other paved shoulder. Panel size is nearly 4.5x3.5m
3. Interior points at a distance of 2.25m from edge (1.5m paved shoulder+0.75m for wheel path). These points will also act as under wheel path for detection of voids. Testing was done at two interior points in at 200m and 600m. Three points @ 0, 400 and 800 in inner lane to know strength/subgrade support. (These have been taken at night)

The collected FWD Data and Analysis is presented in **Appendix 3** of this Report.

2.5 ROUGHNESS SURVEYS

The Roughness data has been collected using **Network Survey Vehicle** and analyzed in terms of International Roughness Index (IRI), separately for each lane, for both direction of travel. Pavement Roughness report covering the data collection and methodology, computation of IRI for each km length in each direction is presented in **Appendix 4** of this Report.

As per Schedule-F of TOT, the desirable level of service for Roughness values for bituminous pavement surface is considered to less than 2000 mm/Km and the acceptable limits are less than 2400mm/Km.

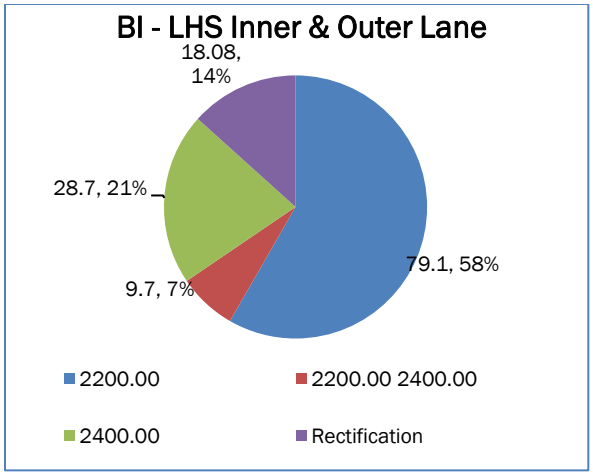
As per Schedule-F of TOT, the desirable level of service for Roughness values for rigid pavement surface is considered to less than 2200 mm/Km and the acceptable limits are less than 2400mm/Km.

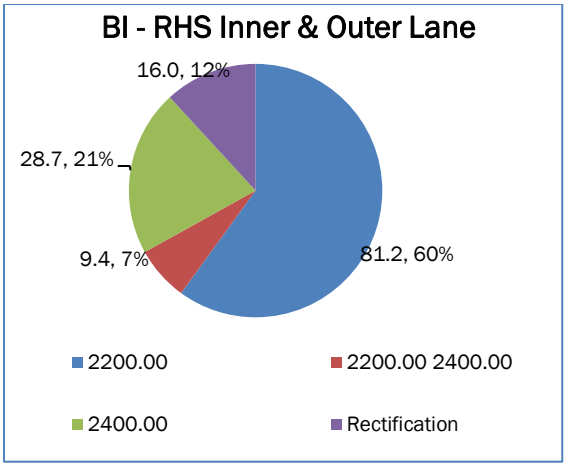
However, as per EPC Contract, Schedule-E, Roughness values should not exceed 2200mm/Km.

Average UI values along the corridor were grouped in to four categories, Pie chart showing the range of UI values in each carriageway of the project road have been presented below:

Roughness >2200 mm/km:

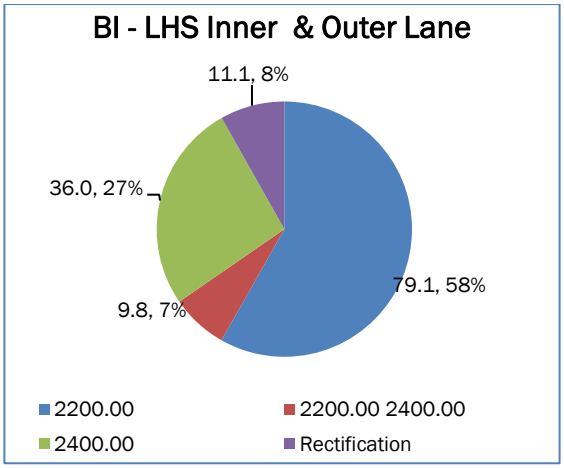
Rectification suggested based on moving average method for values >2200mm/km (based on EPC agreement)

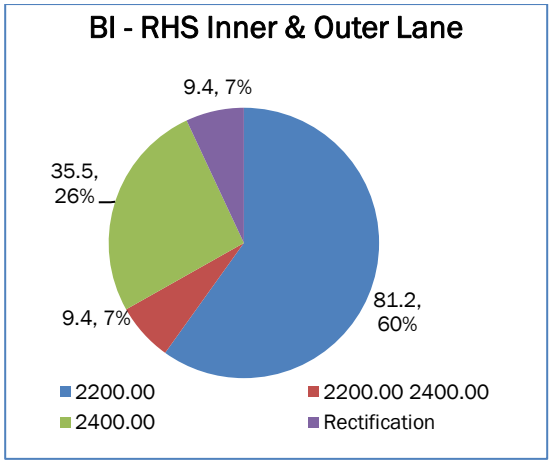




Roughness >2400 mm/km:

The same compared based on moving average method for values >2400mm/km (based on TOT agreement)





Finally, Considered the Roughness criteria with 2200mm/km(EPC),It can be seen from the above pie charts, that about 27% & 26% of the Lane km length of the Project Road has fair riding quality (UI<2200 mm/km) in LHS carriageway and RHS carriageway respectively.

2.6 PAVEMENT COMPOSITION SURVEYS (TEST PITS)

The composition of the existing pavement crust has been noted from test pit surveys. Thus, a total of 16 Nos. of pits have been dug along the corridor and the data on composition of pavement has been noted. In which, 14 Nos. of pits have taken on Main Carriageway edge and remaining 2 Nos. of test pits done on Service Road edge. Photographs have been taken at all test pit locations depicting the crust thickness and nature of material in the pavement. Few photographs are presented below:

Results of the test pit survey showing average thickness of pavement layers are presented in the Table below.

Table 2: Pavement Composition of Existing Pavement along Project Road

S No	Test Pit No	Existing Chainage	Direction	PQC (mm)	DLC (mm)	GSB (mm)	Total	Remarks
1	RJ-TP-13	720+000	RHS	330	150	180	**660**	
2	RJ-TP-14	711+800	RHS	290	160	150	**600**	
3	RJ-TP-15	700+500	RHS	300	150	150	**600**	
4	RJ-TP-16	690+450	RHS	330	150	170	**650**	
5	RJ-TP-17	679+500	RHS	300	150	230	**680**	
6	RJ-TP-18	671+400	RHS	300	150	180	**630**	
7	RJ-TP-19	661+000	RHS	340	150	150	**640**	
8	RJ-TP-20	656+100	RHS	290	130	120	**540**	
9	RJ-TP-21	666+600	LHS	390	120	100	**610**	
10	RJ-TP-22	676+200	LHS	250	150	150	**550**	
11	RJ-TP-23	687+400	LHS	310	150	150	**610**	
12	RJ-TP-24	698+100	LHS	320	140	140	**600**	
13	RJ-TP-25	706+300	LHS	315	140	130	**585**	
14	RJ-TP-26	717+600	LHS	340	100	100	**540**	
15	RJ-SR-TP-1	662+000	RHS	250	150	100	**500**	
16	RJ-SR-TP-2	685+700	LHS	280	200	200	**680**	

The Rigid pavement consists of PQC (280 mm to 340mm)+ DLC(120mm to 180mm)+ GSB(120mm to 250mm) , with total thickness of 520mm to 770mm

2.6 SUBGRADE INVESTIGATIONS & LABORATORY TESTING

Sub-grade Investigations have been carried out to examine the subgrade soil characteristics along the project road. During the test pit survey, subgrade samples have been collected. On Main Carriage way edge 14 Nos. of pits and 2 test pit done on Service road edge have taken. Field density tests have been conducted for subgrade samples and a small quantity of sample has also been collected in airtight containers for determining the field moisture content. Upon completion of the field density test, representative sample of sub-grade soil has been collected in bulk, in gunny bags, from each test pit for laboratory testing.

The soil samples collected have been tested for the following properties to assess the existing sub-grade soil properties.

- Sieve analysis
- Atterberg limits
- Heavy compaction
- Four (4) days soaked CBR as per IS standards at 97% of MDD as applicable for sub-grade (Heavy Compaction)
- Free swelling index

RJ-TP-13

RJ -TP-14

RJ -TP-15

RJ -TP-16

RJ -TP-17

RJ -TP-18

RJ -TP-19	RJ -TP-20
RJ -TP-21	**RJ -TP-22**
RJ -TP-23	**RJ -TP-24**
RJ -TP-25	**RJ -TP-26**

RJ –SR-TP-1

RJ –SR-TP-2

2.7 BORROW AREAS

Potential borrow areas identified at 6 Nos. of locations within the vicinity of the project corridor for sub-grade/ embankment within economic haulage leads have been identified. The sources identified as potential borrow sources are shown in Table below and certain useful information such as distance from the project road, location, village name, etc., have also been presented in this table below.

Table 3: Borrow Area Samples Details

Sl.No	Borrow Area No	Chainage	Side	Offset	Village and contact person	Quantity	Rate	Remarks	Co-ordinate
1	RJ-BP-10	710+200	RHS	2.8 km	Vill- Pahadi Sarpanch Name- Nikhil Mishra Mob- 9425849963	200Acres* 10 feet	Not told	Govt. Land	24.288638 80.814931
2	RJ-BP-11	691+000	LHS	9.0 km	Vill- Obra Name- Mukul Singh Mob- 9993214616	10Acres* 5 feet	Not told	Pvt. Land	24.266960 81.038655
3	RJ-BP-12	681+000	RHS	600 m	Vill- Karani Sarpanch Name- Rahul Singh Mob- 8770079307	10Acres* 5 feet	Not told	Govt. Land	24.372244 81.042036
4	RJ-BP-13	672+800	RHS	5.8 km	Vill- Silpari Name- Umashakar Pandey Mob- 9981039547	15Acres* 5 feet	Not told	Pvt. Land	24.461166 81.074317
5	RJ-BP-18	705+300	RHS	2.1 km	Vill- Bheda Name-Vishnudhar Urmariya Mob- 9424972275	10Acres* 5 feet	Not told	Pvt. Land	24.294887 80.853564

Sl.No	Borrow Area No	Chainage	Side	Offset	Village and contact person	Quantity	Rate	Remarks	Co-ordinate
6	RJ-BP-19	65+600	RHS	200m	Vill-Bela	50Acres* 5 feet	Only Royalty	Govt. Land	24.496862 81.192987

Soil samples from these borrow sources have been collected in bulk by excavating test pits down up to 1.0m depth from the existing ground surface. The top organic soil layer of approximately 150mm thickness was removed before sampling. The samples collected from these identified borrow pits/ gravel quarries have been tested for the suitability of utilizing them as embankment fill/ sub-grade. The sample photos of borrow area locations are as presented below.

RJ-BP-10

RJ-BP-11

RJ-BP-12

RJ-BP-13

RJ-BP-18	RJ-BP-19

2.8 AGGREGATE SAMPLES

Aggregates samples from 4 Nos. of sources from crusher/quarry have identified for the use of sub-base, base, surface courses and concrete works have been collected. The photos of aggregate source locations are as presented below.

Table 4: Aggregate Samples Details

RJ-AQ-2	**RJ-AQ-3**
RJ-AQ-4	**RJ-AQ-5**

The locations, estimated quantity, basic cost of material and the approximate distance from each source to the nearest point on the project corridor are compiled in Tables below.

sample No.	Ex.Chainage (Km.)	Left/ Right	Name of Village	Name of Source/ Crusher	Lead from Nearest Ex.Chainage (Km.)	Approximate Quantity (ton)	Basic cost of the material (Rs.)	Remarks	Co-ordinate
RJ-AQ-2	702+600	RHS	Reusha Barahiya	Crusher- Piyush & Company Village - Piyush Tivari Mob no- 9300550002	0.5 km	Plenty	40mm-Rs 450/- per ton 20mm-Rs 550/- per ton 10mm-Rs 100/- per ton 6mm - Rs 50/- per ton Dust - Rs 100/- Per ton	Royalty: Rs 170/- Per cub and Extra: GST 5%	24.288811 80.882811
RJ-AQ-3	702+600	RHS	Reusha Barahiya	Crusher- Naveen Stone Crusher Village - Naveen Singh Mob no- 7566058758	0.5 km	Plenty	40mm-Rs 450/- per ton 20mm-Rs 600/- per ton 10mm-Rs 120/- per ton 6mm - Rs 60/- per ton Dust - Rs 150/- Per ton	Royalty: Rs 170/- Per cub and Extra: GST 5%	24.290316 80.883756
RJ-AQ-4	660+000	RHS	Bela	Crusher- Bhundavan Stone Crusher Village - Kamalendra Singh Mob no- 9131509920	3.4 km	Plenty	20mm-Rs 720/- per ton 10mm-Rs 180/- per ton 6mm - Rs 80/- per ton Dust - Rs 100/- Per ton	Royalty: Rs 170/- Per cub and Extra: GST 5%	24.508691 81.185937
RJ-AQ-5	660+000	RHS	Bela	Crusher- Singh Stone Crusher Village - Ankit Singh Mob no9685781695	2.4 km	Plenty	40mm-Rs 600/- per ton 20mm-Rs 750/- per ton 10mm-Rs 150/- per ton 6mm - Rs 150/- per ton Dust - Rs 120/- Per ton	Royalty: Rs 170/- Per cub and Extra: GST 5%	24.500858 81.184513

2.9 SAND SAMPLES

River Sand sample of 1 Nos. has been collected from the source and tested. The location of this sand quarry along with lead to the Project Road is presented in the following table

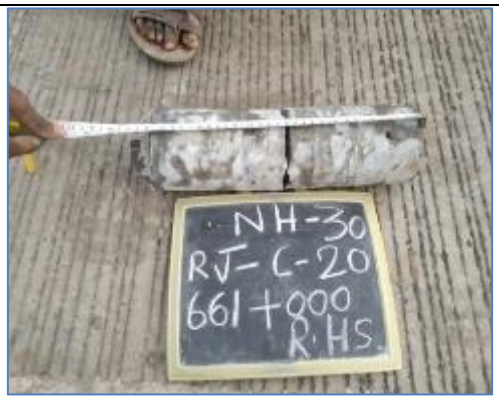
RJ-SQ-3

Table 5: Sand Samples Details

Sand Source	Village & Name	Name of river & Village	Chainage	side	Offset	Rate	Remarks
RJ-SQ-3	Vill -Chhain Pipariya Supplier Name - Ravi Raj Mob- 7909947948	Mahanadi	714+700	LHS	80.0 km	Rs 15000/- Per 300 cft with Loading Transport up to Maihar	Including Royalty

2.10 CORE CUTTING INVESTIGATION

The objective of the core cutting is to examining the engineering properties of the materials relevant to the project as per specifications. As a first step, sections are identified with good, fair and poor based on visual pavement condition observation of existing road. Accordingly, 15 Nos. of cores were taken carefully on the project corridor, in which, 13 cores were cut on Main carriageway and 2 cores on Service road. The photos of the core samples are as presented below.

RJ-C-15	RJ-C-16
RJ-C-17	RJ-C-18
	
RJ-C-19	RJ-C-20

RJ-C-21	RJ-C-22
RJ-C-23	RJ-C-24
RJ-C-25	RJ-C-26

RJ-C-27

RJ-SR-C-1

RJ-SR-C-2

Table 6: Core Cutting Samples Details

S No	Core Id	Existing Chainage	Direction	Carriage Way	Offset From median in (M)	Road Condition	Core Thickness (mm)	Hole Thickness (mm)	Remark
1	RJ-C-15	720+000	RHS	Inner	1.5	Good	**340**	340	Rigid
2	RJ-C-16	708+200	RHS	Outer	6.5	Good	**300**	300	Rigid
3	RJ-C-17	700+500	RHS	Inner	1.6	Good	**320**	320	Rigid
4	RJ-C-18	679+500	RHS	Outer	6.2	Good	**290**	290	Rigid (Rved 2 pices) Crack Middle Section
5	RJ-C-19	671+400	RHS	Inner	4.6	Good	**280**	280	Rigid
6	RJ-C-20	661+000	RHS	Outer	6.5	Good	**310**	310	Rigid (Rved 2 pices) Crack Middle Section
7	RJ-C-21	717+600	LHS	Inner	1.6	Good	**280**	280	Rigid
8	RJ-C-22	698+100	LHS	Outer	6.1	Good	**300**	300	Rigid
9	RJ-C-23	698+050	LHS	Outer	6.0	Poor (Mild Crack Section)	**310**	310	Rigid (Broken)
10	RJ-C-24	687+400	LHS	Inner	1.6	Good	**300**	300	Rigid
11	RJ-C-25	666+600	LHS	Outer	6.0	Good	**300**	300	Rigid
12	RJ-C-26	676+200	LHS	Outer	5.6	Poor Crack Section	**310**	310	Rigid (Top to Bottom crack)
13	RJ-C-27	706+300	LHS	Inner	2.0	Good	**300**	300	Rigid

S No	Core Id	Existing Chainage	Direction	Carriage Way	Offset From median in (M)	Road Condition	Core Thickness (mm)	Hole Thickness (mm)	Remark
14	RJ-SR-C-1	662+000	RHS	Outer service road	6.4	Good	**280**	280	Rigid
15	RJ-SR-C-2	685+700	LHS	Inner Service road	1.6	Good	**280**	280	Rigid

2.11 AXLE LOAD SURVEYS

Traffic loading has a significant impact on pavement performance and design. This is because the damage that vehicles create to a road depends very strongly on the axle loads of the vehicles. The exact relationship is influenced by the type of road structure and the way the road deteriorates but a "fourth power" damage law gives a good approximation.

Axle load study has been conducted using portable axle load pads. The survey was conducted near toll plaza at km 675+700 on date 27.11.2022 for 24 hrs duration in both the directions. The measurements have been made on random sampling basis. The collected axle load data and analysis is presented in **Appendix 5** of this Report.

The vehicle damage factors have been calculated using the standard axle loadings given in IRC: 37-2018. The standard axle loadings adopted have been presented in the following table

Table 7: Details of Standard Axles Used

Axle Configuration	Standard Axle load (Tonnes)*/ KN	Remarks
Single Wheel, Single Axle	6.60/65	As per IRC 37-2018
Dual Wheel, Single Axle	8.16/80	As per IRC 37-2018
Dual Wheel, Tandem Axle group	15.10/148	As per IRC 37-2018
Dual Wheel, Tridem Axle group	22.90/224	As per IRC 37-2018

Few photographs illustrating the survey locations and axle load measurements are presented below.

Survey in Progress

Survey in Progress

Survey in Progress	**Survey in Progress**

Direction wise VDF for each mode of commercial traffic has been estimated. Results of axle load surveys have been presented in the following table.

Table 8: VDF Values Estimated at the Toll Plaza Locations

Vehicle Type	Toll plaza at Km 675+700	
	UP	DN
BUS	0.5	1.5
2-Axle	1.19	2.04
3-Axle	4.78	6.32
M Axle	11.14	12.89
LCV	0.14	1.33

CHAPTER 3. VALIDATION OF EXECUTED WORKS

3.1 ROAD WORKS

The project road has been closely inspected to verify the executed works on ground. The scope works to be executed by the Concessionaire/Contractor as envisaged in CA is compared with the executed work on the Ground. As a part of the validation, the available as-built drawings and the inventory data received from the Concessionaire were also referred. Each structure has been inspected to note down its structural configuration and condition. The following table highlights the scope comparison of the executed works on ground.

Table 9: Scope Comparison of Executed works

Sl. No.	Particulars	Length/ Nos.	Total for O&M Estimation	As per Schedule-B	As per Schedule-A	As per Site	Remarks
1	Start Chainage (Km)	Km	656	656	656	656	
2	End chainage (Km)	Km	725.185	725.185	725.185	725.185	
3	Length of the Project Corridor	Kms	69.185	69.185	69.185	69.185	
4	Service Road / Slip Road	Kms	47.714	17.774	31.141	29.94	
5	Bypass Length	Kms	14.051	0	14.051	14.051	
6	Toll Plaza	Nrs	1	0	1	1	
7	No. of Lanes (Both side)	Nrs	8	0	8	8	3+1 Lanes on Both sides
8	ROBs	Nrs	1	0	1	1	
9	Flyovers	Nrs	0	0	2	0	
10	VUPs	Nrs	3	1	2	2	
11	LVUP's	Nrs	1	1		0	
12	PUP's/CUP's	Nrs	11	0	11	11	
13	Major Bridges	Nrs	1	0	1	1	
14	Minor Bridges	Nrs	6	1	6	6	proposed is Widening
15	Culverts (Pipe)	Nrs	107	17	107	107	proposed is Widening
16	Culvert (Slab/Box)	Nrs	30	8	30	30	proposed is Widening
17	Major Junctions	Nrs	7	0	6	7	
18	Minor junctions	Nrs	59	0	59	59	
19	High Embankments	Kms	16.12	0		16.12	
20	Concrete Lining	Kms	0.79	0		0.79	
21	RCC Wall	Kms	5.6	0		5.6	
22	Partial RE Wall with Concrete Lining	Kms	12.24	0		12.24	
23	Bus Bays with Shelter	Nrs	26	0	26	26	
24	Bus Shelters	Nrs	2	0		2	

Sl. No.	Particulars	Length/ Nos.	Total for O&M Estimation	As per Schedule-B	As per Schedule-A	As per Site	Remarks
25	Truck Lay bye	Nrs	3	0	3	3	
26	Rest Areas	Nrs	1	0	1	1	
27	High Mast Lights	Nrs	10	2		8	
28	Highway Lighting (length only)	Kms	71.462	9.052		62.41	
29	Single Arm Lightnings	Nrs	1021	0		1021	
30	Double Arm Lightnings	Nrs	693	303		390	
31	Solar Blinkers	Nrs	32	0		32	
32	RCC Cover Drain	Kms	42.403	17.774	34.93	24.629	
33	Earthen Drain	Kms	113.741	0		113.741	
34	Median drain	Kms	300	0		300	
35	Median Cuts	Nrs	9	0		9	
36	Median Opening	Nrs	16	0	17	16	
37	Median kerb Damages	Kms	0.311	0		0.311	
38	Median Plantation Functional	Kms	3.465	0		3.465	
39	Median Plantation Non-Functional	Kms	59.75	0		59.75	
40	Road Markings	Kms	69.185	0		69.185	
41	W-Beam Safety Barriers	Kms	94.4	68.81		25.59	
42	Rigid Concrete Barriers	Kms	6.77	0		6.77	
43	Concrete Railing	Kms	0.6	0		0.6	
44	Pedestrian Guard Rails	Kms	27.949	15.364		12.585	
45	Delineators	Nrs	100	0		100	
46	Kilometre Stones	Nrs	140	0		140	
47	Hectometre Stones	Nrs	552	0		552	
48	Boundary Stones	Nrs	553	0		553	2214.4
49	Road Signs	Nrs	910	0		910	
50	Gantry Sign Boards	Nrs	4	0		4	
51	Cantilever Sign Boards	Nrs	22	0		22	
52	Rain water Harvesting pits	Nrs	0	0	276	0	
53	Traffic Attenuators	Nrs	12	12	0	0	
54	RE Wall painting	Sqm	21420			21420	

The project corridor appears to have been constructed with the cross-sectional elements matching to those given in the manual at the time of execution. The carriageway width of 7.0m plus paved shoulders of 1.5m and a shyness of 0.6m has been provided over the entire length except at structures. Earthen shoulders of 1m to 2.0m on either side of carriageway have also been provided.

In the project stretch, the Service/Slip Roads having 7m wide carriageway with an overall both side length of 29.940 km have been observed. Location wise details of service roads and slip roads presented in **Appendix 6** are listed as below:

Table 10: Details of Service Roads/Slip Roads along Project Road

S.No.	Existing Chainage		SR without tapers		Side	Pavement Type	As Per Site (m)	Width (m)
	From (km)	To (km)	From (km)	To (km)				
1	656+350	656+730	656+480	656+678	LHS	Flexible	198	7
2	657+010	658+480	657+050	658+450	LHS	Flexible	1400	7
3	659+630	660+850	659+700	660+800	LHS	Flexible	1100	7
4	662+240	662+810	662+275	662+750	LHS	Rigid	475	7
5	665+730	666+470	665+770	666+432	LHS	Flexible	662	7
6	669+410	670+290	669+500	670+260	LHS	Rigid	760	7
7	679+800	683+110	679+845	683+061	LHS	Flexible	3216	7
8	685+660	685+790	685+660	685+790	LHS	Flexible	130	7
9	685+790	686+350	685+790	686+350	LHS	Rigid	560	7
10	690+420	691+480	690+455	691+450	LHS	Rigid	995	7
11	696+190	696+320	696+190	696+320	LHS	Flexible	130	7
12	696+320	696+890	696+320	696+890	LHS	Rigid	570	7
13	696+890	697+020	696+890	697+020	LHS	Flexible	130	7
14	698+830	699+590	698+838	699+550	LHS	Rigid	712	7
15	701+790	702+650	701+790	702+642	LHS	Flexible	852	7
16	713+070	713+120	713+070	713+120	LHS	Flexible	50	7
17	713+120	713+360	713+120	713+360	LHS	Rigid	240	7
18	713+360	713+410	713+360	713+410	LHS	Flexible	50	7
19	713+810	713+920	713+810	713+920	LHS	Flexible	110	7
20	713+920	714+200	713+920	714+200	LHS	Rigid	280	7
21	714+200	715+160	714+200	715+160	LHS	Flexible	960	7
22	715+160	715+500	715+160	715+500	LHS	Rigid	340	7
23	715+500	716+150	715+500	716+150	LHS	Flexible	650	7
24	716+190	717+350	716+190	717+310	LHS	Flexible	1120	7
25	720+050	720+180	720+100	720+180	LHS	Flexible	80	7
26	720+180	721+062	720+180	721+062	LHS	Rigid	882	7
27	721+062	721+090	721+062	721+090	LHS	Flexible	28	7
1	656+250	656+450	656+250	656+450	RHS	Flexible	200	7
2	656+530	656+680	656+530	656+680	RHS	Rigid	150	7

S.No.	Existing Chainage		SR without tapers		Side	Pavement Type	As Per Site (m)	Width (m)
	From (km)	To (km)	From (km)	To (km)				
3	657+290	657+750	657+290	657+750	RHS	Rigid	460	7
4	657+750	657+830	657+750	657+830	RHS	Flexible	80	7
5	657+830	658+340	657+830	658+340	RHS	Rigid	510	7
6	658+340	658+480	658+340	658+480	RHS	Flexible	140	7
7	659+670	660+300	659+670	660+300	RHS	Flexible	630	7
8	660+300	660+350	660+300	660+350	RHS	Rigid	50	7
9	660+350	660+540	660+350	660+540	RHS	Flexible	190	7
10	660+540	660+720	660+540	660+720	RHS	Rigid	180	7
11	660+720	660+830	660+720	660+830	RHS	Flexible	110	7
12	661+920	662+500	661+950	662+275	RHS	Rigid	325	7
13	662+500	662+590	662+500	662+590	RHS	Flexible	90	7
14	662+590	662+700	662+590	662+700	RHS	Rigid	110	7
15	662+700	663+110	662+700	663+040	RHS	Flexible	340	7
16	665+730	666+430	665+770	666+432	RHS	Flexible	662	7
17	669+500	670+310	669+500	670+270	RHS	Flexible	770	7
18	679+940	681+670	679+970	681+645	RHS	Rigid	1675	7
19	685+640	686+430	685+694	686+400	RHS	Flexible	706	7
20	691+000	691+470	691+040	691+450	RHS	Rigid	410	7
21	696+800	697+330	696+848	697+300	RHS	Flexible	452	7
22	698+800	698+900	698+800	698+900	RHS	Rigid	100	7
23	698+900	698+950	698+900	698+950	RHS	Flexible	50	7
24	698+950	699+490	698+950	699+468	RHS	Rigid	518	7
25	700+930	702+510	700+943	702+480	RHS	Flexible	1537	7
26	713+100	713+390	713+100	713+365	RHS	Flexible	265	7
27	714+170	715+380	714+210	715+350	RHS	Flexible	1140	7
28	715+600	716+150	715+630	716+120	RHS	Flexible	490	7
29	716+190	716+850	716+190	716+850	RHS	Flexible	660	7
30	720+960	721+190	720+900	721+160	RHS	Rigid	260	7
As per Site Total Length of Service/Slip Road (km)							**29.940**	

Drains in a length of 24.629 km are provided at various locations are provided along the Project corridor, the location and condition of the same are presented in **Appendix 6**.Covered slab was missing & damage observed above the lined drain locations, cleaning need to be required. These sections are presented in the Table below.

Table 11: RCC Covered Drains

S.No	Existing Chainage (Km)		Side	Length (km)	Width (m)	Cover Missing (m)	Cover Damage(m)	Remarks
	From	To						
1	656.300	658.100	LHS	1.800	1.20	20		
2	659.750	660.750	LHS	1.000	1.20			
3	662.300	662.770	LHS	0.470	1.20			
4	665.750	666.100	LHS	0.350	1.20			
5	679.850	682.950	LHS	3.100	1.20		10	
6	685.700	686.300	LHS	0.600	1.20			
7	691.470	691.500	LHS	0.030	1.20			
8	696.250	696.850	LHS	0.600	1.20			
9	701.100	701.400	LHS	0.300	1.20			
10	701.700	702.500	LHS	0.800	1.20			
11	713.120	713.350	LHS	0.230	1.20			
12	713.836	716.100	LHS	2.264	1.20			
13	716.200	717.350	LHS	1.150	1.20	5		
14	720.200	720.760	LHS	0.560	1.20			
15	720.840	721.060	RHS	0.220	1.20		5	
16	717.130	717.360	RHS	0.230	1.20			
17	716.180	716.820	RHS	0.640	1.20	25		
18	715.490	716.100	RHS	0.610	1.20	12		
19	714.230	714.260	RHS	0.030	1.20			
20	713.050	713.320	RHS	0.270	1.20			
21	701.030	702.500	RHS	1.470	1.20	20		
22	698.850	699.395	RHS	0.545	1.20	3		
23	696.850	697.200	RHS	0.350	1.20			
24	691.000	691.390	RHS	0.390	1.20			
25	690.550	690.750	RHS	0.200	1.20	5		
26	685.800	686.400	RHS	0.600	1.20			
27	679.870	681.600	RHS	1.730	1.20			
28	669.800	670.230	RHS	0.430	1.20			
29	665.860	666.360	RHS	0.500	1.20			
30	662.600	663.070	RHS	0.470	1.20			
31	662.050	662.480	RHS	0.430	1.20			
32	659.860	660.700	RHS	0.840	1.20	10		
33	657.080	658.400	RHS	1.320	1.20			
34	656.800	656.900	RHS	0.100	1.20			
Total Length of RCC covered Drain(km)				**24.629**		**100**	**15**	

Partial RCC walls, RE walls and green mat are found in approaches of some of the underpass, High embankment, Minor Bridges along the Project Corridor which account for a Total length of 34.750 Km. The summary of the slope protection table was presented below:

Table 12: Summary of Slope Protection along Project Road

S.no	Existing Chainage (km)		Length(Km)	Side	Embankment	Stone Pitching	Geo Grids	Partial RE Wall+Concrete lining	RCC Wall	Concrete lining	Remarks
	From	To									
1	657.530	657.770	0.240	LHS					Yes		
2	657.530	657.770	0.240	RHS					Yes		
3	657.790	657.980	0.190	LHS					Yes		
4	657.790	657.980	0.190	RHS					Yes		
5	659.910	660.130	0.220	LHS					Yes		
6	659.910	660.130	0.220	RHS					Yes		
7	660.200	660.570	0.370	LHS					Yes		
8	660.200	660.570	0.370	RHS					Yes		
9	662.190	662.530	0.340	LHS				Yes			
10	662.190	662.530	0.340	RHS				Yes			
11	662.590	662.810	0.220	LHS				Yes			
12	662.590	662.810	0.220	RHS				Yes			
13	665.920	666.090	0.170	LHS				Yes			
14	665.920	666.090	0.170	RHS				Yes			
15	666.070	666.260	0.190	LHS				Yes			
16	666.070	666.260	0.190	RHS				Yes			
17	669.710	669.880	0.170	LHS					Yes		
18	669.710	669.880	0.170	RHS					Yes		
19	669.910	670.070	0.160	LHS					Yes		
20	669.910	670.070	0.160	RHS					Yes		
21	680.880	681.760	0.880	LHS					Yes		
22	680.880	681.760	0.880	RHS					Yes		
23	681.180	681.380	0.200	LHS					Yes		
24	681.180	681.380	0.200	RHS					Yes		
25	683.020	683.810	0.790	LHS	Yes					Yes	
26	685.820	686.060	0.240	LHS					Yes		
27	685.820	686.060	0.240	RHS					Yes		
28	686.080	686.210	0.130	LHS					Yes		
29	686.080	686.210	0.130	RHS					Yes		
30	688.790	689.280	0.490	LHS	Yes						
31	688.790	689.280	0.490	RHS	Yes						
32	691.000	691.260	0.260	LHS				Yes			
33	691.000	691.260	0.260	RHS				Yes			
34	691.580	692.380	0.800	LHS				Yes			Proposed LVUP

S.no	Existing Chainage (km)		Length(Km)	Side	Embankment	Stone Pitching	Geo Grids	Partial RE Wall+Concrete lining	RCC Wall	Concrete lining	Remarks
	From	To									
35	691.580	692.380	0.800	RHS				Yes			Proposed LVUP
36	692.470	692.900	0.430	LHS	Yes						
37	692.470	692.900	0.430	RHS	Yes						
38	694.000	694.070	0.070	LHS	Yes						
39	694.000	694.070	0.070	RHS	Yes						
40	699.060	699.910	0.850	LHS				Yes			
41	699.060	699.910	0.850	RHS				Yes			
42	699.090	699.320	0.230	LHS				Yes			
43	699.090	699.320	0.230	RHS				Yes			
44	701.430	701.740	0.310	LHS				Yes			
45	701.430	701.740	0.310	RHS				Yes			
46	701.770	702.120	0.350	LHS				Yes			
47	701.770	702.120	0.350	RHS				Yes			
48	710.430	710.910	0.480	LHS	Yes						
49	710.490	711.150	0.660	LHS	Yes						
50	712.950	713.860	0.910	LHS				Yes			Proposed LVUP
51	712.950	713.860	0.910	RHS				Yes			Proposed LVUP
52	714.300	714.740	0.440	LHS				Yes			
53	714.300	714.740	0.440	RHS				Yes			
54	714.700	714.970	0.270	LHS				Yes			
55	714.700	714.970	0.270	RHS				Yes			
56	714.750	714.860	0.110	LHS				Yes			
57	714.750	714.860	0.110	RHS				Yes			
58	715.730	716.110	0.380	LHS				Yes			
59	715.730	716.110	0.380	RHS				Yes			
60	716.210	716.500	0.290	LHS				Yes			
61	716.210	716.500	0.290	RHS				Yes			
62	721.690	727.870	6.180	LHS	Yes						
63	721.690	727.870	6.180	RHS	Yes						
64	723.240	723.560	0.320	LHS	Yes						
65	723.240	723.560	0.320	RHS	Yes						
Total Length(Km)			**34.750**								

In general, the median width varying from is 2m in built-up area to 10.8m with depressed median in rural section. As per site 16 No of Median openings are observed. The location wise details are presented in the table below.

Table 13: Details of Median Openings along Project Road

S. No.	Existing Chainage (km)	Width (m)	Length (m)	Reserve lane	Remarks
1	663.910	7.1	20	Yes	
2	672.515	7.1	30	Yes	
3	675.090	7.1	20	Yes	
4	678.760	7.1	20	Yes	
5	683.865	7.1	30	Yes	
6	687.815	7.1	25	Yes	
7	694.175	7.1	50	Yes	
8	703.210	7.1	20	Yes	
9	705.420	7.1	40	Yes	
10	708.125	7.1	50	Yes	
11	709.970	7.1	20	Yes	
12	711.715	7.1	30	Yes	
13	713.025	7.1	50	Yes	
14	713.375	7.1	50	Yes	
15	717.215	7.1	30	Yes	
16	722.565	7.1	30	Yes	

The Project Road has 7 Nos. of Major Junctions and 59 Nos. of Minor Junctions. The List of Major & Minor junctions are provided with location wise are presented in table below:

Table 14: List of Major Junctions

S. No.	Chainage (km)	Type of Junction	Surface Type of Access Road		Width of Access Road (m)		Remarks
			LHS	RHS	LHS	RHS	
1	660.200	BHS	BT	BT	7	7	
2	662.545	RHS		BT		7	
3	687.850	RHS		BT		7	
4	694.154	RHS		BT		7	
5	713.380	RHS		BT		7	
6	714.725	BHS	BT	BT	7	7	
7	717.215	RHS		BT		7	

Table 15: List of Minor Junctions

S. No.	Chainage (km)	Side	Surface Type of Access Road		Width of Access Road (m)		Remarks
			LHS	RHS	LHS	RHS	
1	656+050	RHS		BT			
2	656+300	LHS	BT				
3	656+600	RHS		BT			
4	657+800	BHS	BT	BT			
5	658+300	LHS	BT				
6	659+300	LHS	BT				
7	659+400	RHS		BT			
8	659+400	LHS	BT				
9	663+038	LHS	Earthen				
10	663+675	LHS	CC				
11	663+910	RHS		BT			
12	664+900	LHS	BT				
13	666+120	BHS	BT	BT			
14	668+348	LHS	BT			3.5	
15	668+770	RHS		BT	3.5		
16	669+900	LHS	BT			3.5	
17	672+500	LHS	BT		3.5	3.5	
18	672+840	RHS		BT	3.5		
19	675+115	LHS	BT		3.5		
20	677+018	LHS	BT			3.5	
21	677+081	RHS		BT	3.8		
22	678+125	LHS	BT				
23	678+725	BHS	BT	BT	3		
24	681+015	RHS		CC		3.5	
25	681+185	BHS	CC	CC	3.5		
26	682+068	LHS	BT		3.5	3.5	
27	682+695	LHS	BT		3.5		
28	684+485	LHS	BT			3.5	
29	686+057	BHS	Earthen	BT	3.5		
30	690+458	LHS	BT		3.5		
31	690+500	RHS		BT		3.5	
32	691 +000	BHS	BT	BT	3.5		
33	691 +920	BHS	BT	BT	3.5		

S. No.	Chainage (km)	Side	Surface Type of Access Road		Width of Access Road (m)		Remarks
			LHS	RHS	LHS	RHS	
34	692+616	BHS	CC	CC		3.5	
35	695+570	LHS	BT		3.5		
36	696+426	LHS	BT		3.5	3.5	
37	698+168	LHS	BT			3	
38	699+100	LHS	BT		3.5	3	
39	699+275	LHS	BT		3.5		
40	701+730	BHS	CC	Earthen	3.5		
41	702+880	RHS		BT	3.5		
42	703+217	BHS	BT	Earthen		3.5	
43	705+400	RHS		BT	3.5		
44	707+000	BHS	BT	BT		3.5	
45	707+750	RHS		BT	5.5	5.5	
46	708+100	RHS		BT	3.5	3.5	
47	708+815	LHS	BT		3	3	
48	709+950	BHS	BT	BT	3.5		
49	711 +600	RHS		BT	3		
50	711+710	LHS	BT		3.5		
51	712+952	BHS	CC	BT	3.5		
52	714+100	RHS		BT	3.5		
53	714+600	BHS	BT	BT	3		
54	715+536	BHS	BT	BT		5.5	
55	719+100	RHS		BT	3.5		
56	719+745	RHS		BT		3.5	
57	720+520	RHS		BT	3.5	3.5	
58	722+575	LHS	BT			3.5	
59	724+400	LHS	BT			3.5	

Safety Barriers are provided at Minor Bridges, Culverts and Underpasses (VUP, PUP and LVUP) and its approach locations. The table below shows the summary of Safety Barriers provided along the project corridor and the location wise details are provided below:

Table 16: Summary of Safety Barriers

S. No.	Description	Length (Kms)
1	W-Beam Safety Barriers	25.590
2	Concrete Crash Barriers	6.770
3	Pedestrian Guard Railings	12.585

Table 17: W-Beam Safety Barriers

S. No	Design Chainage		Side/Location	Length (km)	Condition	Damage (m)	Remarks
	From (km)	To (km)					
1	657.530	657.740	LHS	0.210	Fair		
2	657.760	658.020	LHS	0.260	Fair		
3	659.820	660.120	LHS	0.300	Fair		
4	660.190	660.620	LHS	0.430	Fair		
5	665.820	666.610	LHS	0.790	Fair		
6	666.130	666.340	LHS	0.210	Fair		
7	669.650	669.910	LHS	0.260	Fair		
8	669.940	670.130	LHS	0.190	Fair		
9	680.730	681.170	LHS	0.440	Fair		
10	681.190	681.500	LHS	0.310	Fair		
11	683.490	683.530	LHS	0.040	Fair		
12	683.560	683.600	LHS	0.040	Fair		
13	683.760	683.880	LHS	0.120	Fair		
14	685.770	686.060	LHS	0.290	Fair		
15	686.080	686.290	LHS	0.210	Fair		
16	688.710	689.040	LHS	0.330	Fair		
17	689.070	689.310	LHS	0.240	Fair		
18	690.590	691.030	LHS	0.440	Fair	10	
19	691.060	691.360	LHS	0.300	Fair		
20	692.320	692.590	LHS	0.270	Fair	6	
21	692.620	692.810	LHS	0.190	Fair		
22	694.000	694.060	LHS	0.060	Fair		
23	694.030	694.090	LHS	0.060	Fair		
24	696.180	696.400	LHS	0.220	Fair		
25	696.400	696.640	LHS	0.240	Fair		
26	698.880	699.090	LHS	0.210	Fair		
27	699.110	699.370	LHS	0.260	Fair		

S. No	Design Chainage		Side/Location	Length (km)	Condition	Damage (m)	Remarks
	From (km)	To (km)					
28	701.330	701.730	LHS	0.400	Fair		
29	701.760	702.180	LHS	0.420	Fair		
30	710.510	710.770	LHS	0.260	Fair	5	
31	710.860	711.050	LHS Median	0.190	Fair		
32	710.860	711.050	LHS	0.190	Fair		
33	714.010	714.290	LHS	0.280	Fair	15	
34	714.320	714.690	LHS	0.370	Fair		
35	714.720	717.940	LHS	3.220	Fair		
36	714.955	715.120	LHS	0.165	Fair		
37	715.560	715.970	LHS	0.410	Fair	15	
38	716.070	716.610	LHS	0.540	Fair		
39	718.020	718.050	LHS	0.030	Fair		
40	720.330	720.510	LHS	0.180	Fair		
41	720.530	720.760	LHS	0.230	Fair		
42	721.390	721.420	LHS	0.030	Fair		
43	721.440	721.460	LHS	0.020	Fair		
44	721.660	721.810	LHS	0.150	Fair	5	
45	721.830	721.970	LHS	0.140	Fair		
46	723.160	723.540	LHS	0.380	Fair	20	
47	723.570	723.640	LHS	0.070	Fair		
48	724.370	724.580	RHS	0.210	Fair		
49	724.180	724.330	RHS	0.150	Fair	8	
50	721.790	721.980	RHS	0.190	Fair		
51	721.640	721.770	RHS	0.130	Fair		
52	721.360	721.390	RHS	0.030	Fair		
53	721.300	721.340	RHS	0.040	Fair		
54	720.410	720.740	RHS	0.330	Fair	10	
55	720.290	720.380	RHS	0.090	Fair		
56	718.110	718.170	RHS	0.060	Fair		
57	718.060	718.090	RHS	0.030	Fair		
58	716.130	716.540	RHS	0.410	Fair		
59	715.510	716.070	RHS	0.560	Fair		
60	715.000	715.080	RHS	0.080	Fair		
61	714.670	714.895	RHS	0.225	Fair		

S. No	Design Chainage		Side/Location	Length (km)	Condition	Damage (m)	Remarks
	From (km)	To (km)					
62	714.190	714.640	RHS	0.450	Fair		
63	714.030	714.180	RHS	0.150	Fair		
64	710.960	710.990	RHS	0.030	Fair		
65	710.940	710.970	RHS Median	0.030	Fair		
66	710.860	710.890	RHS	0.030	Fair		
67	710.830	710.890	RHS Median	0.060	Fair		
68	710.820	710.830	RHS	0.010	Fair	5	
69	710.600	710.700	RHS	0.100	Fair	5	
70	710.360	710.580	RHS	0.220	Fair		
71	701.760	702.180	RHS	0.420	Fair		
72	701.330	701.730	RHS	0.400	Fair		
73	699.110	699.370	RHS	0.260	Fair		
74	698.890	699.090	RHS	0.200	Fair		
75	696.430	696.640	RHS	0.210	Fair		
76	696.180	696.400	RHS	0.220	Fair		
77	694.040	694.080	RHS	0.040	Fair		
78	692.620	692.810	RHS	0.190	Fair		
79	692.340	692.590	RHS	0.250	Fair		
80	690.590	691.060	RHS	0.470	Fair		
81	689.070	689.280	RHS	0.210	Fair		
82	688.710	689.040	RHS	0.330	Fair		
83	686.080	686.290	RHS	0.210	Fair		
84	685.770	686.060	RHS	0.290	Fair		
85	683.560	683.600	RHS	0.040	Fair		
86	683.490	683.530	RHS	0.040	Fair		
87	681.190	681.500	RHS	0.310	Fair		
88	680.730	681.170	RHS	0.440	Fair	10	
89	669.940	670.130	RHS	0.190	Fair		
90	669.650	669.910	RHS	0.260	Fair		
91	666.130	666.340	RHS	0.210	Fair		
92	665.820	666.110	RHS	0.290	Fair		
93	662.600	662.880	RHS	0.280	Fair		
94	662.170	662.590	RHS	0.420	Fair		
95	660.190	660.620	RHS	0.430	Fair		

S. No	Design Chainage		Side/Location	Length (km)	Condition	Damage (m)	Remarks
	From (km)	To (km)					
96	659.820	660.120	RHS	0.300	Fair		
97	657.760	658.020	RHS	0.260	Fair		
98	657.530	657.740	RHS	0.210	Fair		
As per Site Total Length of W-Beam Barriers (km)				**25.590**		**114**	

Table 18: Concrete Crash Barriers along Project Road

S. No.	Design Chainage		Length (m)	Side	Condition	Remarks
	From (km)	To (km)				
1	657.740	657.760	20	LHS Shoulder	Fair	
2	660.120	660.190	70	LHS Median	Fair	
3	660.120	660.190	70	LHS Shoulder	Fair	
4	660.290	662.710	2420	LHS Median	Fair	
5	665.590	665.600	10	LHS Shoulder	Fair	
6	666.110	666.130	20	LHS Shoulder	Fair	
7	666.960	666.970	10	LHS Shoulder	Fair	
8	668.180	668.190	10	LHS Shoulder	Fair	
9	669.910	669.940	30	LHS Shoulder	Fair	
10	679.110	679.120	10	LHS Shoulder	Fair	
11	681.170	681.190	20	LHS Shoulder	Fair	
12	683.350	683.360	10	LHS Shoulder	Fair	
13	683.530	683.560	30	LHS Median	Fair	
14	683.530	683.560	30	LHS Shoulder	Fair	
15	684.460	684.470	10	LHS Shoulder	Fair	
16	686.060	686.080	20	LHS Shoulder	Fair	
17	687.190	687.200	10	LHS Shoulder	Fair	
18	688.030	688.040	10	LHS Shoulder	Fair	
19	688.380	688.390	10	LHS Shoulder	Fair	
20	689.040	689.070	30	LHS Shoulder	Fair	
21	689.390	689.400	10	LHS Shoulder	Fair	
22	691.030	691.060	30	LHS Median	Fair	
23	691.030	691.060	30	LHS Shoulder	Fair	
24	692.590	692.620	30	LHS Shoulder	Fair	
25	692.880	692.890	10	LHS Median	Fair	

S. No.	Design Chainage		Length (m)	Side	Condition	Remarks
	From (km)	To (km)				
26	692.880	692.890	10	LHS Shoulder	Fair	
27	694.060	694.090	30	LHS Median	Fair	
28	694.060	694.090	30	LHS Shoulder	Fair	
29	696.400	696.430	30	LHS Shoulder	Fair	
30	699.090	699.110	20	LHS Shoulder	Fair	
31	701.730	701.760	30	LHS Shoulder	Fair	
32	709.400	709.410	10	LHS Shoulder	Fair	
33	710.410	710.750	340	LHS Median	Fair	
34	710.410	710.750	340	LHS Shoulder	Fair	
35	710.770	710.860	90	LHS Median	Fair	
36	710.770	710.860	90	LHS Shoulder	Fair	
37	711.280	711.300	20	LHS Shoulder	Fair	
38	712.230	712.240	10	LHS Shoulder	Fair	
39	714.690	714.700	10	LHS Shoulder	Fair	
40	715.990	716.070	80	LHS Median	Fair	
41	715.990	716.070	80	LHS Shoulder	Fair	
42	718.050	718.080	30	LHS Shoulder	Fair	
43	720.510	720.530	20	LHS Shoulder	Fair	
44	720.980	720.990	10	LHS Shoulder	Fair	
45	721.420	721.440	20	LHS Shoulder	Fair	
46	721.810	721.830	20	LHS Shoulder	Fair	
47	722.590	722.610	20	LHS Shoulder	Fair	
48	723.540	723.570	30	LHS Shoulder	Fair	
49	724.330	724.370	40	RHS Median	Fair	
50	724.330	724.370	40	RHS Shoulder	Fair	
51	723.640	723.650	10	RHS Shoulder	Fair	
52	721.770	721.790	20	RHS Shoulder	Fair	
53	721.770	721.790	20	RHS Median	Fair	
54	721.340	721.360	20	RHS Median	Fair	
55	721.340	721.360	20	RHS Shoulder	Fair	
56	720.380	720.410	30	RHS Median	Fair	
57	720.380	720.410	30	RHS Shoulder	Fair	
58	718.090	718.110	20	RHS Shoulder	Fair	
59	718.090	718.110	20	RHS Median	Fair	
60	716.070	716.130	60	RHS Median	Fair	

S. No.	Design Chainage		Length (m)	Side	Condition	Remarks
	From (km)	To (km)				
61	716.070	716.130	60	RHS Shoulder	Fair	
62	714.640	714.670	30	RHS Shoulder	Fair	
63	712.190	712.210	20	RHS Shoulder	Fair	
64	710.890	710.960	70	RHS Shoulder	Fair	
65	710.700	710.720	20	RHS Median	Fair	
66	710.700	710.720	20	RHS Shoulder	Fair	
67	710.430	710.450	20	RHS Shoulder	Fair	
68	709.400	709.410	10	RHS Shoulder	Fair	
69	701.730	701.760	30	RHS Median	Fair	
70	701.730	701.760	30	RHS Shoulder	Fair	
71	699.090	699.110	20	RHS Median	Fair	
72	699.090	699.110	20	RHS Shoulder	Fair	
73	696.400	696.430	30	RHS Median	Fair	
74	696.400	696.430	30	RHS Shoulder	Fair	
75	694.080	694.110	30	RHS Median	Fair	
76	694.080	694.110	30	RHS Shoulder	Fair	
77	692.880	692.890	10	RHS Median	Fair	
78	692.880	692.890	10	RHS Shoulder	Fair	
79	692.590	692.620	30	RHS Shoulder	Fair	
80	691.030	691.360	330	RHS Shoulder	Fair	
81	691.030	691.060	30	RHS Median	Fair	
82	691.030	691.060	30	RHS Shoulder	Fair	
83	689.390	689.400	10	RHS Shoulder	Fair	
84	689.040	689.070	30	RHS Median	Fair	
85	689.040	689.070	30	RHS Shoulder	Fair	
86	688.380	688.390	10	RHS Shoulder	Fair	
87	688.030	688.040	10	RHS Shoulder	Fair	
88	687.190	687.200	10	RHS Shoulder	Fair	
89	686.060	686.080	20	RHS Median	Fair	
90	686.060	686.080	20	RHS Shoulder	Fair	
91	684.460	684.470	10	RHS Shoulder	Fair	
92	683.530	683.560	30	RHS Median	Fair	
93	683.530	683.560	30	RHS Shoulder	Fair	
94	683.350	683.360	10	RHS Shoulder	Fair	
95	681.170	681.190	20	RHS Shoulder	Fair	

S. No.	Design Chainage		Length (m)	Side	Condition	Remarks
	From (km)	To (km)				
96	679.110	679.120	10	RHS Shoulder	Fair	
97	669.910	669.940	30	RHS Median	Fair	
98	669.910	669.940	30	RHS Shoulder	Fair	
99	668.180	668.190	10	RHS Shoulder	Fair	
100	666.960	666.970	10	RHS Shoulder	Fair	
101	666.110	666.130	20	RHS Shoulder	Fair	
102	665.590	665.600	10	RHS Shoulder	Fair	
103	662.200	662.870	670	RHS Shoulder	Fair	
104	662.590	662.600	10	RHS Shoulder	Fair	
105	660.120	660.190	70	RHS Shoulder	Fair	
106	660.120	660.190	70	RHS Median	Fair	
107	657.740	657.760	20	RHS Shoulder	Fair	
As per Site Total Concrete Crash Barrier(m)			**6770**			

Pedestrian Guard Railing were observed on the separator between the Carriageway and Service Road. Along the project corridor, location wise details are presented below:

Table 19: List of Pedestrian Guard Rails

S.no	Design Chainage(km)		Length (m)	Side	Condition	Damage (m)	Gaps observed
	From	To					
1	656.310	656.330	20	LHS	Fair		
2	656.340	656.680	340	LHS	Fair	20	
3	656.670	656.685	15	LHS	Fair		
4	656.995	657.530	535	LHS	Fair	11	
5	658.020	658.030	10	LHS	Fair		
6	658.040	658.400	360	LHS	Fair		
7	679.990	680.730	740	LHS	Fair	6	
8	681.500	682.970	1470	LHS	Fair	47	
9	692.870	692.880	10	LHS	Fair		
10	692.890	692.900	10	LHS	Fair		
11	696.670	696.910	240	LHS	Fair	15	
12	697.220	697.235	15	LHS	Fair		
13	697.260	697.270	10	LHS	Fair		
14	697.290	697.380	90	LHS	Fair	20	
15	699.370	699.460	90	LHS	Fair		

S.no	Design Chainage(km)		Length (m)	Side	Condition	Damage (m)	Gaps observed
	From	To					
16	700.980	701.270	290	LHS	Fair		
17	702.180	702.410	230	LHS	Fair	20	
18	713.090	713.170	80	LHS	Fair		
19	713.200	713.380	180	LHS	Fair		
20	713.400	713.480	80	LHS	Fair		
21	713.810	713.840	30	LHS	Fair		
22	713.860	713.940	80	LHS	Fair		
23	714.300	714.320	20	LHS	Fair		
24	714.940	714.955	15	LHS	Fair		
25	715.120	715.510	390	LHS	Fair		
26	715.510	715.560	50	LHS	Fair		
27	716.620	717.230	610	LHS	Fair	25	
28	718.890	718.900	10	LHS	Fair		
29	718.920	719.010	90	LHS	Fair	15	
30	719.020	719.230	210	LHS	Fair	50	
31	720.120	720.330	210	LHS	Fair	5	
32	720.780	721.000	220	RHS	Fair		
33	720.110	720.290	180	RHS	Fair	7	
34	717.290	717.370	80	RHS	Fair		
35	716.810	717.180	370	RHS	Fair		
36	716.540	716.780	240	RHS	Fair	10	
37	715.460	715.510	50	RHS	Fair	5	
38	715.210	715.480	270	RHS	Fair		
39	715.090	715.190	100	RHS	Fair	7	
40	714.895	715.000	105	RHS	Fair		
41	714.150	714.190	40	RHS	Fair		
42	713.940	714.000	60	RHS	Fair		
43	713.600	713.910	310	RHS	Fair		
44	713.400	713.580	180	RHS	Fair	5	
45	713.110	713.340	230	RHS	Fair		
46	702.180	702.410	230	RHS	Fair	12	
47	700.980	701.350	370	RHS	Fair	11	
48	699.370	699.410	40	RHS	Fair		
49	696.680	697.210	530	RHS	Fair	25	
50	692.890	692.910	20	RHS	Fair		

S.no	Design Chainage(km)		Length (m)	Side	Condition	Damage (m)	Gaps observed
	From	To					
51	692.870	692.880	10	RHS	Fair		
52	679.930	680.730	800	RHS	Fair	6	
53	677.370	677.410	40	RHS	Fair		
54	658.020	658.400	380	RHS	Fair	17	
55	656.980	657.530	550	RHS	Fair	19	
56	656.310	656.960	650	RHS	Fair	60	
As per Site Total length of PGR's (m)			**12585**			**418**	**0**

Road furniture in the form of High masts, Highway Lighting and Sign boards have been provided along the project road. The tables below depict the Road Furniture and the location wise details are provided.

Table 20: Locations of High mast lighting

S.No.	Ex.Chainage (Km)	Side	Facility,if any	Location	Condition	Remarks
1	713.300	RHS	Junction	Shoulder	Good	High mast
2	717.200	RHS	Junction	Shoulder	Good	High mast
3	694.160	Median	Junction	Median	Good	High mast
4	687.850	Median	Junction	Median	Good	High mast
5	677.800	LHS	Toll plaza	Shoulder	Good	High mast
6	677.800	RHS	Toll plaza	Shoulder	Good	High mast
7	675.600	LHS	Toll plaza	Shoulder	Good	High mast
8	675.600	RHS	Toll plaza	Shoulder	Good	High mast

Table 21: Locations of Highway Lighting

S.No	Chainage (km)		Location	Length (km)	No.of Light poles		Damage	Remarks
	From	To			Single arm	Double arm		
1	656.300	657.000	LHS	0.700	13	-		
2	657.080	657.240	RHS	0.160	13	-		
3	657.300	658.400	RHS	1.100	33	-		
4	658.100	658.300	RHS	0.200	7	-		
5	656.400	658.580	Median	2.180	-	64		
6	659.900	660.300	LHS	0.400	13	-	1	arm damaged
7	659.860	660.180	RHS	0.320	12	-		
8	659.800	660.580	Median	0.780	22	-	1	arm damaged
9	662.400	662.700	LHS	0.300	10	-		

S.No	Chainage (km)		Location	Length (km)	No.of Light poles		Damage	Remarks
	From	To			Single arm	Double arm		
10	662.320	662.780	RHS	0.460	14	-		
11	662.600	662.910	RHS	0.310	9	-		
12	664.600	664.800	LHS	0.200	7	-		
13	664.650	664.850	RHS	0.200	7	-		
14	664.950	665.250	LHS	0.300	11	-		
15	665.850	666.400	LHS	0.550	18	-		
16	665.790	666.410	RHS	0.620	18	-		
17	665.750	666.450	Median	0.700	-	21		
18	665.750	666.450	LHS	0.700	20	-		
19	665.750	666.450	RHS	0.700	20	-		
20	668.450	668.650	LHS	0.200	7	-		
21	668.500	668.700	RHS	0.200	7	-		
22	669.450	669.550	LHS	0.100	20	-		
23	669.450	669.550	RHS	0.100	20	-		
24	667.600	670.230	RHS	2.630	22	-		
25	669.600	670.300	Median	0.700	-	24	1	arm damaged
26	672.600	672.800	RHS	0.200	7	-		
27	672.600	672.800	LHS	0.200	6	-	1	arm damaged
28	674.920	675.120	LHS	0.200	7	-		
29	675.000	675.200	RHS	0.200	7	-		
30	675.250	675.580	Median	0.330	10	-		
31	676.280	695.860	Median	19.580	22	-		
32	676.400	676.600	LHS	0.200	35	-		Rest Area
33	676.850	677.050	RHS	0.200	7	-		
34	677.050	677.250	LHS	0.200	7	-		
35	677.450	677.750	RHS	0.300	11	-		
36	677.500	677.700	Median	0.200	11	-	1	arm damaged
37	677.950	678.150	LHS	0.200	7	-		
38	678.100	678.300	RHS	0.200	7	-		
39	679.950	683.020	LHS	3.070	95	-		
40	680.000	680.800	Median	0.800	-	28		
41	681.718	681.918	RHS	0.200	7	-		
42	680.830	682.080	Median	1.250	-	32		
43	682.080	683.000	Median	0.920	-	29		
44	685.650	686.320	LHS	0.670	20	-	1	1 bulb damaged

S.No	Chainage (km)		Location	Length (km)	No.of Light poles		Damage	Remarks
	From	To			Single arm	Double arm		
45	685.750	686.340	Median	0.590	-	17		
46	685.800	686.380	RHS	0.580	20	-		
47	686.700	686.900	RHS	0.200	7	-		
48	686.700	686.900	LHS	0.200	7	-		
49	689.000	689.200	Median	0.200	7	-		
50	690.860	691.060	RHS	0.200	7	-		
51	690.860	691.060	LHS	0.200	7	-		
52	690.690	691.280	Median	0.590	31	-		
53	692.560	692.780	Median	0.220	7	-		
54	695.060	695.350	Median	0.290	20	-		
55	695.350	695.550	Median	0.200	-	4		
56	695.450	695.650	LHS	0.200	7	-		
57	695.450	696.600	Median	1.150	-	36		
58	695.600	696.700	Median	1.100	-	34	1.00	arm damaged
59	697.800	698.430	Median	0.630	-	19	1.00	arm damaged
60	697.950	698.150	RHS	0.200	7	-		
61	698.300	698.500	LHS	0.200	7	-		
62	698.860	699.200	LHS	0.340	8	-		
63	698.860	699.200	RHS	0.340	10	-		
64	698.930	699.400	Median	0.470	-	14		
65	699.390	699.850	RHS	0.460	8	-		
66	699.880	700.150	Median	0.270	50	-		
67	699.880	701.820	RHS	1.940	32	-		
68	700.750	702.150	Median	1.400	-	36	2.00	
69	701.000	701.430	RHS	0.430	27	-		
70	702.900	703.100	RHS	0.200	7	-		
71	705.150	705.350	LHS	0.200	7	-		
72	705.150	705.350	RHS	0.200	7	-		
73	707.100	707.300	LHS	0.200	7	-		
74	707.100	707.300	RHS	0.200	7	-		
75	707.800	708.600	RHS	0.800	7	-		
76	708.550	708.750	LHS	0.200	7	-		
77	712.550	712.850	LHS	0.300	11	-		
78	714.320	714.950	Median	0.630	32	-		
79	714.320	714.950	RHS	0.630	16	-		

S.No	Chainage (km)		Location	Length (km)	No.of Light poles		Damage	Remarks
	From	To			Single arm	Double arm		
80	714.320	714.950	LHS	0.630	16	-		
81	716.150	716.400	LHS	0.250	20	-		
82	719.680	719.800	Median	0.120	-	4		
83	720.000	720.780	Median	0.780	-	28		
84	720.100	720.640	LHS	0.540	19	-		
Total				**62.410**	**1021**	**390**	**2**	**1**

Table 22: Details of Road Signs along Project Road

Description	LHS (Nos.)	RHS (Nos.)	Junctions (Nos.)	Total (Nos.)
Octagonal	1	1	58	60
Circular	29	32	0	61
Triangular	43	30	85	158
Rectangular	103	90	36	229
Facility informatory	15	11		26
Chevron	73	100		173
Hazard	77	64	5	146
Route Marker	8	10		18
Safety Boards	0	0		0
Toll Boards	7	6		13
Cantilever Gantry	12	10		22
Over Head Gantry	2	2		4
Variable Message Sign	0	0		0
Project Descriptive	0	0		0
Total	**370**	**356**	**184**	**910**

The project road has 26 Nos. of Bus Bays with Bus shelters observed on either sides of Highway and only Bus shelter observed at 2 Nos. of locations.. The details were presented in below.

Table 23: Details of Bus Bays with Shelters

S. No.	Existing Chainage (km)	Side	As per Site	Facilities Provided		Separator	Remarks
				PGR	Single arm Lightings		
1	658.200	RHS	Bus Bay with shelter			-	
2	664.710	LHS	Bus Bay with shelter			-	
3	664.750	RHS	Bus Bay with shelter			-	

S. No.	Existing Chainage (km)	Side	As per Site	Facilities Provided		Separator	Remarks
				PGR	Single arm Lightings		
4	668.555	LHS	Bus Bay with shelter			-	
5	668.600	RHS	Bus Bay with shelter			-	
6	672.700	RHS	Bus Bay with shelter			-	
7	672.700	LHS	Bus Bay with shelter			-	
8	675.020	LHS	Bus Bay with shelter			-	
9	675.100	RHS	Bus Bay with shelter			-	
10	676.950	RHS	Bus Bay with shelter			-	
11	677.150	LHS	Bus Bay with shelter			-	
12	678.050	LHS	Bus Bay with shelter			-	
13	678.200	RHS	Bus Bay with shelter			-	
14	681.818	RHS	Bus Bay with shelter			-	
15	686.800	RHS	Bus Bay with shelter			-	
16	686.800	LHS	Bus Bay with shelter			-	
17	695.550	LHS	Bus Bay with shelter			-	
18	698.050	RHS	Bus Bay with shelter			-	
19	698.400	LHS	Bus Bay with shelter			-	
20	703.000	RHS	Bus Bay with shelter			-	
21	705.250	LHS	Bus Bay with shelter			-	
22	705.250	RHS	Bus Bay with shelter			-	
23	707.200	LHS	Bus Bay with shelter			-	
24	707.200	RHS	Bus Bay with shelter			-	
25	708.650	LHS	Bus Bay with shelter			-	
26	708.700	RHS	Bus Bay with shelter			-	
27	681.400	LHS	Bus Shelter				
28	696.550	LHS	Bus Shelter				

The Project Road has 3 Nos. of Truck laybyes with rigid pavement and the condition appears to be fair. Separator is provided between main carriageway and truck lay bye portion. The details are as presented below.

Table 24: Details of Truck laybyes

S. No.	Chainage (km)	Length (m)	Side	Type of Road	Width (m)	Separator Details				Toilet blocks	Rest room
						Length (m)	Width (m)	Kerb Height	Kerb width		
1	665+100	170	LHS	Rigid	7	60	1.5	0.2	0.15	Yes	No
2	677+610	190	RHS	Rigid	7	90	1.5	0.2	0.15	Yes	No
3	712+700	230	LHS	Rigid	7	120	1.5	0.2	0.15	Yes	No

3.2 STRUCTURES

List of Major Structures found during the inventory surveys along the corridor are as follows:

Table 25: Details of Major Structures along Project Road

S. No.	Chainage	Type of Str	Side	Structure on	Age of Structure	Span Arrangement (No x Length, m)	No. of Decks	Deck width (m)	Remarks
1	660+200	FLYOVER	LHS	MCW	New	2 x 27	1	12.5	-
2	660+200	FLYOVER	RHS	MCW	New	2 x 27	1	12.5	-
3	657+800	LVUP	LHS	MCW	New	1 x 7	1	12.5	-
4	657+800	LVUP	RHS	MCW	New	1 x 7	1	12.5	-
5	662+545	FLYOVER	RHS	MCW	New	2 x 32	1	12.5	-
6	666+120	LVUP	LHS	MCW	New	1 x 7	1	12.5	-
7	666+120	LVUP	RHS	MCW	New	1 x 7	1	12.5	-
8	669+900	LVUP	LHS	MCW	New	1 x 7	1	12.5	-
9	669+900	LVUP	RHS	MCW	New	1 x 7	1	12.5	-
10	681+185	PUP	LHS	MCW	New	1 x 7	1	12.5	-
11	681+185	PUP	RHS	MCW	New	1 x 7	1	12.5	-
12	683+550	MNB	LHS	MCW	New	2 x 7.2 + 1 x 6.8	1	12.5	-
13	683+550	MNB	RHS	MCW	OLD	2 x 7.2 + 1 x 6.8	1	12.5	-
14	686+057	PUP	LHS	MCW	New	1 x 7	1	12.5	-
15	686+057	PUP	RHS	MCW	New	1 x 7	1	12.5	-
16	689+032	LVUP	LHS	MCW	New	1 x 7	1	12.5	-
17	689+032	LVUP	RHS	MCW	New	1 x 7	1	12.5	-
18	691+000	VUP	LHS	MCW	New	2 x 12	1	12.5	-
19	691+000	VUP	RHS	MCW	New	2 x 12	1	12.5	-
20	692+616	LVUP	LHS	MCW	New	1 x 7	1	12.5	-
21	692+616	LVUP	RHS	MCW	New	1 x 7	1	12.5	-
22	694+088	MNB	LHS	MCW	New	1 x 19	1	12.5	-
23	694+088	MNB	RHS	MCW	New	1 x 19	1	12.5	-
24	696+426	LVUP	LHS	MCW	New	1 x 7	1	12.5	-
25	696+426	LVUP	RHS	MCW	New	1 x 7	1	12.5	-
26	699+100	PUP	LHS	MCW	New	1 x 7	1	12.5	-
27	699+100	PUP	RHS	MCW	New	1 x 7	1	12.5	-

S. No.	Chainage	Type of Str	Side	Structure on	Age of Structure	Span Arrangement (No x Length, m)	No. of Decks	Deck width (m)	Remarks
28	701+730	PUP	LHS	MCW	New	1 x 7	1	12.5	-
29	701+730	PUP	RHS	MCW	New	1 x 7	1	12.5	-
30	710+773	MJB	LHS	MCW	New	5 x 18	1	12.5	-
31	710+773	MJB	RHS	MCW	OLD	5 x 18	1	8.5	-
32	714+725	VUP	LHS	MCW	New	2 x 12	1	12.5	-
33	714+725	VUP	RHS	MCW	New	2 x 12	1	12.5	-
34	716+185	ROB	LHS	MCW	New	1 x 19 + 1 x 37 + 1 x 19	1	12.5	-
35	716+185	ROB	RHS	MCW	New	1 x 19 + 1 x 37 + 1 x 19	1	12.5	-
36	718+084	MNB	LHS	MCW	New	2 x 6.8 + 1 x 7.3	1	12.5	-
37	718+084	MNB	RHS	MCW	OLD	2 x 6.8 + 1 x 7.3	1	12.5	-
38	720+520	PUP	LHS	MCW	New	1 x 7	1	12.5	-
39	720+520	PUP	RHS	MCW	New	1 x 7	1	12.5	-
40	721+420	MNB	LHS	MCW	New	1 x 7	1	12.5	-
41	721+420	MNB	RHS	MCW	OLD	1 x 8	1	12.5	-
42	721+815	MNB	LHS	MCW	New	1 x 9.5	1	12.5	-
43	721+815	MNB	RHS	MCW	OLD	1 x 9.5	1	12.5	-
44	723+550	MNB	LHS	MCW	New	3 x 18	1	12.5	-
45	723+550	MNB	RHS	MCW	New	3 x 18	1	12.5	-

Table 26: List of structures proposed as per Sch-B

S.No.	Existing Km	Type of Structure	Side	Span Arrangement	Length of Structure (m)	Carriage way width (m)	Deck Width (m)	Proposed As per Sch B
1	662+655	PIPE	BHS	2 x 1.0	-	-	-	Widening
2	668+670	PIPE	BHS	1 x 1.2	-	-	-	Widening
3	668+770	PIPE	BHS	1 x 1.2	-	-	-	Widening
4	669+238	PIPE	BHS	1 x 1.2	-	-	-	Widening
5	686+305	BOX	BHS	1 x 3	-	-	-	Widening
6	686+556	PIPE	BHS	3 x 1	-	-	-	Widening
7	691+890	PIPE	BHS	1 x 1.2	-	-	-	Widening
8	691+920	LVUP	BHS	1 x 12 x 4	12	-	2 x 14.5	New Construction
9	692+210	PIPE	BHS	1 x 1.2	-	-	-	Widening
10	713+380	VUP	BHS	1 x 20 x 5.5	20		2 x 14.5	New Construction
11	713+425	PIPE	BHS	1 x 1.2	-	-	-	Widening
12	713+575	BOX	BHS	1 x 2	-	-	-	Widening
13	713+730	PIPE	BHS	1 x 1.2	-	-	-	Widening
14	713+870	BOX	BHS	1 x 3	-	-	-	Widening
15	717+747	PIPE	BHS	2 x 1.2	-	-	-	Widening
16	718+580	BOX	BHS	1 x 4	-	-	-	Widening
17	718+635	PIPE	BHS	2 x 1.2	-	-	-	Widening
18	719+518	PIPE	BHS	1 x 1.2	-	-	-	Widening
19	719+575	PIPE	BHS	1 x 1.2	-	-	-	Widening

S.No.	Existing Km	Type of Structure	Side	Span Arrangement	Length of Structure (m)	Carriage way width (m)	Deck Width (m)	Proposed As per Sch B
20	719+853	PIPE	BHS	2 x 1.2	-	-	-	Widening
21	720+060	PIPE	BHS	1 x 1.2	-	-	-	Widening
22	721+000	BOX	BHS	1 x 2	-	-	-	Widening
23	721+140	BOX	BHS	1 x 2	-	-	-	Widening
24	721+815	MNB	LHS	1 x 9.5	9.5	1 x 8.5	1 x 12.5	Widening
25	721+815	MNB	RHS	1 x 9.5	9.5	1 x 8.5	1 x 12.5	Widening
26	722+053	PIPE	BHS	1 x 1.2	-	-	-	Widening
27	722+600	BOX	BHS	1 x 3.8	-	-	-	Widening
28	722+700	PIPE	BHS	2 x 1.2	-	-	-	Widening
29	723+180	BOX	BHS	1 x 3	-	-	-	Widening

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4.1 EMBANKMENT & SUBGRADE

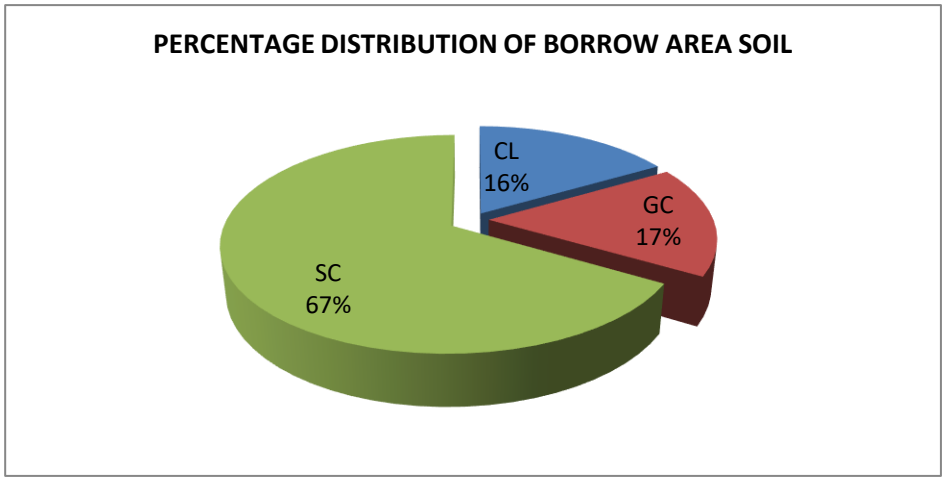
The embankment for project road has been constructed with available soils from nearby areas. The soil appears to be Coarse grained type in nature and embankment appears to be in fair condition over the entire length of project. No major settlements or depressions have been noted even at high embankment locations. There are no marshy/water logging areas along the length of project road.

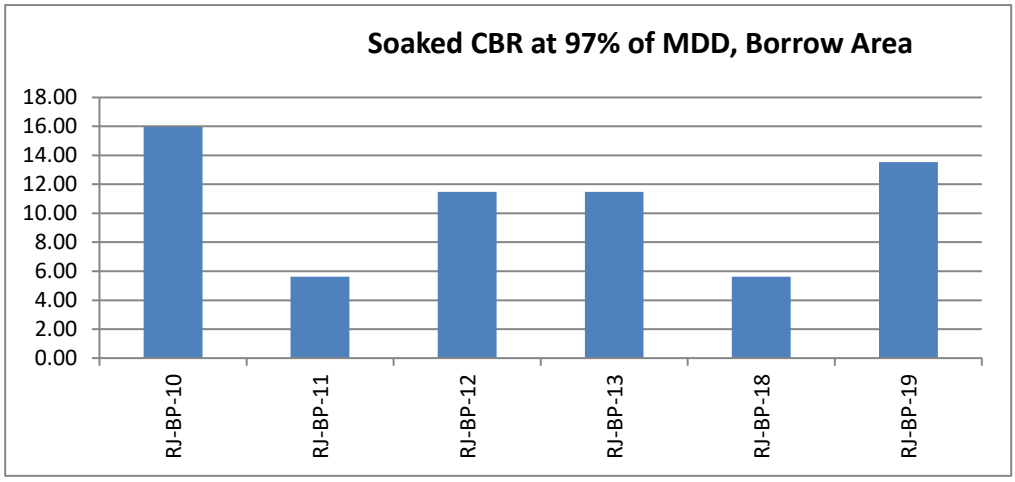
Out of 6 samples 4 samples belongs to SC type of soil, 1 sample belongs to CL type of soil and 1 sample belongs to GC type of soil. The test results of borrow area soils related to soil classification, percentage distribution of grain size, Atterberg limits and other properties are as presented below

Table 27: Test Results of Borrow area Samples Details

Lab Sample No	Site Identification		Grain Size Analysis					Atterberg Limits (%)			Soil Class	MDD (gm/cc)	OMC (%)	Dry Density at 97% MDD	Soaked CBR 97% MDD	Free Swelling Index (%)
	Location (km)	Up/Dn	Percentage passing from													
			4.75 mm IS Sieve	425 mic IS Sieve	75 mic IS Sieve	Gravel %	Sand %	LL	PL	PI						
RJ-BP-10	710+200	RHS	42.91	17.84	13.48	57.09	29.43	28	18	10	GC	2.01	10.00	1.95	15.96	13
RJ-BP-11	691+000	LHS	82.23	72.12	65.54	17.77	16.69	29	18	11	CL	1.89	11.80	1.83	5.62	26
RJ-BP-12	681+000	RHS	64.85	32.05	28.84	35.15	36.01	35	20	15	SC	2.09	8.60	2.03	11.48	17
RJ-BP-13	672+800	RHS	80.72	55.3	44.1	19.28	36.62	29	17	12	SC	2.01	8.50	1.95	11.48	25
RJ-BP-18	705+300	RHS	73.88	44.3	31.86	26.12	42.02	37	19	18	SC	1.85	10.50	1.79	5.62	29
RJ-BP-19	659+600	RHS	76.51	24.34	23.41	23.49	53.1	51	29	22	SC	2.13	9.20	2.07	13.53	33

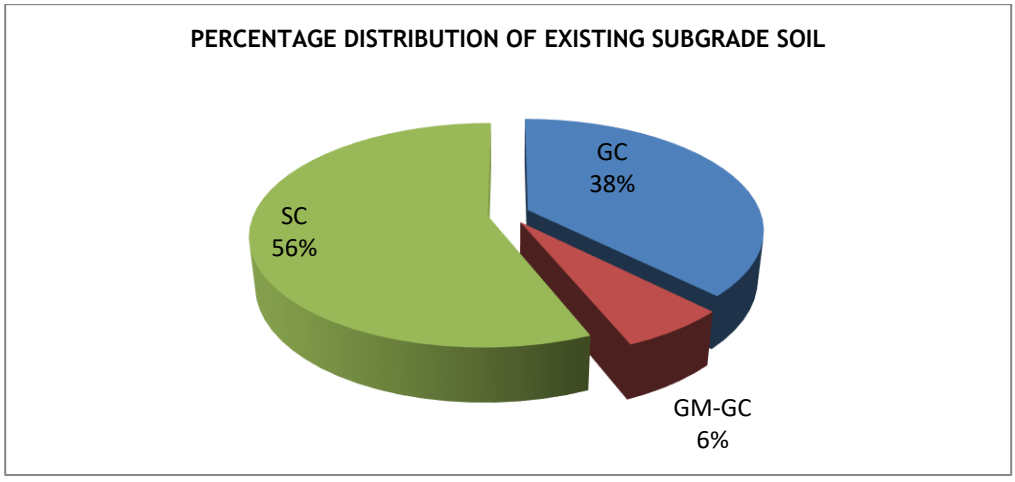
Pie Chart showing the percentage distribution of soil classification of borrow sample is presented below





The subgrade of the project road appears to be in fair condition as revealed by test pit investigations. Soil classification has been done according to IS Classification of Soils (ISC) as detailed in IS 1498 - 1978. Laboratory test results indicate that all the Subgrade soil samples collected belongs to Coarse Grained Soil Out of 16 samples, 6 samples belongs to GC type of soil, 1 sample belongs to GM-GC type of soil and 9 sample belongs to SC type of soil.

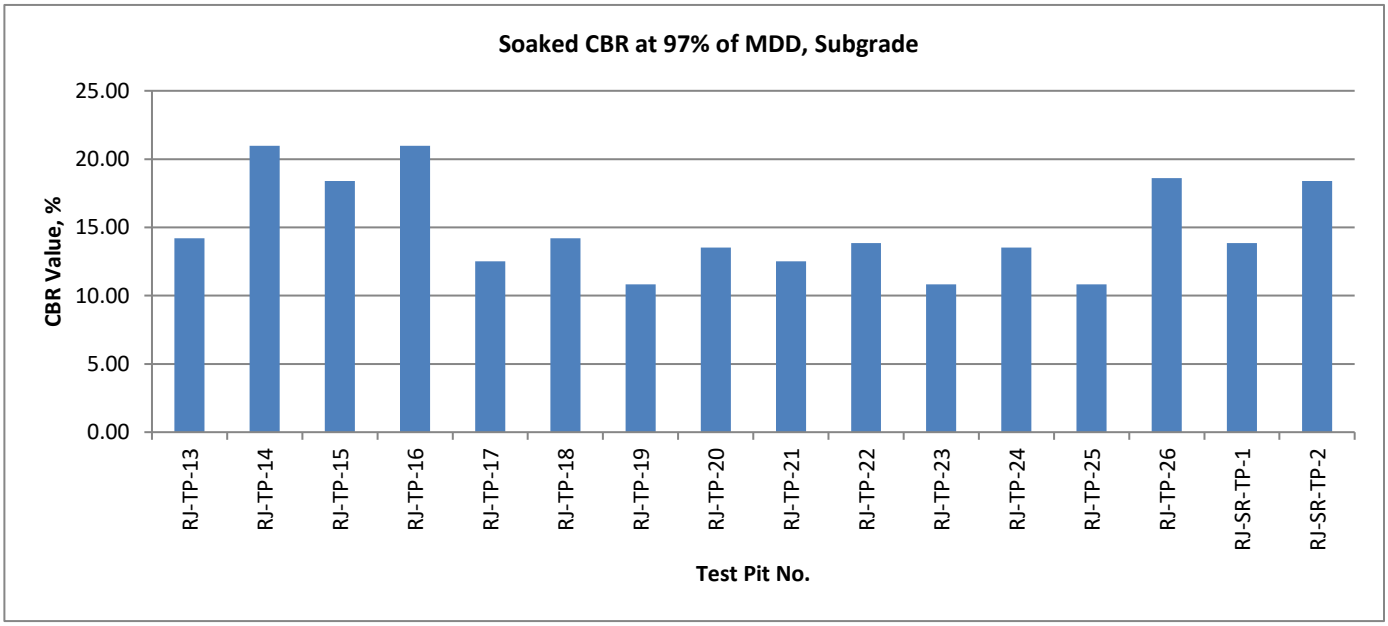
Pie Chart showing the percentage distribution of soil classification of existing subgrade sample is presented below:



Soil classification, percentage distribution from grain size analysis, soaked CBR and other engineering properties of the subgrade samples are presented below.

Table 28: Test results of Existing Subgrade Soils

Lab Sample No	Site Identification		Grain Size Analysis					Atterberg Limits (%)			Soil Class	MDD (gm/cc)	OMC (%)	FDD (gm/cc)	COMPACTION (%)	Dry Density at 97% MDD	Soaked CBR 97% MDD	Free Swelling Index (%)
			Percentage passing from															
	Location (km)	Up/Dn	4.75 mm IS Sieve	425 mic IS Sieve	75 mic IS Sieve	Gravel %	Sand %	LL	PL	PI								
RJ-TP-13	720+000	RHS	75.88	40	32.59	24.12	43.29	31	17	14	SC	2.03	8.70	1.95	96	1.97	14.21	17
RJ-TP-14	711+800	RHS	53.89	22.24	15.78	46.11	38.11	26	16	10	GC	2.14	8.00	-	-	2.08	20.97	27
RJ-TP-15	700+500	RHS	53.89	22.24	15.78	46.11	38.11	29	16	13	GC	2.09	8.50	1.91	91	2.03	18.39	23
RJ-TP-16	690+450	RHS	55.39	22.26	17.63	44.61	37.76	29	16	13	GC	2.14	9.10	1.97	92	2.08	20.97	23
RJ-TP-17	679+500	RHS	71.89	45.92	37.16	28.11	34.73	29	16	13	SC	2.07	10.70	1.91	92	2.01	12.51	23
RJ-TP-18	671+400	RHS	72.79	40.32	27.68	27.21	45.11	26	15	11	SC	2.04	11.60	1.86	91	1.98	14.21	19
RJ-TP-19	661+000	RHS	75.92	41.02	30.49	24.08	45.43	29	15	14	SC	2.06	9.00	1.86	90	2.00	10.82	23
RJ-TP-20	656+100	RHS	64.32	46.82	41.76	35.68	22.56	31	17	14	GC	2.04	9.00	1.88	92	1.98	13.53	21
RJ-TP-21	666+600	LHS	62.58	35.3	24.42	37.42	38.16	24	14	10	SC	2.07	9.40	1.88	91	2.01	12.51	17
RJ-TP-22	676+200	LHS	80.78	58.57	47.95	19.22	32.83	28	17	11	SC	2.02	10.20	1.85	92	1.96	13.86	32
RJ-TP-23	687+400	LHS	61.15	25.83	20.26	38.85	40.89	27	17	10	SC	2.05	9.00	1.84	90	1.99	10.82	27
RJ-TP-24	698+100	LHS	40.74	16.06	12.05	59.26	28.69	29	18	11	GC	2.03	9.60	-	-	1.97	13.53	14
RJ-TP-25	706+300	LHS	64.71	30.98	24.34	35.29	40.37	29	19	10	SC	2.06	9.20	1.85	90	2.00	10.82	19
RJ-TP-26	717+600	LHS	59.82	35.08	26.52	40.18	33.3	24	17	7	GM-GC	2.07	8.60	1.91	92	2.01	18.60	10
RJ-SR-TP-1	662+000	RHS	71.52	42.39	33.55	28.48	37.97	29	17	12	SC	2.02	10.40	1.82	90	1.96	13.86	15
RJ-SR-TP-2	685+700	LHS	35.62	15.25	13.15	64.38	22.47	31	18	13	GC	2.09	10.80	1.88	90	2.03	18.39	22



The following observations can be made from the above test results conducted on of existing subgrade samples

- Maximum Dry Density for all subgrade samples varies between 2.02 and 2.14 gm/cc. All samples satisfying the MDD criterion (MDD>=1.75 gm/cc).
- OMC for existing subgrade samples varies in between 8.00% to 11.6%.
- Free Swelling Index for existing subgrade samples varies in between 10% to 32%. All 16 samples satisfying the FSI criterion (FSI<=50%)

- Compaction levels are lower than the standard value of 97% of MDD
- CBR Values are varying from 11% to 19%.

Material related tests reports are provided in **Appendix-7** of this report.

Aggregates to be used for sub-base, base, surface courses and concrete works have been collected from the crushers under operation from the existing quarries. The Table below represents the test results of the Aggregate and Sand Samples

Table 29: Test Results of Aggregate Samples Details

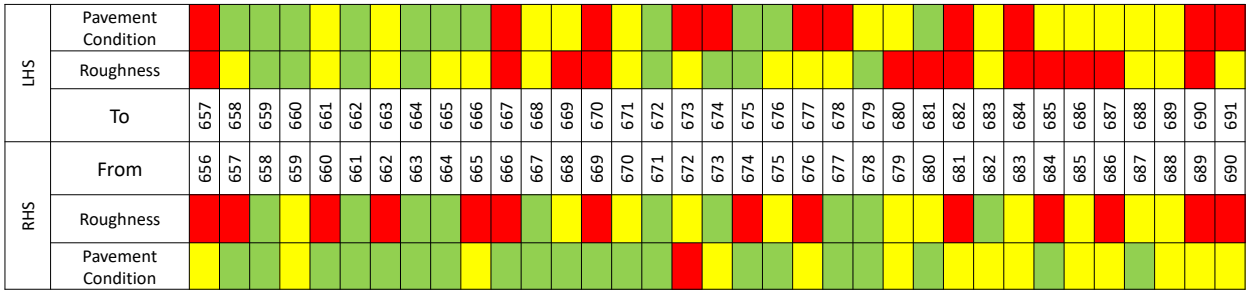
S. No	Sample	Location (km)	Up/Dn	A.I.V (%)	Water Absorption (%)	Specific Gravity	Remark
1	RJ-AQ-2	702+600	RHS	15.47	0.28	2.71	
2	RJ-AQ-3	702+600	RHS	10.81	0.30	2.71	
3	RJ-AQ-4	660+000	RHS	11.24	0.27	2.72	
4	RJ-AQ-5	660+000	RHS	19.40	0.34	2.72	

Table 30: Test Results of Sand Samples Details

Sl No	Sample No	CHAINAGE (KM)	SIDE	10 mm Passing %	4.75 mm Passing %	2.36 mm Passing %	1.18mm Passing %	600mic Passing %	300mic Passing %	150mic Passing %	FM	ZONE
1	RJ-SQ-3	714+700	LHS	100	95	91	83	64	12	1	**2.54**	**ZONE-III**

4.2 PAVEMENT CONDITION

The distresses in bituminous surface have been captured on the project corridor for each lane separately by using the Network Survey Vehicle (NSV).

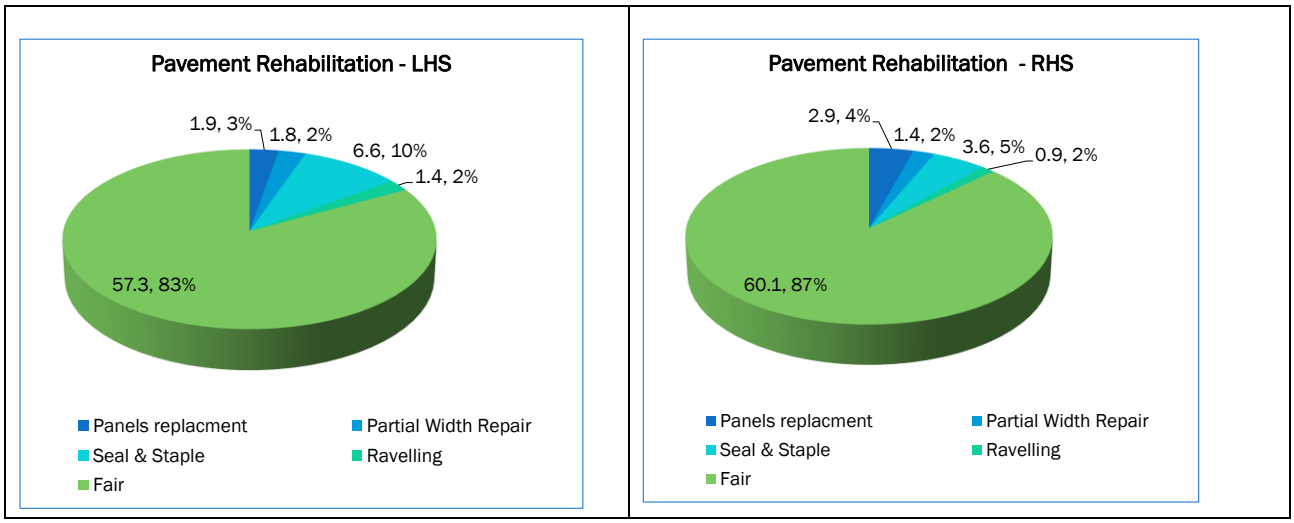


| | | |

LHS	Overall																																
	Ravelling	10	9	4	2	8	14	1	0	2	2	1	1	3	3	0	2	3	3	14	3	0	5	6	3	1	9	14	3	3	2	5	3	4	0
	Seal & Staple	4	24	29	36	30	19	45	55	28	40	18	23	29	4	8	2	3	1	18	23	12	2	23	12	12	19	29	20	8	23	17	22	12	29
	Partial Width Repair	0	2	18	13	13	8	12	8	5	4	14	5	8	1	0	0	4	0	0	15	11	1	12	3	7	10	0	11	1	2	4	5	16	6
	Panels replacment	2	8	8	5	5	2	5	8	2	33	1	9	7	4	20	14	2	0	0	2	4	6	16	20	5	4	3	3	3	2	2	2	5	32
	To	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725
RHS	From	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724
	Panels replacment	4	19	0	1	1	0	0	0	2	1	1	3	71	7	0	15	137	43	9	15	0	0	1	8	4	1	0	0	0	12	4	8	9	1
	Partial Width Repair	6	2	1	1	0	9	6	7	14	17	11	14	7	25	10	10	1	2	20	0	0	16	10	7	8	0	0	3	0	14	3	20	2	0
	Seal & Staple	10	11	0	5	27	27	31	19	20	21	16	13	15	6	6	15	12	1	44	0	0	39	5	21	28	0	10	8	3	14	14	9	31	11
	Ravelling	2	1	1	1	3	6	0	7	1	8	0	1	0	0	0	1	0	2	4	12	0	0	1	3	3	5	8	2	4	22	7	3	25	4
	Overall																																

Poor
Fair
Good

The pie chart showing the %distribution of distress rectification measures for this package are as follows

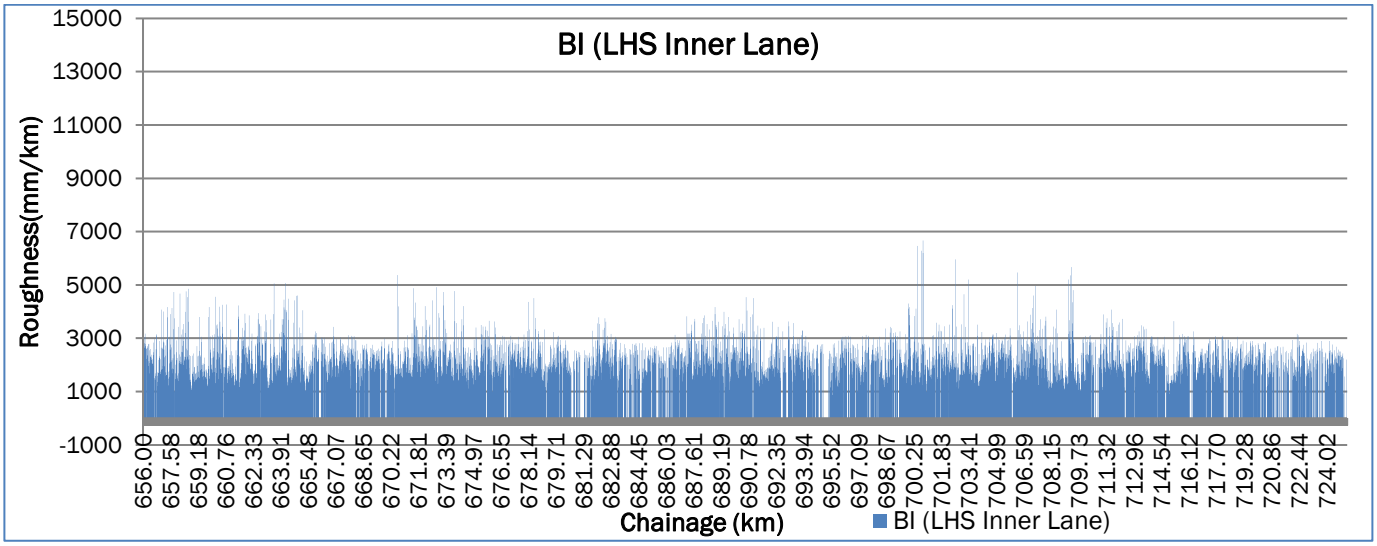


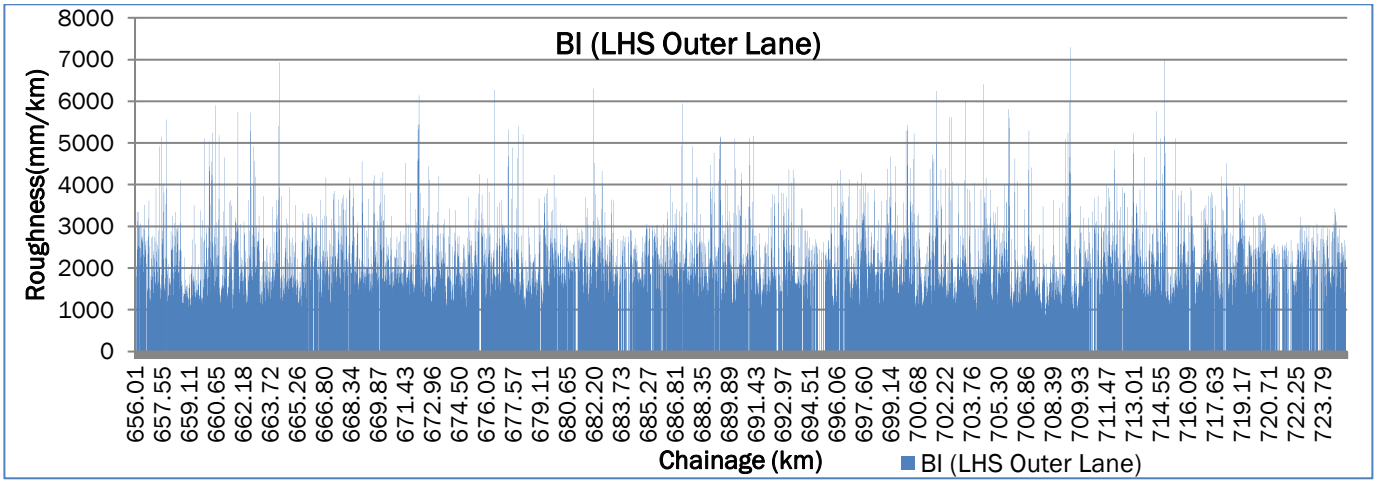
Following panel rectification measured are considered for the rigid pavement.

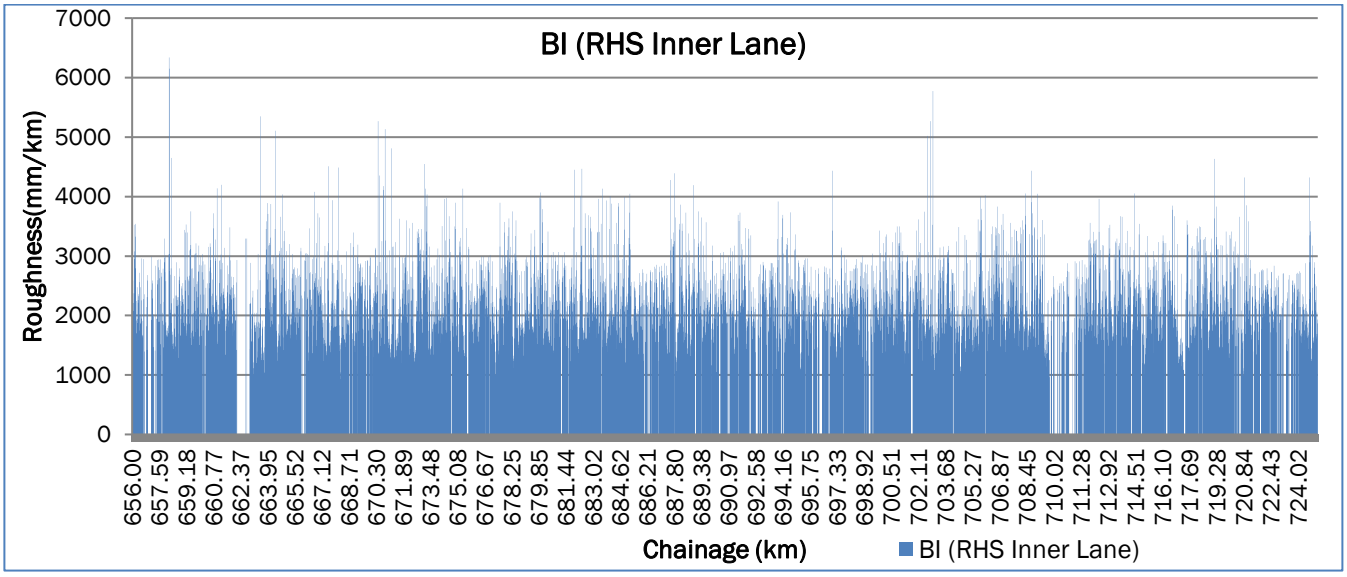
S No	Package	Total Panels for replacement (Nrs.)	Partial 1m Full Depth Repair (Nrs.)	Seal & Staple (in Panels(Nrs.)	Ravelling in Number of Panels (Nrs.)	Corner Break in Panel (Nrs.)
1	Package-1, LHS	420	396	1470	319	32
2	Package-1, RHS	654	318	804	196	32

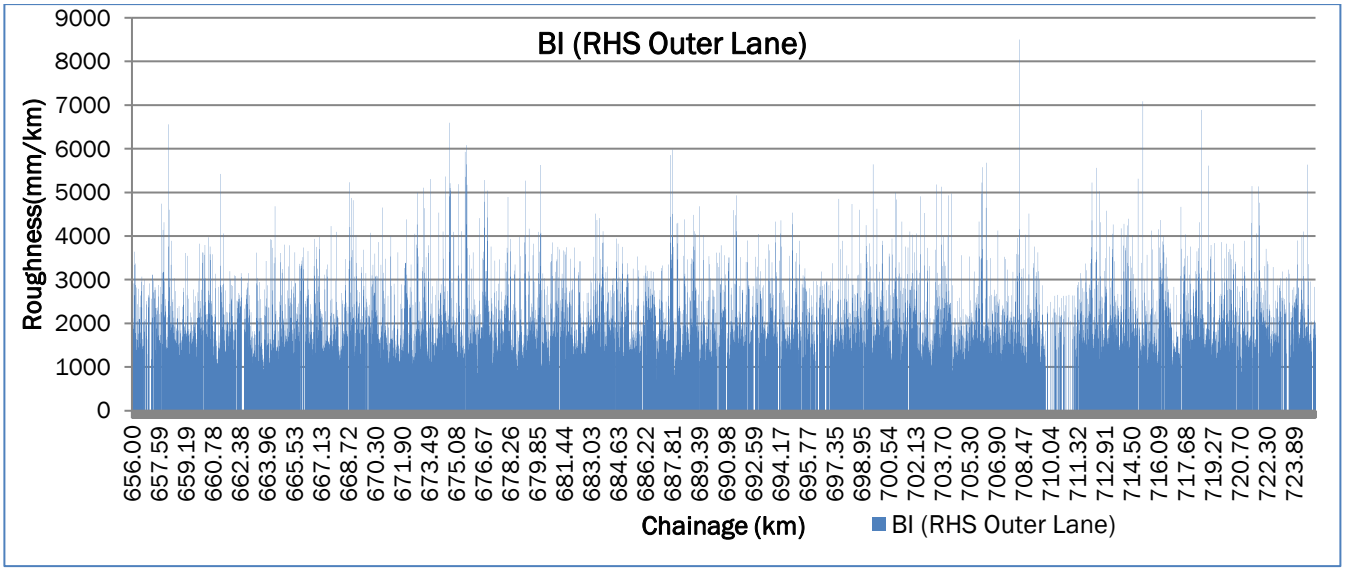
4.3 ROUGHNESS

The roughness surveys conducted along the corridor indicate majority length is having fair riding quality. Bar diagrams showing the Lane-Kilometer roughness along the project road are presented belowxx:









Based on the above, considering the Km-stone reference system the summary of Lane-km having varying roughness values are as presented below

>=Roughness (mm/km)	<Roughness (mm/km)	LHS Inner (Lane Km)	LHS Outer (Lane Km)	RHS Inner (Lane Km)	RHS Outer (Lane Km)	TOTAL (Lane Km)
	2200	35.74	43.35	36.44	44.60	160.13
2200	2400	5.31	4.43	5.32	4.08	19.14
2400	3000	11.05	8.73	10.33	7.71	37.82
3000		15.91	11.57	15.69	12.00	55.17

An alternate exercise with moving average method has been adopted considering 10m point interval roughness data. With this criteria, considering roughness threshold limit (<2200mm/km), the combined lane-km lengths with varying roughness values are as presented below

>=Roughness (mm/km)	<Roughness (mm/km)	LHS Inner & Outer (Lane Km)	RHS Inner & Outer (Lane Km)
	2200	79	81.2
2200	2400	9.7	9.4
2400		28.7	28.7
Lengths for rectification considered		18.8	16.01

By attending the rectification of 18.8 lane-km length in LHS, at identified locations, the roughness values can bring down to required threshold value(<2200m/km) by considering moving average method for roughness values in km-length. However, still there will be accumulated length of 28.7 lane-km at scattered points having roughness higher than threshold value (>2400m/km) and these values may have no impact and nullified while considering average in a km-length.

Similarly, in RHS, by attending the rectification of 16.01 lane-km length at identified locations, the roughness values can bring down to required threshold value(<2200m/km) by considering moving average method for roughness values in km-length. However, still there will be accumulated length of 28.7 lane-km at scattered points having roughness higher than threshold value (>2400m/km) and these values may have no impact and nullified while considering average in a km-length

4.4 FWD ANALYSIS

4.4.1 Flexural strength of Concrete Rigid Pavement (Rigid)

FWD deflections shall be measured and recorded for radial distances at 0 mm, 300 mm, 600 mm and 900 mm from the centre of loading point.

The area parameter of deflection basin should be calculated using the equation 2 of IRC 117-2014.

From area of deflection basin, Radius of relative stiffness (l) can be evaluated from the charts. The excel sheet provided with the guidelines used to get the value of Radius of relative stiffness (l).

After finding the Radius of relative stiffness, normalized deflections (d) are calculated using various equations formed from the charts. The excel sheet directly gives the values of the normalized deflections.

Subgrade modulus values can be found by using the equation 3 of IRC 117-2014 for different normalized deflections and average of all should be taken as subgrade modulus.

Elastic Modulus (MPa) of concrete can be found by using the equation 4 of IRC 117-2014.

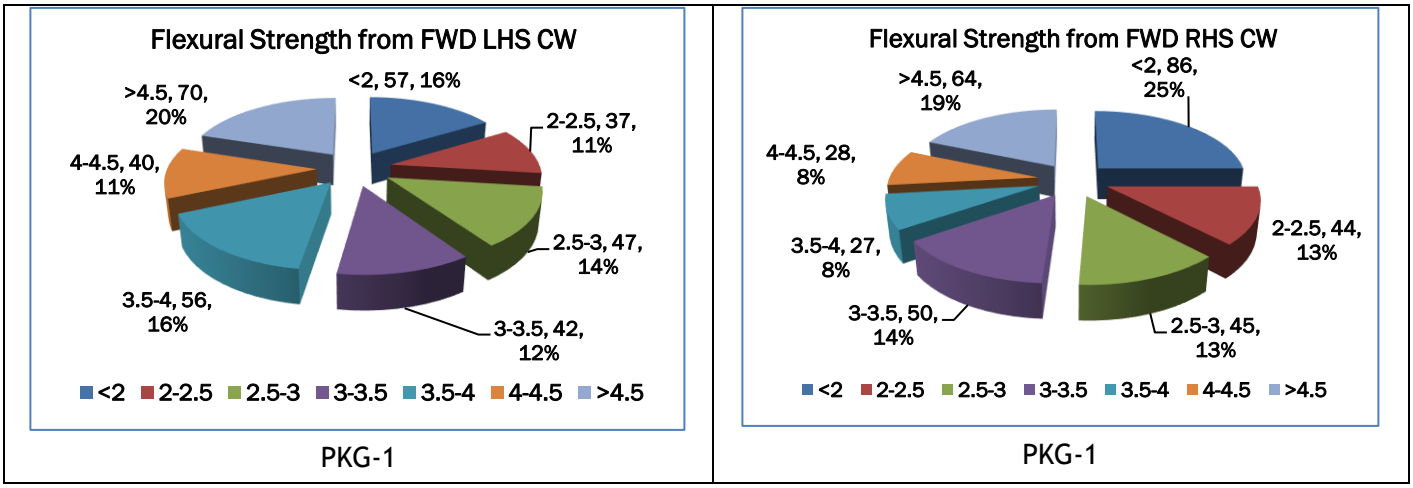
Strength of the concrete and Flexural strength can be determined from the value of Ec from the equation 5 & 6 of IRC 117-2014.

The fck values calculated for the rigid pavement are presented in **Appendix-3** of the report.

Pie charts showing the variation of the Flexural Strength estimated from FWD Surveys are presented below:

Table 31: FWD Data - Summary of Homogenous Section - LHS & RHS

Flexural strength (Mpa) CW		
Range	**LHS**	**RHS**
<2	36	50
2-3	30	42
2.5-3	40	60
3-3.5	35	52
3.5-4	41	40
4-4.5	33	39
>4.5	46	61
Total	261	344



Flexural Strength of the PQC estimated from FWD Surveys indicates that:

a) More than 20% of samples in LHS Carriageway and 19% of samples in RHS Carriageway are having values greater than 4.5 Mpa.

b) 11% of samples in LHS Carriageway and 8% of samples in RHS Carriageway are having values between 4 - 4.5 Mpa in NH-73.

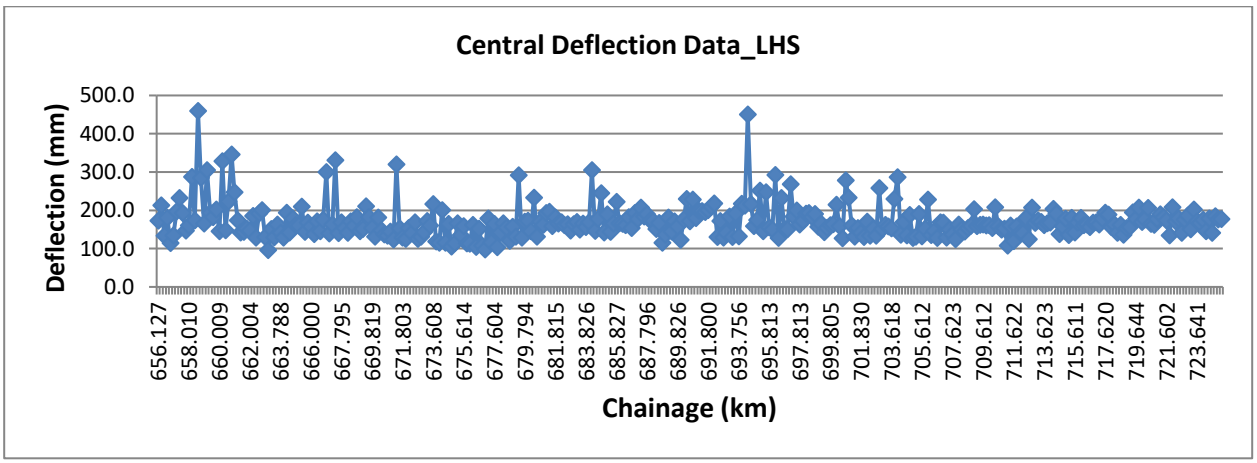
c) 16% of samples in LHS Carriageway and 8% of samples in RHS Carriageway are having values between 3.5 - 4.0 Mpa in NH-73.

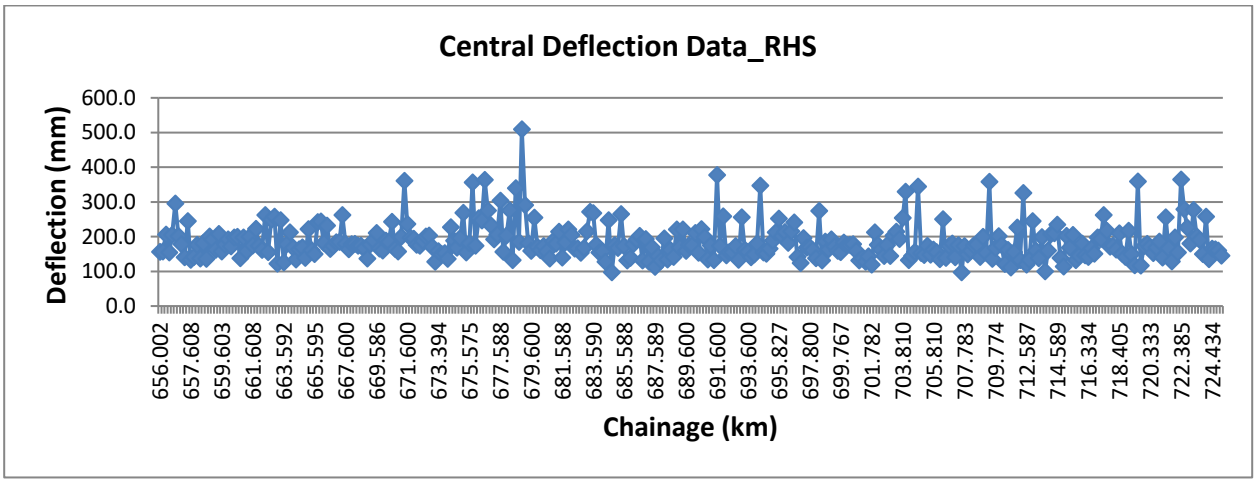
d) 12% of samples in LHS Carriageway and 14% of samples in RHS Carriageway are having values between 3 - 3.5 Mpa in NH-73

e) 41% of samples in LHS Carriageway and 51% of samples in RHS Carriageway are having values less than 3 Mpa in NH-73.

4.4.2 Detection of Voids underneath the Rigid Pavement

- Deflection of Voids below a pavement slab can be easily be done by a FWD. Deflections are measured along the wheel path and a plot of central deflections versus distance has to be made.
- The locations where the deflections are much higher than the normal may indicate presence of voids. Sample is shown in below





From the above graph, voids underneath the pavement are identified as 18 points in LHS, 14 points in RHS. For quantification, every point is considered for 150m length in lane width.

4.4.3 FWD PAVEMENT COMPOSITION

a) Main Carriageway Crust

	PQC (mm)	DLC (mm)	GSB (mm)	Total (mm)
Minimum	250	100	100	540
Maximum	390	160	230	680
Average	315	142	150	607

b) Service road Crust

	PQC (mm)	DLC (mm)	GSB (mm)	Total (mm)
Minimum	250	150	100	500
Maximum	280	200	200	680
Average	265	175	150	590

4.5 CORE STRENGTH

The core strength of the samples is presented below.

S No.	Chainage	SIDE	Core ID	Corrected Strength of core	Equivalent Cube Strength (N/mm^2) 13x1.25.	F_{CK} / 0.7*SQRT(B)	REMARK
				A	B = 1.25*A		
1	720+000	RHS	RJ-C-15	38.2	47.8	4.84	Inner
2	708+200	RHS	RJ- C-16	24.05	30.07	3.84	Outer
3	700+500	RHS	RJ- C-17	27.53	34.42	4.11	Inner
4	679+500	RHS	RJ- C-18	34.47	43.08	4.59	Outer
5	671+400	RHS	RJ- C-19	26.20	32.76	4.01	Inner
6	661+000	RHS	RJ- C-20	42.48	53.11	5.10	Outer
7	717+600	LHS	RJ-C-21	40.9	51.2	5.01	Inner
8	698+100	LHS	RJ- C-22	29.78	37.22	4.27	Outer
9	698+050	LHS	RJ-C-23	32.1	40.1	4.43	Outer
10	687+400	LHS	RJ-C-24	42.3	52.8	5.09	Inner
11	666+600	LHS	RJ- C-25	31.58	39.48	4.40	Outer
12	676+200	LHS	RJ-C-26	27.2	34.0	4.08	Outer
13	706+300	LHS	RJ-C-27	39.3	49.2	4.91	Inner

14	662+000	RHS	RJ-SR-C-1	37.1	46.4	4.77	Outer service road
15	685+700	LHS	RJ- SR-C-2	25.24	31.55	3.93	Inner Service road

Above core strength results showing more than 4.0 fck,

S No.	Chainage	SIDE	Core Fck, MPa		FWD point, Chainage	FWD Fck MPa
1	720+000	RHS	4.84		720.0	3.37
2	708+200	RHS	3.84		708.2	2.75
3	700+500	RHS	4.11		700.6	2.70
4	679+500	RHS	4.59		679.6	2.33
5	671+400	RHS	4.01		671.4	0.77
6	661+000	RHS	5.10		661.0	2.73
7	666.6	LHS	4.40		666.6	3.18
8	676.2	LHS	4.08		676.2	2.04
9	687.4	LHS	5.09		687.4	2.03
10	698.05	LHS	4.43		698.0	6.52
11	698.1	LHS	4.27		698.2	2.89
12	706.3	LHS	4.91		706.2	5.89
13	717.6	LHS	5.01		717.6	2.40

- Fck values at same chainage are compared above with Cores Vs FWD,
- it is prudent to increase about 30% fck values obtained through FWD survey

  Accordingly, FWD-fck values has been increased by 30%. Further fck values less than 3 MPa fck were considered for rehabilitation in MMR.

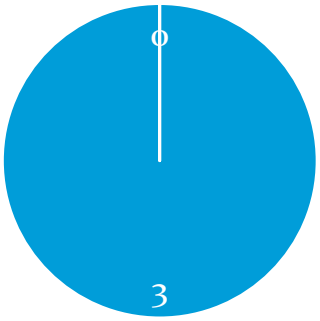
4.6 STRUCTURES

Inventory and asset condition of all the existing structures falling within project road have been verified as per IRC: SP-35 procedures and guidelines with following field surveys

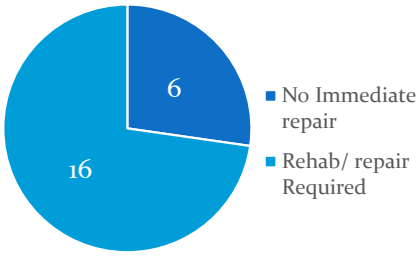
- Inventory of existing highway bridges / structures
- MBIU/Visual condition survey of existing highway bridges / structures

Detailed inventory of all structures is presented in **Appendix 8** of this Report.

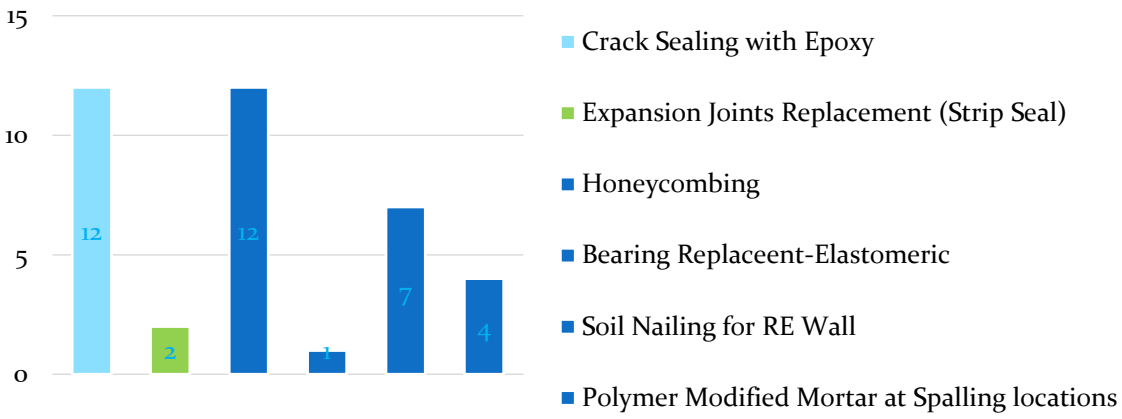
Based on these surveys following structural rehabilitation measures have been considered.



Major Structures



Minor Structures



Rectification of structural Distress in terms of number of locations

List of Bridges found during the inventory surveys along the corridor are as follows

Summary of Structures

S. No	Type of Str	No. of Structures			Total No. of Str's	Total No. of Locations
		LHS	RHS	BHS		
1	ROB	1	1	-	2	1
2	MJB	1	1	-	2	1
3	MNB	6	6	-	12	6
4	Flyover	1	2	-	3	2
5	VUP	3	3	-	6	3
6	LVUP	7	7	-	14	7
7	PUP	5	5	-	10	5
8	BC	-	-	-	27	27
9	PC	-	-	-	107	107

Age of Structures

S. No	Type of Str	LHS		RHS		Total (Nos)		Total no. of Str's
		Old	New	Old	New	Old	New	
1	ROB	-	1	-	1	-	2	2
2	MJB	-	1	1	-	1	1	2
3	MNB	-	6	4	2	4	8	12
4	Flyover	-	1	-	2	-	3	3
5	VUP	-	3	-	3	-	6	6
6	LVUP	-	7	-	7	-	14	14
7	PUP	-	5	-	5	-	10	10

Summary of Expansion Joint & Bearings

S. No	Type of Str	Expansion joints		Bearings									
				Pot PTFE		Elastomeric		Spherical		Rocker Roller		Tar Paper	
		Old	New	Old	New	Old	New	Old	New	Old	New	Old	New
1	ROB	-	8	-	52	-	-	-	-	-	-	-	-
2	MJB	6	6	-	-	30	40	-	-	-	-	-	-
3	MNB	-	12	-	-	-	64	-	-	-	-	-	-
4	Flyover	-	9	-	-	-	48	-	-	-	-	-	-
5	VUP	-	-	-	-	-	-	-	-	-	-	-	-
6	LVUP	-	-	-	-	-	-	-	-	-	-	-	-
7	PUP	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL		**6**	**35**	**0**	**52**	**30**	**152**	**0**	**0**	**0**	**0**	**0**	**0**
		41		**52**		**182**		**0**		**0**		**0**	
				234									

Summary of Super Structures

S. No	Type of Str	RCC Girder	RCC Box	RCC & Steel composite girder	RCC slab	PSC Girder	Total no. of Structures
1	ROB	-	-	2	-	-	2
2	MJB	2	-	-	-	-	2
3	MNB	4	7	-	1	-	12
4	Flyover	-	-	-	-	3	3
5	VUP	-	4	-	-	-	4
6	LVUP	-	12	-	-	-	12
7	PUP	-	10	-	-	-	10

Summary of Sub Structures

S. No	Type of Str	ABUTMENT				PIER			
		RCC wall type	RCC Box	Twin circular column type	Single circular column type	Single circular column type	Twin circular column type	RCC Box	RCC wall type
1	ROB	-	-	2	-	-	2	-	-
2	MJB	2	-	-	-	1	-	-	1
3	MNB	5	7	-	-	2	-	-	1
4	Flyover	-	-	-	3	3	-	-	-
5	VUP	-	4	-	-	-	-	4	-
6	LVUP	-	12	-	-	-	-	-	-
7	PUP	-	10	-	-	-	-	-	-

Details of Major Structures

S. No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
1	660+200	FLYOVER	LHS	MCW	New	2 x 27	12.5	11.5	Not visible	Single circular column type	Single circular column type	PSC Girder	Elastomeric
2	660+200	FLYOVER	RHS	MCW	New	2 x 27	12.5	11.5	Not visible	Single circular column type	Single circular column type	PSC Girder	Elastomeric
3	657+800	LVUP	LHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
4	657+800	LVUP	RHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
5	662+545	FLYOVER	RHS	MCW	New	2 x 32	12.5	11.5	Not visible	Single circular column type	Single circular column type	PSC Girder	Elastomeric
6	666+120	LVUP	LHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
7	666+120	LVUP	RHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
8	669+900	LVUP	LHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
9	669+900	LVUP	RHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
10	681+185	PUP	LHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
11	681+185	PUP	RHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
12	683+550	MNB	LHS	MCW	New	2 x 7.2 + 1 x 6.8	12.5	9	Raft	RCC Box	-	RCC Box	-
13	683+550	MNB	RHS	MCW	OLD	2 x 7.2 + 1 x 6.8	12.5	11.5	Not visible	Single circular column type	RCC wall type	RCC slab	-

S. No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
14	686+057	PUP	LHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
15	686+057	PUP	RHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
16	689+032	LVUP	LHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
17	689+032	LVUP	RHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
18	691+000	VUP	LHS	MCW	New	2 x 12	12.5	11.5	Raft	RCC Box	RCC Box	RCC Box	-
19	691+000	VUP	RHS	MCW	New	2 x 12	12.5	11.5	Raft	RCC Box	RCC Box	RCC Box	-
20	692+616	LVUP	LHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
21	692+616	LVUP	RHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
22	694+088	MNB	LHS	MCW	New	1 x 19	12.5	9	Not visible	RCC wall type	-	RCC Girder	Elastomeric
23	694+088	MNB	RHS	MCW	New	1 x 19	12.5	9	Not visible	RCC wall type	-	RCC Girder	Elastomeric
24	696+426	LVUP	LHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
25	696+426	LVUP	RHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
26	699+100	PUP	LHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
27	699+100	PUP	RHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
28	701+730	PUP	LHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
29	701+730	PUP	RHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
30	710+773	MJB	LHS	MCW	New	5 x 18	12.5	9	Not visible	RCC wall type	Single circular column type	RCC Girder	Elastomeric
31	710+773	MJB	RHS	MCW	OLD	5 x 18	8.5	7.5	Not visible	RCC wall type	RCC wall type	RCC Girder	Elastomeric
32	714+725	VUP	LHS	MCW	New	2 x 12	12.5	11.5	Raft	RCC Box	RCC Box	RCC Box	-
33	714+725	VUP	RHS	MCW	New	2 x 12	12.5	11.5	Raft	RCC Box	RCC Box	RCC Box	-
34	716+185	ROB	LHS	MCW	New	1 x 19 + 1 x 37 + 1 x 19	12.5	9	Not visible	Single circular column type	Twin circular column type	RCC & Steel composite girder	Pot PTFE

S. No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
35	716+185	ROB	RHS	MCW	New	1 x 19 + 1 x 37 + 1 x 19	12.5	9	Not visible	Single circular column type	Twin circular column type	RCC & Steel composite girder	Pot PTFE
36	718+084	MNB	LHS	MCW	New	2 x 6.8 + 1 x 7.3	12.5	9	Raft	RCC Box	-	RCC Box	-
37	718+084	MNB	RHS	MCW	OLD	2 x 6.8 + 1 x 7.3	12.5	9	Raft	RCC Box	-	RCC Box	-
38	720+520	PUP	LHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
39	720+520	PUP	RHS	MCW	New	1 x 7	12.5	11.5	Raft	RCC Box	-	RCC Box	-
40	721+420	MNB	LHS	MCW	New	1 x 7	12.5	9	Raft	RCC Box	-	RCC Box	-
41	721+420	MNB	RHS	MCW	OLD	1 x 8	12.5	9	Raft	RCC Box	-	RCC Box	-
42	721+815	MNB	LHS	MCW	New	1 x 9.5	12.5	9.5	Raft	RCC Box	-	RCC Box	-
43	721+815	MNB	RHS	MCW	OLD	1 x 9.5	12.5	9.5	Raft	RCC Box	-	RCC Box	-
44	723+550	MNB	LHS	MCW	New	3 x 18	12.5	11.5	Not visible	RCC wall type	Single circular column type	RCC Girder	Elastomeric
45	723+550	MNB	RHS	MCW	New	3 x 18	12.5	11.5	Not visible	RCC wall type	Single circular column type	RCC Girder	Elastomeric

Visual Inspection with MBIU at following locations

S No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m) As per Site	Total Length (m)	Type of Superstructure	Type of Bearings	MBIU Required
1	694+088	MNB	LHS	MCW	New	1 x 19.00	19 m	RCC Girder	Elastomeric	Yes
2	694+088	MNB	RHS	MCW	New	1 x 19.00	19 m	RCC Girder	Elastomeric	Yes
3	710+773	MJB	LHS	MCW	New	5 x 18	90 m	RCC Girder	Elastomeric	Yes
4	710+773	MJB	RHS	MCW	Old	5 x 18	90 m	RCC Girder	Tar Paper	Yes
5	723+550	MNB	LHS	MCW	New	3 x 18	54 m	RCC Girder	Elastomeric	Yes
6	723+550	MNB	RHS	MCW	New	3 x 18	54 m	RCC Girder	Elastomeric	Yes

Details of Culverts

S No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
						LHS	RHS	LHS	RHS	
1	656+590	PIPE	BHS	2 x 1.0	60	No	No	Yes	Yes	> Culvert is in fair condition.
2	657+440	PIPE	BHS	1 x 1.0	60	No	No	Yes	Yes	> Culvert is in fair condition.
3	657+620	PIPE	BHS	1 x 1.0	60	No	No	Yes	Yes	> Culvert is in fair condition.
4	658+100	PIPE	BHS	2 x 1.0	60	No	No	No	No	> Culvert is in fair condition.
5	658+830	PIPE	BHS	2 x 1.0	40	No	No	No	No	> Culvert is in fair condition.
6	659+735	PIPE	BHS	1 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition.
7	660+110	PIPE	BHS	2 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition.
8	660+560	PIPE	BHS	2 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition.
9	660+740	PIPE	BHS	2 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition.
10	661+159	PIPE	BHS	2 x 1.2	42	No	No	Yes	Yes	> Culvert is in fair condition.
11	661+516	PIPE	BHS	1 x 1.2	42	No	No	Yes	Yes	> Culvert is in fair condition.
12	661+614	PIPE	BHS	1 x 1.2	42	No	No	Yes	Yes	> Culvert is in fair condition.
13	661+775	PIPE	BHS	1 x 1.2	50	No	No	Yes	Yes	> Culvert is in fair condition.
14	662+000	PIPE	BHS	1 x 1.2	42	No	No	Yes	Yes	> Culvert is in fair condition.
15	662+175	PIPE	BHS	1 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition.
16	662+345	PIPE	BHS	1 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition.
17	662+655	PIPE	BHS	2 x 1.0	60	No	No	Yes	Yes	> Culvert is in fair condition.
18	664+456	PIPE	BHS	2 x 1.0	44	No	No	No	No	> Culvert is in fair condition.
19	664+860	PIPE	BHS	1 x 1.0	40	No	No	No	No	> Culvert is in fair condition.
20	665+592	BOX	BHS	1 x 2	26	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
21	666+315	PIPE	BHS	2 x 1.0	56	No	No	Yes	Yes	> Culvert is in fair condition.
22	666+865	BOX	BHS	1 x 2	24	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
23	668+160	BOX	BHS	1 x 2.5	24	No	No	Yes	Yes	> Culvert is in fair condition.
24	668+670	PIPE	BHS	1 x 1.2	0	0	0	0	0	> Culvert not found at site.
25	668+770	PIPE	BHS	1 x 1.2	26	No	No	Yes	Yes	> Culvert is in fair condition.
26	669+238	PIPE	BHS	1 x 1.2	27	No	No	Yes	Yes	> Culvert is in fair condition.
27	670+365	PIPE	BHS	1 x 1.2	36	No	No	Yes	Yes	> Culvert is in fair condition.
28	671+260	PIPE	BHS	2 x 1.0	42	No	No	Yes	No	> Culvert buried on LHS.
29	671+700	PIPE	BHS	1 x 1.2	36	No	No	Yes	Yes	> Culvert is in fair condition.
30	672+037	PIPE	BHS	1 x 1.2	36	No	No	Yes	Yes	> Culvert is in fair condition.
31	672+417	PIPE	BHS	1 x 1.2	34	No	No	Yes	Yes	> Culvert is in fair condition.
32	672+617	PIPE	BHS	1 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
33	673+056	PIPE	BHS	1 x 1.2	34	No	No	Yes	Yes	> Culvert is in fair condition.
34	673+674	PIPE	BHS	2 x 1.0	50	No	No	Yes	Yes	> Culvert is in fair condition.
35	675+318	PIPE	BHS	2 x 1.0	40	No	No	Yes	Yes	> Culvert is in fair condition.
36	675+900	PIPE	BHS	4 x 1.0	42	No	No	Yes	Yes	> Culvert is in fair condition.
37	676+770	PIPE	BHS	1 x 1.2	24	No	No	Yes	Yes	> Culvert is in fair condition.
38	677+205	PIPE	BHS	1 x 1.2	44	No	No	No	Yes	> Culvert is in fair condition.
39	677+380	PIPE	BHS	1 x 1.2	40	No	No	Yes	No	> Culvert is in fair condition.
40	677+839	PIPE	BHS	1 x 1.2	34	No	No	Yes	No	> Culvert is in fair condition.
41	678+659	PIPE	BHS	1 x 1.2	40	No	No	Yes	No	> Culvert is in fair condition.
42	679+133	BOX	BHS	1 x 3	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
43	680+075	BOX	BHS	1 x 3	60	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
44	680+759	PIPE	BHS	3 x 1.0	60	No	No	Yes	Yes	> Culvert is in fair condition.
45	681+950	PIPE	BHS	1 x 1.2	45	No	No	Yes	Yes	> Culvert is in fair condition.
46	682+595	PIPE	BHS	1 x 1.2	45	No	No	Yes	Yes	> Culvert is in fair condition.
47	683+356	BOX	BHS	1 x 2	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
48	683+956	BOX	BHS	1 x 2	0	0	0	0	0	> Culvert not found at site.

S No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
						LHS	RHS	LHS	RHS	
49	684+145	PIPE	BHS	2 x 1.0	35	No	No	Yes	Yes	> Culvert is in fair condition.
50	684+450	BOX	BHS	1 x 3	30	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
51	684+621	PIPE	BHS	1 x 1.0	40	No	No	Yes	Yes	> Culvert is in fair condition.
52	685+015	PIPE	BHS	1 x 1.0	45	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
53	685+230	PIPE	BHS	2 x 1.0	36	No	No	Yes	Yes	> Culvert is in fair condition.
54	685+755	BOX	BHS	1 x 3.7	60	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
55	686+305	BOX	BHS	1 x 3	50	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
56	686+556	PIPE	BHS	3 x 1.0	30	No	No	Yes	Yes	> Culvert is in fair condition.
57	687+201	BOX	BHS	1 x 2	35	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
58	687+700	PIPE	BHS	1 x 1.2	50	No	No	Yes	No	> Culvert buried on LHS
59	688+030	BOX	BHS	1 x 4	35	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
60	688+180	PIPE	BHS	2 x 1.2	36	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
61	688+380	BOX	BHS	1 x 3	32.5	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
62	688+600	PIPE	BHS	2 x 1.2	36	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
63	688+720	PIPE	BHS	2 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
64	689+140	PIPE	BHS	2 x 1.2	50	No	No	Yes	Yes	> Culvert is in fair condition.
65	689+390	BOX	BHS	1 x 3	30	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
66	689+638	PIPE	BHS	2 x 1.2	45	No	No	Yes	Yes	> Culvert is in fair condition.
67	689+951	PIPE	BHS	3 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
68	690+273	PIPE	BHS	3 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
69	690+390	PIPE	BHS	1 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
70	690+513	PIPE	BHS	2 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition.
71	690+710	PIPE	BHS	2 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition.
72	691+090	PIPE	BHS	2 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition.
73	691+890	PIPE	BHS	1 x 1.2	36	No	No	Yes	Yes	> Culvert is in fair condition.
74	692+210	PIPE	BHS	1 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
75	692+920	BOX	BHS	1 x 5	36	No	No	Yes	Yes	> Culvert is in fair condition.
76	693+280	BOX	BHS	1 x 3	50	No	No	Yes	Yes	> Culvert is in fair condition.
77	693+547	PIPE	BHS	1 x 1.2	35	No	No	No	Yes	> Culvert buried on LHS
78	693+980	PIPE	BHS	1 x 1.2	50	No	No	Yes	Yes	> Culvert is in fair condition.
79	694+860	PIPE	BHS	1 x 1.2	36	No	No	Yes	Yes	> Culvert is in fair condition.
80	695+056	PIPE	BHS	1 x 1.2	36	No	No	Yes	Yes	> Culvert is in fair condition.
81	695+320	PIPE	BHS	1 x 1.2	36	No	No	Yes	Yes	> Culvert is in fair condition.
82	695+650	PIPE	BHS	1 x 1.2	32	No	No	Yes	Yes	> Culvert is in fair condition.
83	695+927	PIPE	BHS	1 x 1.2	60	No	No	No	Yes	> Culvert is in fair condition.
84	696+615	PIPE	BHS	1 x 1.0	45	No	No	No	No	> Vegetation cleaning required.
85	697+110	PIPE	BHS	1 x 1.0	60	No	No	Yes	Yes	> Culvert is in fair condition.
86	697+800	PIPE	BHS	1 x 1.0	32	No	No	Yes	Yes	> Culvert is in fair condition.
87	698+000	PIPE	BHS	2 x 1.0	40	No	No	Yes	Yes	> Culvert is in fair condition.
88	699+325	PIPE	BHS	2 x 1.0	60	No	No	Yes	Yes	> Culvert is in fair condition.
89	699+820	PIPE	BHS	1 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
90	701+300	PIPE	BHS	1 x 1.0	60	No	No	Yes	Yes	> Culvert is in fair condition.
91	702+471	BOX	BHS	1 x 3	60	No	No	Yes	Yes	> Culvert is in fair condition.
92	702+800	PIPE	BHS	1 x 1.2	36	No	No	No	Yes	> Culvert buried on LHS.
93	704+300	PIPE	BHS	1 x 1.2	36	No	No	Yes	Yes	> Culvert is in fair condition.
94	704+538	PIPE	BHS	1 x 1.2	36	No	No	Yes	Yes	> Culvert is in fair condition.
95	704+980	PIPE	BHS	2 x 1.0	36	No	No	Yes	Yes	> Culvert is in fair condition.
96	706+028	PIPE	BHS	1 x 1.2	36	No	No	Yes	Yes	> Culvert is in fair condition.
97	706+824	PIPE	BHS	1 x 1.2	36	No	No	Yes	Yes	> Culvert is in fair condition.
98	707+100	PIPE	BHS	1 x 1.2	36	No	No	Yes	Yes	> Culvert is in fair condition.
99	707+954	PIPE	BHS	1 x 1.2	36	No	No	Yes	Yes	> Culvert is in fair condition.
100	708+294	PIPE	BHS	1 x 1.2	36	Yes	Yes	Yes	Yes	> Culvert is in fair condition.

S No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
						LHS	RHS	LHS	RHS	
101	709+144	PIPE	BHS	1 x 1.2	36	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
102	709+450	BOX	BHS	1 x 2	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
103	709+900	PIPE	BHS	1 x 1.2	13	No	No	Yes	Yes	> Culvert not found in LHS. > Culvert found on RHS
104	710+040	PIPE	BHS	1 x 1.2	14	No	No	Yes	Yes	> Culvert not found in RHS. > Culvert found on LHS and it is in fair condition.
105	710+700	BOX	BHS	1 x 4	26	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
106	711+270	BOX	BHS	1 x 2	13	Yes	Yes	Yes	Yes	> Culvert not found in RHS. > Culvert found on LHS and it is in fair condition.
107	712+210	BOX	BHS	1 x 3	52	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
108	713+425	PIPE	BHS	1 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition.
109	713+575	BOX	BHS	1 x 2	60	No	No	Yes	Yes	> Culvert is in fair condition.
110	713+730	PIPE	BHS	1 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition.
111	713+870	BOX	BHS	1 x 3	60	No	No	Yes	Yes	> Culvert is in fair condition.
112	714+200	PIPE	BHS	1 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition.
113	714+800	PIPE	BHS	2 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition.
114	715+165	PIPE	BHS	1 x 1.2	54	No	No	Yes	Yes	> Culvert is in fair condition.
115	715+450	PIPE	BHS	3 x 1.2	36	No	No	Yes	Yes	> Culvert is in fair condition.
116	716+229	PIPE	BHS	1 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition.
117	716+600	PIPE	BHS	3 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition.
118	716+960	PIPE	BHS	1 x 1.2	60	No	No	Yes	Yes	> Culvert buried on LHS.
119	717+500	BOX	BHS	1 x 2	0	0	0	0	0	> Culvert not found at site.
120	717+530	PIPE	BHS	1 x 1.2	40	No	No	No	No	> Culvert additional found at site
121	717+547	PIPE	BHS	2 x 1.2	50	No	No	Yes	Yes	> Culvert additional found at site
122	717+747	PIPE	BHS	2 x 1.2	0	0	0	0	0	> Culvert not found at site.
123	718+580	BOX	BHS	1 x 4	0	0	0	0	0	> Culvert not found at site.
124	718+635	PIPE	BHS	2 x 1.2	32	No	No	Yes	Yes	> Culvert is in fair condition.
125	719+518	PIPE	BHS	1 x 1.2	32	No	No	No	Yes	> Culvert is in fair condition.
126	719+575	PIPE	BHS	1 x 1.2	38	No	No	No	No	> Culvert is in fair condition.
127	719+853	PIPE	BHS	2 x 1.2	36	No	No	Yes	Yes	> Culvert is in fair condition.
128	720+060	PIPE	BHS	1 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
129	720+328	PIPE	BHS	2 x 1.2	50	No	No	Yes	Yes	> Culvert is in fair condition.
130	720+520	PIPE	BHS	2 x 1.2	50	No	No	Yes	Yes	> Culvert is in fair condition.
131	720+700	PIPE	BHS	1 x 1.2	50	No	Yes	Yes	Yes	> Culvert is in fair condition.
132	721+000	BOX	BHS	1 x 2	50	No	No	Yes	Yes	> Culvert is in fair condition.
133	721+140	BOX	BHS	1 x 2	28	No	No	Yes	Yes	> Culvert is in fair condition.
134	722+053	PIPE	BHS	1 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
135	722+600	BOX	BHS	1 x 3.8	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
136	722+700	PIPE	BHS	2 x 1.2	36	No	No	No	Yes	> Culvert is in fair condition.
137	723+180	BOX	BHS	1 x 3	40	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
138	723+300	BOX	BHS	1 x 3.5	50	No	No	Yes	Yes	> Culvert is in fair condition.
139	723+918	PIPE	BHS	1 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.

Sample photos of Box Culverts

Box culvert: 666+865

Box culvert: 687+201

Box culvert: 689+390

Box culvert: 709+450

Box culvert: 710+700

Box culvert :723+300

Sample photos of Pipe Culverts

Pipe culvert: 659+735

Pipe culvert: 616+614

Pipe culvert: 673+056

Pipe culvert: 701+300

Pipe culvert: 715+450

Pipe culvert: 723+918

DRAINAGE AND SLOPE PROTECTION

- ✓ Lined Covered drains observed at urban locations and at service road Locations along the corridor.
- ✓ No major damages observed at covered drain locations.

4.7 TRAFFIC SAFETY AND ROAD FURNITURE

- ✓ Metal beam crash barriers provided along the project road appear to be intact over entire length except for few locations where it got damaged.
- ✓ Pedestrian guard rails installed on the median & appear to be intact over entire length except for few locations where it got damaged.
- ✓ Median Opening locations appear to be in good condition. The width of the existing standing lane median openings was observed for a width of 1.0m.
- ✓ No Traffic blinkers observed at median openings in the entire project corridor.
- ✓ Street lightings and High masts are observed at urban locations, at few locations' street lightings are got damaged and not functioning well, and those locations are mentioned in the above presented table.

4.8 ROAD USER FACILITIES

The Bus Bay with Shelters and truck lay byes were provided along the corridor.

CHAPTER 5. REHABILITATION PLANS AND DESIGNS

5.1 DESIGN TRAFFIC LOADING

Design Traffic loading has been estimated by considering the latest traffic (given) and VDFs as estimated from the latest axle load survey data and with min. 5% growth rates and actual growth rates for 10 years, 15 years and 20 years design period as below:

Table 32: Traffic Volume (AADT)-FY2023

Vehicle/Mode	Toll Plaza-1 (LHS)	Toll Plaza-1 (RHS)
CAR	1389	1389
BUS	56	56
2A truck	239	239
3A truck	139	139
MAV truck	898	898
LCV	93	93

Table 33: Estimated Design traffic loading

Year	MSA Summary -5% Growth rates	
	Toll plaza-1	
	UP	DN
10th year from Now	40	48
15th year from Now	68	82
20th year from Now	105	125

The computation of traffic loadings is presented in **Appendix 9** of this Report. The traffic loading on RHS direction is high compared to LHS direction. Design traffic corresponding to 10 years period has been considered for overlay design.

5.2 PAVEMENT REHABILITATION AND STRENGTHENING

5.2.1 Rigid Pavement Strengthening

Based on the FWD survey and their results it appears that about 60% in LHS, 49% in RHS of the flexural strength values ranges from 3.0MPa to more than 4.5 Mpa. The rigid pavement design period has been checked with various flexural strength values by considering the existing PQC & DLC thickness.

Number of axle load repetitions for each year of operation is estimated and cumulated for entire operation period of 20 years from now. Using IRC 58-2015 design charts, stress ratios corresponding each Flexural strength values ranging from 3.75MPa-4.5MPa have been estimated and number repetitions that existing pavement serves is also established.

The summary of the Design period satisfies for various flexural strength values as given below:

Flexural Strength (Mpa)	Existing Rigid Pavement Thickness satisfies to the design period in Years	
Side	LHS	RHS
3.30 / 3.28	10 Years	10 Years
3.47 / 3.44	20 Years	20 Years
3.75	30 Years	30 Years
4	30 Years	30 Years
4.5	30 Years	30 Years

From the FWD data analysis it is found that nearly 60% points in on LHS & 49% points in RHS were having flexural strength values more than 3Mpa. These are considered to be fair condition and requires minimal maintenance. Similarly, flexural strength values less than 3mpa were considered to be average to poor condition and are estimated nearly 40% of samples in on LHS & 51% sample in RHS of project road may require major rehabilitation measures during operation period. Thus, the same has been considered in cost estimates apart from routine and periodic maintenance of rigid pavement.

5.3 STRUCTURAL REHABILITATION

All the structure found to be in good condition except little minor treatment like repair of stone pitching, cleaning of drainage spouts, cleaning of vegetation etc. may be required. Detailed structural rehabilitation quantities have been worked out based on the prevailing condition of existing structures. This methodology describes in detail the procedure for the execution of each item of rehabilitation work of the Existing Bridges of the project.

The scope of this methodology covers the items mentioned below for rehabilitation work of all the existing Bridges.

- Repair/ Replacement of Existing Bearings
- Repair / Replacement of Existing Expansion Joints
- Repair / Replacement of Existing Wearing Coat
- Profile Correction for Existing Deck Slab by Cement Concrete
- Sealing of Cracks for Bridges by Epoxy Resin
- Replacement of Spalled Concrete of ECW by Epoxy Mortar
- Cement Grouting for Repair of Existing Bridges
- Guniting / Shotcrete for Repair of Existing Bridges
- Providing & Fixing of Drainage Spouts
- Repair of Substructure Component
- Repair / Replacement of Railing & Crash Barrier
- Epoxy Bonding between New and Old Concrete.

About Six locations, structures are closely monitored by use of Mobile Bridge Inspection Unit (MBIU). Details of these structures where MBIU is used are presented in the following table

Table 34: Locations of MBIU survey

S.No.	Chainage	Type of Structure	Side
1	694+088	MNB	LHS
2	694+088	MNB	RHS
3	710+773	MJB	LHS
4	710+773	MJB	RHS
5	723+550	MNB	LHS
6	723+550	MNB	RHS

Based on the Visual Inspection, as the structures are in fair condition there is no necessity of NDT tests to evolve rehabilitation strategies for the following structures.

5.4 DEVELOPMENT ZONES (Schedule-B PROVISIONS)

5.4.1 Maintenance Works

Schedule B stipulates the obligation of immediate maintenance which is to be done by the incoming Concessionaire. However, NHAI has represented to NHIT that they will undertake the immediate maintenance themselves, confirming to CA obligations, before handing over the asset to NHIT. .

For Service Road: Existing service road shall be provided with overlay at following locations for 30 MSA by carrying FWD.

S.No	Location		One Side Length	Side	Minimum Overlay
	From	To			
1	662+275	663+080	805	RHS	40 mm BC + 50 mm DBM
2	713+860	716+120	2260	LHS	40 mm BC + 50 mm DBM
3	714+300	715+250	950	RHS	40 mm BC + 50 mm DBM
	Total		4015		

-Overlay shall also be carried out Entry / Exit

.Median Openings

The details of the median openings and their treatments are given in table below:

Proposed Median Opening:

S. No.	Existing Kilometer (km)	Recommendations
1	684+475	Median opening shall be improved as per IRC:35-2015 and IRC 67:2012

5.4.2 Project Facilities

- **Truck Lay Bye**

Truck Lay bye shall be upgraded at the following locations as per IRC: SP:84- 2019 within the ROW.

S.N.	Existing Kilometer (Km)		Side	Improvement Proposal
	From	To		
1	665+000	665+150	LHS	Facilities / repaired to be provided as per IRC SP: 84-2019
2	677+510	677+615	RHS	
3	712+600	712+750	LHS	

The existing toilets shall be suitably modified to give an aesthetically pleasing look and shall gel with the surroundings. The Sewage disposal system shall be through Bio-digestible system (including Septic Tank & Soak pit). The drinking water facility shall be RO Treated Water.

5.4.3 Completion Schedule for Improvement Proposals

Completion schedule for Scope mentioned in Schedule-B shall be as below.

S. No.	Description of Work	Date of Completion
1	Incident Management (9.7, 9.8 and 9.9)	From Appointed Date / O & M Handover Date, whichever is later
2	Installation / Rectification of road furniture related items (Section 10) Landscaping and Tree Plantation (Section 9.4)	9 months from Appointed Date
3	Maintenance and Rehabilitation (Section 4)	6 months from Appointed Date / O&M Handover Date, whichever is later
4	Toll Plaza and other facilities at Toll Plaza (Section 9.1, 9.11,9.12)	6 months from Appointed Date
5	ATMS (Section 9.10)	18 months from Appointed Date ***(pre-bid reply dtd 11.10.2023, annexure-2, S.No3: Installation, operation and maintenance of the ATMS shall be done by NHAI)***
6	Other Improvements (Section 1, 2, 3, 5, 6, 7, 8, 9.2, 9.3, 9.5, 9.6 and 9.13)	18 months from Appointed Date

CHAPTER 6. OPERATION AND MAINTENANCE

6.1 INTRODUCTION

Looking at the contractual requirements of maintaining project road under specified level of roughness it is felt that roughness is the most important criterion for finalizing the O&M schedule for the project. Accordingly, the methodology adopted by present consultants includes predicting the roughness year by year under the traffic using a well acknowledged HDM-4 model developed for developing countries like India after lot of research by World Bank. The said model is widely prescribed by MORTH and NHAI during the preparation of detailed project reports for several projects in doing economic analysis for the projects. The economic analysis mainly consists of two parts:

1. Predicting the road deterioration and estimating VOC
2. Estimating Benefits

Considering its importance and present use in India, consultants felt prudent to use the first part, i.e. estimating road deterioration and predicting roughness in HDM 4 model to finalize the O&M schedule for the project. This approach is more scientific as it does not assume hypothetical deflection values at 10th and 20th year and includes main criterion of maintaining roughness at 2400mm/Km as per Schedule K.

6.2 CA SPECIFICATIONS FOR MAJOR MAINTENANCE

- Schedule K of CA specifies that Roughness values exceeds 2400mm/km in a length of KM, needs to be corrected within 180 days.
- No specific requirement with respect to deflection (FWD) measurement

6.3 RIGID PAVEMENT PERIODIC MAINTENANCE STRATEGY

Apart from the above requirements of Sch-F and maintaining the roughness and skid number for the rigid pavements, there are several other repair strategies included in Sch-F for rectification of defects in rigid pavement. These include following:

- Crack Seal
- Seal & Stitch
- Staple or Dowel Bar Retrofit
- Partial Depth Repair with Stapling
- Full Depth Repair: Dismantle and reconstruct affected Portion
- Diamond Grinding
- Joint Cleaning & Repair

Looking at the above requirements, it is felt necessary to consider following activities as part of periodic maintenance cycle apart from routine maintenance activities:

Description	%	Unit	Rate	Quantity	Amount
Length of Rigid Pavement		Kms		64.72	
PQC Qty		Cum		455028	
Total Area		Sqm		1289704	
No of Transverse Joints		no		14382	
No of Panels		no		63689	
Length of Transverse Joints		m		143300	
Longitudinal Joint		m		161800	258880
Repair of Transverse Joint Sealant	75.00%	m	64.5	107475	6932159
Repair of Longitudinal Joint Sealant	75.00%	m	64.5	121350	7827075
Replacement of Transverse Joint@ 7years	2.00%	m	833	2866	2387385
Replacement of Longitudinal Joint@ 7years	2.00%	m	833	3236	2695588
Raveling surface @7years	3.00%	Sqm	935	38691	36176197
Crack sealing Surface @ 7years	5.00%	m	436	12944	5647726
Repair of Panels @ 7years	0.50%	No	8773	318	2789788
Removal of Panels @ 7years	1.50%	No	3411	955	3257123
Relaying of Panels @ 7years	1.50%	No	34748	955	33184728
Retexturing@ 7years	20%	Sqm	100	257941	25794080
Regrinding and Retexturing@ 7years	10%	Sqm	500	128970	64485200
Total Amount in Rs.					191435929
periodic maintenance cost in Crores					**19.118**
Per Sqm per Cycle (Rs.)					**175**

Note :

1. The above Costs are considered in 3 cycles
2. Apart from the above, the additional cost of Rehabilitation is considered in 2nd Cycle based on the current FWD Data

The above are in addition to routine maintenance activities which include following for every year:

Longitudinal Cracks more than 1.5m	Lin.m	0.50%
Longitudinal Cracks less than 1.5m	Lin.m	0.50%
Transverse Cracks less than 1.5m	Lin.m	0.50%
Transverse Cracks more than 1.5m	Lin.m	0.50%
Longitudinal Crack full Depth	Cum	0.10%
Pothole	sq.m	0.10%
Corner Cracks	cum	0.10%
Condition of Joints	Lin.m	1.00%
Diagonal Cracking	Lin.m	0.50%
Raveling of panel	sq.m	0.25%

6.4 STRUCTURAL PERIODIC MAINTENANCE STRATEGY

Expansion joints:

- Visual inspection is carried out to check for seal breakages, Armor angle, Weld failures, cracks between deck & Expansion joints concrete and Joints filled with debris. Such joints replaced immediately.
- Joint buried with debris shall be inspected for any distress, if any distress is shown it shall be replays immediately.
- During visual inspection it is seen that some Expansion joints are bad where as some are not showing any defects.
- Due to this it is considered provident to change the Expansion joints which are visibly damaged in initial stage.
- In the absence of records pertaining to Expansion joint replacements it is highly difficult to predict the date of replacement needed for compliance to IRC codal requirements. Balance joints which are not replaced initially will be replaced as on when defects are shown in the joints. This aspect is considered in BOQ.

Bearings:

- In order to identify the bearings requiring immediate replacement, the following strategy is adopted.
- Girder Bridges showing diagonal cracks at support, distress in the Pedestals and any form of distress in support location is regarded as a candidate for replacement. By visual inspection there are only a handful of such situations.
- Wherever pedestals are damaged either by cracking or spalling poisons confinement is proposed by Jacketing/MS plate bonding such procedure is very effective and common.
- All Metallic Bearings need to be taken up for servicing.

Wearing Coat:

It is necessary to replace the Wearing coat at every 15years interval, as wearing coat is a very weak component of the bridge structure which is subjected to severe deterioration due to Loading, Environment etc. As of now, we have considered sealing of cracks by Fog Seal and for which does not show any distress other than cracking by viz. Pot holes, abrading etc. Based on this aspect, this cost has been considered in highway O&M cost.

Periodic Maintenance strategy for Replacement of Bearings & Expansion joint:

Below strategy has been considered for periodic major maintenance of the structures.

S no	Description		Bridge components
1	Old structure	Structures which are older than 15years as of now	Periodic Replacement of bearings, Expansion joint
2	New Structure	Structures which are Not older than 15years as of now	

.

Age	Description	Item	structures-Assumption-MMR							
			% of Replacement of Major components							
			2024	2028	2033	2038	2043	2048	2053	2052
New	Super structure lifting with Pot bearings	Pot	0%	10%	50%	25%	50%	25%	25%	0%
New	Super structure lifting with Elastomeric bearings	Ela	0%	10%	75%	50%	50%	25%	50%	0%
New	Super structure lifting with Rocker bearings	Rocker	0%	0%	0%	0%	0%	0%	0%	0%
Old	Super structure lifting with Pot bearings	Pot	50%	25%	50%	25%	25%	25%	50%	0%
Old	Super structure lifting with Elastomeric bearings	Ela	50%	25%	50%	25%	25%	25%	50%	0%
Old	Super structure lifting with Rocker bearings	Rocker	25%	10%	25%	10%	25%	25%	25%	0%
New	Pot bearing cost	Pot	0%	10%	50%	25%	50%	25%	25%	0%
New	Elastomeric bearing cost	Ela	0%	10%	75%	50%	50%	25%	50%	0%
New	Rocker bearing cost	0	0%	0%	0%	0%	0%	0%	0%	0%
Old	Pot bearing cost	Pot	50%	25%	50%	25%	25%	25%	50%	0%
Old	Elastomeric bearing cost	Ela	50%	25%	50%	25%	25%	25%	50%	0%
Old	Rocker bearing cost	0	25%	10%	25%	10%	25%	25%	25%	0%
New	Expansion joint Replacement	0	0%	20%	50%	50%	50%	25%	50%	0%
Old	Expansion joint Replacement	0	75%	25%	25%	25%	50%	25%	50%	0%
New	Others	0	0%	20%	50%	25%	25%	25%	50%	0%
Old	Others	0	75%	25%	25%	25%	25%	25%	50%	0%

Cost Component for various items and activities have been worked out by considering the Best Industry practice and most appropriate methods. Detailed quantities for work items have been estimated based on the details presented in previous chapters for various heads.

The gist of the cost components considered are presented below:

- Immediate Repair's Cost
- Routine Maintenance Cost
- Incident Management Cost
- Periodic Maintenance Cost
- Operations Cost
- Year by Year total O&M Costs

7.1 RATE ANALYSIS

Detailed rate analysis has been carried out based on MORTH guidelines to arrive at the unit rates of various items. Material rates and their leads from the project corridor are considered as per the material investigations done on the project road. Summary of unit rates arrived at are presented in table below:

Table 35: Summary of Unit Rates

Sl.no	Description	Units	Source	Basic rate excluding Transportation & GST	Lead in Kms
1	Good earth	Cum	BA	31	5.20
2	40 mm	Cum	Crusher	750	5.09
3	20 mm	Cum	Crusher	950	5.09
4	12 mm	Cum	Crusher	185	5.09
5	6 mm	Cum	Crusher	130	5.09
6	Dust	Cum	Crusher	185	5.09
7	M sand	Cum	Crusher	216	5.09
8	Flyash	Cum	Nearest Plant	0	691.09
9	Boulders	Cum	Quarry	389	1.00
10	Sand source to Plant	Cum	River	216	6.00
11	Sand source to working site	Cum	Stock yard	216	3.00
12	Bitumen 60/70	MT	Mathura	48566	623.00
13	Bitumen 80/100	MT	Mathura	47806	623.00
14	VG-40	MT	Mathura	48000	623.00
15	CRMB-55	MT	Mathura	49516	623.00
16	PMB	MT	Mathura	53200	623.00

Sl.no	Description	Units	Source	Basic rate excluding Transportation & GST	Lead in Kms
17	SS1	MT	Mathura	50000	623.00
18	Steel	MT	Rewa	63833	0.00
19	HTS Strands	MT	Rewa	70000	1263.00
20	Cement	MT	Rewa	5313	0.00
21	Structural Steel	MT	Rewa	65833	46.00
22	RCC Pipe NP 4 heavy duty non presure pipe 1000 mm dia	RM	Rewa	4500	90.00
23	RCC Pipe NP 4 heavy duty non presure pipe 1200 mm dia	RM	Rewa	5500	90.00
24	RCC Pipe NP 4 heavy duty non presure pipe 900 mm dia	RM	Rewa	3500	90.00

Table 36: Major Material Rates

Sl.no	Item	Unit	Rate (INR) Excluding GST
1	Embankment - borrow	Cum	268
2	Embankment - Excavation	Cum	77
3	SG	Cum	274
4	GSB G-2	Cum	1058
5	WMM	Cum	1196
6	Prime Coat	Sqm	42
7	Tack coat on granular	Sqm	14
8	DBM G-1	Cum	7695
9	Tack coat on bituminous surface	Sqm	13
10	BC - G1	Cum	9211
11	Road Marking	Sqm	531
12	RE wall	Sqm	4673
13	Select Fill	Cum	301
14	Filter Media	Cum	1664
15	M15	Cum	4825
16	M20	Cum	5219
17	M25	Cum	5681
18	M30	Cum	5734
19	M35	Cum	5849
20	M40	Cum	5968
21	PSC M45	Cum	7181
22	HYSD	MT	91815
23	HT strand	MT	144705

7.2 INITIAL IMPROVEMENT WORKS (SCHEDULE-B)

Costs associated with initial improvements are estimated based on the detailed asset inventory and condition assessment surveys, Pavement condition and structural condition assessment surveys. Items which are not executed as part of scope or in damaged condition have been considered for immediate costs as a part of 1-year capex. Following items are mainly considered for Initial Improvement costs:

- Scope given in schedule-B
- Scope which is not executed
- Road work items
- Bridge Work Items
- Pavement Rehabilitation works
- Structural Rehabilitation works
- Drainage Works
- Slope Protection works
- Safety Works

Summary of Initial Improvement Costs are included in table below:

Table 37: Summary of Initial Improvement Cost

S No	Description	Unit	Quantity	Rate (Rs)	Amount (Rs.)
1	EPC (Highway & Structure) Schedule-B	LS	1	3,95,20,156	3,95,20,156
2	TMS	LS	1	2,15,53,444	2,15,53,444
3	ATMS	LS	1	-	-
4	Revalidation surveys	LS	1	1,63,54,528.50	1,63,54,529
5	Pavement Rehabilation-void filling	LS	1	63,48,000.00	63,48,000
Immediate Repair's - Structures					9,29,099
Total Cost excluding GST					**8,47,05,228**
GST at 18%					**1,52,46,941**
Total Cost including GST					**9,99,52,169**
Total Cost including GST in Rs. Crores					**10.00**

Note: This above cost arrived is with due consideration of reply to pre-bid queries dtd 27.09.2023 Annexure-D

The structure approach lengths as given in the DPR has been redesigned with due verification at site and following revised lengths were considered in EPC cost estimations

S No.	Package	Str_Chianage	Str. Type	As Per DPR, length in KM			Difference In Km	As Per Samarth,length in KM		
				From	To	Length		From	To	Length
1	PKG-1	691.92	LVUP	691.58	692.38	0.8	-0.009	691.535	692.326	0.791
2		713.38	VUP	712.95	713.86	0.91	0.07	712.87	713.85	0.98

7.3 ROUTINE MAINTENANCE & INCIDENT MANAGEMENT COSTS

Routine maintenance costs include general maintenance costs of road elements, bridge elements and road furniture and appurtenances. This can be mainly divided into two parts as:

- ✓ General Maintenance of Works
- ✓ Repairs to Highway & Bridge Elements

7.3.1 General Routine Maintenance

General Routine Maintenance of Roads generally include following items:

- Cleaning of Project facilities
- Structures cleaning,
- Cleaning of ROW
- Cleaning and Maintenance of Toll Plaza
- Unlined Drain Maintenance
- Lined Drain Maintenance
- Maintenance of Highway Lighting at Toll Plaza and other project locations
- Median Plantation maintenance & Avenue plantation maintenance:
- Maintenance of Road Furniture
- Maintenance of Road Safety Items

The above items are estimated by considering the detailed break-up of following items:

- Manpower including Managers/Labour etc.
- Vehicles for Labour Transport/Water Tankers/Sweeping Machines etc.
- Resources/Equipment's such as grass cutters, tools, jet sprayers, hydraulic trimmers etc.

7.3.2 Repairs to Highway & Bridge Works

Repairs to highway and bridge works have been estimated based on the assumed quantities (Percentage basis) of execution for every year.

These items include the following:

1	Providing treatment for sealing of road surface / isolated cracks at scattered locations
	i) Covered with 6.7 mm size stone chipping @ 0.1 cum/ 10 sqm.
	ii) covered with dry coarse sand passing through 2.36 mm sieve and retained on 180 micron sieve @ 0.03 cum/10 sqm heated to 600 C
	iii) filling discrete cracks with slow curing bitumen emulsion as per Technical Specification Clause 3004.3.3
2	Providing treatment to bleeding bituminous surface at scattered locations
3	Providing localized repair to rutted portion and edge breaking of bituminous surface
4	Providing treatment and repair to pot-holes and patch work
5	Providing and laying dense bituminous macadam using bitumen grade VG 40 complete as per Technical Specification Clause 507
6	Proving and laying bituminous concrete (asphaltic concrete)

	(a) Using bitumen (VG-40) as per IRC: SP: 53
7	Road Roughness survey
8	Turfing on embankment slopes and at all other Project Facilities
9	Providing repair to stone pitching/apron at scattered locations
10	Rain Cuts Maintenance: Restoration of rain cuts soil, moorum, gravel or a mixture of these
11	Providing and laying apron/ stone pitching on slopes of guide bunds/ road embankment / other location
12	Providing and laying stone aggregate filter material (150 mm compacted thickness) underneath pitching
13	Unlined drain
14	Filling in median island with approved materials with all leads and lifts complete as per TS Clause No. 407
15	Replacing damaged / broken railing with new pre-cast / cast-in-situ, concrete railing to match with existing design and pattern.
24	Carrying out repair to road signs including strengthening resetting or otherwise repairing signs and delineators
	a) Road sign board mounted on single post
	b) Road sign board mounted on double post
	c) Overhead/ Gantry Sign boards
	d) Delineator
25	Supplying and fixing at site retro-reflectorized type sign boards/signs
	90cm Equilateral triangle
	60cm circular
	90 cm circular
	90cm high octagon
	80cm x 60cm rectangle
	Chevron signs 60cm x 45cm
	Place identification signs (Fig 15.7 of IRC 67)
	Providing and fixing Object Markers
	Providing and fixing of retro-reflectorized Route Marker signs (size 450mm x 600mm)
26	**Hazard Marker Sign :**
	a) size 90 x 30 cm
	b) size 30cm triangular side cluster of red reflectors (screen printed)
27	Cats Eyes/Raised pavement marker (NMC Nails Less)
28	Painting two coats on old surface after minor repairs to give an even and smooth surface and printing letters and figures with synthetic enamel paint
	a) Hectometer stones
	b) Kilometer Stone
	c) 5 Kilometer stone
	d) Boundary stone
	e) Guard stone
29	Providing painting lettering and fixing of distance measurement stones including dismantling of old damaged/ broken ones, confirming to TS Clause 804
	a) Hectometer stones
	b) Kilometer Stone
	c) 5 Kilometer stone
	d) Boundary stone
	e) Guard stone
30	Providing and fixing road delineators conforming to TS Clause No. 805 as directed by the Engineer.
31	Repainting the kerb stones and separation barrier with first quality synthetic enamel paint of approved brand
32	Painting all types of pavement markings including lines, dashes, arrows etc. on roads as per relevant IRC/MOST standards after cleaning the surface complete in all respects as directed by the Engineer.

	a) Hot applied Thermoplastic compound
	(i) Lane / Centre Line / Edge Line
	(ii) Direction Arrows
	(iii) Diagonal Chevrons Markings
33	Supplying and laying cast-in-situ cement concrete kerb without channel section
	a) by Manual/machine including formwork
34	Major repair / replacement of metal beam crash barrier (W profile guard rails)
35	Providing and fixing chain link/ welded mesh fencing / square bars fencing
36	Dismantling the old damaged chain link/welded mesh / square bars fencing and replacing it with new chain link/ welded mesh/square bars fencing
37	Provision of rumble strips
38	Shoulder Maintenance:
39	synthetic enamel paint of approved brand on metal pedestrian guard rail
40	Dismantling of wearing course

B. Structures

1. Wearing coat comprising of 50 mm thick BC.
2. Cleaning and adding rubber sealant near expansion joints.
3. Modular Expansion joints.
4. Replacement of Damaged Concrete Railing all complete as per Technical specifications and as directed by the Engineer
5. Provision of an RCC crash barrier (0.35sqm cross sectional area) constructed with M-40 grade concrete including reinforcement
6. Cleaning of rocker & roller bearing using high pressure water jet, free from rust scales, re-setting & greasing the bearings using graphite grease including cost of materials, labour etc., complete.
7. POT PTF Bearings greasing and maintaining (sand plastering).
8. Elastomeric Bearings and maintaining.
9. Cutting of groove of 15 mm x 15 mm along crack and sealing the same with epoxy putty including cost of material, labour etc.
10. Carrying out 50 mm to 60 mm thick shortcreting using a mix proportion of 1:2:2 (cement: sand:6 mm down aggregate) added with Polypropylene fibers at a dosage rate of 125 gms/bag of cement including cost of labour, material, scaffolding, equipment etc. complete.
11. Repair of Floor Aprons, pitching and other protection works
12. Cleaning of Drainage Spouts
13. M-25 Concrete

7.3.3 Incident Management Cost

Incident Management & Safety items include the following:

- ✓ Regular patrolling & reaching accident/incident site,

- ✓ providing relief to injured persons including taking them to nearest hospital and attending to the safety requirements at the location (putting cones, safely guide & manage the traffic using signs, safety barricades, etc.),
- ✓ removal of accident /breakdown vehicles, removing of dead animals/birds lying on the highway and loading, unloading, transportation & disposal of surplus material left over by accidental vehicle or otherwise lying on road (on carriageway) and
- ✓ Encroachment prevention & removal with all lead & lifts complete with proper communication equipment,
- ✓ consumables, materials, suitable Towing vehicles, Ambulance, patrolling vehicles and manpower like drivers, helpers, para-medical staff, labour including deployment of crane and all works shall be done as per requirement and as directed by Client representative and as per Relevant Specifications as applicable.

7.4 OPERATIONS COSTS

Cost towards Operations include the following:

- Electricity Bill of lighting
- Toll Plaza Operation cost
- Operation and management costs of rest areas and lay byes
- SPV Costs
- Survey Costs
- Insurance
- IE Fee
- Administrative Cost

Table 38: 1st year O&M Cost

S. No.	Particulars	Amount in Cr (Including GST)
1	Tolling Operations	3.71
2	Incident Management	2.24
3	Routine Maintenance	4.87
4	Repairs	1.70
5	ATMS	-
6	Admin Expenses	4.49
7	Insurance	1.23
Total O&M Cost (FY 2024)		**18.25**
	For FY 2027, Additional cost towards special repairs is to be added	**4.29**
	TOTAL OPERATIONS COST (FY 2027)	**22.54**

All the Costs are in Rs. Crore inclusive of applicable GST, without escalation

7.5 PERIODIC MAINTENANCE COSTS

Cost towards major maintenance include following:

- ✓ Cost of Periodic maintenance of Pavement based on Finalized MM schedule
- ✓ Cost of Periodic Maintenance of Structures
- ✓ Cost of Periodic replacement of Toll Equipment's & Software

Table 39: Cost of Periodic maintenance

S. No	Year	Periodic Maintenance				
		Functional +Structural overlay MCW+ S/R	Major Maintenance of Rigid Pavement	R&R of **ATMS**	R&R of **TMS**	Structure specified repairs
-	2023					
1	2024		-			-
2	2025	-	-			-
3	2026		-			-
4	2027	0.14	2.09			-
5	2028		-			0.35
6	2029	-	-			-
7	2030	6.52	28.32			0.68
8	2031		-	-	1.27	-
9	2032	-	-			-
10	2033	0.14	2.09			0.56
11	2034		-			-
12	2035	-	-			-
13	2036	6.37	57.93			1.92
14	2037		-			-
15	2038	-	-	-	2.54	0.35
16	2039	2.34	2.09			-
17	2040		-			-
18	2041	-	-			-
19	2042	4.32	28.32			1.37
20	2043		-			0.56
21	2044	-	-			-
Total:		**19.83**	**120.82**	**0.00**	**3.81**	**5.79**
Major / Periodic Maintenance (For 20 years period)		**150.26**				

Note: All the Costs are in Rs. Crore inclusive of applicable GST, without escalation and rates are based on FY24.

7.6 TOTAL OPERATION & MAINTENANCE COSTS

Year on year operation cost is summation of following:

- ✓ Immediate Costs
- ✓ Routine Maintenance & Incident Management

- ✓ Periodic Maintenance
- ✓ Operations Cost

Following table presents the summary of Operations & Maintenance cost for the project

Table 40: Cost Abstract

Calendar Year	SUMMARY OF VARIOUS EXPENSES in Rs. Crs					
	Immediate Repair's Cost	Toll Operation expenses	Routine Maintenance Expenses	Periodic Maintenanace (Functional +Struc Overlay+ Toll collection system)	Total Cost (Rs. Cr.)	Additional Cost (For special repair) - Already included in routine maintenance expenses
2022-2023		-	-	-	-	
2023-2024	10.00	3.71	14.54	-	28.24	
2024-2025		3.71	14.54	-	18.25	
2025-2026		3.71	14.54	-	18.25	
2026-2027		3.71	18.83	2.23	24.77	4.29
2027-2028		3.71	14.54	0.35	18.60	
2028-2029		3.71	14.54	-	18.25	
2029-2030		3.71	14.54	35.52	53.76	
2030-2031		3.71	14.54	1.27	19.52	
2031-2032		3.71	14.54	-	18.25	
2032-2033		3.71	14.54	2.79	21.04	
2033-2034		3.71	14.54	-	18.25	
2034-2035		3.71	14.54	-	18.25	
2035-2036		3.71	14.54	66.22	84.47	
2036-2037		3.71	14.54	-	18.25	
2037-2038		3.71	14.54	2.89	21.14	
2038-2039		3.71	14.54	4.42	22.67	
2039-2040		3.71	14.54	-	18.25	
2040-2041		3.71	14.54	-	18.25	
2041-2042		3.71	14.54	34.01	52.26	
2042-2043		3.71	14.54	0.56	18.81	
2043-2044		0.93	7.00	-	7.92	
Total Cost:	***10.00***	***75.14***	***302.02***	***150.26***	**537.41**	

Note: All the Costs are in Rs. Crore inclusive of applicable GST, without escalation and rates are based on FY24.

7.7 CAPACITY AUGMENTATION

The project has not envisaged the capacity augmentation during the concession period.

8.1 DATA COLLECTION AND REVIEW TMS Works

- ✓ **Clause 10 of Schedule A –**

  Existing Odhaki Paipkhar toll plaza with 8 physical lanes at Km. 675.700 i.e. 10 toll lanes with 2 reversible lanes with Hybrid ETC system is under operation.

- ✓ **Clause 9.1 of Schedule B**

  (a) Existing Toll Plaza at **675+700** (Odhaki Paipkhar) is proposed to be retained. The existing Toll booths shall be retained and any modification if required shall be done as per NHAI / Policy Guidelines / Management of Plaza / 2021 Policy Circular No. 17.5.82 Dated 25th May 2021. Apart from this, Static Weigh Bridge along with one room, loading / unloading platform and storage facility for overloaded material for each direction of traffic are to be repaired, modified and maintained within the available ROW as per the specifications and standards given in IRC: SP:84-2019. Existing Toll Plaza Administration building shall be repaired/ rehabilitated as per the specifications and standards given in IRC: SP: 84-2019. Required numbers of parking bays are to be provided within the Toll Plaza premises in consultation with Independent Engineer. Toilet blocks and Water ATM (one in each direction) with adequate parking facility near Toll Plaza Area shall be provided as per the drawings and standards give in NHAI Circular dated 09-11-2017 (Ref. NHAI/GM(T)HO/Highway Nest (Mini)/2017/108290).

  (b) The Existing Toll Booths, Toll Plaza premises including all facilities, parking etc. shall be repaired, maintained and upgraded for smooth toll operation as per IRC SP: 84-2019.

  (c) The Concessionaire shall be responsible to ensure toll plaza assets, TMS, equipment's and systems shall conform to the latest available technology / MORTH Specification / IRC / MORTH and NHAI Circular/ Policy as applicable and NO COS shall be admissible on this account for future amendments / upgradation.

- ✓ **Schedule C states as below:**

  a. Engineering and safety improvements along the project highway shall conform to the IRC: SP: 84:2019, Manual of specifications & Standards for Four Laning of Highways through Public Private Partnership published by IRC.

  b. Clause 2 – Deviations from the manual - Section 10: Existing Toll Plaza office complex (under construction) is to be retained. Facilities as mentioned in Clause 10.12 are to be provided within the existing Toll Plaza office Complex.

  (d) IRC SP: 84:2019 clause 10.6.2 – Not less than 2 middle toll lanes shall be capable of being used as reversible lane to meet the demand of tidal flow.

- ✓ **Present major issues at site:**

  (e) As AVC performance is very poor, new AVC system is recommended.

  (f) Incident capture cameras not functioning.

  (g) 6 Nos. receipt printers are not working

  (h) Static weigh bridge – Capacity of installed weigh bridge is 100 MT as against 120 MT.

8.2 DATA COLLECTION AND REVIEW ATMS Works

- ✓ **Nil-**

  Pre-bid reply dtd 11.10.2023, annexure-2, S.No3: Installation, operation and maintenance of the ATMS shall be done by NHAI.

CHAPTER 9. CONCLUSIONS

- Project is a Four-Lane divided Carriageway have a combination of flexible and rigid pavements comprising of 69.185 Km length.
- The project corridor is constructed by Larsen & Toubro Limited and is under Defect Liability Period (DLP) up to 29th Oct 2023.
- Three Truck lay byes were observed in the Project Highway, the pavement condition of these lay byes is observed to be in fair condition.
- There are 2 Nos. of Bus Shelters &26 Nos of Bus Bays with shelters are observed along the project corridor. 4 Nos. of Bus Bays with shelters are having flexible pavement and remaining are provided with rigid pavement.
- The project corridor has the 16.680 Kms length of the service road in LHS and 13.260 kms length of service road in RHS having carriageway width of 7m with combination of Rigid and Flexible pavements.
- From Roughness Consideration, moving average method has been adopted considering 10m point interval roughness data. In order to maintain roughness within threshold limit (<2200mm/km), rectification suggested at identified locations accumulated to 18.8 lane-km length in LHS, 16.01 lane-km length in RHS.
- The Pavement Condition of the project appears to be fair in condition for most of the length. However, in rigid pavement longitudinal cracks, Ravelling, Transverse Cracks and longitudinal wide joints are observed at few locations. Overall, total pane replacement suggested for 124 Nos., partial 1m full depth repair for 2462 Nos.,staple and stich for 1036 Nos and raveling for 13258 sqm.
- From structural (FWD) consideration, the Project Road (Main Carriageway) requires voids filling underneath the pavement are identified as 18 points in LHS, 14 points in RHS and every point is considered for 150m length in lane width.
- As per Site 32 No Solar Blinkers are observed at median opening locations, in that 1 Nos was not working.
- Highway lighting observed entire project corridor for a length of Km 62.410. At few locations Lightings were missed.
- There are 8 Nos of High Mast Lights, 390 Nos of double arm lights, and 1021 Nos of Single arm lightings are observed along the Project Corridor.
- Median plantation is observed for a length of 3.465kms in the entire project corridor.
- 45 No. of Kilometre stones and 401 No. of Hectometre stones are missing and the same shall be replaced with new one. 2 No of Hectometre stones was not painted and same shall be rectified

- MCB's were observed for a length of 25.590 Kms and these are in fair condition. At few locations MCB were damaged for a length of 114m.
- Pedestrian Guard Railing were observed for a length of 12.585 Kms in the project corridor. At few locations PGR's were damaged for a length of 418m.
- There is one Toll plaza in the entire project namely Odhaki Paipkhar Toll plaza with 3+1 lanes at Km 675+700
- Median Kerb damages were observed for a length of 311m along the Project length.
- At some locations Service roads were not constructed for about overall length of 1.201km due to Land Acquisition issue.
- Pavement condition of the main carriageway is mostly good/fair but the pavement condition of service road is mostly fair but poor at some locations.
- Based on the Site Survey and Investigations, Immediate Repair Cost has been estimated by considering the present condition of all the elements of highway and structures.
- The Project Stretch having different types of super structure for various structures such as PSC Girders, RCC Girders, Steel girders, RCC Solid slab & RCC Box.
- As per site inventory it is understand from the structures, 2 No's of Flyovers are having PSC girder type super structure, 1 No of ROB is having RCC & Steel composite girder type super structure, 1 No of MJB is having RCC girder type super structure.
- The project stretch has 06 No's of MNBs, out of which 2 No's of MNBs having RCC Girder type super structure, 1 No of MNB having RCC Solid slab type super structure, 3 No's of MNBs having RCC box type super structure.
- Underpasses which are of 02 VUPs, 05 PUPs, and 06 LVUPs are having RCC Box type structures.
- Structures are having 41 No's of Strip Seal Expansion joints in the project stretch.
- In this project it is observed that Pot PTFE Bearings (52 No's) and Elastomeric bearings (182 No's) are provided for all girder type structures wherever required.
- Cleaning of expansion joints, drainage spouts need to be done regularly.
- Some structures are already repaired and it would be necessary to closely examine these structures for further distress during the maintenance period/Project duration, by way of close inspection and testing.
- All the structures appear to be in good condition. Few locations cracks have been noticed Soffit girders and deck slab & Side Face May require to undertake NDT to assess the actual structural condition.
- As Built Drawings not available for all major structures and culverts.
- All the Costs presented in this report are inclusive of applicable GST.

SAMARTH INFRAENGG Technocrats Pvt. Ltd

SIT/PJRP/2411610/11
12th February 2024

Chief Operating Officer
National Highways Infra Investment Managers Pvt. Ltd.
G-5&6, Sector 10, Dwarka,
New Delhi – 110075

Sub: Submission of Supplementary Report for Final Reports for RKJL-Package-I

Ref: Our letter reference SIT/PJRP/223607/067 dated 03.06.2023

K/A Mr. Shubhra Bhattacharya

In continuation to above reference, we are pleased to submit hereby the "Supplementary Report for Final Reports" in hard/soft copies for the following asset.

- ✓ Tolling, Operation, Maintenance & Transfer of Rewa to Katni (Km 656+000 to Km 725+125 of NH-30 (old NH 7) in the State of Madhya Pradesh (MP)- RKJL-Package I

Thanking you and assuring you best services all the time.

Yours Sincerely,
SAMARTH Infraengg Technocrats Pvt. Ltd.

D V Sridhar Murthy
Managing Director

Encl.: "Supplementary Report for Final Reports" for the above project in hard/soft copy.

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SUPPLEMENTARY REPORT FOR FINAL REPORT

1.1 INTRODUCTION

The Final Report was submitted on 1st Day of November 2023. Subsequent to this submission, the Operation Cost has been revised in due consultation with the Competent Authority. The following changes were made.

1. Operation Costs particularly Toll Operation Cost has been revised for Year FY 2027, FY 2028 and FY 2029 considering the reduction in Manpower. The same Operation Cost pertaining to FY2029 has been considered for rest of the Concession Period.
2. Abstract Cost has been updated in line with the above changes made in Operation Cost.
3. The updated Table-38 (O&M Cost) and Table-40 (Cost Abstract) have been presented below.
4. The Cost numbers presented in the following table supersedes cost numbers presented in the respective tables of the earlier submitted report

1.2 OPERATIONS COSTS

Table 38: O&M Cost

S.No	Particulars	FY-25	FY-26	FY-27	FY-28	FY-29
A1.1	**Tolling Operations**	3.711	3.711	3.168	3.168	2.880
A1.2	**Incident Management**	2.245	2.245	2.245	2.245	2.245
A2.1	**Routine Maintenance**	4.871	4.871	4.871	4.871	4.871
A2.2	**Repairs**	1.703	1.703	1.703	1.703	1.703
A2.3	**ATMS**	0.000	0.000	0.000	0.000	0.000
B	**Admin Expenses**	4.778	4.778	4.778	4.778	4.778
		17.307	17.307	16.765	16.765	16.477
	For FY 2027, Additional cost towards special repairs.	-	-	4.29	-	-
	Total Operation Cost	**17.307**	**17.307**	**21.056**	**16.765**	**16.477**

Note: All the amounts are in Rs. Cr and is inclusive of GST, without escalation

1.3 TOTAL COSTS

Year on year operation cost is summation of following:

- ✓ Immediate Costs
- ✓ Routine Maintenance & Incident Management
- ✓ Periodic Maintenance
- ✓ Operations Cost

Following table presents the Cost Abstract for the project

Table 40: Cost Abstract

Project Years	Calendar Year	SUMMARY OF VARIOUS EXPENSES in Rs. Crs					Remarks
		Immediate Repair's Cost	Toll Collection Expenses and Patrolling expenses	Routine Maintenance Expenses	Periodic Maintenance (Functional +Struc Overlay+ Toll collection system)	Total Cost (Rs. Cr.)	
1	2023-2024	10.00	3.71	13.60	-	27.30	
2	2024-2025		3.71	13.60	-	17.31	
3	2025-2026		3.71	13.60	-	17.31	
4	2026-2027		3.17	17.89	2.23	23.28	4.29 cr. Special repair cost added in RM
5	2027-2028		3.17	13.60	0.35	17.11	
6	2028-2029		2.88	13.60	-	16.48	
7	2029-2030		2.88	13.60	35.52	51.99	
8	2030-2031		2.88	13.60	1.27	17.75	
9	2031-2032		2.88	13.60	-	16.48	
10	2032-2033		2.88	13.60	2.79	19.27	
11	2033-2034		2.88	13.60	-	16.48	
12	2034-2035		2.88	13.60	-	16.48	
13	2035-2036		2.88	13.60	66.22	82.70	
14	2036-2037		2.88	13.60	-	16.48	
15	2037-2038		2.88	13.60	2.89	19.37	
16	2038-2039		2.88	13.60	4.42	20.90	
17	2039-2040		2.88	13.60	-	16.48	
18	2040-2041		2.88	13.60	-	16.48	
19	2041-2042		2.88	13.60	34.01	50.49	
20	2042-2043		2.88	13.60	0.56	17.04	
21	2043-2044		0.72	6.06	-	6.77	
	Total Cost:	***10.00***	***61.38***	***282.28***	***150.26***	**503.92**	

Note: All the Costs are in Crores, inclusive of GST, without escalation considering FY 2024 price

National Highways Infra Projects Private Limited

FINAL REPORT

Tolling, Operation, Maintenance & Transfer of Rewa – Katni – Jabalpur including Katni Bypass, Km 725+185 to Km 813+257 of NH-30 (old NH 7) in the State of Madhya Pradesh (MP) Package-2

SAMARTH INFRAENGG Technocrats Private Limited

NOVEMBER 2023

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LIST OF ABBREVIATIONS AND SYMBOLS

AADT	-Average Annual Daily Traffic
AE	-Authority Engineer
AMC	-Annual Maintenance Contract
ATMS	-Advanced Traffic Management System
BC	-Bituminous Concrete
BOQ	-Bill of Quantities
BOT	-Build, Operate & Transfer
CA	-Concession Agreement
CBR	-California Bearing Ratio
CCB	-Concrete Crash Barrier
CCR	-Cement Concrete Railing
COD	-Commercial Operation Date
COS	-Change of scope
CPI	-Consumer Price Index
CUP	-Cattle Underpass
CVC	-Classified Volume Count
CVPD	-Commercial Vehicles per Day
DBM	-Dense Bituminous Concrete
DPR	-Detailed Project Report
ECB	-Emergency Call Box
EPC	-Engineering, Procurement and Construction
ESI	- Employees' State Insurance
FDD	-Filed Dry Density
FOB	-Foot Over Bridge
FRL	-Finished Road Level
FSI	-Free Swell Index
FWD	-Falling Weight Deflectometer
FY	-Financial Year
GOI	- Government of India
GR	-Growth Rates
GS	-Grade Separated
GSB	-Granular Sub Base
GST	-Goods and Services Tax
HCPT	-Half cell Potential Test
HPC	-Hume Pipe Culvert
HR	- Human Resources
HTMS	-Highway Traffic Management Systems

IE	-Independent Engineer
IRC	- Indian Roads Congress
IRC SP	- Indian Roads Congress Special Publications
IRI	-International Roughness Index
Km	-kilometer
LHS	-Left Hand Side
LL	-Liquid Limit
LS	-Lumpsum
m	-Meter
MBIU	-Mobile Bridge Inspection Unit
MCB	-Metal Beam Crash Barrier
MCS	-Micro Surfacing
MCW	-Main Carriageway
MDD	-Maximum Dry Density
MHR	-Metallic Hand Rail
MJB	-Major Bridge
mm	-Millimeter
MM	-Major Maintenance
MNB	-Minor Bridge
MoRTH	- Ministry of Road Transport & Highways
Mpa	-Mega Pascal
MR	-Resilient Modulus
MSA	-Million Standard Axle
NDT	-Non-Destructive Testing
NHAI	- National Highways Authority of India
NSV	-Network survey Vehicle
O&M	- Operation and Maintenance
OL	-Overlay
PF	-Provident Fund
PGR	-Pedestrian Guard Rail
PI	-Plasticity Index
PL	-Plastic Limit
PM	-Periodic Maintenance
PUP	-Pedestrian Under pass
R&R	-Repair and Rehabilitation
RCC	-Reinforced Cement Concrete
RE Wall	-Reinforced Earth Wall
RHS	-Right Hand Side
RHT	-Rebound Hammer Test
RM	-Routine Maintenance

ROB	-Road Over Bridge
RPO	-Route Patrol Officer
RUB	-Road Under Bridge
SDBC	-Semi-Dense Bituminous Concrete
SPV	-Special Purpose Vehicle
SR	-Service Road
SWB	-Static Weigh Bridge
TCS	-Typical cross Section
TDRT	-Transient Dynamic Response test
TMS	-Toll Management System
UI	-Unevenness Index
UPVT	-Ultra Pulse Velocity test
VDF	-Vehicle Damage Factor
VG	-Viscosity Grade
VUP	-Vehicular Underpass
WBM	-Water Bound Macadam
WMM	-Wet Mix Macadam
WPI	-Wholesale Price Index

CHAPTER 1. INTRODUCTION

1.1 INTRODUCTION

National Highways Authority of India ("NHAI"/ "Authority") is an autonomous body of the Government of India ("GoI") under the Ministry of Road Transport and Highways ("MoRTH") and was constituted on June 15, 1989 by an Act of Parliament titled - The National Highways Authority of India Act, 1988 ("NHAI Act"). NHAI was operationalized in February 1995 with the appointment of full time Chairman and other Members. The functioning of NHAI is governed by NHAI Act and rules, and regulations framed thereunder.

NHAI has set up an Infrastructure Investment Trust Namely National Highways Infra Trust ("InvIT") and is acting as its Sponsor to the said InvIT.

National Highways Infra Investment Managers Private Limited ("NHIIMPL") has been appointed as the Investment Manager to the InvIT

National Highways Infra Projects Private Limited ("NHIPPL"), a wholly owned subsidiary of InvIT is planning to enter into concession agreements with NHAI for "Tolling, Operation, Maintenance & Transfer of Rewa – Katni – Jabalpur Pkg 2 including Katni Bypass, Km 725+185 to Km 813+257 of NH-30 (old NH 7) in the State of Madhya Pradesh (MP).

National Highways Infra Projects Private Limited ("NHIPPL") has engaged M/s SAMARTH INFRAENGG Technocrats Pvt Ltd as their Technical Consultants for undertaking technical due diligence study for the said project to estimate initial improvement cost (EPC) including immediate requirements for repair & rehabilitation of various elements and make an assessment of Operation & Maintenance costs for entire concession period.

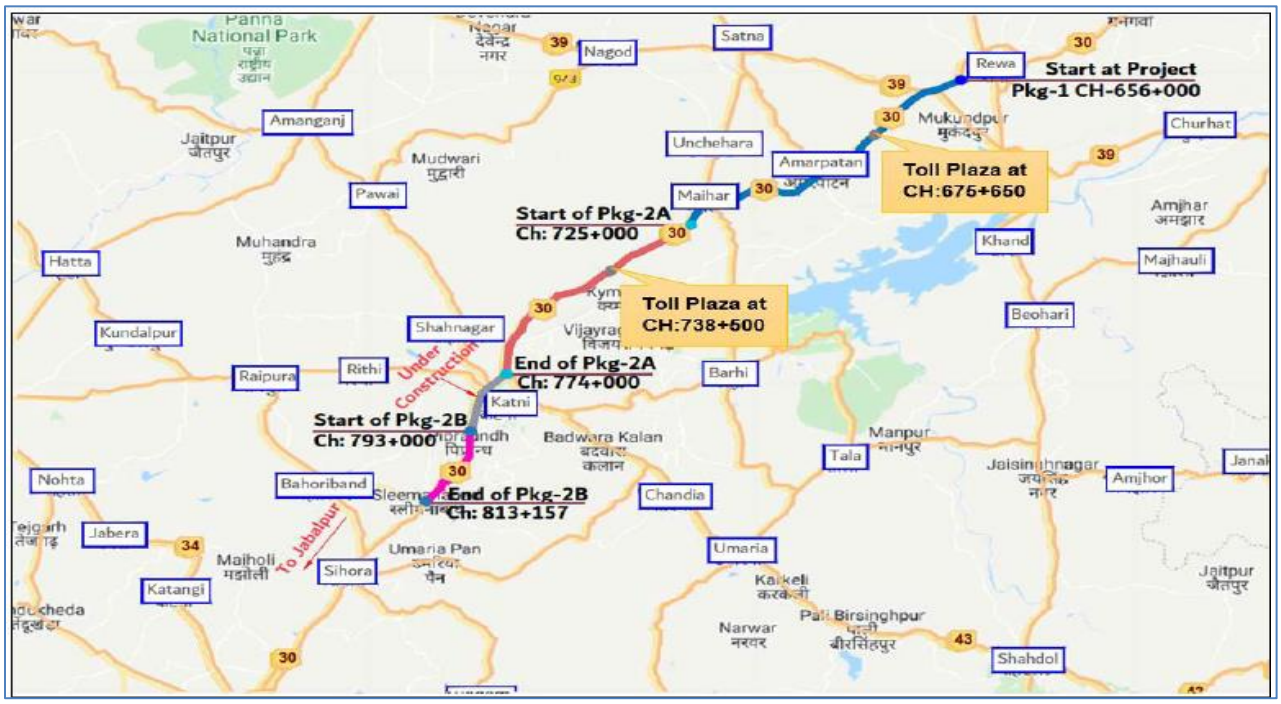
1.2 PROJECT AT A GLANCE

Project Corridor is a four-lane divided highway and is part of new NH-30 (old NH-7), which starts at Km 725+185, and ends at Km 813+257. The total length of the project Highway is 88.072 Km.

The project road is under Operation and Maintenance except Package 3 Km 774+068 to Km 793+065 is under-construction. Presently toll is being collected at Km 739+000 (Kherwasani). The section of project road Package 2A and 2B has been executed under EPC mode and currently under DLP.

NH-30 starts at the junction of NH-9 at Sitarganj and ends at the junction of NH-65 at Ibrahimpatnam, Vijayawada. The highway passes through the states Uttarakhand, Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Telangana and Andhra Pradesh in India.

The Highway connects several cities and town such as Sitarganj, Pilibhit, Bareilly, Tilhar, Shahjahanpur, Sitapur, Lucknow, Raebareli, Allahabad, Rewa, Jabalpur, Mandla, Raipur, Dhamtari, Charama, Kanker, Kondagaon, Jagdalpur, Sukma, Konta, Nellipaka, Bhadrachalam, Paloncha, Kothagudem, Tiruvuru, Ibrahimpatnam and Vijayawada. The total length of this highway is 1,984 km.



Map Showing the Project Corridor

The existing and design chainages of the project corridor is presented as below.

Table 1: Project Corridor Chainage System

Pkg. No.	Existing Km		Name of Contractor	Defect Liability Period
	From	To		
2A	725+185	774.068	Larsen & Toubro Limited	19 Aug 2023
	774+068	793.065	M/s Shreeji Infrastructure India Pvt Ltd JV with M.s PEL Projects & Infrastructure Pvt. Ltd	Construction is scheduled to be completed by May 2023 & DLP Shall be 5 years from completion of work.
	Katni Bypass(under Construction)			
2B	793+065	813+257	Larsen & Toubro Limited	19 Aug 2023

Photograph showing the start and end point of the project road are presented below.

A view of the Start Point of Project Road at km 725.185	**A view of the End Point of Project Road at km 813.257**

1.3 OBJECTIVE AND SCOPE OF SERVICES

The main objective of the study is to review the current status of project corridor including details pertaining to its construction and maintenance and to provide requisite technical information for processing the acquisition of said project by client. Objective of the study can be broadly defined with following tasks:

- Study CA requirements for construction/maintenance requirements
- Undertake Detailed Reconnaissance to appreciate the project corridor characteristics
- Collection of relevant records and documents and review of same
- Undertake Engineering Studies to Establish:
    - Present Condition of Existing Road Assets
    - Quality of Executed Works/Quantity of Reutilization
    - Requirement of Immediate improvement costs as per Sch B (1st Year Capex)
    - Major Maintenance Strategies Over Concession Period
    - Routine Maintenance & Operations Requirements Over Concession Period
    - Prepare BOQ
    - Prepare Rate Analysis and finalize unit rates
    - EPC and O&M Cost

End Result is the finalization of:

- Initial improvement Works
- Major Maintenance Schedules/Cost
- Routine Maintenance Cost
- Operations Cost

The elaborate scope of services as defined in the “terms of reference” for consultants is as below:

i) Detailed reconnaissance.

ii) Video graphic survey of the entire Project corridor.

iii) Carrying out inventory and condition surveys for Project Road.

iv) Carrying out Inventory and detailed condition surveys for bridges & cross drainage structures (along with Photographs thereof) including recommendation for either strengthening/rehabilitation or reconstruction.

v) 24 hrs. Axle load survey along with axle load spectrum analysis for rigid pavement of the project corridor at two locations, wherever applicable (7-day traffic count to be provided by client)

vi) Test pits required @ every 10 km interval along the Project corridor.

vii) Carrying out necessary laboratory tests to determine the CBR value of the subgrade materials to be obtained from potential borrow pits and the quality of the aggregates from potential quarries for the pavement layers, concrete etc. The existing ground which will support the embankment and pavement must be tested for its adequacy, particularly in silty or clayey water-logged areas.

viii) Carrying out deflection test by Falling Weight Deflect meter (FWD) for existing pavement as per relevant IRC code at the rate of 5 points in km in each direction making it 10 points for both directions in the damaged stretches as well as fair stretches.

ix) Availability of construction materials as per required specification to be confirmed. Detailed Logistic plan showing the locations of the potential Borrow pits, Quarries, etc.

x) Report on existing condition of Toll Plazas and its associated facilities and proposal for their improvement.

xi) Preparation of Maintenance (Routine, Periodic and Major) costs to be incurred over the period of the concession keeping in mind the requirements of the draft Concession Agreement like adequate resources, maintenance of Cranes, Ambulance, etc.,

xii) Independently develop a bottom-up forecast of Operating expenses for each project, with detailed break-up of each type of operating expense, along with underlying assumptions

1.4 DATA COLLECTION AND REVIEW

The following data has been reviewed to understand the project characteristics

- ✓ Review of Concession Agreement & Schedules,
- ✓ Review of Detailed Project Report prepared by NHAI
- ✓ Review of As-built drawings, Plan and profiles, Structural drawings & Detailed Project Reports and Designs where available
- ✓ Review of O&M costs as presented in DPR reports
- ✓ Review of MPR provided by NHAI
- ✓ Review of Latest NSV and FWD data provided by PIU, NHAI

1.5 PAVEMENT DESIGN REVIEW

As per Schedule-B

Flexible Pavement shall be provided for minimum design traffic of 115 MSA or 20 years design traffic whichever is maximum for main carriageway. Whereas, service road shall be designed for 10MSA and 30MSA.

Considering CTSB, Consultants have suggested as an option the following thicknesses has been arrived as follows.

CBR: 8%				
S No	**Layers**	**10 MSA**	**30 MSA**	**115 MSA**
1	**BC in mm**	40	40	**40**
2	**DBM in mm**	-	50	**110**
3	**WMM in mm**	150	150	**150**
4	**CTSB in mm**	200	200	**200**
	Total in mm	**390**	**440**	**500**

However, as TCS cross section drawings are showing conventional layers so an attempt has been made with design of conventional layers thicknesses as below.

S No	**Layers**	**Conventional - Option**			
		CBR-10%			
		10 MSA	**30 MSA**	**60 MSA**	**110 / 115 MSA**
		Va-4.5 & Vb-10.5	**Va-3.5 & Vb-10.6**	**Va-3.2 & Vb-10.6**	**Va-3.2 & Vb-10.6**
1	BC in mm	30	40	40	50
2	DBM in mm	50	95	115	130
3	WMM in mm	250	250	250	250
4	GSB in mm	200	200	200	200
	Total in mm	**530**	**585**	**605**	**630**

DPR has suggested the following conventional thicknesses has been arrived as follows

S No	**Layers**	**10 MSA**	**30 MSA**	**115 MSA**
1	**BC in mm**	**30**	40	50
2	**DBM in mm**	**50**	85	95
3	**WMM in mm**	**250**	250	150
4	**GSB in mm**	**200**	200	
5	**CTSB in mm**			200
	Total in mm	**530**	**575**	**495**

CHAPTER 2. SURVEYS AND INVESTIGATIONS

2.1 INTRODUCTION

The main objective of undertaking Surveys and Investigations is to appreciate the existing engineering features along the project corridor and to understand the present condition of the various elements of the project road and to prepare required inputs for various rehabilitation and maintenance strategies.

Following Survey and Investigations have been undertaken as a part of study with an objective to understand the present condition of the road and there by access the quality of construction and as well to prepare requisite rehabilitation/corrective designs where necessary.

- Road Inventory Surveys
- Pavement Condition using NSV
- FWD Surveys
- Roughness Surveys using NSV
- Pavement Composition surveys (Test Pits)
- Subgrade Investigations & Laboratory testing
- Material Investigations
- Core Cutting Investigation
- Axle Load Survey
- Structure Inventory and Condition Surveys

2.2 ROAD INVENTORY

The project corridor is a Four-lane divided carriageway having consisting of both Flexible and Rigid pavement, with 7.5m wide carriageway including shyness, flanked by 1.5m paved shoulder plus 1.0 m to 1.5 m earthen shoulder on either side of the median expect at structure approach locations. Flexible pavement is applicable to Katni bypass for a length 19km, which is under construction and the rest of the project is of rigid pavement. Majority of the project road is provided with depressed median of 10.8m width. Whereas Kati bypass is provided with raised median of 5m width.

Description	LHS (km)	RHS (km)
	Before Improvement Works	
Rigid Pavement	66.395	65.945
Flexible Pavement	21.677	22.127
	After Improvement Works	
Rigid Pavement	65.005	64.575
Flexible Pavement	23.067	23.497
Project Length	88.072	88.072

From the above table, flexible pavement length includes Katni bypass of 18.997 km, from Km 774.068 to Km793.065. The remaining length is the distress rectified portions at scattered locations with flexible overlay at structure approaches.

The project corridor generally runs in plain terrain. The land use along the project road is mostly Agricultural. It passes through urban settlements like, Lohee, Ghunwara, Kherwasaani, Amdara, Rohaniya Khurd & Paalaa, Praayganj, Jhulekhi, Tikarwara, Kailwara Kala, Paduwaa & Piproudha, Lakhaapateri, Tewari, Slimanabaad.

In general, road embankments are in the range of 0.5m-2.5m height. Embankments higher than 2.5m are observed mainly in the approaches of CD structures and Underpass locations.

Typical View of Project Road is shown below:

A view of the Project Road at km 725.185

A view of the Project Road at km 729.300

A view of the Project Road at km 735.100

A view of the Project Road at km 772.200

A view of the Project Road at km 729.300

A view of the Project Road at km 777.300

The Project Road has 13 Nos. of major junctions and 49 Nos. of minor junctions. Photographs showing the Major Junctions and minor junctions are presented below:

Major Junction at km 751.730 LHS

Major Junction at km 755.210 RHS

Minor Junction at km 725.175 RHS

Minor Junction at km 754.200 LHS

Minor Junction at km 768.320 LHS

Minor Junction at km 808.510 RHS

There are 18 Nos. of High mast located at major Junctions and Toll Plaza locations. Highway lighting is observed in a length of 25.590 Kms at urban/ built-up locations. Few photos showing High masts & lighting are presented below:

A view of High Mast Lighting at km 741.000 Median

A view of Single Arm lighting at km 760.100 RHS SR

A view of Double Arm lighting at km 750.150 Median

A view of Major Junction at km 761.650 RHS

All together about 31 Nos. of Bus-bays with Bus-shelters and 1 No. of Bus-bay without Bus-shelter is observed along the project road. Few photos taken at the Bus Bays and Bus Shelters are presented below:

Bus Bay with Shelter at km 732.060-LHS

Bus Bay with Shelter at km 744.640 -RHS

The Project Road has 4 Nos. of Truck laybyes in two locations on both-sides. These truck laybyes have been provided with Rigid and paver blocks and the condition appears to be fair. Toilet blocks was provided and also fair in condition. Separator is provided between main carriageway and Truck lay bye portion. Lighting in the form of single arm poles have been provided on the shoulder side of the truck laybye. On each side, 11 nos. of 1-arm lights are observed and almost all are found to be in good condition.

Few photos depicting the truck lay bye portion are presented below:

A view Truck Lay Bye at Km 771.700-LHS

A view Rest area near Truck Lay Bye at Km 771.700-RHS

The Project Road has 1 No. of Toll Plaza near Kherwasani village, at Km 739+000. Entire length of the Toll Plaza is constructed with rigid pavement and pavement condition appears to be fair. It has 3+1 lanes on each side. In the median portion of Toll Plaza, double-arm lighting has been provided in addition to 4 Nos. of High mast lighting.

A view of the Existing Toll Plaza near km 739+000 (Kherwasani Toll plaza)

A view of the Toll plaza (3+1 Lanes)

A view of the Admin Building at Toll plaza

A view of the Toll Collection Booth near Toll plaza

A view of the Static Weight Bridge at Toll plaza

Service road/slip roads of carriageway width of 7.0 m have been observed for a length of 25.8 km along the Project Corridor. In which, 18.771km length is flexible and 7.029km length is of rigid pavement. Photos depicting the service road pavement surface type, Condition and the other associated features like drain. Few photos taken at service/slip road locations are presented below:

Slip road at km 729.050 LHS

Slip road at km 740.150 RHS

Slip road at km 760.120 RHS

Slip road at km 767.100 RHS

The collected Road Inventory Data is presented in Appendix 1 of this Report

2.3 PAVEMENT CONDITION SURVEYS

In the entire stretch, the surface of the pavement condition is fair to poor. The surface distresses like Raveling, Cracking, and panel repair works were observed along the project corridor on both sides. The collected Pavement Condition Data is presented in Appendix 2 of this Report.

The photographs showing the pavement condition of the Project Road is presented below.

Longitudinal Crack @ 729.500 RHS

Multiple Cracks @ Km 802.600 RHS

Longitudinal Crack @ Km 796.700 RHS

Multiple Cracks @ Km 732.900 LHS

Raveling @ Km 768.500 RHS

Panel Replacement @ Km 764.400 RHS

Epoxy Sealing @ 730.450 RHS	Raveling @ Km 811.100 LHS	Fair Condition @ km 768.500 RHS
Longitudinal Crack @ Km 727+100 LHS	Wide crack Sealing @ km 752.650 RHS	Longitudinal Crack @ Km 800.400 RHS

- **Standards and Specifications of IRC:82-2015 (for Flexible Pavement)**

  The Pavement condition survey may be undertaken by the visual assessment of the surface by identifying the type, location and magnitude of the distress and the rating of the Pavement may be assignment as per the criteria given in Table 5.1 of IRC: 82-2015 as below:

Defects (type)	**Ranges of Distress**		
Cracking (%)	>10	5 to 10	<5
Ravelling (%)	>10	1 to 10	<1
Potholes (%)	>1	0.1 to 1	<0.1
Shoving (%)	>1	0.1 to 1	<0.1
Patching (%)	>10	1 to 10	<1
Settlement and Depression (%)	>5	1 to 5	<1
Rut depth (mm) using 3m straight edge	>10	5 to 10	<5
Rating	1	1.1 - 2	2.1 - 3
Condition	**Poor**	**Fair**	**Good**

For the calculation of the Weighted Rating Value of each individual parameter, the following fixed weightages have been assigned.

S.No.	Parameter	Weightage (Fixed) (Multiplier Factor)
1	Cracking	1.00
2	Raveling	0.75
3	Potholes	0.50
4	Shoving	1.00
5	Patching	0.75
6	Settlement	0.75
7	Rut depth	1.00

The Final Rating Value is calculated by taking the average of the Weighted Rating Values of all parameters viz: cracking, raveling, potholes, shoving, patching, settlement and rut depth.

It may be noted the acceptable/desirable level of service mentioned under IRC 82-2015 indicates at condition rating in terms of 1-3, <=1 being the poor and >2.1-3 being the good condition.

- **Standards and Specifications of IRC: SP: 83-2018 (for Rigid Pavement)**

  Pavement Condition Survey with various distresses like (cracking pop outs, raveling, settled panels damaged panels etc.) are identified. For identified distresses, based on the Severity and Extent of distress, suggested following various treatments as per IRC SP 83-2018 guidelines

Treatment Proposed	Distress Identified	Severity criteria
Panel Replacement	Multiple cracks (>30)	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Alligator Cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Transverse Cracks	5 .>6mm wide
	Longitudinal Crack	5. >12mm wide
Partial Panel Replacement	Multiple cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Alligator Cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Transverse Cracks	4. 3mm-6mm wide
	Longitudinal Crack	4. 6mm-12mm wide
Stitching and stapling	Multiple cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Alligator Cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Transverse Cracks	3. 0.5mm-3 mm wide
	Longitudinal Crack	2. 0.5mm-3mm wide
		3. 3mm-6mm wide

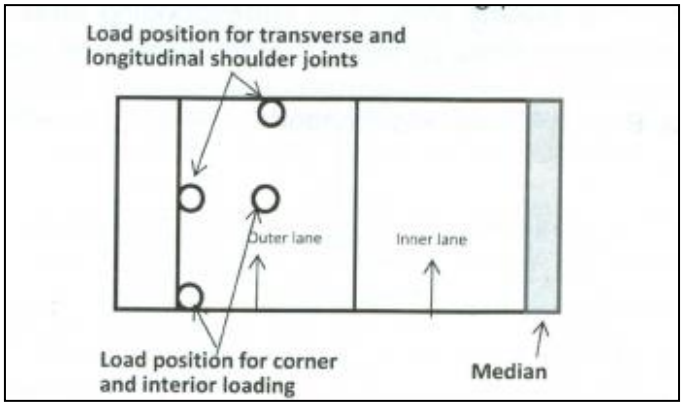
2.4 FALLING WEIGHT DEFLECTOMETER (FWD) SURVEYS

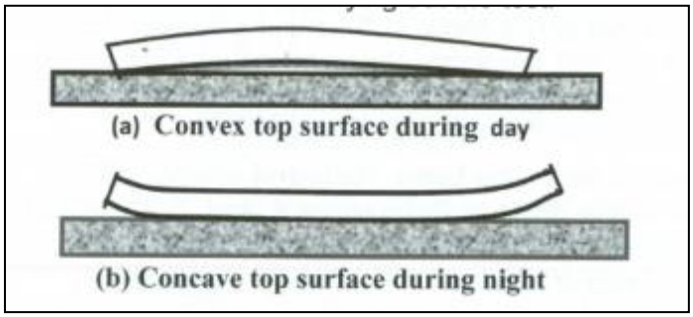
2.4.1. Pavement Evaluation Using FWD - Rigid Pavement

Structural condition of in-service rigid pavement can be evaluated using Falling Weight Deflectometer as per IRC:117-2014 guidelines. FWD surveys are done at interior of panel to determine the Strength of Concrete and Subgrade Support and to Detect voids for loss of support FWD has been done in Wheel path.

For Evaluation of Modulus of Subgrade reaction and Strength of Concrete i.e., "Interior" loading case is done when temp gradient is zero or Negative (Top Surface is Cooler than Bottom), i.e., in the Early Morning or night time has been done.

Corner loading has no indirect measure from the test, FWD test to be done when pavement is not in curled position and Deflections measured along wheel paths to get void locations. Load position for various cases has been presented below:





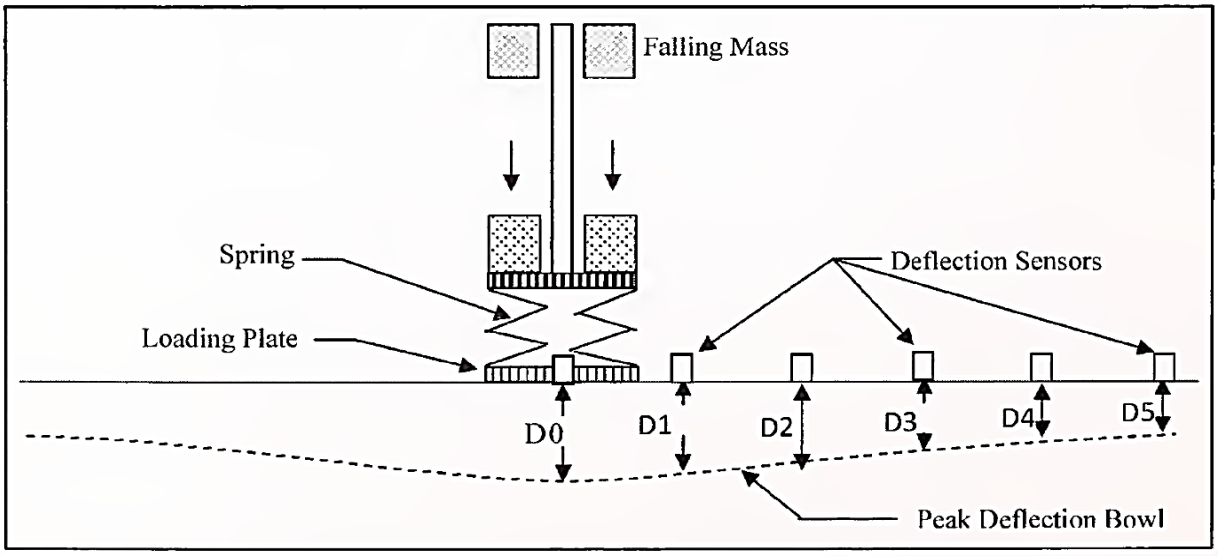
Among equipment available for structural evaluation of pavements, the Falling Weight Deflectometer (FWD) is extensively used world-wide because it simulates, to a large extent, the actual loading conditions of the pavement. When a moving wheel load passes over the pavement it produces load pulses. Normal stresses (vertical as well as horizontal) at a location in the pavement will increase in magnitude from zero to a peak value as the moving wheel load approaches the location. The time taken for the stress pulse to vary from zero to peak value is termed as 'rise time of the pulse'. As the wheel moves away from the location, magnitude of stress reduces from peak value to zero. The time period during which the magnitude of stress pulse varies from 'zero-to-peak-to-zero' is the pulse

duration. Peak load and the corresponding pavement responses are of interest for pavement evaluation.

Working Principle of Falling Weight Deflectometer:

Falling Weight Deflectometer (FWD) is an impulse-loading device in which a transient load is applied to the pavement and the deflected shape of the pavement surface is measured. The working principle of a typical FWD is illustrated in Fig below. D0, D1, etc., are surface deflections measured at different radial distances. Impulse load is applied by means of a falling mass, which is allowed to drop vertically on a system of springs placed over a circular loading plate. The deflected shape of the pavement surface is measured using displacement sensors which are placed at different radial distances starting with the center of the load plate.

A mass of weights is dropped from a pre-determined height onto a series of springs / buffers placed on top of a loading plate. The corresponding peak load and peak vertical surface deflections at different radial locations are measured and recorded.



Basically, the FWD generates a transient, of different magnitudes of impulse load by selection of a suitable mass and an appropriate height of fall. Under the application of the impulse load, the pavement deflects. Velocity transducers are placed on the pavement surface at different radial locations to measure surface deflections. Geophones or seismometers are used as displacement transducers. Load and deflection data are acquired with the help of a data acquisition system.

FWD includes a circular loading plate of 300 to 450mm diameter, in the present survey 300mm diameter load plate is used. A falling mass in the range of 50 to 350 kg is dropped from a height of fall in the range of 100 to 600mm to produce load pulses of desired peak load and duration. The target peak load in the range of 40KN to 60KN or Higher may be applied on Concrete Pavement to get a reasonable deflection of the order of 0.15 mm since pavements of major highways in India consisting of 150mm DLC and 300mm PQC are very stiff and a higher load may be required to get a deflection of about

0.15mm. In the present case target peak load as high as 150 KN is also used to get a reasonable deflection on concrete pavement.

In present study, Falling Weight Deflectometer (FWD) Test system has been used to generate the requisite NDT load-deflection data which was analyzed and is presented in this report. Surface deflections were measured at the center of the 300mm diameter loading plate and at the radial distances shown in the below table:

Sl. No	Geophone Ref No	Radial distance measured from center of load plate (mm)
1	D0	0
2	D1	300
3	D2	600
4	D3	900

Methodology adopted for carrying the survey:

1. The FWD Surveys are carried out as per IRC:117-2014
2. The project road has two longitudinal joint one at center and other paved shoulder. Panel size is nearly 4.5x3.5m
3. Interior points at a distance of 2.25m from edge (1.5m paved shoulder+0.75m for wheel path). These points will also act as under wheel path for detection of voids. Testing was done at two interior points in a km at 200 and 600. Three points @ 0, 400 and 800 in inner lane to know strength/subgrade support. (These have been taken at night)

The collected FWD Data and Analysis is presented in **Appendix 3** of this Report.

2.4.2. Falling Weight Deflectometer Survey (Flexible Pavement)

In order to evaluate the structural strength of the existing pavement, Falling Weight Deflectometer (FWD) survey has been carried out along the project road as per IRC:117-2014 guidelines. The collected FWD Data and Analysis is presented in **Appendix 3** of this Report.

Few photos taken during the progress of FWD Surveys are presented below:

FWD Machine

Deflection Measurement in progress

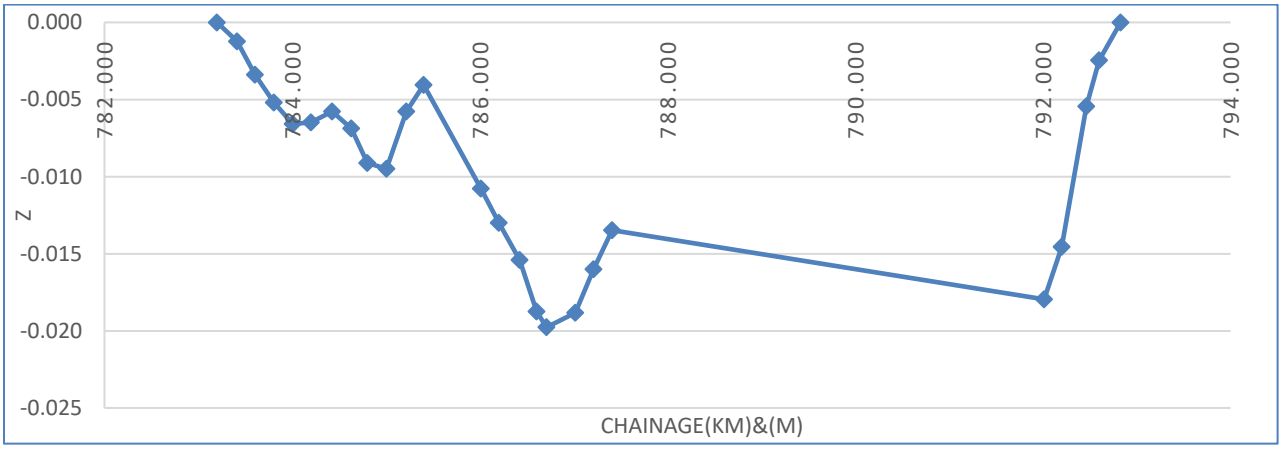
FWD tests are performed in Katni bypass in completed stretch of 9km out of 19km, and balance length is under construction. The homogenous sections in each direction of traffic (i.e., LHS & RHS) for the project stretch have been identified and are given in the below table followed by graphical representation of the same.

Table 2: FWD Data -Homogenous Sections as per FWD for Katni bypass – LHS

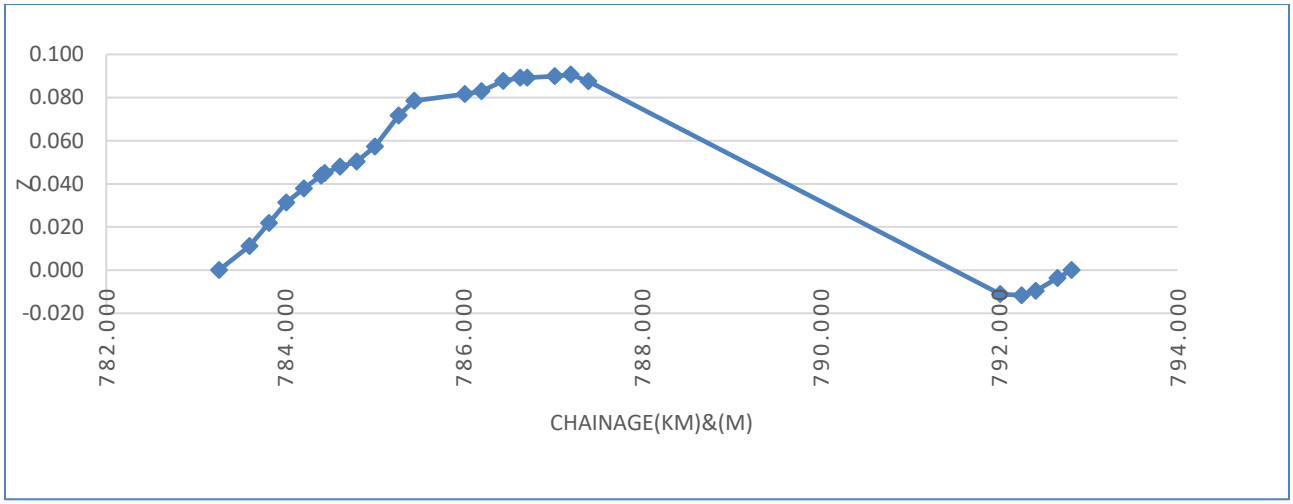
S. No	Chainage (Km)		Length (Km)
	From	To	
1	783.20	785.40	2.2
2	785.40	792.83	7.4

Table 3: FWD Data -Homogenous Sections as per FWD for Katni bypass – RHS

S. No	Chainage (Km)		Length (Km)
	From	To	
1	783.26	785.45	2.2
2	785.45	792.81	7.4



Delineation of Homogeneous Section – LHS



Delineation of Homogeneous Section - RHS

2.5 ROUGHNESS SURVEYS

The Roughness data has been collected using **Network Survey Vehicle** and analyzed in terms of International Roughness Index (IRI), separately for each lane, for both direction of travel. Pavement Roughness report covering the data collection and methodology, computation of IRI for each km length in each direction is presented in **Appendix 4** of this Report.

As per Schedule-F of TOT, the desirable level of service for Roughness values for bituminous pavement surface is considered to less than 2000 mm/Km and the acceptable limits are less than 2400mm/Km.

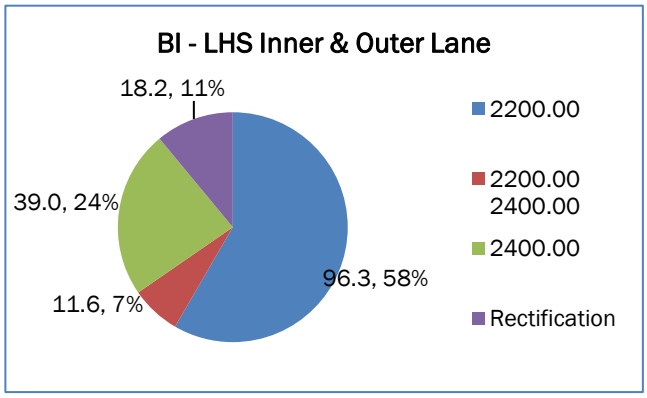
As per Schedule-F of TOT, the desirable level of service for Roughness values for rigid pavement surface is considered to less than 2200 mm/Km and the acceptable limits are less than 2400mm/Km.

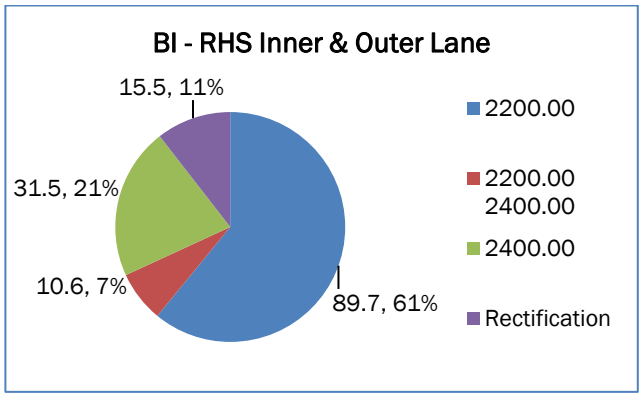
However, as per EPC Contract, Schedule-E, Roughness values should not exceed 2200mm/Km.

Average UI values along the corridor were grouped in to four categories, Pie chart showing the range of UI values in each carriageway of the project road have been presented below:

Roughness >2200 mm/km:

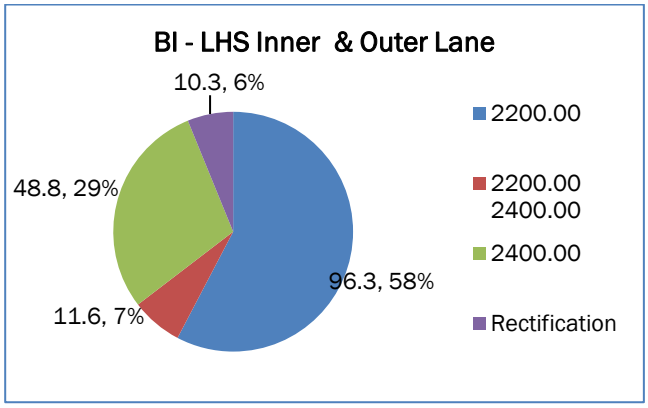
Rectification suggested based on moving average method for values >2200mm/km (based on EPC agreement)

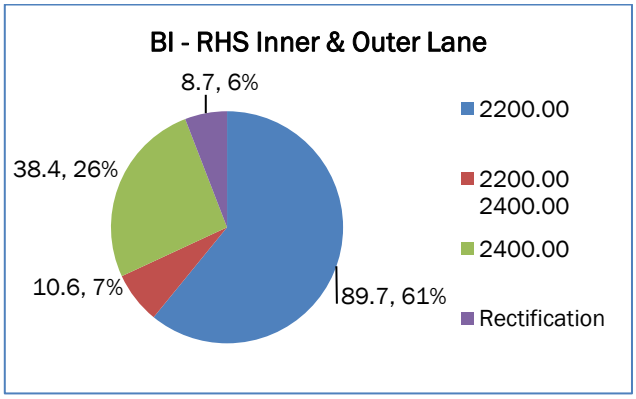




Roughness >2400 mm/km:

Rectification suggested based on moving average method for values >2400mm/km (based on TOT agreement)





Finally, Considering Roughness criteria with 2200mm/km (EPC), It can be seen from the above pie charts, that about 58% & 61% of the Lane-km length of the Project Road has fair riding quality (UI<2200 mm/km) in LHS carriageway and RHS carriageway respectively.

2.6 PAVEMENT COMPOSITION SURVEYS (TEST PITS)

Test pits have been excavated at @ 5 km staggered along the road and composition of the existing pavement crust has been noted. Thus, a total of 17 Nos. pits have been dug along the corridor and the data on composition of pavement has been noted. In which, 16 nos. of pits taken on Main Carriageway edge and remaining 1 test pits done on Service Road edge. Photographs have been taken at all test pit locations depicting the crust thickness and nature of material in the pavement.

Results of the test pit survey showing average thickness of pavement layers are presented in the Table below.

Table 4: Pavement Composition of Existing Pavement along Project Road

Sl No	Test Pit No	Existing Chainage	Direction	BT (mm)	WMM (mm)	GSB (mm)	PQC (mm)	DLC (mm)	GSB (mm)	Total (mm)	Remarks
1	RJ-TP-27	726+900	LHS				310	130	130	**570**	
2	RJ-TP-28	736+600	LHS				280	150	180	**610**	
3	RJ-TP-29	746+200	LHS				350	150	130	**630**	
4	RJ-TP-30	756+100	LHS				280	140	100	**520**	
5	RJ-TP-31	766+700	LHS				290	140	140	**570**	
6	RJ-TP-32	794+200	LHS				340	150	100	**590**	
7	RJ-TP-33	804+100	LHS				300	160	170	**630**	
8	RJ-TP-34	808+800	RHS				315	150	170	**635**	
9	RJ-TP-35	800+000	RHS				305	150	150	**605**	
10	RJ-TP-36	776+550	LHS	140	200	200				**540**	
11	RJ-TP-37	776+400	RHS	140	260	200				**600**	
12	RJ-TP-38	771+000	RHS				320	130	150	**600**	
13	RJ-TP-39	760+950	RHS				310	130	120	**560**	
14	RJ-TP-40	750+950	RHS				320	150	150	**620**	
15	RJ-TP-41	740+600	RHS				300	120	160	**580**	
16	RJ-TP-42	730+000	RHS				320	120	130	**570**	
17	RJ-SR-TP-3	767+500	LHS				280	150	120	**550**	

The flexible pavement consists of BT (140 mm) + WMM (200mm to 260mm) + GSB (200mm), with total thickness of 540mm to 600mm.

The Rigid pavement consists of PQC (280mm to 350mm) + DLC (120mm to 160mm) + GSB (100mm to 180mm), with total thickness of 520mm to 635mm

The service road of Rigid pavement consists of PQC (280mm) + DLC (150mm) + GSB (120mm), with total thickness of 550mm.

2.7 SUBGRADE INVESTIGATIONS & LABORATORY TESTING

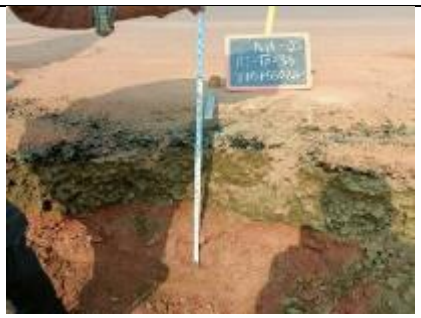
From the test pits excavated at @ 5 km staggered along the road, Sub-grade samples have been collected to examine the subgrade soil characteristics along the project road. Out of 17 Nos. of total tests pits, 16 Nos. of pits done on Main Carriage way edge and remaining 1 No. of test pit done on Service road edge. Field density tests have been conducted for subgrade samples and a small quantity of sample has also been collected in airtight containers for determining the field moisture content.

Upon completion of the field density test, representative sample of sub-grade soil has been collected in bulk, in gunny bags, from each test pit for laboratory testing.

The soil samples collected have been tested for the following properties to assess the existing sub-grade soil properties.

- Sieve analysis
- Atterberg limits
- Heavy compaction
- Four (4) days soaked CBR as per IS standards at 97% of MDD as applicable for sub-grade (Heavy Compaction)
- Free swelling index

RJ-TP-27	RJ-TP-28
RJ-TP-29	RJ-TP-30
RJ-TP-31	RJ-TP-32

RJ-TP-33	RJ-TP-34
	
RJ-TP-35	RJ-TP-36
RJ-TP-37	RJ-TP-38
RJ-TP-39	RJ-TP-40

RJ-TP-41	RJ-TP-42
RJ-SR-TP-3	

2.8 BORROW AREAS

Potential borrow areas identified at 7 Nos. of locations within the vicinity of the project corridor for sub-grade/ embankment within economic haulage leads have been identified. The sources identified as potential borrow sources are shown in Table below with certain useful information such as distance from the project road, location, village name, etc., have also been presented in this table below.

Table 5: Borrow Area Samples Details

Sl. No	Borrow Area No	Chainage	Side	Offset	Village and contact person	Quantity	Rate	Remarks	Co-ordinate
1	RJ-BP-7	809+700	RHS	10.0 km	Vill- Barda Name-Vinod Garg Mob no- 9926419511	20Acres* 5 feet	Not told	Pvt. Land	23.671928 80.155675
2	RJ-BP-8	795+100	LHS	8.0 km	Vill- Pahadiniwas Name-Monu Thakur Mob no- 78980 80232	5Acres* 5 feet	Not told	Pvt. Land	23.706646 80.378587
3	RJ-BP-9	779+000	RHS	2.5 km	Vill- Amradand Name-Samundra Singh	15Acres* 5 feet	Not told	Govt. Land	23.891450 80.365448
4	RJ-BP-14	730+900	RHS	1.9km	Vill- Goriya Kala Name-Gulab Ch. Patel Mob- 8871557574	15Acres* 5 feet	Not told	Govt. Land	21.175461 80.659556
5	RJ-BP-15	746+300	RHS	1.0 km	Vill- Gumehi Name- Jay Kumar Singh	25Acres* 5 feet	Rs - 100/- Per 100 Cft	Pvt. Land	24.081411 80.536105
6	RJ-BP-16	766+100	RHS	8.7 km	Vill- Kachauri Sarpanch Name- Sharda Paraha Name- Subhash Patel Mob- 9131933227	50Acres* 5 feet	Not told	Govt. Land	23.971804 80.339903

Sl. No	Borrow Area No	Chainage	Side	Offset	Village and contact person	Quantity	Rate	Remarks	Co-ordinate
7	RJ-BP-17	782+700	RHS	1.0 km	Vill- Pausara Sarpanch-Name- Manish Pandey Mob- 9826657095	100Acres* 5 feet	Not told	Govt. Land	23.844857 80.335054

Soil samples from these borrow sources have been collected in bulk by excavating test pits down up to 1.0m depth from the existing ground surface. The top organic soil layer of approximately 150mm thickness was removed before sampling. The samples collected from these identified borrow pits/ gravel quarries have been tested for the suitability of utilizing them as embankment fill/ sub-grade. The sample photos of borrow area locations are as presented below.

RJ-BP-7

RJ-BP-8

RJ-BP-9

RJ-BP-14

RJ-BP-15

RJ-BP-16

RJ-BP-17

2.9 AGGREGATE SAMPLES

Aggregates sources of 3 Nos. have been identified for the use of sub-base, base, surface courses and concrete works .The sample have been collected from crusher/quarry, which are under operations. The locations, estimated quantity, basic cost of material and the approximate distance from each source to the nearest point on the project corridor are compiled in Tables below.

RJ-AQ-1

RJ-AQ-2

RJ-AQ-3

Table 6: Aggregate Samples Details

sample No.	Ex. Chainage (Km.)	Left/ Right	Name of Village	Name of Source/ Crusher	Lead from Nearest Ex. Chainage (Km.)	Approximate Quantity (ton)	Basic cost of the material (Rs.)	Remarks	Co-ordinate
RJ-AQ-1	828+000	RHS	Dhanari Khamariya	Crusher- Omm Infrastructure Village - Bhagvan Singh Mob no- 9893989230	4.5 km	Plenty	40mm-Rs 400/- per ton 20mm-Rs 500/- per ton 10mm-Rs 350/- per ton 6mm - Rs 400/- per ton M-Sand -Rs 400/-Per ton WMM - Rs 350/- per ton GSB - Rs 350/- per ton	Royalty: Rs 170/- Per cub and Extra: GST 5%	23.550068 80.137551
RJ-AQ-2	702+600	RHS	Reusha Barahiya	Crusher- Piyush & Company Village - Piyush Tivari Mob no- 9300550002	0.5 km	Plenty	40mm-Rs 450/- per ton 20mm-Rs 550/- per ton 10mm-Rs 100/- per ton 6mm - Rs 50/- per ton Dust - Rs 100/- Per ton	Royalty: Rs 170/- Per cub and Extra: GST 5%	24.288811 80.882811
RJ-AQ-3	702+600	RHS	Reusha Barahiya	Crusher- Naveen Stone Crusher Village - Naveen Singh Mob no- 7566058758	0.5 km	Plenty	40mm-Rs 450/- per ton 20mm-Rs 600/- per ton 10mm-Rs 120/- per ton 6mm - Rs 60/- per ton Dust - Rs 150/- Per ton	Royalty: Rs 170/- Per cub and Extra: GST 5%	24.290316 80.883756

2.10 SAND SAMPLES

River Sand samples of 3 Nos. have been collected from the source and tested. The location of this sand quarry along with lead to the Project Road is presented in the following table.

RJ-SQ-1

RJ-AQ-2

RJ-SQ-3

Table 7: Sand Samples Details

Sand Source	Village & Name	Name of river & Village	Chainage	side	Offset	Rate	Remarks	Co-ordinate
RJ-SQ-1	Vill -Khini Name - Ramdev Varma Mob-7999474732	Hiran	843+500	RHS	11.4 km	Rs 1800/- Per 100 Cft with Loading	Royalty - Rs -2500/- Per 300 Cft	23.417072 49.979455
RJ-SQ-2	Vill - Ramkhiriya Name - Pintu Yadav Mob-6264733462	Bani	844+000	LHS	5.6 km	Rs 4500/- Per ton with Loading	Royalty Rs- 2000/- 120 cft	23.407634 80.118284
RJ-SQ-3	Vill -Chhain Pipariya Supplier Name - Ravi Raj Mob-7909947948	Mahanadi	714+700	LHS	80.0 km	Rs 15000/- Per 300 cft with Loading Transport up to Maihar	Including Royalty	

2.11 CORE CUTTING INVESTIGATION

The objective of the core cutting is examining the engineering properties of the materials relevant to the project such as compressive strength of concrete core as per specification. As a first step, Details of sections are identified with good, fair and poor locations. The locations have been identified with the help of Visual observation of existing Road condition and past history. Thereafter the Location has been identified for core cutting. A total number of 12 cores have been carefully taken along the project corridor, in which 11 Nos. from the Main Carriageway and 1 Nos. from the Service Road.

RJ-C-10

RJ-C-11

RJ-C-12	RJ-C-13
RJ-C-14	RJ-C-28
RJ-C-29	RJ-C-30
RJ-C-31	RJ-C-32

RJ-C-33	RJ-SR-C-3

Location and Details of the core cutting are given below

Table 8: Core Cutting Samples Details

S.NO	Core Id	Existing Chainage (km)	Direction	Carriage Way	Offset From median in (M)	Road Condition	Core Thickness (mm)	Hole Thickness (mm)	Remark
1	RJ-C-10	807+000	RHS	Outer	6.4	Good	**300**	300	Rigid
2	RJ-C-11	771+000	RHS	Inner	4.8	Good	**280**	280	Rigid
3	RJ-C-12	750+950	RHS	Outer	6.0	Poor (Crack Section)	**290**	290	Rigid (Top to Bottom crack)
4	RJ-C-13	740+600	RHS	Inner	1.4	Good	**290**	290	Rigid
5	RJ-C-14	730+00	RHS	Outer	6.6	Poor (Crack Section)	**300**	300	Rigid (Top to Bottom crack)
6	RJ-C-28	726+900	LHS	Outer	6.4	Good	**310**	310	Rigid
7	RJ-C-29	736+600	LHS	Inner	1.5	Good	**310**	310	Rigid
8	RJ-C-30	746+200	LHS	Outer	6.1	Good	**320**	320	Rigid
9	RJ-C-31	754+150	LHS	Inner	4.2	Poor Crack Section	**280**	280	Rigid (Top to Bottom crack)
10	RJ-C-32	766+700	LHS	Inner	4.4	Good	**330**	330	Rigid
11	RJ-C-33	804+100	LHS	Outer	6.4	Good	**300**	300	Rigid
12	RJ-SR-C-3	767+600	LHS	Inner Service road	1.8	Good	**210**	210	Rigid

2.12 AXLE LOAD SURVEYS

Traffic loading has a significant impact on pavement performance and design. This is because the damage that vehicles create to a road depends very strongly on the axle loads of the vehicles. The exact relationship is influenced by the type of road structure and the way the road deteriorates but a "fourth power" damage law gives a good approximation.

Axle load study has been conducted using portable axle load pads near toll plaza at km 739+000 on date 27.11.2022 for 24 hrs duration. The measurements have been made on random sampling basis. The collected axle load data and analysis is presented in **Appendix 5** of this Report.

The vehicle damage factors have been calculated using the standard axle loadings given in IRC: 37-2018. The standard axle loadings adopted have been presented in the following table

Table 9: Details of Standard Axles Used

Axle Configuration	Standard Axle load (Tonnes)*/ KN	Remarks
Single Wheel, Single Axle	6.60/65	As per IRC 37-2018
Dual Wheel, Single Axle	8.16/80	As per IRC 37-2018
Dual Wheel, Tandem Axle group	15.10/148	As per IRC 37-2018
Dual Wheel, Tridem Axle group	22.90/224	As per IRC 37-2018

Few photographs illustrating the survey locations and axle load measurements are presented below.

Survey in Progress

Survey in Progress

Survey in Progress

Survey in Progress

Direction wise VDF for each mode of commercial traffic has been estimated. Results of axle load surveys have been presented in the following table.

Table 10: VDF Values Estimated at the Toll Plaza Locations

Vehicle Type	Kherwasani Toll plaza at Km 739+000	
	UP	DN
BUS	0.5	1.2
2-Axle	1.23	3.15
3-Axle	7.3	6.98
M Axle	14.73	17.84
LCV	0.13	2.52

CHAPTER 3. VALIDATION OF EXECUTED WORKS

3.1 ROAD WORKS

The project road has been closely inspected to verify the executed works on ground. The scope works to be executed by the Concessionaire/Contractor as envisaged in CA is compared with the executed work on the Ground. As a part of the validation, the available as-built drawings and the inventory data received from the Concessionaire were also referred. Each structure has been inspected to note down its structural configuration and condition. The following table highlights the scope comparison of the executed works on ground.

Table 11: Scope Comparison of Executed works

Sl. No.	Particulars	Length/ Nos.	Total for O&M Estimation	As per Schedule-B	As per Schedule-A	As per Site	Remarks
1	Start Chainage (Km)	Km	725.185	725.185	725.185	725.185	
2	End chainage (Km)	Km	813.257	813.257	813.257	813.257	
3	Length of the Project Corridor	Kms	88.072	88.072	88.072	88.072	
4	Service Road / Slip Road	Kms	32.932	7.132	25.800	25.800	
5	Bypass Length	Kms	42.794		42.794	42.794	
6	Toll Plaza	Nos.	1		1	1	
7	No. of Lanes (Both side)	Nos.	8		8		3+1 Lanes on Both sides
8	ROBs	Nos.	1		1	1	
9	Flyovers	Nos.			2		
10	Overpasses	Nos.	1			1	
11	VUPs	Nos.	6		6	6	
12	LVUP's	Nos.	6	2		4	
13	PUP's/CUP's	Nos.	16		18	16	
14	Major Bridges	Nos.	1		1	1	
15	Minor Bridges	Nos.	37		34	36.5	proposed is Widening
16	Culverts (Pipe)	Nos.	163	16	158	163	proposed is Widening
17	Culvert (Slab/Box)	Nos.	57	3	58	57	proposed is Widening
18	Major Junctions	Nos.	13		13	13	
19	Minor junctions	Nos.	49		44	49	
20	High Embankments	Kms	4.881			4.881	
21	Partial RCC Wall with Embankment	Kms	6.565			6.565	
22	Partial RCC Wall with Concrete Lining	Kms	1.140			1.140	
23	Full Height RE Wall	Kms	9.068			9.068	
24	Partial RE Wall with Concrete Lining	Kms	4.605			4.605	
25	Bus Bays with Shelter	Nos.	31			31	
26	Bus Bays	Nos.	1			1	
27	Truck Lay bye	Nos.	4	2	2.000	2	
28	Rest Areas	Nos.	1		2.000	1	
29	High Mast Lights	Nos.	22		4	18	
30	Highway Lighting (length only)	Kms	30.070	4.480		25.590	
31	Single Arm Lightings	Nos.	666	16	471	650	
32	Double Arm Lightings	Nos.	528	314	292	214	

Sl. No.	Particulars	Length/ Nos.	Total for O&M Estimation	As per Schedule-B	As per Schedule-A	As per Site	Remarks
33	Lights below underpass/FO	Nos.	136	80	56		
34	Solar Blinkers	Nos.	58			58	
35	RCC Cover Drain	Kms	35.954	7.832	14.260	28.122	
36	Earthen Drain	Kms	148.022			148.022	
37	Median Opening	Nos.	29		28	29	
38	Median kerb Damages	Kms	0.048			0.048	
39	Median Plantation Functional	Kms	62.057			62.057	
40	Median Plantation_Non Functional	Kms	26.015			26.015	
41	Road Markings	Kms	88.072			88.072	
42	W-Beam Safety Barriers	Kms	32.895			32.895	
43	Thrie-Beam Safety Barriers	Kms	7.818			7.818	
44	Rigid Concrete Barriers	Kms	23.052			23.052	
45	Concrete Railing	Kms	2.026			2.026	
46	Pedestrian Guard Rails	Kms	7.398	4.668		2.730	
47	Delineators	Nos.	54			54	
48	Kilometre Stones	Nos.	176			176	
49	Hectometre Stones	Nos.	706			706	
50	Boundary Stones	Nos.	4407	3526		881	
51	Road Signs	Nos.	4286	3296		990	
52	Gantry Sign Boards	Nos.	11			11	
53	Cantilever Sign Boards	Nos.	35	4		31	
54	Traffic Attenuators	Nos.	3	3			

The project corridor appears to have been constructed with the cross-sectional elements matching to those given in the manual at the time of execution. The carriageway width of 7.0m plus paved shoulders of 1.5m, shyness of 0.5m and earth shoulder of 1m-1.5m has been provided over the entire length except at structures.

The Service Roads/Slip Roads comprising of an overall length of km 25.8 km have been provided in the project road. The service roads have carriageway width of 7.0m with flexible pavement. The location details are listed as below:

Table 12: Details of Service Roads/Slip Roads along Project Road

Service/Slip Road Details Both Sides- As per site									
S.No.	Existing Chainage		SR without tapers		Side	Pavement Type	As Per Site (m)	Width (m)	Remarks
	From (km)	To (km)	From (km)	To (km)					
1	728+850	729+854	729+050	729+654	LHS	Flexible	604	7	
2	739+300	740+295	739+450	740+095	LHS	Rigid	645	7	
3	739+300	740+295	739+450	740+095	RHS	Rigid	645	7	
4	749+450	750+859	749+600	750+709	LHS	Rigid	1109	7	

Service/Slip Road Details Both Sides- As per site									
S.No.	Existing Chainage		SR without tapers		Side	Pavement Type	As Per Site (m)	Width (m)	Remarks
	From (km)	To (km)	From (km)	To (km)					
5	749+450	750+600	749+600	750+600	RHS	Flexible	1000	7	
6	759+170	760+552	759+270	760+432	LHS	Rigid	1162	7	
7	759+170	760+552	759+270	760+432	RHS	Rigid	1162	7	
8	766+680	767+773	766+800	767+653	LHS	Rigid	853	7	
9	766+680	767+773	766+800	767+653	RHS	Rigid	853	7	
10	769+980	770+850	770+100	770+700	LHS	Rigid	600	7	
11	769+980	770+850	770+100	770+700	RHS	Flexible	600	7	
12	773+930	776+138	774+130	775+938	LHS	Flexible	1808	7	
13	773+930	776+138	774+130	775+938	RHS	Flexible	1808	7	
14	776+555	777+693	776+755	777+493	LHS	Flexible	738	7	
15	776+555	777+693	776+755	777+493	RHS	Flexible	738	7	
16	778+258	779+900	778+458	779+700	LHS	Flexible	1242	7	
17	778+258	779+900	778+458	779+700	RHS	Flexible	1242	7	
18	781+600	783+000	781+800	782+800	LHS	Flexible	1000	7	
19	781+600	783+000	781+800	782+800	RHS	Flexible	1000	7	
20	787+266	788+892	787+466	788+692	LHS	Flexible	1226	7	
21	787+266	788+892	787+466	788+692	RHS	Flexible	1226	7	
22	794+870	796+004	795+000	795+804	LHS	Flexible	804	7	
23	794+870	796+004	795+000	795+804	RHS	Flexible	804	7	
24	798+345	799+585	798+505	799+385	RHS	Flexible	880	7	
25	798+920	799+585	798+920	799+385	LHS	Flexible	465	7	
26	809+165	810+278	809+325	810+118	LHS	Flexible	793	7	
27	809+165	810+278	809+325	810+118	RHS	Flexible	793	7	
As per Site Total Length of Service/Slip Road (km)							**25.800**		

RCC Lined Covered drains are available along the project road. In few locations cover-slabs are missing & damage and in some places cleaning of drains is need to be done. These sections are presented in the Table below.

Table 13: RCC Covered Drains

Covered Drains-As per Site								
S. No	Existing Chainage (Km)		Side	Length (km)	Width (m)	Cover Missing (m)	Cover Damage(m)	Remarks
	From	To						
1	729.030	729.620	LHS	0.590	1.20			
2	739.350	740.050	LHS	0.700	1.20			
3	749.650	750.750	LHS	1.100	1.20		5	
4	759.250	760.400	LHS	1.150	1.20	15		
5	766.900	767.600	LHS	0.700	1.20		5	
6	770.100	770.800	LHS	0.700	1.20			
7	795.000	795.800	LHS	0.800	1.20	10		
8	798.550	799.400	LHS	0.850	1.20			
9	809.550	810.020	LHS	0.470	1.20			
10	739.500	740.100	RHS	0.600	1.20		2	
11	749.600	750.800	RHS	1.200	1.20	10		
12	759.300	760.500	RHS	1.200	1.20	10		
13	766.900	767.750	RHS	0.850	1.20			
14	770.100	770.800	RHS	0.700	1.20			
15	795.020	795.920	RHS	0.900	1.20			
16	798.350	799.400	RHS	1.050	1.20			
17	809.300	810.000	RHS	0.700	1.20			
Total Length of RCC covered Drain(km)				**14.260**		**45**	**12**	

Partial RCC walls, Partial RE walls and Full Height RE walls are found in approaches to the underpass locations, high embankment sections, and Minor / Major Bridges locations along the Project Corridor accounting to a total length of 44.160 Km. The summary of the slope protection details are presented below:

Table 14: Summary of Slope Protection along Project Road

Approaches as per Site										
S.no	Existing Chainage (km)		Length (Km)	Side	Embankment	RE Wall	Partial RE Wall + Concrete lining	Partial RCC Wall + embankment	Partial RCC wall + Concrete lining	Remarks
	From	To								
1	729.300	729.520	0.220	LHS					YES	Concrete Lining Damaged
2	729.300	729.520	0.220	RHS					YES	
3	739.600	739.950	0.350	LHS			YES			
4	739.600	739.950	0.350	RHS			YES			Slight Bulging

Approaches as per Site										
S.no	Existing Chainage (km)		Length (Km)	Side	Embankment	RE Wall	Partial RE Wall + Concrete lining	Partial RCC Wall + embankment	Partial RCC wall + Concrete lining	Remarks
	From	To								
5	741.800	742.080	0.280	LHS-A1	YES					
6	741.800	742.080	0.280	RHS-A1	YES					
7	742.100	742.280	0.180	LHS-A2				YES		
8	742.100	742.280	0.180	RHS-A2				YES		
9	750.180	750.530	0.350	LHS				YES		
10	750.180	750.530	0.350	RHS				YES		
11	755.410	755.750	0.340	LHS	YES					
12	755.410	755.750	0.340	RHS	YES					
13	756.400	756.700	0.300	LHS-A1	YES					
14	756.400	756.700	0.300	RHS-A1	YES					
15	756.720	757.000	0.280	LHS-A2	YES					
16	756.720	757.000	0.280	RHS-A2	YES					
17	757.620	757.880	0.260	LHS-A1	YES					
18	757.620	757.880	0.260	RHS-A1	YES					
19	757.890	758.100	0.210	LHS-A2	YES					
20	757.890	758.100	0.210	RHS-A2	YES					
21	759.600	759.950	0.350	LHS					YES	
22	759.600	759.950	0.350	RHS					YES	
23	767.050	767.550	0.500	LHS			YES			Slight Bulging
24	767.050	767.550	0.500	RHS			YES			Slight Bulging
25	770.250	770.560	0.310	LHS			YES			Slight Bulging
26	770.250	770.560	0.310	RHS			YES			Slight Bulging
27	795.170	795.480	0.310	LHS				YES		
28	795.170	795.480	0.310	RHS				YES		
29	798.650	799.250	0.600	LHS			YES			Slight Bulging
30	798.650	799.250	0.600	RHS			YES			Slight Bulging
31	809.450	809.690	0.240	LHS-A1			YES			RE wall damaged
32	809.450	810.000	0.550	RHS			YES			
33	809.705	810.000	0.295	LHS-A2			YES			
34	778.686	779.034	0.348	LHS				Yes		
35	779.066	779.288	0.222	LHS				Yes		
36	779.322	779.928	0.606	LHS				Yes		
37	782.028	782.729	0.701	LHS				Yes		

Approaches as per Site										
S.no	Existing Chainage (km)		Length (Km)	Side	Embankment	RE Wall	Partial RE Wall + Concrete lining	Partial RCC Wall + embankment	Partial RCC wall + Concrete lining	Remarks
	From	To								
38	782.759	783.028	0.269	LHS				Yes		
39	787.694	788.336	0.642	LHS				Yes		
40	788.364	788.920	0.556	LHS				Yes		
41	778.686	779.034	0.348	RHS		Yes				
42	779.066	779.288	0.222	RHS		Yes				
43	779.322	779.928	0.606	RHS		Yes				
44	782.028	782.729	0.701	RHS		Yes				
45	782.759	783.028	0.269	RHS		Yes				
46	787.694	788.336	0.642	RHS		Yes				
47	788.364	788.920	0.556	RHS		Yes				
48	774.358	774.833	0.475	LHS		Yes				
49	774.863	774.948	0.085	LHS		Yes				
50	774.978	776.022	1.044	LHS		Yes				
51	776.034	776.166	0.132	LHS		Yes				
52	776.983	777.406	0.423	LHS		Yes				
53	777.418	777.721	0.303	LHS		Yes				
54	774.358	774.833	0.475	RHS		Yes				
55	774.863	774.948	0.085	RHS		Yes				
56	774.978	776.022	1.044	RHS		Yes				
57	776.034	776.166	0.132	RHS		Yes				
58	776.983	777.406	0.423	RHS		Yes				
59	777.418	777.721	0.303	RHS		Yes				
60	780.154	780.404	0.250	LHS	Yes					
61	780.492	780.938	0.446	LHS	Yes					
62	780.154	780.404	0.250	RHS				Yes		
63	780.492	780.938	0.446	RHS				Yes		
64	789.476	789.938	0.462	LHS	Yes					
65	789.945	790.328	0.383	LHS	Yes					
66	789.476	789.938	0.462	RHS				Yes		
67	789.945	790.328	0.383	RHS				Yes		
68	792.828	793.028	0.200	RHS Shoulder		Yes				VOP
69	792.828	793.028	0.200	RHS SR edge		Yes				VOP

Approaches as per Site										
S.no	Existing Chainage (km)		Length (Km)	Side	Embankment	RE Wall	Partial RE Wall + Concrete lining	Partial RCC Wall + embankment	Partial RCC wall + Concrete lining	Remarks
	From	To								
70	792.828	793.028	0.200	LHS Shoulder		Yes				VOP-Junction
71	792.828	793.028	0.200	LHS Shoulder		Yes				VOP-Junction

In general, the median widths are varying from 10.8m to 4.0m in the project road. As per site 29 No of Median openings are observed in that 5 Nos. are with normal lanes and remaining have provision for reserve lane. For the reserve lane locations, the width of the reserved lane is 4.0m. The location wise details are presented in the table below.

Table 15: Details of Median Openings along Project Road

Median Openings As per Site					
S. No.	Existing Chainage (km)	Width (m)	Length (m)	Reserve lane	Remarks
1	725.185	7.1	30	Yes	
2	727.380	7.1	40	Yes	
3	728.430	1.5	20	No	
4	730.920	7.1	20	Yes	
5	731.940	7.1	30	Yes	
6	734.120	7.1	30	Yes	
7	735.920	7.1	25	Yes	
8	737.030	7.1	50	Yes	
9	740.990	7.1	20	Yes	
10	743.030	7.1	30	Yes	
11	744.440	7.1	20	Yes	
12	748.920	7.1	20	Yes	
13	751.730	7.1	30	Yes	
14	753.190	7.1	30	Yes	
15	755.270	7.1	20	Yes	
16	760.580	4	20	No	
17	761.620	7.1	50	Yes	
18	761.690	7.1	20	Yes	
19	765.940	7.1	40	Yes	
20	768.300	7.1	30	Yes	
21	771.440	1.5	30	No	

Median Openings As per Site					
S. No.	**Existing Chainage (km)**	**Width (m)**	**Length (m)**	**Reserve lane**	**Remarks**
22	771.680	1.5	20	No	
23	801.090	4	25	No	
24	803.000	7.1	30	Yes	
25	805.820	7.1	30	Yes	
26	807.620	7.1	20	Yes	
27	808.500	7.1	30	Yes	
28	810.650	7.1	20	Yes	
29	811.700	7.1	20	Yes	

The Project Road has 13 Nos. of Major Junctions and 49 Nos. of Minor Junctions. The location-wise details of the junctions are provided in table below:

Table 16: List of Major Junctions

Major Junctions-As per Site										
SR. No.	**Design Chainage (km)**	**Type of Junction**	**Cross roads Hits (MCW/SR)**	**Name of Access Road**		**Surface Type of Access Road**		**Width of Access Road (m)**		**Remarks**
				LHS	**RHS**	**LHS**	**RHS**	**LHS**	**RHS**	
1	734.127	RHS	MCW		Ghunwra		BT		7.5	
2	735.915	RHS	MCW		Mahedar		BT		7.5	
3	741.000	LHS	MCW	Suhaula		BT		7.5		
4	743.026	LHS	MCW	Amdara		BT		7.5		
5	751.730	LHS	MCW	Village		BT		7.5		
6	753.130	LHS	MCW	Village		BT		7.5		
7	755.210	RHS	MCW		Sabhaganj		BT		7.5	
8	761.600	RHS	MCW		Gugdi		BT		7.5	
9	765.950	RHS	MCW		Satna		BT		7.5	
10	803.000	LHS	MCW	Teori		BT		7.5		
11	805.800	LHS	MCW	Teori		BT		7		
12	807.600	LHS	MCW	Sleemanabad		BT		7.5		
13	809.740	BHS	MCW	Sleemanabad	Bah riband	BT	BT	7.5	7.5	Extra

Table 17: List of Minor Junctions

Minor Junctions as per site								
SR. No.	**Design Chainage (km)**	**Side**	**Merging into (MCW/SR)**	**Width of Access Road (m)**		**Surface Type of Access Road**		**Remarks**
				LHS	**RHS**	**LHS**	**RHS**	
1	725175	RHS	MCW		4		BT	

Minor Junctions as per site								
SR. No.	Design Chainage (km)	Side	Merging into (MCW/SR)	Width of Access Road (m)		Surface Type of Access Road		Remarks
				LHS	RHS	LHS	RHS	
2	726670	LHS	MCW	5.5		BT		
3	727380	RHS	MCW		4		BT	
4	728431	LHS	MCW	3.5		BT		
5	729180	LHS	MCW	4		BT		
6	729345	RHS	MCW		4.5		BT	
7	729925	RHS	MCW		4.5		BT	
8	730915	RHS	MCW		4.5		BT	
9	731942	LHS	MCW	4.5		BT		
10	731990	RHS	MCW		3		CC	
11	732455	LHS	MCW	7		BT		
12	735225	BHS	SR	4.5	4.5	BT	BT	
13	736452	RHS	MCW		4		BT	
14	736675	RHS	MCW		4.5		BT	
15	737010	RHS	MCW		4.5		BT	
16	737023	RHS	MCW	4.5		BT	BT	
17	737424	LHS	MCW	7		BT		
18	738550	LHS	MCW	7.5		BT		
19	739760	LHS	MCW	4.5		BT		
20	739950	RHS	MCW		4.5		BT	
21	743550	RHS	MCW		3.5		CC	
22	744075	LHS	MCW	4		BT		
23	744150	RHS	MCW		4		BT	
24	744200	LHS	MCW	4		BT		Extra
25	744444	LHS	MCW	4		BT		
26	748910	LHS	MCW	4		BT		Extra (750+300)
27	750300	RHS	SR		4		BT	
28	754210	LHS	MCW	3.5		CC		Extra
29	757730	BHS	MCW	4	4	BT	BT	
30	758250	RHS	MCW		7.5		BT	
31	760538	RHS	MCW		4		Earthen	
32	763812	BHS	SR	7.5	7.5	BT	BT	
33	766100	RHS	MCW		7.5		BT	
34	768300	RHS	MCW		4.5		BT	
35	768320	LHS	MCW	4.5		BT		
36	770405	LHS	SR	4		BT		

Minor Junctions as per site								
SR. No.	Design Chainage (km)	Side	Merging into (MCW/SR)	Width of Access Road (m)		Surface Type of Access Road		Remarks
				LHS	RHS	LHS	RHS	
37	794388	RHS	MCW		5.5		BT	
38	795158	LHS	MCW	4		BT		
39	795808	RHS	MCW		4		BT	
40	798924	BHS	SR	4	4	BT	BT	PUP
41	799470	LHS	MCW	4		BT		
42	801085	RHS	MCW		4		BT	
43	801600	LHS	MCW	4		BT		Extra
44	804975	BHS	MCW	3.5	3.5	Earthen	Earthen	
45	806058	LHS	MCW	4		BT		
46	807210	BHS	SR	4	4	BT	BT	
47	808510	BHS	SR	5	5	BT	BT	
48	811800	BHS	SR	7.5	7.5	BT	BT	
49	810650	BHS	SR	4	4	BT	BT	

Safety Barriers are provided at high embankments, structure approach locations and in built-up areas. The location wise details of Safety Barriers provided along the project corridor are presented below:

Table 18: Summary of Safety Barriers

S. No.	Description	Length (Kms)
1	W-Beam Safety Barriers	32.895
2	Thrie-Beam Safety Barriers	7.818
3	Concrete Crash Barriers	23.052
4	Pedestrian Guard Railings	2.730

Table 19: W-Beam Safety Barriers

W-Beam Crash Barriers							
S. No	Design Chainage		Side/Location	Length (km)	Condition	Damage (m)	Remarks
	From (km)	To (km)					
1	729.180	729.370	LHS	0.190			
2	729.110	729.270	RHS	0.160			
3	729.380	729.620	LHS	0.240			
4	729.290	729.540	RHS	0.250			
5	732.070	732.110	LHS	0.040			
6	732.150	732.200	LHS	0.050			
7	732.190	732.220	RHS	0.030			
8	732.250	732.280	RHS	0.030			

W-Beam Crash Barriers							
S. No	Design Chainage		Side/Location	Length (km)	Condition	Damage (m)	Remarks
	From (km)	To (km)					
9	732.650	732.950	LHS	0.300		50	
10	733.000	733.030	RHS	0.030			
11	733.250	733.310	RHS	0.060			
12	733.600	733.670	LHS	0.070			
13	733.820	734.020	LHS	0.200			
14	733.880	734.050	RHS-Median	0.170			
15	734.080	734.110	RHS-Median	0.030			
16	734.770	734.810	RHS	0.040		2	
17	734.940	734.970	LHS	0.030			
18	734.910	734.950	RHS	0.040			
19	735.000	735.300	LHS	0.300			
20	734.990	735.260	RHS	0.270			
21	735.310	735.420	LHS	0.110		20	
22	735.280	735.380	RHS	0.100			
23	736.540	736.980	RHS	0.440		7	
24	737.070	737.110	RHS	0.040			
25	737.150	737.180	LHS	0.030		5	
26	737.150	737.180	RHS	0.030		3	
27	737.210	737.240	LHS	0.030			
28	739.380	739.510	RHS	0.130			
29	739.550	739.780	LHS	0.230			
30	739.790	739.990	LHS	0.200			
31	739.530	739.970	RHS	0.440			
32	740.750	740.830	LHS	0.080			
33	740.890	741.000	LHS	0.110			
34	741.150	741.180	RHS	0.030			
35	741.340	741.420	LHS	0.080			
36	741.430	741.610	RHS	0.180			
37	741.760	741.820	LHS	0.060			
38	741.835	741.900	LHS	0.065			
39	741.640	741.910	RHS	0.270			
40	743.420	743.550	LHS	0.130			
41	744.070	744.130	LHS	0.060			
42	744.140	744.220	LHS	0.080			
43	746.230	746.280	LHS	0.050			

W-Beam Crash Barriers							
S. No	Design Chainage		Side/Location	Length (km)	Condition	Damage (m)	Remarks
	From (km)	To (km)					
44	746.210	746.240	RHS	0.030			
45	746.290	746.330	LHS	0.040			
46	746.260	746.290	RHS	0.030			
47	746.450	746.480	RHS	0.030			
48	746.500	746.530	RHS	0.030			
49	746.650	746.700	LHS	0.050			
50	746.730	746.820	LHS	0.090			
51	746.920	747.020	LHS	0.100			
52	747.140	747.195	LHS	0.055			
53	747.410	747.440	LHS	0.030			
54	747.610	747.640	RHS	0.030			
55	747.650	747.670	LHS	0.020			
56	747.685	747.750	LHS	0.065			
57	747.660	747.690	RHS	0.030			
58	748.320	748.380	RHS	0.060			
59	748.600	748.720	LHS	0.120			
60	748.810	748.920	LHS	0.110			
61	750.130	750.270	LHS	0.140			
62	750.110	750.260	RHS	0.150		2	
63	750.280	750.500	LHS	0.220			
64	750.280	750.480	RHS	0.200			
65	752.170	752.480	LHS-Median	0.310			
66	752.180	752.400	LHS	0.220			
67	752.260	752.360	RHS	0.100			
68	752.420	752.850	LHS	0.430			
69	752.420	752.920	LHS-Median	0.500			
70	752.380	752.880	RHS	0.500			
71	754.800	755.190	LHS-Median	0.390			
72	754.840	755.180	RHS	0.340			
73	755.220	755.240	LHS-Median	0.020			
74	755.270	755.370	LHS	0.100			
75	755.390	755.420	LHS	0.030			
76	755.280	755.400	RHS	0.120			
77	753.420	755.480	RHS	2.060			
78	756.560	756.670	LHS	0.110			

W-Beam Crash Barriers							
S. No	Design Chainage		Side/Location	Length (km)	Condition	Damage (m)	Remarks
	From (km)	To (km)					
79	756.580	756.650	RHS	0.070			
80	756.685	756.910	LHS	0.225			
81	756.680	756.870	RHS	0.190			
82	757.000	757.460	RHS	0.460			
83	757.220	757.750	LHS	0.530			
84	757.760	757.830	LHS	0.070			
85	757.730	757.780	RHS	0.050			
86	757.900	758.300	LHS-Median	0.400			
87	757.890	758.130	RHS	0.240		5	
88	758.160	758.180	RHS	0.020			
89	758.360	758.450	LHS-Median	0.090			
90	759.650	759.870	LHS	0.220			
91	759.880	759.970	LHS	0.090			
92	759.870	759.950	RHS	0.080			
93	761.130	761.170	LHS	0.040			
94	761.130	761.160	RHS	0.030			
95	761.185	761.210	LHS	0.025			
96	761.180	761.210	RHS	0.030			
97	761.380	761.520	RHS	0.140		7	
98	761.700	761.720	RHS	0.020			
99	763.270	763.320	LHS	0.050			
100	763.290	763.380	RHS	0.090			
101	763.600	763.810	LHS	0.210		15	
102	763.580	763.800	RHS	0.220			
103	763.830	764.370	LHS	0.540			
104	764.420	764.450	LHS	0.030			
105	763.830	764.430	RHS	0.600			
106	764.470	764.510	LHS	0.040			
107	764.460	764.480	RHS	0.020			
108	765.660	765.710	RHS	0.050			
109	765.750	765.870	LHS	0.120			
110	765.740	765.870	RHS	0.130			
111	765.900	765.950	LHS	0.050			
112	765.890	766.010	RHS	0.120			
113	767.050	767.330	LHS	0.280			

W-Beam Crash Barriers							
S. No	Design Chainage		Side/Location	Length (km)	Condition	Damage (m)	Remarks
	From (km)	To (km)					
114	767.040	767.300	RHS	0.260			
115	767.340	767.570	LHS	0.230			
116	767.320	767.580	RHS	0.260			
117	767.880	768.030	RHS	0.150			
118	767.700	768.500	LHS	0.800			
119	770.280	770.470	LHS	0.190			
120	770.310	770.460	RHS	0.150			
121	770.480	770.600	LHS	0.120			
122	770.480	770.630	RHS	0.150			
123	773.020	773.180	LHS	0.160			
124	773.190	773.320	LHS	0.130			
125	772.950	773.450	RHS	0.500			
126	795.140	795.470	LHS	0.330			
127	795.140	795.470	RHS	0.330			
128	795.490	795.680	LHS	0.190			
129	795.490	795.680	RHS	0.190			
130	796.050	796.380	LHS	0.330			
131	796.050	796.380	RHS	0.330			
132	796.690	797.160	LHS	0.470			
133	796.690	797.160	RHS	0.470		10	
134	798.590	798.830	LHS	0.240			
135	798.590	798.830	RHS	0.240			
136	798.850	799.000	LHS	0.150			
137	798.850	799.000	RHS	0.150			
138	799.620	799.640	LHS	0.020			
139	799.620	799.640	RHS	0.020			
140	799.660	799.690	LHS	0.030			
141	799.660	799.690	RHS	0.030			
142	800.030	800.050	LHS	0.020			
143	800.030	800.050	RHS	0.020			
144	800.050	800.070	LHS	0.020			
145	800.050	800.070	RHS	0.020			
146	800.070	800.100	LHS	0.030			
147	800.070	800.100	RHS	0.030			
148	800.380	800.410	LHS	0.030			

W-Beam Crash Barriers							
S. No	Design Chainage		Side/Location	Length (km)	Condition	Damage (m)	Remarks
	From (km)	To (km)					
149	800.380	800.410	RHS	0.030			
150	800.480	800.630	LHS	0.150			
151	800.480	800.630	RHS	0.150			
152	800.650	800.680	LHS	0.030			
153	800.650	800.680	RHS	0.030			
154	801.200	801.230	LHS	0.030			
155	801.200	801.230	RHS	0.030			
156	801.250	801.280	LHS	0.030			
157	801.250	801.280	RHS	0.030			
158	804.790	804.950	LHS	0.160			
159	804.790	804.950	RHS	0.160			
160	804.980	805.150	LHS	0.170			
161	804.980	805.150	RHS	0.170			
162	805.710	805.740	LHS	0.030			
163	805.710	805.740	RHS	0.030			
164	805.760	805.790	LHS	0.030			
165	805.760	805.790	RHS	0.030			
166	808.870	809.070	LHS	0.200			
167	808.870	809.070	RHS	0.200			
168	809.100	809.130	LHS	0.030			
169	809.100	809.130	RHS	0.030			
170	809.270	809.650	LHS	0.380			
171	809.270	809.650	RHS	0.380			
172	809.650	810.000	LHS	0.350			
173	809.650	810.000	RHS	0.350			
174	810.050	811.690	LHS	1.640			
175	810.050	811.690	RHS	1.640			
176	812.000	812.840	LHS	0.840			
177	812.000	812.840	RHS	0.840			
As per Site Total Length of W-Beam Barriers (km)				**32.895**		**126**	

Table 20: Thrie Beam Crash Barriers along Project Road

Thrie Beam Crash Barrier in Katni Bypass							
S. No	Design Chainage		Side/Location	Length (km)	Condition	Damage (m)	Remarks
	From (km)	To (km)					
1	778.686	779.034	LHS Shoulder	0.348			
2	779.066	779.288	LHS Shoulder	0.222			
3	779.322	779.928	LHS Shoulder	0.606			
4	782.028	782.729	LHS Shoulder	0.701			
5	782.759	783.028	LHS Shoulder	0.269			
6	787.694	788.336	LHS Shoulder	0.642			
7	788.364	788.920	LHS Shoulder	0.556			
8	780.154	780.404	LHS Shoulder	0.250			
9	780.492	780.938	LHS Shoulder	0.446			
10	780.154	780.404	LHS Median	0.250			
11	780.492	780.938	LHS Median	0.446			
12	780.154	780.404	RHS Shoulder	0.250			
13	780.492	780.938	RHS Shoulder	0.446			
14	780.154	780.404	RHS Median	0.250			
15	780.492	780.938	RHS Median	0.446			
16	789.476	789.938	LHS Shoulder	0.462			
17	789.945	790.328	LHS Shoulder	0.383			
18	789.476	789.938	RHS Shoulder	0.462			
19	789.945	790.328	RHS Shoulder	0.383			
As per Site Total Length of Thrie-Beam Barriers (km)				**7.818**			

Table 21: Concrete Crash Barriers along Project Road

Concrete Crash Barriers as per Site						
S. No.	Design Chainage		Length (m)	Side	Condition	Remarks
	From (km)	To (km)				
1	728.36	728.38	20	RHS	Fair	
2	729.27	729.29	20	RHS	Fair	
3	729.370	729.380	10	LHS	Fair	
4	730.130	730.150	20	LHS	Fair	
5	730.340	730.350	10	LHS	Fair	
6	730.31	730.52	210	RHS	Fair	
7	732.110	732.150	40	LHS-Median	Fair	
8	732.22	732.25	30	RHS-Median	Fair	
9	732.970	732.985	15	LHS	Fair	
10	732.970	732.985	15	LHS-Median	Fair	
11	732.96	732.99	30	RHS-Median	Fair	
12	733.06	733.08	20	RHS	Fair	
13	734.72	734.75	30	RHS	Fair	
14	734.970	735.000	30	LHS	Fair	
15	734.970	735.000	30	LHS-Median	Fair	
16	734.95	734.99	40	RHS-Median	Fair	
17	735.26	735.28	20	RHS-Median	Fair	
18	735.300	735.310	10	LHS	Fair	
19	735.300	735.310	10	LHS-Median	Fair	
20	736.980	737.000	20	LHS	Fair	
21	736.98	737	20	RHS	Fair	
22	737.11	737.13	20	RHS-Median	Fair	
23	737.180	737.210	30	LHS	Fair	
24	737.180	737.210	30	LHS-Median	Fair	
25	737.56	737.57	10	RHS	Fair	
26	737.600	737.650	50	LHS	Fair	
27	737.600	737.650	50	LHS-Median	Fair	
28	738.010	738.020	10	LHS	Fair	
29	738.010	738.020	10	LHS-Median	Fair	
30	738	738.02	20	RHS	Fair	
31	738.16	738.18	20	RHS	Fair	
32	738.230	738.250	20	LHS	Fair	
33	738.98	739	20	RHS	Fair	
34	739.180	739.200	20	LHS	Fair	
35	739.51	739.53	20	RHS	Fair	
36	739.780	739.790	10	LHS	Fair	
37	739.780	739.790	10	LHS-Median	Fair	
38	740.050	740.060	10	LHS	Fair	
39	740.540	740.565	25	LHS	Fair	
40	740.88	740.9	20	RHS	Fair	
41	741.61	741.64	30	RHS-Median	Fair	
42	741.820	741.835	15	LHS	Fair	
43	741.820	741.835	15	LHS-Median	Fair	
44	741.900	741.910	10	LHS	Fair	
45	742.110	742.120	10	LHS	Fair	
46	742.135	742.15	15	RHS	Fair	
47	743.09	743.11	20	RHS	Fair	
48	743.400	743.420	20	LHS	Fair	
49	743.52	743.53	10	RHS	Fair	
50	743.960	743.975	15	LHS	Fair	

Concrete Crash Barriers as per Site						
S. No.	Design Chainage		Length (m)	Side	Condition	Remarks
	From (km)	To (km)				
51	743.98	743.99	10	RHS	Fair	
52	744.130	744.140	10	LHS	Fair	
53	744.25	744.26	10	RHS	Fair	
54	744.720	744.735	15	LHS	Fair	
55	745.070	745.120	50	LHS	Fair	
56	746.065	746.07	5	RHS	Fair	
57	746.23	746.26	30	RHS	Fair	
58	746.280	746.290	10	LHS	Fair	
59	746.280	746.290	10	LHS-Median	Fair	
60	746.48	746.5	20	RHS	Fair	
61	746.700	746.730	30	LHS	Fair	
62	746.700	746.730	30	LHS-Median	Fair	
63	747.64	747.66	20	RHS-Median	Fair	
64	747.670	747.685	15	LHS	Fair	
65	747.670	747.685	15	LHS-Median	Fair	
66	748.150	748.200	50	LHS	Fair	
67	748.150	748.200	50	LHS-Median	Fair	
68	748.16	748.18	20	RHS-Median	Fair	
69	748.720	748.810	90	LHS	Fair	
70	748.720	748.810	90	LHS-Median	Fair	
71	748.765	748.78	15	RHS	Fair	
72	750.17	750.18	10	RHS	Fair	
73	750.270	750.280	10	LHS	Fair	
74	750.26	750.28	20	RHS	Fair	
75	752.150	752.160	10	LHS	Fair	
76	752.14	752.16	20	RHS	Fair	
77	752.380	752.480	100	LHS	Fair	
78	752.380	752.480	100	LHS-Median	Fair	
79	752.36	752.38	20	RHS	Fair	
80	753.070	753.085	15	LHS	Fair	
81	751.46	753.18	1720	RHS	Fair	
82	753.49	753.51	20	RHS	Fair	
83	753.550	753.580	30	LHS	Fair	
84	753.78	753.8	20	RHS	Fair	
85	753.870	753.890	20	LHS	Fair	
86	755.370	755.390	20	LHS	Fair	
87	755.370	755.390	20	LHS-Median	Fair	
88	755.4	755.42	20	RHS	Fair	
89	755.765	755.78	15	RHS	Fair	
90	755.830	755.840	10	LHS	Fair	
91	756.240	756.250	10	LHS	Fair	
92	756.34	756.36	20	RHS	Fair	
93	756.670	756.685	15	LHS	Fair	
94	756.670	756.685	15	LHS-Median	Fair	
95	756.65	756.68	30	RHS	Fair	
96	756.685	756.910	225	LHS	Fair	
97	756.685	756.910	225	LHS-Median	Fair	
98	757	757.73	730	RHS	Fair	
99	757.750	757.760	10	LHS	Fair	
100	757.750	757.760	10	LHS-Median	Fair	
101	758.120	758.140	20	LHS	Fair	
102	758.13	758.16	30	RHS	Fair	

Concrete Crash Barriers as per Site						
S. No.	Design Chainage		Length (m)	Side	Condition	Remarks
	From (km)	To (km)				
103	758.43	758.45	20	RHS	Fair	
104	758.460	758.470	10	LHS	Fair	
105	758.76	758.78	20	RHS	Fair	
106	758.820	758.850	30	LHS	Fair	
107	759.040	759.060	20	LHS	Fair	
108	759.06	759.08	20	RHS	Fair	
109	759.57	759.84	270	RHS	Fair	
110	759.870	759.880	10	LHS	Fair	
111	759.870	759.880	10	LHS-Median	Fair	
112	759.84	759.87	30	RHS-Median	Fair	
113	761.170	761.185	15	LHS-Median	Fair	
114	761.16	761.18	20	RHS-Median	Fair	
115	763.810	763.830	20	LHS	Fair	
116	763.810	763.830	20	LHS-Median	Fair	
117	763.8	763.83	30	RHS	Fair	
118	764.450	764.470	20	LHS	Fair	
119	764.450	764.470	20	LHS-Median	Fair	
120	764.43	764.45	20	RHS-Median	Fair	
121	765.870	765.900	30	LHS	Fair	
122	765.870	765.900	30	LHS-Median	Fair	
123	765.87	765.89	20	RHS-Median	Fair	
124	767.3	767.32	20	RHS-Median	Fair	
125	767.330	767.340	10	LHS	Fair	
126	767.330	767.340	10	LHS-Median	Fair	
127	768.985	768.990	5	LHS	Fair	
128	768.975	768.99	15	RHS	Fair	
129	770.470	770.480	10	LHS	Fair	
130	770.470	770.480	10	LHS-Median	Fair	
131	770.46	770.48	20	RHS-Median	Fair	
132	773.180	773.190	10	LHS	Fair	
133	773.180	773.190	10	LHS-Median	Fair	
134	773.520	773.535	15	LHS	Fair	
135	773.5	773.54	40	RHS	Fair	
136	795.47	795.49	20	LHS	Fair	
137	795.47	795.49	20	RHS	Fair	
138	796.87	796.89	20	LHS	Fair	
139	796.87	796.89	20	LHS-Median	Fair	
140	796.87	796.89	20	RHS	Fair	
141	796.87	796.89	20	RHS-Median	Fair	
142	797.07	797.09	20	LHS	Fair	
143	797.07	797.09	20	RHS	Fair	
144	798.83	798.85	20	LHS	Fair	
145	798.83	798.85	20	LHS-Median	Fair	
146	798.83	798.85	20	RHS	Fair	
147	798.83	798.85	20	RHS-Median	Fair	
148	796.64	799.66	3020	LHS	Fair	
149	796.64	799.66	3020	RHS	Fair	
150	800.63	800.65	20	LHS	Fair	
151	800.63	800.65	20	RHS	Fair	
152	801.23	801.25	20	LHS	Fair	
153	801.23	801.25	20	RHS	Fair	
154	803.15	803.495	345	LHS	Fair	

Concrete Crash Barriers as per Site						
S. No.	Design Chainage		Length (m)	Side	Condition	Remarks
	From (km)	To (km)				
155	803.15	803.495	345	LHS-Median	Fair	
156	803.15	803.495	345	RHS	Fair	
157	803.15	803.495	345	RHS-Median	Fair	
158	804.95	804.98	30	LHS	Fair	
159	804.95	804.98	30	LHS-Median	Fair	
160	804.95	804.98	30	RHS	Fair	
161	804.95	804.98	30	RHS-Median	Fair	
162	805.74	805.76	20	LHS	Fair	
163	805.74	805.76	20	LHS-Median	Fair	
164	805.74	805.76	20	RHS	Fair	
165	805.74	805.76	20	RHS-Median	Fair	
166	805.875	805.89	15	LHS	Fair	
167	805.875	805.89	15	RHS	Fair	
168	808.07	808.09	20	LHS	Fair	
169	808.07	808.09	20	RHS	Fair	
170	808.48	808.5	20	LHS	Fair	
171	808.48	808.5	20	LHS-Median	Fair	
172	808.48	808.5	20	RHS	Fair	
173	808.48	808.5	20	RHS-Median	Fair	
174	809.07	809.1	30	LHS	Fair	
175	809.07	809.1	30	LHS-Median	Fair	
176	809.07	809.1	30	RHS	Fair	
177	809.07	809.1	30	RHS-Median	Fair	
178	811.21	811.23	20	LHS	Fair	
179	811.21	811.23	20	RHS	Fair	
180	812.51	812.53	20	LHS	Fair	
181	812.51	812.53	20	RHS	Fair	
182	812.84	812.86	20	LHS	Fair	
183	812.84	812.86	20	LHS-Median	Fair	
184	812.84	812.86	20	RHS	Fair	
185	812.84	812.86	20	RHS-Median	Fair	
	Katni Bypass					
186	778.686	779.034	0.348	RHS Shoulder		
187	779.066	779.288	0.222	RHS Shoulder		
188	779.322	779.928	0.606	RHS Shoulder		
189	782.028	782.729	0.701	RHS Shoulder		
190	782.759	783.028	0.269	RHS Shoulder		
191	787.694	788.336	0.642	RHS Shoulder		
192	788.364	788.920	0.556	RHS Shoulder		
193	774.358	774.833	0.475	RHS Shoulder		
194	774.863	774.948	0.085	RHS Shoulder		
195	774.978	776.022	1.044	RHS Shoulder		
196	776.034	776.166	0.132	RHS Shoulder		
197	776.983	777.406	0.423	RHS Shoulder		
198	777.418	777.721	0.303	RHS Shoulder		
199	792.828	793.028	0.200	RHS SR edge		Ramp for VOP
200	792.828	793.028	0.200	RHS Shoulder		Ramp for VOP
201	774.833	774.863	0.030	LHS Shoulder		
202	774.948	774.978	0.030	LHS Shoulder		
203	776.022	776.034	0.012	LHS Shoulder		
204	777.406	777.418	0.012	LHS Shoulder		
205	774.833	774.863	0.030	LHS Median		

Concrete Crash Barriers as per Site						
S. No.	Design Chainage		Length (m)	Side	Condition	Remarks
	From (km)	To (km)				
206	774.948	774.978	0.030	LHS Median		
207	776.022	776.034	0.012	LHS Median		
208	777.406	777.418	0.012	LHS Median		
209	774.833	774.863	0.030	RHS Shoulder		
210	774.948	774.978	0.030	RHS Shoulder		
211	776.022	776.034	0.012	RHS Shoulder		
212	777.406	777.418	0.012	RHS Shoulder		
213	774.833	774.863	0.030	RHS Median		
214	774.948	774.978	0.030	RHS Median		
215	776.022	776.034	0.012	RHS Median		
216	777.406	777.418	0.012	RHS Median		
217	779.034	779.066	0.032	LHS Shoulder		
218	779.288	779.322	0.034	LHS Shoulder		
219	782.729	782.759	0.030	LHS Shoulder		
220	788.336	788.364	0.028	LHS Shoulder		
221	789.938	789.945	0.007	LHS Shoulder		
222	779.034	779.066	0.032	LHS Median		
223	779.288	779.322	0.034	LHS Median		
224	782.729	782.759	0.030	LHS Median		
225	788.336	788.364	0.028	LHS Median		
226	789.938	789.945	0.007	LHS Median		
227	779.034	779.066	0.032	RHS Shoulder		
228	779.288	779.322	0.034	RHS Shoulder		
229	782.729	782.759	0.030	RHS Shoulder		
230	788.336	788.364	0.028	RHS Shoulder		
231	789.938	789.945	0.007	RHS Shoulder		
232	779.034	779.066	0.032	RHS Median		
233	779.288	779.322	0.034	RHS Median		
234	782.729	782.759	0.030	RHS Median		
235	788.336	788.364	0.028	RHS Median		
236	789.938	789.945	0.007	RHS Median		
237	780.404	780.492	0.088	LHS Shoulder		ROB
238	780.404	780.492	0.088	RHS Shoulder		ROB
239	780.404	780.492	0.088	LHS Median		ROB
240	780.404	780.492	0.088	RHS Median		ROB
241	785.707	785.799	0.092	RHS Shoulder		MJB
242	785.707	785.799	0.092	RHS Median		MJB
243	776.600	776.610	0.010	LHS Shoulder		MNB
244	776.600	776.610	0.010	RHS Shoulder		MNB
245	778.280	778.290	0.010	LHS Shoulder		MNB
246	778.280	778.290	0.010	RHS Shoulder		MNB
247	778.360	778.380	0.020	LHS Shoulder		MNB
248	778.360	778.380	0.020	RHS Shoulder		MNB
249	781.310	781.330	0.020	LHS Shoulder		MNB
250	781.310	781.330	0.020	RHS Shoulder		MNB
251	784.020	784.030	0.010	LHS Shoulder		MNB
252	784.020	784.030	0.010	LHS Median		MNB
253	784.020	784.030	0.010	RHS Shoulder		MNB
254	784.020	784.030	0.010	RHS Median		MNB
255	784.970	784.990	0.020	LHS Shoulder		MNB
256	784.970	784.990	0.020	RHS Shoulder		MNB
257	786.025	786.040	0.015	LHS Shoulder		MNB

Concrete Crash Barriers as per Site						
S. No.	Design Chainage		Length (m)	Side	Condition	Remarks
	From (km)	To (km)				
258	786.025	786.040	0.015	RHS Shoulder		MNB
259	790.280	790.295	0.015	LHS Shoulder		MNB
260	790.280	790.295	0.015	RHS Shoulder		MNB
261	790.445	790.495	0.050	RHS Shoulder		MNB
262	790.445	790.495	0.050	RHS Median		MNB
263	791.720	791.735	0.015	LHS Shoulder		MNB
264	791.720	791.735	0.015	RHS Shoulder		MNB
265	792.597	792.637	0.040	LHS Shoulder		VOP
266	792.597	792.637	0.040	RHS Shoulder		VOP
267	792.828	793.028	0.200	LHS Shoulder		VOP Ramp - Junction side
268	792.828	793.028	0.200	LHS Shoulder		
As per Site Total Concrete Crash Barrier(km)			**23.052**			

Pedestrian Guard Railing (PGR) were observed on the separator between the Carriageway and Service Road. Location-wise details are presented below:

Table 22: List of Pedestrian Guard Rails

Pedestrian Guard Rails							
S.no	Design Chainage(km)		Length(m)	Side	Condition	Damage (m)	Gaps observed (m)
	From	To					
1	749.680	750.110	430	RHS	Fair	10	
2	749.700	750.130	430	LHS	Fair		
3	750.480	750.680	200	RHS	Fair	5	
4	750.500	750.700	200	LHS	Fair		10
5	759.290	759.570	280	RHS	Fair		
6	759.320	759.610	290	LHS	Fair	5	
7	759.950	760.370	420	RHS	Fair		
8	759.970	760.460	490	LHS	Fair		
As per Site Total length of PGR's (Km)			**2.730**			**20**	**10**

Road furniture in the form of High masts, Low mast, Highway Lighting and Sign boards have been provided along the project road. All the road related items are presented in **Appendix-6** of this report.

The tables below depict location-wise details of road furniture.

Table 23: Locations of High mast lighting

High mast Lighting-as per site						
S.No.	Ex. Chainage (Km)	Side	Facility, if any	Location	Condition	Remarks
1	734+200	LHS	Junction	Shoulder	Fair	
2	735+900	LHS	Junction	Shoulder	Fair	
3	739+000	LHS	Toll Plaza	Shoulder	Fair	
4	739+000	LHS	Toll Plaza	Shoulder	Fair	
5	739+000	RHS	Toll Plaza	Shoulder	Fair	
6	739+000	RHS	Toll Plaza	Shoulder	Fair	
7	741+000	LHS	Junction	Shoulder	Fair	

High mast Lighting-as per site						
S.No.	Ex. Chainage (Km)	Side	Facility, if any	Location	Condition	Remarks
8	743+000	LHS	Junction	Shoulder	Fair	
9	751+800	LHS	Junction	Shoulder	Fair	
10	753+200	LHS	Junction	Shoulder	Fair	
11	755+200	RHS	Junction	Shoulder	Fair	
12	758+250	LHS	Junction	Shoulder	Fair	
13	761+650	RHS	Junction	Shoulder	Fair	
14	766+000	LHS	Junction	Shoulder	Fair	
15	774+800	MEDIAN	Junction	Median	Fair	
16	775+900	RHS	Junction	Median	Fair	
17	792+600	LHS	Junction	Shoulder	Fair	
18	803+000	LHS	Junction	Shoulder	Fair	

Table 24: Locations of Highway Lighting

Highway Lighting-as per site								
S.No.	Chainage (km)		Location	Length (km)	No. of Light poles		Damage (Nos.)	Remarks
	From	To			Single arm	Double arm		
1	728.4	728.6	RHS	0.20	7			
2	728.6	728.8	RHS	0.20	7			
3	729.11	729.65	LHS	0.54		18		
4	729.14	729.65	LHS	0.51	17			
5	731.7	731.9	RHS	0.20	7			
6	732.05	732.25	LHS	0.20	7			
7	735.3	735.55	LHS	0.25	22			
8	736.2	736.4	RHS	0.20	7			
9	736.3	736.5	Median	0.20	7			
10	738.4	739	RHS	0.60	20			
11	738.55	738.75	LHS	0.20	2			
12	738.75	738.8	RHS	0.05		8		
13	739.3	740.2	RHS	0.90		25	1	Bulb
14	739.3	740.2	LHS	0.90	20		1	Bulb
15	740.5	740.7	RHS	0.20	7			
16	740.5	740.7	LHS	0.20	7			
17	741.3	741.9	RHS	0.60	20		1	Bulb
18	744.5	744.7	RHS	0.20	7			
19	744.5	744.7	Median	0.20	7			
20	749.7	750.8	RHS	1.10		34		
21	749.7	750.8	RHS	1.10	34			
22	749.7	750.8	LHS	1.10	34		1	Arm
23	751	751.2	LHS	0.20	7			

Highway Lighting-as per site								
S.No.	Chainage (km)		Location	Length (km)	No. of Light poles		Damage (Nos.)	Remarks
	From	To			Single arm	Double arm		
24	751	751.2	RHS	0.20	7			
25	752.26	752.5	Median	0.24	16			
26	757.55	757.75	Median	0.20	12			
27	758.45	758.65	LHS	0.20	7			
28	758.45	758.65	RHS	0.20	7			
29	759.26	760.4	Median	1.14		33		
30	759.26	760.4	LHS	1.14	34			
31	759.26	760.4	RHS	1.14	33			
32	761	761.2	Median	0.20	7			
33	761	761.2	LHS	0.20	6		1	Pole
34	763.7	764	RHS	0.30	22			
35	767.12	767.8	LHS	0.68		24		
36	767.12	767.8	Median	0.68	24			
37	767.12	767.8	RHS	0.68	24		1	Pole
38	767.6	767.8	LHS	0.20	7			
39	768.2	768.4	Median	0.20	7			
40	769.5	769.7	Median	0.20	7			
41	770.1	770.8	RHS	0.70		17		
42	770.1	770.8	LHS	0.70	17			
43	770.1	770.8	Median	0.70	17			
44	770.85	771.75	RHS	0.90	35			
45	794.17	794.5	RHS	0.33	12			
46	794.38	795.1	Median	0.72		23		
47	794.38	795.1	LHS	0.72	25			
48	794.38	795.1	Median	0.72	25			
49	795.78	795.98	RHS	0.20	7			
50	798.15	798.25	LHS	0.10	7			
51	798.2	798.4	Median	0.20	7			
52	798.55	799.6	LHS	1.05		32	2	Bulb
53	799.1	799.3	Median	0.20	10		1	Pole
54	799.1	799.3	Median	0.20	10			
55	799.8	800.1	Median	0.30	12			
Total				**25.590**	**650**	**214**	**9**	

Table 25: Details of Road Signs along Project Road

Description	LHS (Nos.)	RHS (Nos.)	Junctions (Nos.)	Total (Nos.)
Octagonal	0	2	40	42
Circular	53	47	1	101
Triangular	56	63	29	148
Rectangular	69	76	32	177
Facility informatory	13	16		29
Chevron	96	102		198
Hazard	104	84	14	202
Route Marker	17	22		39
Safety Boards	0	0		0
Toll Boards	6	6		12
Cantilever Gantry	16	15		31
Over Head Gantry	4	3	4	11
Variable Message Sign	0	0		0
Project Descriptive	0	0		0
Total	**434**	**436**	**120**	**990**

The project road has total 32 Nos. of Bus Bays & Bus shelters along the highway. In that, 31 Nos. are Bus Bay with shelters & 1 No. is Bus bay. Facilities like Highway lighting was observed. The most of the Bus bay with shelters are in fair condition, the details were presented in below.

Table 26: Details of Bus Bays with Shelters

Bus Bays & Bus Shelters as per Site							
S. No.	Existing Chainage (km)	Side	As per Site	Facilities Provided		Separator	Remarks
				PGR	Single arm Lightings		
1	728+300	RHS	Bus Bay	-	7	No	
2	728+550	LHS	Bus Bay with Shelter	-	7	No	
3	731+850	RHS	Bus Bay with Shelter	-	7	No	
4	732+060	LHS	Bus Bay with Shelter	-	7	No	
5	736+250	RHS	Bus Bay with Shelter	-	7	No	
6	736+350	LHS	Bus Bay with Shelter	-	7	No	
7	740+530	RHS	Bus Bay with Shelter	-	7	No	
8	740+540	LHS	Bus Bay with Shelter	-	7	No	
9	744+640	LHS	Bus Bay with Shelter	-	7	No	
10	744+640	RHS	Bus Bay with Shelter	-	7	No	
11	751+050	RHS	Bus Bay with Shelter	-	7	No	
12	751+050	LHS	Bus Bay with Shelter	-	7	No	
13	758+600	LHS	Bus Bay with Shelter	-	7	No	
14	758+580	RHS	Bus Bay with Shelter	-	7	No	
15	761+030	RHS	Bus Bay with Shelter	-	7	No	
16	761+030	LHS	Bus Bay with Shelter	-	7	No	

Bus Bays & Bus Shelters as per Site							
S. No.	Existing Chainage (km)	Side	As per Site	Facilities Provided		Separator	Remarks
				PGR	Single arm Lightings		
17	767+780	LHS	Bus Bay with Shelter	-	7	No	
18	768+190	RHS	Bus Bay with Shelter	-	7	No	
19	769+550	RHS	Bus Bay with Shelter	-	7	No	
20	769+700	LHS	Bus Bay with Shelter	-	7	No	
21	778+565	LHS	Bus Bay with Shelter	-	7	No	
22	778+565	RHS	Bus Bay with Shelter	-	7	No	
23	782+260	RHS	Bus Bay with Shelter	-	7	No	
24	782+310	LHS	Bus Bay with Shelter	-	7	No	
25	787+830	LHS	Bus Bay with Shelter	-	7	No	
26	788+281	RHS	Bus Bay with Shelter	-	7	No	
27	794+350	LHS	Bus Bay with Shelter	-	7	No	
28	795+900	RHS	Bus Bay with Shelter	-	7	No	
29	798+150	RHS	Bus Bay with Shelter	-	7	No	
30	798+180	LHS	Bus Bay with Shelter	-	7	No	
31	806+250	RHS	Bus Bay with Shelter	-	7	No	
32	806+270	LHS	Bus Bay with Shelter	-	7	No	

The Project Road has 4 Nos. of Truck laybyes on both sides at two locations. The truck laybyes are provided with rigid pavement and the condition appears to be fair to poor. Separator is provided between main carriageway and truck lay bye portion.

Table 27: Details of Truck laybyes

Truck Laybyes											
S. No.	Chainage (km)	Length (m)	Side	Type of Road	Width (m)	Separator Details				Toilet blocks	Rest room
						Length (m)	Width (m)	Kerb Height(m)	Kerb width(m)		
1	771+700	240	BHS	Rigid Pavement	7	100	0.8	0.18	0.11	Yes	No
2	794+700	240	BHS	Paver Blocks	7	100	0.8	0.18	0.11	Yes	No

3.2 STRUCTURES

List of Major structures found during the inventory surveys along the corridor are as follows:

Table 28: Details of Major Structures along Project Road

S No.	Chainage (km)	Type of Str	Side	Structure on	Age of Structure	Span Arrangement (No x Length, m)	No. of Decks	Deck width(m)	Remarks
1	729+345	PUP	LHS	MCW	New	1 x 7	1	12.50	-
2	729+345	PUP	RHS	MCW	New	1 x 7	1	12.50	-
3	732+227	MNB	LHS	MCW	New	2 x 7.3	1	12.50	-
4	732+227	MNB	RHS	MCW	Old	2 x 7.3	1	12.50	-
5	732+964	MNB	LHS	MCW	New	2 x 7.43	1	12.50	-
6	732+964	MNB	RHS	MCW	New	2 x 7.43	1	12.50	-
7	735+000	MNB	LHS	MCW	New	1 x 21.7	1	12.50	-
8	735+000	MNB	RHS	MCW	New	1 x 21.7	1	12.50	-
9	735+255	PUP	LHS	MCW	New	1 x 8.5	1	12.50	-
10	735+255	PUP	RHS	MCW	New	1 x 8.5	1	12.50	-
11	737+167	MNB	LHS	MCW	New	1 x 6.5	1	12.50	-
12	737+167	MNB	RHS	MCW	New	1 x 6.5	1	12.50	-
13	739+760	PUP	LHS	MCW	New	1 x 7	1	12.75	-
14	739+760	PUP	RHS	MCW	New	1 x 7	1	12.75	-
15	741+920	PUP	LHS	MCW	New	1 x 7	1	12.50	-
16	741+920	PUP	RHS	MCW	New	1 x 7	1	12.50	-
17	742+120	MNB	LHS	SR	New	1 x 8.6	1	10.80	-
18	742+120	MNB	LHS	MCW	New	1 x 8.6	1	11.00	-
19	742+120	MNB	RHS	MCW	New	1 x 8.6	1	11.00	-
20	746+260	MNB	LHS	MCW	New	1 x 7	1	12.50	-
21	746+260	MNB	RHS	MCW	Old	1 x 7	1	12.00	-
22	746+555	MNB	LHS	MCW	New	2 x 4.5	1	12.50	-
23	746+555	MNB	RHS	MCW	New	2 x 4.5	1	12.50	-
24	747+700	MNB	LHS	MCW	New	1 x 18	1	12.50	-
25	747+700	MNB	RHS	MCW	Old	2 x 9	1	12.00	-
26	748+200	MNB	LHS	MCW	New	3 x 13.5	1	12.50	-
27	748+200	MNB	RHS	MCW	Old	3 x 13.5	1	12.50	-
28	750+300	PUP	LHS	MCW	New	1 x 7	1	12.50	-
29	750+300	PUP	RHS	MCW	New	1 x 7	1	12.50	-
30	752+432	PUP	LHS	MCW	New	1 x 7	1	12.75	-
31	752+432	PUP	RHS	MCW	New	1 x 7	1	12.75	-
32	755+420	MNB	LHS	MCW	New	1 x 22.2	1	12.50	-
33	755+420	MNB	RHS	MCW	New	1 x 22.2	1	12.50	-
34	756+654	PUP	LHS	MCW	New	1 x 7	1	12.50	-
35	756+654	PUP	RHS	MCW	New	1 x 7	1	12.50	-
36	757+730	PUP	LHS	MCW	New	1 x 7	1	12.50	-
37	757+730	PUP	RHS	MCW	New	1 x 7	1	12.50	-
38	759+806	PUP	LHS	MCW	New	1 x 7	1	12.50	-
39	759+806	PUP	RHS	MCW	New	1 x 7	1	12.50	-
40	761+138	MNB	LHS	MCW	New	2 x 4.5	1	12.50	-
41	761+138	MNB	RHS	MCW	New	2 x 4.5	1	12.50	-
42	763+275	MNB	LHS	MCW	New	3 x 5	1	12.50	-
43	763+275	MNB	RHS	MCW	New	3 x 5	1	12.50	-
44	763+812	VUP	LHS	MCW	New	1 x 16.2	1	12.50	-
45	763+812	VUP	RHS	MCW	New	1 x 16.2	1	12.50	-
46	764+414	MNB	LHS	MCW	New	1 x 21	1	12.50	-
47	764+414	MNB	RHS	MCW	New	1 x 21	1	12.50	-

S No.	Chainage (km)	Type of Str	Side	Structure on	Age of Structure	Span Arrangement (No x Length, m)	No. of Decks	Deck width(m)	Remarks
48	765+825	MNB	LHS	MCW	New	1 x 21	1	12.50	-
49	765+825	MNB	RHS	MCW	New	1 x 21	1	12.50	-
50	766+911	MNB	LHS	SR	New	1 x 9.4	1	10.80	-
51	766+911	MNB	LHS	MCW	New	1 x 9.4	1	11.00	-
52	766+911	MNB	RHS	MCW	New	1 x 9.4	1	11.00	-
53	766+911	MNB	RHS	SR	New	1 x 9.4	1	10.80	-
54	767+311	PUP	LHS	MCW	New	1 x 7	1	12.50	-
55	767+311	PUP	RHS	MCW	New	1 x 7	1	12.50	-
56	770+405	PUP	LHS	MCW	New	1 x 7	1	12.50	-
57	770+405	PUP	RHS	MCW	New	1 x 7	1	12.50	-
58	773+213	PUP	LHS	MCW	New	1 x 7	1	12.50	-
59	773+213	PUP	RHS	MCW	New	1 x 7	1	12.50	-
60	774+620	Flyover	LHS	MCW	New	1 x 30	1	14.50	Under Construction
61	774+620	Flyover	RHS	MCW	New	1 x 30	1	14.50	Under Construction
62	774+735	Flyover	LHS	MCW	New	1 x 30	1	14.50	Under Construction
63	774+735	Flyover	RHS	MCW	New	1 x 30	1	14.50	Under Construction
64	775+800	LVUP	LHS	MCW	New	1 x 12	1	13.50	Under Construction
65	775+800	LVUP	RHS	MCW	New	1 x 12	1	13.50	Under Construction
66	776+603	MNB	LHS	MCW	New	3 x 3	1	14.50	Under Construction
67	776+603	MNB	RHS	MCW	New	3 x 3	1	14.50	Under Construction
68	777+184	LVUP	LHS	MCW	New	1 x 12	1	13.50	Under Construction
69	777+184	LVUP	RHS	MCW	New	1 x 12	1	13.50	Under Construction
70	778+283	MNB	LHS	MCW	New	3 x 3	1	14.50	Under Construction
71	778+283	MNB	RHS	MCW	New	3 x 3	1	14.50	Under Construction
72	778+375	MNB	LHS	MCW	New	4 x 3	1	14.50	Under Construction
73	778+375	MNB	RHS	MCW	New	4 x 3	1	14.50	Under Construction
74	778+822	VUP	LHS	MCW	Old	3 x 10.45	1	12.00	-
75	778+822	VUP	RHS	MCW	New	3 x 10.45	1	14.50	Under Construction
76	779+077	VUP	LHS	MCW	Old	3 x 11.6	1	12.00	-
77	779+077	VUP	RHS	MCW	New	3 x 11.6	1	14.50	Under Construction
78	780+320	ROB	LHS	MCW	Old	1 x 25 + 1 x 23.25 + 1 x 25.6	1	12.00	-
79	780+320	ROB	RHS	MCW	New	1 x 31.2 + 1 x 25.2 + 1 x 31.2	1	14.50	Under Construction
80	780+570	MNB	LHS	MCW	Old	3 x 3	1	12.50	-
81	780+570	MNB	RHS	MCW	New	3 x 3	1	12.50	Under Construction

S No.	Chainage (km)	Type of Str	Side	Structure on	Age of Structure	Span Arrangement (No x Length, m)	No. of Decks	Deck width(m)	Remarks
82	781+325	MNB	LHS	MCW	New	5 x 3	1	12.50	Under Construction
83	781+325	MNB	RHS	MCW	New	5 x 3	1	12.50	Under Construction
84	782+516	VUP	LHS	MCW	Old	3 x 9	1	12.00	-
85	782+516	VUP	RHS	MCW	New	3 x 9	1	14.50	Under Construction
86	784+030	MNB	LHS	MCW	New	3 x 2.6	1	12.50	Under Construction
87	784+030	MNB	RHS	MCW	New	3 x 2.6	1	12.50	Under Construction
88	784+980	MNB	LHS	MCW	New	3 x 3	1	12.50	Under Construction
89	784+980	MNB	RHS	MCW	New	3 x 3	1	12.50	Under Construction
90	785+625	MJB	LHS	MCW	Old	1 x 30.2 + 1 x 30.5 + 1 x 30.5	1	12.00	-
91	785+625	MJB	RHS	MCW	New	1 x 30.7 + 1 x 30.3 + 1 x 30.7	1	14.50	Under Construction
92	786+032	MNB	LHS	MCW	New	3 x 3	1	12.50	Under Construction
93	786+032	MNB	RHS	MCW	New	3 x 3	1	12.50	Under Construction
94	788+122	VUP	LHS	MCW	Old	3 x 9	1	12.00	-
95	788+122	VUP	RHS	MCW	New	3 x 9	1	14.50	Under Construction
96	789+713	PUP	LHS	MCW	Old	1 x 6.2	1	12.00	-
97	789+713	PUP	RHS	MCW	New	1 x 7	1	14.45	Under Construction
98	790+287	MNB	LHS	MCW	New	3 x 3	1	12.50	Under Construction
99	790+287	MNB	RHS	MCW	New	3 x 3	1	12.50	Under Construction
100	790+470	MNB	LHS	MCW	Old	2 x 23.8	1	12.50	-
101	790+470	MNB	RHS	MCW	New	2 x 23.8	1	12.50	Under Construction
102	791+730	MNB	LHS	MCW	New	3 x 3	1	12.50	Under Construction
103	791+730	MNB	RHS	MCW	New	3 x 3	1	12.50	Under Construction
104	792+389	VOP	BHS	MCW	New	2 x 20	2	14.50	Under Construction
105	795+480	PUP	LHS	MCW	New	1 x 7	1	12.50	-
106	795+480	PUP	RHS	MCW	New	1 x 7	1	12.50	-
107	798+694	MNB	LHS	SR	New	1 x 10	1	10.80	-
108	798+694	MNB	LHS	MCW	New	1 x 10	1	11.00	-
109	798+694	MNB	RHS	MCW	New	1 x 10	1	11.00	-
110	798+694	MNB	RHS	SR	New	1 x 10	1	10.80	-
111	798+924	PUP	LHS	MCW	New	1 x 7	1	12.50	-
112	798+924	PUP	RHS	MCW	New	1 x 7	1	12.50	-
113	799+665	MNB	LHS	MCW	New	2 x 6.4	1	12.50	-
114	799+665	MNB	RHS	MCW	New	2 x 6.4	1	12.50	-
115	800+085	MNB	LHS	MCW	New	1 x 9.7	1	12.50	-

S No.	Chainage (km)	Type of Str	Side	Structure on	Age of Structure	Span Arrangement (No x Length, m)	No. of Decks	Deck width(m)	Remarks
116	800+085	MNB	RHS	MCW	Old	1 x 9.7	1	12.50	-
117	800+617	MNB	LHS	MCW	New	1 x 10.4	1	12.50	-
118	800+617	MNB	RHS	MCW	Old	1 x 10.4	1	12.50	-
119	801+260	MNB	LHS	MCW	New	1 x 6.3	1	12.50	-
120	801+260	MNB	RHS	MCW	Old	1 x 6.3	1	12.50	-
121	804+975	PUP	LHS	MCW	New	1 x 7	1	12.50	-
122	804+975	PUP	RHS	MCW	New	1 x 7	1	12.50	-
123	805+540	MNB	LHS	MCW	New	1 x 12.15	1	12.50	-
124	805+540	MNB	RHS	MCW	New	1 x 12.15	1	12.50	-
125	808+510	LVUP	LHS	MCW	New	1 x 12	1	14.50	New Construction proposed as per schedule B
126	808+510	LVUP	RHS	MCW	New	1 x 12	1	14.50	New Construction proposed as per schedule B
127	809+117	MNB	LHS	MCW	New	3 x 18	1	12.50	-
128	809+117	MNB	RHS	MCW	New	3 x 18	1	12.50	-
129	809+740	VUP	LHS	MCW	New	1 x 12	1	12.50	-
130	809+740	VUP	RHS	MCW	New	1 x 12	1	12.50	-
131	810+650	LVUP	LHS	MCW	New	1 x 12	1	14.50	New Construction proposed as per schedule B
132	810+650	LVUP	RHS	MCW	New	1 x 12	1	14.50	New Construction proposed as per schedule B
133	812+912	MNB	LHS	MCW	Old	1 x 9.4	1	12.10	-
134	812+912	MNB	RHS	MCW	New	1 x 9.4	1	12.50	-

3.3 BALANCE WORKS

Katni bypass consists of 18.997 km length, from Km 774+068 to Km 793+065 is under-construction including its associated structural works. Presently, about 9km length of road works are completed.

4.1 EMBANKMENT & SUBGRADE

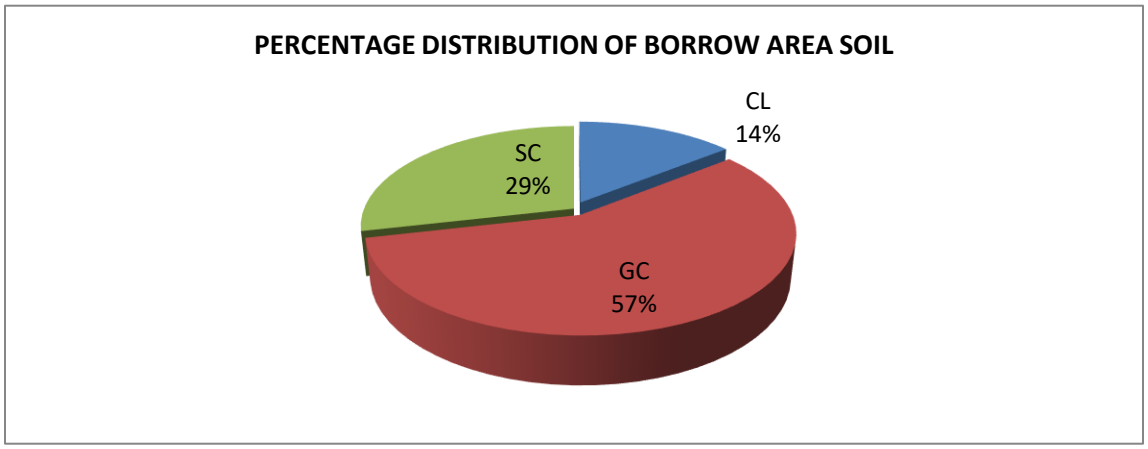
The embankment for project road has been constructed with available soils from nearby areas. Borrow pits sample reveal that the soil collected primarily belong to coarse grain soil type. Out of 7 samples collected from borrow areas, 4 samples belongs to GC type of soil, 2 samples belongs to SC type of soil and 1 sample belongs to CL type of soil.

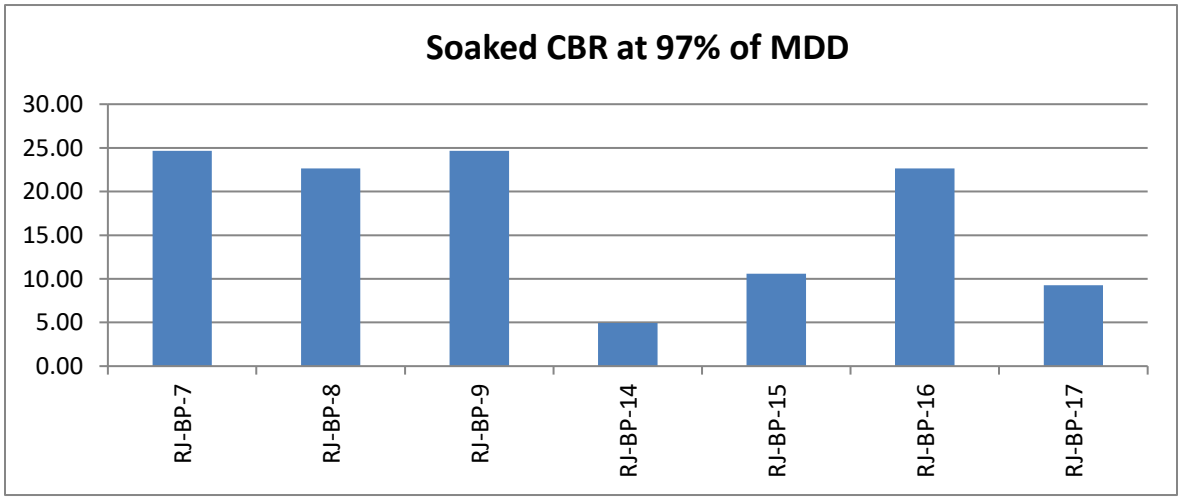
The test results of borrow area soils related to soil classification, percentage distribution of grain size, Atterberg limits and other properties are as presented below.

Table 29: Test Results of Borrow area Samples Details

Lab Sample No	Site Identification		Grain Size Analysis					Atterberg Limits (%)			Soil Class	MDD (gm/cc)	OMC (%)	Dry Density at 97% MDD	Soaked CBR 97% MDD	Free Swelling Index (%)
	Location (km)	Up/Dn	Percentage passing from					LL	PL	PI						
			4.75 mm IS Sieve	425 mics IS Sieve	75 mics IS Sieve	Gravel %	Sand %									
RJ-BP-7	809+700	RHS	49.36	18.27	15.62	50.64	33.74	28	19	9	GC	2.22	10.20	2.15	24.67	21
RJ-BP-8	795+100	LHS	60.62	34.77	31.93	39.38	28.69	46	25	21	GC	2.11	12.40	2.05	22.64	20
RJ-BP-9	779+000	RHS	61.97	36.35	26.65	38.03	35.32	33	19	14	GC	2.18	10.00	2.11	24.67	15
RJ-BP-14	730+900	RHS	78.08	56.87	44.24	21.92	33.84	33	22	11	SC	1.94	10.40	1.88	4.96	14
RJ-BP-15	746+300	RHS	91.28	71.54	59.7	8.72	31.58	35	19	16	CL	1.99	9.80	1.93	10.57	17
RJ-BP-16	766+100	RHS	48.93	36.23	31.02	51.07	17.91	44	22	22	GC	2.05	11.60	1.99	22.64	22
RJ-BP-17	782+700	RHS	87.91	54.08	46.31	12.09	41.6	36	20	16	SC	1.97	12.60	1.91	9.25	27

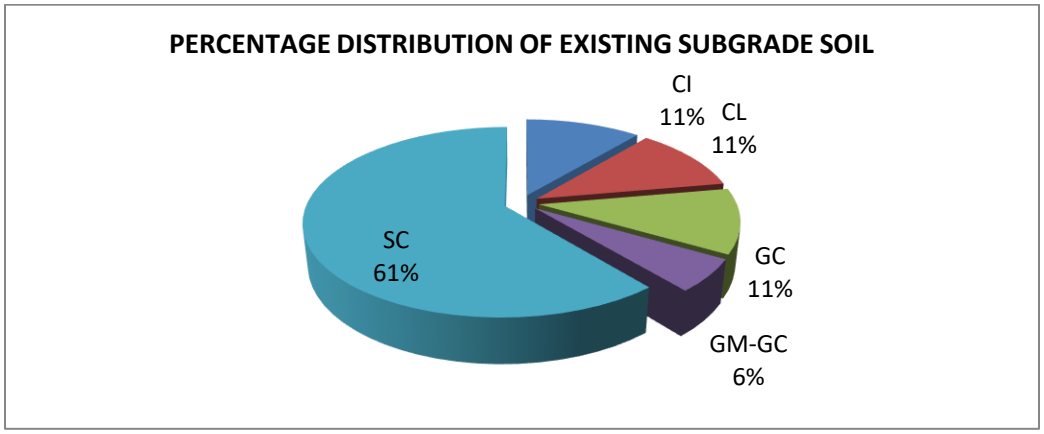
Pie chart showing the percentage distribution of soil classification of Borrow area sample is presented below:





The subgrade samples collected from test pit locations have sent for laboratory for testing. Soil classification has been done in accordance to IS Classification of Soils (ISC) as detailed in IS 1498 - 1978. Laboratory test results indicate that all the Subgrade soil samples collected belongs to Coarse Grained Soil. From existing road, 17 Nos. of subgrade samples and 1 No. of sample from Katni bypass construction site have been collected. Out of 18 samples, 11 samples belong to SC type of soil, 2 samples belong to CL type of soil, 2 samples belong to CI type of soil, 2 samples belong to GC type of soil and 1 sample belongs to GM-GC type of soil.

Pie Chart showing the percentage distribution of soil classification of existing subgrade sample is presented below:

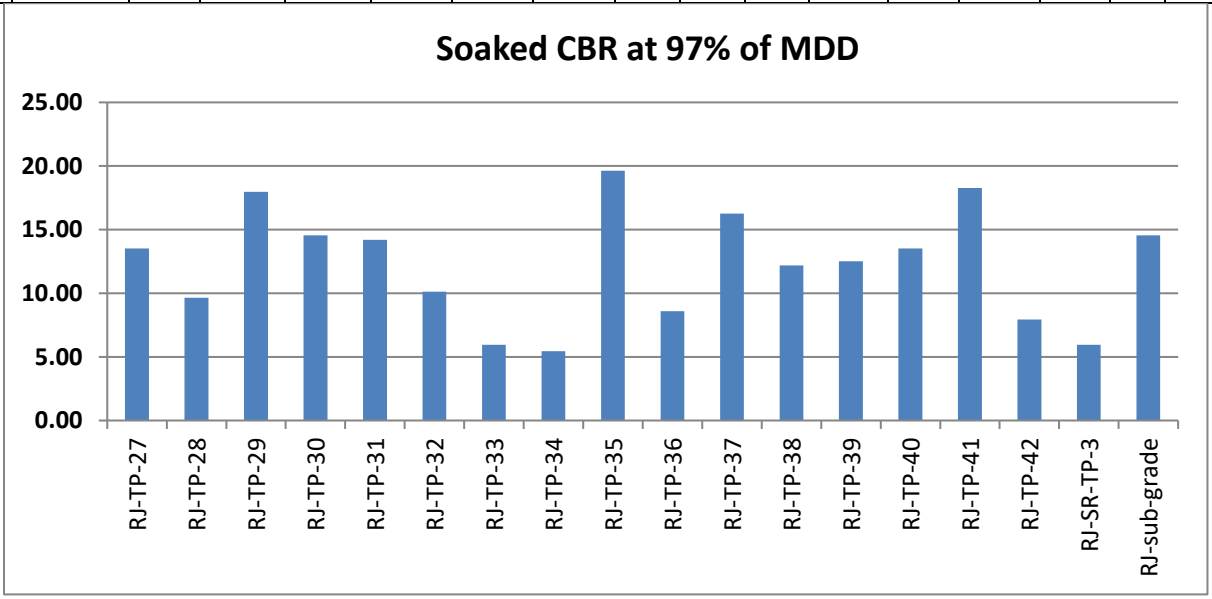


Soil classification, percentage distribution from grain size analysis, soaked CBR and other engineering properties of the subgrade samples are presented below

Table 30: Test results of Existing Subgrade Soils

Lab Sample No	Site Identification		Grain Size Analysis					Atterberg Limits (%)			Soil Class	MDD (gm/cc)	OMC (%)	FDD (gm/cc)	COMPACTION (%)	Dry Density at 97% MDD	Soaked CBR 97% MDD	Free Swelling Index (%)
	Location (km)	Up/Dn	Percentage passing from					LL	PL	PI								
			4.75 mm IS Sieve	425 mic IS Sieve	75 mic IS Sieve	Gravel %	Sand %											
RJ-TP-27	726+900	LHS	74.80	44.98	39.69	25.2	35.11	32	18	14	SC	2.00	10.00	1.80	90	1.94	13.53	16
RJ-TP-28	736+600	LHS	74.31	47.64	38.14	25.69	36.17	30	16	14	SC	1.96	10.80	1.81	93	1.90	9.64	26
RJ-TP-29	746+200	LHS	48.21	15.56	11.17	51.79	37.04	21	15	6	GM-GC	2.21	6.90	1.98	90	2.14	17.96	19
RJ-TP-30	756+100	LHS	66.55	40.51	26.13	33.45	40.42	22	13	9	SC	2.15	8.60	1.95	91	2.09	14.54	10
RJ-TP-31	766+700	LHS	68.78	46.04	36.40	31.22	32.38	26	18	8	SC	2.04	9.40	1.94	95	1.98	14.21	13
RJ-TP-32	794+200	LHS	80.52	57.92	46.87	19.48	33.65	39	21	18	SC	2.06	8.60	1.89	92	2.00	10.12	24
RJ-TP-33	804+100	LHS	95.57	86.34	73.94	4.43	21.63	39	20	19	CI	1.85	12.60	1.80	97	1.79	5.94	36
RJ-TP-34	808+800	RHS	66.56	42.5	31.86	33.44	34.7	37	19	18	SC	1.85	11.70	1.79	96	1.79	5.45	17
RJ-TP-35	800+000	RHS	62.38	39.45	30.51	37.62	31.87	30	16	14	GC	2.10	11.40	1.96	93	2.04	19.62	15
RJ-TP-36	776+550	LHS	84.54	64	55.31	15.46	29.23	35	18	17	CL	1.99	11.80	1.82	92	1.93	8.59	24
RJ-TP-37	776+400	RHS	76.70	27.02	20.92	23.3	55.78	33	18	15	SC	2.15	9.00	1.93	90	2.09	16.25	16
RJ-TP-38	771+000	RHS	58.83	33.18	24.91	41.17	33.92	27	16	11	GC	2.08	7.80	1.90	91	2.02	12.18	25
RJ-TP-39	760+950	RHS	66.12	38.66	29.53	33.88	36.59	25	16	9	SC	2.08	9.20	1.96	94	2.02	12.51	25
RJ-TP-40	750+950	RHS	62.71	26.23	21.89	37.29	40.82	28	12	16	SC	1.99	10.40	1.85	93	1.93	13.53	25
RJ-TP-41	740+600	RHS	75.67	46.07	35.88	24.33	39.79	30	17	13	SC	2.06	8.80	1.88	91	2.00	18.26	22

Lab Sample No	Site Identification		Grain Size Analysis					Atterberg Limits (%)			Soil Class	MDD (gm/cc)	OMC (%)	FDD (gm/cc)	COMPACTION (%)	Dry Density at 97% MDD	Soaked CBR 97% MDD	Free Swelling Index (%)
	Location (km)	Up/Dn	Percentage passing from					LL	PL	PI								
			4.75 mm IS Sieve	425 mic IS Sieve	75 mic IS Sieve	Gravel %	Sand %											
RJ-TP-42	730+000	RHS	86.51	76.64	67.22	13.49	19.29	32	19	13	CL	1.85	12.20	1.77	96	1.79	7.93	25
RJ-SR-TP-3	767+500	LHS	98.85	96.04	92.43	1.15	6.42	48	25	23	CI	1.85	12.80	1.82	98	1.79	5.94	48
RJ-sub-grade	774+500	RHS	71.87	34.73	27.36	28.13	44.51	38	20	18	SC	2.13	9.00	-	-	2.07	14.54	17



The following observations can be made from the above test results conducted on of existing subgrade samples

- Maximum Dry Density for all subgrade samples varies between 1.85 gm/cc and 2.21 gm/cc. all 18 samples satisfying the MDD criterion (MDD>=1.75 gm/cc).
- OMC for existing subgrade samples varies in between 6.90% to 12.8%.
- Free Swelling Index for existing subgrade samples varies in between 10% to 48%. All 18 samples satisfying the FSI criterion (FSI<=50%)
- Compaction levels are lower than the standard value (<97% of MDD) at many points.
- CBR Values are varying 5.4% to 19.6%

Material test reports are provided in **Appendix-7** of this report.

Aggregates to be used for sub-base, base, surface courses and concrete works have been collected from the crushers under operation from the existing quarries. The Table below represents the test results of the Aggregate and Sand Samples

Table 31: Test Results of Aggregate Samples Details

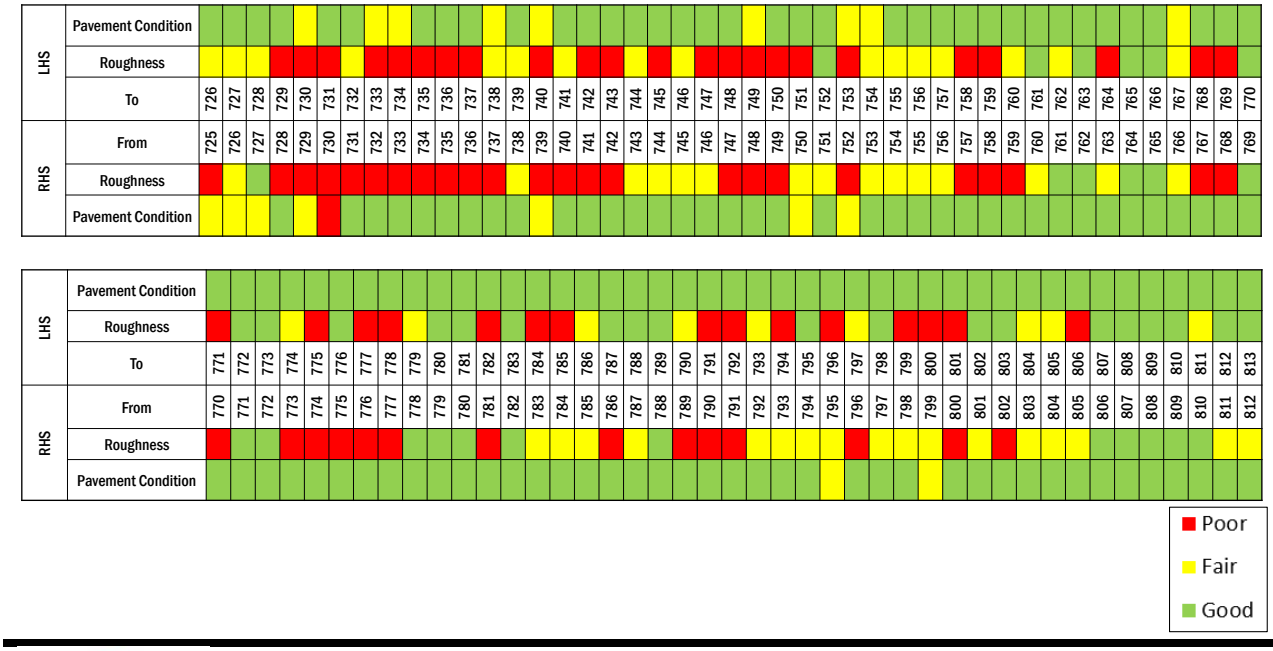
S. No	Sample	Location (km)	Up/ Dn	A.I.V (%)	Water Absorption (%)	Specific Gravity	Remark
1	RJ-AQ-1	828+000	RHS	7.83	0.20	2.91	
2	RJ-AQ-2	702+600	RHS	15.47	0.28	2.71	
3	RJ-AQ-3	702+600	RHS	10.81	0.30	2.71	

Table 32: Test Results of Sand Samples Details

S No	Sample No	CHAINAGE (KM)	SIDE	10 mm Passing %	4.75 mm Passing %	2.36 mm Passing %	1.18mm Passing %	600mm Passing %	300mm Passing %	150mm Passing %	FM	ZONE	REMARKS
1	RJ-SQ-1	843+500	RHS	100	90	85	77	64	23	2	**2.60**	**ZONE-III**	
2	RJ-SQ-2	844+000	LHS	100	90	81	69	54	21	4	**2.82**	**ZONE-II**	
3	RJ-SQ-3	714+700	LHS	100	95	91	83	64	12	1	**2.54**	**ZONE-III**	

4.2 PAVEMENT CONDITION

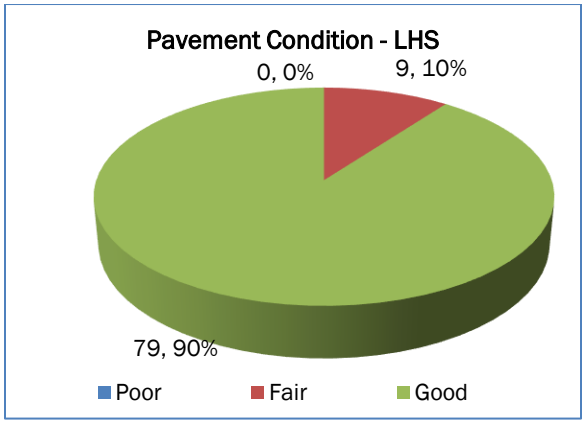
The distresses in bituminous surface have been captured on the project corridor for each lane separately by using the Network Survey Vehicle (NSV).

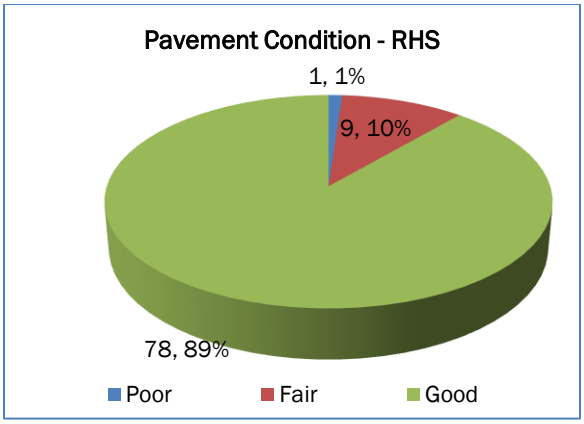


Pavement Condition report covering the data collection for each km length in each direction has been presented in the **Annexure-2.**

Based on IRC: SP: 83-2018 guidelines the summary of the pavement distresses the following rehabilitation measures for rigid panels have be considered.

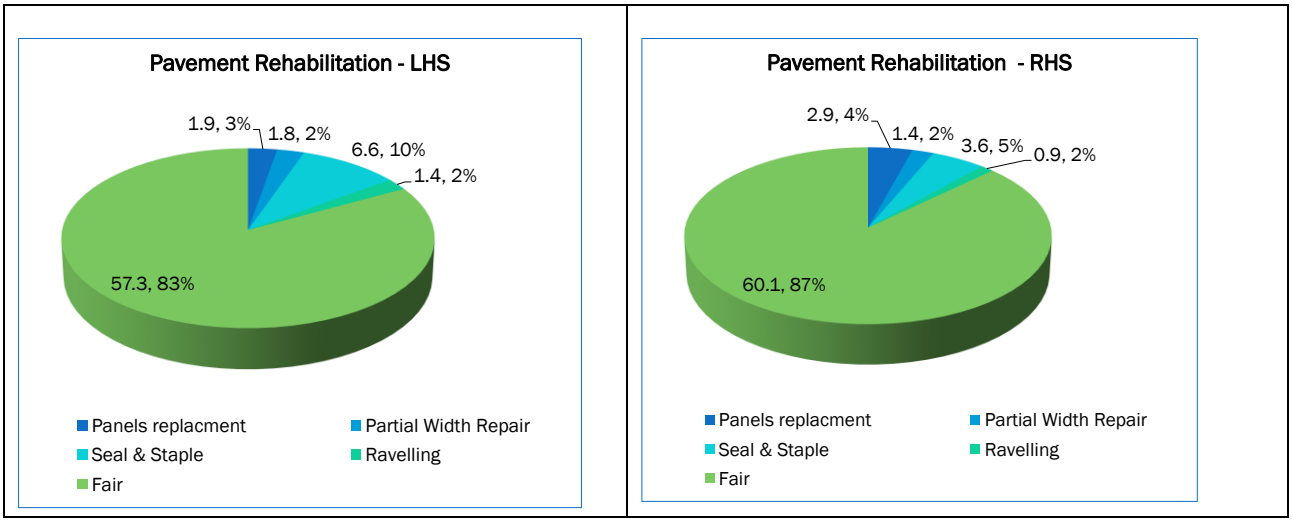
The overall pavement condition rated from good to poor is presented in pie-chart as below.





The suggested Pavement rehabilitation in terms of No. of panels based on visual pavement condition are as:

| | | |

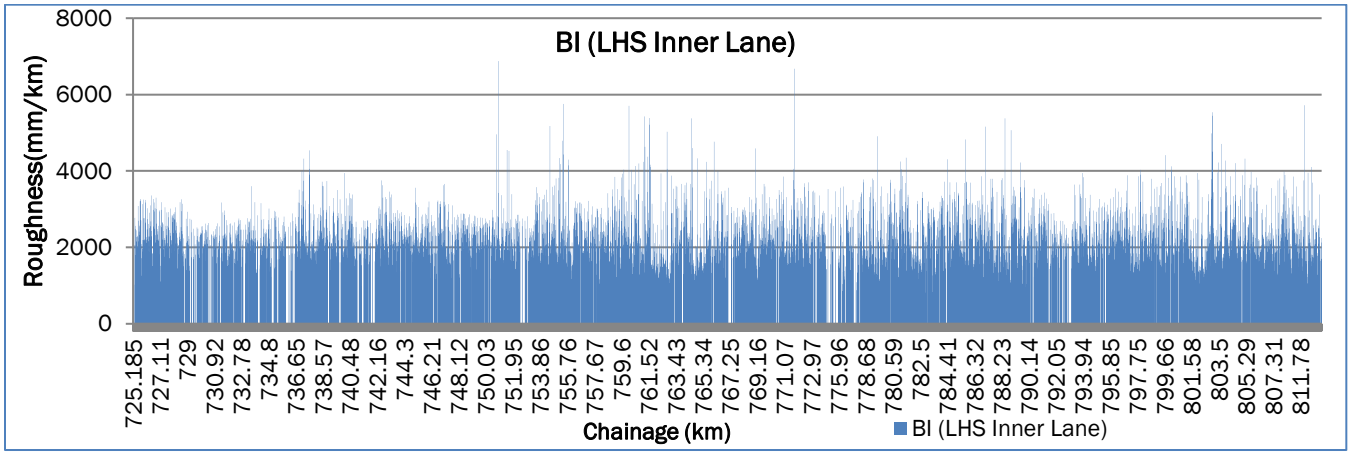


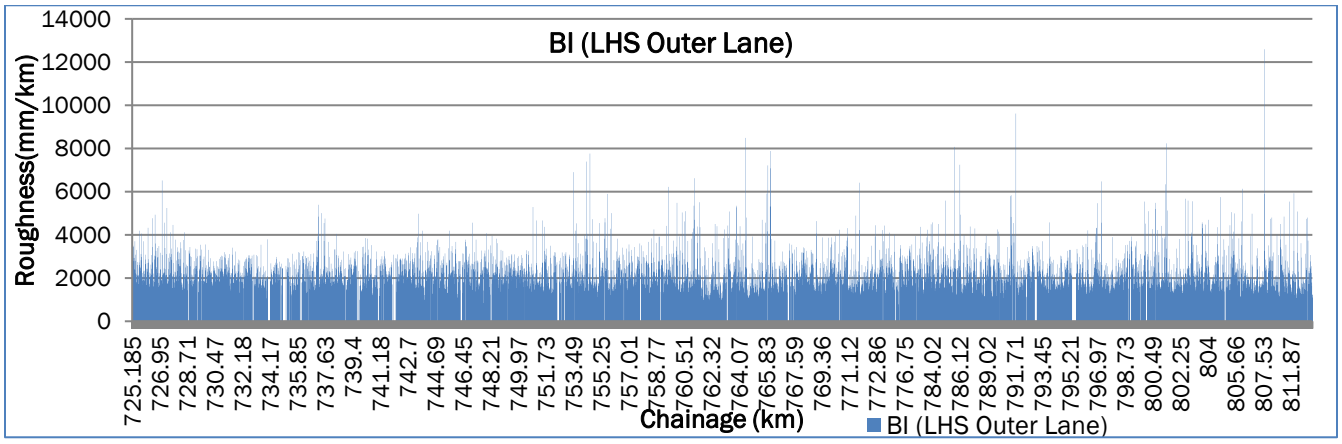
Following panel rectification measured are considered for the rigid pavement.

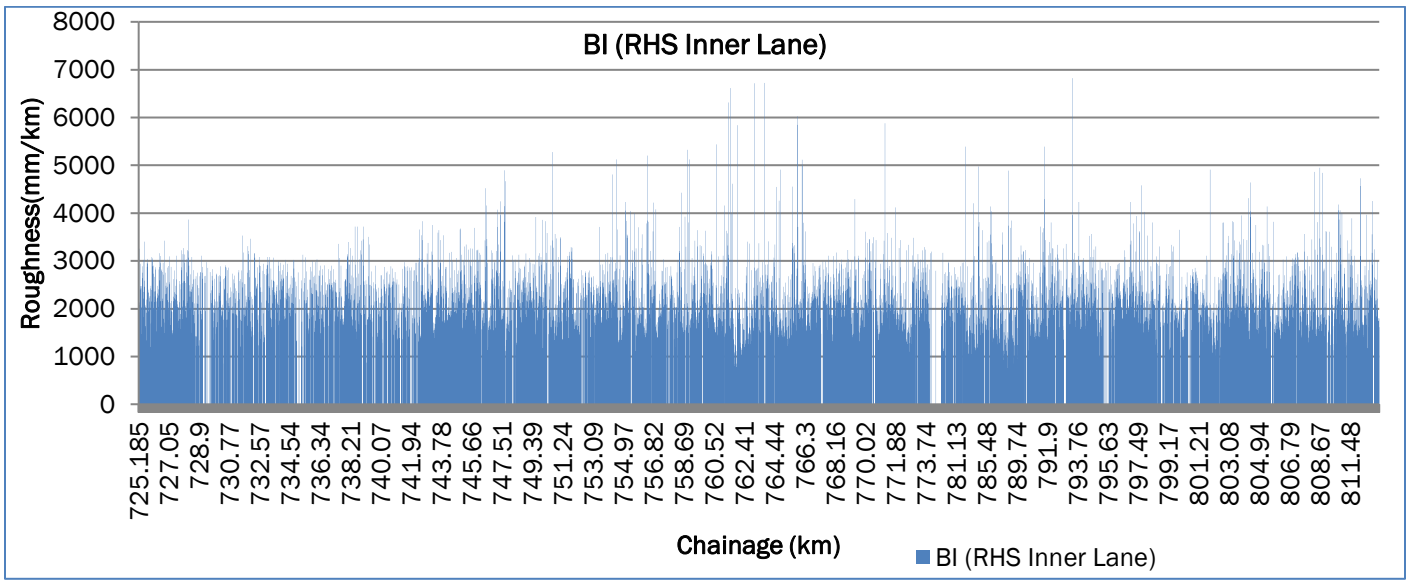
S No	Package	Total Panels for replacement (Nrs.)	Partial 1m Full Depth Repair (Nrs.)	Seal & Staple (in Panels(Nrs.)	Ravelling in Number of Panels (Nrs.)	Corner Break in Panel (Nrs.)
1	Package-2, LHS	443	195	964	368	41
2	Package-2, RHS	329	403	794	238	13

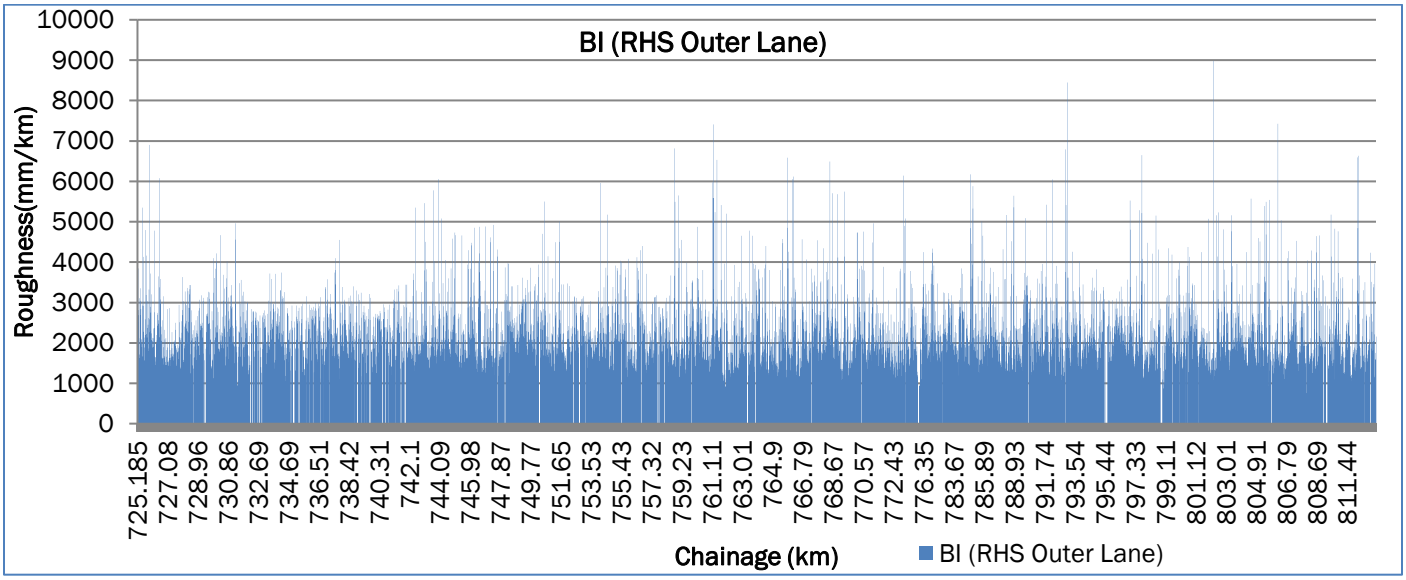
4.3 ROUGHNESS

The roughness surveys conducted along the corridor indicate majority length is having fair riding quality. Bar diagrams showing the Lane-Kilometer roughness along the project road are presented below:


BI (LHS Inner Lane)
Roughness(mm/km)
8000
6000
4000
2000
0
725.185
727.11
729
730.92
732.78
734.8
736.65
738.57
740.48
742.16
744.3
746.21
748.12
750.03
751.95
753.86
755.76
757.67
759.6
761.52
763.43
765.34
767.25
769.16
771.07
772.97
775.96
778.68
780.59
782.5
784.41
786.32
788.23
790.14
792.05
793.94
795.85
797.75
799.66
801.58
803.5
805.29
807.31
811.78
Chainage (km)
BI (LHS Inner Lane)


BI (LHS Outer Lane)
Roughness(mm/km)
14000
12000
10000
8000
6000
4000
2000
0
725.185
726.95
728.71
730.47
732.18
734.17
735.85
737.63
739.4
741.18
742.7
744.69
746.45
748.21
749.97
751.73
753.49
755.25
757.01
758.77
760.51
762.32
764.07
765.83
767.59
769.36
771.12
772.86
776.75
784.02
786.12
789.02
791.71
793.45
795.21
796.97
798.73
800.49
802.25
804
805.66
807.53
811.87
Chainage (km)
BI (LHS Outer Lane)


BI (RHS Inner Lane)
Roughness(mm/km)
8000
7000
6000
5000
4000
3000
2000
1000
0
725.185
727.05
728.9
730.77
732.57
734.54
736.34
738.21
740.07
741.94
743.78
745.66
747.51
749.39
751.24
753.09
754.97
756.82
758.69
760.52
762.41
764.44
766.3
768.16
770.02
771.88
773.74
781.13
785.48
789.74
791.9
793.76
795.63
797.49
799.17
801.21
803.08
804.94
806.79
808.67
811.48
Chainage (km)
BI (RHS Inner Lane)



Based on the above, considering the Km-stone reference system the summary of Lane-km having varying roughness values are as presented below

>=Roughness (mm/km)	<Roughness (mm/km)	LHS Inner (Lane Km)	LHS Outer (Lane Km)	RHS Inner (Lane Km)	RHS Outer (Lane Km)	TOTAL-LHS (Lane Km)	TOTAL-RHS (Lane Km)
	2200	43.97	45.44	41.18	48.04	89.4	89.2
2200	2400	6.25	5.33	5.71	4.98	11.6	10.7
2400	3000	11.75	9.11	11.51	8.81	20.9	20.3
3000		17.10	12.10	14.11	12.60	29.2	26.7

An alternate exercise with moving average method has been adopted considering 10m point interval roughness data. With this criteria, considering roughness threshold limit (<2200mm/km), the combined lane-km lengths with varying roughness values are as presented below.

>=Roughness (mm/km)	<Roughness (mm/km)	LHS Inner & Outer (Lane Km)	RHS Inner & Outer (Lane Km)
	2200	96.4	89.7
2200	2400	11.5	10.6
2400		39	31.5
Lengths for rectification considered		18.15	15.47

By attending the rectification of 18.15 lane-km length in LHS, at identified locations, the roughness values can bring down to required threshold value(<2200m/km) by considering moving average method for roughness values in km-length. However, still there will be accumulated length of 39 lane-km at scattered points having roughness higher than threshold value (>2200m/km).

Similarly, in RHS, by attending the rectification of 15.47 lane-km length at identified locations, the roughness values can bring down to required threshold value(<2200m/km) by considering moving average method for roughness values in km-length. However, still there will be accumulated length of 31.5 lane-km at scattered points having roughness higher than threshold value (>2200m/km).

4.4 FWD ANALYSIS

4.4.1 Flexural strength of Concrete Rigid Pavement

FWD deflections shall be measured and recorded for radial distances at 0 mm, 300 mm, 600 mm and 900 mm from the center of loading point.

The area parameter of deflection basin should be calculated using the equation 2 of IRC 117-2014.

From area of deflection basin, Radius of relative stiffness (l) can be evaluated from the charts. The excel sheet provided with the guidelines used to get the value of Radius of relative stiffness (l).

After finding the Radius of relative stiffness, normalized deflections (d) are calculated using various equations formed from the charts. The excel sheet directly gives the values of the normalized deflections.

Subgrade modulus values can be found by using the equation 3 of IRC 117-2014 for different normalized deflections and average of all should be taken as subgrade modulus.

Elastic Modulus (MPa) of concrete can be found by using the equation 4 of IRC 117-2014.

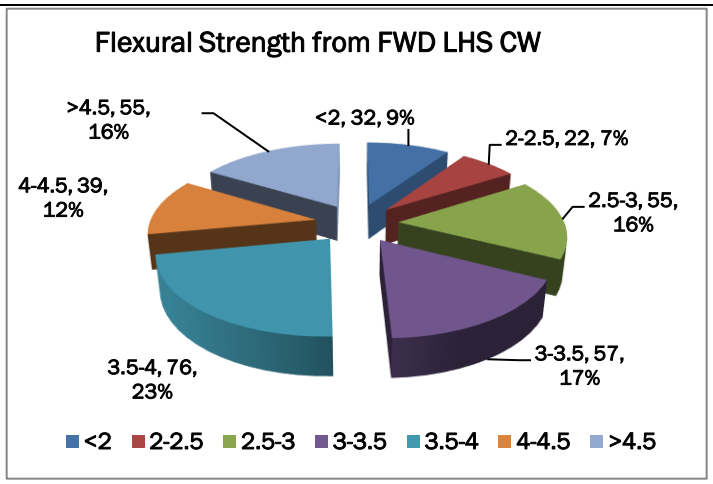
Strength of the concrete and Flexural strength can be determined from the value of Ec from the equation 5 & 6 of IRC 117-2014.

The Fck values calculated for the rigid pavement are presented in **Appendix-3** of the report.

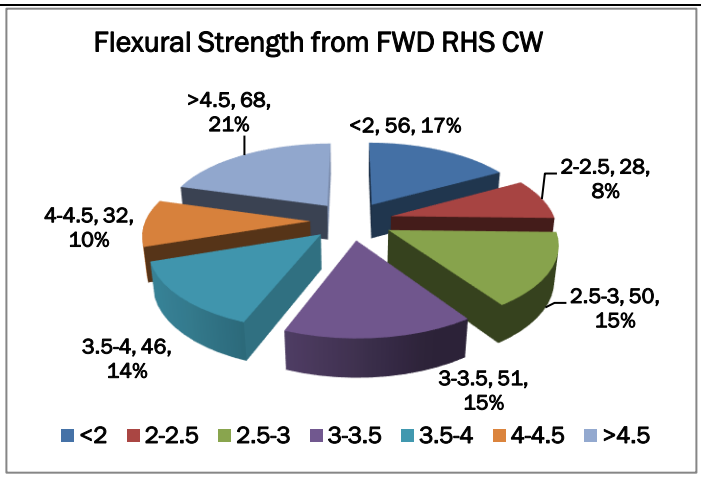
Pie charts showing the variation of the Flexural Strength estimated from FWD Surveys are presented below:

Table 33: FWD Data - Summary of Homogenous Section – LHS & RHS

Flexural strength (Mpa) CW		
Range	**LHS**	**RHS**
<2	32	56
2-2.5	22	28
2.5-3	55	50
3-3.5	57	51
3.5-4	76	46
4-4.5	39	32
>4.5	55	68
Total	**336**	**331**



RKJL_PKG-2



RKJL_PKG-2

Flexural Strength of the PQC estimated from FWD Surveys indicates that:

a) More than 16% of samples in LHS Carriageway and 21% of samples in RHS Carriageway are having values greater than 4.5 Mpa.

b) 12% of samples in LHS Carriageway and 10% of samples in RHS Carriageway are having values between 4 – 4.5 Mpa.

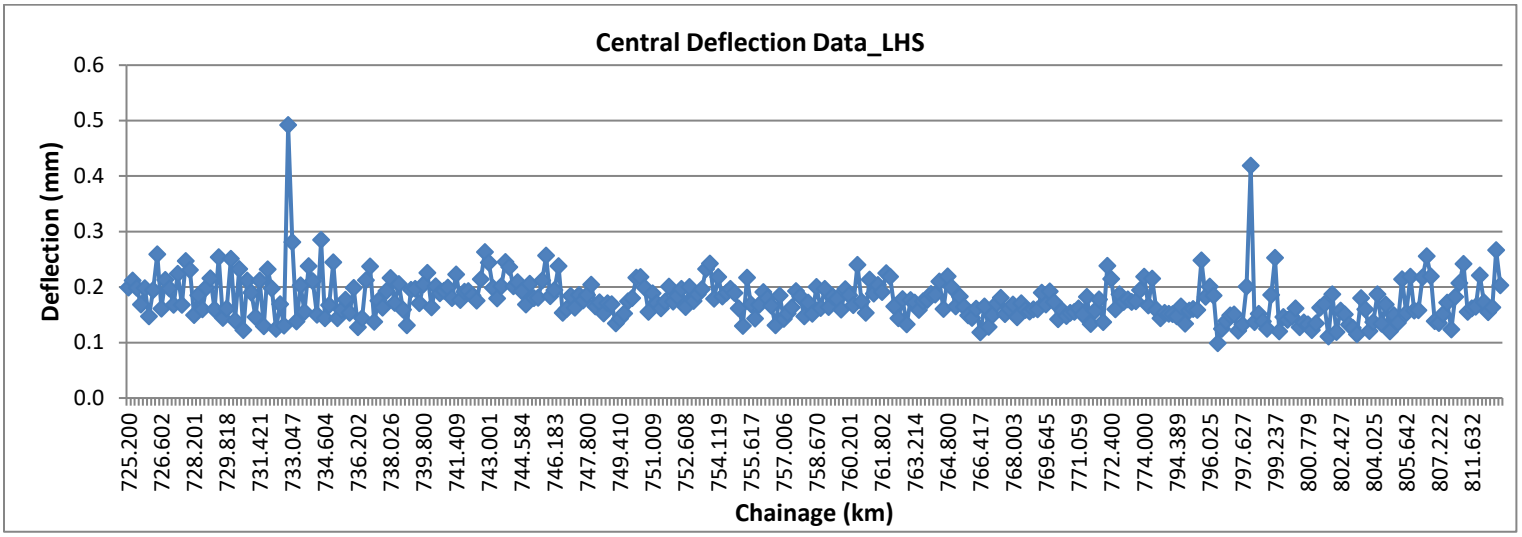
c) 23% of samples in LHS Carriageway and 14% of samples in RHS Carriageway are having values between 3.5 – 4.0 Mpa.

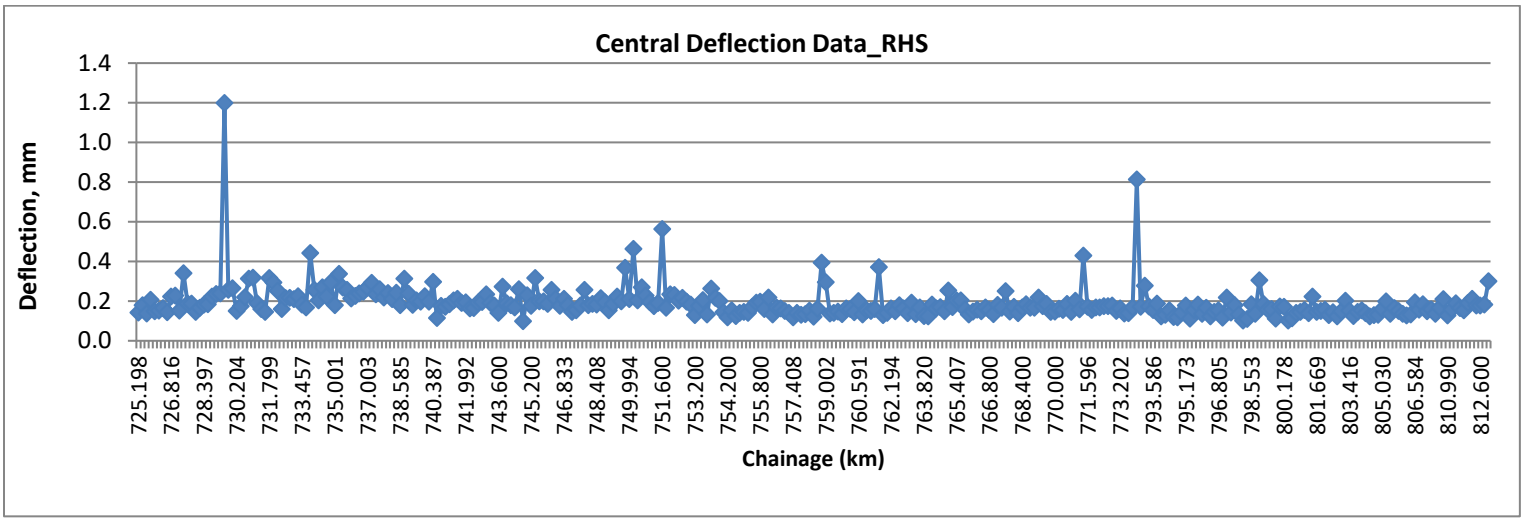
d) 17% of samples in LHS Carriageway and 15% of samples in RHS Carriageway are having values between 3 – 3.5 Mpa.

e) 32% of samples in LHS Carriageway and 40% of samples in RHS Carriageway are having values less than 3 Mpa.

4.4.2 Detection of Voids underneath the Rigid Pavement

- Deflection of Voids below a pavement slab can be easily be done by a FWD. Deflections are measured along the wheel path and a plot of central deflections versus distance has to be made.
- The locations where the deflections are much higher than the normal may indicate presence of voids. Sample is shown in below





From the above graph, voids underneath the pavement are identified as 12 points in LHS, 18 points in RHS. For quantification, every point is considered for 150m length in lane width.

4.4.3 FWD analysis and assessment of overlay requirement (flexible)

The FWD data collected has been analyzed as per IRC-115 guidelines with the suggested ranges for in-service pavements

- Subgrade Modulus---------- 5 CBR to 20 CBR
- Granular Layer Modulus---------- 100 MPa to 500 MPa
- Bituminous Layers –Thick without distress--------- 750 MPa to 3000 MPa
- Bituminous Layers in distressed condition--------- 400 MPa to 1500 MPa

The above suggested ranges for guidance only and pavement engineer shall use his judgment based on available data while fixing the above ranges. By looking at the age and condition and performance

of the pavement following different set of ranges have been used while finalizing the modulus values:

Layer	Bituminous Layers	Granular Layer Modulus	Subgrade
Modulus Value (MPa)	750-3000	100-500	50-100

Bituminous layer Moduli obtained from back calculations shall be corrected for a standard pavement temperature of 35°C using given equations. Whereas, for back calculated moduli values obtained for granular and subgrade layer shall be corrected for seasonal variations (using winter and summer equations). As FWD tests, performed during the winter, seasonal correction factor is applied for granular and subgrade layer. The design moduli (15th percentile moduli) of in-service layers for each homogenous section are given in table below.

Table 34: Summary of Design Moduli of different layers – LHS CW

Sl. No	Chainage (Km)		Length (Km)	15th Percentile MR values		
	From	To		MR for BT	MR for Granular	MR for Subgrade
1	783.20	785.40	2.2	3101	386	87
2	785.40	792.83	7.4	3023	348	87

Table 35: Summary of Design Moduli of different layers – RHS CW

Sl. No	Chainage (Km)		Length (Km)	15th Percentile MR values		
	From	To		MR for BT	MR for Granular	MR for Subgrade
1	783.26	785.45	2.2	2795	390	87
2	785.45	792.81	7.4	2797	388	87

Observations on FWD Results

It can be noticed from the above table that the layer moduli for the three layers are varying along the length and direction. The MR value for BT layer is 3023 Mpa to 3101 Mpa in LHS & 2795 Mpa to 2797 Mpa in RHS Carriageway. The MR value for Granular Layers is 348 Mpa to 386 Mpa in LHS & 388 Mpa to 390 Mpa in RHS Carriageway. Similarly, the MR value for Subgrade Layer is 87 Mpa in Both LHS & RHS Carriageway.

4.5 PAVEMENT COMPOSITION

a) Main Carriageway Crust

	BT (mm)	WMM (mm)	GSB (mm)	PQC (mm)	DLC (mm)	GSB (mm)	Total (mm)
Minimum	140	200	200	280	120	100	520
Maximum	140	260	200	350	160	180	635

Average	140	230	200	310	141	141	589

b) Service Road Crust

	PQC, mm	DLC, mm	GSB, mm	Total, mm
Minimum	280	150	120	550
Maximum	280	150	120	550
Average	280	150	120	550

4.6 CORE STRENGTH

The core strength of the samples is presented below.

S No.	Chainage	SIDE	Core ID	Corrected Strength of core	Equivalent Cube Strength (N/mm^2) 13x1.25.	F_{CK} 0.7*SQRT(B)	REMARK
				A	B = 1.25*A		
1	807+000	RHS	RJ- C-10	40.62	50.77	4.99	Outer
2	771+000	RHS	RJ- C-11	32.60	40.75	4.47	Inner
3	750+950	RHS	RJ-C-12	31.2	39.0	4.37	Outer
4	740+600	RHS	RJ-C-13	36.8	46.0	4.75	Inner
5	730+000	RHS	RJ-C-14	26.2	32.7	4.00	Outer
6	726+900	LHS	RJ- C-28	33.74	42.17	4.55	Outer
7	736+600	LHS	RJ-C-29	28.5	35.7	4.18	Inner
8	746+200	LHS	RJ- C-30	29.17	36.46	4.23	Outer
9	754+150	LHS	RJ-C-31	31.4	39.3	4.39	Inner
10	766+700	LHS	RJ-C-32	39.7	49.6	4.93	Inner
11	804+100	LHS	RJ-C-33	37.4	46.77	4.79	Outer
12	767+600	LHS	RJ-SR-C-3	36.16	45.20	4.71	Service rd

It can be noted from the above table that the core strength more than 4.0 fck at all the points. These values have compared with the obtained Fck values from FWD test and presented below.

S No.	Chainage	SIDE	Core Fck	FWD point	FWD Fck
1	726+900	LHS	4.55	727	2.86
2	736+600	LHS	4.18	736.6	3.18
3	746+200	LHS	4.23	746.2	3.74
4	754+150	LHS	4.39	754.1	1.99
5	766+700	LHS	4.93	766.6	2.71
6	771+000	RHS	4.47	771	1.891
7	750+950	RHS	4.37	751	5.6
8	740+600	RHS	4.75	740.6	3.31
9	730+00	RHS	4	730	1.59
10	813+500	LHS	4.49	813.6	3.29

- Fck values at same chainage are compared above with Cores Vs FWD,

- it is prudent to increase about 30% fck values obtained through FWD survey

Accordingly, FWD-fck values has been increased by 30%. Further fck values less than 3 MPa fck were considered for rehabilitation in MMR.

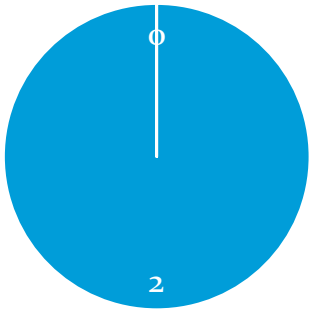
4.7 STRUCTURES

Inventory and asset condition of all the existing structures falling within project road have been verified as per IRC: SP-35 procedures and guidelines with following field surveys

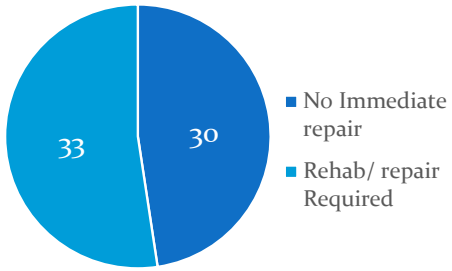
- Inventory of existing highway bridges / structures
- MBIU/Visual condition survey of existing highway bridges / structures

Inventory of all structures is presented in **Appendix 8** of this report.

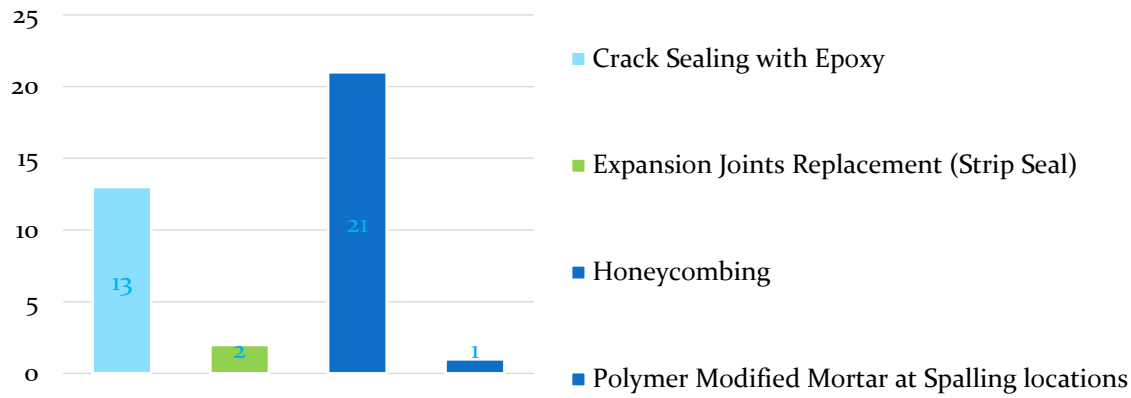
Based on these surveys following structural rehabilitation measures have been considered.



Major Structures



Minor Structures



Rectification of structural Distress in terms of number of locations

List of Bridges found during the inventory surveys along the corridor are as follows

Summary of Structures

S. No	Type of Str	No. of Str			Total No. of Str's	Total No. of Locations	Remarks
		LHS	RHS	BHS			
1	ROB	1	1	0	2	1	-
2	MJB	1	1	0	2	1	-
3	MNB	37	36	0	73	34	-
4	Flyover	2	2	0	4	2	-
5	VUP	6	6	0	12	6	-
6	LVUP	4	4	0	8	4	**2 no's LVUP's new proposed as per schedule B**
7	PUP	16	16	0	32	16	-
8	VOP	0	0	1	1	1	-
9	BC	0	0	57	57	57	**55 Found, 1 Extra, 1 Not Found.**
10	PC	0	0	163	163	163	**152 Found, 4 Extra, 7 Not Found.**

Age of Structures

S. No	Type of Str	LHS (Nos.)		RHS (Nos.)		BHS (Nos.)		Total (Nos)		Total no. of Str's
		Old	New	Old	New	Old	New	Old	New	
1	ROB	1	0	0	1	0	0	1	1	**2**
2	MJB	1	0	0	1	0	0	1	1	**2**
3	MNB	3	34	7	29	0	0	10	63	**73**
4	Flyover	0	2	0	2	0	0	0	4	**4**
5	VUP	4	2	0	6	0	0	4	8	**12**
6	LVUP	0	4	0	4	0	0	0	8	**8**
7	PUP	1	15	0	16	0	0	1	31	**32**
8	VOP	0	0	0	0	0	1	0	1	**1**

Summary of Expansion Joint & Bearings

S. No	Type of Str	Expansion joints		Bearings					
				Pot PTFE		Elastomeric		Tar Paper	
		Old	New	Old	New	Old	New	Old	New
1	ROB	0	0	0	0	24	30	0	0
2	MJB	4	4	18	30	0	0	0	0
3	MNB	3	29	12	0	0	142	0	0
4	Flyover	0	8	0	0	0	32	0	0
5	VUP	0	0	0	0	0	0	120	0
6	VOP	0	3	0	0	0	16	0	0
TOTAL		**7**	**44**	**30**	**30**	**24**	**220**	**120**	**0**
		51		**60**		**244**		**120**	
				424					

Summary of Super Structures

S. No.	Type of Str	RCC Box (Nos.)	RCC Slab (Nos.)	RCC Girder (Nos.)	PSC Girder (Nos.)	Total no. of Structures
1	ROB	0	0	0	2	2
2	MJB	0	0	0	2	2
3	MNB	52	8	13	0	73
4	Flyover	0	0	0	4	4
5	VUP	8	4	0	0	12
6	LVUP	4	0	0	0	4
7	PUP	31	1	0	0	32
8	VOP	0	0	1	0	1

Summary of Sub Structures

S. No	Type of Str	ABUTMENT (Nos.)			PIER (Nos.)	
		RCC Wall	Circular Type	Stone Masonry	RCC Wall	Circular Type
1	ROB	2	0	0	1	1
2	MJB	2	0	0	1	1
3	MNB	72	0	1	32	3
4	Flyover	4	0	0	0	0
5	VUP	12	0	0	8	0
6	LVUP	4	0	0	0	0
7	PUP	32	0	0	0	0
8	VOP	0	1	0	0	1

Details of Major Bridges

S. No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Super structure	Type of Bearings
										Abutment	Pier		
1	No	785+625	MJB	LHS	MCW	Old	1 x 30.2 + 1 x 30.5 + 1 x 30.5	12	Not Visible	RCC Wall	Circular Type	PSC Girder	Pot PTFE
2	No	785+625	MJB	RHS	MCW	New	1 x 30.7 + 1 x 30.3 + 1 x 30.7	14.5	Not Visible	RCC Wall	RCC Wall	PSC Girder	Pot PTFE

Details of Minor Bridges

S. No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
1	No	732+227	MNB	LHS	MCW	New	2 x 7.3	12.5	Raft	RCC Wall	-	RCC Box	-
2	No	732+227	MNB	RHS	MCW	Old	2 x 7.3	12.5	Open	RCC Wall	-	RCC Slab	-
3	No	732+964	MNB	LHS	MCW	New	2 x 7.43	12.5	Raft	RCC Wall	-	RCC Box	-
4	No	732+964	MNB	RHS	MCW	New	2 x 7.43	12.5	Raft	RCC Wall	-	RCC Box	-
5	No	735+000	MNB	LHS	MCW	New	1 x 21.7	12.5	Not Visible	RCC Wall	-	RCC Girder	Elastomeric
6	No	735+000	MNB	RHS	MCW	New	1 x 21.7	12.5	Not Visible	RCC Wall	-	RCC Girder	Elastomeric
7	No	737+167	MNB	LHS	MCW	New	1 x 6.5	12.5	Raft	RCC Wall	-	RCC Box	-
8	No	737+167	MNB	RHS	MCW	New	1 x 6.5	12.5	Raft	RCC Wall	-	RCC Box	-
9	Yes	742+120	MNB	LHS	SR	New	1 x 8.6	10.8	Raft	RCC Wall	-	RCC Box	-
10	Yes	742+120	MNB	LHS	MCW	New	1 x 8.6	11	Raft	RCC Wall	-	RCC Box	-
11	Yes	742+120	MNB	RHS	MCW	New	1 x 8.6	11	Raft	RCC Wall	-	RCC Box	-
12	No	746+260	MNB	LHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
13	No	746+260	MNB	RHS	MCW	Old	1 x 7	12	Open	Stone Masonry	-	RCC Slab	-

S. No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
14	No	746+555	MNB	LHS	MCW	New	2 x 4.5	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
15	No	746+555	MNB	RHS	MCW	New	2 x 4.5	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
16	No	747+700	MNB	LHS	MCW	New	1 x 18	12.5	Not Visible	RCC Wall	-	RCC Girder	Elastomeric
17	No	747+700	MNB	RHS	MCW	Old	2 x 9	12	Not Visible	RCC Wall	RCC Wall	RCC Slab	-
18	Yes	748+200	MNB	LHS	MCW	New	3 x 13.5	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
19	Yes	748+200	MNB	RHS	MCW	Old	3 x 13.5	12.5	Open	RCC Wall	RCC Wall	RCC Slab	-
20	No	755+420	MNB	LHS	MCW	New	1 x 22.2	12.5	Not Visible	RCC Wall	-	RCC Girder	Elastomeric
21	No	755+420	MNB	RHS	MCW	New	1 x 22.2	12.5	Not Visible	RCC Wall	-	RCC Girder	Elastomeric
22	No	761+138	MNB	LHS	MCW	New	2 x 4.5	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
23	No	761+138	MNB	RHS	MCW	New	2 x 4.5	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
24	Yes	763+275	MNB	LHS	MCW	New	3 x 5	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
25	Yes	763+275	MNB	RHS	MCW	New	3 x 5	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
26	No	764+414	MNB	LHS	MCW	New	1 x 21	12.5	Not Visible	RCC Wall	-	RCC Girder	Elastomeric
27	No	764+414	MNB	RHS	MCW	New	1 x 21	12.5	Not Visible	RCC Wall	-	RCC Girder	Elastomeric
28	No	765+825	MNB	LHS	MCW	New	1 x 21	12.5	Not Visible	RCC Wall	-	RCC Girder	Elastomeric
29	No	765+825	MNB	RHS	MCW	New	1 x 21	12.5	Not Visible	RCC Wall	-	RCC Girder	Elastomeric
30	No	766+911	MNB	LHS	SR	New	1 x 9.4	10.8	Raft	RCC Wall	-	RCC Box	-
31	No	766+911	MNB	LHS	MCW	New	1 x 9.4	11	Raft	RCC Wall	-	RCC Box	-
32	No	766+911	MNB	RHS	MCW	New	1 x 9.4	11	Raft	RCC Wall	-	RCC Box	-
33	No	766+911	MNB	RHS	SR	New	1 x 9.4	10.8	Raft	RCC Wall	-	RCC Box	-
34	No	776+603	MNB	LHS	MCW	New	3 x 3	14.5	Raft	RCC Wall	RCC Wall	RCC Box	-
35	No	776+603	MNB	RHS	MCW	New	3 x 3	14.5	Raft	RCC Wall	RCC Wall	RCC Box	-
36	No	778+283	MNB	LHS	MCW	New	3 x 3	14.5	Raft	RCC Wall	RCC Wall	RCC Box	-
37	No	778+283	MNB	RHS	MCW	New	3 x 3	14.5	Raft	RCC Wall	RCC Wall	RCC Box	-
38	No	778+375	MNB	LHS	MCW	New	4 x 3	14.5	Raft	RCC Wall	RCC Wall	RCC Box	-

S. No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
39	No	778+375	MNB	RHS	MCW	New	4 x 3	14.5	Raft	RCC Wall	RCC Wall	RCC Box	-
40	No	780+570	MNB	LHS	MCW	Old	3 x 3	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
41	No	780+570	MNB	RHS	MCW	New	3 x 3	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
42	No	781+325	MNB	LHS	MCW	New	5 x 3	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
43	No	781+325	MNB	RHS	MCW	New	5 x 3	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
44	No	784+030	MNB	LHS	MCW	New	3 x 2.6	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
45	No	784+030	MNB	RHS	MCW	New	3 x 2.6	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
46	No	784+980	MNB	LHS	MCW	New	3 x 3	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
47	No	784+980	MNB	RHS	MCW	New	3 x 3	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
48	No	786+032	MNB	LHS	MCW	New	3 x 3	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
49	No	786+032	MNB	RHS	MCW	New	3 x 3	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
50	No	790+287	MNB	LHS	MCW	New	3 x 3	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
51	No	790+287	MNB	RHS	MCW	New	3 x 3	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
52	No	790+470	MNB	LHS	MCW	Old	2 x 23.8	12.5	Not Visible	RCC Wall	Circular Type	RCC Girder	Pot PTFE
53	No	790+470	MNB	RHS	MCW	New	2 x 23.8	12.5	Not Visible	RCC Wall	RCC Wall	RCC Girder	Elastomeric
54	No	791+730	MNB	LHS	MCW	New	3 x 3	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
55	No	791+730	MNB	RHS	MCW	New	3 x 3	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
56	No	798+694	MNB	LHS	SR	New	1 x 10	10.8	Raft	RCC Wall	-	RCC Box	-
57	No	798+694	MNB	LHS	MCW	New	1 x 10	11	Raft	RCC Wall	-	RCC Box	-
58	No	798+694	MNB	RHS	MCW	New	1 x 10	11	Raft	RCC Wall	-	RCC Box	-
59	No	798+694	MNB	RHS	SR	New	1 x 10	10.8	Raft	RCC Wall	-	RCC Box	-
60	No	799+665	MNB	LHS	MCW	New	2 x 6.4	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
61	No	799+665	MNB	RHS	MCW	New	2 x 6.4	12.5	Raft	RCC Wall	RCC Wall	RCC Box	-
62	No	800+085	MNB	LHS	MCW	New	1 x 9.7	12.5	Raft	RCC Wall	-	RCC Box	-
63	No	800+085	MNB	RHS	MCW	Old	1 x 9.7	12.5	Open	RCC Wall	-	RCC Slab	-

S. No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
64	No	800+617	MNB	LHS	MCW	New	1 x 10.4	12.5	Raft	RCC Wall	-	RCC Box	-
65	No	800+617	MNB	RHS	MCW	Old	1 x 10.4	12.5	Open	RCC Wall	-	RCC Slab	-
66	No	801+260	MNB	LHS	MCW	New	1 x 6.3	12.5	Raft	RCC Wall	-	RCC Box	-
67	No	801+260	MNB	RHS	MCW	Old	1 x 6.3	12.5	Open	RCC Wall	-	RCC Slab	-
68	Yes	805+540	MNB	LHS	MCW	New	1 x 12.15	12.5	Raft	RCC Wall	-	RCC Box	-
69	Yes	805+540	MNB	RHS	MCW	New	1 x 12.15	12.5	Raft	RCC Wall	-	RCC Box	-
70	No	809+117	MNB	LHS	MCW	New	3 x 18	12.5	Not Visible	RCC Wall	Circular Type	RCC Girder	Elastomeric
71	No	809+117	MNB	RHS	MCW	New	3 x 18	12.5	Not Visible	RCC Wall	Circular Type	RCC Girder	Elastomeric
72	No	812+912	MNB	LHS	MCW	Old	1 x 9.4	12.1	Open	RCC Wall	-	RCC Slab	-
73	No	812+912	MNB	RHS	MCW	New	1 x 9.4	12.5	Raft	RCC Wall	-	RCC Box	-

Details of Flyovers

S. No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
1	No	774+620	Flyover	LHS	MCW	New	1 x 30	14.5	Not Visible	RCC Wall	-	PSC Girder	Elastomeric
2	No	774+620	Flyover	RHS	MCW	New	1 x 30	14.5	Not Visible	RCC Wall	-	PSC Girder	Elastomeric
3	No	774+735	Flyover	LHS	MCW	New	1 x 30	14.5	Not Visible	RCC Wall	-	PSC Girder	Elastomeric
4	No	774+735	Flyover	RHS	MCW	New	1 x 30	14.5	Not Visible	RCC Wall	-	PSC Girder	Elastomeric

Details of ROB's

S. No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
1	Yes	780+320	ROB	LHS	MCW	Old	1 x 25 + 1 x 23.25 + 1 x 25.6	12	Not Visible	RCC Wall	RCC Wall	PSC Girder	Elastomeric
2	Yes	780+320	ROB	RHS	MCW	New	1 x 31.2 + 1 x 25.2 + 1 x 31.2	14.5	Not Visible	RCC Wall	Circular Type	PSC Girder	Elastomeric

Details of VOP's

S. No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
1	Yes	792+389	VOP	BHS	MCW	New	2 x 20	14.5	Not Visible	Circular Type	Circular Type	RCC Girder	Elastomeric

Details of VUP's

S. No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
1	Yes	763+812	VUP	LHS	MCW	New	1 x 16.2	12.5	Raft	RCC Wall	-	RCC Box	-
2	Yes	763+812	VUP	RHS	MCW	New	1 x 16.2	12.5	Raft	RCC Wall	-	RCC Box	-
3	No	778+822	VUP	LHS	MCW	Old	3 x 10.45	12	Open	RCC Wall	RCC Wall	RCC Slab	Tar Paper
4	No	778+822	VUP	RHS	MCW	New	3 x 10.45	14.5	Raft	RCC Wall	RCC Wall	RCC Box	-
5	No	779+077	VUP	LHS	MCW	Old	3 x 11.6	12	Open	RCC Wall	RCC Wall	RCC Slab	Tar Paper
6	No	779+077	VUP	RHS	MCW	New	3 x 11.6	14.5	Raft	RCC Wall	RCC Wall	RCC Box	-
7	No	782+516	VUP	LHS	MCW	Old	3 x 9	12	Open	RCC Wall	RCC Wall	RCC Slab	Tar Paper
8	No	782+516	VUP	RHS	MCW	New	3 x 9	14.5	Raft	RCC Wall	RCC Wall	RCC Box	-
9	No	788+122	VUP	LHS	MCW	Old	3 x 9	12	Open	RCC Wall	RCC Wall	RCC Slab	Tar Paper
10	No	788+122	VUP	RHS	MCW	New	3 x 9	14.5	Raft	RCC Wall	RCC Wall	RCC Box	-
11	No	809+740	VUP	LHS	MCW	New	1 x 12	12.5	Raft	RCC Wall	-	RCC Box	-
12	No	809+740	VUP	RHS	MCW	New	1 x 12	12.5	Raft	RCC Wall	-	RCC Box	-

Details of LVUP's

S. No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
1	No	775+800	LVUP	LHS	MCW	New	1 x 12	13.5	Raft	RCC Wall	-	RCC Box	-
2	No	775+800	LVUP	RHS	MCW	New	1 x 12	13.5	Raft	RCC Wall	-	RCC Box	-
3	No	777+184	LVUP	LHS	MCW	New	1 x 12	13.5	Raft	RCC Wall	-	RCC Box	-
4	No	777+184	LVUP	RHS	MCW	New	1 x 12	13.5	Raft	RCC Wall	-	RCC Box	-
5	-	808+510	LVUP	LHS	MCW	New	1 x 12	14.5	-	-	-	-	-
6	-	808+510	LVUP	RHS	MCW	New	1 x 12	14.5	-	-	-	-	-
7	-	810+650	LVUP	LHS	MCW	New	1 x 12	14.5	-	-	-	-	-
8	-	810+650	LVUP	RHS	MCW	New	1 x 12	14.5	-	-	-	-	-

Details of PUP's

S. No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
1	No	729+345	PUP	LHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
2	No	729+345	PUP	RHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
3	Yes	735+255	PUP	LHS	MCW	New	1 x 8.5	12.5	Raft	RCC Wall	-	RCC Box	-
4	Yes	735+255	PUP	RHS	MCW	New	1 x 8.5	12.5	Raft	RCC Wall	-	RCC Box	-
5	No	739+760	PUP	LHS	MCW	New	1 x 7	12.75	Raft	RCC Wall	-	RCC Box	-
6	No	739+760	PUP	RHS	MCW	New	1 x 7	12.75	Raft	RCC Wall	-	RCC Box	-
7	No	741+920	PUP	LHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
8	No	741+920	PUP	RHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
9	No	750+300	PUP	LHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
10	No	750+300	PUP	RHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
11	No	752+432	PUP	LHS	MCW	New	1 x 7	12.75	Raft	RCC Wall	-	RCC Box	-
12	No	752+432	PUP	RHS	MCW	New	1 x 7	12.75	Raft	RCC Wall	-	RCC Box	-
13	No	756+654	PUP	LHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
14	No	756+654	PUP	RHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
15	No	757+730	PUP	LHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
16	No	757+730	PUP	RHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-

S. No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
17	No	759+806	PUP	LHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
18	No	759+806	PUP	RHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
19	No	767+311	PUP	LHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
20	No	767+311	PUP	RHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
21	No	770+405	PUP	LHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
22	No	770+405	PUP	RHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
23	No	773+213	PUP	LHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
24	No	773+213	PUP	RHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
25	No	789+713	PUP	LHS	MCW	Old	1 x 6.2	12	Open	RCC Wall	-	RCC Slab	-
26	No	789+713	PUP	RHS	MCW	New	1 x 7	14.45	Raft	RCC Wall	-	RCC Box	-
27	No	795+480	PUP	LHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
28	No	795+480	PUP	RHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
29	No	798+924	PUP	LHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
30	No	798+924	PUP	RHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
31	No	804+975	PUP	LHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-
32	No	804+975	PUP	RHS	MCW	New	1 x 7	12.5	Raft	RCC Wall	-	RCC Box	-

Structure Deviations with CA and Site

S.No.	Chainage		Type of Culvert		Side	Span Arrangement	
	As per CA	As per Site	As per CA	As per Site		As per CA	As per Site
1	759+000	759+000	Box	Box	BHS	1 x 3	1 x 4.5 x 4
2	809+117	809+117	MNB	MNB	BHS	2 x 17 + 1 x 16	3 x 18
3	812+912	812+912	MNB	MNB	BHS	1 x 11.5	1 x 9.4
4	725+200	725+200	Pipe	Pipe	BHS	1 x 1.7	1 x 1.2
5	732+345	732+345	Pipe	Pipe	BHS	1 x 1.1	1 x 1.2
6	738+600	738+600	Pipe	Pipe	BHS	1 x 1.2	3 x 1
7	738+786	738+786	Pipe	Pipe	BHS	2 x 1.2	2 x 1
8	751+110	751+110	Pipe	Pipe	BHS	2 x 1	3 x 1

S.No.	Chainage		Type of Culvert		Side	Span Arrangement	
	As per CA	As per Site	As per CA	As per Site		As per CA	As per Site
9	763+115	763+115	Pipe	Pipe	BHS	1 x 1.2	2 x 1.2
10	768+385	768+385	Pipe	Pipe	BHS	1 x 1.2	2 x 1.2
11	771+955	771+955	Pipe	Pipe	BHS	1 x 1	2 x 1
12	803+093	803+093	Pipe	Pipe	BHS	1 x 1	2 x 1.2
13	809+580	809+580	Pipe	Pipe	BHS	1 x 1.2	2 x 1.2
14	780+320	780+320	ROB	ROB	BHS	1 x 31.2 + 1 x 25.2 + 1 x 31.2	1 x 25 + 1 x 23.25 + 1 x 25.6

Deviation in Span Arrangement at following locations

S.No.	Chainage as per CA (KM)		Type of Culvert	Side	Span Arrangement (No x Length)		Remarks
	As per CA	As per Site			As per CA	As per Site	
1	742+050	742+050	Pipe	BHS	1 x 1.2	1 x 1.2	Extra
2	760+400	760+400	Pipe	BHS	2 x 1	2 x 1	Extra
3	769+400	769+400	Pipe	BHS	1 x 1.2	1 x 1.2	Extra
4	799+020	799+020	Pipe	BHS	1 x 1.2	1 x 1.2	Extra
5	811+250	811+250	Box	BHS	1 x 4.5	1 x 4.5	Extra
6	732+560	732+560	Pipe	BHS	1 x 1.2	1 x 1.2	Not Found
7	741+775	741+775	Pipe	BHS	1 x 1.2	1 x 1.2	Not Found
8	753+192	753+192	Box	BHS	1 x 3.1	1 x 3.1	Not Found
9	764+200	764+200	Pipe	BHS	2 x 1.2	2 x 1.2	Not Found
10	765+550	765+550	Pipe	BHS	2 x 1.2	2 x 1.2	Not Found
11	770+010	770+010	Pipe	BHS	1 x 1.2	1 x 1.2	Not Found
12	785+230	785+230	Pipe	BHS	2 x 1	2 x 1	Not Found
13	810+135	810+135	Pipe	BHS	1 x 1.2	1 x 1.2	Not Found

Visual Inspection with MBIU at Following Locations

S. No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m) As per Site	Total Length (m)	Type of Superstructure	Type of Bearings	MBIU Requirement
1	735+000	MNB	LHS	MCW	New	1 x 21.5	22 m	RCC Girder	Elastomeric	Yes
2	735+000	MNB	RHS	MCW	New	1 x 21.5	22 m	RCC Girder	Elastomeric	Yes
3	755+420	MNB	LHS	MCW	New	1 x 22	22 m	RCC Girder	Elastomeric	Yes
4	755+420	MNB	RHS	MCW	New	1 x 22	22 m	RCC Girder	Elastomeric	Yes
5	765+825	MNB	LHS	MCW	New	1 x 21	21 m	RCC Girder	Elastomeric	Yes
6	765+825	MNB	RHS	MCW	New	1 x 21	21 m	RCC Girder	Elastomeric	Yes
7	809+117	MNB	LHS	MCW	New	3 x 18	54 m	RCC Girder	Elastomeric	Yes
8	809+117	MNB	RHS	MCW	New	3 x 18	54 m	RCC Girder	Elastomeric	Yes

Visual Inspection with MBIU at Following Locations

Culverts Inventory

Sl No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Str. Proposal As per Sch-B	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
							LHS	RHS	LHS	RHS	
1	725+200	Pipe	BHS	-	1 x 1.2	38.5	Yes	Yes	Yes	Yes	> Bushes observed on BHS.
2	725+700	Pipe	BHS	-	2 x 1	38.5	Yes	No	Yes	No	> Bushes observed on BHS.
3	726+363	Pipe	BHS	-	4 x 1	35	No	Yes	No	Yes	> Bushes observed on BHS.
4	727+160	Pipe	BHS	Widening	1 x 1.2	35	Yes	Yes	Yes	Yes	> Culvert is partially buried at RHS.
5	728+087	Pipe	BHS	-	1 x 1.2	38.5	Yes	Yes	Yes	Yes	> Structure is in fair condition.
6	728+499	Box	BHS	-	1 x 3	28	Yes	Yes	Yes	Yes	> Structure is in fair condition.
7	728+923	Pipe	BHS	Widening	2 x 1	36	Yes	Yes	Yes	Yes	> Culvert is fully buried at LHS.
8	729+046	Pipe	BHS	Widening	1 x 1	50	No	No	No	No	> Headwall not provided at RHS.
9	729+215	Pipe	BHS	Widening	2 x 1	58.6	Yes	No	Yes	No	> Culvert is in fair condition. > Culvert widened at RHS.
10	729+658	Pipe	BHS	-	2 x 1	45	Yes	No	Yes	No	> Bushes observed on BHS.
11	729+824	Pipe	BHS	Widening	2 x 1	38.5	Yes	Yes	Yes	Yes	> Bushes observed on BHS.
12	730+198	Box	BHS	-	1 x 3	35	Yes	Yes	Yes	Yes	> Structure is in fair condition. > RHS old widened by box.
13	730+342	Box	BHS	-	1 x 3	35	No	Yes	No	Yes	> Crash barrier is partially damaged at LHS. > Bushes observed a BHS.
14	731+047	Pipe	BHS	-	1 x 1.2	42.5	Yes	Yes	Yes	Yes	> Bushes observed on BHS.
15	731+276	Pipe	BHS	-	3 x 1	40	Yes	Yes	Yes	Yes	> Bushes observed on BHS.
16	732+345	Pipe	BHS	-	1 x 1.2	38.5	Yes	Yes	Yes	Yes	> Culvert is buried at LHS. > Bushes observed on BHS.
17	732+480	Pipe	BHS	-	1 x 1.2	42.5	Yes	Yes	Yes	Yes	> Bushes observed on BHS.
18	732+560	Pipe	BHS	-	1 x 1.2	-	-	-	-	-	> Culvert is not found at site.
19	732+572	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Bushes observed on BHS.
20	732+792	Pipe	BHS	-	2 x 1.2	45	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
21	733+283	Pipe	BHS	-	3 x 1	45	Yes	Yes	Yes	Yes	> Culvert not visible at BHS. > Bushes are observed at BHS.
22	733+580	Pipe	BHS	-	4 x 1.2	42.5	Yes	Yes	Yes	Yes	> Crack observed on RHS head wall.
23	733+952	Pipe	BHS	-	2 x 1	40	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
24	734+117	Box	BHS	-	1 x 2	38	Yes	Yes	Yes	Yes	> Honeycombing and reinforcement exposed on parapet. > Bushes observe at BHS.
25	734+790	Box	BHS	-	1 x 4	38.5	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
26	735+304	Pipe	BHS	-	2 x 1.2	48	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
27	735+549	Pipe	BHS	-	2 x 1.2	40	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
28	735+785	Pipe	BHS	-	3 x 1.2	48.5	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
29	736+007	Pipe	BHS	-	3 x 1.2	40	Yes	Yes	Yes	Yes	> Culvert is in fair condition.

Sl No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Str. Proposal As per Sch-B	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
							LHS	RHS	LHS	RHS	
30	736+200	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
31	736+325	Pipe	BHS	-	2 x 1	55	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
32	736+551	Pipe	BHS	-	3 x 1.2	45	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
33	736+817	Pipe	BHS	-	2 x 1.0	45	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
34	736+980	Box	BHS	-	1 x 3 x 1.5	35	Yes	Yes	Yes	Yes	> Quadrant pitching is damaged at RHS.
35	737+407	Pipe	BHS	-	1 x 1.2	40	No	No	No	No	> Bushes are observed at BHS.
36	737+551	Box	BHS	-	1 x 2	35	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
37	737+700	Pipe	BHS	-	1 x 1.2	46	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
38	737+870	Pipe	BHS	-	2 x 1.2	42.5	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
39	738+006	Box	BHS	-	1 x 2	35	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
40	738+235	Box	BHS	-	1 x 4	32.5	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
41	738+600	Pipe	BHS	-	3 x 1	35	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
42	738+786	Pipe	BHS	-	2 x 1	35	No	No	No	No	> Culvert is in fair condition. > Debris observed in vent way.
43	739+169	Box	BHS	-	1 x 3	24	Yes	Yes	Yes	Yes	> Culvert is in fair condition. > LHS widened with Box.
44	739+490	Pipe	BHS	-	2 x 1	58	No	No	No	No	> Bushes are observed at LHS.
45	739+654	Box	BHS	-	1 x 4	57.25	Yes	Yes	Yes	Yes	> Quadrant pitching is damaged at A2.
46	740+060	Box	BHS	-	1 x 2.5	57.25	Yes	Yes	Yes	Yes	> Structure is in fair condition.
47	740+507	Box	BHS	-	1 x 3	37.25	Yes	Yes	Yes	Yes	> Structure is in fair condition.
48	740+713	Pipe	BHS	-	2 x 1	35	Yes	Yes	Yes	Yes	> Structure is in fair condition. > Bushes observed at BHS.
49	740+930	Box	BHS	-	1 x 2	40	Yes	Yes	Yes	Yes	> Structure is in fair condition.
50	741+200	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Culvert is buried at RHS.
51	741+313	Pipe	BHS	-	2 x 1.2	40	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
52	741+535	Pipe	BHS	-	2 x 1.2	45	Yes	Yes	Yes	Yes	> Bushes observed at LHS. > Culvert is buried at RHS.
53	741+775	Pipe	BHS	-	1 x 1.2	45	-	-	-	-	> Culvert is not found at site.
54	742+050	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Culvert is in fair condition. > Culvert is found extra at site.
55	742+318	Box	BHS	-	1 x 2	35	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
56	742+420	Pipe	BHS	-	1 x 1.2	37.25	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
57	742+600	Pipe	BHS	-	1 x 1.2	37.25	Yes	Yes	Yes	Yes	> Bushes observed at BHS.
58	742+755	Pipe	BHS	-	3 x 1.2	40	Yes	Yes	Yes	Yes	> Bushes observed at BHS. > RHS buried partially.
59	742+900	Pipe	BHS	-	3 x 1.2	35	Yes	Yes	Yes	Yes	> Bushes observed at BHS.
60	743+165	Box	BHS	-	1 x 4	37.5	Yes	Yes	Yes	Yes	> Debris are present at RHS. > Culvert is in fair condition.

Sl No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Str. Proposal As per Sch-B	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
							LHS	RHS	LHS	RHS	
61	743+658	Box	BHS	-	1 x 3.5	30	Yes	Yes	Yes	Yes	> Debris are present at RHS. > Stone masonry structure is present at RHS.
62	743+975	Box	BHS	-	1 x 4	30	Yes	Yes	Yes	Yes	> Culvert is in fair condition. > Stone masonry structure is present at RHS.
63	744+351	Box	BHS	-	1 x 4.5	30	Yes	Yes	Yes	Yes	> Culvert is in fair condition. > Stone masonry structure is present at RHS.
64	744+780	Box	BHS	-	1 x 4	37.5	Yes	Yes	Yes	Yes	> Culvert is in fair condition. > RHS SR is present for HP petrol bunk.
65	745+013	Pipe	BHS	-	3 x 1	40	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
66	745+123	Pipe	BHS	-	2 x 1	45	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
67	745+480	Pipe	BHS	-	2 x 1	40	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
68	745+680	Pipe	BHS	-	2 x 1	45	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
69	746+059	Box	BHS	-	1 x 2	36	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
70	746+427	Pipe	BHS	-	1 x 1	38	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
71	746+970	Pipe	BHS	-	2 x 1	40	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
72	747+223	Box	BHS	-	1 x 4	35	Yes	Yes	Yes	Yes	> Bushes are observed at BHS. > No head wall present at LHS.
73	747+232	Pipe	BHS	-	3 x 1.2	37.5	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
74	747+436	Pipe	BHS	-	2 x 1	40	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
75	748+332	Box	BHS	-	1 x 2	35	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
76	748+531	Pipe	BHS	-	3 x 1.2	35	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
77	748+750	Box	BHS	-	1 x 4	35.6	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
78	748+950	Pipe	BHS	-	2 x 1	35	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
79	749+124	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
80	749+237	Box	BHS	-	1 x 2.5	35	Yes	No	Yes	No	> Bushes are observed at BHS.
81	749+442	Box	BHS	-	1 x 2	40	Yes	Yes	Yes	Yes	> Culvert is in fair condition. > RHS no access to go.
82	749+615	Pipe	BHS	-	2 x 1.2	55	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
83	749+900	Box	BHS	-	1 x 2	55	Yes	No	Yes	No	> Bushes are observed at BHS.
84	750+191	Box	BHS	-	1 x 4	56	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
85	750+444	Pipe	BHS	Widening	2 x 1	57.5	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
86	750+647	Pipe	BHS	Widening	3 x 1	50	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
87	750+887	Pipe	BHS	Widening	3 x 1	35	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
88	751+110	Pipe	BHS	-	3 x 1	35	No	No	Yes	Yes	> Culvert is buried at LHS.> Culvert is in fair condition at RHS.

Sl No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Str. Proposal As per Sch-B	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
							LHS	RHS	LHS	RHS	
89	751+300	Pipe	BHS	-	1 x 1.2	32.5	No	No	Yes	Yes	> Culvert is in fair condition.
90	751+550	Pipe	BHS	-	3 x 1	32.5	No	No	Yes	Yes	> Bushes are observed at BHS.
91	751+817	Pipe	BHS	-	1 x 1.2	50	No	No	Yes	Yes	> Bushes are observed at BHS.
92	751+910	Pipe	BHS	-	1 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
93	752+164	Box	BHS	-	1 x 2	32.5	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
94	752+334	Pipe	BHS	-	2 x 1.2	50	No	No	Yes	Yes	> Culvert is in fair condition.
95	752+683	Pipe	BHS	-	1 x 1.2	55	No	No	Yes	Yes	> Culvert is in fair condition.
96	752+909	Pipe	BHS	-	1 x 1.2	45	No	No	Yes	Yes	> Culvert is in fair condition.
97	753+087	Pipe	BHS	-	1 x 1.2	45	No	No	Yes	Yes	> Bushes are observed at LHS. > Culvert is in fair condition at RHS.
98	753+184	Box	BHS	-	1 x 3.1	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
99	753+192	Box	BHS	-	1 x 3.1	-	-	-	-	-	> Culvert is not found at site.
100	753+532	Box	BHS	-	1 x 3	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
101	753+876	Box	BHS	-	1 x 4	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
102	755+550	Pipe	BHS	-	1 x 1.2	35	No	No	Yes	Yes	> Bushes are observed at BHS.
103	755+680	Pipe	BHS	-	1 x 1.2	32	No	No	Yes	Yes	> Culvert is in fair condition.
104	755+795	Box	BHS	-	1 x 3	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
105	756+220	Box	BHS	-	1 x 2	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
106	756+805	Pipe	BHS	-	1 x 1.2	45	No	No	Yes	Yes	> Culvert is in fair condition.
107	757+563	Pipe	BHS	-	1 x 1.2	50	No	No	Yes	Yes	> Culvert is in fair condition.
108	757+837	Pipe	BHS	-	1 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
109	758+103	Box	BHS	-	1 x 2	34	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
110	758+400	Box	BHS	-	1 x 4	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
111	758+813	Box	BHS	Widening	1 x 4	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
112	759+000	Box	BHS	Widening	1 x 4.5 x 4	24	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
113	759+255	Pipe	BHS	Widening	1 x 1	55	No	No	Yes	Yes	> Culvert is in fair condition.
114	759+320	Pipe	BHS	Widening	1 x 1	55	No	No	Yes	Yes	> Culvert is in fair condition.
115	759+472	Pipe	BHS	-	1 x 1	55	No	No	Yes	Yes	> Culvert is in fair condition.
116	760+014	Pipe	BHS	-	1 x 1	55	No	No	Yes	Yes	> Culvert is in fair condition.
117	760+340	Pipe	BHS	-	2 x 1	60	No	No	Yes	Yes	> Culvert is in fair condition.
118	760+400	Pipe	BHS	-	2 x 1	60	No	No	Yes	Yes	> Culvert is in fair condition. > Culvert is found extra at site.
119	760+825	Pipe	BHS	-	2 x 1	35	No	No	Yes	Yes	> Culvert is in fair condition.
120	761+336	Pipe	BHS	-	2 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
121	761+650	Pipe	BHS	-	2 x 1.2	30	No	No	Yes	Yes	> Culvert is in fair condition.
122	761+920	Pipe	BHS	-	2 x 1.2	35	No	No	Yes	Yes	> Culvert is in fair condition.
123	762+350	Pipe	BHS	-	2 x 1.2	35	No	No	Yes	Yes	> Culvert is in fair condition.

Sl No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Str. Proposal As per Sch-B	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
							LHS	RHS	LHS	RHS	
124	762+718	Pipe	BHS	-	2 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
125	763+115	Pipe	BHS	-	2 x 1.2	45	No	No	Yes	Yes	> Culvert is in fair condition.
126	763+543	Pipe	BHS	-	2 x 1.2	45	No	No	Yes	Yes	> Culvert is in fair condition.
127	763+980	Pipe	BHS	-	2 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition.
128	764+200	Pipe	BHS	-	2 x 1.2	-	-	-	-	-	> Culvert is not found at site.
129	764+615	Pipe	BHS	-	2 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
130	765+073	Pipe	BHS	-	2 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
131	765+230	Pipe	BHS	-	2 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
132	765+417	Pipe	BHS	-	2 x 1.2	45	No	No	Yes	Yes	> Culvert is in fair condition.
133	765+550	Pipe	BHS	-	2 x 1.2	-	-	-	-	-	> Culvert is not found at site.
134	765+708	Pipe	BHS	-	2 x 1.2	50	No	No	Yes	Yes	> Culvert is in fair condition.
135	766+560	Pipe	BHS	-	1 x 1.2	35	No	No	Yes	Yes	> Culvert is in fair condition at LHS. > Bushes are observed at RHS.
136	767+850	Pipe	BHS	-	1 x 1.2	30	No	No	Yes	Yes	> Bushes are observed at BHS.
137	768+036	Pipe	BHS	-	1 x 1.2	30	No	No	Yes	Yes	> Culvert is in fair condition.
138	768+385	Pipe	BHS	-	2 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition.
139	768+941	Box	BHS	-	1 x 2	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
140	769+400	Pipe	BHS	-	1 x 1.2	35	No	No	Yes	Yes	> Culvert is in fair condition. > Culvert is found extra at site.
141	769+655	Pipe	BHS	-	1 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
142	770+010	Pipe	BHS	-	1 x 1.2	-	-	-	-	-	> Culvert is not found at site.
143	770+680	Pipe	BHS	-	1 x 1	35	No	No	Yes	Yes	> Culvert is in fair condition.
144	771+330	Pipe	BHS	-	1 x 1.2	30	No	No	Yes	Yes	> Culvert is in fair condition.
145	771+955	Pipe	BHS	-	2 x 1	30	No	No	Yes	Yes	> Culvert is in fair condition.
146	773+110	Box	BHS	-	1 x 3	36	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
147	773+500	Box	BHS	-	1 x 2	25	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
148	774+965	Pipe	BHS	-	2 x 1	60	No	No	No	No	> Culvert is under construction. > Head wall is pending.
149	775+440	Pipe	BHS	-	2 x 1	60	No	No	No	No	> Culvert is under construction. > Head wall is not constructed at LHS.
150	775+604	Box	BHS	-	2 x 3	60	No	No	Yes	Yes	> Culvert is under construction. > Parapet wall is not constructed at RHS.
151	775+695	Pipe	BHS	-	1 x 1.0	60	No	No	No	No	> Culvert is buried. > Approach is under construction.
152	775+935	Pipe	BHS	-	1 x 1.0	60	No	No	No	No	> Culvert is under construction. > Culvert is buried at RHS.
153	776+804	Pipe	BHS	-	2 x 1	60	No	No	No	No	> Culvert is under construction. > Head wall is not constructed.

Sl No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Str. Proposal As per Sch-B	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
							LHS	RHS	LHS	RHS	
154	778+020	Pipe	BHS	-	1 x 1.0	60	No	No	No	No	> Culvert is under construction.
155	779+650	Pipe	BHS	-	1 x 1.2	50	No	No	No	No	> Culvert is under construction.
156	780+050	Pipe	BHS	-	2 x 1	40	No	No	No	No	> Bushes are observed at BHS.
157	780+346	Pipe	BHS	-	2 x 1.2	62.5	No	No	No	No	> Bushes are observed at BHS.
158	782+450	Pipe	BHS	-	1 x 1.0	57.5	No	Yes	No	Yes	> Bushes are observed at LHS.
159	782+650	Pipe	BHS	-	1 x 1.0	57.5	No	No	No	No	> Culvert is in fair condition at LHS.
160	782+967	Pipe	BHS	-	1 x 1.0	42.5	No	No	No	No	> Culvert is under construction.
161	783+430	Pipe	BHS	-	1 x 1.0	42.5	No	No	No	No	> Head wall is pending at BHS.
162	784+646	Box	BHS	-	2 x 3	42.5	No	No	No	No	> Culvert is under construction.
163	784+824	Box	BHS	-	2 x 3	42.5	Yes	No	Yes	No	> Wing wall is present for LHS culvert.
164	785+230	Pipe	BHS	-	2 x 1	42.5	-	-	-	-	> Culvert is not found at site.
165	786+695	Pipe	BHS	-	2 x 1.2	42.5	No	No	No	No	> Culvert is under construction.
166	787+915	Pipe	BHS	-	1 x 1.0	57.5	Yes	Yes	Yes	Yes	> Chamber is constructed at RHS.
167	788+840	Pipe	BHS	-	2 x 1	42.5	No	No	No	No	> Culvert is under construction.
168	789+140	Pipe	BHS	-	3 x 1	42.5	No	No	No	No	> Culvert is under construction.
169	789+271	Box	BHS	-	1 x 2.5	42.5	Yes	No	Yes	No	> Wing wall is present for LHS culvert. > Parapet wall is not constructed at RHS.
170	790+550	Pipe	BHS	-	2 x 1	42.5	No	No	No	No	> Culvert is under construction.
171	791+249	Pipe	BHS	-	1 x 1.0	42.5	No	No	No	No	> Culvert is under construction.
172	792+133	Pipe	BHS	-	2 x 1	42.5	No	No	No	No	> Culvert is under construction.
173	793+175	Pipe	BHS	-	1 x 1.2	32	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
174	793+375	Pipe	BHS	-	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
175	793+732	Pipe	BHS	-	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
176	794+540	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
177	794+810	Pipe	BHS	-	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Culvert is partially buried at RHS. > Bushes are observed at LHS.
178	795+075	Pipe	BHS	-	1 x 1.2	55	Yes	Yes	Yes	Yes	> Debris and bushes are observed at BHS.
179	795+450	Box	BHS	-	1 x 2	55	Yes	Yes	Yes	Yes	> Quadrant pitching is partially damaged at RHS. > LHS culvert is merged into drain.
180	795+792	Box	BHS	-	1 x 3	56.5	Yes	Yes	Yes	Yes	> Debris are observed at BHS.
181	796+832	Box	BHS	-	1 x 2	28	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
182	797+041	Box	BHS	-	1 x 2	33	Yes	Yes	Yes	Yes	> Culvert is in fair condition.

Sl No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Str. Proposal As per Sch-B	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
							LHS	RHS	LHS	RHS	
183	797+312	Pipe	BHS	-	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> LHS culvert is merged into drain. > Culvert is in fair condition at RHS.
184	797+843	Pipe	BHS	-	1 x 1.2	35	Yes	Yes	Yes	Yes	> Quadrant pitching is partially damaged at RHS. > Bushes are observed at BHS.
185	799+020	Pipe	BHS	-	1 x 1.2	55	Yes	Yes	Yes	Yes	> Culvert is in fair condition. > Culvert is found extra at site.
186	801+541	Pipe	BHS	-	1 x 1.2	55	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
187	802+226	Pipe	BHS	-	2 x 1.2	55	Yes	Yes	Yes	Yes	> Quadrant pitching is partially damaged at BHS. > Bushes are observed at BHS.
188	803+093	Pipe	BHS	-	2 x 1.2	40	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
189	803+480	Box	BHS	-	1 x 2	33	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
190	803+995	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Culvert is in skew. > Bushes are observed at RHS.
191	804+100	Pipe	BHS	-	1 x 1.2	35	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
192	804+244	Pipe	BHS	-	2 x 1.2	35	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
193	804+458	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Quadrant pitching is partially damaged at BHS. > Bushes are observed at BHS.
194	804+658	Pipe	BHS	-	1 x 1.2	35	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
195	804+956	Pipe	BHS	-	2 x 1.2	40	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
196	805+460	Pipe	BHS	-	2 x 1.2	37.5	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
197	805+730	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Quadrant pitching is partially damages at LHS. > Crack is observed on head wall at LHS. > Reinforcement is exposed on RHS pipe.
198	805+838	Box	BHS	-	1 x 2	33	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
199	805+995	Pipe	BHS	-	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Quadrant pitching is covered by debris at RHS.
200	806+175	Pipe	BHS	-	4 x 1	45	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
201	806+975	Pipe	BHS	-	1 x 1.2	35	Yes	Yes	Yes	Yes	> Bushes are observed at BHS. > Pipe is damaged and reinforcement is exposed at RHS.
202	807+741	Pipe	BHS	-	1 x 1.2	35	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
203	807+853	Pipe	BHS	-	1 x 1.2	35	Yes	Yes	Yes	Yes	> Bushes are observed at RHS. > Culvert is in fair condition.
204	807+975	Pipe	BHS	-	3 x 1.2	40	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.

Sl No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Str. Proposal As per Sch-B	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
							LHS	RHS	LHS	RHS	
205	808+050	Box	BHS	-	1 x 2	33.5	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
206	808+180	Pipe	BHS	Widening	1 x 1.2	40	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
207	808+500	Box	BHS	Reconstruction	1 x 4	33.5	Yes	Yes	Yes	Yes	> Culvert reconstruction proposed at 808+483 Span 1 x 4.5 as per schedule-B.
208	808+671	Pipe	BHS	Widening	1 x 1.2	40	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
209	808+780	Pipe	BHS	Widening	2 x 1.2	40	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
210	808+946	Pipe	BHS	Widening	1 x 1.2	45	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
211	809+261	Pipe	BHS	-	2 x 1.2	50	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
212	809+505	Pipe	BHS	-	1 x 1.2	60	Yes	Yes	Yes	Yes	> Culvert is merged into drain.
213	809+580	Pipe	BHS	-	2 x 1.2	60	Yes	Yes	Yes	Yes	> Culvert is merged into drain.
214	810+135	Pipe	BHS	-	1 x 1.2	-	-	-	-	-	> Culvert is not found at site.
215	810+500	Box	BHS	-	1 x 2	35	Yes	Yes	Yes	Yes	> Quadrant pitching is covered by debris. > Bushes are observed at RHS.
216	810+826	Pipe	BHS	Widening	1 x 1.2	40	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
217	811+007	Pipe	BHS	Widening	1 x 1.2	40	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
218	811+250	Box	BHS	-	1 x 4.5	32.5	Yes	Yes	Yes	Yes	> Bushes are observed at BHS. > Culvert is found extra at site.
219	811+600	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Bushes are observed at BHS.
220	812+505	Box	BHS	-	1 x 4.5	33.5	Yes	Yes	Yes	Yes	> Culvert is in fair condition.

Photos Depicting the Existing Culvert Are Presented Below

Photos of Box Culvert

Box @ 730+198

Box @ 742+318

Box @ 758+400

Box @ 768+941

Box @ 803+480

Box @ 812+505

Photos of Pipe Culvert

Pipe @ 772+160

Pipe @ 736+200

Pipe @ 768+036

Pipe @ 780+364

790+550

808+780

4.8 DRAINAGE AND SLOPE PROTECTION

- ✓ Lined Covered drains observed at urban locations and at service road Locations along the corridor.
- ✓ No major damages observed at covered drain locations.

4.9 TRAFFIC SAFETY AND ROAD FURNITURE

- ✓ Metal beam crash barriers provided along the project road appear to be intact over entire length except for few locations where it got damaged.
- ✓ Pedestrian guard rails installed on the median, Separator & appear to be intact over entire length except for few locations where it got damaged.
- ✓ Median Opening locations appear to be in good condition. The width of the existing standing lane median openings was observed for a width of 1.0m.
- ✓ Solar blinkers in Fair condition observed at median openings in the entire project corridor.
- ✓ Street lightings and High masts are observed at urban, Toll plaza, Junction Locations, at few locations' street lightings are got damaged and not functioning well, and those locations are mentioned in the above presented table.

4.10 ROAD USER FACILITIES

The Bus Bay with Shelters and truck lay byes were provided along the corridor.

CHAPTER 5. REHABILITATION PLANS AND DESIGNS

5.1 DESIGN TRAFFIC LOADING

With due consideration of traffic data (supplied), computed VDFs from the latest axle load surveys and thus by populating with minimum 5% growth rates to establish traffic loading for 10 years, 15 years and 20 years design period as below:

Table 36: Traffic Volume (AADT)-FY2023

Vehicle/Mode	LHS	RHS
BUS	75	75
2 Axle	322	322
3 Axle	192	192
M Axle	1000	1000
LCV	150	150

Table 37: Estimated Design traffic loading

Year	MSA, with min. 5% Growth rates	
	LHS	RHS
10th year from Now	59	73
15th year from Now	101	125
20th year from Now	154	192

The computation of traffic loadings is presented in **Appendix 9** of this Report. The traffic loading on RHS direction is high compared to LHS direction. Design traffic corresponding to 10 years period has been considered for overlay design.

5.2 PAVEMENT REHABILITATION AND STRENGTHENING

5.2.1 Rigid Pavement Strengthening

Based on the FWD survey and their results it appears that the majority of the flexural strength values ranges from 3.0MPa to more than 4.5 Mpa. The rigid pavement design period has been checked with various flexural strength values by considering the existing PQC & DLC thickness.

Number of axle load repetitions for each year of operation is estimated and cumulated for entire operation period of 20 years from now. Using IRC 58-2015 design charts, stress ratios corresponding each Flexural strength values ranging from 3.6 Mpa-4.5Mpa have been estimated and number repetitions that existing pavement serves is also established.

The summary of the Design period satisfies for various flexural strength values as given below:

Flexural Strength (MPa)	Existing Rigid Pavement Thickness satisfies to the design period in Years	
	LHS	RHS
3.43/3.41	10 Years	10 Years
3.61/3.57	20 Years	20 Years
3.75	30 Years	30 Years
4.0	30 Years	30 Years
4.5	30 Years	30 Years

From the FWD data analysis it is found that nearly 68% points in on LHS & 60% points in RHS were having flexural strength values more than 3.4Mpa. These are considered to be fair condition and requires minimal maintenance. Similarly, flexural strength values less than 3.4mpa were considered to be average to poor condition and are estimated nearly 32% of samples in on LHS & 40% sample in RHS of project road may require major rehabilitation measures during operation period. Thus, the same has been considered in cost estimates apart from routine and periodic maintenance of rigid pavement.

5.2.2 Flexible Pavement Strengthening

For Design the Overlay Thickness the following method as suggested in IRC: 115 has been used

- The existing pavement is considered as a 3-layer system consisting of subgrade, granular and bituminous layer. The remaining life of exiting pavement in terms of Fatigue and Rutting life (MSA) are estimated.
- The remaining life is compared with design traffic loading. An overlay with assumed thickness is considered on exiting pavement where required.
- The Total system including the proposed Overlay (Trial thickness) is assumed as a four-layer system and considered the relevant MR values for all the four layers namely New BT layer, existing bituminous surface, total existing Granular layers and Subgrade layers.
- The MR value for the New BT is assumed as 3000 MPA (considering VG40 Bituminous grade) for Main Carriageway and 2000 MPA (considering VG30 Bituminous grade) for Service Road and for all the remaining three layers, the MR Values derived and finalized from the FWD Analysis are considered
- Critical Tensile strains and Vertical strains are found out by using the IIT PAVE Software at the bottom of existing bituminous layer and at the top of the subgrade layer respectively.
- The Fatigue and Rutting equations (equation given in the IRC: 37) have been used to estimate the Fatigue and Rutting Life of The Pavement system.
- The Obtained Fatigue and Rutting Life are compared with the required life for the assumed trial overlay thickness.

Remaining life of the existing pavement from the above analysis is presented in the following tables:

Table 38: Remaining life of the existing pavement on Both Carriageways

S No	From (km)	To (km)	Length (km)	15th Percentile MR values, MPa			Avg. Existing Crust (mm)		Total Crust (mm)	MR for BT	Strains From IITPAVE		Nf-Fatigue life, MSA	Rutting life, MSA	Critical Life, MSA
				MR for BT	MR for Granular	MR for Subgrade	BC	Granular			Vertical strain at bottom, epZ	Tangential strain at top, epT			
LHS															
1	783.20	785.40	2.2	3101	386	87	140	400	540	3000	0.0002619	0.0001431	97	245	97
2	785.40	792.83	7.4	3023	310	87	140	400	540	3000	0.0002808	0.0001610	62	178	62

S No	From (km)	To (km)	Length (km)	15th Percentile MR values, MPa			Avg. Existing Crust (mm)		Total Crust (mm)	MR for BT	Strains From IITPAVE		Nf-Fatigue life, MSA	Rutting life, MSA	Critical Life, MSA
				MR for BT	MR for Granular	MR for Subgrade	BC	Granular			Vertical strain at bottom, epZ	Tangential strain at top, epT			
RHS															
1	783.26	785.45	2.2	2795	383	87	140	460	600	2795	0.0002283	0.0001462	95	456	95
2	785.45	792.81	7.4	2797	359	87	140	460	600	2797	0.0002337	0.0001516	83	410	83

It can be seen from the above tables that the assessed, minimum remaining life of the existing pavement is 62 MSA in LHS direction and 83 MSA in RHS direction which more than the 10 years design traffic 59 MSA and 73 MSA respectively. Hence, there is no requirement of Strengthening Overlay.

5.3 STRUCTURAL REHABILITATION

All the structure found to be in good condition except minor treatment like repair of stone pitching, cleaning of drainage spouts, cleaning of vegetation etc. may be required. Detailed structural rehabilitation quantities have been worked out based on the prevailing condition of existing structures. This methodology describes in detail the procedure for the execution of each item of rehabilitation work of the Existing Bridges of the project.

The scope of this methodology covers the items mentioned below for rehabilitation work of all the existing Bridges.

- Repair/ Replacement of Existing Bearings
- Repair / Replacement of Existing Expansion Joints
- Repair / Replacement of Existing Wearing Coat
- Profile Correction for Existing Deck Slab by Cement Concrete
- Sealing of Cracks for Bridges by Epoxy Resin
- Replacement of Spalled Concrete of ECW by Epoxy Mortar
- Cement Grouting for Repair of Existing Bridges
- Guniting / Shotcrete for Repair of Existing Bridges

- Providing & Fixing of Drainage Spouts
- Repair of Substructure Component
- Repair / Replacement of Railing & Crash Barrier
- Epoxy Bonding between New and Old Concrete.

About 8 Nos. of locations, structures are closely monitored by use of Mobile Bridge Inspection Unit (MBIU). Details of these structures where MBIU is used are presented in the following table

Table 39: Locations of MBIU survey

S.No.	Chainage	Type of Structure	Side
1	735+000	MNB	LHS
2	735+000	MNB	RHS
3	755+420	MNB	LHS
4	755+420	MNB	RHS
5	765+825	MNB	LHS
6	765+825	MNB	RHS
7	809+117	MNB	LHS
8	809+117	MNB	RHS

Based on the visual Inspection, majority of structures are found to be in fair condition. However, NDT tests are suggested for Old Bridges on LHS at 3 Nos. of locations viz., MJB @ Km 785+625 & MNB @ Km 790+470 & ROB @ Km 780+320

5.4 DEVELOPMENT ZONES (Schedule-B PROVISIONS)

5.4.1 MAINTENANCE WORKS

Schedule B stipulates the obligation of immediate maintenance which is to be done by the incoming Concessionaire. However, NHAI has represented to NHIT that they will undertake the immediate maintenance themselves, confirming to CA obligations, before handing over the asset to NHIT.

For Service Road: Existing service road shall be provided with overlay at following locations for 30 MSA by carrying FWD.

Sn	Location		One Side Length	Side	Minimum Overlay
	From	To			
1	809+325	810+118	1586	BHS	40 mm BC + 50 mm DBM

5.4.2 Project Facilities

- **Truck Lay Bye**

Truck Lay bye shall be upgraded at the following locations as per IRC: SP:84- 2019 within the ROW.

S.N.	Location	Side	Improvement Proposal
1	771+400	LHS	Facilities / repaired to be provided as per IRC SP: 84-2019
2	794+700	RHS	

The existing toilets shall be suitably modified to give an aesthetically pleasing look and shall gel with the surroundings. The Sewage disposal system shall be through Bio-digestible system (including Septic Tank & Soak pit). The drinking water facility shall be RO Treated Water.

- **RE Wall Painting**

All surface area of existing and new RE wall shall be painted reflecting local cultural heritage in consultation with IE and Authority

5.4.3 COMPLETION SCHEDULE FOR IMPROVEMENT PROPOSALS

Completion schedule for Scope mentioned in Schedule-B shall be as below.

S. No.	Description of Work	Date of Completion
1	Incident Management (9.7, 9.8 and 9.9)	From Appointed Date / O & M Handover Date, whichever is later
2	Installation / Rectification of road furniture related items (Section 10) Landscaping and Tree Plantation (Section 9.4)	9 months from Appointed Date
3	Maintenance and Rehabilitation (Section 4)	6 months from Appointed Date / O&M Handover Date, whichever is later
4	Toll Plaza and other facilities at Toll Plaza (Section 9.1, 9.11,9.12)	6 months from Appointed Date
5	ATMS (Section 9.10)	18 months from Appointed Date ***(pre-bid reply dtd 11.10.2023, annexure-2, S.No3: Installation, operation and maintenance of the ATMS shall be done by NHAI)***
6	Other Improvements (Section 1, 2, 3, 5, 6, 7, 8, 9.2, 9.3, 9.5, 9.6 and 9.13)	18 months from Appointed Date

CHAPTER 6. OPERATION AND MAINTENANCE

6.1 INTRODUCTION

Looking at the contractual requirements of maintaining project road under specified level of roughness it is felt that roughness is the most important criterion for finalizing the O&M schedule for the project. Accordingly, the methodology adopted by present consultants includes predicting the roughness year by year under the traffic using a well acknowledged HDM-4 model developed for developing countries like India after lot of research by World Bank. The said model is widely prescribed by MORTH and NHAI during the preparation of detailed project reports for several projects in doing economic analysis for the projects. The economic analysis mainly consists of two parts:

1. Predicting the road deterioration and estimating VOC
2. Estimating Benefits

Considering its importance and present use in India, consultants felt prudent to use the first part, i.e. estimating road deterioration and predicting roughness in HDM 4 model to finalize the O&M schedule for the project. This approach is more scientific as it does not assume hypothetical deflection values at 10th and 20th year and includes main criterion of maintaining roughness at 2400mm/Km as per Schedule F.

6.2 CA SPECIFICATIONS FOR MAJOR MAINTENANCE

- Schedule F of CA specifies that Roughness values exceeds 2400mm/km in a length of KM, needs to be corrected within 180 days.
- No specific requirement with respect to deflection (FWD) measurement

6.3 RIGID PAVEMENT PERIODIC MAINTENANCE STRATEGY

Apart from the above requirements of Sch-F and maintaining the roughness and skid number for the rigid pavements, there are several other repair strategies included in Sch-F for rectification of defects in rigid pavement. These include following:

- Crack Seal
- Seal & Stitch
- Staple or Dowel Bar Retrofit
- Partial Depth Repair with Stapling
- Full Depth Repair: Dismantle and reconstruct affected Portion
- Diamond Grinding
- Joint Cleaning & Repair

Looking at the above requirements, it is felt necessary to consider following activities as part of periodic maintenance cycle apart from routine maintenance activities:

Description	%	Unit	Rate	Quantity	Amount
Length of Rigid Pavement		Kms		60.095	
PQC Qty		Cum		392820	
Total Area		Sqm		1165080	
No of Transverse Joints		no		28206	
No of Panels		no		69042	
Length of Transverse Joints		m		258907	
Longitudinal Joint		m		300475	
Repair of Transverse Joint @ 7 years	75.0%	m	64.50	194180	12524610
Repair of Longitudinal Joint @ 7 years	75.0%	m	64.50	225356	14535478
Replacement of Transverse Joint@ 7years	2.0%	m	833.00	5178	4313385
Replacement of Longitudinal Joint@ 7years	2.0%	m	833.00	6009	5005913
Ravelling surface @7years	3.0%	Sqm	935	34952	32680494
Crack sealing Surface @ 7years	2.0%	m	436	4808	2097652
Repair of Panels @ 7years	0.50%	No	9390	345	3239698
Removal of Panels @ 7years	1.50%	No	3411	1036	3533381
Relaying of Panels @ 7years	1.50%	No	37364	1036	38708835
Retexturing of Panels @ 7years	20%	Sqm	100	233016	23301600
Regrinding and Retexturing@ 7years	10%	Sqm	500	116508	58254000
Total Amount in Rs.					198195046
GST @ 18%					35675108
Periodic maintenance cost in Crores					23.40
Per Sqm per Cycle (Rs.)					**201**

Note :

1. The above Costs are considered in 4 cycles
2. Apart from the above, the additional cost of Rehabilitation is considered in 2nd Cycle based on the current FWD Data

The above are in addition to routine maintenance activities which include following for every year:

Longitudinal Cracks more than 1.5m	Lin.m	0.50%
Longitudinal Cracks less than 1.5m	Lin.m	0.50%
Transverse Cracks less than 1.5m	Lin.m	0.50%
Transverse Cracks more than 1.5m	Lin.m	0.50%
Longitudinal Crack full Depth	Cum	0.10%
Pothole	Sqm	0.10%
Corner Cracks	cum	0.10%
Condition of Joints	Lin.m	1.00%
Diagonal Cracking	Lin.m	0.50%
Raveling of panel	Sqm	0.15%

6.4 STRUCTURAL PERIODIC MAINTENANCE STRATEGY

Expansion joints:

- Visual inspection is carried out to check for seal breakages, Armor angle, Weld failures, cracks between deck & Expansion joints concrete and Joints filled with debris. Such joints replaced immediately.
- Joint buried with debris shall be inspected for any distress, if any distress is shown it shall be replays immediately.
- During visual inspection it is seen that some Expansion joints are bad where as some are not showing any defects.
- Due to this it is considered provident to change the Expansion joints which are visibly damaged in initial stage.
- In the absence of records pertaining to Expansion joint replacements it is highly difficult to predict the date of replacement needed for compliance to IRC codal requirements. Balance joints which are not replaced initially will be replaced as on when defects are shown in the joints. This aspect is considered in BOQ.

Bearings:

- In order to identify the bearings requiring immediate replacement, the following strategy is adopted.
- Girder Bridges showing diagonal cracks at support, distress in the Pedestals and any form of distress in support location is regarded as a candidate for replacement. By visual inspection there are only a handful of such situations.
- Wherever pedestals are damaged either by cracking or spalling poisons confinement is proposed by Jacketing/MS plate bonding such procedure is very effective and common.
- All Metallic Bearings need to be taken up for servicing.

Wearing Coat:

It is necessary to replace the Wearing coat at every 15years interval, as wearing coat is a very weak component of the bridge structure which is subjected to severe deterioration due to Loading, Environment etc. As of now, we have considered sealing of cracks by Fog Seal and for which does not show any distress other than cracking by viz. Pot holes, abrading etc. Based on this aspect, this cost has been considered in highway O&M cost.

Periodic Maintenance strategy for Replacement of Bearings & Expansion joint:

Below strategy has been considered for periodic major maintenance of the structures.

S.No	Description		Bridge Component
1	Old structure	Structures which are older than 15years as of now	Periodic Replacement of bearings, Expansion joint
2	New Structure	Structures which are Not older than 15years as of now	

Age	Description	Item	structures-Assumption-MMR							
			% of Replacement of Major components							
			2024	2028	2033	2038	2043	2048	2053	2052
New	Super structure lifting with Pot bearings	Pot	0%	10%	50%	25%	50%	25%	25%	0%
New	Super structure lifting with Elastomeric bearings	Ela	0%	10%	75%	50%	50%	25%	50%	0%
New	Super structure lifting with Rocker bearings	Rocker	0%	0%	0%	0%	0%	0%	0%	0%
Old	Super structure lifting with Pot bearings	Pot	50%	25%	50%	25%	25%	25%	50%	0%
Old	Super structure lifting with Elastomeric bearings	Ela	50%	25%	50%	25%	25%	25%	50%	0%
Old	Super structure lifting with Rocker bearings	Rocker	25%	10%	25%	10%	25%	25%	25%	0%
New	Pot bearing cost	Pot	0%	10%	50%	25%	50%	25%	25%	0%
New	Elastomeric bearing cost	Ela	0%	10%	75%	50%	50%	25%	50%	0%
New	Rocker bearing cost	0	0%	0%	0%	0%	0%	0%	0%	0%
Old	Pot bearing cost	Pot	50%	25%	50%	25%	25%	25%	50%	0%
Old	Elastomeric bearing cost	Ela	50%	25%	50%	25%	25%	25%	50%	0%
Old	Rocker bearing cost	0	25%	10%	25%	10%	25%	25%	25%	0%
New	Expansion joint Replacement	0	0%	20%	50%	50%	50%	25%	50%	0%
Old	Expansion joint Replacement	0	75%	25%	25%	25%	50%	25%	50%	0%
New	Others	0	0%	20%	50%	25%	25%	25%	50%	0%
Old	Others	0	75%	25%	25%	25%	25%	25%	50%	0%

Cost Component for various items and activities have been worked out by considering the Best Industry practice and most appropriate methods. Detailed quantities for work items have been estimated based on the details presented in previous chapters for various heads.

The List of the cost components considered are presented below:

- Immediate Repair's Cost
- Routine Maintenance Cost
- Incident Management Cost
- Periodic Maintenance Cost
- Operations Cost
- Year by Year total O&M Costs

7.1 RATE ANALYSIS

Detailed rate analysis has been carried out based on MORTH guidelines to arrive at the unit rates of various items. Material rates and their leads from the project corridor are considered as per the material investigations done on the project road. Summary of unit rates arrived at are presented in table below:

Table 40 Summary of Unit Rates of Basic material

S no	Description	Units	Source	Basic rate excluding Transportation & GST	Lead in Kms
1	Good earth	Cum	BA	6	5.50
2	40 mm	Cum	Crusher	638	5.17
3	20 mm	Cum	Crusher	743	5.17
4	12 mm	Cum	Crusher	285	5.17
5	6 mm	Cum	Crusher	145	5.17
6	Dust	Cum	Crusher	180	5.17
7	M sand	Cum	Crusher	216	5.17
8	Flyash	Cum	Nearest Plant	0	769.72
9	Boulders	Cum	Quarry	64	1.00
10	Sand source to Plant	Cum	River	216	6.00
11	Sand source to working site	Cum	Stock yard	216	2.00
12	Bitumen 60/70	MT	Mathura	48566	626.00
13	Bitumen 80/100	MT	Mathura	47806	626.00
14	VG-40	MT	Mathura	48000	626.00
15	CRMB-55	MT	Mathura	49516	626.00
16	PMB	MT	Mathura	53200	626.00
17	SS1	MT	Mathura	60000	626.00
18	Steel	MT	Rewa	63833	0.00
19	HTS Strands	MT	Rewa	70000	1182.00
20	Cement	MT	Rewa	5313	0.00
21	Structural Steel	MT	Rewa	65833	121.00
22	RCC Pipe NP 4 heavy duty non pressure pipe 1000 mm dia	RM	Rewa	4500	90.00
23	RCC Pipe NP 4 heavy duty non pressure pipe 1200 mm dia	RM	Rewa	5500	90.00
24	RCC Pipe NP 4 heavy duty non pressure pipe 900 mm dia	RM	Rewa	3500	90.00

Table 41 Major Material Cost

Sl.no	Item	Unit	Rate (INR) Excluding GST
1	Embankment - borrow	Cum	245
2	Embankment - Excavation	Cum	82
3	SG	Cum	251
4	GSB G-2	Cum	1081
5	WMM	Cum	1179
6	Prime Coat	Sqm	50
7	Tack coat on granular	Sqm	17
8	DBM G-1	Cum	7675
9	Tack coat on bituminous surface	Sqm	15
10	BC - G1	Cum	9237
11	Road Marking	Sqm	531
12	RE wall	Sqm	4700
13	Select Fill	Cum	276
14	Filter Media	Cum	1171
15	M15	Cum	4923
16	M20	Cum	5360
17	M25	Cum	5821
18	M30	Cum	5846
19	M35	Cum	5990
20	M40	Cum	6109
21	PSC M45	Cum	7352
22	HYSD	MT	91834
23	HT starnd	MT	144275
24	Pile 0.75 dia	Rm	10497
25	Pile 1 dia	Rm	13837
26	Pile 1.2 dia	Rm	18196

7.2 INITIAL COSTING

Costs associated with initial improvements are estimated based on the detailed asset inventory and condition assessment surveys, Pavement condition and structural condition assessment surveys. Items which are not executed as part of scope or in damaged condition have been considered for immediate costs as a part of 1-year Capex. Following items are mainly considered for Initial Improvement costs:

- Scope given in schedule-B
- Scope which is not executed
- Road work items
- Bridge Work Items
- Pavement Rehabilitation works
- Structural Rehabilitation works
- Drainage Works
- Slope Protection works
- Safety Works

Summary of Initial Improvement Costs are included in table below:

Table 42: Summary of Initial Cost

S.no	Description	Unit	Quantity	Rate (Rs.)	Amount (Rs.)
1	Initial Improvement works (Highway & Str)	LS	1	2,05,94,590	2,05,94,590
2	TMS	LS	1	2,15,53,444	2,15,53,444
3	ATMS	LS	1	-	-
4	Revalidation surveys	LS	1	75,13,465	75,13,465
5	Pavement Rehabilitation- void filling	LS	1	59,51,250	59,51,250
Immediate Repair's - Structures					32,37,593
Total Cost excluding GST					**5,88,50,342**
GST at 18%					1,05,93,062
Total Cost including GST					**6,94,43,403**
Total Cost including GST, in Crores					**6.94**

Note: This above cost arrived is with due consideration of reply to pre-bid queries dtd 27.09.2023 Annexure-E

The structure approach lengths as given in the DPR has been redesigned with due verification at site and following revised lengths were considered in EPC cost estimations.

S No.	Package	Str_Chianage	Str. Type	As Per DPR, length in KM			Difference In Km	As Per Samarth,length in KM		
				From	To	Length		From	To	Length
1	PKG-2	808.51	LVUP	808.16	808.86	0.7	0.049	808.168	808.917	0.749
2		810.65	LVUP	810.3	811	0.7	0.09	810.277	811.067	0.79

7.3 ROUTINE MAINTENANCE & INCIDENT MANAGEMENT COSTS

Routine maintenance costs include general maintenance costs of road elements, bridge elements and road furniture and appurtenances. This can be mainly divided into two parts as:

- ✓ General Maintenance of Works
- ✓ Repairs to Highway & Bridge Elements

7.3.1 General Routine Maintenance

General Routine Maintenance of Roads generally include following items:

- Cleaning of Project facilities
- Structures cleaning,
- Cleaning of ROW
- Cleaning and Maintenance of Toll Plaza

- Unlined Drain Maintenance
- Lined Drain Maintenance
- Maintenance of Highway Lighting at Toll plaza and other project locations
- Median Plantation maintenance & Avenue plantation maintenance:
- Maintenance of Road Furniture
- Maintenance of Road Safety Items

The above items are estimated by considering the detailed break-up of following items:

- Manpower including Managers/Labour etc.
- Vehicles for Labour Transport/Water Tankers/Sweeping Machines etc.
- Resources/Equipment's such as grass cutters, tools, jet sprayers, hydraulic trimmers etc.

7.3.2 Repairs to Highway & Bridge Works

Repairs to highway and bridge works have been estimated based on the assumed quantities (Percentage basis) of execution for every year.

These items include the following:

1	Providing treatment for sealing of road surface / isolated cracks at scattered locations
	i) Covered with 6.7 mm size stone chipping @ 0.1 cum/ 10 sqm.
	ii) covered with dry coarse sand passing through 2.36 mm sieve and retained on 180 micron sieve @ 0.03 cum/10 sqm heated to 600 C
	iii) filling discrete cracks with slow curing bitumen emulsion as per Technical Specification Clause 3004.3.3
2	Providing treatment to bleeding bituminous surface at scattered locations
3	Providing localized repair to rutted portion and edge breaking of bituminous surface
4	Providing treatment and repair to pot-holes and patch work
5	Providing and laying dense bituminous macadam using bitumen grade VG 40 complete as per Technical Specification Clause 507
6	Proving and laying bituminous concrete (asphaltic concrete)
	(a) Using bitumen (VG-40) as per IRC: SP: 53
7	Road Roughness survey
8	Turfing on embankment slopes and at all other Project Facilities
9	Providing repair to stone pitching/apron at scattered locations
10	Rain Cuts Maintenance: Restoration of rain cuts soil, moorum, gravel or a mixture of these
11	Providing and laying apron/ stone pitching on slopes of guide bunds/ road embankment / other location
12	Providing and laying stone aggregate filter material (150 mm compacted thickness) underneath pitching
13	Unlined drain
14	Filling in median island with approved materials with all leads and lifts complete as per TS Clause No. 407
15	Replacing damaged / broken railing with new pre-cast / cast-in-situ, concrete railing to match with existing design and pattern.
24	Carrying out repair to road signs including strengthening resetting or otherwise repairing signs and delineators
	a) Road sign board mounted on single post
	b) Road sign board mounted on double post
	c) Overhead/ Gantry Sign boards
	d) Delineator

25	Supplying and fixing at site retro-reflectorized type **sign boards/signs**
	90cm Equilateral triangle
	60cm circular
	90 cm circular
	90cm high octagon
	80cm x 60cm rectangle
	Chevron signs 60cm x 45cm
	Place identification signs (Fig 15.7 of IRC 67)
	Providing and fixing Object Markers
	Providing and fixing of retro-reflectorized Route Marker signs (size 450mm x 600mm)
26	**Hazard Marker Sign :**
	a) size 90 x 30 cm
	b) size 30cm triangular side cluster of red reflectors (screen printed)
27	Cats Eyes/Raised pavement marker (NMC Nails Less)
28	Painting two coats on old surface after minor repairs to give an even and smooth surface and printing letters and figures with synthetic enamel paint
	a) Hectometer stones
	b) Kilometer Stone
	c) 5 Kilometer stone
	d) Boundary stone
	e) Guard stone
29	Providing painting lettering and fixing of distance measurement stones including dismantling of old damaged/ broken ones, confirming to TS Clause 804
	a) Hectometer stones
	b) Kilometer Stone
	c) 5 Kilometer stone
	d) Boundary stone
	e) Guard stone
30	Providing and fixing road delineators conforming to TS Clause No. 805 as directed by the Engineer.
31	Repainting the kerb stones and separation barrier with first quality synthetic enamel paint of approved brand
32	Painting all types of pavement markings including lines, dashes, arrows etc. on roads as per relevant IRC/MOST standards after cleaning the surface complete in all respects as directed by the Engineer.
	a) Hot applied Thermoplastic compound
	(i) Lane / Centre Line / Edge Line
	(ii) Direction Arrows
	(iii) Diagonal Chevrons Markings
33	Supplying and laying cast-in-situ cement concrete kerb without channel section
	a) by Manual/machine including formwork
34	Major repair / replacement of metal beam crash barrier (W profile guard rails)
35	Providing and fixing chain link/ welded mesh fencing / square bars fencing
36	Dismantling the old damaged chain link/welded mesh / square bars fencing and replacing it with new chain link/ welded mesh/square bars fencing
37	Provision of rumble strips
38	Shoulder Maintenance:
39	synthetic enamel paint of approved brand on metal pedestrian guard rail
40	Dismantling of wearing course

B. Structures

1. Wearing coat comprising of 50 mm thick BC.
2. Cleaning and adding rubber sealant near expansion joints.
3. Modular Expansion joints.
4. Replacement of Damaged Concrete Railing all complete as per Technical specifications and as directed by the Engineer
5. Provision of an RCC crash barrier (0.35sqm cross sectional area) constructed with M-40 grade concrete including reinforcement
6. Cleaning of rocker & roller bearing using high pressure water jet, free from rust scales, re-setting & greasing the bearings using graphite grease including cost of materials, labour etc., complete.
7. POT PTF Bearings greasing and maintaining (sand plastering).
8. Elastomeric Bearings and maintaining.
9. Cutting of groove of 15 mm x 15 mm along crack and sealing the same with epoxy putty including cost of material, labour etc.
10. Carrying out 50 to 60 mm thick shortsheeting using a mix proportion of 1:2:2 (cement: sand:6 mm down aggregate) added with Polypropylene fibers at a dosage rate of 125 gms/bag of cement including cost of labour, material, scaffolding, equipment etc complete.
11. Repair of Floor Aprons, pitching and other protection works
12. Cleaning of Drainage Spouts
13. M-25 Concrete

7.3.3 Incident Management Cost

Incident Management & Safety items include the following:

- ✓ Regular patrolling & reaching accident/incident site,
- ✓ providing relief to injured persons including taking them to nearest hospital and attending to the safety requirements at the location (putting cones, safely guide & manage the traffic using signs, safety barricades, etc.),
- ✓ removal of accident /breakdown vehicles, removing of dead animals/birds lying on the highway and loading, unloading, transportation & disposal of surplus material left over by accidental vehicle or otherwise lying on road (on carriageway) and
- ✓ Encroachment prevention & removal with all lead & lifts complete with proper communication equipment,
- ✓ consumables, materials, suitable Towing vehicles, Ambulance, patrolling vehicles and manpower like drivers, helpers, para-medical staff, labour including deployment of

crane and all works shall be done as per requirement and as directed by Client representative and as per Relevant Specifications as applicable.

7.4 OPERATIONS COSTS

Cost towards Operations include the following:

- Electricity Bill of lighting
- Toll Plaza Operation cost
- Operation and management costs of rest areas and lay byes
- SPV Costs
- Survey Costs
- Insurance
- Audit Charges
- IE Fee
- Administrative Cost

Table 43: 1st year O&M Cost

S. No.	Particulars	Amount in Cr. (Including GST)
1	Tolling Operations	3.71
2	Incident Management	3.58
3	Routine Maintenance (excluding Saving in Katni bypass during DLP of EPC contractor (5years) i.e., (5.52-0.40)	5.12
4	Repairs	2.48
5	ATMS	-
6	Admin Expenses	4.49
7	Insurance	1.54
Total O&M Cost (FY 2024)		**20.93**
	For FY 2027, Additional cost towards special repairs is to be added	**5.46**
	TOTAL OPERATIONS COST(FY 2027)	**26.39**

Note: Costs are in Crores, inclusive of GST, without escalation

7.5 PERIODIC MAINTENANCE COSTS

Cost towards major maintenance include following:

- ✓ Cost of Periodic maintenance of Pavement based on Finalized MM schedule
- ✓ Cost of Periodic Maintenance of Structures
- ✓ Cost of Periodic replacement of Toll Equipment's & Software

Table 44: Periodic Maintenance Cost

S. No	Year	Periodic Maintenance				
		Functional +Structural overlay MCW+ S/R	Major Maintenance of Rigid Pavement	R&R of **ATMS**	R&R of **TMS**	Structure specified repairs
-						
1	2024	0.00	-			-
2	2025	0.00	-			-
3	2026	0.00	-			-
4	2027	0.75	2.64			-
5	2028	0.00	-			1.02
6	2029	0.00	-			-
7	2030	32.71	30.67			1.19
8	2031	0.00	-	-	1.27	-
9	2032	0.00	-			-
10	2033	0.75	2.64			1.34
11	2034	0.00	-			-
12	2035	0.00	-			-
13	2036	34.68	49.21			1.97
14	2037	0.00	-			-
15	2038	0.00	-	-	2.54	1.02
16	2039	0.75	2.64			-
17	2040	0.00	-			-
18	2041	0.00	-			-
19	2042	32.71	30.67			1.47
20	2043	0.00	-			1.34
21	2044	0.00	-			-
Total:		**102.35**	**118.47**	**0.00**	**3.81**	**9.33**
Major / Periodic Maintenance (For 20 years period)		**233.97**				

Note: Costs are in Crores, inclusive of GST, without escalation considering FY 2024 price

7.6 TOTAL OPERATION & MAINTENANCE COSTS

Year on year operation cost is summation of following:

- ✓ Immediate Costs
- ✓ Routine Maintenance & Incident Management
- ✓ Periodic Maintenance
- ✓ Operations Cost

Following table presents the summary of Operations & Maintenance cost for the project

Table 45: Cost Abstract

Calendar Year	SUMMARY OF VARIOUS EXPENSES in Rs. Crs					
	Immediate Repair's Cost	Toll Operation expenses	Routine Maintenance Expenses	Periodic Maintenanace (Functional +Struc Overlay+ Toll collectio system)	Total Cost (Rs. Cr.)	Additional Cost (For special repair) Already included in routine maintenance expenses
-		-	-	-	-	
2023-2024	6.94	3.71	6.03	-	16.69	
2024-2025		3.71	17.22	-	20.93	
2025-2026		3.71	17.22	-	20.93	
2026-2027		3.71	22.68	3.39	29.78	5.46
2027-2028		3.71	17.22	1.02	21.94	
2028-2029		3.71	17.62	-	21.33	
2029-2030		3.71	17.62	64.56	85.89	
2030-2031		3.71	17.62	1.27	22.60	
2031-2032		3.71	17.62	-	21.33	
2032-2033		3.71	17.62	4.73	26.06	
2033-2034		3.71	17.62	-	21.33	
2034-2035		3.71	17.62	-	21.33	
2035-2036		3.71	17.62	85.87	107.19	
2036-2037		3.71	17.62	-	21.33	
2037-2038		3.71	17.62	3.56	24.89	
2038-2039		3.71	17.62	3.39	24.72	
2039-2040		3.71	17.62	-	21.33	
2040-2041		3.71	17.62	-	21.33	
2041-2042		3.71	17.62	64.85	86.18	
2042-2043		3.71	17.62	1.34	22.66	
2043-2044		0.93	7.76	-	8.69	
2044-2045		-	-	-	-	
2045-2046		-	-	-	-	
2046-2047		-	-	-	-	
2047-2048		-	-	-	-	
2048-2049		-	-	-	-	
2049-2050		-	-	-	-	
2050-2051		-	-	-	-	
2051-2052		-	-	-	-	
2052-2053		-	-	-	-	
Total Cost:	***6.94***	***75.14***	***352.39***	***233.97***	**668.44**	**-**

Note: Costs are in Crores, inclusive of GST, without escalation considering FY 2024 price

7.7 CAPACITY AUGMENTATION

The project has not envisaged the capacity augmentation during concession period.

8.1 DATA COLLECTION AND REVIEW TMS Works

- **Clause 9.1 of Schedule B**

(a) Existing Toll Plaza at Km **738+500 (Kherwasani)** is proposed to be retained. The existing Toll booths shall be retained and any modification if required shall be done as per NHAI / Policy Guidelines / Management of Plaza / 2021 Policy Circular No. 17.5.82 Dated 25th May 2021. Apart from this, Static Weigh Bridge along with one room, loading / unloading platform and storage facility for overloaded material for each direction of traffic are to be repaired, modified and maintained within the available ROW as per the specifications and standards given in IRC: SP:84-2019. Existing Toll Plaza Administration building shall be repaired/ rehabilitated as per the specifications and standards given in IRC: SP: 84-2019. Required numbers of parking bays are to be provided within the Toll Plaza premises in consultation with Independent Engineer. Toilet blocks and Water ATM (one in each direction) with adequate parking facility near Toll Plaza Area shall be provided as per the drawings and standards give in NHAI Circular dated 09-11-2017 (Ref. NHAI/GM(T)HO/Highway Nest (Mini)/2017/108290).

(b) The Existing Toll Booths, Toll Plaza premises including all facilities, parking etc. shall be repaired, maintained and upgraded for smooth toll operation as per IRC SP: 84-2019.

(c) The Concessionaire shall be responsible to ensure toll plaza assets, TMS, equipment's and systems shall conform to the latest available technology / MORTH Specification / IRC / MORTH and NHAI Circular/ Policy as applicable and NO COS shall be admissible on this account for future amendments / upgradation.

- **Schedule C states as below:**

a. Engineering and safety improvements along the project highway shall conform to the IRC: SP: 84:2019, Manual of specifications & Standards for Four Laning of Highways through Public Private Partnership published by IRC.

b. Clause 2 – Deviations from the manual - Section 10: Existing Toll Plaza office complex (under construction) is to be retained. Facilities as mentioned in Clause 10.12 are to be provided within the existing Toll Plaza office Complex.

(d) IRC SP: 84:2019 clause 10.6.2 – Not less than 2 middle toll lanes shall be capable of being used as reversible lane to meet the demand of tidal flow.

- **Present major issues at site:**

(e) As AVC performance is very poor, new AVC system is recommended.

(f) Incident capture cameras not functioning.

(g) 6 Nos. receipt printers are not working

(h) Static weigh bridge – Capacity of installed weigh bridge is 100 MT as against 120 MT.

8.2 DATA COLLECTION AND REVIEW ATMS Works

✓ **Nil-**

Pre-bid reply dtd 11.10.2023, annexure-2, S.No3: Installation, operation and maintenance of the ATMS shall be done by NHAI.

- Project Road is a Four-Lane divided Carriageway consisting of both flexible and rigid pavements comprising to a total length of 88.072 Km. This project stretch is inclusive of Katni bypass of 19km which is under construction and type of its pavement is flexible. Details of pavement type and its lengths are as presented below.

Description	LHS (km)	RHS (km)
	Before Improvement Works	
Rigid Pavement	66.395	65.945
Flexible Pavement	21.677	22.127
	After Improvement Works	
Rigid Pavement	65.005	64.575
Flexible Pavement	23.067	23.497
Project Length	**88.072**	**88.072**

- Four Truck lay byes were observed in the Project Highway, the pavement condition of these lay byes is observed to be in fair condition.
- There are only Bus bay & 31 Nos of Bus bay with bus shelters are observed along the project corridor. The pavement of bus bays is observed to be in fair condition.
- The project corridor has service road of 13.049 kms length on LHS and on RHS, 12.751 kms length.
- From Roughness Consideration, moving average method has been adopted considering 10m point interval roughness data. In order to maintain roughness within threshold limit (<2200mm/km), rectification suggested at identified locations accumulated to 18.15 lane-km length in LHS, 15.47 lane-km length in RHS.
- The Pavement Condition of the project appears to be fair in condition for most of the length. However, in rigid pavement longitudinal cracks, Ravelling, Transverse Cracks and longitudinal wide joints are observed at few locations. Overall, total pane replacement suggested for 458 Nos., partial 1m full depth repair for 333 Nos.,staple and stich for 2339Nos and raveling for 39164 sqm.
- From structural (FWD) consideration, the Project Road (Main Carriageway) requires no overlay.
- Major maintenance of Flexible pavement for either carriageway is considered with 3 cycles of 40mm BC + 2 cycles of 30mm BC +2 cycles of DBM for 10% length.
- As per Site 58 nos. Solar Blinkers are observed at median opening locations, all are observed to be in fair condition.
- Highway lighting observed in the project corridor for a length of 25.59 km. At few locations lights are non-functional.
- There are 18 Nos of High Mast Lights, 214 Nos of double arm lights, 650 Nos of Single arm lightings are observed along the Project Corridor.

- The project corridor has a Lined cover drain for a length of 28.122 kms. At few locations covered slab were damaged & few are missing.
- Pavement condition of the main carriageway is mostly good/fair but the pavement condition of service road is poor at some locations.
- Median plantation is observed for a length of 62.057 kms in the entire project corridor.
- 42 No. of Kilometer stones and 513 No. of Hectometre stones are missing and the same shall be replaced with new one. 32 No of Hectometre stones paint damaged and same shall be rectified.
- MCB's were observed for a length of 32.895 Kms and these are in fair condition. At few locations MCB were damaged for a length of 126m.
- Pedestrian Guard Railing were observed for a length of 2.73 Kms in the project corridor. At few locations PGR's were damaged for a length of 20m.
- There is one Toll plaza in the entire project namely Kherwasani Toll plaza with 4+1 lanes at Km 739+000.
- The Project Stretch have 65 No's of Major Structures, in that 01 MJB's, 34 MNB's, 02 Flyovers, 01 ROB, 06 VUP's, 04 LVUP's, 16 PUP's & 01 VOP.
- The Project Road has verities of super structure types for various structures such as PSC Girder, RCC Girder, RCC Slab & RCC Box.
- In this Project stretch, there are Pot PTFE (Old-30 No's & New-30 No's), Elastomeric (Old-24 no's, New-220 no's) & Tar Paper (120 No's) observed in Girder & Slab type Structures.
- Structures are having 51 No's of Expansion joints in that 7 No's on old Structure.
- There are 17 No's of old bridges existing on left side 10 no's & right side 7no's. (MJB - 01 no., MNB – 10 no's, ROB - 01 no., VUP – 04 no's, PUP – 01 no)
- Some structures are already repaired and it would be necessary to closely examine these structures for further distress during the maintenance period/Project duration, by way of close inspection and testing.
- Debris observed on Abutment & pier cap at couple of locations, Cleaning of expansion joints, drainage spouts need to be done regularly.
- NDT Required for Old Bridges on LHS at following locations MJB at Km 785+625 & MNB at Km 790+470 & ROB at Km 780+320.
- No special NDT techniques are warranted to monitor the condition. Standard tests as UPV, Half-Cell Potential, rebound hammer, cover meter survey and Carbonation depth are adequate to assess the condition.
- The frequency of testing, test plan would be evolved on initiation of the project.
- Based on the Site Survey and Investigations, Immediate Repair Cost has been estimated by considering the present condition of all the elements of highway and structures.
- All the Costs presented in this report are inclusive of applicable GST.

SAMARTH INFRAENGG Technocrats Pvt. Ltd

SIT/PJRP/2411610/12
12th February 2024

Chief Operating Officer
National Highways Infra Investment Managers Pvt. Ltd.
G-5&6, Sector 10, Dwarka,
New Delhi – 110075

Sub: Submission of Supplementary Report for Final Reports for RKJL-Package-II

Ref: Our letter reference SIT/PJRP/223607/067 dated 03.06.2023

K/A Mr. Shubhra Bhattacharya

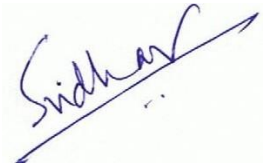
In continuation to above reference, we are pleased to submit hereby the "Supplementary Report for Final Reports" in hard/soft copies for the following asset.

- ✓ Tolling, Operation, Maintenance & Transfer of Rewa – Katni – Jabalpur including Katni Bypass, Km 725+185 to Km 813+257 of NH-30 (old NH 7) in the State of Madhya Pradesh (MP) -RKJL-Package II.

✓

Thanking you and assuring you best services all the time.

Yours Sincerely,
SAMARTH Infraengg Technocrats Pvt. Ltd.



D V Sridhar Murthy
Managing Director

Encl.: "Supplementary Report for Final Reports" for the above project in hard/soft copy.

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SUPPLEMENTARY REPORT FOR FINAL REPORT

1.1 INTRODUCTION

The Final Report was submitted on 1st Day of November 2023. Subsequent to this submission, the Operation Cost has been revised in due consultation with the Competent Authority. The following changes were made.

1. Operation Costs particularly Toll Operation Cost has been revised for Year FY 2027, FY 2028 and FY 2029 considering the reduction in Manpower. The same Operation Cost pertaining to FY2029 has been considered for rest of the Concession Period.
2. Abstract Cost has been updated in line with the above changes made in Operation Cost.
3. The updated Table-43 (O&M Cost) and Table-45 (Cost Abstract) have been presented below.
4. The Cost numbers presented in the following table supersedes cost numbers presented in the respective tables of the earlier submitted report

1.2 OPERATIONS COSTS

Table 43: O&M Cost

S.No	Particulars	FY-25	FY-26	FY-27	FY-28	FY-29
A1.1	**Tolling Operations**	3.711	3.711	3.168	3.168	2.880
A1.2	**Incident Management**	3.581	3.581	3.581	3.581	3.581
A2.1	**Routine Maintenance (excluding Saving in Katni bypass during DLP of EPC contractor (5years up to FY2028) i.e., (5.526-0.402)**	5.124	5.124	5.124	5.124	5.526
A2.2	**Repairs**	2.475	2.475	2.475	2.475	2.475
A2.3	**ATMS**	0.000	0.000	0.000	0.000	0.000
B	**Admin Expenses**	5.095	5.095	5.095	5.095	5.095
		19.987	**19.987**	**19.444**	**19.444**	**19.557**
	For FY 2027, Additional cost towards special repairs	-	-	5.463	-	-
	Total Operation Cost	**19.987**	**19.987**	**24.906**	**19.444**	**19.557**

Note: All the amounts are in Rs. Cr and is inclusive of GST, without escalation

1.3 TOTAL COSTS

Year on year operation cost is summation of following:

- ✓ Immediate Costs
- ✓ Routine Maintenance & Incident Management
- ✓ Periodic Maintenance
- ✓ Operations Cost

Following table presents the Cost Abstract for the project

Table 45: Cost Abstract

Project Years	Calendar Year	SUMMARY OF VARIOUS EXPENSES in Rs. Crs					Remarks
		Immediate Repair's Cost	Toll Collection Expenses and Patrolling expenses	Routine Maintenance Expenses	Periodic Maintenance (Functional +Struc Overlay+ Toll collection system)	Total Cost (Rs. Cr.)	
1	2023-2024	6.94	3.71	5.09	-	15.75	
2	2024-2025		3.71	16.28	-	19.99	
3	2025-2026		3.71	16.28	-	19.99	
4	2026-2027		3.17	21.74	3.39	28.30	5.463 Cr. Special repair cost added in RM
5	2027-2028		3.17	16.28	1.02	20.46	
6	2028-2029		2.88	16.68	-	19.56	
7	2029-2030		2.88	16.68	64.56	84.12	
8	2030-2031		2.88	16.68	1.27	20.83	
9	2031-2032		2.88	16.68	-	19.56	
10	2032-2033		2.88	16.68	4.73	24.28	
11	2033-2034		2.88	16.68	-	19.56	
12	2034-2035		2.88	16.68	-	19.56	
13	2035-2036		2.88	16.68	85.87	105.42	
14	2036-2037		2.88	16.68	-	19.56	
15	2037-2038		2.88	16.68	3.56	23.12	
16	2038-2039		2.88	16.68	3.39	22.95	
17	2039-2040		2.88	16.68	-	19.56	
18	2040-2041		2.88	16.68	-	19.56	
19	2041-2042		2.88	16.68	64.85	84.40	
20	2042-2043		2.88	16.68	1.34	20.89	
21	2043-2044		0.72	6.82	-	7.54	
	Total Cost:	***6.94***	***61.38***	***332.65***	***233.97***	**634.95**	

Note: All the Costs are in Crores, inclusive of GST, without escalation considering FY 2024 price

National Highways Infra Projects Private Limited

FINAL REPORT

Tolling, Operation, Maintenance & Transfer of Rewa – Katni – Jabalpur Pkg 4 (Km 813+257 to Km 880+600 of NH-30 (old NH 7) in the State of Madhya Pradesh (MP) Package-4

SAMARTH INFRAENGG Technocrats Private Limited

NOVEMBER 2023

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LIST OF ABBREVIATIONS AND SYMBOLS

AADT	-Average Annual Daily Traffic
AE	-Authority Engineer
AMC	-Annual Maintenance Contract
ATMS	-Advanced Traffic Management System
BC	-Bituminous Concrete
BOQ	-Bill of Quantities
BOT	-Build, Operate & Transfer
CA	-Concession Agreement
CBR	-California Bearing Ratio
CCB	-Concrete Crash Barrier
CCR	-Cement Concrete Railing
COD	-Commercial Operation Date
COS	-Change of Scope
CPI	-Consumer Price Index
CUP	-Cattle Underpass
CVC	-Classified Volume Count
CVPD	-Commercial Vehicles per Day
DBM	-Dense Bituminous Concrete
DPR	-Detailed Project Report
ECB	-Emergency Call Box
EPC	-Engineering, Procurement and Construction
ESI	- Employees' State Insurance
FDD	-Filed Dry Density
FOB	-Foot Over Bridge
FRL	-Finished Road Level
FSI	-Free Swell Index
FWD	-Falling Weight Deflectometer

FY	-Financial Year
GOI	- Government of India
GR	-Growth Rates
GS	-Grade Separated
GSB	-Granular Sub Base
GST	-Goods and Services Tax
HCPT	-Half cell Potential Test
HPC	-Hume Pipe Culvert
HR	- Human Resources
HTMS	-Highway Traffic Management Systems
IE	-Independent Engineer
IRC	- Indian Roads Congress
IRC SP	- Indian Roads Congress Special Publications
IRI	-International Roughness Index
Km	-kilometer
LHS	-Left Hand Side
LL	-Liquid Limit
LS	-Lumpsum
m	-Meter
MBIU	-Mobile Bridge Inspection Unit
MCB	-Metal Beam Crash Barrier
MCS	-Micro Surfacing
MCW	-Main Carriageway
MDD	-Maximum Dry Density
MHR	-Metallic Hand Rail
MJB	-Major Bridge
mm	-Millimeter
MM	-Major Maintenance
MNB	-Minor Bridge
MoRTH	- Ministry of Road Transport & Highways
Mpa	-Mega Pascal
MR	-Resilient Modulus
MSA	-Million Standard Axle
NDT	-Non-Destructive Testing
NHAI	- National Highways Authority of India
NSV	-Network survey Vehicle
O&M	- Operation and Maintenance
OL	-Overlay
PF	-Provident Fund

PGR	-Pedestrian Guard Rail
PI	-Plasticity Index
PL	-Plastic Limit
PM	-Periodic Maintenance
PUP	-Pedestrian Under pass
R&R	-Repair and Rehabilitation
RCC	-Reinforced Cement Concrete
RE Wall	-Reinforced Earth Wall
RHS	-Right Hand Side
RHT	-Rebound Hammer Test
RM	-Routine Maintenance
ROB	-Road Over Bridge
RPO	-Route Patrol Officer
RUB	-Road Under Bridge
SDBC	-Semi-Dense Bituminous Concrete
SPV	-Special Purpose Vehicle
SR	-Service Road
SWB	-Static Weigh Bridge
TCS	-Typical cross Section
TDRT	-Transient Dynamic Response test
TMS	-Toll Management System
UI	-Unevenness Index
UPVT	-Ultra Pulse Velocity test
VDF	-Vehicle Damage Factor
VG	-Viscosity Grade
VUP	-Vehicular Underpass
WBM	-Water Bound Macadam
WMM	-Wet Mix Macadam
WPI	-Wholesale Price Index

CHAPTER 1. INTRODUCTION

1.1 INTRODUCTION

National Highways Authority of India ("NHAI"/ "Authority") is an autonomous body of the Government of India ("GoI") under the Ministry of Road Transport and Highways ("MoRTH") and was constituted on June 15, 1989 by an Act of Parliament titled - The National Highways Authority of India Act, 1988 ("NHAI Act"). NHAI was operationalized in February 1995 with the appointment of full time Chairman and other Members. The functioning of NHAI is governed by NHAI Act and rules, and regulations framed thereunder.

NHAI has set up an Infrastructure Investment Trust namely **National Highways Infra Trust ("InvIT")** and is acting as its Sponsor to the said InvIT.

National Highways Infra Investment Managers Private Limited ("NHIIMPL") has been appointed as the Investment Manager to the InvIT

National Highways Infra Projects Private Limited ("NHIPPL"), a wholly owned subsidiary of InvIT is planning to enter into concession agreements with NHAI for "Tolling, Operation, Maintenance & Transfer of Rewa – Katni – Jabalpur Pkg 4 (Km 813+257 to Km 880+600 of NH-30 (old NH 7) in the State of Madhya Pradesh (MP).

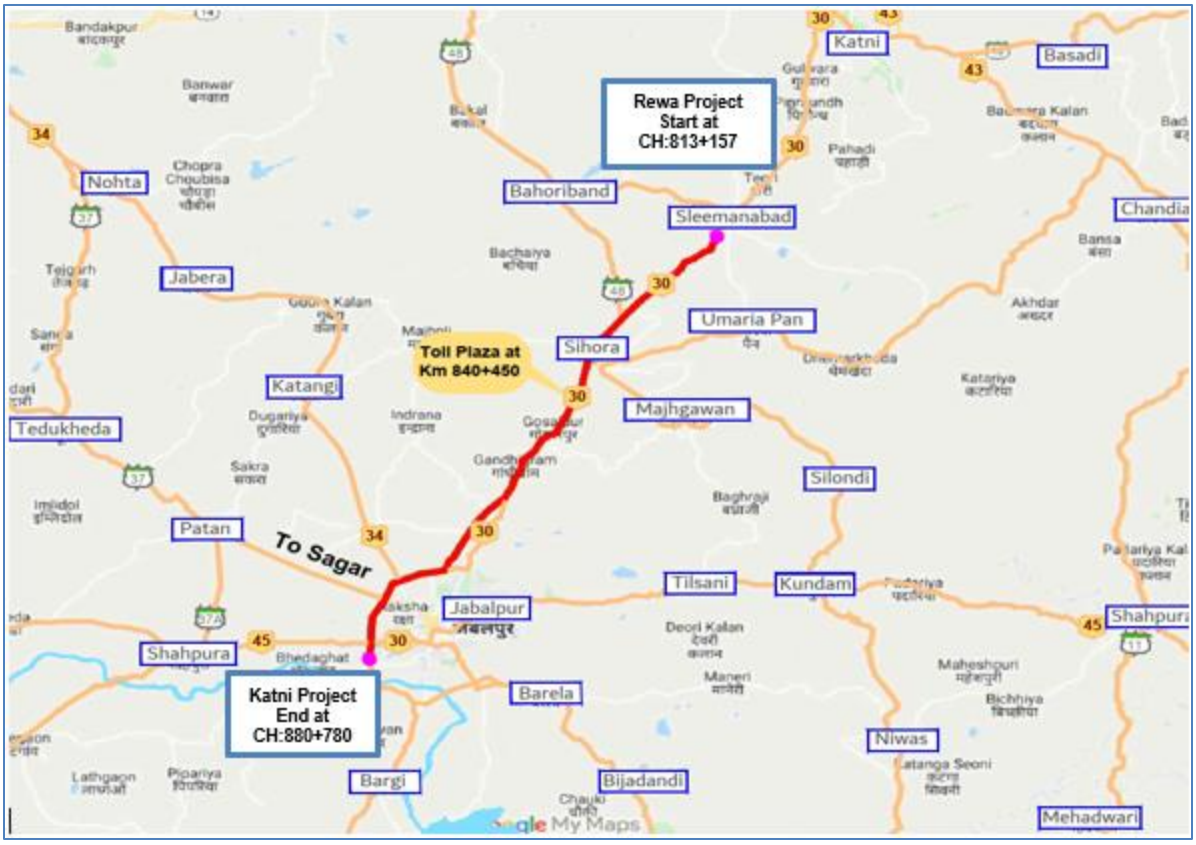
M/s National Highways Infra Projects Private Limited ("NHIPPL") has engaged M/s SAMARTH INFRAENGG Technocrats Pvt Ltd as their Technical Consultants for undertaking technical due diligence study for the said project to estimate initial improvement cost (EPC) including immediate requirements for repair & rehabilitation of various elements and make an assessment of Operation & Maintenance costs for entire concession period.

1.2 PROJECT AT A GLANCE

Project road is a four-lane divided Project Highway starts at Km 813+257 (old NH-7) New NH-30 and ends at Km 880+600. The total length of the project highway is 67.343 Km.

The project corridor is constructed by Larsen & Toubro Limited and is under Defect Liability Period (DLP) up to 3rd Sep 2023

NH-30 starts at the junction of NH-9 at Sitarganj and ends at the junction of NH-65 at Ibrahimpatnam, Vijayawada. The highway passes through the states Uttarakhand, Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Telangana and Andhra Pradesh in India. The Highway connects several cities and town such as Sitarganj, Pilibhit, Bareilly, Tahir, Shahjahanpur, Sitapur, Lucknow, Raebareli, Allahabad, Rewa, Jabalpur, Mandla, Raipur, Dhamtari, Charama, Kanker, Kondagaon, Jagdalpur, Sukma, Konta, Nellipaka, Bhadrachalam, Paloncha, Kothagudem, Tiruvuru, Ibrahimpatnam and Vijayawada. The total length of this highway is 1,984.3 km.



Map Showing the Project Corridor

The start and end of the project chainage system with respect to CA and Site are as presented below.

Table 1: Project Corridor Chainage System

Referencing system	Project Corridor Start Point (km)	Project Corridor End Point (km)	Length (km)
As per CA Chainage	813.275	880.600	67.343
As per Site	813.275	880.600	67.343

Photograph showing the start and end point of the project road are presented below:

A view of the Start Point of Project Road at km 813.257	**A view of the End Point of Project Road at km 880.600**

1.3 OBJECTIVE AND SCOPE OF SERVICES

The main objective of the study is to review the current status of project corridor including details pertaining to its construction and maintenance and to provide requisite technical information for processing the acquisition of said project by client. Objective of the study can be broadly defined with following tasks:

- Study CA requirements for construction/maintenance requirements
- Undertake Detailed Reconnaissance to appreciate the project corridor characteristics
- Collection of relevant records and documents and review of same
- Undertake Engineering Studies to Establish:
    - Present Condition of Existing Road Assets
    - Quality of Executed Works/Quantity of Reutilization
    - Requirement of Immediate improvement costs as per Sch B (1st Year Capex)
    - Major Maintenance Strategies Over Concession Period
    - Routine Maintenance & Operations Requirements Over Concession Period
    - Prepare BOQ
    - Prepare Rate Analysis and finalize unit rates
    - EPC and O&M Cost

End Result is the finalization of:

- Initial improvement Works
- Major Maintenance Schedules/Cost
- Routine Maintenance Cost
- Operations Cost

The elaborate scope of services as defined in the “terms of reference” for consultants is as below:

i) Detailed reconnaissance.

ii) Video graphic survey of the entire Project corridor.

iii) Carrying out inventory and condition surveys for Project Road.

iv) Carrying out Inventory and detailed condition surveys for bridges & cross drainage structures (along with Photographs thereof) including recommendation for either strengthening/rehabilitation or reconstruction.

v) 24 hrs. Axle load survey along with axle load spectrum analysis for rigid pavement of the project corridor at one locations, wherever applicable (7-day traffic count to be provided by client)

vi) Test pits required @ every 10 km interval along the Project corridor.

vii) Carrying out necessary laboratory tests to determine the CBR value of the subgrade materials to be obtained from potential borrow pits and the quality of the aggregates from potential quarries for the pavement layers, concrete etc. The existing ground which will support the embankment and pavement must be tested for its adequacy, particularly in silty or clayey water-logged areas.

viii) Carrying out deflection test by Falling Weight Deflect meter (FWD) for existing pavement as per relevant IRC code at the rate of 5 points in km in each direction making it 10 points for both directions in the damaged stretches as well as fair stretches.

ix) Availability of construction materials as per required specification to be confirmed. Detailed Logistic plan showing the locations of the potential Borrow pits, Quarries, etc.

x) Report on existing condition of Toll Plazas and its associated facilities and proposal for their improvement.

xi) Preparation of Maintenance (Routine, Periodic and Major) costs to be incurred over the period of the concession keeping in mind the requirements of the draft Concession Agreement like adequate resources, maintenance of Cranes, Ambulance, etc.,

xii) Independently develop a bottom-up forecast of Operating expenses for each project, with detailed break-up of each type of operating expense, along with underlying assumptions

1.4 DATA COLLECTION AND REVIEW

In brief, following were covered

- ✓ Review of Concession Agreement & Schedules,
- ✓ Review of Detailed Project Report prepared by NHAI
- ✓ Review of As-built drawings, Plan and profiles, Structural drawings & Detailed Project Reports and Designs where available
- ✓ Review of O&M costs as presented in DPR reports
- ✓ Review of MPR provided by NHAI
- ✓ Review of Latest NSV and FWD data provided by PIU , NHAI

1.5 PAVEMENT DESIGN REVIEW

As per Schedule-B

Flexible Pavement shall be provided for minimum design traffic of 110 MSA or 20 years design traffic whichever is maximum for main carriageway. Whereas, service road shall be designed for 10MSA and 30MSA.

Considering CTSB, Consultants have suggested as an option the following thicknesses has been arrived as follows.

CBR: 8%				
S No	**Layers**	**10 MSA**	**30 MSA**	**110 MSA**
1	**BC in mm**	40	40	**40**
2	**DBM in mm**	-	50	**110**
3	**WMM in mm**	150	150	**150**
4	**CTSB in mm**	200	200	**200**
	Total in mm	**390**	**440**	**500**

However, as TCS cross section drawings are showing conventional layers so an attempt has been made with design of conventional layers thicknesses as below.

S No	**Layers**	**Conventional - Option**			
		CBR-10%			
		10 MSA	**30 MSA**	**60 MSA**	**110 / 115 MSA**
		Va-4.5 & Vb-10.5	**Va-3.5 & Vb-10.6**	**Va-3.2 & Vb-10.6**	**Va-3.2 & Vb-10.6**
1	BC in mm	30	40	40	50
2	DBM in mm	50	95	115	130
3	WMM in mm	250	250	250	250
4	GSB in mm	200	200	200	200
	Total in mm	**530**	**585**	**605**	**630**

DPR has suggested the following conventional thicknesses has been arrived as follows

S No	**Layers**	**10 MSA**	**30 MSA**	**110 MSA**
1	**BC in mm**	**30**	40	50
2	**DBM in mm**	**50**	85	95
3	**WMM in mm**	**250**	250	150
4	**GSB in mm**	**200**	200	
5	**CTSB in mm**			200
	Total in mm	**530**	**575**	**495**

CHAPTER 2. SURVEYS AND INVESTIGATIONS

2.1 INTRODUCTION

The main objective of undertaking Surveys and Investigations is to appreciate the existing engineering features along the project corridor and to understand the present condition of the various elements of the project road and to prepare required inputs for various rehabilitation and maintenance strategies.

Following Survey and Investigations have been undertaken as a part of study with an objective to understand the present condition of the road and there by access the quality of construction and as well to prepare requisite rehabilitation/corrective designs where necessary.

- Road Inventory Surveys
- Pavement Condition using NSV
- FWD Surveys
- Roughness Surveys using NSV
- Pavement Composition surveys (Test Pits)
- Subgrade Investigations & Laboratory testing
- Material Investigations
- Core Cutting Investigation
- Axle Load Survey
- Structure Inventory and Condition Surveys

2.2 ROAD INVENTORY

The project corridor has combination of both Flexible and Rigid pavement, with 7.5m wide carriageway including shyness flanked by 1.5m paved shoulder plus 1.0 m to 1.5 m earthen shoulder on each side expect at Structure Approach locations. The length of Rigid and flexible pavement is presented below.

Description	LHS (km)	RHS (km)
Before Improvement Works		
Rigid Pavement	50.703	65.873
Flexible Pavement	16.640	1.470
Project Length	67.343	67.343
After Improvement Works		
Rigid Pavement	45.073	58.943
Flexible Pavement	22.270	8.400
Project Length	67.343	67.343

The road has varying median width ranging from 4m wide raised median to depressed median of 10.8m width at intermittent locations.

The project corridor generally runs through plain terrain. The land use along the project road is mostly Agricultural. It passes through urban settlements like Saleemanabad, Badkhera, Simariya, Sihora, Muhtara, Gosalpur, Gandhigram, Kusner, Jabalpur.

In general, road embankments are in the range of 0.5m-2.5m height. Embankment heights higher than 2.5m are observed mainly in the approaches of CD-Structures and Underpass locations.

Typical View of Project Road is shown below:

A view of the Project Road at km 870.200

A view of the Project Road at km 848.000

A view of the Project Road at km 878.010

A view of the Project Road at km 834.050

A view of the Project Road at km 866.330

A view of the Project Road at km 880.010

The Project Road has 16 Nos. of major junctions and 29 Nos. of minor junctions along its length. Photographs showing the Major Junctions and minor junctions are presented below:

Major Junction at km 835.620 LHS

Major Junction at km 875.680 BHS

Minor Junction at km 823.550-LHS

Minor Junction at km 825.270-RHS

Minor Junction at km 833.333-LHS

Minor Junction at km 865.790-RHS

There are 18 Nos. of High masts located near Major Junctions and Toll Plaza locations. Highway lighting for length of 21.762 Kms. is observed near urban locations. Few photos showing High mast and highway lighting are presented below:

A view of High Mast Lighting at km 853.050 RHS

A view of Single Arm lighting at km 815.010 Median

A view of Double Arm lighting at km 873.050 Median

A view of Single Arm lighting at km 855.010 LHS

Project Road consists of 20 Nos. of Bus bays with shelters along the project road. Few photos taken at the Bus Bays and Bus Shelters are presented below:

Bus Bay with Shelter at km 816.180 -RHS

Bus Bay with Shelter at km 859.150 -LHS

The Project Road has 1 No. of Truck layby (RHS) along the project corridor. It has rigid pavement and the condition appears to be fair. Separator also provided between main carriageway and Truck layby portion. Lighting in the form of single arm poles have been provided on the shoulder side of the Truck layby counting to 11 nos. of single-arm lights and almost all are found to be in good condition.

Few photos depicting the Truck layby portion are presented below:

A view Truck Layby at Km 866.220 RHS

A view Truck Layby at Km 866.220 RHS

The Project Road has 1 No. of Toll Plaza at Km 840+567. Rigid pavement exists at toll plaza location and condition appears to be fair. It has 3+1 lanes on each side. 4 Nos. of High mast lighting have been provided at Toll Plaza location. In the median portion of approach to Toll Plaza, double arm lighting has been provided.

A view of the Existing Toll Plaza near km 840.567 (Mohtara Toll plaza)

A view of the Admin building near Toll plaza

A view of the Ambulance Toll plaza

Service/slip roads are provided with 7m carriageway with Flexible pavement for a length of 34.87 km along the Project Corridor. Photos depicting the service road pavement surface type, Condition and the other associated features like drain. Few photos taken at service/slip road locations are presented below

Service road at km 828.000 RHS

Service road at km 837.000 LHS

Service road at km 855.620 LHS

Service road at km 880.600 RHS

The collected Road Inventory Data is presented in **Appendix 1** of this Report

2.3 PAVEMENT CONDITION SURVEYS

The present condition of pavement appears to be fair to average. The collected Pavement Condition Data is presented in **Appendix 2** of this Report.

The photographs showing the pavement condition of the Project Road is presented below.

Multiple crack @ km 813.100 LHS	**Bleeding @ km 828.600 LHS**	**Pop-outs @ km 844.600 LHS**
Longitudinal crack Km 872.500 LHS	**Longitudinal W. Joint @ km 844.100 RHS**	**Delamination @ km 866.200 RHS**
Longitudinal crack @ km 862.400 RHS	**Raveling @ Km 878.000 RHS**	**Longitudinal crack @ Km 865.010 LHS**

Multiple crack @ km 844.100 RHS	**Raveling @ Km 855.600 LHS**	**Bleeding @ Km 874.030 LHS**

✓ **Standards and Specifications of IRC:82-2015 (for Flexible Pavement)**

The Pavement condition survey may be undertaken by the visual assessment of the surface by identifying the type, location and magnitude of the distress and the rating of the Pavement may be assignment as per the criteria given in Table 5.1 of IRC: 82-2015 as below:

Defects (type)	**Ranges of Distress**		
Cracking (%)	>10	5 to 10	<5
Raveling (%)	>10	1 to 10	<1
Potholes (%)	>1	0.1 to 1	<0.1
Shoving (%)	>1	0.1 to 1	<0.1
Patching (%)	>10	1 to 10	<1
Settlement and Depression (%)	>5	1 to 5	<1
Rut depth (mm) using 3m straight edge	>10	5 to 10	<5
Rating	1	1.1 - 2	2.1 - 3
Condition	**Poor**	**Fair**	**Good**

For the calculation of the Weighted Rating Value of each individual parameter, the following fixed weightages have been assigned.

S.No.	**Parameter**	**Weightage (Fixed) (Multiplier Factor)**
1	Cracking	1.00
2	Raveling	0.75
3	Potholes	0.50
4	Shoving	1.00
5	Patching	0.75
6	Settlement	0.75
7	Rut depth	1.00

The Final Rating Value is calculated by taking the average of the Weighted Rating Values of all parameters viz: cracking, raveling, potholes, shoving, patching, settlement and rut depth.

It may be noted the acceptable/desirable level of service mentioned under IRC 82-2015 indicates at condition rating in terms of 1-3 in that <=1 being the poor and >2.1-3 being the good condition.

- ✓ **Standards and Specifications of IRC: SP: 83-2018 (for Rigid Pavement)**

  Pavement Condition Survey with various distresses like (cracking, pop outs, raveling, settled panels damaged panels etc.) are identified. For identified distresses, based on the Severity and Extent of distress, following various treatments are suggested as per IRC SP 83-2018 guidelines

Treatment Proposed	Distress Identified	Severity criteria
Panel Replacement	Multiple cracks (>30)	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Alligator Cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Transverse Cracks	5 .>6mm wide
	Longitudinal Crack	5. >12mm wide
Partial Panel Replacement	Multiple cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Alligator Cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Transverse Cracks	4. 3mm-6mm wide
	Longitudinal Crack	4. 6mm-12mm wide
Stitching and stapling	Multiple cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Alligator Cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Transverse Cracks	3. 0.5mm-3 mm wide
	Longitudinal Crack	2. 0.5mm-3mm wide
		3. 3mm-6mm wide

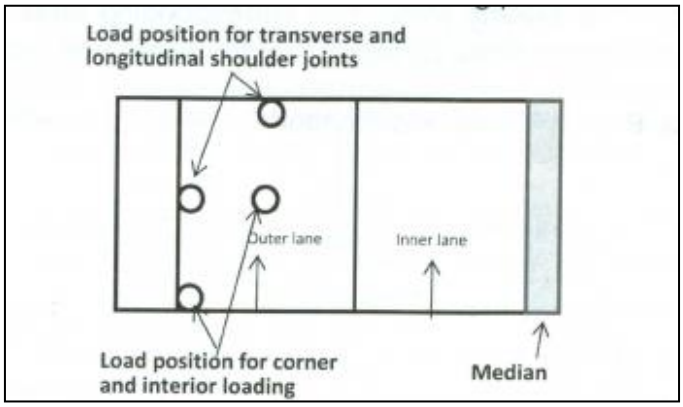
2.4 FALLING WEIGHT DEFLECTOMETER (FWD) SURVEYS

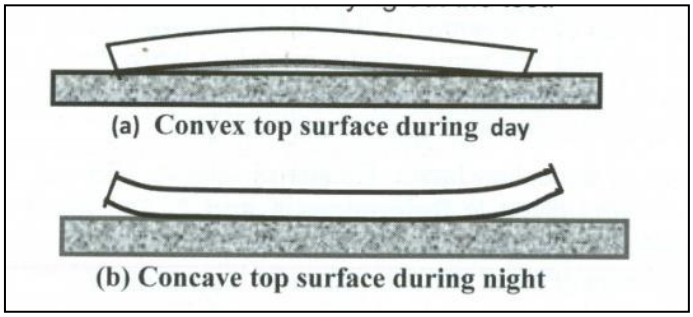
2.4.1 Pavement Evaluation Using FWD - RIGID Pavement

Structural condition of in-service rigid pavement can be evaluated using Falling Weight Deflectometer. FWD surveys are done at interior of panel to determine the Strength of Concrete and Subgrade Support and to Detect voids for loss of support FWD has been done in wheel path.

For evaluation of Modulus of Subgrade reaction and Strength of Concrete i.e., "Interior" loading case is done when temp gradient is zero or negative (Top Surface is Cooler than Bottom), i.e., either in early morning or in night time tests have to be performed.

Corner loading has no indirect measure from the test, FWD test to be done when pavement is not in curled position and Deflections measured along wheel paths to get void locations. Load position for various cases has been presented below:





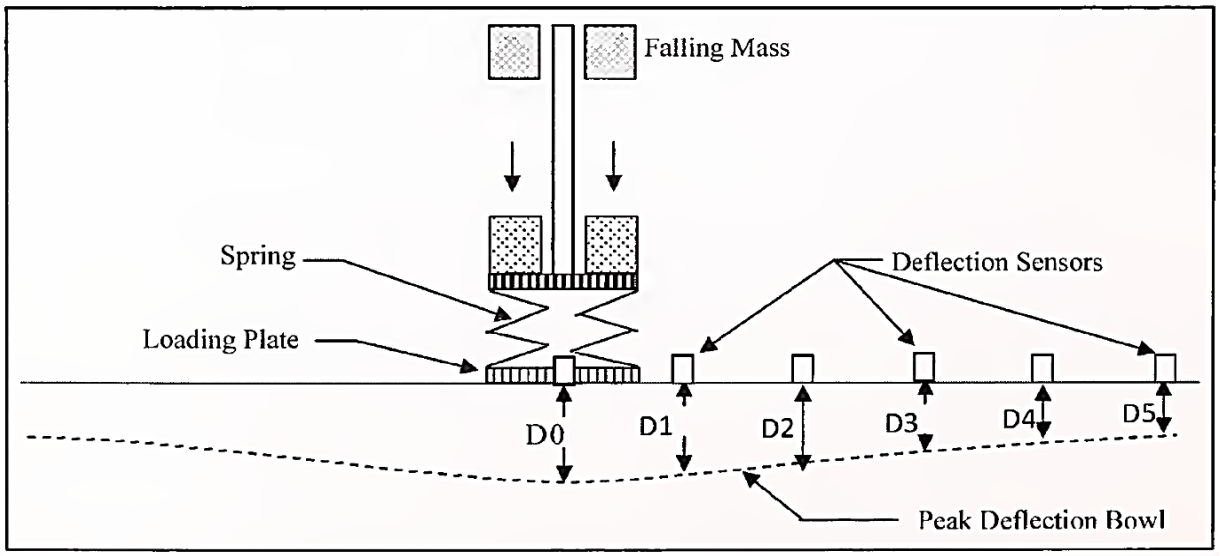
Among equipment available for structural evaluation of pavements, the Falling Weight Deflectometer (FWD) is extensively used world-wide because it simulates, to a large extent, the actual loading conditions of the pavement. When a moving wheel load passes over the pavement it produces load pulses. Normal stresses (vertical as well as horizontal) at a location in the pavement will increase in magnitude from zero to a peak value as the moving wheel load approaches the location. The time taken for the stress pulse to vary from zero to peak value is termed as 'rise time of the pulse'. As the wheel moves away from the location, magnitude of stress reduces from peak value to zero. The time period during which the magnitude of stress pulse varies from 'zero-to-

peak-to-zero' is the pulse duration. Peak load and the corresponding pavement responses are of interest for pavement evaluation.

Working Principle of Falling Weight Deflectometer

Falling Weight Deflectometer (FWD) is an impulse-loading device in which a transient load is applied to the pavement and the deflected shape of the pavement surface is measured. The working principle of a typical FWD is illustrated in Fig below. D0, D1, etc., are surface deflections measured at different radial distances. Impulse load is applied by means of a falling mass, which is allowed to drop vertically on a system of springs placed over a circular loading plate. The deflected shape of the pavement surface is measured using displacement sensors which are placed at different radial distances starting with the center of the load plate.

A mass of weights is dropped from a pre-determined height onto a series of springs / buffers placed on top of a loading plate. The corresponding peak load and peak vertical surface deflections at different radial locations are measured and recorded.



Basically, FWD generates a transient, of different magnitudes of impulse load by selection of a suitable mass and an appropriate height of fall. Under the application of the impulse load, the pavement deflects. Velocity transducers are placed on the pavement surface at different radial locations to measure surface deflections. Geophones or seismometers are used as displacement transducers. Load and deflection data are acquired with the help of a data acquisition system.

FWD includes a circular loading plate of 300 to 450mm diameter, in the present survey 300mm diameter load plate is used. A falling mass in the range of 50 to 350 kg is dropped from a height of fall in the range of 100mm to 600mm to produce load pulses of desired peak load and duration. The target peak load in the range of 40KN to 60KN or Higher may be applied on Concrete Pavement to get a reasonable deflection of the order of 0.15 mm since pavements of major highways in India consisting of 150mm DLC and 300mm PQC are very stiff and a higher load may be required to get a

deflection of about 0.15mm. In the present case target peak load as high as 150 KN is also used to get a reasonable deflection on concrete pavement.

In present study, Falling Weight Deflectometer (FWD) Test system has been used to generate the requisite NDT load-deflection data which was analyzed and is presented in this report. Surface deflections were measured at the center of the 300mm diameter loading plate and at the radial distances shown in the below table:

S. No	Geophone Ref No	Radial distance measured from center of load plate (mm)
1	D0	0
2	D1	300
3	D2	600
4	D3	900

Methodology adopted for carrying the survey:

1. The FWD Surveys are carried out as per IRC:117-2014
2. The project road has two longitudinal joint one at center and other paved shoulder. Panel size is nearly 4.5x3.5m
3. Interior points at a distance of 2.25m from edge (1.5m paved shoulder+0.75m for wheel path). These points will also act as under wheel path for detection of voids. Testing was done at two interior points in at 200m and 600m. Three points @ 0, 400 and 800 in inner lane to know strength/subgrade support. (These have been taken at night)

The collected FWD Data and Analysis is presented in **Appendix 3** of this Report.

2.4.2 Falling Weight Deflectometer Survey (Flexible Pavement)

In order to evaluate the structural strength of the existing pavement, Falling Weight Deflectometer (FWD) survey has been carried out along the project road. The collected FWD Data and Analysis is presented in **Appendix 3** of this Report.

Few photos taken during the progress of FWD Surveys are presented below:

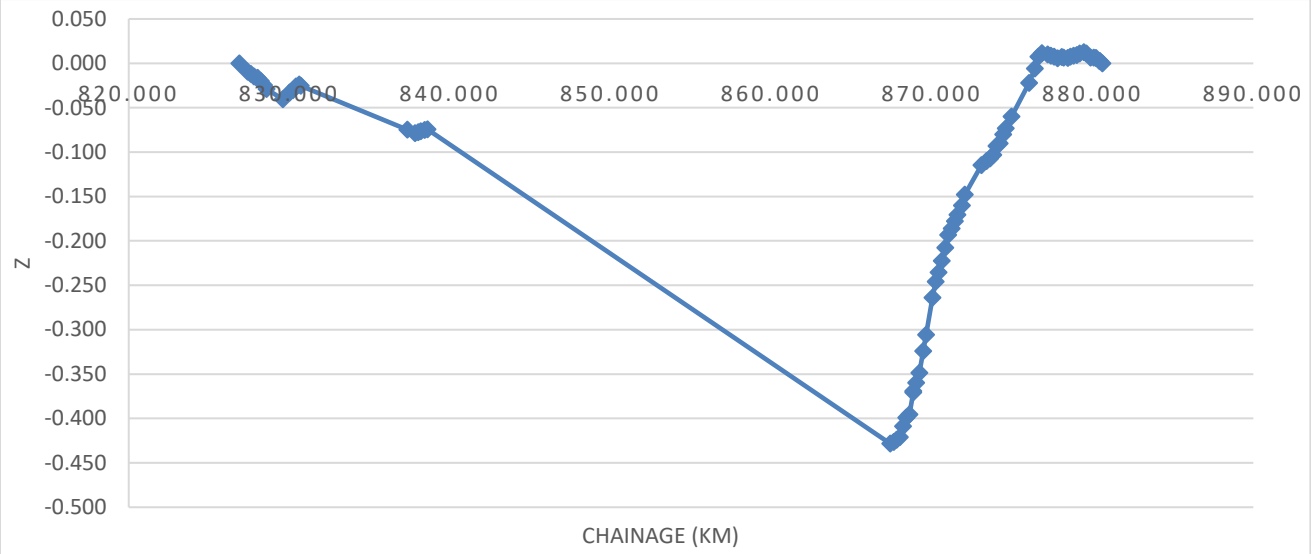
FWD Machine

Deflection Measurement in progress

The flexible pavement section has been sub-divided into homogeneous section for LHS direction as given below followed by graphical representation of the same.

Table 2: FWD Data - Summary of Homogenous Section of Main Carriageway – LHS

S. No	Homogenous section	From (km)	To (km)	Length (km)	Remarks
1	1	826.89	828.58	1.7	
2		828.58	829.60	1.0	Rigid pavement
3		829.60	830.71	1.1	
4	2	830.71	837.35	6.6	Rigid pavement
5	3	837.35	838.60	1.3	
6		838.60	867.40	28.8	Rigid pavement
7		867.40	868.40	1.0	
8	4	868.40	872.03	3.6	
9	5	872.03	873.07	1.0	
10	6	873.07	874.95	1.9	Rigid pavement
11		874.95	876.05	1.1	
12		876.05	876.62	0.6	Rigid pavement
13	7	876.62	880.60	4.0	
		Total Length		**53.7**	



Delineation of Homogeneous Section - LHS

2.5 ROUGHNESS SURVEYS

The Roughness data has been collected using **Network Survey Vehicle** and analyzed in terms of International Roughness Index (IRI), separately for each lane, for both direction of travel. Pavement Roughness report covering the data collection and methodology, computation of IRI for each km length in each direction is presented in **Appendix 4** of this Report.

As per Schedule-F of TOT, the desirable level of service for Roughness values for bituminous pavement surface is considered to less than 2000 mm/Km and the acceptable limits are less than 2400mm/Km.

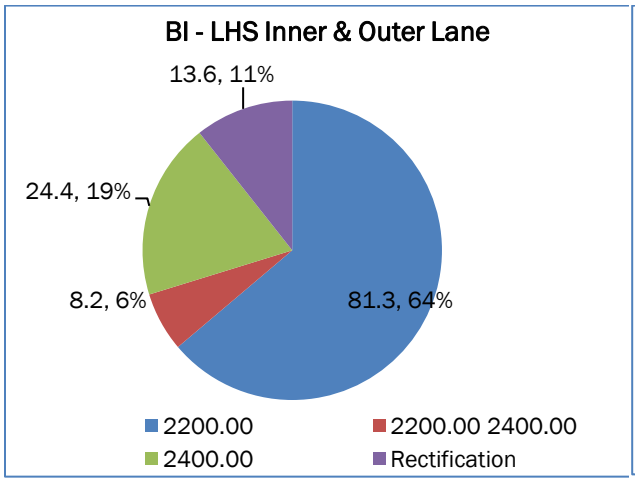
As per Schedule-F of TOT, the desirable level of service for Roughness values for rigid pavement surface is considered to less than 2200 mm/Km and the acceptable limits are less than 2400mm/Km.

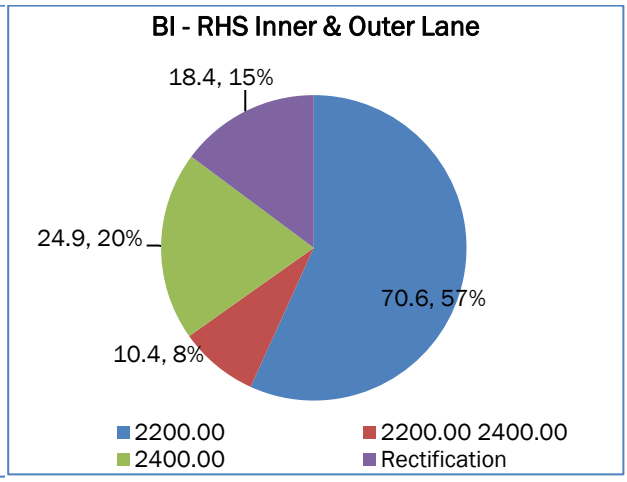
However, as per EPC Contract, Schedule-E, Roughness values should not exceed 2200mm/Km.

Average UI values along the corridor were grouped in to four categories, Pie chart showing the range of UI values in each carriageway of the project road have been presented below:

Roughness >2200 mm/km:

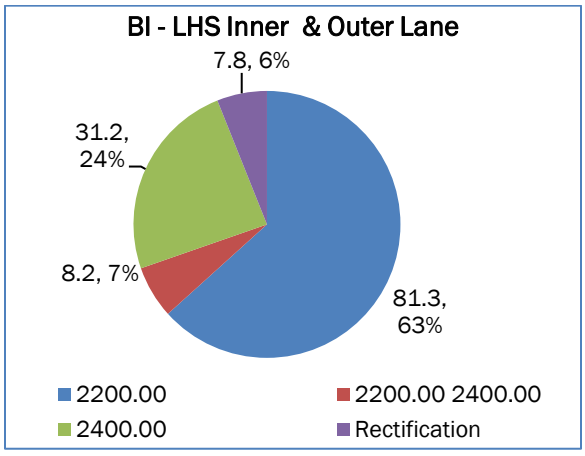
Rectification suggested based on moving average method for values >2200mm/km (based on EPC agreement)

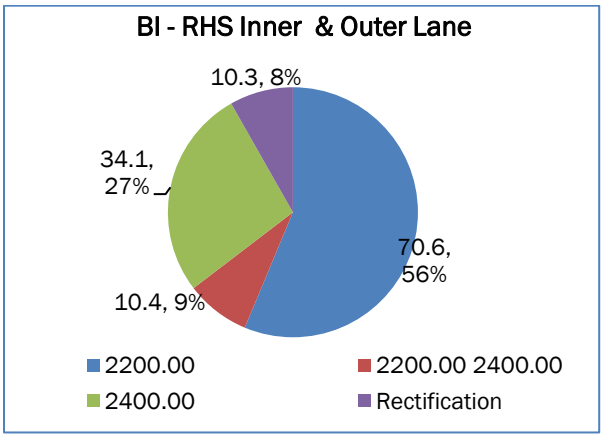




Roughness >2400 mm/km:

The same compared based on moving average method for values >2400mm/km (based on TOT agreement)





Finally, Considered the Roughness criteria with 2200mm/km (EPC),It can be seen from the above pie charts, that about 64% & 57% of the Lane-km length of the Project Road has fair riding quality (UI<2200 mm/km) in LHS carriageway and RHS carriageway respectively.

2.6 PAVEMENT COMPOSITION SURVEYS (TEST PITS)

The composition of the existing pavement crust has been noted from test pit surveys. Thus, a total of 12 Nos. of pits have been dug along the corridor and its pavement composition has been noted. All these 12 Nos. of pits done on the edge of Main Carriageway.

Results of the test pit survey showing average thickness of pavement layers are presented in the Table below.

Table 3: Pavement Composition of Existing Pavement along Project Road

Sl. No	Test Pit No	Existing Chainage (km)	Direction	PQC (mm)	DLC (mm)	GSB (mm)	Total (mm)	Remarks
1	RJ-TP-1	866+400	RHS	300	150	140	**590**	
2	RJ-TP-2	858+600	RHS	320	150	150	**620**	
3	RJ-TP-3	848+800	RHS	300	120	140	**560**	
4	RJ-TP-4	838+600	RHS	280	180	250	**710**	
5	RJ-TP-5	828+800	RHS	305	150	130	**585**	
6	RJ-TP-6	817+600	RHS	340	150	150	**640**	
7	RJ-TP-7	813+500	LHS	330	150	160	**640**	
8	RJ-TP-8	823+200	LHS	290	150	150	**590**	
9	RJ-TP-9	833+050	LHS	320	160	120	**600**	
10	RJ-TP-10	843+050	LHS	305	130	120	**555**	
11	RJ-TP-11	853+000	LHS	290	170	170	**630**	
12	RJ-TP-12	863+000	LHS	300	150	120	**570**	

The Rigid pavement consists of PQC (280 mm to 340 mm) + DLC (120mm to 180mm) + GSB (120mm to 250mm), with total thickness of 555mm to 710mm

2.7 SUBGRADE INVESTIGATIONS & LABORATORY TESTING

Sub-grade Investigations have been carried out to examine the subgrade soil characteristics along the project road. A total 12 Nos. of test pits have been carefully dug from the pavement surface up to sub-grade level. All 12 Nos. of pits done on Main Carriage way edge. Field density tests have been conducted for subgrade samples and a small quantity of sample has also been collected in airtight containers for determining the field moisture content. Upon completion of the field density test, representative sample of sub-grade soil has been collected in bulk, in gunny bags from each test pit for laboratory testing.

The soil samples collected have been tested for the following properties to assess the existing sub-grade soil properties.

- Sieve analysis
- Atterberg limits
- Heavy compaction
- Four (4) days soaked CBR as per IS standards at 97% of MDD as applicable for sub-grade (Heavy Compaction)
- Free swelling index

The photos of the test pit locations where the subgrade samples collected are as presented below.

RJ-TP-1

RJ-TP-2

RJ -TP-3

RJ -TP-4

RJ -TP-5

RJ -TP-6

RJ -TP-7

RJ -TP-8

RJ -TP-9

RJ -TP-10

RJ -TP-11

RJ -TP-12

2.8 BORROW AREAS

Potential borrow areas identified at 6 Nos. of locations for the use of embankment/subgrade construction works within economic haulage leads. The sources identified as potential borrow areas along with certain useful information such as distance from the project road, location, village name, etc., have also been presented in this table below.

Table 4: Borrow Area Samples Details

S No	Borrow Area No	Chainage (km)	Side	Offset	Village and contact person	Quantity	Rate	Remarks	Co-ordinate
1	RJ-BP-1	863+600	LHS	100 m	Vill-Bihar	4Acres* 5 feet	Not told	Govt. Land	23.266360 79.962426
2	RJ-BP-2 (iron ore)	843+500	RHS	2.4 km	Vill- Ghoshalpur Name- Niraj Srivastav Mob no- 9826155515	150 Acres* 5 feet	Not told	Pvt. Land	23.397004 80.054356
3	RJ-BP-3 (iron ore)	850+900	LHS	300 m	Vill- Gandhi Gram Name- Subham Chaorasiya Mob no- 8770849399	100 Acres* 5 feet	Not told	Pvt. Land	23.360327 80.030824
4	RJ-BP-4	833+500	RHS	100 m	Vill- Lalpura Gram	15 Acres* 5 feet	Only Royalty	Govt. Land	23.520236 80.077220
5	RJ-BP-5	823+600	RHS	4.3 km	Vill- Amoch (Mohla) Name- Bantu Jain Mob no- 9826158080	100 Acres* 5 feet	Not told	Pvt. Land	23.567058 80.162930
6	RJ-BP-6	813+950	LHS	1.3 km	Vill- Sihudi	15Acres* 5 feet	Not told	Govt. Land	23.60.6043 80.241915

Soil samples from these borrow sources have been collected in bulk by excavating test pits down up to 1.0m depth from the existing ground surface. The top organic soil layer of approximately 150mm thickness was removed before sampling. The samples collected from these identified borrow pits/ gravel quarries have been tested for the suitability of utilizing them as embankment fill/ sub-grade. The sample photos of borrow area locations are as presented below.

RJ-BP-1

RJ-BP-2

LR-BP-5	LR-BP-6
LR-BP-7	LR-BP-8

2.9 AGGREGATE SAMPLES

Aggregates samples 1 Nos. from crusher/quarry have identified for the use of sub-base, base, surface courses and concrete works has been collected. The locations, estimated quantity, basic cost of material and the approximate distance from each source to the nearest point on the project corridor are compiled in Tables below.

RJ-AQ-1

Table 5: Aggregate Samples Details

sample No.	Ex. Chainage (Km.)	Left/ Right	Name of Village	Name of Source/ Crusher	Lead from Nearest Ex. Chainage (Km.)	Approximate Quantity (ton)	Basic cost of the material (Rs.)	Remarks	Co-ordinate
RJ-AQ-1	828+000	RHS	Dhanari Khamariya	Crusher-Omm Infrastructure Village - Bhagvan Singh Mob no-9893989230	4.5 km	Plenty	40mm-Rs 400/- per ton 20mm-Rs 500/- per ton 10mm-Rs 350/- per ton 6mm - Rs 400/- per ton M-Sand -Rs 400/- Perton WMM - Rs 350/- per ton GSB - Rs 350/- per ton	Royalty: Rs 170/- Per cub and Extra: GST 5%	23.550068 80.137551

2.10 SAND SAMPLES

River Sand samples of 3 Nos. have been collected from the source and tested. The location of this sand quarry along with lead to the Project Road is presented in the following table

RJ-SQ-1

RJ-SQ-2

Table 6: Sand Samples Details

Sand Source	Village & Name	Name of river & Village	Chainage	side	Offset	Rate	Remarks	Co-ordinate
JL-SQ-1	Vill -Gotegaon Suplier Name - Surendra Mob-9131735315	Narmada (Jhansighat)	881+500	RHS	50km	Rs 25000/- Per 600 Cft With Transport	with Royalty and GST	
RJ-SQ-1	Vill -Khini Name - Ramdev Varma Mob-7999474732	Hiran	843+500	RHS	11.4 km	Rs 1800/- Per 100 Cft with Loading	Royalty -Rs -2500/- Per 300 Cft	23.417072 49.979455

Sand Source	Village & Name	Name of river & Village	Chainage	side	Offset	Rate	Remarks	Co-ordinate
RJ-SQ-2	Vill -Ramkhiriya Name - Pintu Yadav Mob-6264733462	Bani	844+000	LHS	5.6 km	Rs 4500/- Per ton with Loading	Royalty Rs-2000/- 120 cft	23.407634 80.118284

2.11 CORE CUTTING INVESTIGATION

The objective of the core cutting is to examining the engineering properties of the materials relevant to the project as per specifications. As a first step, sections are identified with good, fair and poor based on visual pavement condition observation of existing road. Accordingly, 9 Nos. of cores were taken carefully from the project corridor, in which 8 Nos. on rigid pavement and 1 Nos. on flexible pavement location.

RJ-C-1

RJ-C-2

RJ-C-3

RJ-C-4

RJ-C-5

RJ-C-6

RJ-C-7

RJ-C-8

RJ-C-9

Table 7: Core Cutting Samples Details

S.NO	Core Id	Existing Chainage	Direction	Carriage Way	Offset From median in (M)	Road Condition	Core Thickness (mm)	Hole Thickness (mm)	Remark
1	RJ-C-1	866+400	RHS	Outer	6.5	Good	**260**	260	Rigid
2	RJ-C-2	848+800	RHS	Inner	1.5	Good	**300**	300	Rigid
3	RJ-C-3	828+800	RHS	Outer	4.2	Good	**305**	305	Rigid

S.NO	Core Id	Existing Chainage	Direction	Carriage Way	Offset From median in (M)	Road Condition	Core Thickness (mm)	Hole Thickness (mm)	Remark
4	RJ-C-4	813+500	LHS	Outer	6.6	Good	**280**	280	Rigid
5	RJ-C-5	873+400	LHS	Inner	1.4	Good	**130**	160	Flexible
6	RJ-C-6	853+000	LHS	Outer	6.1	Good	**270**	270	Rigid
7	RJ-C-7	843+800	RHS	Inner	2.9	Poor (Crack Section)	**290**	290	Rigid (Top to Bottom crack)
8	RJ-C-8	833+050	LHS	Inner	2.8	Good	**310**	310	Rigid
9	RJ-C-9	825+100	LHS	Inner	2.8	Poor (Crack Section)	**320**	320	Rigid (Top to Bottom crack)

2.12 AXLE LOAD SURVEYS

Traffic loading has a significant impact on pavement performance and design. This is because the damage that vehicles create to a road depends very strongly on the axle loads of the vehicles. The exact relationship is influenced by the type of road structure and the way the road deteriorates but a “fourth power” damage law gives a good approximation.

Axle load study has been conducted using portable axle load pads near toll plaza at km 840+567 on date 24.12.2022 for 24 hrs. duration. The survey has been conducted in both the directions and data captured on random sampling basis. The collected axle load data and analysis is presented in **Appendix 5** of this Report.

The vehicle damage factors have been calculated using the standard axle loadings given in IRC: 37-2018. The standard axle loadings adopted have been presented in the following table

Table 8: Details of Standard Axles Used

Axle Configuration	Standard Axle load (Tonnes)*/ KN	Remarks
Single Wheel, Single Axle	6.60/65	As per IRC 37-2018
Dual Wheel, Single Axle	8.16/80	As per IRC 37-2018
Dual Wheel, Tandem Axle group	15.10/148	As per IRC 37-2018
Dual Wheel, Tridem Axle group	22.90/224	As per IRC 37-2018

Few photographs illustrating the survey locations and axle load measurements are presented below.

Survey in Progress

Survey in Progress

Survey in Progress

Survey in Progress

Direction wise VDF for each mode of commercial traffic has been estimated. Results of axle load surveys have been presented in the following table.

Table 9: VDF Values Estimated at the Toll Plaza Locations

Vehicle Type	Mohtara Toll plaza at Km 840+567	
	UP	DN
BUS	0.73	1.39
2-Axle	1.73	2.22
3-Axle	5.74	6.02
M Axle	11.88	12.04
LCV	0.28	1.71

CHAPTER 3. VALIDATION OF EXECUTED WORKS

3.1 ROAD WORKS

The project road has been closely inspected to verify the executed works on ground. The scope works to be executed by the Concessionaire/Contractor as envisaged in CA is compared with the executed work on the Ground. As a part of the validation, the available as-built drawings and the inventory data received from the Concessionaire were also referred. Each structure has been inspected to note down its structural configuration and condition. The following table highlights the scope comparison of the executed works on ground.

Table 10: Scope Comparison of Executed works

Sl. No.	Particulars	Length / Nos.	Total for O&M Estimation	As per Schedule-B	As per Vendor list	As per Site	Remarks
1	Start Chainage (Km)	Km	813.257	813.257	813.257	813.257	
2	End chainage (Km)	Km	880.6	880.6	880.6	880.6	
3	Length of the Project Corridor	Kms	67.343	67.343	67.343	67.343	
4	Service Road / Slip Road	Kms	34.87	19.3	34.462	34.87	
5	Bypass Length	Kms	26.407			26.407	
6	Toll Plaza	Nos.	1			1	
7	No.of Lanes (Both side)	Nos.	8			8	3+1 Lanes on Both sides
8	ROBs	Nos.	1		1	1	
9	Flyovers	Nos.	4	-	4	4	
10	VUPs	Nos.	5	3	-	2	
11	LVUP's	Nos.	1	1	-	-	
12	PUP's/CUP's	Nos.	5	1	-	4	
13	Major Bridges	Nos.	2		2	2	
14	Minor Bridges	Nos.	23	1	23	23	1 No. widening
15	Culverts (Pipe)	Nos.	133	-	130	133	
16	Culvert (Slab/Box)	Nos.	21		19	21	
17	Major Junctions	Nos.	16	3	16	16	
18	Minor junctions	Nos.	29	4	29	29	
19	High Embankments	Kms	19.58			19.58	
20	Stone Pitching	Sqm	65870			65870	
21	Concrete Lining	Kms	0.32			0.32	
22	Full Height RE Wall	Kms	1.54			1.54	
23	Partial RE Wall with PCC Lining	Kms	3.89			3.89	
24	Bus Bays with Shelter	Nos.	20		20	20	
25	Truck Lay bye	Nos.	1	14	1	1	

Sl. No.	Particulars	Length / Nos.	Total for O&M Estimation	As per Schedule-B	As per Vendor list	As per Site	Remarks
26	High Mast Lights	Nos.	18	8	0	18	
27	Highway Lighting (length only)	Kms	21.762	12.695		21.762	
28	Single Arm lightings	Nos.	665			665	
29	Double Arm Lightings	Nos.	106			106	
30	Lights below underpass/FO	Nos.	146			146	
31	Solar Blinkers	Nos.	42			42	
32	RCC Cover Drain	Kms	32.49	24.4	28.598	32.49	
33	RCC Open Lined Drain	Kms	2.8			2.8	
34	Earthen Drain	Kms	99.396			99.396	
35	Median drain	Kms	0.58			0.58	
36	Chutes	Nrs	131			131	
37	Median Opening	Nrs	42		42	42	
38	Median Plantation Functional	Kms	38.703			38.703	
39	Median Plantation Functional	Kms	25.44			25.44	
40	Road Markings	Kms	67.343			67.343	
41	W-Beam Safety Barriers	Kms	34.285			34.285	
42	Rigid Concrete Barriers	Kms	25.9			25.9	
43	Pedestrian Guard Rails	Kms	20.19			20.19	
44	Delineators	Nos.	-			195	
45	Kilometre Stones	Nos.	134			134	
46	Hectometre Stones	Nos.	540			540	
47	Boundary Stones	Nos.	2693			1347	
48	Gantry Sign Boards	Nos.	4			4	
49	Cantilever Sign Boards	Nos.	38			38	
50	Varying Message Signs (VMS)	Nos.	4			4	
51	Emergency Call Box	Nos.	48			48	
52	Edge Kerb in High embankment locations	Kms	3.94			3.94	
53	Energy Dissipation Chambers	Nos.	41			41	

The project corridor appears to have been constructed with the cross-sectional elements matching to those given in the manual at the time of execution. The carriageway width of 7.0m plus paved shoulders of 1.5m and a shyness of 0.6m has been provided over the entire length except at structures. Earthen shoulders of 1m to 2.0m on either side of carriageway have also been provided.

In the project stretch, the Service/Slip Roads having 7m carriageway width with an overall both side length of km 32.870 have been observed. Location wise details of service roads and slip roads presented in **Appendix 6** are listed as below:

Table 11: Details of Service Roads/Slip Roads along Project Road

S.No.	Existing Chainage		SR without tapers		Side	Pavement Type	As Per Site (m)	Width (m)
	From (km)	To (km)	From (km)	To (km)				
1	814+880	815+000	814+880	815+000	RHS	Flexible	120	
2	814+880	815+070	814+880	815+070	LHS	Flexible	190	
3	827+290	828+680	827+500	828+480	RHS	Flexible	980	
4	833+100	834+300	833+300	834+100	RHS	Flexible	800	
5	836+550	837+250	836+700	837+150	RHS	Flexible	450	
6	846+600	848+650	846+800	848+450	RHS	Flexible	1650	
7	855+650	856+250	855+600	856+200	RHS	Flexible	600	
8	867+450	878+700	867+500	878+700	RHS	Flexible	11200	
9	878+900	880+600	878+900	880+600	RHS	Flexible	1700	
11	827+500	828+410	827+720	828+200	LHS	Flexible	480	
12	833+150	834+100	833+400	834+300	LHS	Flexible	900	
13	836+500	837+350	836+700	837+150	LHS	Flexible	450	
14	846+600	848+650	846+800	848+450	LHS	Flexible	1650	
15	855+250	856+500	855+450	856+400	LHS	Flexible	950	
16	867+350	878+600	867+450	878+600	LHS	Flexible	11150	
17	879+000	880+600	879+000	880+600	LHS	Flexible	1600	
As per Site Total Length of Service/Slip Road (km)							**34.870**	

RCC Lined Covered drains are provided in a length of 32.490 km at various locations and open lined drains are provided in a length of 2.800 Km respectively along the Project corridor, the location and condition of the same are presented in **Appendix 6**. The summary of the same is tabulated below

Table 12: RCC Covered Drains

S. No	Existing Chainage (Km)		Side	Length (km)	Width (m)	Cover Missing (m)	Cover Damage(m)	Remarks
	From	To						
1	833.350	833.700	LHS	0.350	1.50		4	
2	833.850	834.100	LHS	0.250	1.50		1	
3	836.700	837.150	LHS	0.450	1.50		2	
4	846.800	848.450	LHS	1.650	1.50		6	
5	854.450	854.540	LHS	0.090	1.50			
6	855.570	856.430	LHS	0.860	1.50		6	
7	867.500	869.800	LHS	2.300	1.50		45	
8	869.900	871.500	LHS	1.600	1.50		10	

S. No	Existing Chainage (Km)		Side	Length (km)	Width (m)	Cover Missing (m)	Cover Damage(m)	Remarks
	From	To						
9	871.530	872.600	LHS	1.070	1.50		13	
10	872.750	874.530	LHS	1.780	1.50		12	
11	874.640	875.510	LHS	0.870	1.50		5	
12	875.590	878.580	LHS	2.990	1.50		35	
13	879.010	880.600	LHS	1.590	1.50		28	
14	880.600	878.900	RHS	1.700	1.50		30	
15	878.700	873.000	RHS	5.700	1.50		62	
16	872.950	872.800	RHS	0.150	1.50		3	
17	872.700	871.900	RHS	0.800	1.50		30	
18	871.870	869.900	RHS	1.970	1.50		2	
19	869.800	867.500	RHS	2.300	1.50		15	
20	848.450	846.800	RHS	1.650	1.50			
21	837.150	836.700	RHS	0.450	1.50		2	
22	834.050	833.350	RHS	0.700	1.50		12	
23	828.480	828.150	RHS	0.330	1.50		5	
24	828.120	827.500	RHS	0.620	1.50			
25	815.070	814.800	RHS	0.270	1.50		2	
Total Length of RCC covered Drain(km)				**32.490**			**330**	

Table 13: Open Lined Drains

S. No	Design Chainage (Km)		Side	Length (km)	Width (m)	Depth (m)	Condition	Damage	Remarks
	From	To							
1	872.65	872.9	RHS	0.25	0.3	0.25	Fair		
2	872.22	872.55	RHS	0.33	0.3	0.25	Fair		
3	814.75	814.95	RHS	0.2	0.3	0.25	Fair		
4	827.95	828.3	RHS	0.35	0.3	0.25	Fair		
5	827.65	827.92	RHS	0.27	0.25	0.25	Fair		
6	814.75	814.95	RHS	0.2	0.35	0.25	Fair		
7	875.25	875.5	LHS	0.25	0.3	0.25	Fair		
8	875.55	875.9	LHS	0.35	0.3	0.25	Fair		
9	875.25	875.5	RHS	0.25	0.28	0.25	Fair		
10	875.55	875.9	RHS	0.35	0.3	0.25	Fair		
Total Length of Open lined Drain(km)				**2.80**					

Partial RCC walls, RE walls and green mat are found in approaches to the underpass locations, high embankment locations and at CD-structures locations along the Project Corridor which account for a total length of 34.740Km. The summary of the slope protection table was presented below:

Table 14: Summary of Slope Protection along Project Road

S.no	Existing Chainage (km)		Length (Km)	Side	Embankment	Stone Pitching	Geo Grids	Partial RE Wall +Concrete lining	RE Wall	Concrete lining	Remarks
	From	To									
1	814.090	814.200	0.110	LHS	Yes						
2	814.090	814.200	0.110	RHS	Yes						
3	814.220	814.250	0.030	LHS	Yes						
4	814.500	814.850	0.350	LHS	Yes						
5	814.680	814.950	0.270	LHS				Yes			Bulging observed
6	814.500	814.850	0.350	RHS	Yes						
7	814.880	814.950	0.070	RHS				Yes			Bulging observed
8	814.950	815.050	0.100	LHS	Yes						
9	814.950	815.070	0.120	RHS	Yes						
10	815.250	815.280	0.030	LHS	Yes						
11	815.280	815.320	0.040	RHS	Yes						
12	815.320	815.500	0.180	LHS	Yes						
13	815.350	815.400	0.050	RHS	Yes						
14	816.650	816.950	0.300	RHS	Yes						
15	817.100	817.520	0.420	LHS	Yes						
16	817.700	818.250	0.550	RHS	Yes						
17	818.300	818.580	0.280	LHS	Yes						
18	818.250	818.570	0.320	RHS	Yes						
19	818.600	818.900	0.300	LHS	Yes						
20	818.600	819.000	0.400	RHS	Yes						
21	820.400	820.650	0.250	RHS	Yes						
22	821.080	821.100	0.020	RHS		Yes					
23	821.200	821.600	0.400	LHS		Yes					
24	821.150	821.300	0.150	RHS		Yes					
25	821.600	821.750	0.150	LHS	Yes						
26	821.300	821.650	0.350	RHS	Yes						
27	821.030	821.680	0.650	RHS	Yes						
28	821.950	822.050	0.100	RHS	Yes						
29	825.010	825.050	0.040	LHS	Yes						
30	825.070	825.120	0.050	LHS	Yes						
31	827.460	827.500	0.040	LHS	Yes						
32	827.150	827.500	0.350	RHS	Yes						
33	827.650	827.920	0.270	LHS					Yes		
34	827.500	827.650	0.150	RHS	Yes						
35	827.650	827.920	0.270	RHS					Yes		Bulging observed

S.no	Existing Chainage (km)		Length (Km)	Side	Embankment	Stone Pitching	Geo Grids	Partial RE Wall +Concrete lining	RE Wall	Concrete lining	Remarks
	From	To									
36	827.950	828.300	0.350	RHS					Yes		
37	828.300	828.480	0.180	RHS	Yes						
38	821.180	829.010	7.830	LHS		Yes					
39	830.620	830.700	0.080	LHS	Yes						
40	830.740	830.820	0.080	LHS	Yes						
41	830.650	830.750	0.100	RHS	Yes						
42	830.780	830.850	0.070	RHS	Yes						
43	831.400	838.050	6.650	RHS	Yes						
44	833.350	833.400	0.050	RHS	Yes						
45	833.400	833.450	0.050	LHS	Yes						
46	833.450	833.700	0.250	LHS				Yes			Bulging observed
47	833.400	833.680	0.280	RHS				Yes			Bulging observed
48	833.720	834.000	0.280	LHS				Yes			Bulging observed
49	833.700	833.980	0.280	RHS				Yes			Bulging observed
50	834.000	834.100	0.100	LHS	Yes						
51	833.980	834.070	0.090	RHS	Yes						
52	834.070	834.300	0.230	RHS	Yes						
53	834.600	834.650	0.050	RHS	Yes						
54	834.650	834.750	0.100	LHS	Yes						
55	834.680	834.750	0.070	RHS	Yes						
56	835.900	835.950	0.050	LHS	Yes						
57	839.200	839.450	0.250	LHS	Yes						
58	839.450	839.500	0.050	LHS		Yes					
59	839.400	839.550	0.150	RHS		Yes					
60	839.650	839.900	0.250	LHS		Yes					
61	839.740	839.850	0.110	RHS		Yes					
62	840.000	840.100	0.100	RHS	Yes						
63	840.150	840.280	0.130	RHS	Yes						
64	842.000	842.850	0.850	LHS	Yes						
65	842.400	842.500	0.100	LHS	Yes						
66	842.350	842.470	0.120	RHS	Yes						
67	842.500	842.570	0.070	RHS	Yes						
68	843.400	843.920	0.520	LHS	Yes						
69	843.600	843.930	0.330	LHS	Yes						
70	843.600	843.930	0.330	RHS	Yes						
71	843.940	844.050	0.110	LHS		Yes					

S.no	Existing Chainage (km)		Length (Km)	Side	Embankment	Stone Pitching	Geo Grids	Partial RE Wall +Concrete lining	RE Wall	Concrete lining	Remarks
	From	To									
72	843.930	843.980	0.050	LHS	Yes						
73	843.930	843.980	0.050	RHS	Yes						
74	844.000	844.050	0.050	RHS							
75	844.000	844.050	0.050	RHS		Yes					
76	844.000	844.050	0.050	LHS		Yes					
77	844.050	844.350	0.300	LHS	Yes						
78	844.050	844.350	0.300	RHS	Yes						Full of vegetation
79	848.750	848.920	0.170	LHS	Yes						
80	852.000	852.070	0.070	RHS	Yes						
81	852.100	852.150	0.050	RHS	Yes						
82	855.480	855.580	0.100	RHS	Yes						
83	855.550	855.600	0.050	RHS	Yes						
84	855.600	856.250	0.650	RHS					Yes		Bulging observed
85	858.780	858.820	0.040	RHS	Yes						
86	858.770	858.930	0.160	RHS	Yes						
87	865.750	865.800	0.050	RHS	Yes						
88	865.850	866.070	0.220	LHS		Yes					
89	865.800	866.050	0.250	RHS							
90	866.200	866.320	0.120	LHS	Yes						
91	866.200	866.220	0.020	LHS		Yes					
92	866.230	866.260	0.030	LHS	Yes						
93	866.280	866.320	0.040	RHS	Yes						
94	866.900	867.100	0.200	LHS	Yes						
95	872.220	872.950	0.730	LHS				Yes			Bulging observed
96	872.400	872.700	0.300	RHS				Yes			Bulging observed
97	872.950	873.050	0.100	LHS	Yes						
98	872.750	873.000	0.250	RHS				Yes			Bulging observed
99	875.320	875.900	0.580	LHS				Yes			Bulging observed
100	875.300	875.500	0.200	RHS				Yes			
101	875.550	875.900	0.350	RHS				Yes			Bulging observed
102	875.900	875.950	0.050	LHS				Yes			Bulging observed
103	875.950	876.000	0.050	LHS	Yes						
104	875.900	876.000	0.100	RHS	Yes						
105	878.450	878.550	0.100	RHS	Yes						Full of Vegetation

S.no	Existing Chainage (km)		Length (Km)	Side	Embankment	Stone Pitching	Geo Grids	Partial RE Wall +Concrete lining	RE Wall	Concrete lining	Remarks
	From	To									
106	878.520	878.720	0.200	RHS						Yes	
107	878.800	878.920	0.120	RHS						Yes	
108	878.920	879.150	0.230	RHS	Yes						
Total Length (Km)			**34.740**								

In general, the median widths are varying in between 4.0m and 10.8m all along the project road. As per site 42 No of Median openings are observed. In case of median opening with reserve lane provision, the width of median has been reduced to 1.0m. The location wise details are presented in the table below.

Table 15: Details of Median Openings along Project Road

S. No.	Existing Chainage (km)	Width (m)	Length (m)	Reserve lane	Remarks
1	814.310	7.1	20	Yes	
2	814.380	7.1	12	Yes	
3	815.350	7.1	20	Yes	
4	815.410	7.1	12	Yes	
5	818.930	1.2	30	No	
6	819.740	1.2	20	No	
7	820.640	7.1	20	Yes	
8	820.730	10.8	12	No	
9	821.900	7.1	20	Yes	
10	821.975	7.1	12	No	
11	823.600	7.1	30	Yes	
12	825.265	7.1	30	Yes	
13	831.288	7.1	12	Yes	
14	831.350	7.1	20	Yes	
15	832.080	7.1	20	Yes	
16	835.550	7.1	12	Yes	
17	835.624	7.1	20	Yes	
18	836.775	1.2	30	No	
19	838.370	7.1	26	Yes	
20	838.880	7.1	12	Yes	
21	842.010	7.1	30	Yes	
22	843.600	7.1	30	Yes	
23	843.690	7.1	12	Yes	
24	845.410	7.1	30	Yes	
25	846.450	7.1	20	Yes	
26	846.532	7.1	12	Yes	

S. No.	Existing Chainage (km)	Width (m)	Length (m)	Reserve lane	Remarks
27	847.740	1.2	30	No	
28	848.964	7.1	30	Yes	
29	850.800	7.1	25	Yes	
30	850.873	7.1	12	Yes	
31	853.000	7.1	26	Yes	
32	853.088	7.1	14	Yes	
33	855.960	7.1	30	Yes	
34	856.975	7.1	20	Yes	
35	858.780	7.1	30	Yes	
36	860.530	7.1	20	Yes	
37	862.010	7.1	30	Yes	
38	865.750	7.1	30	Yes	
39	867.214	7.1	30	Yes	
40	869.050	7.1	30	Yes	
41	878.005	7.1	20	Yes	
42	880.600	7.1	20	Yes	

The Project Road has sixteen Major Junctions and Twenty-nine Minor Junctions are observed in the project corridor. The List of Major & Minor junctions are provided with location wise are presented in table below:

Table 16: List of Major Junctions

SR. No.	Design Chainage (km)	Type of Junction	Surface Type of Access Road		Width of Access Road (m)		Remarks
			LHS	RHS	LHS	RHS	
1	814+290	RHS		BT		7	
2	815+370	RHS		BT		7	
3	820+650	RHS		BT		7	
4	821+910	RHS		BT		7	
5	827+917	RHS		BT		7	
6	831+350	LHS	BT		7		
7	835+620	LHS	BT		7		
8	843+610	RHS		BT		7	
9	846+460	RHS		BT		7	
10	850+810	RHS		BT		7	
11	853+050	RHS		BT		7	
12	856+060	LHS	BT		7		
13	867+200	LHS	BT		7		
14	869+030	BHS	BT	BT	7	7	
15	872+780	BHS	BT	BT	7	7	
16	875+680	BHS	BT	BT	7	7	

Table 17: List of Minor Junctions

SR. No.	Design Chainage (km)	Side	Width of Access Road (m)		Surface Type of Access Road		Remarks
			LHS	RHS	LHS	RHS	
1	815+610	RHS				Earthen road	
2	815+810	LHS			Earthen road		
3	817+010	RHS		3.5		BT	
4	818+930	LHS	5.5		BT		
5	821+162	BHS	Earthen road	Earthen road			
6	823+550	LHS	4		BT		
7	823+620	RHS		5.5		BT	
8	825+270	BHS	3.5	3.5	BT	BT	
9	827+830	LHS	3.5		BT		
10	829+660	RHS		3.5		BT	
11	832+090	BHS	5.5	5.5	CC	CC	
12	833+433	BHS	5.5	5.5	BT	BT	
13	833+700	BHS	7	7	CC	CC	
14	836+730	LHS	3.5		BT		
15	838+844	RHS		3.5		BT	
16	839+783	RHS		5.5		BT	
17	842+580	RHS		3.5		BT	
18	843+946	BHS	3.5	3	BT	CC	
19	845+400	BHS	3	3.5	CC	BT	
20	847+050	BHS	3	3	CC	CC	
21	847+150	RHS		3.5		BT	
22	854+199	RHS		3.5		BT	
23	854+575	LHS	3.5		BT		
24	856+530	BHS	3.5	3.5	BT	BT	
25	858+780	BHS	7	7	CC	CC	
26	860+540	BHS	3.5	3.5	BT	BT	
27	862+000	BHS	7	7	CC	CC	
28	865+790	BHS	3.5	4.5	BT	BT	
29	866+228	BHS	3.5	4.5	BT	BT	

Safety Barriers are provided at Minor Bridges, Culverts and Underpasses (VUP, PUP and LVUP) and approach Locations. The table below shows the summary of Safety Barriers provided along the project corridor and the location wise details are provided below:

Table 18: Summary of Safety Barriers

S. No.	Description	Length (Kms)
1	W-Beam Safety Barriers	34.285
2	Concrete Crash Barriers	25.900
3	Pedestrian Guard Railings	20.190

Table 19: W-Beam Safety Barriers

S. No	Design Chainage		Side/Location	Length (km)	Condition	Damage (m)	Remarks
	From (km)	To (km)					
1	814.310	814.330	LHS Shoulder	0.020	Fair		
2	814.350	814.390	LHS Shoulder	0.040	Fair		
3	814.620	814.910	LHS Shoulder	0.290	Fair	8	
4	814.940	815.220	LHS Shoulder	0.280	Fair		
5	815.480	815.510	LHS Shoulder	0.030	Fair		
6	815.530	815.610	LHS Shoulder	0.080	Fair	5	
7	816.540	816.590	LHS Shoulder	0.050	Fair		
8	816.610	816.630	LHS Shoulder	0.020	Fair		
9	817.230	817.610	LHS Shoulder	0.380	Fair		
10	817.970	818.410	LHS Median	0.440	Fair	9	
11	818.420	818.680	LHS Shoulder	0.260	Fair		
12	818.700	818.920	LHS Shoulder	0.220	Fair	3	
13	819.520	819.540	LHS Shoulder	0.020	Fair		
14	821.140	821.270	LHS Shoulder	0.130	Fair		
15	821.290	821.870	LHS Shoulder	0.580	Fair		
16	825.100	825.120	LHS Shoulder	0.020	Fair	2	
17	825.160	825.180	LHS Shoulder	0.020	Fair		
18	827.510	827.600	LHS Shoulder	0.090	Fair		
19	828.120	828.150	LHS Shoulder	0.030	Fair		
20	828.180	828.210	LHS Shoulder	0.030	Fair		
21	828.240	828.270	LHS Shoulder	0.030	Fair		
22	832.300	832.320	LHS Shoulder	0.020	Fair		
23	832.330	832.340	LHS Shoulder	0.010	Fair		
24	833.220	833.450	LHS Shoulder	0.230	Fair		
25	833.620	833.810	LHS Shoulder	0.190	Fair		
26	833.840	834.190	LHS Shoulder	0.350	Fair		
27	834.710	834.740	LHS Shoulder	0.030	Fair		

S. No	Design Chainage		Side/Location	Length (km)	Condition	Damage (m)	Remarks
	From (km)	To (km)					
28	834.770	834.810	LHS Shoulder	0.040	Fair		
29	835.750	835.820	LHS Shoulder	0.070	Fair		
30	836.000	836.030	LHS Shoulder	0.030	Fair		
31	836.190	836.340	LHS Shoulder	0.150	Fair		
32	839.310	839.560	LHS Shoulder	0.250	Fair	13	
33	839.730	839.970	LHS Shoulder	0.240	Fair		
34	840.130	840.170	LHS Shoulder	0.040	Fair		
35	840.200	840.220	LHS Shoulder	0.020	Fair		
36	842.500	842.530	LHS Shoulder	0.030	Fair		
37	842.580	852.590	LHS Shoulder	10.010	Fair		
38	842.710	844.030	LHS Shoulder	1.320	Fair		
39	844.070	844.410	LHS Shoulder	0.340	Fair		
40	848.520	848.670	LHS Shoulder	0.150	Fair		
41	851.870	851.930	LHS Shoulder	0.060	Fair		
42	852.120	852.170	LHS Shoulder	0.050	Fair		
43	852.200	852.215	LHS Shoulder	0.015	Fair		
44	852.370	852.380	LHS Shoulder	0.010	Fair		
45	854.110	854.130	LHS Shoulder	0.020	Fair		
46	854.150	854.170	LHS Shoulder	0.020	Fair		
47	858.940	858.980	LHS Shoulder	0.040	Fair		
48	858.900	859.930	LHS Shoulder	1.030	Fair		
49	864.310	864.330	LHS Shoulder	0.020	Fair		
50	864.355	864.370	LHS Shoulder	0.015	Fair		
51	864.970	864.990	LHS Shoulder	0.020	Fair		
52	865.010	865.030	LHS Shoulder	0.020	Fair		
53	865.990	866.090	LHS Shoulder	0.100	Fair		
54	866.300	866.315	LHS Shoulder	0.015	Fair		
55	866.335	866.350	LHS Shoulder	0.015	Fair		
56	867.010	867.210	LHS Shoulder	0.200	Fair		
57	867.370	867.560	LHS Shoulder	0.190	Fair		
58	872.210	872.720	LHS Shoulder	0.510	Fair	25	
59	872.800	873.130	LHS Shoulder	0.330	Fair		
60	875.230	875.610	LHS Shoulder	0.380	Fair		
61	875.700	876.100	LHS Shoulder	0.400	Fair		
62	878.490	878.780	LHS Shoulder	0.290	Fair		
63	878.800	879.040	LHS Shoulder	0.240	Fair		
64	879.130	878.840	RHS Shoulder	0.290			

S. No	Design Chainage		Side/Location	Length (km)	Condition	Damage (m)	Remarks
	From (km)	To (km)					
65	879.130	878.830	RHS Median	0.300			
66	878.800	878.770	RHS Median	0.030			
67	878.790	878.470	RHS Shoulder	0.320			
68	876.180	875.710	RHS Shoulder	0.470			
69	875.630	875.220	RHS Shoulder	0.410			
70	873.130	872.810	RHS Shoulder	0.320			
71	872.730	872.240	RHS Shoulder	0.490			
72	867.530	866.980	RHS Shoulder	0.550		15	
73	866.380	866.350	RHS Shoulder	0.030			
74	866.190	866.000	RHS Shoulder	0.190			
75	865.010	865.000	RHS Shoulder	0.010			
76	864.980	864.965	RHS Shoulder	0.015			
77	864.410	864.390	RHS Shoulder	0.020			
78	864.350	864.330	RHS Shoulder	0.020			
79	859.310	859.300	RHS Shoulder	0.010			
80	859.020	858.990	RHS Shoulder	0.030			
81	858.970	858.940	RHS Shoulder	0.030			
82	856.390	856.380	RHS Shoulder	0.010			
83	856.230	856.200	RHS Shoulder	0.030			
84	856.150	856.130	RHS Shoulder	0.020			
85	855.980	855.950	RHS Shoulder	0.030			
86	855.920	855.890	RHS Shoulder	0.030			
87	855.730	855.690	RHS Shoulder	0.040			
88	855.670	855.650	RHS Shoulder	0.020			
89	854.180	854.160	RHS Shoulder	0.020			
90	854.145	854.120	RHS Shoulder	0.025			
91	851.995	851.980	RHS Shoulder	0.015			
92	850.800	850.770	RHS Shoulder	0.030			
93	850.720	850.680	RHS Shoulder	0.040			
94	848.590	848.580	RHS Shoulder	0.010			
95	848.530	847.950	RHS Shoulder	0.580			
96	847.810	846.970	RHS Shoulder	0.840			
97	846.840	846.640	RHS Shoulder	0.200			
98	846.460	846.400	RHS Shoulder	0.060			
99	845.020	844.980	RHS Shoulder	0.040			
100	844.390	844.120	RHS Shoulder	0.270			
101	844.090	843.780	RHS Shoulder	0.310			

S. No	Design Chainage		Side/Location	Length (km)	Condition	Damage (m)	Remarks
	From (km)	To (km)					
102	842.670	842.580	RHS Shoulder	0.090			
103	842.560	842.430	RHS Shoulder	0.130			
104	842.080	841.990	RHS Shoulder	0.090			
105	840.300	840.200	RHS Shoulder	0.100			
106	839.940	839.780	RHS Shoulder	0.160			
107	839.580	839.280	RHS Shoulder	0.300		3	
108	836.780	836.760	RHS Shoulder	0.020			
109	836.740	836.620	RHS Shoulder	0.120			
110	834.910	834.800	RHS Shoulder	0.110			
111	834.770	834.720	RHS Shoulder	0.050			
112	834.430	833.920	RHS Shoulder	0.510			
113	833.890	833.710	RHS Shoulder	0.180			
114	832.400	832.370	RHS Shoulder	0.030			
115	830.980	830.960	RHS Shoulder	0.020			
116	830.940	830.840	RHS Shoulder	0.100			
117	830.840	830.800	RHS Shoulder	0.040			
118	828.830	828.800	RHS Shoulder	0.030			
119	828.730	828.110	RHS Shoulder	0.620			
120	828.030	827.420	RHS Shoulder	0.610			
121	825.200	825.170	RHS Shoulder	0.030			
122	825.140	825.110	RHS Shoulder	0.030			
123	822.220	822.080	RHS Shoulder	0.140			
124	821.920	821.310	RHS Shoulder	0.610			
125	821.290	821.190	RHS Shoulder	0.100		5	
126	820.770	820.530	RHS Shoulder	0.240			
127	820.370	820.350	RHS Shoulder	0.020			
128	819.880	818.730	RHS Shoulder	1.150			
129	818.700	817.810	RHS Shoulder	0.890		17	
130	817.080	816.840	RHS Shoulder	0.240			
131	816.690	816.630	RHS Shoulder	0.060			
132	816.610	816.590	RHS Shoulder	0.020			
133	815.590	815.560	RHS Shoulder	0.030			
134	815.520	815.500	RHS Shoulder	0.020			
135	815.290	814.980	RHS Shoulder	0.310			
136	814.950	814.660	RHS Shoulder	0.290			
137	814.410	814.390	RHS Shoulder	0.020			
138	814.370	814.320	RHS Shoulder	0.050			
As per Site Total Length of W-Beam Barriers (km)				**34.285**		**105**	

Table 20: Concrete Crash Barriers along Project Road

S. No.	Design Chainage		Length (m)	Side	Condition	Remarks
	From (km)	To (km)				
1	814.330	814.350	20	LHS Shoulder	Fair	
2	814.430	814.450	20	LHS Shoulder	Fair	
3	814.910	814.940	30	LHS Shoulder	Fair	
4	814.910	814.940	30	LHS Median	Fair	
5	815.510	815.530	20	LHS Median	Fair	
6	815.510	815.530	20	LHS Shoulder	Fair	
7	816.590	816.610	20	LHS Median	Fair	
8	816.590	816.610	20	LHS Shoulder	Fair	
9	818.680	818.700	20	LHS Shoulder	Fair	
10	821.270	821.290	20	LHS Shoulder	Fair	
11	821.630	824.650	3020	LHS Median	Fair	
12	821.630	824.650	3020	LHS Shoulder	Fair	
13	825.120	825.160	40	LHS Median	Fair	
14	825.120	825.160	40	LHS Shoulder	Fair	
15	825.450	825.470	20	LHS Median	Fair	
16	825.450	825.470	20	LHS Shoulder	Fair	
17	826.200	826.215	15	LHS Median	Fair	
18	826.200	826.215	15	LHS Shoulder	Fair	
19	827.810	828.270	460	LHS Shoulder	Fair	
20	828.210	828.240	30	LHS Shoulder	Fair	
21	828.710	828.730	20	LHS Shoulder	Fair	
22	830.780	830.860	80	LHS Shoulder	Fair	
23	830.860	830.890	30	LHS Median	Fair	
24	830.860	830.890	30	LHS Shoulder	Fair	
25	830.890	830.920	30	LHS Shoulder	Fair	
26	831.650	831.680	30	LHS Shoulder	Fair	
27	832.320	832.330	10	LHS Shoulder	Fair	
28	833.810	833.840	30	LHS Shoulder	Fair	
29	834.740	834.770	30	LHS Shoulder	Fair	
30	834.740	834.770	30	LHS Median	Fair	
31	835.510	835.525	15	LHS Shoulder	Fair	
32	836.700	836.715	15	LHS Shoulder	Fair	
33	839.560	839.730	170	LHS Median	Fair	
34	839.560	839.730	170	LHS Shoulder	Fair	
35	840.170	840.200	30	LHS Median	Fair	
36	840.170	840.200	30	LHS Shoulder	Fair	
37	842.530	852.580	10050	LHS Shoulder	Fair	
38	844.030	844.070	40	LHS Shoulder	Fair	

S. No.	Design Chainage		Length (m)	Side	Condition	Remarks
	From (km)	To (km)				
39	850.530	850.545	15	LHS Shoulder	Fair	
40	851.930	851.945	15	LHS Median	Fair	
41	851.930	851.945	15	LHS Shoulder	Fair	
42	852.170	852.200	30	LHS Median	Fair	
43	852.170	852.200	30	LHS Shoulder	Fair	
44	853.285	853.300	15	LHS Shoulder	Fair	
45	854.130	854.150	20	LHS Median	Fair	
46	854.130	854.150	20	LHS Shoulder	Fair	
47	855.310	855.325	15	LHS Shoulder	Fair	
48	855.670	855.690	20	LHS Median	Fair	
49	855.670	855.690	20	LHS Shoulder	Fair	
50	855.720	856.410	690	LHS Median	Fair	
51	855.720	856.430	710	LHS Shoulder	Fair	
52	856.840	856.850	10	LHS Shoulder	Fair	
53	858.980	859.900	920	LHS Median	Fair	
54	858.980	859.900	920	LHS Shoulder	Fair	
55	859.960	859.980	20	LHS Shoulder	Fair	
56	862.590	862.610	20	LHS Shoulder	Fair	
57	864.340	864.355	15	LHS Median	Fair	
58	864.340	864.355	15	LHS Shoulder	Fair	
59	864.990	865.010	20	LHS Median	Fair	
60	864.990	865.010	20	LHS Shoulder	Fair	
61	866.090	866.300	210	LHS Median	Fair	
62	866.090	866.300	210	LHS Shoulder	Fair	
63	866.315	866.355	40	LHS Median	Fair	
64	866.315	866.355	40	LHS Shoulder	Fair	
65	869.990	870.020	30	LHS Median	Fair	
66	869.990	870.020	30	LHS Shoulder	Fair	
67	871.210	871.240	30	LHS Median	Fair	
68	871.210	871.240	30	LHS Shoulder	Fair	
69	872.720	872.800	80	LHS Median	Fair	
70	872.720	872.800	80	LHS Shoulder	Fair	
71	874.600	874.640	40	LHS Median	Fair	
72	874.600	874.640	40	LHS Shoulder	Fair	
73	875.610	875.700	90	LHS Median	Fair	
74	875.610	875.700	90	LHS Shoulder	Fair	
75	878.780	878.800	20	LHS Median	Fair	
76	878.780	878.800	20	LHS Shoulder	Fair	
77	878.840	878.790	50	RHS Shoulder	Fair	

S. No.	Design Chainage		Length (m)	Side	Condition	Remarks
	From (km)	To (km)				
78	878.830	878.800	30	RHS Median	Fair	
79	875.710	875.630	80	RHS Shoulder	Fair	
80	874.620	874.580	40	RHS Shoulder	Fair	
81	874.620	874.580	40	RHS Median	Fair	
82	872.810	872.730	80	RHS Shoulder	Fair	
83	871.280	871.200	80	RHS Median	Fair	
84	871.280	871.180	100	RHS Shoulder	Fair	
85	870.030	869.990	40	RHS Median	Fair	
86	870.030	869.990	40	RHS Shoulder	Fair	
87	866.340	866.310	30	RHS Shoulder	Fair	
88	866.330	866.310	20	RHS Shoulder	Fair	
89	866.310	866.290	20	RHS Median	Fair	
90	866.290	866.190	100	RHS Median	Fair	
91	866.290	866.190	100	RHS Shoulder	Fair	
92	865.000	864.985	15	RHS Median	Fair	
93	865.000	864.985	15	RHS Shoulder	Fair	
94	864.380	864.365	15	RHS Median	Fair	
95	864.380	864.365	15	RHS Shoulder	Fair	
96	862.490	862.470	20	RHS Shoulder	Fair	
97	859.980	859.960	20	RHS Shoulder	Fair	
98	858.990	858.970	20	RHS Shoulder	Fair	
99	858.990	858.970	20	RHS Median	Fair	
100	856.890	856.880	10	RHS Shoulder	Fair	
101	856.200	856.180	20	RHS Shoulder	Fair	
102	856.170	856.150	20	RHS Shoulder	Fair	
103	855.950	855.930	20	RHS Shoulder	Fair	
104	855.690	855.670	20	RHS Median	Fair	
105	855.690	855.670	20	RHS Shoulder	Fair	
106	855.340	855.330	10	RHS Shoulder	Fair	
107	854.160	854.145	15	RHS Median	Fair	
108	854.160	854.145	15	RHS Shoulder	Fair	
109	853.310	853.295	15	RHS Shoulder	Fair	
110	852.220	852.190	30	RHS Median	Fair	
111	852.220	852.190	30	RHS Shoulder	Fair	
112	852.010	851.995	15	RHS Median	Fair	
113	852.010	851.995	15	RHS Shoulder	Fair	
114	850.580	850.570	10	RHS Shoulder	Fair	
115	844.120	844.090	30	RHS Shoulder	Fair	
116	842.580	842.560	20	RHS Median	Fair	

S. No.	Design Chainage		Length (m)	Side	Condition	Remarks
	From (km)	To (km)				
117	842.580	842.560	20	RHS Shoulder	Fair	
118	840.200	840.170	30	RHS Median	Fair	
119	840.200	840.170	30	RHS Shoulder	Fair	
120	840.170	840.040	130	RHS Shoulder	Fair	
121	839.780	839.580	200	RHS Median	Fair	
122	839.780	839.580	200	RHS Shoulder	Fair	
123	836.760	836.740	20	RHS Shoulder	Fair	
124	835.570	835.555	15	RHS Shoulder	Fair	
125	834.800	834.770	30	RHS Median	Fair	
126	834.800	834.770	30	RHS Shoulder	Fair	
127	833.920	833.890	30	RHS Shoulder	Fair	
128	832.370	832.350	20	RHS Median	Fair	
129	832.370	832.350	20	RHS Shoulder	Fair	
130	831.710	831.690	20	RHS Median	Fair	
131	831.710	831.690	20	RHS Shoulder	Fair	
132	830.960	830.940	20	RHS Median	Fair	
133	830.960	830.940	20	RHS Shoulder	Fair	
134	828.710	828.690	20	RHS Shoulder	Fair	
135	828.510	827.730	780	RHS Median	Fair	
136	828.110	828.030	80	RHS Shoulder	Fair	
137	826.230	826.210	20	RHS Shoulder	Fair	
138	825.500	825.480	20	RHS Shoulder	Fair	
139	825.170	825.140	30	RHS Median	Fair	
140	825.170	825.140	30	RHS Shoulder	Fair	
141	824.690	824.660	30	RHS Median	Fair	
142	824.690	824.660	30	RHS Shoulder	Fair	
143	822.000	821.990	10	RHS Shoulder	Fair	
144	821.310	821.290	20	RHS Median	Fair	
145	821.310	821.290	20	RHS Shoulder	Fair	
146	818.730	818.700	30	RHS Median	Fair	
147	818.730	818.700	30	RHS Shoulder	Fair	
148	816.630	816.610	20	RHS Median	Fair	
149	816.630	816.610	20	RHS Shoulder	Fair	
150	815.560	815.540	20	RHS Shoulder	Fair	
151	814.980	814.930	50	RHS Median	Fair	
152	814.980	814.930	50	RHS Shoulder	Fair	
153	814.510	814.495	15	RHS Shoulder	Fair	
154	814.390	814.370	20	RHS Shoulder	Fair	
As per Site Total Concrete Crash Barrier(km)			**25.900**		Fair	

Pedestrian Guard Railing were observed on the separator between the Carriageway and Service Road. Along the project corridor, location wise details are presented below:

Table 21: List of Pedestrian Guard Rails

S.no	Design Chainage(km)		Length (m)	Side	Condition	Damage (m)	Gaps observed
	From	To					
1	836.930	837.210	280	LHS	Fair		
2	857.000	857.010	10	LHS			
3	858.220	858.230	10	LHS			
4	862.310	862.320	10	LHS			
5	867.580	869.130	1550	LHS			
6	869.380	869.970	590	LHS			
7	870.020	871.210	1190	LHS		7	
8	871.250	872.110	860	LHS			
9	873.200	874.600	1400	LHS		12	
10	874.640	875.130	490	LHS		4	
11	876.130	878.490	2360	LHS		24	
12	879.110	880.600	1490	LHS		35	
13	880.600	879.470	1130	RHS		2	
14	879.450	879.200	250	RHS			
15	878.380	878.130	250	RHS		5	
16	878.110	876.300	1810	RHS		5	
17	875.110	874.620	490	RHS		2	
18	874.580	873.310	1270	RHS		3	
19	872.170	871.280	890	RHS		3	
20	871.180	870.030	1150	RHS			
21	869.990	869.220	770	RHS			
22	869.190	867.600	1590	RHS		5	
23	842.860	842.850	10	RHS			
24	837.260	836.960	300	RHS		3	
25	836.920	836.880	40	RHS			
As per Site Total length of PGR's			**20190**			**110**	**0**

Road furniture in the form of High masts, Low mast, Highway Lighting and Sign boards have been provided along the project road. The tables below depict the Road Furniture and the location wise details are provided.

Table 22: Locations of High mast lighting

S No.	Ex. Chainage (Km)	Side	Facility, if any	Location	Condition	Remarks
1	876.400	LHS	Junction	Shoulder	Good	Highmast
2	869.030	RHS	Junction	Median	Good	Highmast
3	840.600	LHS	Toll plaza	Shoulder	Good	Highmast

S No.	Ex. Chainage (Km)	Side	Facility, if any	Location	Condition	Remarks
4	840.500	RHS	Toll plaza	Shoulder	Good	Highmast
5	840.700	LHS	Toll plaza	Shoulder	Good	Highmast
6	840.500	RHS	Toll plaza	Shoulder	Good	Highmast
7	850.800	RHS	Junction	Shoulder	Good	Highmast
8	846.460	RHS	Junction	Shoulder	Good	Highmast
9	843.800	RHS	Junction	Shoulder	Good	Highmast
10	831.350	RHS	Junction	Shoulder	Good	Highmast
11	831.600	LHS	Junction	Shoulder	Good	Highmast
12	867.200	LHS	Junction	Shoulder	Good	Highmast
13	853.000	RHS	Junction	Shoulder	Good	Highmast
14	821.500	RHS	Junction	Shoulder	Good	Highmast
15	822.400	RHS	Junction	Shoulder	Good	Highmast
16	820.800	RHS	Junction	Shoulder	Good	Highmast
17	815.600	RHS	Junction	Shoulder	Good	Highmast
18	814.200	RHS	Junction	Shoulder	Good	Highmast

Table 23: Locations of Highway Lighting

S.No.	Chainage (km)		Location	Length (km)	No. of Light poles		Damage	Remarks
	From	To			Single arm	Double arm		
1	814.80	815.30	LHS	0.50	15		-	
2	814.80	815.30	RHS	0.50	15		-	
3	816.10	816.40	LHS	0.30		10	-	
4	816.10	816.30	LHS	0.20	7		-	Bus Bay
5	816.10	816.30	RHS	0.20	7		-	Bus Bay
6	822.15	822.30	RHS	0.15	7		-	Bus Bay
7	820.10	820.30	LHS	0.20	7		-	Bus Bay
8	827.70	828.20	LHS	0.50	25		-	
9	827.70	828.20	RHS	0.50	25		-	
10	833.20	834.00	LHS	0.80	18		-	
11	833.20	834.00	RHS	0.80	18		-	
12	833.31	834.10	LHS	0.79	6		-	
13	836.25	836.45	LHS	0.20	7		-	Bus Bay
14	836.70	837.10	RHS	0.40	11		-	
15	836.70	837.10	LHS	0.40	11		-	
16	838.85	839.05	LHS	0.20	7		-	Bus Bay
17	838.50	838.70	RHS	0.20	7		-	Bus Bay
18	840.50	840.90	LHS	0.40	22		-	
19	842.00	842.20	RHS	0.20	7		-	Bus Bay

S.No.	Chainage (km)		Location	Length (km)	No. of Light poles		Damage	Remarks
	From	To			Single arm	Double arm		
20	842.60	842.80	LHS	0.20	7		-	Bus Bay
21	843.00	843.20	RHS	0.20	6		-	
22	843.90	844.20	RHS	0.30	10		-	
23	844.00	844.20	RHS	0.20	8		-	
24	844.20	844.50	Median	0.30	20		-	
25	846.80	848.60	Median	1.80	100		-	
26	846.80	848.70	LHS	1.90	50		-	
27	846.80	848.70	RHS	1.90	50		-	
28	847.00	848.00	Median	1.00		50	-	
29	854.00	854.20	LHS	0.20	7		-	Bus Bay
30	854.10	854.30	LHS	0.20	7		-	Bus Bay
31	854.30	854.50	RHS	0.20	7		-	Bus Bay
32	854.95	855.20	RHS	0.25	7		-	Bus Bay
33	855.60	856.20	Median	0.60		24	1.00	
34	855.60	856.20	RHS	0.60	20		-	
35	855.90	856.50	RHS	0.60	20		-	
36	857.00	857.20	LHS	0.20	7		-	Bus Bay
37	858.90	859.10	RHS	0.20	7		-	Bus Bay
38	859.00	859.20	LHS	0.20	7		-	Bus Bay
39	859.00	859.20	RHS	0.20	7		-	Bus Bay
40	862.00	862.20	LHS	0.20	7		-	Bus Bay
41	862.00	862.20	RHS	0.20	7		-	Bus Bay
42	862.22	862.45	RHS	0.23	7		1.00	Bus Bay
43	866.11	866.40	RHS	0.29	10		-	Truck lay bye
44	872.40	873.20	Median	0.80	22		-	
45	872.50	872.80	LHS	0.30	8		1.00	
46	872.80	873.20	LHS	0.40	20		-	
47	875.10	875.40	LHS	0.30	10		-	
48	875.20	875.55	Median	0.35	5	22	-	
Total				**21.762**	**665**	**106**	**3**	

Table 24: Details of Road Signs along Project Road

Description	LHS	RHS	Junctions	Total
Octagonal	0	0	33	33
Circular	18	27		45
Triangular	49	37	51	137
Rectangular	207	91	17	315

Description	LHS	RHS	Junctions	Total
Facility Informatory	7	23		30
Chevron	0	81		81
Hazard	140	119	24	283
Route Marker	0	20		20
Safety Boards	0	0		0
Toll Boards	6	6		12
Cantilever Gantry	19	19		38
Over Head Gantry	2	2		4
Variable Message Sign	2	2		4
Project Descriptive	0	0		0
Total	**450**	**427**	**125**	**1002**

The project road has total 20 Nos. of Bus Bays along & Bus shelters observed on both sides of Highway. Highway lighting, were observed. PGR were observed near bus shelter. The details were presented in below.

Table 25: Details of Bus Bays with Shelters

S. No.	Existing Chainage (km)	Side	As per Site	Facilities Provided		Separator	Remarks
				PGR	Single arm Lightnings		
1	816.180	LHS	Bus Bay with shelter	Yes		-	
2	816.181	RHS	Bus Bay with shelter	Yes			
3	820.195	LHS	Bus Bay with shelter	Yes		-	
4	822.205	LHS	Bus Bay with shelter	Yes		-	
5	836.370	RHS	Bus Bay with shelter	Yes			
6	838.630	LHS	Bus Bay with shelter	Yes		-	
7	838.960	LHS	Bus Bay with shelter	Yes		-	
8	842.682	LHS	Bus Bay with shelter	Yes		-	
9	842.682	RHS	Bus Bay with shelter	Yes			
10	845.431	RHS	Bus Bay with shelter	Yes			
11	848.310	RHS	Bus Bay with shelter	Yes			
12	848.431	LHS	Bus Bay with shelter	Yes		-	
13	854.150	RHS	Bus Bay with shelter	Yes			
14	854.950	LHS	Bus Bay with shelter	Yes		-	
15	856.250	RHS	Bus Bay with shelter	Yes			
16	856.900	RHS	Bus Bay with shelter	Yes			
17	859.150	LHS	Bus Bay with shelter	Yes		-	
18	859.150	RHS	Bus Bay with shelter	Yes			
19	862.220	LHS	Bus Bay with shelter	Yes			
20	862.220	RHS	Bus Bay with shelter	Yes			

The Project Road has one Truck lay bye on RHS sides of Highway. The truck lay bye has been provided with paver block and the condition appears to be fair. Separator is provided between main carriageway and truck lay bye portion.

Table 26: Details of truck lay byes

S. No.	Chainage(km)	Length (m)	Side	Type of Road	Width (m)	Separator Details				Toilet blocks	Rest room
						Length (m)	Width (m)	Kerb Height	Kerb width		
1	866.220	210	RHS	Paver blocks	6	150	1.0	0.2	0.15	Yes	No

Solar Blinkers are provided at most of the Median opening locations and the number accounts to 10. The table below represents the summary of the Solar Blinker and their condition..

Table 27: Details of Solar Blinkers along Project Road

Solar Blinkers				
S. No.	Chainage (km)	Location	Blinkers (Nos.)	Non-functional (Nos.)
1	814.500	Median	2	
2	815.500	Median	2	
3	820.800	Median	2	
4	822.000	Median	2	
5	823.700	Median	2	
6	825.500	Median	2	
7	831.500	Median	2	
8	835.800	Median	2	
9	843.700	Median	2	
10	845.600	Median	2	
11	846.600	Median	2	2
12	847.800	Median	2	2
13	849.000	Median	2	1
14	850.900	Median	2	2
15	853.000	Median	2	
16	855.100	Median	2	
17	858.900	Median	2	
18	860.300	Median	2	2
19	862.100	Median	2	
20	865.900	Median	2	
21	867.400	Median	2	
Total Numbers			**42**	**9**

All above road related items are presented in the **Appendix 6** of this report.

3.2 STRUCTURES

List of Major Structures found during the inventory surveys along the corridor are as follows:

Table 28: Details of Major CD & Other Structures along Project Road

Sl. No.	Chainage	Type of Str	Side	Str on	Age of Structure	Span Arrangement (No x Length)	No. of Span	Span length	No. of Decks	Deck width	Remarks
1	827+917	Flyover	RHS	MCW	New	2 x 30	2	30.00	1	12.50	-
2	856+060	Flyover	LHS	MCW	New	1 x 21 + 1 x 30 + 1 x 21	3	24.00	1	12.50	-
3	872+780	Flyover	LHS	MCW	New	1 x 21 + 1 x 30 + 1 x 21	3	24.00	1	12.50	-
4	872+780	Flyover	RHS	MCW	New	1 x 21 + 1 x 30 + 1 x 21	3	24.00	1	12.50	-
5	875+680	Flyover	LHS	MCW	New	1 x 21 + 1 x 30 + 1 x 21	3	24.00	1	12.50	-
6	875+680	Flyover	RHS	MCW	New	1 x 21 + 1 x 30 + 1 x 21	3	24.00	1	12.50	-
7	839+656	MJB	LHS	MCW	New	6 x 30	6	30.00	1	12.50	-
8	839+656	MJB	RHS	MCW	New	6 x 30	6	30.00	1	12.50	-
9	866+244	MJB	LHS	MCW	New	3 x 30	3	30.00	1	12.50	-
10	866+244	MJB	RHS	MCW	New	3 x 30	3	30.00	1	12.50	-
11	814+245	MNB	LHS	MCW	New	1 x 7	1	7.00	1	16.50	-
12	814+245	MNB	RHS	MCW	New	1 x 7	1	7.00	1	16.50	-
13	815+381	MNB	LHS	MCW	New	1 x 7	1	7.00	1	12.50	-
14	815+381	MNB	RHS	MCW	New	1 x 7	1	7.00	1	16.00	-
15	816+471	MNB	LHS	MCW	New	1 x 7.5	1	7.50	1	12.50	-
16	816+471	MNB	RHS	MCW	Old	1 x 8.3	1	8.30	1	12.50	-
17	824+524	MNB	LHS	MCW	New	2 x 10	2	10.00	1	12.50	-
18	824+524	MNB	RHS	MCW	Old	2 x 8.5	2	8.50	1	12.50	-
19	825+052	MNB	LHS	MCW	New	3 x 11	3	11.00	1	12.50	-
20	825+052	MNB	RHS	MCW	New	3 x 11	3	11.00	1	12.50	-
21	828+091	MNB	LHS	SR	New	3 x 12.5	3	12.50	1	10.75	-
22	828+091	MNB	LHS	MCW	Old	3 x 12.5	3	12.50	1	12.50	-
23	828+091	MNB	RHS	MCW	New	3 x 12.5	3	12.50	1	12.50	-
24	828+091	MNB	RHS	SR	New	3 x 12.5	3	12.50	1	10.50	-
25	830+758	MNB	LHS	MCW	New	3 x 11	3	11.00	1	12.50	-
26	830+758	MNB	RHS	MCW	New	3 x 11	3	11.00	1	12.50	-
27	832+204	MNB	LHS	MCW	New	1 x 8	1	8.00	1	12.50	-
28	832+204	MNB	RHS	MCW	New	1 x 8	1	8.00	1	12.50	-
29	834+629	MNB	LHS	MCW	New	2 x 9	2	9.00	1	12.50	-
30	834+629	MNB	RHS	MCW	New	2 x 9	2	9.00	1	12.50	-
31	840+104	MNB	LHS	MCW	New	1 x 24.2	1	24.20	1	12.50	-
32	840+104	MNB	RHS	MCW	New	1 x 24.2	1	24.20	1	12.50	-
33	842+429	MNB	LHS	MCW	New	1 x 22	1	22.00	1	12.50	-

Sl. No.	Chainage	Type of Str	Side	Str on	Age of Structure	Span Arrangement (No x Length)	No. of Span	Span length	No. of Decks	Deck width	Remarks
34	842+429	MNB	RHS	MCW	Old	2 x 11	2	11.00	1	12.50	-
35	851+884	MNB	LHS	MCW	New	1 x 7	1	7.00	1	12.50	-
36	851+884	MNB	RHS	MCW	New	1 x 7	1	7.00	1	12.50	-
37	852+088	MNB	LHS	MCW	New	3 x 8	3	8.00	1	12.50	-
38	852+088	MNB	RHS	MCW	New	3 x 8	3	8.00	1	12.50	-
39	854+040	MNB	LHS	MCW	New	1 x 7	1	7.00	1	12.50	-
40	854+040	MNB	RHS	MCW	Old	1 x 7	1	7.00	1	12.50	-
41	855+575	MNB	LHS	SR	New	2 x 7	2	7.00	1	10.50	-
42	855+575	MNB	LHS	MCW	New	2 x 7	2	7.00	1	12.50	-
43	855+575	MNB	RHS	MCW	New	2 x 7	2	7.00	1	12.50	-
44	855+824	MNB	LHS	SR	New	1 x 15	1	15.00	1	10.75	-
45	855+824	MNB	LHS	MCW	New	1 x 15	1	15.00	1	12.50	-
46	855+824	MNB	RHS	MCW	New	1 x 15	1	15.00	1	12.50	-
47	855+824	MNB	RHS	SR	New	1 x 15	1	15.00	1	10.75	-
48	856+077	MNB	LHS	SR	New	1 x 12	1	12.00	1	10.75	-
49	856+077	MNB	LHS	MCW	New	1 x 12	1	12.00	1	12.50	-
50	856+077	MNB	RHS	MCW	New	1 x 12	1	12.00	1	12.50	-
51	856+077	MNB	RHS	SR	New	1 x 12	1	12.00	1	10.75	-
52	858+884	MNB	LHS	MCW	New	1 x 10	1	10.00	1	12.50	Reconstruction proposed as per schedule B
53	858+884	MNB	RHS	MCW	New	1 x 10	1	10.00	1	12.50	Reconstruction proposed as per schedule B
54	864+250	MNB	LHS	MCW	New	1 x 12	1	12.00	1	12.50	-
55	864+250	MNB	RHS	MCW	New	1 x 12	1	12.00	1	12.50	-
56	864+905	MNB	LHS	MCW	New	1 x 15	1	15.00	1	12.50	-
57	864+905	MNB	RHS	MCW	New	1 x 15	1	15.00	1	12.50	-
58	869+999	MNB	LHS	SR	Old	3 x 11	3	11.00	1	10.50	-
59	869+999	MNB	LHS	MCW	Old	3 x 11	3	11.00	1	12.50	-
60	869+999	MNB	RHS	MCW	New	3 x 11	3	11.00	1	12.50	-
61	869+999	MNB	RHS	SR	New	3 x 11	3	11.00	1	10.50	-
62	871+223	MNB	LHS	SR	Old	3 x 12.5	3	12.50	1	10.50	-
63	871+223	MNB	LHS	MCW	Old	3 x 12.5	3	12.50	1	12.50	-
64	871+223	MNB	RHS	MCW	New	3 x 12.5	3	12.50	1	12.50	-
65	871+223	MNB	RHS	SR	New	3 x 12.5	3	12.50	1	10.50	-
66	874+619	MNB	LHS	SR	New	4 x 12	4	12.00	1	10.50	-
67	874+619	MNB	LHS	MCW	Old	4 x 12	4	12.00	1	12.50	-
68	874+619	MNB	RHS	MCW	New	4 x 12	4	12.00	1	12.50	-
69	874+619	MNB	RHS	SR	Old	4 x 12	4	12.00	1	10.50	-
70	878+725	ROB	LHS	MCW	Old	1 x 16.1	1	16.10	1	12.50	-
71	878+725	ROB	RHS	MCW	New	1 x 37.2	1	37.20	1	12.50	-

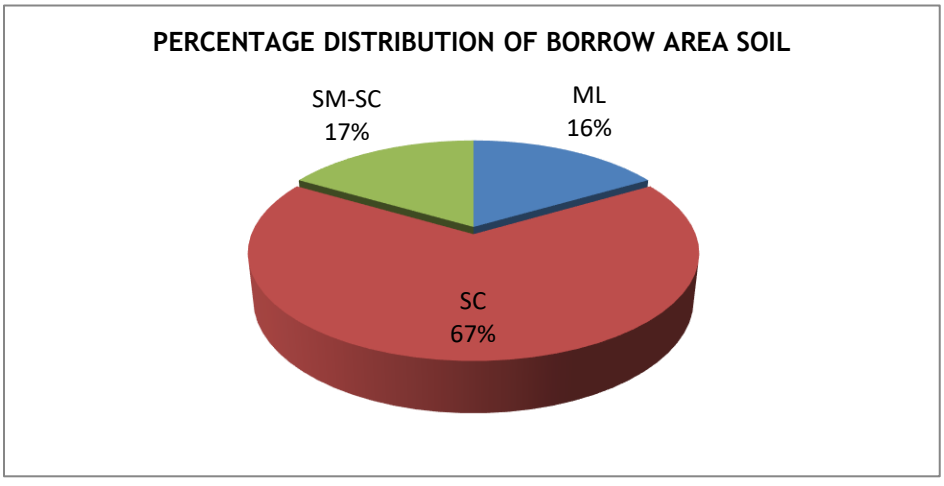
Sl. No.	Chainage	Type of Str	Side	Str on	Age of Structure	Span Arrangement (No x Length)	No. of Span	Span length	No. of Decks	Deck width	Remarks
72	833+700	VUP	LHS	MCW	New	1 x 13	1	13.00	1	12.50	-
73	833+700	VUP	RHS	MCW	New	1 x 13	1	13.00	1	12.50	-
74	843+946	VUP	LHS	MCW	New	1 x 13.6	1	13.60	1	12.50	-
75	843+946	VUP	RHS	MCW	New	1 x 13.6	1	13.60	1	12.50	-
76	814+789	PUP	LHS	MCW	New	1 x 7	1	7.00	1	12.50	-
77	814+789	PUP	RHS	MCW	New	1 x 7	1	7.00	1	12.50	-
78	818+574	PUP	LHS	MCW	New	1 x 7	1	7.00	1	12.75	-
79	818+574	PUP	RHS	MCW	New	1 x 7	1	7.00	1	12.75	-
80	821+162	PUP	LHS	MCW	New	1 x 7	1	7.00	1	12.50	-
81	821+162	PUP	RHS	MCW	New	1 x 7	1	7.00	1	12.50	-
82	866+228	PUP	LHS	MCW	New	1 x 7.2	1	7.20	1	12.50	-
83	866+228	PUP	RHS	MCW	New	1 x 7.2	1	7.20	1	12.50	
84	847+150	SVUP	LHS	MCW	New	1 x 7	1	7.00	1	14.50	New construction proposed
85	847+150	SVUP	RHS	MCW	New	1 x 7	1	7.00	1	14.50	New construction proposed
86	878+725	SVUP	LHS	MCW	New	1 x 7	1	7.00	1	19.00	New construction proposed
87	878+725	SVUP	RHS	MCW	New	1 x 7	1	7.00	1	19.00	New construction proposed
88	878+725	SVUP	LHS	MCW	New	1 x 7	1	7.00	1	19.00	New construction proposed
89	878+725	SVUP	RHS	MCW	New	1 x 7	1	7.00	1	19.00	New construction proposed
90	858+780	LVUP	LHS	MCW	New	1 x 12	1	12.00	1	14.50	New construction proposed
91	858+780	LVUP	RHS	MCW	New	1 x 12	1	12.00	1	14.50	New construction proposed
92	862+000	LVUP	LHS	MCW	New	1 x 12	1	12.00	1	14.50	New construction proposed
93	862+000	LVUP	RHS	MCW	New	1 x 12	1	12.00	1	14.50	New construction proposed
94	865+400	LVUP	LHS	MCW	New	1 x 12	1	12.00	1	14.50	New construction proposed
95	865+400	LVUP	RHS	MCW	New	1 x 12	1	12.00	1	14.50	New construction proposed
96	835+620	VUP	LHS	MCW	New	1 x 20	1	20.00	1	14.50	New construction proposed
97	835+620	VUP	RHS	MCW	New	1 x 20	1	20.00	1	14.50	New construction proposed
98	847+757	VUP	LHS	MCW	New	1 x 20	1	20.00	1	14.50	New construction proposed
99	847+757	VUP	RHS	MCW	New	1 x 20	1	20.00	1	14.50	New construction proposed
100	867+200	Flyover	LHS	MCW	New	1 x 15 + 1 x 30 + 1 x 15	3	20.00	1	14.50	New construction proposed
101	869+030	Flyover	LHS	MCW	New	2 x 25	2	25.00	1	14.50	New construction proposed
102	869+030	Flyover	RHS	MCW	New	2 x 25	2	25.00	1	14.50	New construction proposed

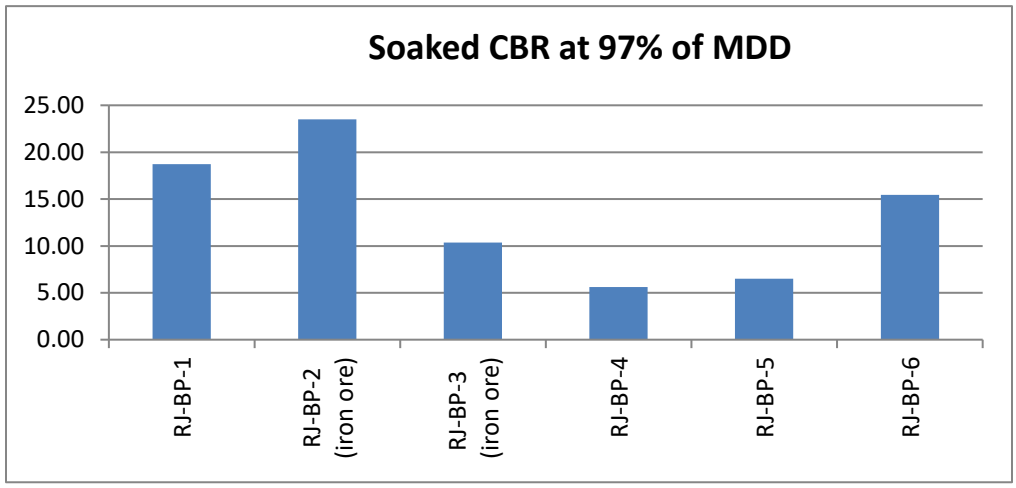
4.1 EMBANKMENT & SUBGRADE

The embankment for project road has been constructed with available soils from nearby areas. The soil appears to be Coarse grained type in nature and embankment appears to be in good condition over the entire length of project. No major settlements or depressions have been noted even at high embankment locations. Out of 6 samples 4 samples belongs to SC type of soil, 1 sample belongs to SM-SC type of soil and 1 sample belongs to ML type of soil. There are no marshy/water logging areas along the length of project road.

Table 29: Test Results of Borrow area Samples Details

Lab Sample No	Site Identification		Grain Size Analysis					Atterberg Limits (%)			Soil Class	MDD (gm/cc)	OMC (%)	Dry Density at 97% MDD	Soaked CBR 97% MDD	Free Swelling Index (%)
	Location (km)	Up/Dn	Percentage passing from					LL	PL	PI						
			4.75 mm IS Sieve	425 mic IS Sieve	75 mic IS Sieve	Gravel %	Sand %									
RJ-BP-1	863+600	LHS	96.02	41.94	17.2	3.98	78.82	23	16	7	SM-SC	2.04	10.00	1.98	18.73	5
RJ-BP-2 (iron ore)	843+500	RHS	77.43	58.16	47.77	22.57	29.66	32	18	14	SC	2.10	10.60	2.04	23.50	14
RJ-BP-3 (iron ore)	850+900	LHS	87.91	72.76	61.3	12.09	26.61	-	NP	NP	ML	1.97	11.40	1.91	10.35	5
RJ-BP-4	833+500	RHS	80.78	36.81	29.00	19.22	51.78	44	26	18	SC	1.80	18.00	1.75	5.62	30
RJ-BP-5	823+600	RHS	83.38	53.85	40.71	16.62	42.67	36	26	10	SC	1.84	18.80	1.78	6.50	27
RJ-BP-6	813+950	LHS	68.03	32.78	21.42	31.97	46.61	29	17	12	SC	2.10	7.80	2.04	15.43	23





The subgrade samples collected from the test pits taken from project road appears to be in fair condition as revealed by test pit investigations. Soil classification has been done according to IS Classification of Soils (ISC) as detailed in IS 1498 - 1978.

Laboratory test results indicate that majority of the Subgrade soil samples collected belongs to Coarse Grained Soil out of 12 Nos. of samples 8 Nos. of samples belongs to SC type of soil, 4 Nos. of sample belongs to CI type of soil.

Pie Chart showing the percentage distribution of soil classification of existing subgrade sample is presented below:

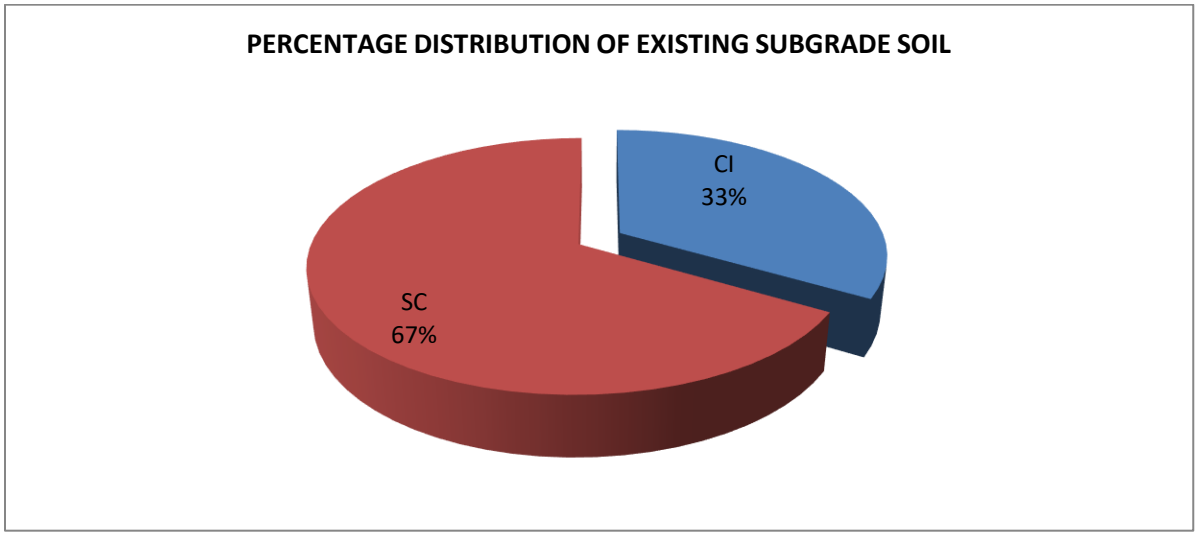
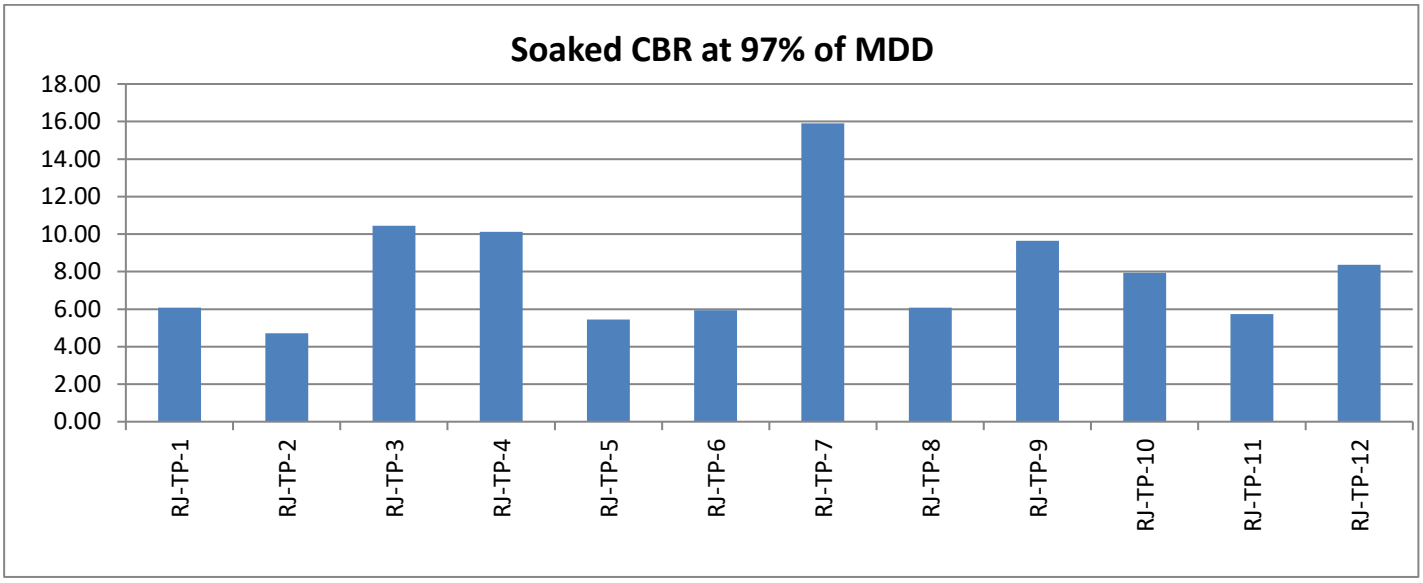


Table 30: Test results of Existing Subgrade Soils

Lab Sample No	Site Identification		Grain Size Analysis					Atterberg Limits (%)			Soil Class	MDD (gm/cc)	OMC (%)	FDD (gm/cc)	COMPACTION (%)	Dry Density at 97% MDD	Soaked CBR 97% MDD	Free Swelling Index (%)
			Percentage passing from															
	Location (km)	Up/Dn	4.75 mm IS Sieve	425 mic IS Sieve	75 mic IS Sieve	Gravel %	Sand %	LL	PL	PI								
RJ-TP-1	866+400	RHS	66.46	30.45	25.56	33.54	40.9	45	33	12	SC	1.92	12.40	1.75	91	1.86	6.08	36
RJ-TP-2	858+600	RHS	84.06	67.11	65.04	15.94	19.02	48	24	24	CI	1.88	13.50	1.74	93	1.82	4.72	24
RJ-TP-3	848+800	RHS	89.07	54.33	50.48	10.93	38.59	47	28	19	CI	2.00	13.00	1.81	91	1.94	10.44	30
RJ-TP-4	838+600	RHS	75.33	48.49	28.59	24.67	46.74	29	18	11	SC	2.06	11.20	1.88	91	2.00	10.12	24
RJ-TP-5	828+800	RHS	77.93	47.73	41.54	22.07	36.39	42	26	16	SC	1.85	14.80	1.74	94	1.79	5.45	32
RJ-TP-6	817+600	RHS	96.83	84.53	77.71	3.17	19.12	41	23	18	CI	1.85	17.00	1.75	94	1.79	5.94	32
RJ-TP-7	813+500	LHS	87.15	60.38	44.5	12.85	42.65	26	18	8	SC	2.09	11.00	1.90	91	2.03	15.90	20
RJ-TP-8	823+200	LHS	85.62	52.57	42.2	14.38	43.42	36	22	14	SC	1.90	15.40	1.75	92	1.84	6.08	13
RJ-TP-9	833+050	LHS	66.32	36.44	28.1	33.68	38.22	36	19	17	SC	1.97	11.60	1.79	91	1.91	9.64	22
RJ-TP-10	843+050	LHS	81.38	23.61	15.25	18.62	66.13	35	19	16	SC	1.94	12.80	1.75	90	1.88	7.93	17
RJ-TP-11	853+000	LHS	70.57	41.95	32.34	29.43	38.23	36	22	14	SC	1.89	14.00	1.77	94	1.83	5.73	12
RJ-TP-12	863+000	LHS	85.26	61.39	57.58	14.74	27.68	42	23	19	CI	1.86	15.60	1.72	92	1.80	8.37	36



The following observations can be made from the above test results conducted on of existing subgrade samples

- Maximum Dry Density for all subgrade samples varies between 1.85 and 2.09 gm/cc. All samples satisfying the MDD criterion (MDD>=1.75 gm/cc).
- OMC for existing subgrade samples varies in between 11% to 17%.
- Free Swelling Index for existing subgrade samples varies in between 12% to 36%. All the samples satisfying the FSI criterion (FSI<=50%)
- Compaction levels are lower than the standard value of 97% of MDD
- CBR Values are varying from 5% to 16%.

Material related tests reports are provided in **Appendix-7** of this report.

Aggregates to be used for sub-base, base, surface courses and concrete works have been collected from the crushers under operation from the existing quarries. The Table below represents the test results of the Aggregate and Sand Samples

Table 31: Test Results of Aggregate Samples Details

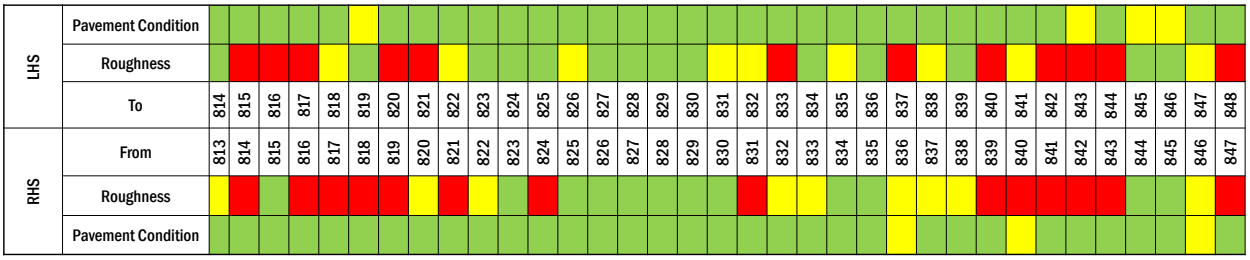
S. No	Sample	Location (km)	Up/Dn	A.I.V (%)	Water Absorption (%)	Specific Gravity	Remark
1	RJ-AQ-1	828+000	RHS	7.83	0.20	2.91	

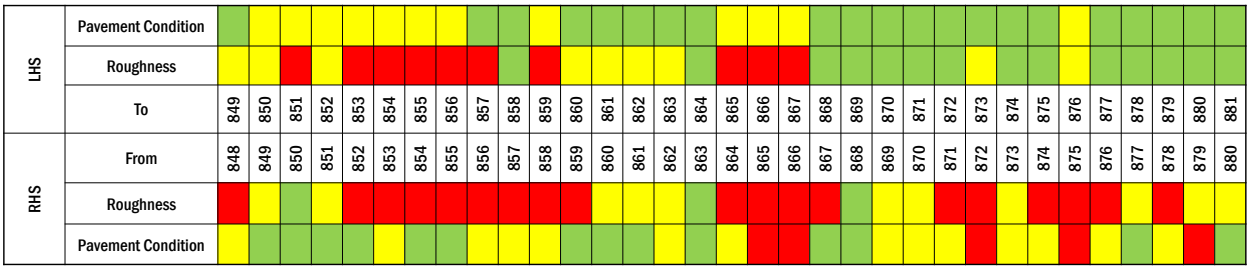
Table 32: Test Results of Sand Samples Details

Sl No	Sample No	Chainage (Km)	SIDE	10 mm Passing %	4.75 mm Passing %	2.36 mm Passing %	1.18 mm Passing %	600 mic. Passing %	300 mic. Pas sing %	150 mic. Passing %	FM	ZONE	REMARKS
1	JL-SQ-1	881+500	RHS	100	91	80	63	42	9	1	3.15	ZONE -II	
2	RJ-SQ-1	843+500	RHS	100	90	85	77	64	23	2	2.60	ZONE-III	
3	RJ-SQ-2	844+000	LHS	100	90	81	69	54	21	4	2.82	ZONE-II	

4.2 PAVEMENT CONDITION

The distresses in bituminous surface have been captured on the project corridor for each lane separately by using the Network Survey Vehicle (NSV).





Pavement Condition report covering the data collection for each km length in each direction has been presented in the **Annexure-2.**

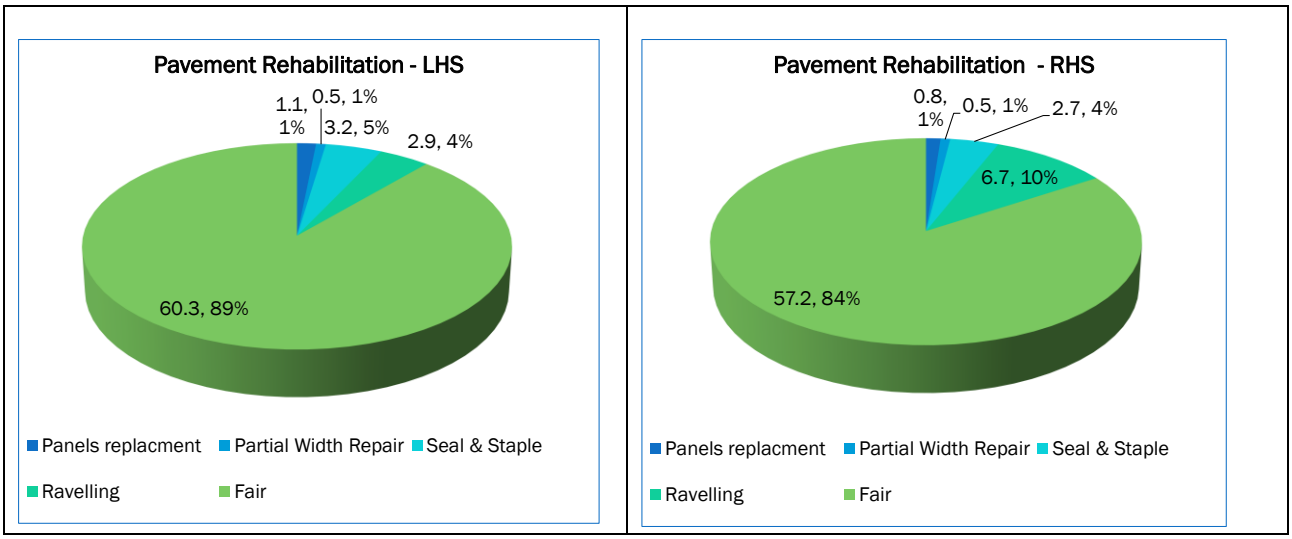
Based on IRC: SP: 83-2018 guidelines the summary of the pavement distresses the following rehabilitation measures for rigid panels have be considered.

The suggested Pavement rehabilitation in terms of No. of panels based on visual pavement condition are as:

LHS	Overall																																				
	Ravelling	4	4	4	0	1	5	2	4	9	3	0	0	0	0	0	0	0	0	1	0	1	0	6	3	2	1	8	22	17	26	12	25	19	30	11
	Seal & Staple	15	23	26	9	6	36	16	9	17	8	4	6	5	1	0	9	3	5	0	3	3	6	8	3	7	6	4	6	13	16	7	12	13	4	13
	Partial Width Repair	6	0	6	0	1	2	4	0	2	0	1	0	1	1	0	0	1	2	0	2	1	0	5	1	0	0	1	3	2	4	1	2	4	3	3
	Panels replacment	0	1	2	3	1	37	3	0	2	0	0	7	2	0	0	0	0	0	0	0	0	1	0	4	0	3	0	2	2	1	4	10	25	6	0
	To	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848
RHS	From	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847
	Panels replacment	0	0	0	0	5	1	0	1	0	17	0	0	0	1	7	23	0	0	0	0	4	2	0	1	2	0	4	0	0	4	2	4	0	2	2
	Partial Width Repair	0	0	0	3	4	11	0	2	1	1	0	2	0	0	1	1	0	1	0	1	0	3	0	1	0	0	2	16	0	0	0	5	1	5	5
	Seal & Staple	2	3	6	4	0	13	0	3	1	3	8	1	2	0	13	48	0	0	1	4	1	16	3	5	1	4	13	10	10	8	4	31	6	34	15
	Ravelling	1	8	2	0	0	0	13	7	1	2	1	1	7	1	1	13	0	2	5	0	13	14	13	63	10	23	18	25	2	2	40	10	6	23	20
	Overall																																			

LHS	Overall																																
	Ravelling	11	24	26	26	23	26	27	24	12	18	56	7	8	13	12	5	21	27	20	14	0	0	0	0	3	0	0	14	1	0	0	0	0
	Seal & Staple	12	19	16	18	14	18	12	8	38	24	22	19	3	4	10	13	32	28	23	1	0	0	0	0	27	0	0	27	2	0	0	0	0
	Partial Width Repair	4	0	2	1	3	2	5	4	1	0	3	15	0	1	4	0	4	1	2	1	0	0	0	0	1	0	0	8	1	0	0	0	0
	Panels replacment	1	10	24	7	6	4	2	11	3	0	7	0	0	0	0	0	7	11	10	11	1	0	0	0	0	3	0	0	3	1	0	0	0	0
	To	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881
RHS	From	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880
	Panels replacment	2	0	2	0	0	0	3	0	3	2	3	3	1	3	0	2	4	0	1	0	1	0	3	4	1	0	1	1	10	5	0	44	0
	Partial Width Repair	11	0	2	1	0	0	1	2	1	13	0	0	0	0	0	0	3	4	1	0	0	0	5	0	0	0	0	1	5	0	3	1	0
	Seal & Staple	26	2	7	6	1	3	5	0	10	16	19	19	10	8	3	1	9	4	7	3	0	11	27	2	11	13	3	44	15	13	22	14	1
	Ravelling	12	11	16	14	5	42	13	34	59	20	36	19	13	12	46	18	39	83	81	23	2	38	34	39	81	51	50	56	40	17	75	37	17
	Overall																																	

The pie chart showing the %distribution of distress rectification measures for this package are as follows

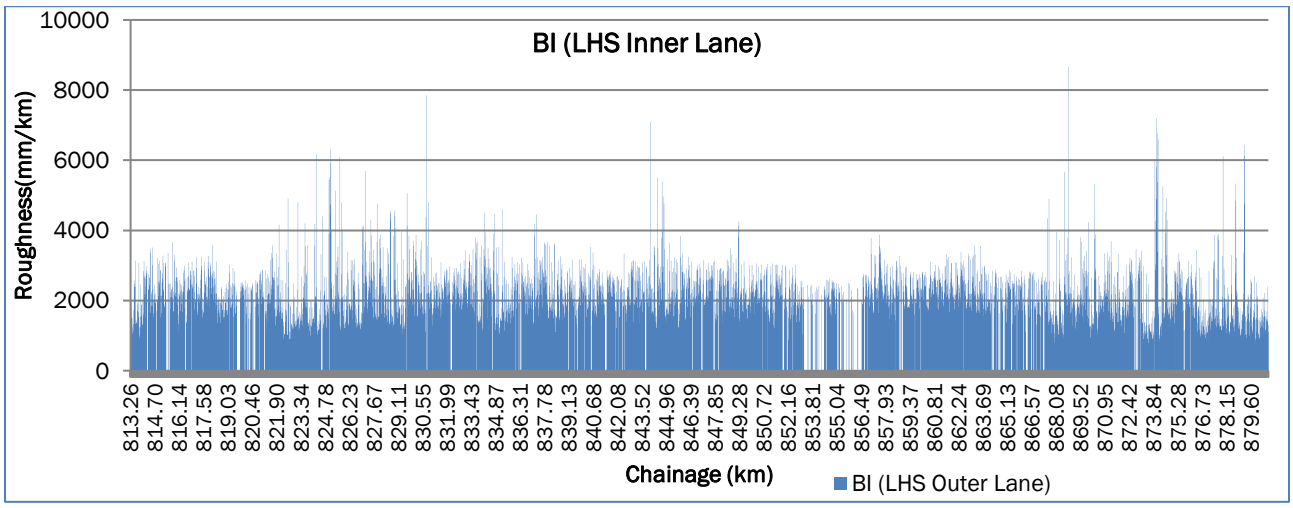


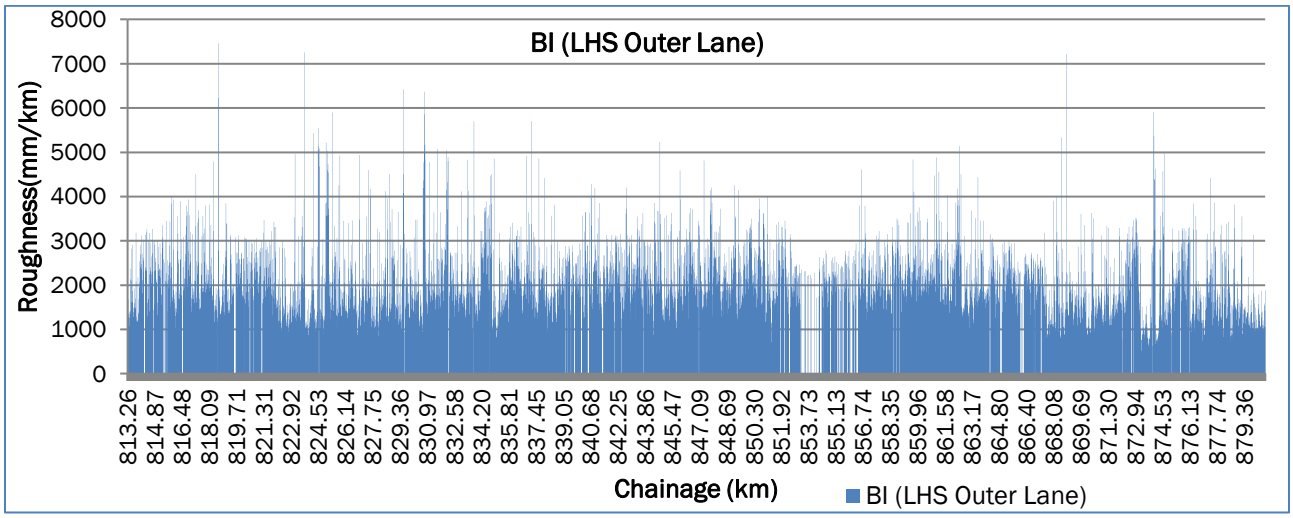
Following panel rectification measured are considered for the rigid pavement.

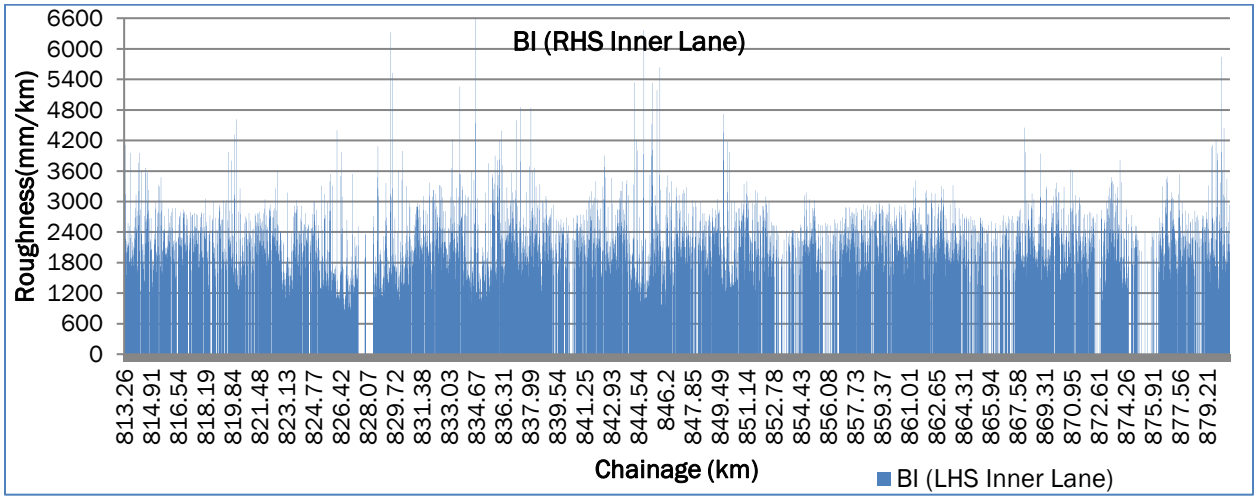
S No	Package	Total Panels for replacement (Nrs.)	Partial 1m Full Depth Repair (Nrs.)	Seal & Staple in Panels (Nrs.)	Ravelling in Number of Panels (Nrs.)	Corner Break in Panel (Nrs.)
1	Package-4, LHS	238	122	712	638	21
2	Package-4, RHS	181	120	608	1480	16

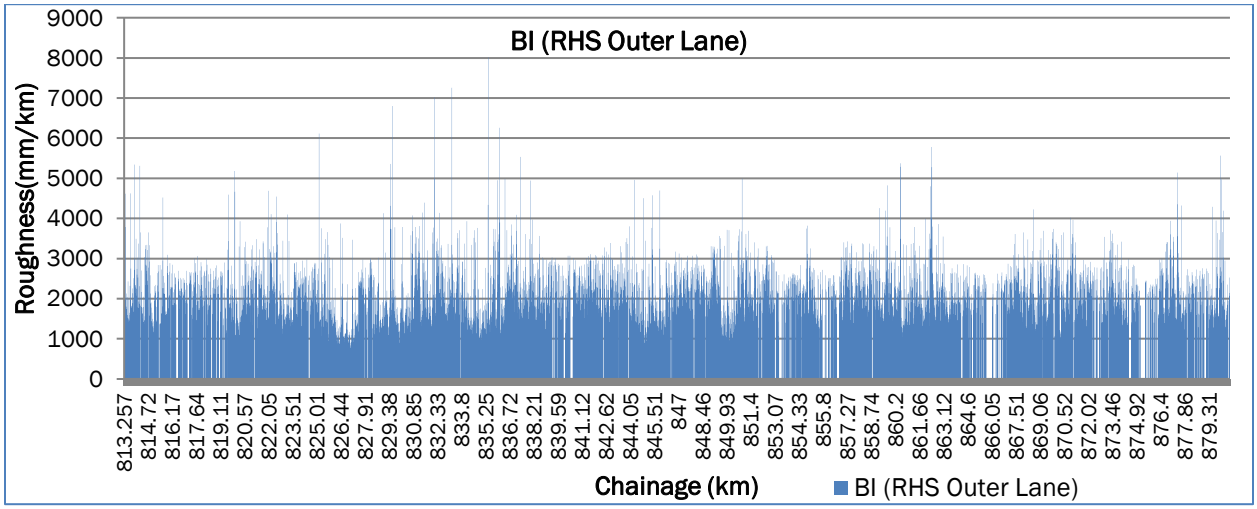
4.3 ROUGHNESS

The roughness surveys conducted along the corridor indicate fair to average riding quality over the length of project corridor. Bar diagrams showing the Kilometer wise roughness along the project road are presented below:









Based on the above, considering the Km-stone reference system the summary of Lane-km having varying roughness values are as presented below.

>=Roughness (mm/km)	<Roughness (mm/km)	LHS Inner (Lane Km)	LHS Outer (Lane Km)	RHS Inner (Lane Km)	RHS Outer (Lane Km)	TOTAL (Lane Km)
	2200	37.76	43.16	33.06	37.66	151.64
2200	2400	4.51	3.66	5.64	4.86	18.67
2400	3000	10.19	7.88	11.29	9.87	39.23
3000		12.09	10.15	13.49	11.22	46.95

An alternate exercise with moving average method has been adopted considering 10m point interval roughness data. With this criteria, considering roughness threshold limit (<2200mm/km), the combined lane-km lengths with varying roughness values are as presented below.

>=Roughness (mm/km)	<Roughness (mm/km)	LHS Inner & Outer (Lane Km)	RHS Inner & Outer (Lane Km)
	2200	81.3	70.5
2200	2400	8.1	10.4
2400		24.4	24.8
Lengths for rectification considered		36.29	13.55

By attending the rectification of 36.29 lane-km length in LHS, at identified locations, the roughness values can bring down to required threshold value(<2200m/km) by considering moving average method for roughness values in km-length. However, still there will be accumulated length of 24.4 lane-km at scattered points having roughness higher than threshold value (>2400m/km) and these values may have no impact and nullified while considering average in a km-length.

Similarly in RHS, by attending the rectification of 13.55 lane-km length at identified locations, the roughness values can bring down to required threshold value(<2200m/km) by considering moving average method for roughness values in km-length. However, still there will be accumulated length of 24.8 lane-km at scattered points having roughness higher than threshold value (>2400m/km) and these values may have no impact and nullified while considering average in a km-length.

4.4 FWD ANALYSIS

4.4.1 Flexural strength of Concrete Rigid Pavement (Rigid)

FWD deflections shall be measured and recorded for radial distances at 0 mm, 300 mm, 600 mm and 900 mm from the center of loading point.

The area parameter of deflection basin should be calculated using the equation 2 of IRC 117-2014.

From area of deflection basin, Radius of relative stiffness (l) can be evaluated from the charts. The excel sheet provided with the guidelines used to get the value of Radius of relative stiffness (l).

After finding the Radius of relative stiffness, normalized deflections (d) are calculated using various equations formed from the charts. The excel sheet directly gives the values of the normalized deflections.

Subgrade modulus values can be found by using the equation 3 of IRC 117-2014 for different normalized deflections and average of all should be taken as subgrade modulus.

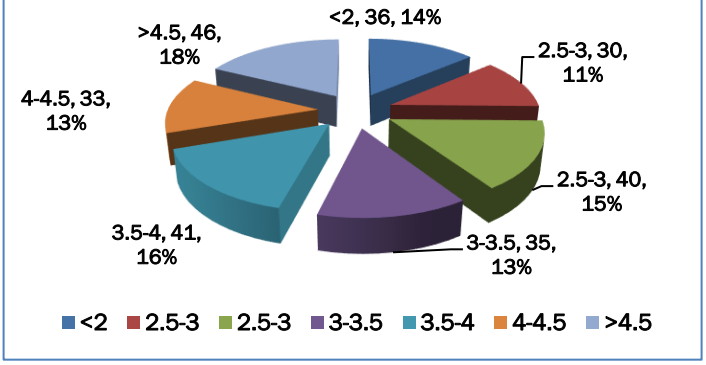
Elastic Modulus (MPa) of concrete can be found by using the equation 4 of IRC 117-2014.

Strength of the concrete and Flexural strength can be determined from the value of Ec from the equation 5 & 6 of IRC 117-2014.

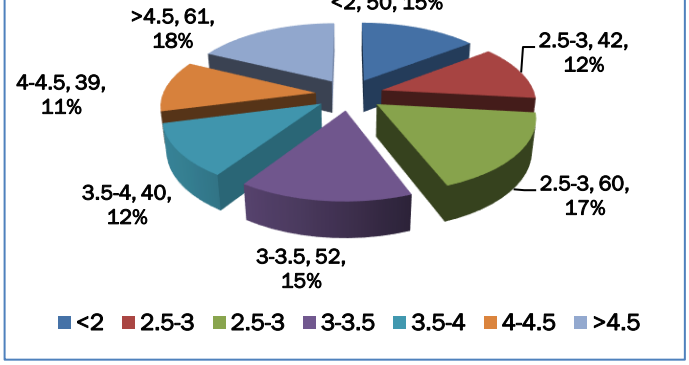
The fck values calculated for the rigid pavement are presented in **Appendix-3** of the report.

Table 33: FWD Data – Summary of Homogenous Section – LHS & RHS

Flexural strength (Mpa) CW		
Range	**LHS**	**RHS**
<2	36	50
2-3	30	42
2.5-3	40	60
3-3.5	35	52
3.5-4	41	40
4-4.5	33	39
>4.5	46	61
Total	261	344



RKJL-PKG-4



RKJL-PKG-4

Flexural Strength of the PQC estimated from FWD Surveys indicates that:

a) More than 18% of samples in LHS Carriageway and 18% of samples in RHS Carriageway are having values greater than 4.5 Mpa.

b) 13% of samples in LHS Carriageway and 11% of samples in RHS Carriageway are having values between 4 – 4.5 MPa.

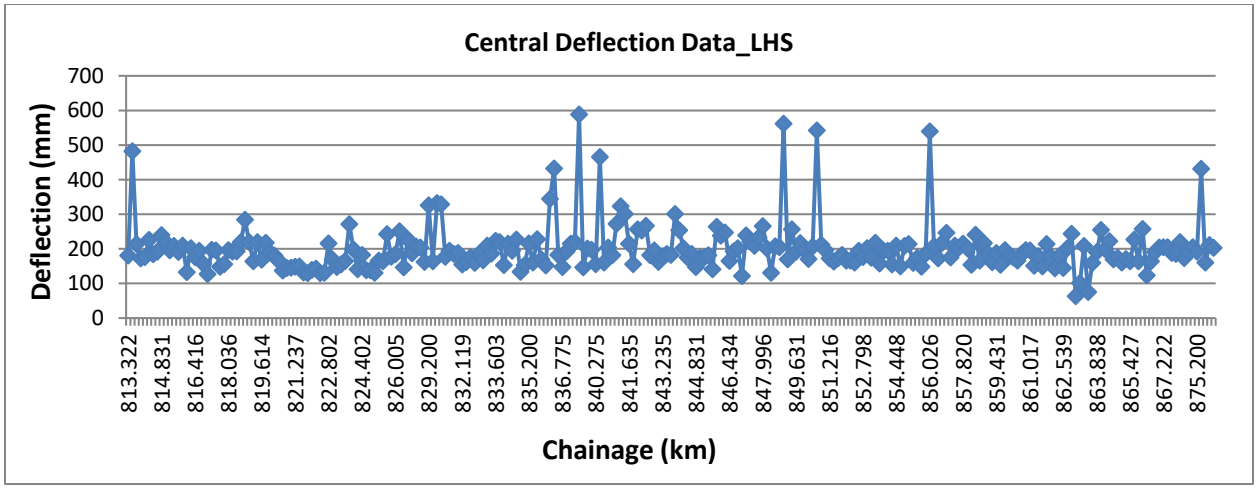
c) 16% of samples in LHS Carriageway and 12% of samples in RHS Carriageway are having values between 3.5 – 4.0 Mpa.

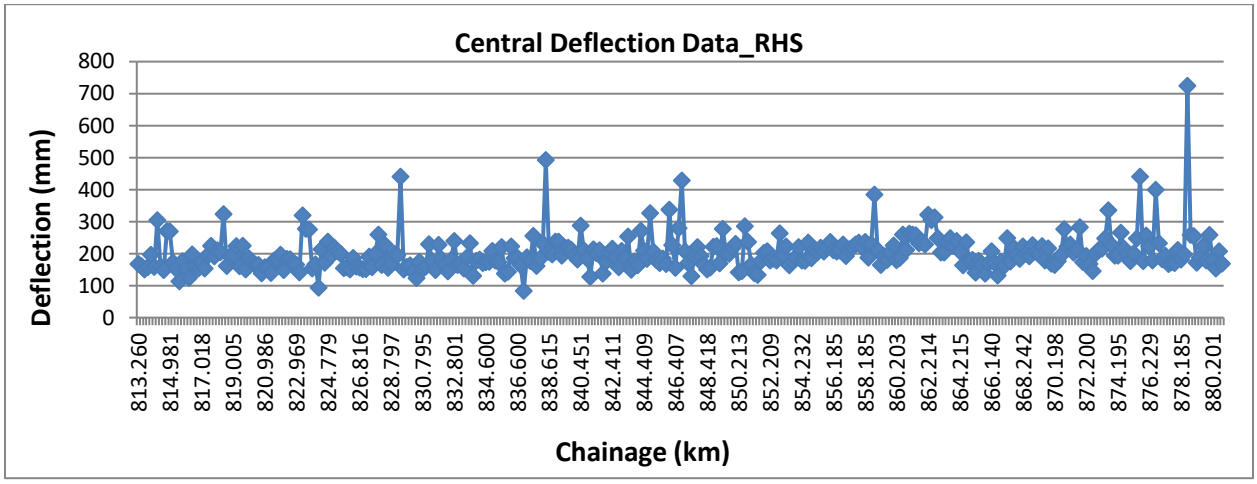
d) 13% of samples in LHS Carriageway and 15% of samples in RHS Carriageway are having values between 3 – 3.5 Mpa.

e) 40% of samples in LHS Carriageway and 44% of samples in RHS Carriageway are having values less than 3 Mpa.

4.4.2 Detection of Voids underneath the Rigid Pavement

- Deflection of Voids below a pavement slab can be easily be done by a FWD. Deflections are measured along the wheel path and a plot of central deflections versus distance has to be made.
- The locations where the deflections are much higher than the normal may indicate presence of voids. Sample is shown in below





From the above graph, voids underneath the pavement are identified as 28 points in LHS, 40 points in RHS. For quantification, every point is considered for 150m length in lane width.

4.4.3 FWD ANALYSIS AND ASSESSMENT OF OVERLAY REQUIREMENT (Flexible)

The FWD data collected has been analyzed as per IRC-115 guidelines with the suggested ranges for in-service pavements

- Subgrade Modulus---------- -- 5 CBR to 20 CBR
- Granular Layer Modulus---------- - 100 Mpa to 500 MPa
- Bituminous Layers –Thick without distress --- 750 Mpa to 3000 MPa
- Bituminous Layers in distressed condition----- 400 Mpa to 1500 MPa

The above suggested ranges for guidance only and pavement engineer shall use his judgment based on available data while fixing the above ranges. By looking at the age and condition and performance of the pavement following different set of ranges have been used while finalizing the modulus values:

Layer	Bituminous Layers	Granular Layer Modulus	Subgrade
Modulus Value (MPa)	750-3000	100-500	50-100

Bituminous layer Moduli obtained from back calculations shall be corrected for a standard pavement temperature of 35ºC using given equations. Whereas, for back calculated moduli values obtained for granular and subgrade layer shall be corrected for seasonal variations (using winter and summer equations). As FWD tests, performed, during the monsoon, no seasonal correction factor is applied for granular and subgrade layer. The design moduli (15th percentile moduli) of in-service layers for each homogenous section are given in table below.

Table 34: Summary of Design Moduli of different layers – LHS CW

Sl. No	From (km)	To (km)	Length (km)	Pavement type	15th Percentile MR values, MPa		
					MR for BT	MR for Granular	MR for Subgrade
1	826.89	828.58	1.7	Flexible	2344	391	87
2	828.58	829.60	1.0	Rigid			
3	829.60	830.71	1.1	Flexible			
4	830.71	837.35	6.6	Rigid			
5	837.35	838.60	1.3	Flexible	2385	390	87
6	838.60	867.40	28.8	Rigid			
7	867.40	868.40	1.0	Flexible			
8	868.40	872.03	3.6	Flexible	2330	361	87
9	872.03	873.07	1.0	Rigid			
10	873.07	874.95	1.9	Flexible	2656	392	87
11	874.95	876.05	1.1	Rigid			
12	876.05	876.62	0.6	Flexible			
13	876.62	880.60	4.0	Flexible	2636	391	87

Observations on FWD Results

It can be noticed from the above table that the layer moduli for the three layers are varying along the length and direction. The MR value for BT layer is 2330 MPa to 2656 MPa in LHS Carriageway.

The MR value for Granular Layers is 361 MPa to 392 MPa in LHS Carriageway. Similarly, the MR value for Subgrade Layer is 87 MPa in LHS Carriageway.

4.5 PAVEMENT COMPOSITION

a) Main Carriageway Crust

	PQC (mm)	DLC (mm)	GSB (mm)	Total (mm)
Average	310	150	150	610
Minimum	280	120	120	555
Maximum	340	180	250	710

4.6 CORE STRENGTH

The core strength of the samples is presented below.

S No.	Chainage	SIDE	Core ID	Corrected Strength of core	Equivalent Cube Strength (N/mm^2)	F_{ck} / 0.7*SQRT(B)	REMARK
				A	B = 1.25*A		
1	866+400	RHS	RJ- C-1	34.76	43.45	4.61	Outer
2	848+800	RHS	RJ- C-2	25.31	31.64	3.94	Inner
3	828+800	RHS	RJ-C-3	34.4	43.0	4.59	Outer
4	813+500	LHS	RJ-C-4	33.0	41.2	4.49	Outer
5	853+000	LHS	RJ- C-6	36.16	45.20	4.71	Outer
6	843+800	RHS	RJ-C-7	28.0	35.1	4.14	Inner
7	833+050	LHS	RJ- C-8	23.82	29.78	3.82	Inner
8	825+100	LHS	RJ-C-9	29.3	36.7	4.24	Inner

Majority of above core strength results showing more than 4.0 fck,

Sl.No.	Chainage	SIDE	Core Fck, MPa		FWD point, Chainage	FWD Fck MPa
23	**813+500**	**LHS**	**4.49**		**813+600**	**3.29**
24	**853+000**	**LHS**	**4.71**		**853+000**	**2.59**
25	**833+050**	**LHS**	**3.82**		**833+000**	**2.78**
26	**825+100**	**LHS**	**4.24**		**825+100**	**3.63**
27	**866+400**	**RHS**	**4.61**		**866+400**	**2.95**
28	**848+800**	**RHS**	**3.94**		**848+800**	**2.96**
29	**828+800**	**RHS**	**4.59**		**828+800**	**5.89**
30	**843+800**	**RHS**	**4.14**		**843+800**	**2.84**

- Fck values at same chainage are compared above with Cores Vs FWD,
- it is prudent to increase about 30% fck values obtained through FWD survey

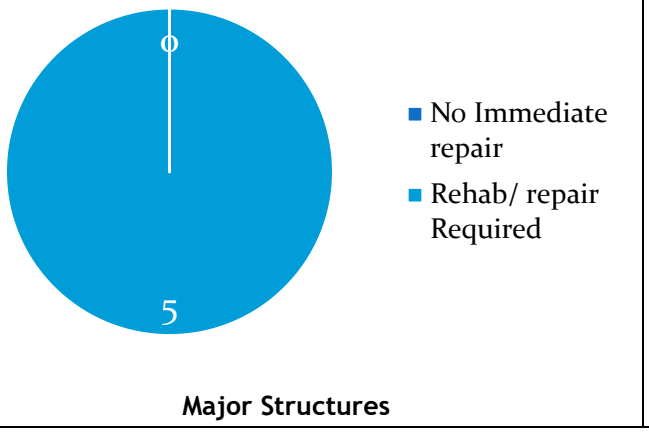
Accordingly, FWD-fck values has been increased by 30%. Further fck values less than 3 MPa fck were considered for rehabilitation in MMR.

4.7 STRUCTURES

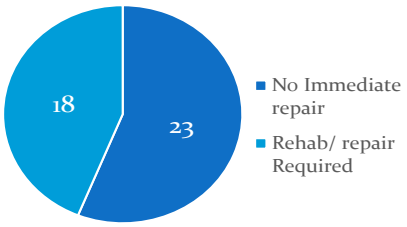
Inventory and asset condition of all the existing structures falling within project road have been verified as per IRC: SP-35 procedures and guidelines with following field surveys

- Inventory of existing highway bridges / structures
- MBIU/Visual condition survey of existing highway bridges / structures

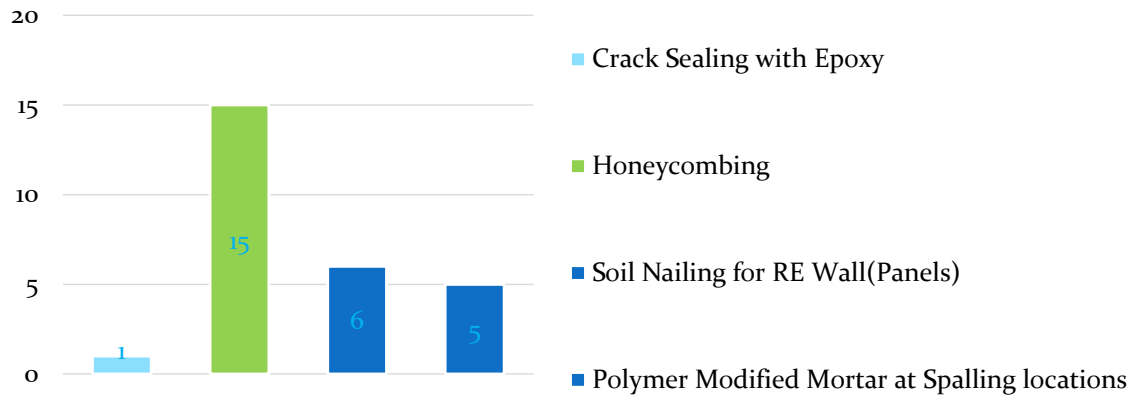
Detailed Inventory of all the structures is presented in **Appendix 8** of this report.



Major Structures



Minor Structures



Rectification of structural Distress in terms of number of locations

List of Bridges found during the inventory surveys along the corridor are as follows

Summary of Structures

S. No	Type of Str	Structures (Nos.)			Total Structures (Nos.)	Total Locations (Nos.)
		LHS	RHS	BHS		
1	ROB	1	1	-	2	**1**
2	MJB	2	2	-	4	**2**
3	MNB	30	29	-	59	**23**
4	Flyover	5	4	-	9	**6**
5	VUP	4	4	-	8	**4**
6	LVUP	3	3	-	6	**3**
7	SVUP	3	3	-	6	**3**
8	PUP	4	4	-	8	**4**
9	BC	-	-	21	21	**21**
10	PC	-	-	133	133	**133**

Age of Structures

S. No	Type of Str	LHS (Nos.)		RHS (Nos.)		BHS (Nos.)		Total (Nos)		Total Structures (Nos.)
		Old	New	Old	New	Old	New	Old	New	
1	ROB	1	0	-	1	-	-	1	1	**2**
2	MJB	-	2	-	2	-	-	-	4	**4**
3	MNB	6	24	5	24	-	-	11	48	**59**
4	Flyover	-	5	-	4	-	-	-	9	**9**
5	VUP	-	4	-	4	-	-	-	8	**8**
6	LVUP	-	3	-	3	-	-	-	6	**6**
7	SVUP	-	3	-	3	-	-	-	6	**6**
8	PUP	-	4	-	4	-	-	-	8	**8**
9	BC	-	-	-	0	-	21	-	21	**21**
10	PC	-	-	-	0	-	133	-	133	**133**

Summary of Expansion Joint & Bearings

S. No	Type of Structure	Expansion Joints (Nos.)		Bearings (Nos.)			
				Pot PTFE		Elastomeric	
		Old	New	Old	New	Old	New
1	ROB	2	2	-	10	8	-
2	MJB	-	22	-	-	-	144
3	MNB	-	6	-	-	-	24
4	Flyover	-	23	-	-	-	136
TOTAL		**2**	**53**	-	**10**	**8**	**304**
		55		**10**		**312**	
				322			

Summary of Super Structures

S. No	Type of Str	RCC Box (Nos.)	PSC Girder (Nos.)	RCC Girder (Nos.)	RCC Slab (Nos.)	RCC Girder & PSC Girder (Nos.)	Total Structures (Nos.)
1	ROB	-	1	1	-	-	2
2	MJB	-	4	-	-	-	4
3	MNB	46	-	3	10	-	59
4	Flyover	-	1	-	-	5	6
5	VUP	4	-	-	-	-	4
6	PUP	8	-	-	-	-	8

Summary of Sub Structures

S. No	Type of Str	ABUTMENT (Nos.)			PIER (Nos.)	
		Wall Type	Twin Circular	Circular Type	Wall Type	Circular Type
1	ROB	1	1	-	-	-
2	MJB	4	-	-	4	-
3	MNB	59	-	-	24	-
4	Flyover	-	-	6	-	6
5	VUP	4	-	-	-	-
6	PUP	8		-	-	-

Details of Major Bridges

S.No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
1	No	839+656	MJB	LHS	MCW	New	6 x 30	12.5	Pile	Wall Type	Wall Type	PSC Girder	Elastomeric
2	No	839+656	MJB	RHS	MCW	New	6 x 30	12.5	Pile	Wall Type	Wall Type	PSC Girder	Elastomeric
3	No	866+244	MJB	LHS	MCW	New	3 x 30	12.5	Pile	Wall Type	Wall Type	PSC Girder	Elastomeric
4	No	866+244	MJB	RHS	MCW	New	3 x 30	12.5	Pile	Wall Type	Wall Type	PSC Girder	Elastomeric

Details of Minor Bridges

S.No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Super structure	Type of Bearings
										Abutment	Pier		
1	Yes	814+245	MNB	LHS	MCW	New	1 x 7	16.5	Raft	Wall Type	-	RCC Box	-
2	Yes	814+245	MNB	RHS	MCW	New	1 x 7	16.5	Raft	Wall Type	-	RCC Box	-
3	Yes	815+381	MNB	LHS	MCW	New	1 x 7	12.5	Raft	Wall Type	-	RCC Box	-
4	Yes	815+381	MNB	RHS	MCW	New	1 x 7	16	Raft	Wall Type	-	RCC Box	-
5	No	816+471	MNB	LHS	MCW	New	1 x 7.5	12.5	Raft	Wall Type	-	RCC Box	-
6	No	816+471	MNB	RHS	MCW	Old	1 x 8.3	12.5	Open	Wall Type	-	RCC Slab	-
7	No	824+524	MNB	LHS	MCW	New	2 x 10	12.5	Raft	Wall Type	Wall Type	RCC Box	-
8	No	824+524	MNB	RHS	MCW	Old	2 x 8.5	12.5	Open	Wall Type	Wall Type	RCC Slab	-
9	Yes	825+052	MNB	LHS	MCW	New	3 x 11	12.5	Raft	Wall Type	Wall Type	RCC Box	-
10	Yes	825+052	MNB	RHS	MCW	New	3 x 11	12.5	Raft	Wall Type	Wall Type	RCC Box	-
11	Yes	828+091	MNB	LHS	SR	New	3 x 12.5	10.75	Raft	Wall Type	-	RCC Box	-
12	Yes	828+091	MNB	LHS	MCW	Old	3 x 12.5	12.5	Raft	Wall Type	-	RCC Box	-
13	Yes	828+091	MNB	RHS	MCW	New	3 x 12.5	12.5	Raft	Wall Type	-	RCC Box	-
14	Yes	828+091	MNB	RHS	SR	New	3 x 12.5	10.5	Raft	Wall Type	-	RCC Box	-
15	No	830+758	MNB	LHS	MCW	New	3 x 11	12.5	Raft	Wall Type	Wall Type	RCC Box	-

S.No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Super structure	Type of Bearings
										Abutment	Pier		
16	No	830+758	MNB	RHS	MCW	New	3 x 11	12.5	Raft	Wall Type	Wall Type	RCC Box	-
17	Yes	832+204	MNB	LHS	MCW	New	1 x 8	12.5	Raft	Wall Type	-	RCC Box	-
18	Yes	832+204	MNB	RHS	MCW	New	1 x 8	12.5	Raft	Wall Type	-	RCC Box	-
19	No	834+629	MNB	LHS	MCW	New	2 x 9	12.5	Raft	Wall Type	Wall Type	RCC Box	-
20	No	834+629	MNB	RHS	MCW	New	2 x 9	12.5	Raft	Wall Type	Wall Type	RCC Box	-
21	No	840+104	MNB	LHS	MCW	New	1 x 24.2	12.5	Not Visible	Wall Type	-	RCC Girder	Elastomeric
22	No	840+104	MNB	RHS	MCW	New	1 x 24.2	12.5	Not Visible	Wall Type	-	RCC Girder	Elastomeric
23	No	842+429	MNB	LHS	MCW	New	1 x 22	12.5	Not Visible	Wall Type	-	RCC Girder	Elastomeric
24	No	842+429	MNB	RHS	MCW	Old	2 x 11	12.5	Open	Wall Type	Wall Type	RCC Slab	-
25	Yes	851+884	MNB	LHS	MCW	New	1 x 7	12.5	Raft	Wall Type	-	RCC Box	-
26	Yes	851+884	MNB	RHS	MCW	New	1 x 7	12.5	Raft	Wall Type	-	RCC Box	-
27	Yes	852+088	MNB	LHS	MCW	New	3 x 8	12.5	Raft	Wall Type	-	RCC Box	-
28	Yes	852+088	MNB	RHS	MCW	New	3 x 8	12.5	Raft	Wall Type	-	RCC Box	-
29	No	854+040	MNB	LHS	MCW	New	1 x 7	12.5	Raft	Wall Type	-	RCC Box	-
30	No	854+040	MNB	RHS	MCW	Old	1 x 7	12.5	Open	Wall Type	-	RCC Slab	-
31	Yes	855+575	MNB	LHS	SR	New	2 x 7	10.5	Raft	Wall Type	Wall Type	RCC Box	-
32	No	855+575	MNB	LHS	MCW	New	2 x 7	12.5	Raft	Wall Type	Wall Type	RCC Box	-
33	No	855+575	MNB	RHS	MCW	New	2 x 7	12.5	Raft	Wall Type	Wall Type	RCC Box	-
34	Yes	855+824	MNB	LHS	SR	New	1 x 15	10.75	Raft	Wall Type	-	RCC Box	-
35	Yes	855+824	MNB	LHS	MCW	New	1 x 15	12.5	Raft	Wall Type	-	RCC Box	-
36	Yes	855+824	MNB	RHS	MCW	New	1 x 15	12.5	Raft	Wall Type	-	RCC Box	-
37	Yes	855+824	MNB	RHS	SR	New	1 x 15	10.75	Raft	Wall Type	-	RCC Box	-
38	Yes	856+077	MNB	LHS	SR	New	1 x 12	10.75	Raft	Wall Type	-	RCC Box	-
39	Yes	856+077	MNB	LHS	MCW	New	1 x 12	12.5	Raft	Wall Type	-	RCC Box	-

S.No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Super structure	Type of Bearings
										Abutment	Pier		
40	Yes	856+077	MNB	RHS	MCW	New	1 x 12	12.5	Raft	Wall Type	-	RCC Box	-
41	Yes	856+077	MNB	RHS	SR	New	1 x 12	10.75	Raft	Wall Type	-	RCC Box	-
42	Yes	858+884	MNB	LHS	MCW	New	1 x 10	12.5	Raft	Wall Type	-	RCC Box	-
43	Yes	858+884	MNB	RHS	MCW	New	1 x 10	12.5	Raft	Wall Type	-	RCC Box	-
44	Yes	864+250	MNB	LHS	MCW	New	1 x 12	12.5	Raft	Wall Type	-	RCC Box	-
45	Yes	864+250	MNB	RHS	MCW	New	1 x 12	12.5	Raft	Wall Type	-	RCC Box	-
46	No	864+905	MNB	LHS	MCW	New	1 x 15	12.5	Raft	Wall Type	-	RCC Box	-
47	No	864+905	MNB	RHS	MCW	New	1 x 15	12.5	Raft	Wall Type	-	RCC Box	-
48	No	869+999	MNB	LHS	SR	Old	3 x 11	10.5	Open	Wall Type	Wall Type	RCC Slab	-
49	No	869+999	MNB	LHS	MCW	Old	3 x 11	12.5	Open	Wall Type	Wall Type	RCC Slab	-
50	No	869+999	MNB	RHS	MCW	New	3 x 11	12.5	Raft	Wall Type	Wall Type	RCC Box	-
51	No	869+999	MNB	RHS	SR	New	3 x 11	10.5	Raft	Wall Type	Wall Type	RCC Box	-
52	Yes	871+223	MNB	LHS	SR	Old	3 x 12.5	10.5	Open	Wall Type	Wall Type	RCC Slab	-
53	Yes	871+223	MNB	LHS	MCW	Old	3 x 12.5	12.5	Open	Wall Type	Wall Type	RCC Slab	-
54	Yes	871+223	MNB	RHS	MCW	New	3 x 12.5	12.5	Raft	Wall Type	Wall Type	RCC Box	-
55	Yes	871+223	MNB	RHS	SR	New	3 x 12.5	10.5	Raft	Wall Type	Wall Type	RCC Box	-
56	Yes	874+619	MNB	LHS	SR	New	4 x 12	10.5	Raft	Wall Type	Wall Type	RCC Box	-
57	Yes	874+619	MNB	LHS	MCW	Old	4 x 12	12.5	Open	Wall Type	Wall Type	RCC Slab	-
58	Yes	874+619	MNB	RHS	MCW	New	4 x 12	12.5	Raft	Wall Type	Wall Type	RCC Box	-
59	Yes	874+619	MNB	RHS	SR	Old	4 x 12	10.5	Open	Wall Type	Wall Type	RCC Slab	-

Details of Flyovers

S.No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Super structure	Type of Bearings
										Abutment	Pier		
1	No	827+917	Flyover	RHS	MCW	New	2 x 30	12.5	Not Visible	Circular Type	Circular Type	PSC Girder	Elastomeric
2	No	856+060	Flyover	LHS	MCW	New	1 x 21 + 1 x 30 + 1 x 21	12.5	Not Visible	Circular Type	Circular Type	RCC Girder & PSC Girder	Elastomeric
3	-	867+200	Flyover	LHS	MCW	New	1 x 15 + 1 x 30 + 1 x 15	14.5	-	-	-	-	-
4	-	869+030	Flyover	LHS	MCW	New	2 x 25	14.5	-	-	-	-	-
5	-	869+030	Flyover	RHS	MCW	New	2 x 25	14.5	-	-	-	-	-
6	No	872+780	Flyover	LHS	MCW	New	1 x 21 + 1 x 30 + 1 x 21	12.5	Not Visible	Circular Type	Circular Type	RCC Girder & PSC Girder	Elastomeric
7	No	872+780	Flyover	RHS	MCW	New	1 x 21 + 1 x 30 + 1 x 21	12.5	Not Visible	Circular Type	Circular Type	RCC Girder & PSC Girder	Elastomeric
8	No	875+680	Flyover	LHS	MCW	New	1 x 21 + 1 x 30 + 1 x 21	12.5	Not Visible	Circular Type	Circular Type	RCC Girder & PSC Girder	Elastomeric
9	No	875+680	Flyover	RHS	MCW	New	1 x 21 + 1 x 30 + 1 x 21	12.5	Not Visible	Circular Type	Circular Type	RCC Girder & PSC Girder	Elastomeric

Details of ROB's

S.No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
1	No	878+725	ROB	LHS	MCW	Old	1 x 16.1	12.5	Not Visible	Wall Type	-	RCC Girder	Elastomeric
2	No	878+725	ROB	RHS	MCW	New	1 x 37.2	12.5	Not Visible	Twin Circular	-	PSC Girder	Pot PTFE

Details of VUP's

S.No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Super structure	Remarks
										Abutment	Pier		
1	Yes	833+700	VUP	LHS	MCW	New	1 x 13	12.5	Raft	Wall Type	-	RCC Box	-
2	Yes	833+700	VUP	RHS	MCW	New	1 x 13	12.5	Raft	Wall Type	-	RCC Box	-
3	-	835+620	VUP	LHS	MCW	New	1 x 20	14.5	-	-	-	-	**Proposed as per sch-B**
4	-	835+620	VUP	RHS	MCW	New	1 x 20	14.5	-	-	-	-	
5	Yes	843+946	VUP	LHS	MCW	New	1 x 13.6	12.5	Raft	Wall Type	-	RCC Box	-
6	Yes	843+946	VUP	RHS	MCW	New	1 x 13.6	12.5	Raft	Wall Type	-	RCC Box	-
7	-	847+757	VUP	LHS	MCW	New	1 x 20	14.5	-	-	-	-	**Proposed as per sch-B**
8	-	847+757	VUP	RHS	MCW	New	1 x 20	14.5	-	-	-	-	

Details of LVUP's

S.No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Super structure	Remarks
										Abutment	Pier		
1	-	858+780	LVUP	LHS	MCW	New	1 x 12	14.5	-	-	-	-	Proposed as per sch-B
2	-	858+780	LVUP	RHS	MCW	New	1 x 12	14.5	-	-	-	-	
3	-	862+000	LVUP	LHS	MCW	New	1 x 12	14.5	-	-	-	-	
4	-	862+000	LVUP	RHS	MCW	New	1 x 12	14.5	-	-	-	-	
5	-	865+400	LVUP	LHS	MCW	New	1 x 12	14.5	-	-	-	-	
6	-	865+400	LVUP	RHS	MCW	New	1 x 12	14.5	-	-	-	-	

Details of SVUP's

S.No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
1	-	847+150	SVUP	LHS	MCW	New	1 x 7	14.5	-	-	-	-	Proposed as per sch-B
2	-	847+150	SVUP	RHS	MCW	New	1 x 7	14.5	-	-	-	-	
3	-	878+725	SVUP	LHS (A1)	MCW	New	1 x 7	19	-	-	-	-	
4	-	878+725	SVUP	RHS (A1)	MCW	New	1 x 7	19	-	-	-	-	
5	-	878+725	SVUP	LHS (A2)	MCW	New	1 x 7	19	-	-	-	-	
6	-	878+725	SVUP	RHS (A2)	MCW	New	1 x 7	19	-	-	-	-	

Details of PUP's

S.No.	Skew (Yes /No)	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
1	No	814+789	PUP	LHS	MCW	New	1 x 7	12.5	Raft	Wall Type	-	RCC Box	-
2	No	814+789	PUP	RHS	MCW	New	1 x 7	12.5	Raft	Wall Type	-	RCC Box	-
3	No	818+574	PUP	LHS	MCW	New	1 x 7	12.75	Raft	Wall Type	-	RCC Box	-
4	No	818+574	PUP	RHS	MCW	New	1 x 7	12.75	Raft	Wall Type	-	RCC Box	-
5	No	821+162	PUP	LHS	MCW	New	1 x 7	12.5	Raft	Wall Type	-	RCC Box	-
6	No	821+162	PUP	RHS	MCW	New	1 x 7	12.5	Raft	Wall Type	-	RCC Box	-
7	Yes	866+228	PUP	LHS	MCW	New	1 x 7.2	12.5	Raft	Wall Type	-	RCC Box	-
8	Yes	866+228	PUP	RHS	MCW	New	1 x 7.2	12.5	Raft	Wall Type	-	RCC Box	-

Structure Deviations with CA and Site

S.No.	Chainage		Type of Culvert As per Site	Side	Span Arrangement (No x Length)		Remarks
	As per CA	As per Site			As per CA	As per Site	
1	-	821+604	Box	BHS	-	1 x 2	Extra
2	-	832+020	Pipe	BHS	-	2 x 1.2	Extra
3	-	851+910	Pipe	BHS	-	1 x 1.2	Extra
4	-	856+755	Pipe	BHS	-	1 x 1.2	Extra
5	831+548	-	Pipe	BHS	1 x 1.2	-	Not Found
6	869+358	-	Pipe	BHS	1 x 1.0	-	Not Found
7	874+587	-	Box	BHS	1 x 5.5	-	Not Found

Deviation in Span Arrangement at following locations

S.No.	Chainage		Type of Culvert As per CA	Type of Culvert As per Site	Side	Span Arrangement (No x Length)	
	As per CA	As per Site				As per CA	As per Site
1	850+436	850+436	Box	Box	BHS	1 x 1.8	1 x 2.0
2	856+132	856+132	Box	Box	BHS	1 x 6.0	1 x 9.6
3	824+524	824+524	MNB	MNB	RHS	2 x 10	2 x 8.5
4	815+701	815+701	Pipe	Pipe	BHS	1 x 1.2	2 x 1.2
5	817+406	817+406	Pipe	Pipe	BHS	1 x 1.2	2 x 1.2
6	818+067	818+067	Pipe	Pipe	BHS	2 x 1.0	1 x 1.2
7	823+536	823+536	Pipe	Pipe	BHS	2 x 1.0	1 x 1.2
8	831+930	831+930	Pipe	Pipe	BHS	2 x 1.2	1 x 1.2
9	848+740	848+740	Pipe	Pipe	BHS	2 x 1.0	2 x 1.2
10	850+905	850+905	Pipe	Pipe	BHS	1 x 1.2	1 x 1
11	851+870	851+870	Pipe	Pipe	BHS	2 x 1.2	1 x 1.2
12	856+161	856+161	Pipe	Pipe	BHS	2 x 1.2	1 x 1.2
13	878+725	878+725	ROB	ROB	LHS	1 x 15	1 x 16.1
14	878+725	878+725	ROB	ROB	RHS	1 x 36	1 x 37.2

Culverts Inventory

Sl No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Str. Proposal As per Sch-B	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
							LHS	RHS	LHS	RHS	
1	814+034	Pipe	BHS	-	2 x 1.2	40	Yes	Yes	Yes	Yes	> Culvert is fully covered with bushes. > Quadrant pitching is in fair condition.
2	814+090	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Culvert is fully covered with bushes. > Quadrant pitching is in fair condition.
3	814+310	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Culvert is fully covered with bushes. > Quadrant pitching is in fair condition.
4	814+358	Box	BHS	-	1 x 4.0	33	Yes	Yes	Yes	Yes	> Culvert is in fair condition. > Quadrant pitching is in fair condition.
5	814+589	Pipe	BHS	-	1 x 1.2	42.5	Yes	Yes	Yes	Yes	> Culverts fully covered with bushes. > Quadrant pitching is in fair condition.
6	814+722	Pipe	BHS	-	2 x 1.2	55	Yes	Yes	Yes	Yes	> Culvert is fully covered with bushes. > Quadrant pitching is in fair condition.
7	814+800	Pipe	RHS	New	1 x 1.2	-	-	-	-	-	> New culvert is proposed at RHS service road as per Schedule-B.
8	814+923	Box	BHS	-	1 x 2.0	60	No	No	No	No	> Quadrant pitching not provided at BHS. > Culvert is in fair condition.
9	815+090	Pipe	BHS	-	1 x 1.2	60	Yes	Yes	Yes	Yes	> Quadrant pitching is covered by debris.

Sl No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Str. Proposal As per Sch-B	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
							LHS	RHS	LHS	RHS	
											> Culvert is in fair condition.
10	815+433	Box	BHS	Widening	1 x 3.1	31.3	Yes	Yes	Yes	Yes	> Quadrant pitching is in fair condition. > Culvert is in fair condition.
11	815+701	Pipe	BHS	Widening	2 x 1.2	37.5	Yes	Yes	Yes	Yes	> Quadrant pitching is in fair condition. > Culvert is fully covered with bushes.
12	817+406	Pipe	BHS	-	2 x 1.2	37.5	Yes	Yes	Yes	Yes	> Culvert is fully covered with bushes. > Quadrant pitching is in fair condition.
13	818+067	Pipe	BHS	-	1 x 1.2	30	Yes	Yes	Yes	Yes	> Culvert is in fair condition. > Quadrant pitching is in fair condition.
14	818+189	Pipe	BHS	-	2 x 1.0	30	Yes	Yes	Yes	Yes	> Culvert is in fair condition. > Quadrant pitching is in fair condition.
15	818+468	Pipe	BHS	Widening	2 x 1.0	42.5	Yes	Yes	Yes	Yes	> Quadrant pitching is in fair condition. > Culvert is fully covered with bushes.
16	818+518	Pipe	BHS	Widening	1 x 1.0	47.5	Yes	Yes	Yes	Yes	> Quadrant pitching is in fair condition. > Culvert is fully covered with bushes.
17	818+797	Pipe	BHS	Widening	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Culvert is fully covered with bushes at LHS. > Quadrant pitching is in fair condition.

Sl No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Str. Proposal As per Sch-B	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
							LHS	RHS	LHS	RHS	
18	819+375	Pipe	BHS	-	3 x 1.2	45	Yes	Yes	Yes	Yes	> Culvert is fully covered with bushes at LHS. > Quadrant pitching not visible at LHS.
19	819+881	Pipe	BHS	-	2 x 1.0	37.5	Yes	Yes	Yes	Yes	> Quadrant pitching is in fair condition. > Culvert is fully covered with bushes at RHS.
20	820+473	Pipe	BHS	-	1 x 1.2	45	Yes	Yes	Yes	Yes	> Quadrant pitching is in fair condition. > Culvert is fully covered with bushes at BHS.
21	820+548	Pipe	BHS	-	1 x 1.2	42.5	Yes	Yes	Yes	Yes	> Quadrant pitching is in fair condition. > Culvert is in fair condition.
22	820+606	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Quadrant pitching is in fair condition. > Culvert is in fair condition.
23	820+745	Pipe	BHS	-	1 x 1.2	42.5	Yes	Yes	Yes	Yes	> Quadrant pitching is in fair condition. > Culvert is in fair condition.
24	821+241	Pipe	BHS	-	1 x 1.2	50	Yes	Yes	Yes	Yes	> Quadrant pitching is in fair condition. > Culvert is in fair condition.
25	821+455	Pipe	BHS	-	1 x 1.2	45	Yes	Yes	Yes	Yes	> Culvert is fully covered with bushes. > Quadrant pitching is in fair condition.
26	821+604	Box	BHS	Extra	1 x 2	40	Yes	Yes	Yes	Yes	> Quadrant pitching is in fair condition.> Culvert is in fair condition.

Sl No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Str. Proposal As per Sch-B	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
							LHS	RHS	LHS	RHS	
27	821+624	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Culvert is fully covered with bushes. > Quadrant pitching is in fair condition.
28	821+846	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Culvert is in fair condition at RHS. > Quadrant pitching is in fair condition. > Culvert is fully covered with bushes at LHS
29	822+427	Pipe	BHS	-	2 x 1.2	37.5	Yes	Yes	Yes	Yes	> Culvert is in fair condition. > Quadrant pitching is in fair condition.
30	822+745	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Culvert is fully covered with bushes. > Quadrant pitching is in fair condition.
31	823+536	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Culvert is fully covered with bushes. > Quadrant pitching is in fair condition. > Debris observed at RHS.
32	825+368	Box	BHS	-	1 x 3.0	29	Yes	Yes	Yes	Yes	> Parapet wall damaged at LHS A1. > Structure is in fair condition. > Quadrant pitching is in fair condition.
33	825+494	Pipe	BHS	-	1 x 1.0	40	Yes	Yes	Yes	Yes	> Structure is fully covered with bushes. > Quadrant pitching is in fair condition.
34	826+076	Box	BHS	-	1 x 4.0	31	Yes	Yes	Yes	Yes	> Culvert is in fair condition. > Quadrant

Sl No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Str. Proposal As per Sch-B	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
							LHS	RHS	LHS	RHS	
											pitching is in fair condition.
35	826+530	Pipe	BHS	-	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Structure is fully covered with bushes and debris. > Quadrant pitching is in fair condition.
36	827+290	Pipe	BHS	-	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Structure is in fair condition. > Quadrant pitching is in fair condition.
37	827+737	Pipe	BHS	-	1 x 1.2	52.5	No	Yes	No	Yes	> Head wall is not constructed at LHS service road. > Quadrant pitching is not provided at LHS service road. > Pipe damage is observed on LHS SR. > Culvert and quadrant pitching is in fair condition at RHS.
38	828+585	Box	BHS	-	1 x 3.0	36.5	No	No	Yes	Yes	> Quadrant pitching is in fair condition. > Floor protection not provided at BHS. > Culvert is in fair condition.
39	829+472	Pipe	BHS	-	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Culvert is fully covered with bushes. > Quadrant pitching is in fair condition.
40	830+254	Pipe	BHS	-	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Culvert is in fair condition. > Quadrant pitching is in fair condition.
41	830+601	Pipe	BHS	-	3 x 1.2	42.5	Yes	Yes	Yes	Yes	> Culvert is in fair condition.

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							LHS	RHS	LHS	RHS	
											> Quadrant pitching is in fair condition.
42	830+930	Pipe	BHS	-	1 x 1.2	42.5	No	No	Yes	Yes	> Structure is in fair condition. > Quadrant pitching is in fair condition. > Floor protection not provided.
43	830+985	Pipe	BHS	-	1 x 1.2	40	No	No	Yes	Yes	> Structure is in fair condition. > Quadrant pitching is in fair condition. > Floor protection not provided.
44	831+035	Pipe	BHS	-	1 x 1.2	35	No	No	Yes	Yes	> Structure is in fair condition. > Quadrant pitching is in fair condition. > Floor protection not provided.
45	831+290	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Structure is fully covered with bushes. > Quadrant pitching is in fair condition.
46	831+548	Pipe	BHS	-	1 x 1.2	-	-	-	-	-	> Culvert not found at site.
47	831+556	Box	BHS	-	1 x 2.0	32.5	Yes	Yes	Yes	Yes	> Structure is in fair condition.> Quadrant pitching is in fair condition.
48	831+729	Pipe	BHS	-	1 x 1.2	37.5	No	No	Yes	Yes	> Structure is in fair condition. > Quadrant pitching is in fair condition. > Floor protection not provided.
49	831+930	Pipe	BHS	-	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Culvert is fully covered with bushes. > Quadrant pitching is in fair condition.

Sl No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Str. Proposal As per Sch-B	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
							LHS	RHS	LHS	RHS	
50	832+020	Pipe	BHS	Extra	2 x 1.2	37.5	Yes	Yes	Yes	Yes	> Structure is in fair condition. > Quadrant pitching is in fair condition.
51	832+265	Pipe	BHS	-	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Structure is in fair condition. > Quadrant pitching is in fair condition.
52	832+513	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Structure is in fair condition. > Quadrant pitching is in fair condition.
53	833+345	Pipe	BHS	-	1 x 1.2	60	Yes	No	Yes	No	> Quadrant pitching is not provided at RHS service road. > Culvert is in fair condition.
54	833+911	Pipe	BHS	-	1 x 1.2	60	NA	NA	NA	NA	> Culvert is fully covered with bushes. > Quadrant pitching is not applicable on BHS as drain is present at BHS.
55	834+267	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Structure and quadrant pitching are in fair condition.
56	834+682	Box	BHS	-	1 x 2.0	45	Yes	Yes	Yes	Yes	> Structure and quadrant pitching are in fair condition.
57	835+396	Box	BHS	Reconstruction	1 x 2.0	33	Yes	Yes	Yes	Yes	> Structure and quadrant pitching are in fair condition.
58	836+066	Pipe	BHS	Widening	1 x 1.0	35	Yes	Yes	Yes	Yes	> Quadrant pitching is covered by bushes at LHS. > Chamber is provided at RHS.
59	836+613	Box	BHS	Widening	1 x 3.0	31.5	Yes	Yes	Yes	Yes	> Quadrant pitching is covered by

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							LHS	RHS	LHS	RHS	
											bushes at BHS. > Structure is in fair condition.
60	837+582	Pipe	BHS	-	1 x 1.0	37.5	Yes	Yes	Yes	Yes	> Quadrant pitching is covered by bushes at BHS. > Structure is in fair condition.
61	839+048	Pipe	BHS	-	2 x 1.2	40	Yes	Yes	Yes	Yes	> Structure and quadrants are covered by bushes at LHS. > Quadrants and floor protection are in fair condition at RHS.
62	840+318	Pipe	BHS	-	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Quadrant pitching is covered by bushes at BHS. > Structure is in fair condition.
63	840+785	Pipe	BHS	-	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Quadrant pitching is covered by bushes at BHS. > Debris are present at RHS. > Structure is in fair condition.
64	841+447	Pipe	BHS	-	2 x 1.0	40	Yes	Yes	Yes	Yes	> Quadrant pitching and structure are covered by bushes at BHS. > Structure is in fair condition.
65	841+650	Pipe	BHS	-	2 x 1.0	40	Yes	Yes	Yes	Yes	> Quadrant pitching is covered by bushes at BHS. > Structure is in fair condition.
66	841+901	Pipe	BHS	-	2 x 1.0	42.5	Yes	Yes	Yes	Yes	> Quadrant pitching and structure are covered by bushes at BHS.

Sl No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Str. Proposal As per Sch-B	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
							LHS	RHS	LHS	RHS	
67	843+295	Pipe	BHS	-	1 x 1.0	35	Yes	Yes	Yes	Yes	> Structure is in fair condition at BHS. > Lined canal is present at BHS.
68	843+469	Pipe	BHS	-	1 x 1.2	45	Yes	Yes	Yes	Yes	> Structure is in fair condition. > Quadrant pitching is partially covered by bushes.
69	843+704	Pipe	BHS	-	1 x 1.2	50	Yes	Yes	Yes	Yes	> Culvert is covered by bushes at BHS.
70	844+039	Pipe	BHS	-	1 x 1.2	55	Yes	Yes	Yes	Yes	> Culvert is in fair condition at LHS. > RHS fully covered with bushes.
71	844+243	Pipe	BHS	-	2 x 1.2	40	Yes	Yes	Yes	Yes	> Quadrant pitching is covered by bushes at BHS. > Structure is in fair condition.
72	844+597	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Structure is in fair condition.
73	845+232	Box	BHS	-	1 x 2.0	45	No	No	No	No	> Quadrant pitching not provided at BHS. > Parapet wall not constructed at BHS > Culvert is in fair condition.
74	845+443	Pipe	BHS	-	1 x 1.2	45	Yes	Yes	Yes	Yes	> Quadrant pitching is fully covered with bushes at BHS. > Pipe is in fair condition.
75	845+614	Pipe	BHS	-	2 x 1.2	42.5	Yes	Yes	Yes	Yes	> Chamber is being construed at LHS. > Culvert is in fair condition at RHS.
76	845+739	Pipe	BHS	-	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Quadrant pitching is fully covered with bushes at BHS.

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							LHS	RHS	LHS	RHS	
											>Vegetation growth is observed on head wall at BHS.
77	845+879	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Quadrant pitching is fully covered with bushes at BHS. > Pipe is in fair condition.
78	846+482	Pipe	BHS	-	2 x 1.2	40	Yes	Yes	Yes	Yes	> Quadrant pitching is covered with bushes at BHS. > Pipe is in fair condition.
79	847+408	Pipe	BHS	-	2 x 1.0	55	Yes	NA	Yes	NA	> Quadrant pitching is not applicable as drain is present. > Pipe is in fair condition.
80	847+540	Pipe	BHS	-	1 x 1.2	55	Yes	Yes	Yes	Yes	> Quadrant pitching is present at A1 side only and A2 side drain is present. > Quadrant pitching is fully covered with vegetation at LHS. > Pipe is in fair condition.
81	847+980	Pipe	BHS	-	1 x 1.2	55	Yes	Yes	Yes	Yes	> Quadrant pitching is covered by bushes at LHS. > Structure is in fair condition at RHS.
82	848+547	Pipe	BHS	-	2 x 1.2	42.5	Yes	Yes	Yes	Yes	> Quadrant pitching is covered by bushes at BHS. > Structure is in fair condition.
83	848+740	Pipe	BHS	-	2 x 1.2	42.5	Yes	Yes	Yes	Yes	> Quadrant pitching is covered by

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							LHS	RHS	LHS	RHS	
											bushes at BHS. > Pipes are partially clogged with mud.
84	849+583	Pipe	BHS	Widening	2 x 1.0	45	Yes	Yes	Yes	Yes	> Quadrant pitching is covered by bushes at BHS. > Structure is in fair condition.
85	850+400	Box	BHS	New	1 x 4.0	-	-	-	-	-	> New Construction with height of 2.5 m to be used as Pedestrian Underpass
86	850+436	Box	BHS	Reconstruction	1 x 2.0	32.5	Yes	Yes	Yes	Yes	> At RHS existing slab is widened with box type structure. > At LHS Box type structure is present. > Median is open to sky.
87	850+649	Pipe	BHS	Widening	2 x 1.2	40	Yes	Yes	Yes	Yes	> Quadrant pitching is covered by bushes at BHS. > Structure is in fair condition.
88	850+905	Pipe	BHS	Widening	1 x 1	42.5	Yes	Yes	Yes	Yes	> Quadrant pitching is covered by bushes at BHS. > Structure is in fair condition.
89	851+338	Pipe	BHS	-	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Quadrant pitching and vent way are covered by bushes at BHS. >Pipe is in fair condition.
90	851+512	Pipe	BHS	-	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Quadrant pitching is covered by bushes at BHS. > Structure is in fair condition.

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							LHS	RHS	LHS	RHS	
91	851+693	Pipe	BHS	-	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Pipe is in fair condition.
92	851+870	Pipe	BHS	-	1 x 1.2	55	Yes	Yes	Yes	Yes	> Structure is covered by bushes at BHS. > Structure is in fair condition.
93	851+910	Pipe	BHS	Extra	1 x 1.2	52.5	Yes	Yes	Yes	Yes	> Extra culvert found at site. > Cracks are observed on head wall and pipe at RHS. > Structure is in fair condition at LHS.
94	852+197	Pipe	BHS	-	1 x 1.2	35	Yes	Yes	Yes	Yes	> Debris are present at LHS.> Bushes are present at RHS.> Quadrant pitching is in fair condition.
95	852+401	Pipe	BHS	-	1 x 1.2	40	Yes	Yes	Yes	Yes	> Structure is in fair condition.
96	852+970	Pipe	BHS	-	1 x 1.2	35	Yes	Yes	Yes	Yes	> Structure is in fair condition.
97	853+350	Pipe	BHS	Widening	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Structure is in fair condition.
98	853+387	Box	BHS	Widening	1 x 3	37.5	Yes	Yes	Yes	Yes	> Structure is in fair condition.
99	853+654	Pipe	BHS	Widening	1 x 1.2	25	Yes	Yes	Yes	Yes	> Structure is covered by bushes at BHS. > Quadrant pitching is in fair condition.
100	855+225	Box	BHS	Widening	1 x 4.2	34	Yes	Yes	Yes	Yes	> At LHS slab is widened by 2.25 m with box type structure. > Structure is in fair condition at BHS.
101	856+132	Box	BHS	-	1 x 9.6	44.5	Yes	Yes	Yes	Yes	> Structure is in fair condition at BHS. > Debris are present in vent way.

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							LHS	RHS	LHS	RHS	
											> Quadrant pitching is in fair condition.
102	856+161	Pipe	BHS	-	1 x 1.2	45	Yes	Yes	Yes	Yes	> Structure is in fair condition.
103	856+755	Pipe	BHS	Extra	1 x 1.2	40	Yes	Yes	Yes	Yes	> Structure is in fair condition.
104	856+769	Box	BHS	-	1 x 4.0	34	Yes	Yes	Yes	Yes	> Structure is in fair condition.
105	857+298	Pipe	BHS	-	2 x 1.2	35	Yes	Yes	Yes	Yes	> Pipe is covered with vegetation. > Quadrant pitching is in fair condition.
106	857+630	Pipe	BHS	-	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Pipe is covered with vegetation. > Quadrant pitching is in fair condition.
107	857+969	Pipe	BHS	-	1 x 1.2	35	Yes	Yes	Yes	Yes	> Structure is in fair condition. > Quadrant pitching is in fair condition.
108	858+418	Pipe	BHS	Widening	1 x 1.2	32.5	Yes	Yes	Yes	Yes	> Structure is in fair condition. > Quadrant pitching is in fair condition.
109	859+253	Pipe	BHS	Widening	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Pipe is covered with vegetation. > Quadrant pitching is in fair condition.
110	859+869	Box	BHS	-	1 x 6.0	40	Yes	Yes	Yes	Yes	> At RHS service road is present for HP petrol bunk. > Structure is in fair condition.
111	860+456	Pipe	BHS	-	1 x 1.2	50	Yes	Yes	Yes	Yes	> Culvert is fully buried at LHS. > Culvert is in fair condition at RHS.
112	861+195	Pipe	BHS	-	1 x 1.2	32.5	Yes	Yes	Yes	Yes	> Culvert is covered with bushes. > Quadrant

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							LHS	RHS	LHS	RHS	
											pitching is in fair condition.
113	861+490	Pipe	BHS	Widening	3 x 1.2	32.5	Yes	Yes	Yes	Yes	> Culvert is in fair condition. > Quadrant pitching is in fair condition.
114	861+793	Pipe	BHS	Widening	1 x 1.2	35	Yes	Yes	Yes	Yes	> Culvert is in fair condition. > Quadrant pitching is in fair condition.
115	862+053	Pipe	BHS	Widening	1 x 1.2	35	Yes	Yes	Yes	Yes	> Culvert is covered with bushes. > Quadrant pitching is covered with bushes.
116	862+448	Box	BHS	Reconstruction	1 x 6.0	158	Yes	Yes	Yes	Yes	> Culvert is in fair condition. > The structure is canal bridge passing across carriageway.
117	862+931	Pipe	BHS	-	1 x 1.2	42.5	Yes	Yes	Yes	Yes	> Culvert is covered with bushes. > Quadrant pitching is in fair condition.
118	863+501	Pipe	BHS	-	1 x 1.2	42.5	Yes	Yes	Yes	Yes	> Culvert is in fair condition. > Quadrant pitching is in fair condition.
119	863+939	Pipe	BHS	-	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Culvert is fully covered with bushes. > Quadrant pitching is in fair condition.
120	865+217	Pipe	BHS	Widening	1 x 1.2	35	Yes	Yes	Yes	Yes	> Culvert is in fair condition. > Quadrant pitching is in fair condition.

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							LHS	RHS	LHS	RHS	
121	865+635	Pipe	BHS	Widening	1 x 1.2	37.5	Yes	Yes	Yes	Yes	> Culvert is in fair condition.> Quadrant pitching is in fair condition.
122	865+978	Pipe	BHS	Widening	1 x 1.2	55	Yes	Yes	Yes	Yes	> Culvert fully buried. > Quadrant pitching is in fair condition.
123	866+479	Pipe	BHS	Widening	1 x 1.2	40	Yes	Yes	Yes	Yes	> Culvert is in fair condition. > Quadrant pitching is in fair condition.
124	866+992	Pipe	BHS	Widening	1 x 1.2	38.75	Yes	Yes	Yes	Yes	> Culvert is covered with bushes. > Quadrant pitching is in fair condition.
125	867+477	Pipe	BHS	Widening	1 x 1.2	55	NA	NA	NA	NA	> Quadrant pitching is not provided at A1 side at BHS. > Drain is present at A2 side at BHS. > Culvert is in fair condition.
126	867+862	Pipe	BHS	-	1 x 1.0	55	NA	NA	NA	NA	> Quadrant pitching is not applicable as drain is present at BHS. > Pipe is in fair condition.
127	868+583	Pipe	BHS	-	1 x 1.0	60	NA	NA	NA	NA	> Quadrant pitching is not applicable as drain is present at BHS. > Pipe is in fair condition.
128	868+910	Pipe	BHS	-	1 x 1.0	57.5	NA	NA	NA	NA	> Culvert is fully covered with debris. > Quadrant pitching is not applicable as

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							LHS	RHS	LHS	RHS	
											drain is present at BHS.
129	869+048	Pipe	BHS	-	2 x 1.0	57.5	NA	NA	NA	NA	> Culvert merged with drain at LHS. > Culvert fully covered with bushes at RHS.
130	869+358	Pipe	BHS	-	1 x 1.0	-	-	-	-	-	> Culvert is buried at LHS. > Culvert is covered with bushes at RHS.
131	870+387	Pipe	BHS	-	3 x 1.0	57.5	NA	No	NA	No	> Culvert fully covered with bushes. > Quadrant pitching is not applicable at LHS as drain is present at LHS. > Quadrant pitching is not provided at RHS.
132	870+470	Pipe	BHS	-	3 x 1.0	55	NA	Yes	NA	Yes	> Culvert merged with drain at BHS. > Culvert is fully covered with bushes.
133	870+609	Pipe	BHS	-	1 x 1.0	55	NA	NA	NA	NA	> Culvert merged with drain at BHS.
134	870+835	Pipe	BHS	-	1 x 1.0	57.5	NA	NA	NA	NA	> Culvert merged with drain at LHS. > Culvert is in fair condition. > Quadrant pitching is not applicable at BHS as drain is present.
135	871+465	Pipe	BHS	-	2 x 1.0	57.5	No	No	No	No	> Culvert fully covered with bushes. > Quadrant pitching is not provided at RHS.

Sl No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Str. Proposal As per Sch-B	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
							LHS	RHS	LHS	RHS	
136	871+538	Pipe	BHS	-	2 x 1.0	57.5	NA	No	NA	No	> Culvert merged with drain at LHS. > Culvert is in fair condition. > Quadrant pitching is not provided at RHS.
137	871+639	Pipe	BHS	-	1 x 1.0	57.5	NA	No	NA	No	> Culvert merged with drain at LHS. > Culvert is fully covered with bushes at RHS.
138	872+037	Pipe	BHS	-	1 x 1.0	57.5	NA	No	NA	No	> Culvert merged with drain at LHS. > Culvert is fully covered with bushes at RHS.
139	872+478	Pipe	BHS	-	1 x 1.0	55	NA	No	NA	No	> Quadrant pitching is not provided at BHS. > Drain is present at A2 side. > Culvert is fully covered with bushes at RHS.
140	872+933	Pipe	BHS	-	1 x 1.0	60	NA	NA	NA	NA	> Culvert merged with drain at BHS.
141	873+159	Pipe	BHS	-	1 x 1.0	57.5	NA	NA	NA	NA	> Quadrant pitching is not applicable as drain is present at BHS. > Culvert is in fair condition.
142	873+609	Pipe	BHS	-	1 x 1.0	60	NA	NA	NA	NA	> Quadrant pitching is not applicable as drain is present at BHS.> Culvert is in fair condition.
143	874+170	Pipe	BHS	-	2 x 1.0	57.5	NA	NA	NA	NA	> Culvert fully covered with bushes.
144	874+587	Box	BHS	-	1 x 5.5	-	-	-	-	-	> Culvert not found at site.
145	875+170	Pipe	BHS	-	2 x 1.0	55	NA	NA	NA	NA	> Culvert merged with drain at BHS.

Sl No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Str. Proposal As per Sch-B	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Stone Pitching (Yes/No)		Observations
							LHS	RHS	LHS	RHS	
											> Culvert fully covered with bushes at RHS.
146	875+504	Pipe	BHS	-	1 x 0.9	52.5	NA	NA	NA	NA	> Culvert merged with drain at RHS. > Quadrant pitching is not provided at LHS.
147	875+817	Pipe	BHS	-	2 x 1.0	50	NA	NA	NA	NA	> Culvert merged with drain at BHS.
148	876+951	Pipe	BHS	-	1 x 1.0	60	NA	NA	NA	NA	> Culvert fully covered with bushes.
149	877+226	Pipe	BHS	-	1 x 1.0	60	NA	NA	NA	NA	> Culvert fully covered with bushes.
150	878+109	Pipe	BHS	-	1 x 1.0	55	No	No	No	No	> Quadrant pitching is not provided. > Pipe is in fair condition.
151	878+237	Pipe	BHS	-	1 x 1.0	57.5	NA	NA	NA	NA	> Culvert fully covered with bushes.
152	879+303	Pipe	BHS	-	2 x 1.0	57.5	NA	NA	NA	NA	> Culvert fully covered with bushes a BHS. > Quadrant pitching is in fair condition at RHS.
153	879+727	Pipe	BHS	-	2 x 1.0	57.5	NA	NA	NA	NA	> Culvert is merged with drain at LHS. > Culvert is buried at RHS.
154	880+354	Pipe	BHS	-	1 x 1.0	57.5	NA	NA	NA	NA	> Culvert is merged with drain at LHS. > Structure and quadrant pitching is in fair condition at RHS.

Photos depicting the existing culvert are presented below

Photos of Box Culvert

Box @ 814+358	Box @ 826+076
Box @ 850+436	Box @ 856+132

Box @ 832+682	Box @ 862+448

Photos of Pipe Culvert

Pipe @ 814+034	Pipe @ 818+067

Pipe @ 826+530

Pipe @ 836+066

Pipe @ 820+548

Pipe @ 843+295

Photos of Pipe Culvert

Pipe @ 846+482

Pipe @ 850+649

Pipe @ 863+939

Pipe @ 873+609

4.8 DRAINAGE AND SLOPE PROTECTION

- ✓ Lined Covered drains observed at urban locations and at service road Locations along the corridor.
- ✓ No major damages observed at covered drain locations.

4.9 TRAFFIC SAFETY AND ROAD FURNITURE

- ✓ Metal beam crash barriers provided along the project road appear to be intact over entire length except for few locations where it got damaged.
- ✓ Pedestrian guard rails installed on the median, Separator & appear to be intact over entire length except for few locations where it got damaged.
- ✓ Median Opening locations appear to be in good condition. The width of the existing standing lane median openings was observed for a width of 1.0m.
- ✓ Solar blinkers in Fair condition observed at median openings in the entire project corridor.
- ✓ Street lightings and High masts are observed at urban, Toll plaza, Junction Locations, at few locations' street lightings are got damaged and not functioning well, and those items are addressed in the initial cost.

4.10 ROAD USER FACILITIES

- ✓ The Bus Bay with Shelters and truck lay byes were provided along the corridor.

CHAPTER 5. REHABILITATION PLANS AND DESIGNS

5.1 DESIGN TRAFFIC LOADING

Design Traffic loading has been estimated by considering the latest traffic (given) and VDFs as estimated from the latest axle load survey data and with min. 5% growth rates for 10 years, 15 years and 20 years design period as below:

Table 35: Traffic Volume (AADT)

Vehicle/Mode	Toll Plaza-1 (LHS)	Toll Plaza-1 (RHS)
BUS	80	80
2A truck	398	398
3A truck	276	276
MAV truck	772	772
LCV	190	190

Table 36: Estimated Design traffic loading

Year	MSA Summary -5% Growth rates)	
	Toll plaza-1 (Mohtara plaza)	
	UP	DN
10th year from Now	41	44
15th year from Now	71	75
20th year from Now	108	115

The computation of traffic loadings is presented in **Appendix 9** of this Report. Design traffic corresponding to 10 years period has been considered for overlay design.

5.2 PAVEMENT REHABILITATION AND STRENGTHENING

5.2.1 Rigid Pavement Strengthening

Based on the FWD survey and their results it appears that about 45% in LHS, 40% in RHS of the flexural strength values ranges from 3.0MPa to more than 4.5 Mpa. The rigid pavement design period has been checked with various flexural strength values by considering the existing PQC & DLC thickness.

Number of axle load repetitions for each year of operation is estimated and cumulated for entire operation period of 20 years from now. Using IRC 58-2015 design charts, stress ratios corresponding each Flexural strength values ranging from 3.75MPa-4.5MPa have been estimated and number repetitions that existing pavement serves is also established.

The summary of the Design period satisfies for various flexural strength values as given below:

Flexural Strength (Mpa)	Existing Rigid Pavement Thickness satisfies to the design period in Years	
Side	LHS	RHS
3.36 / 3.32	10 Years	10 Years
3.53 / 3.48	20 Years	20 Years
3.75	23 Years	18 Years
4	30 Years	30 Years
4.5	30 Years	30 Years

From the FWD data analysis it is found that nearly 59% points in on LHS & 56% points in RHS were having flexural strength values more than 3Mpa. These are considered to be fair condition and requires minimal maintenance. Similarly, flexural strength values less than 3mpa were considered to be average to poor condition and are estimated nearly 41% of samples in on LHS & 44% sample in RHS of project road may require major rehabilitation measures during operation period. Thus, the same has been considered in cost estimates apart from routine and periodic maintenance of rigid pavement.

5.2.2 Flexible Pavement Strengthening

For Design the Overlay Thickness the following method as suggested in IRC: 115 has been used

- The existing pavement is considered as a 3-layer system consisting of subgrade, granular and bituminous layer. The remaining life of exiting pavement in terms of Fatigue and Rutting life (MSA) are estimated
- The remaining life is compared with design traffic loading. An overlay with assumed thickness is considered on exiting pavement where required.
- The Total system including the proposed Overlay (Trial thickness) is assumed as a four-layer system and considered the relevant MR values for all the four layers namely New BT layer, existing bituminous surface, total existing Granular layers and Subgrade layers.
- The MR value for the New BT is assumed as 3000 MPA (considering VG40 Bituminous grade) for Main Carriageway and 2000 MPA (considering VG30 Bituminous grade) for Service Road and for all the remaining three layers, the MR Values derived and finalized from the FWD Analysis are considered
- Critical Tensile strains and Vertical strains are found out by using the IIT PAVE Software at the bottom of existing bituminous layer and at the top of the subgrade layer respectively.
- The Fatigue and Rutting equations (equation given in the IRC: 115) have been used to estimate the Fatigue and Rutting Life of The Pavement system.
- The Obtained Fatigue and Rutting Life are compared with the required life for the assumed trial overlay thickness.

Remaining life of the existing pavement from the above analysis is presented in the following tables:

Table 37: Remaining life of the existing pavement on LHS Carriageway

Sl.No	Side	From	To	Length	Pavement type	15th Percentile MR values, MPa			Avg. Existing Crust, mm		Total Crust	Strains From IITPAVE x 10^-6		Nf- Fatigue life, MSA	Rutting life, MSA
						MR for BT	MR for Granular	MR for Subgrade	BC	Granular		Vertical strain at bottom, epZ	Tangential strain at top, epT		
1	LHS	826.89	828.58	1.7		2344	391	87	140	450	590	238.9	155.1	62	371
2	LHS	828.58	829.60	1.0											
3	LHS	829.60	830.71	1.1											
4	LHS	830.71	837.35	6.6											
5	LHS	837.35	838.60	1.3		2385	390	87	140	450	590	2385	154.2	62	374
6	LHS	838.60	867.40	28.8											
7	LHS	867.40	868.40	1.0											
8	LHS	868.40	872.03	3.6		2330	361	87	140	450	590	246.2	163.3	51	324
9	LHS	872.03	873.07	1.0											
10	LHS	873.07	874.95	1.9		2656	392	87	140	450	590	234.0	147.5	68	407
11	LHS	874.95	876.05	1.1											
12	LHS	876.05	876.62	0.6											
13	LHS	876.62	880.60	4.0		2636	391	87	140	450	590	234.5	148.1	67	404

It can be seen from the above table, in LHS the minimum remaining life of the existing pavement is 51 MSA in LHS direction which is greater than 10 years design traffic of 41 MSA. Hence no Strengthening Overlay required.

5.3 STRUCTURAL REHABILITATION

All the structure found to be in good condition except minor treatment like repair of stone pitching, cleaning of drainage spouts, cleaning of vegetation etc. may be required. Detailed structural rehabilitation quantities have been worked out based on the prevailing condition of existing structures. This methodology describes in detail the procedure for the execution of each item of rehabilitation work of the Existing Bridges of the project.

The scope of this methodology covers the items mentioned below for rehabilitation work of all the existing Bridges.

- Repair/ Replacement of Existing Bearings
- Repair / Replacement of Existing Expansion Joints
- Repair / Replacement of Existing Wearing Coat
- Profile Correction for Existing Deck Slab by Cement Concrete
- Sealing of Cracks for Bridges by Epoxy Resin
- Replacement of Spalled Concrete of ECW by Epoxy Mortar
- Cement Grouting for Repair of Existing Bridges

- Guniting / Shotcrete for Repair of Existing Bridges
- Providing & Fixing of Drainage Spouts
- Repair of Substructure Component
- Repair / Replacement of Railing & Crash Barrier
- Epoxy Bonding between New and Old Concrete.

About 12 Nos. of locations, structures are closely monitored by use of Mobile Bridge Inspection Unit (MBIU). Details of these structures where MBIU is used are presented in the following table

Table 38: Locations of MBIU survey

S.No.	Chainage	Type of Structure	Side
1	827+917	Flyover	RHS
2	839+656	MJB	LHS
3	839+656	MJB	RHS
4	840+104	MNB	LHS
5	840+104	MNB	RHS
6	842+429	MNB	LHS
7	866+244	MJB	LHS
8	866+244	MJB	RHS
9	872+780	Flyover	LHS
10	872+780	Flyover	RHS
11	875+680	Flyover	LHS
12	875+680	Flyover	RHS

NDT test has been suggested for Old ROB on LHS Km 878+725. No special NDT techniques are warranted to monitor the condition. Standard tests as UPV, Half-Cell Potential, rebound hammer, cover meter survey and Carbonation depth are adequate to assess the condition.

5.4 DEVELOPMENT ZONES (Schedule-B PROVISIONS)

5.4.1 MAINTENANCE WORKS

Schedule B stipulates the obligation of immediate maintenance which is to be done by the incoming Concessionaire. However, NHAI has represented to NHIT that they will undertake the immediate maintenance themselves, confirming to CA obligations, before handing over the asset to NHIT.

For Service Road: Existing Service / Slip Road shall be provided with overlay at following locations for 30 MSA by carrying FWD.

S. No	Location		One Side Length	Side	Minimum Overlay
	From	To			
1	846+850	848+340	1490	LHS	40 mm BC + 50 mm DBM

2	846+875	848+525	1650	RHS	40 mm BC + 50 mm DBM
3	871+800	873+050	2500	BHS	40 mm BC + 50 mm DBM
4	875+100	876+000	1800	BHS	40 mm BC + 50 mm DBM
			7440		

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5.4.2 Median openings

The details of the median openings and their treatments are given in table below:

S. No.	Existing Kilometre (km)	Recommendations
1	818+930	Median opening shall be closed
2	860+530	Median opening shall be improved with storage lane confirming to IRC SP: 84 -2019

5.4.3 Project Facilities

- **Truck Lay Bye**

Truck Lay bye shall be upgraded at the following locations as per IRC: SP:84- 2019 within the ROW.

S. No	Location	Side	Facility to be provided
1	866+750	RHS	Facilities / repaired to be provided as per IRC SP: 84-2019

The existing toilets shall be suitably modified to give an aesthetically pleasing look and shall gel with the surroundings. The Sewage disposal system shall be through Bio-digestible system (including Septic Tank & Soak pit). The drinking water facility shall be RO Treated Water.

- **Truck Parking**

Truck parking shall be provided within available space between MCW and Service Road (existing separator) with Rigid Pavement matching with MCW Crust at following locations:

S. No	Location	Side	Facility to be provided
1	827+100	LHS	100 m length excluding entry and exit and having paved width minimum 5.5 m.
2	828+800	RHS	100 m length excluding entry and exit and having paved width minimum 5.5 m.
3	832+800	LHS	100 m length excluding entry and exit and having paved width minimum 5.5 m.

S. No	Location	Side	Facility to be provided
4	836+000	RHS	100 m length excluding entry and exit and having paved width minimum 5.5 m.
5	854+500	LHS	100 m length excluding entry and exit and having paved width minimum 5.5 m.
6	857+100	RHS	100 m length excluding entry and exit and having paved width minimum 5.5 m.
7	867+700	LHS	100 m length excluding entry and exit and having paved width minimum 5.5 m.
8	869+700	RHS	100 m length excluding entry and exit and having paved width minimum 5.5 m.
9	871+500	LHS	100 m length excluding entry and exit and having paved width minimum 5.5 m.
10	873+500	RHS	100 m length excluding entry and exit and having paved width minimum 5.5 m.
11	874+200	LHS	100 m length excluding entry and exit and having paved width minimum 5.5 m.
12	876+700	RHS	100 m length excluding entry and exit and having paved width minimum 5.5 m.
13	877+200	LHS	100 m length excluding entry and exit and having paved width minimum 5.5 m.
14	879+700	RHS	100 m length excluding entry and exit and having paved width minimum 5.5 m.

Note: the above locations shall be decided as per discussion with IE / NHAI during execution of work.

5.4.4 COMPLETION SCHEDULE FOR IMPROVEMENT PROPOSALS

Completion schedule for Scope mentioned in Schedule-B shall be as below.

S. No.	Description of Work	Date of Completion
1	Incident Management (9.8, 9.9 and 9.10)	From Appointed Date / O & M Handover Date, whichever is later
2	Installation / Rectification of road furniture related items (Section 10) Landscaping and Tree Plantation (Section 9.5)	9 months from Appointed Date
3	Maintenance and Rehabilitation (Section 4)	6 months from Appointed Date / O&M Handover Date, whichever is later
4	Toll Plaza and other facilities at Toll Plaza (Section 9.1, 9.12,9.13)	6 months from Appointed Date
5	ATMS (Section 9.10)	18 months from Appointed Date ***(Pre-bid reply dtd 11.10.2023, annexure-2, S.No3: Installation, operation and maintenance of the ATMS shall be done by NHAI)***
6	Other Improvements (Section 1, 2, 3, 5, 6, 7, 8, 9.2, 9.3, 9.4, 9.6, 9.7 and 9.14)	18 months from Appointed Date

CHAPTER 6. OPERATION AND MAINTENANCE

6.1 INTRODUCTION

Looking at the contractual requirements of maintaining project road under specified level of roughness it is felt that roughness is the most important criterion for finalizing the O&M schedule for the project. Accordingly, the methodology adopted by present consultants includes predicting the roughness year by year under the traffic using a well acknowledged HDM-4 model developed for developing countries like India after lot of research by World Bank. The said model is widely prescribed by MORTH and NHAI during the preparation of detailed project reports for several projects in doing economic analysis for the projects. The economic analysis mainly consists of two parts:

1. Predicting the road deterioration and estimating VOC
2. Estimating Benefits

Considering its importance and present use in India, consultants felt prudent to use the first part, i.e estimating road deterioration and predicting roughness in HDM 4 model to finalize the O&M schedule for the project. This approach is more scientific as it does not assume hypothetical deflection values at 10th and 20th year and includes main criterion of maintaining roughness at 2400mm/Km as per Schedule F.

6.2 CA SPECIFICATIONS FOR MAJOR MAINTENANCE

- Schedule F of CA specifies that Roughness values exceeds 2400mm/km in a length of KM, needs to be corrected within 180 days.
- No specific requirement with respect to deflection (FWD) measurement

6.3 RIGID PAVEMENT PERIODIC MAINTENANCE STRATEGY

Apart from the above requirements of Sch-F and maintaining the roughness and skid number for the rigid pavements, there are several other repair strategies included in Sch-K for rectification of defects in rigid pavement. These include following:

- Crack Seal
- Seal & Stitch
- Staple or Dowel Bar Retrofit
- Partial Depth Repair with Stapling
- Full Depth Repair: Dismantle and reconstruct affected Portion
- Diamond Grinding
- Joint Cleaning & Repair

Looking at the above requirements, it is felt necessary to consider following activities as part of periodic maintenance cycle apart from routine maintenance activities:

Description	%	Unit	Rate	Quantity	Amount
Length of Rigid Pavement		Kms		54.563	
PQC Qty		Cum		305254	
Total Area		Sqm		1017513	
No of Transverse Joints		no		24257	
No of Panels		no		60297	
Length of Transverse Joints		m		226114	
Longitudinal Joint		m		272815	
Repair of Transverse Joint Sealant	75.0%	m	64.50	169585	10938260
Repair of Longitudinal Joint Sealant	75.0%	m	64.50	204611	13197426
Replacement of Transverse Joint@ 7years	2.0%	m	833.00	4522	3767058
Replacement of Longitudinal Joint@ 7years	2.0%	m	833.00	5456	4545098
Ravelling surface @7years	3.0%	Sqm	935	30525	28541228
Crack sealing Surface @ 7years	2.0%	m	436	4365	1904554
Repair of Panels @ 7years	0.50%	No	9101	301	2739371
Removal of Panels @ 7years	1.50%	No	3411	904	3083182
Relaying of Panels @ 7years	1.50%	No	36138	904	32668308
Retexturing@ 7years	20%	Sqm	100	203503	20350252
Regrinding and Retexturing@ 7years	10%	Sqm	500	101751	50875630
Total Amount in Rs.					172610367
GST @ 18%					31069866
Periodic maintenance cost in Crores					**20.37**
Per Sqm per Cycle (Rs.)					**200**

The above are in addition to routine maintenance activities which include following for every year:

Longitudinal Cracks more than 1.5m	Lin.m	0.50%
Longitudinal Cracks less than 1.5m	Lin.m	0.50%
Transverse Cracks less than 1.5m	Lin.m	0.50%
Transverse Cracks more than 1.5m	Lin.m	0.50%
Longitudinal Crack full Depth	Cum	0.10%
Pothole	sq.m	0.10%
Corner Cracks	cum	0.10%
Condition of Joints	Lin.m	1.00%
Diagonal Cracking	Lin.m	0.50%
Raveling of panel	sq.m	0.15%

6.4 STRUCTURAL PERIODIC MAINTENANCE STRATEGY

Expansion joints:

- Visual inspection is carried out to check for seal breakages, Armor angle, Weld failures, cracks between deck & Expansion joints concrete and Joints filled with debris. Such joints replaced immediately.
- Joint buried with debris shall be inspected for any distress, if any distress is shown it shall be replays immediately.
- During visual inspection it is seen that some Expansion joints are bad where as some are not showing any defects.
- Due to this it is considered provident to change the Expansion joints which are visibly damaged in initial stage.
- In the absence of records pertaining to Expansion joint replacements it is highly difficult to predict the date of replacement needed for compliance to IRC codal requirements. Balance joints which are not replaced initially will be replaced as on when defects are shown in the joints. This aspect is considered in BOQ.

Bearings:

- In order to identify the bearings requiring immediate replacement, the following strategy is adopted.
- Girder Bridges showing diagonal cracks at support, distress in the Pedestals and any form of distress in support location is regarded as a candidate for replacement. By visual inspection there are only a handful of such situations.
- Wherever pedestals are damaged either by cracking or spalling poisons confinement is proposed by Jacketing/MS plate bonding such procedure is very effective and common.
- All Metallic Bearings need to be taken up for servicing.

Wearing Coat:

It is necessary to replace the Wearing coat at every 15years interval, as wearing coat is a very weak component of the bridge structure which is subjected to severe deterioration due to Loading, Environment etc. As of now, we have considered sealing of cracks by Fog Seal and for which does not show any distress other than cracking by viz. Pot holes, abrading etc. Based on this aspect, this cost has been considered in highway O&M cost.

Periodic Maintenance strategy for Replacement of Bearings & Expansion joint:

Below strategy has been considered for periodic major maintenance of the structures.

S no	Description	Bridge components
1	Old structure	Structures which are older than 15years as of now
2	New Structure	Structures which are Not older than 15years as of now

Age	Description	Item	structures-Assumption-MMR							
			% of Replacement of Major components							
			2024	2028	2033	2038	2043	2048	2053	2052
New	Super structure lifting with Pot bearings	Pot	0%	10%	50%	25%	50%	25%	25%	0%
New	Super structure lifting with Elastomeric bearings	Ela	0%	10%	75%	50%	50%	25%	50%	0%
New	Super structure lifting with Rocker bearings	Rocker	0%	0%	0%	0%	0%	0%	0%	0%
Old	Super structure lifting with Pot bearings	Pot	50%	25%	50%	25%	25%	25%	50%	0%
Old	Super structure lifting with Elastomeric bearings	Ela	50%	25%	50%	25%	25%	25%	50%	0%
Old	Super structure lifting with Rocker bearings	Rocker	25%	10%	25%	10%	25%	25%	25%	0%
New	Pot bearing cost	Pot	0%	10%	50%	25%	50%	25%	25%	0%
New	Elastomeric bearing cost	Ela	0%	10%	75%	50%	50%	25%	50%	0%
New	Rocker bearing cost	0	0%	0%	0%	0%	0%	0%	0%	0%
Old	Pot bearing cost	Pot	50%	25%	50%	25%	25%	25%	50%	0%
Old	Elastomeric bearing cost	Ela	50%	25%	50%	25%	25%	25%	50%	0%
Old	Rocker bearing cost	0	25%	10%	25%	10%	25%	25%	25%	0%
New	Expansion joint Replacement	0	0%	20%	50%	50%	50%	25%	50%	0%
Old	Expansion joint Replacement	0	75%	25%	25%	25%	50%	25%	50%	0%
New	Others	0	0%	20%	50%	25%	25%	25%	50%	0%
Old	Others	0	75%	25%	25%	25%	25%	25%	50%	0%

Cost Component for various items and activities have been worked out by considering the Best Industry practice and most appropriate methods. Detailed quantities for work items have been estimated based on the details presented in previous chapters for various heads.

The gist of the cost components considered are presented below:

- Immediate Repair's Cost
- Routine Maintenance Cost
- Incident Management Cost
- Periodic Maintenance Cost
- Operations Cost
- Year by Year total O&M Costs

7.1 RATE ANALYSIS

Detailed rate analysis has been carried out based on MORTH guidelines to arrive at the unit rates of various items. Material rates and their leads from the project corridor are considered as per the material investigations done on the project road. Summary of unit rates arrived at are presented in table below:

Table 39: Unit Rates of Basic Material

Sl.no	Description	Units	Source	Basic rate excluding Transportation & GST	Lead in Kms
1	Good earth	Cum	BA	20	3.60
2	40 mm	Cum	Crusher	600	23.93
3	20 mm	Cum	Crusher	750	23.93
4	12 mm	Cum	Crusher	525	23.93
5	6 mm	Cum	Crusher	600	23.93
6	Dust	Cum	Crusher	480	23.93
7	M sand	Cum	Crusher	600	23.93
8	Flash	Cum	Nearest Plant	0	847.43
9	Boulders	Cum	Quarry	184	1.00
10	Sand source to Plant	Cum	River	600	24.00
11	Sand source to working site	Cum	Stock yard	600	5.00
12	Bitumen 60/70	MT	Mathura	48566	642.00
13	Bitumen 80/100	MT	Mathura	47806	642.00
14	VG-40	MT	Mathura	48000	642.00
15	CRMB-55	MT	Mathura	49516	642.00
16	PMB	MT	Mathura	53200	642.00
17	SS1	MT	Mathura	50000	642.00
18	Steel	MT	Jabalpur	63833	0.00
19	HTS Strands	MT	Jabalpur	70000	1138.00
20	Cement	MT	Jabalpur	5313	0.00
21	Structural Steel	MT	Jabalpur	65833	46.00
22	RCC Pipe NP 4 heavy duty non pressure pipe 1000 mm dia	RM	Jabalpur	4500	90.00
23	RCC Pipe NP 4 heavy duty non pressure pipe 1200 mm dia	RM	Jabalpur	5500	90.00
24	RCC Pipe NP 4 heavy duty non presure pipe 900 mm dia	RM	Jabalpur	3500	90.00

Table 40 Major Material Rates

Sl.no	Item	Unit	Rate (INR) Excluding GST
1	Embankment - borrow	Cum	245
2	Embankment - Excavation	Cum	77
3	SG	Cum	250
4	GSB G-2	Cum	1523
5	WMM	Cum	1592
6	Prime Coat	Sqm	42
7	Tack coat on granular	Sqm	14
8	DBM G-1	Cum	8102
9	Tack coat on bituminous surface	Sqm	13
10	BC - G1	Cum	9722
11	Road Marking	Sqm	531
12	RE wall	Sqm	4723
13	Select Fill	Cum	275
14	Filter Media	Cum	733
15	M15	Cum	5024
16	M20	Cum	5581
17	M25	Cum	6043
18	M30	Cum	5987
19	M35	Cum	6211
20	M40	Cum	6330
21	PSC M45	Cum	7620
22	HYSD	MT	91813
23	HT strand	MT	144042
24	Pile 0.75 dia	Rm	10495
25	Pile 1 dia	Rm	13836
26	Pile 1.2 dia	Rm	18195

7.2 Initial improvement works (SCHEDULE-B)

Costs associated with initial improvements are estimated based on the detailed asset inventory and condition assessment surveys, Pavement condition and structural condition assessment surveys. Items which are not executed as part of scope or in damaged condition have been considered for immediate costs as a part of 1-year capex. Following items are mainly considered for Initial Improvement costs:

- Scope given in schedule-B
- Scope which is not executed
- Road work items
- Bridge Work Items
- Pavement Rehabilitation works
- Structural Rehabilitation works
- Drainage Works
- Slope Protection works
- Safety Works

Summary of Initial Improvement Costs are included in table below:

Table 41: Summary of Initial Improvement Cost

S.no	Description	Unit	Quantity	Rate (Rs.)	Amount (Rs.)
1	Initial Improvement works (Highway & Str)-Schedule-B	LS	1	14,18,01,963	14,18,01,963
2	TMS	LS	1	2,15,53,444	2,15,53,444
3	ATMS	LS	1	-	-
4	Revalidation surveys	LS	1	65,15,882	65,15,882
5	Pavement Rehabilitation-void filling	LS	1	1,34,89,500	1,34,89,500
Immediate Repair's - Structures					5,54,467
Total Cost excluding GST					18,39,15,256
GST at 18%					3,31,04,746
Total Cost including GST					**21,70,20,002**
Total Cost including GST IN Crores					**21.70**

Note: This above cost arrived is with due consideration of reply to pre-bid queries dtd 27.09.2023 annexure-F

The structure approach lengths as given in the DPR has been redesigned with due verification at site and following revised lengths were considered in EPC cost estimations.

S No.	Package	Str_Chianage	Str. Type	As Per DPR, length in KM			Difference In Km	As Per Samarth,length in KM		
				From	To	Length		From	To	Length
1	PKG-4	835.62	VUP	835.14	836.02	0.88	-0.052	835.165	835.993	0.828
2		847.775	SVUP & VUP	846.8	848.3	1.5	0.043	846.795	848.338	1.543
3		858.78	LVUP	858.39	859.13	0.74	-0.063	858.41	859.087	0.677
4		862	LVUP	861.65	862.3	0.65	-0.002	861.65	862.298	0.648
5		865.4	LVUP	865.07	865.8	0.73	-0.037	865.065	865.758	0.693
6		867.2	Flyover	866.67	867.75	1.08	-0.01	866.675	867.745	1.07
7		869.03	Flyover	868.53	869.58	1.05	0.05	868.51	869.61	1.1

7.3 ROUTINE MAINTENANCE & INCIDENT MANAGEMENT COSTS

Routine maintenance costs include general maintenance costs of road elements, bridge elements and road furniture and appurtenances. This can be mainly divided into two parts as:

- ✓ General Maintenance of Works
- ✓ Repairs to Highway & Bridge Elements

7.3.1 General Routine Maintenance

General Routine Maintenance of Roads generally include following items:

- Cleaning of Project facilities
- Structures cleaning,
- Cleaning of ROW
- Cleaning and Maintenance of Toll Plaza
- Unlined Drain Maintenance
- Lined Drain Maintenance
- Maintenance of Highway Lighting at Toll plaza and other project locations
- Median Plantation maintenance & Avenue plantation maintenance:
- Maintenance of Road Furniture
- Maintenance of Road Safety Items

The above items are estimated by considering the detailed break-up of following items:

- Manpower including Managers/Labour etc.
- Vehicles for Labour Transport/Water Tankers/Sweeping Machines etc.
- Resources/Equipment's such as grass cutters, tools, jet sprayers, hydraulic trimmers etc.

7.3.2 Repairs to Highway & Bridge Works

Repairs to highway and bridge works have been estimated based on the assumed quantities (Percentage basis) of execution for every year.

These items include the following:

1	Providing treatment for sealing of road surface / isolated cracks at scattered locations
	i) Covered with 6.7 mm size stone chipping @ 0.1 cum/ 10 sqm.
	ii) covered with dry coarse sand passing through 2.36 mm sieve and retained on 180 micron sieve @ 0.03 cum/10 sqm heated to 600 C
	iii) filling discrete cracks with slow curing bitumen emulsion as per Technical Specification Clause 3004.3.3
2	Providing treatment to bleeding bituminous surface at scattered locations
3	Providing localized repair to rutted portion and edge breaking of bituminous surface
4	Providing treatment and repair to pot-holes and patch work
5	Providing and laying dense bituminous macadam using bitumen grade VG 40 complete as per Technical Specification Clause 507
6	Proving and laying bituminous concrete (asphaltic concrete)
	(a) Using bitumen (VG-40) as per IRC: SP: 53
7	Road Roughness survey
8	Turfing on embankment slopes and at all other Project Facilities
9	Providing repair to stone pitching/apron at scattered locations
10	Rain Cuts Maintenance: Restoration of rain cuts soil, moorum, gravel or a mixture of these

11	Providing and laying apron/ stone pitching on slopes of guide bunds/ road embankment / other location
12	Providing and laying stone aggregate filter material (150 mm compacted thickness) underneath pitching
13	Unlined drain
14	Filling in median island with approved materials with all leads and lifts complete as per TS Clause No. 407
15	Replacing damaged / broken railing with new pre-cast / cast-in-situ, concrete railing to match with existing design and pattern.
24	Carrying out repair to road signs including strengthening resetting or otherwise repairing signs and delineators
	a) Road sign board mounted on single post
	b) Road sign board mounted on double post
	c) Overhead/ Gantry Sign boards
	d) Delineator
25	Supplying and fixing at site retro-reflectorized type **sign boards/signs**
	90cm Equilateral triangle
	60cm circular
	90 cm circular
	90cm high octagon
	80cm x 60cm rectangle
	Chevron signs 60cm x 45cm
	Place identification signs (Fig 15.7 of IRC 67)
	Providing and fixing Object Markers
	Providing and fixing of retro-reflectorized Route Marker signs (size 450mm x 600mm)
26	**Hazard Marker Sign :**
	a) size 90 x 30 cm
	b) size 30cm triangular side cluster of red reflectors (screen printed)
27	Cats Eyes/Raised pavement marker (NMC Nails Less)
28	Painting two coats on old surface after minor repairs to give an even and smooth surface and printing letters and figures with synthetic enamel paint
	a) Hectometer stones
	b) Kilometer Stone
	c) 5 Kilometer stone
	d) Boundary stone
	e) Guard stone
29	Providing painting lettering and fixing of distance measurement stones including dismantling of old damaged/ broken ones, confirming to TS Clause 804
	a) Hectometer stones
	b) Kilometer Stone
	c) 5 Kilometer stone
	d) Boundary stone
	e) Guard stone
30	Providing and fixing road delineators conforming to TS Clause No. 805 as directed by the Engineer.
31	Repainting the kerb stones and separation barrier with first quality synthetic enamel paint of approved brand
32	Painting all types of pavement markings including lines, dashes, arrows etc. on roads as per relevant IRC/MOST standards after cleaning the surface complete in all respects as directed by the Engineer.
	a) Hot applied Thermoplastic compound
	(i) Lane / Centre Line / Edge Line
	(ii) Direction Arrows

	(iii) Diagonal Chevrons Markings
33	Supplying and laying cast-in-situ cement concrete kerb without channel section
	a) by Manual/machine including formwork
34	Major repair / replacement of metal beam crash barrier (W profile guard rails)
35	Providing and fixing chain link/ welded mesh fencing / square bars fencing
36	Dismantling the old damaged chain link/welded mesh / square bars fencing and replacing it with new chain link/ welded mesh/square bars fencing
37	Provision of rumble strips
38	Shoulder Maintenance:
39	synthetic enamel paint of approved brand on metal pedestrian guard rail
40	Dismantling of wearing course

B. Structures

1. Wearing coat comprising of 50 mm thick BC.
2. Cleaning and adding rubber sealant near expansion joints.
3. Modular Expansion joints.
4. Replacement of Damaged Concrete Railing all complete as per Technical specifications and as directed by the Engineer
5. Provision of an RCC crash barrier (0.35sqm cross sectional area) constructed with M-40 grade concrete including reinforcement
6. Cleaning of rocker & roller bearing using high pressure water jet, free from rust scales, re-setting & greasing the bearings using graphite grease including cost of materials, labour etc., complete.
7. POT PTF Bearings greasing and maintaining (sand plastering).
8. Elastomeric Bearings and maintaining.
9. Cutting of groove of 15 mm x 15 mm along crack and sealing the same with epoxy putty including cost of material, labour etc.
10. Carrying out 50 to 60 mm thick shortsheeting using a mix proportion of 1:2:2 (cement: sand:6 mm down aggregate) added with Polypropylene fibers at a dosage rate of 125 gms/bag of cement including cost of labour, material, scaffolding, equipment etc complete.
11. Repair of Floor Aprons, pitching and other protection works
12. Cleaning of Drainage Spouts
13. M-25 Concrete

7.3.3 Incident Management Cost

Incident Management & Safety items include the following:

- ✓ Regular patrolling & reaching accident/incident site,
- ✓ providing relief to injured persons including taking them to nearest hospital and attending to the safety requirements at the location (putting cones, safely guide & manage the traffic using signs, safety barricades, etc.),

- ✓ removal of accident /breakdown vehicles, removing of dead animals/birds lying on the highway and loading, unloading, transportation & disposal of surplus material left over by accidental vehicle or otherwise lying on road (on carriageway) and
- ✓ Encroachment prevention & removal with all lead & lifts complete with proper communication equipment,
- ✓ consumables, materials, suitable Towing vehicles, Ambulance, patrolling vehicles and manpower like drivers, helpers, para-medical staff, labour including deployment of crane and all works shall be done as per requirement and as directed by Client representative and as per Relevant Specifications as applicable.

7.4 OPERATIONS COSTS

Cost towards Operations include the following:

- SPV Costs
- Electricity Bill of lighting
- Toll Plaza Operation cost
- Operation and management cost of TAP& MAP
- Operation and management costs of rest areas and lay byes
- Survey Costs
- Insurance
- IE Fee
- Audit Charges
- Administrative Cost

Table 42: 1st year O&M Cost

S No.	Particulars	Amount in Crs. (Including GST)
1	Tolling Operations	4.12
2	Incident Management	2.44
3	Routine Maintenance	5.37
4	Repairs	2.26
5	ATMS	-
6	Admin Expenses	4.49
7	Insurance	1.32
Total O&M Cost (FY 2024)		**20.00**
	For FY 2027, Additional cost towards special repairs is to be added	**4.18**
	TOTAL OPERATIONS COST(FY 2027)	**24.18**

Note: All the Costs are in Crores, inclusive of GST, without escalation

7.5 PERIODIC MAINTENANCE COSTS

Cost towards major maintenance include following:

- ✓ Cost of Periodic maintenance of Pavement based on Finalized MM schedule
- ✓ Cost of Periodic Maintenance of Structures
- ✓ Cost of Periodic replacement of Toll Equipment's & Software

Table 43: Periodic Maintenance Cost

S. No	Year	Periodic Maintenance				
		Functional +Structural overlay MCW+ S/R	Major Maintenance of Rigid Pavement	R&R of **ATMS**	R&R of **TMS**	Structure specified repairs
-	-					
1	2024	-	-			-
2	2025	-	-			-
3	2026	-	-			-
4	2027	0.44	2.05			-
5	2028	-	-			0.85
6	2029	-	-			-
7	2030	28.49	26.49			1.40
8	2031	-	-	-	1.27	-
9	2032	-	-			-
10	2033	0.44	2.05			1.13
11	2034	-	-			-
12	2035	-	-			-
13	2036	30.92	48.32			3.00
14	2037	-	-			-
15	2038	-	-	-	2.54	0.85
16	2039	0.44	2.05			-
17	2040	-	-			-
18	2041	-	-			-
19	2042	28.49	26.49			2.35
20	2043	-	-			1.13
21	2044	-	-			-
Total:		89.22	107.45	0.00	3.81	10.70
Major / Periodic Maintenance (For 20 years period)		**211.19**				

Note: All the Costs are in Crores, inclusive of GST, without escalation considering FY 2024 price

7.6 TOTAL OPERATION & MAINTENANCE COSTS

Year on year operation cost is summation of following:

- ✓ Immediate Costs

- ✓ Routine Maintenance & Incident Management
- ✓ Periodic Maintenance
- ✓ Operations Cost

Following table presents the summary of Operations & Maintenance cost for the project

Table 44: Cost Abstract

Calendar Year	SUMMARY OF VARIOUS EXPENSES in Rs. Crs					
	Immediate Repair's Cost	**Toll Operation expenses**	**Routine Maintenance Expenses**	**Periodic Maintenance (Functional +Struc Overlay+ Toll collection system)**	**Total Cost (Rs. Cr.)**	**Additional Cost (For special repair) -** Already included in routine maintenance expenses-
-		-	-	-	-	
2023-2024	21.70	4.12	5.81	-	31.63	
2024-2025		4.12	15.88	-	20.00	
2025-2026		4.12	15.88	-	20.00	
2026-2027		4.12	20.06	2.49	26.67	4.18
2027-2028		4.12	15.88	0.85	20.85	
2028-2029		4.12	15.88	-	20.00	
2029-2030		4.12	15.88	56.38	76.38	
2030-2031		4.12	15.88	1.27	21.27	
2031-2032		4.12	15.88	-	20.00	
2032-2033		4.12	15.88	3.62	23.62	
2033-2034		4.12	15.88	-	20.00	
2034-2035		4.12	15.88	-	20.00	
2035-2036		4.12	15.88	82.24	102.23	
2036-2037		4.12	15.88	-	20.00	
2037-2038		4.12	15.88	3.39	23.39	
2038-2039		4.12	15.88	2.49	22.49	
2039-2040		4.12	15.88	-	20.00	
2040-2041		4.12	15.88	-	20.00	
2041-2042		4.12	15.88	57.33	77.33	
2042-2043		4.12	15.88	1.13	21.13	
2043-2044		1.03	7.33	-	8.36	
Total Cost:	***21.70***	***83.40***	***319.03***	***211.19***	**635.32**	**-**

Note: All the Costs are in Crores, inclusive of GST, without escalation considering FY 2024 price

7.7 CAPACITY AUGMENTATION

The project has not envisaged the capacity augmentation during the concession period.

8.1 DATA COLLECTION AND REVIEW TMS Works

- ✓ **Clause 9.1 of Schedule B**

(a) Existing Toll Plaza at Km 840+567 (Mohtara) and all toll booths are proposed to be retained. Any modification if required shall be done as per NHAI / Policy Guidelines / Management of Plaza / 2021 Policy Circular No. 17.5.82 Dated 25th May 2021. The Concessionaire shall modify / improve Toll Management System (TMS) as per latest Hybrid ETC system. Existing Toll Plaza Administration building shall be repaired/ rehabilitated as per the specifications and standards given in IRC: SP: 84-2019. Required numbers of parking bays are to be provided within the Toll Plaza premises in consultation with Independent Engineer. Toilet blocks and Water ATM (one in each direction) with adequate parking facility near Toll Plaza Area shall be provided / maintained as per the drawings and standards give in NHAI Circular dated 09-11-2017 (Ref. NHAI/GM(T)HO/Highway Nest (Mini)/2017/108290).

(b) The Existing Toll Booths, Toll Plaza premises including all facilities, parking etc. shall be repaired, maintained and upgraded for smooth toll operation as per IRC SP: 84-2019.

(c) The Concessionaire shall be responsible to ensure toll plaza assets, TMS, equipment's and systems shall conform to the latest available technology / MORTH Specification / IRC / MORTH and NHAI Circular/ Policy as applicable and NO COS shall be admissible on this account for future amendments / upgradation.

- ✓ **Schedule C states as below:**

a. Engineering and safety improvements along the project highway shall conform to the IRC: SP: 84:2019, Manual of specifications & Standards for Four Laning of Highways through Public Private Partnership published by IRC.

b. Clause 2 – Deviations from the manual - Section 10: Existing Toll Plaza office complex (under construction) is to be retained. Facilities as mentioned in Clause 10. Existing Toll Plaza office complex (under construction) is to be retained. Facilities as mentioned in Clause 10.12 are to be provided within the existing Toll Plaza office Complex.

(d) IRC SP: 84:2019 clause 10.6.2 – Not less than 2 middle toll lanes shall be capable of being used as reversible lane to meet the demand of tidal flow.

- ✓ **Present major issues at site:**

(e) As AVC performance is very poor, new AVC system is recommended.

(f) 6 Nos. receipt printers are not working

(g) Static weigh bridge – Capacity of installed weigh bridge is 100 MT as against 120 MT.

8.2 DATA COLLECTION AND REVIEW ATMS Works

- ✓ **Nil-**

Pre-bid reply dtd 11.10.2023, annexure-2, S.No3: Installation, operation and maintenance of the ATMS shall be done by NHAI.

CHAPTER 9. CONCLUSIONS

- Project is a Four-lane divided Highway having rigid Pavement in either direction of 67.343 Km length, except 16.64km length on LHS has flexible pavement. Some of the structure approaches are provided with flexible pavement as a corrective measure for distressed panels.
- From Roughness Consideration, moving average method has been adopted considering 10m point interval roughness data. In order to maintain roughness within threshold limit (<2200mm/km), rectification suggested at identified locations accumulated to 36.29 lane-km length in LHS, 13.55 lane-km length in RHS.
- The Pavement Condition of the project appears to be fair in condition for most of the length. However, in rigid pavement longitudinal cracks, Raveling, Transverse Cracks and longitudinal wide joints are observed at few locations. Overall, total pane replacement suggested for 315 Nos., partial 1m full depth repair for 1396 Nos., staple and stich for 937 Nos and raveling for 75069 sqm.
- For the available flexible pavement in regard to structural (FWD) consideration there is no requirement no overlay.
- One Truck lay byes was observed in the Project Highway. Toilets blocks, Water Kiosks & Rest Areas were not constructed due to non-land availability. Paver blocks pavement is provided at Laybys.
- As per Site 42 No Solar Blinkers are observed at median opening locations, in which 9 Nos are non-functional.
- Highway lighting provided for a length of Km 21.762 in which bulbs are missing at few locations. There are 18 Nos. of High Mast Lights, 106 Nos. of double arm lights, 665 Nos. of Single arm lightings are observed along the Project Corridor.
- The project corridor has a closed lined drain for a length of 32.490kms. At few locations covered slab is damaged.
- Pavement condition of the main carriageway and service road is mostly fair. However, few locations some distresses are observed.
- Median plantation is observed for a length of 38.703kms in the entire project corridor.
- 25 Nos. of KM-stones and 337 No. of HM-stones are missing and the same shall be replaced. There is no painting 3 Nos. of HM-stones was and same shall be rectified
- MCB's were observed for a length of 34.285 Kms and these are in fair condition. At few locations MCB were damaged for a length of 105m.
- Pedestrian Guard Railing were observed for a length of 20.190 Kms in the project corridor. At few locations for a length of 110m damaged PGR is observed.
- There is 1 Nos. of Toll Plaza @ Km 840+567 near Mohtara village consisting of 4+4 lanes.

- The Project Stretch have 36 Nos. of Major Structures, in that 02 Nos. MJBs, 23 Nos. MNBs, 04 Nos. Flyovers, 01 Nos. ROB, 02 Nos, VUPs & 04 Nos. PUPs.
- The Project Road has verities of super structure types for various structures such as PSC Girder, RCC Girder, RCC Slab & RCC Box.
- In this Project stretch, there are Pot PTFE (New-10 Nos.) & Elastomeric (Old-08 no's, New-304 no's) observed in Girder & Slab type Structures.
- Structures are having 55 Nos. of Expansion joints in that 2 Nos. on old Structure.
- There are 12 Nos. of old bridges existing on left side 7 Nos. & right side 5 Nos. (MNB – 11 Nos., ROB - 01 Nos.)
- Some structures are already repaired and it would be necessary to closely examine these structures for further distress during the maintenance period/Project duration, by way of close inspection and testing.
- Debris observed on Abutment & pier cap at couple of locations, Cleaning of expansion joints, drainage spouts need to be done regularly.
- NDT is suggested for old ROB Bridges on LHS at Km 878+725. There are no special NDT techniques are warranted to monitor the condition. Standard tests as UPV, Half-Cell Potential, rebound hammer, cover meter survey and Carbonation depth are adequate to assess the condition. The frequency of testing, test plan would be evolved on initiation of the project.
- Based on the Site Survey and Investigations, Immediate Repair Cost has been estimated by considering the present condition of all the elements of highway and structures.
- All the Costs presented in this report are inclusive of applicable GST.

SAMARTH INFRAENGG Technocrats Pvt. Ltd

SIT/PJRP/2411610/13
12th February 2024

Chief Operating Officer
National Highways Infra Investment Managers Pvt. Ltd.
G-5&6, Sector 10, Dwarka,
New Delhi – 110075

Sub: Submission of Supplementary Report for Final Reports for RKJL-Package-IV

Ref: Our letter reference SIT/PJRP/223607/067 dated 03.06.2023

K/A Mr. Shubhra Bhattacharya

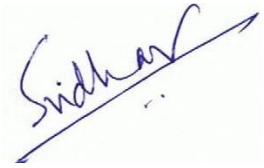
In continuation to above reference, we are pleased to submit hereby the "Supplementary Report for Final Reports" in hard/soft copies for the following asset.

- ✓ Tolling, Operation, Maintenance & Transfer of Rewa – Katni – Jabalpur Pkg 4 (Km 813+257 to Km 880+600 of NH-30 (old NH 7) in the State of Madhya Pradesh (MP).- RKJL-Package IV.

✓

Thanking you and assuring you best services all the time.

Yours Sincerely,
SAMARTH Infraengg Technocrats Pvt. Ltd.



D V Sridhar Murthy
Managing Director

Encl.: "Supplementary Report for Final Reports" for the above project in hard/soft copy.

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SUPPLEMENTARY REPORT FOR FINAL REPORT

1.1 INTRODUCTION

The Final Report was submitted on 1st Day of November 2023. Subsequent to this submission, the Operation Cost has been revised in due consultation with the Competent Authority. The following changes were made.

1. Operation Costs particularly Toll Operation Cost has been revised for Year FY 2027, FY 2028 and FY 2029 considering the reduction in Manpower. The same Operation Cost pertaining to FY2029 has been considered for rest of the Concession Period.
2. Abstract Cost has been updated in line with the above changes made in Operation Cost.
3. The updated Table-42 (O&M Cost) and Table-44 (Cost Abstract) have been presented below.
4. The Cost numbers presented in the following table supersedes cost numbers presented in the respective tables of the earlier submitted report

1.2 OPERATIONS COSTS

Table 42: O&M Cost

S.No	Particulars	FY-25	FY-26	FY-27	FY-28	FY-29
A1.1	**Tolling Operations**	4.118	4.118	3.483	3.483	3.146
A1.2	**Incident Management**	2.440	2.440	2.440	2.440	2.440
A2.1	**Routine Maintenance**	5.370	5.370	5.370	5.370	5.370
A2.2	**Repairs**	2.263	2.263	2.263	2.263	2.263
A2.3	**ATMS**	0.000	0.000	0.000	0.000	0.000
B	**Admin Expenses**	4.868	4.868	4.868	4.868	4.868
		19.058	**19.058**	**18.423**	**18.423**	**18.086**
	For FY 2027, Additional cost towards special repairs	-	-	**4.18**	-	-
	Total Operation Cost	**19.058**	**19.058**	**22.600**	**18.423**	**18.086**

Note: All the amounts are in Rs. Cr and is inclusive of GST, without escalation

1.3 TOTAL COSTS

Year on year operation cost is summation of following:

- ✓ Immediate Costs
- ✓ Routine Maintenance & Incident Management
- ✓ Periodic Maintenance
- ✓ Operations Cost

Following table presents the Cost Abstract for the project

Table 44: Cost Abstract

Project Years	Calendar Year	SUMMARY OF VARIOUS EXPENSES in Rs. Crs					Remarks
		Immediate Repair's Cost	Toll Collection Expenses and Patrolling expenses	Routine Maintenance Expenses	Periodic Maintenance (Functional +Struc Overlay+ Toll collection system)	Total Cost (Rs. Cr.)	
1	2023-2024	21.70	4.12	4.87	-	30.69	
2	2024-2025		4.12	14.94	-	19.06	
3	2025-2026		4.12	14.94	-	19.06	
4	2026-2027		3.48	19.12	2.49	25.09	4.177 Cr. Special repair cost added in RM
5	2027-2028		3.48	14.94	0.85	19.27	
6	2028-2029		3.15	14.94	-	18.09	
7	2029-2030		3.15	14.94	56.38	74.47	
8	2030-2031		3.15	14.94	1.27	19.36	
9	2031-2032		3.15	14.94	-	18.09	
10	2032-2033		3.15	14.94	3.62	21.71	
11	2033-2034		3.15	14.94	-	18.09	
12	2034-2035		3.15	14.94	-	18.09	
13	2035-2036		3.15	14.94	82.24	100.32	
14	2036-2037		3.15	14.94	-	18.09	
15	2037-2038		3.15	14.94	3.39	21.48	
16	2038-2039		3.15	14.94	2.49	20.58	
17	2039-2040		3.15	14.94	-	18.09	
18	2040-2041		3.15	14.94	-	18.09	
19	2041-2042		3.15	14.94	57.33	75.42	
20	2042-2043		3.15	14.94	1.13	19.22	
21	2043-2044		0.78	6.39	-	7.18	
	Total Cost:	***21.70***	***67.30***	***299.29***	***211.19***	**599.49**	

Note: All the Costs are in Crores, inclusive of GST, without escalation considering FY 2024 price

National Highways Infra Projects Private Limited

FINAL REPORT

Tolling, Operation, Maintenance & Transfer of Jabalpur Lakhandon (Km 880+600 to Km 891+780 of NH-30 & Km 1358+000 to Km 1428+557 of NH-34) in the State of Madhya Pradesh (MP): Package-JL

SAMARTH INFRAENGG Technocrats Private Limited

NOVEMBER 2023

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LIST OF ABBREVIATIONS AND SYMBOLS

AADT	-Average Annual Daily Traffic
AE	-Authority Engineer
AMC	-Annual Maintenance Contract
ATMS	-Advanced Traffic Management System
BC	-Bituminous Concrete
BOQ	-Bill of Quantities
BOT	-Build, Operate & Transfer
CA	-Concession Agreement
CBR	-California Bearing Ratio
CCB	-Concrete Crash Barrier
CCR	-Cement Concrete Railing
COD	-Commercial Operation Date
COS	-Change of scope
CPI	-Consumer Price Index
CUP	-Cattle Underpass
CVC	-Classified Volume Count
CVPD	-Commercial Vehicles per Day
DBM	-Dense Bituminous Concrete
DPR	-Detailed Project Report
ECB	-Emergency Call Box
EPC	-Engineering, Procurement and Construction
ESI	- Employees' State Insurance
FDD	-Filed Dry Density
FOB	-Foot Over Bridge
FRL	-Finished Road Level
FSI	-Free Swell Index
FWD	-Falling Weight Deflectometer

FY	-Financial Year
GOI	- Government of India
GR	-Growth Rates
GS	-Grade Separated
GSB	-Granular Sub Base
GST	-Goods and Services Tax
HCPT	-Half cell Potential Test
HPC	-Hume Pipe Culvert
HR	- Human Resources
HTMS	-Highway Traffic Management Systems
IE	-Independent Engineer
IRC	- Indian Roads Congress
IRC SP	- Indian Roads Congress Special Publications
IRI	-International Roughness Index
Km	-kilometer
LHS	-Left Hand Side
LL	-Liquid Limit
LS	-Lumpsum
m	-Meter
MBIU	-Mobile Bridge Inspection Unit
MCB	-Metal Beam Crash Barrier
MCS	-Micro Surfacing
MCW	-Main Carriageway
MDD	-Maximum Dry Density
MHR	-Metallic Hand Rail
MJB	-Major Bridge
mm	-Millimeter
MM	-Major Maintenance
MNB	-Minor Bridge
MoRT&H	- Ministry of Road Transport & Highways
MPa	-Mega Pascal
MR	-Resilient Modulus
MSA	-Million Standard Axle
NDT	-Non-Destructive Testing
NHAI	- National Highways Authority of India
NSV	-Network survey Vehicle
O&M	- Operation and Maintenance
OL	-Overlay
PF	-Provident Fund
PGR	-Pedestrian Guard Rail

PI	-Plasticity Index
PL	-Plastic Limit
PM	-Periodic Maintenance
PUP	-Pedestrian Underpass
R&R	-Repair and Rehabilitation
RCC	-Reinforced Cement Concrete
RE Wall	-Reinforced Earth Wall
RHS	-Right Hand Side
RHT	-Rebound Hammer Test
RM	-Routine Maintenance
ROB	-Road Over Bridge
RPO	-Route Patrol Officer
RUB	-Road Under Bridge
SDBC	-Semi-Dense Bituminous Concrete
SPV	-Special Purpose Vehicle
SR	-Service Road
SWB	-Static Weigh Bridge
TCS	-Typical cross Section
TDRT	-Transient Dynamic Response test
TMS	-Toll Management System
UI	-Unevenness Index
UPVT	-Ultra Pulse Velocity test
VDF	-Vehicle Damage Factor
VG	-Viscosity Grade
VUP	-Vehicular Underpass
WBM	-Water Bound Macadam
WMM	-Wet Mix Macadam
WPI	-Wholesale Price Index

CHAPTER 1. INTRODUCTION

1.1 INTRODUCTION

National Highways Authority of India ("NHAI"/ "Authority") is an autonomous body of the Government of India ("GoI") under the Ministry of Road Transport and Highways ("MoRTH") and was constituted on June 15, 1989 by an Act of Parliament titled - The National Highways Authority of India Act, 1988 ("NHAI Act"). NHAI was operationalized in February 1995 with the appointment of full time Chairman and other Members. The functioning of NHAI is governed by NHAI Act and rules, and regulations framed thereunder.

NHAI has set up an Infrastructure Investment Trust Namely National Highways Infra Trust ("InvIT") and is acting as its Sponsor to the said InvIT.

National Highways Infra Investment Managers Private Limited ("NHIIMPL") has been appointed as the Investment Manager to the InvIT

National Highways Infra Projects Private Limited ("NHIPPL"), a wholly owned subsidiary of InvIT is planning to enter into concession agreements with NHAI for "Tolling, Operation, Maintenance & Transfer of Jabalpur Lakhandon (Km 880+600 to Km 891+780 of NH-30 & Km 1358+000 to Km 1428+557 of NH-34) in the State of Madhya Pradesh (MP).

M/s National Highways Infra Projects Private Limited ("NHIPPL") has engaged M/s SAMARTH INFRAENGG Technocrats Pvt Ltd as their Technical Consultants for undertaking technical due diligence study for the said project to estimate initial improvement cost (EPC) including immediate requirements for repair & rehabilitation of various elements and make an assessment of Operation & Maintenance costs for entire concession period.

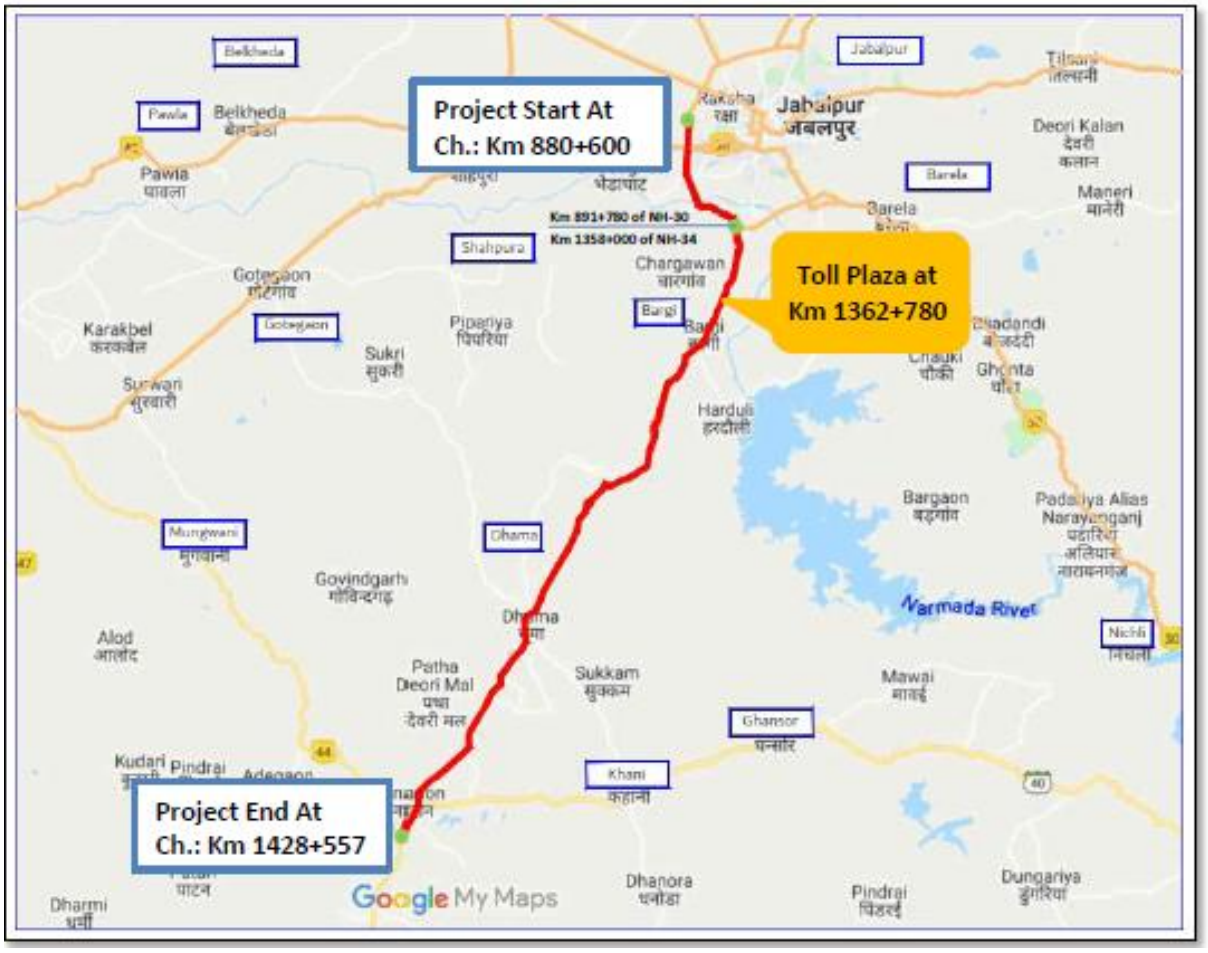
1.2 PROJECT AT A GLANCE

The site of the four-lane divided Project Highway comprises the section of National Highway NH-30 & 34 (old NH-7) commencing from Km 881+516 to Km 891+780 (at NH-30) and Km 1358+000 to Km 1428+557 (at NH-34) in the state of Madhya Pradesh.

The project road was awarded to M/s Larsen and Turbo Limited under EPC and Commercial Operation Date (COD) achieved on 14 Aug 2020. The defect liability Period of EPC Contractor is till 12 Feb 2024

The National Highway (NH-30) starts at the junction of NH-9 at Sitarganj and ends at the junction of NH-65 at Ibrahimpatnam, Vijayawada. the highway passes through the states Uttarakhand, Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Telangana and Andhra Pradesh in India. The National Highway connects several cities and town such as Sitarganj, Pilibhit, Bareilly, Tilhar, Shahjahanpur, Sitapur, Lucknow, Raebareli, Allahabad, Rewa, Jabalpur, Mandla, Raipur, Dhamtari, Charama, Kanker, Kondagaon, Jagdalpur, Sukma, Konta, Nellipaka, Bhadrachalam, Paloncha, Kothagudem, Tiruvuru, Ibrahimpatnam and Vijayawada. The total length of this highway is 1,984.3 km.

National Highway (NH 34) starts at Gangotri Dham in Uttarakhand and ends at Lakhnadon in Madhya Pradesh, the highway passes through the states Uttarakhand, Uttar Pradesh, Madhya Pradesh in India, the national highway connects several cities and towns such as Gangotri Dham, Bhatwari, Uttarkashi, Dharasu, Tehri, Ampata, Rishikesh, Haridwar - Uttar Pradesh border. Najibabad, Bijnore, Meerut, Mawana, Ghaziabad, Bulandshahr, Aligarh, Sikandra Rao (Hathras) Etah, Kannauj, Kanpur, Hamirpur, Mahoba - Madhya Pradesh border, Chhatarpur, Hirapur, Damoh, Jabalpur, Lakhnadon, the total length of this highway is 1,426 km.



Map Showing the Project Corridor

Table 1: Project Corridor Chainage System

Referencing system	Project Corridor Start Point (km)	Intermediate point (km)	Project Corridor End Point (km)	Length (km)
As per CA Chainage	880.600 (NH-30)	891.780 (NH-30)/ 1358.000 (NH-34)	1428.557 (NH-34)	81.737
As per Site	880.600 (NH-30)	891.780 (NH-30)/ 1358.000 (NH-34)	1428.557 (NH-34)	81.737

Photograph showing the start and end point of the project road are presented below

A view of the Start Point of Project Road at km 880.600

A view of the End Point of Project Road at km 1428.557

1.3 OBJECTIVE AND SCOPE OF SERVICES

The main objective of the study is to review the current status of project corridor including details pertaining to its construction and maintenance and to provide requisite technical information for processing the acquisition of said project by client. Objective of the study can be broadly defined with following tasks:

- Study CA requirements for construction/maintenance requirements
- Undertake Detailed Reconnaissance to appreciate the project corridor characteristics
- Collection of relevant records and documents and review of same
- Undertake Engineering Studies to Establish:
    - Present Condition of Existing Road Assets
    - Quality of Executed Works/Quantity of Reutilization
    - Requirement of Immediate improvement costs as per Sch B (1st Year Capex)
    - Major Maintenance Strategies Over Concession Period
    - Routine Maintenance & Operations Requirements Over Concession Period

- Prepare BOQ
- Prepare Rate Analysis and finalize unit rates
- EPC and O&M Cost

End Result is the finalization of:

- Initial improvement Works
- Major Maintenance Schedules/Cost
- Routine Maintenance Cost
- Operations Cost

The elaborate scope of services as defined in the "terms of reference" for consultants is as below:

i) Detailed reconnaissance.

ii) Video graphic survey of the entire Project corridor.

iii) Carrying out inventory and condition surveys for Project Road.

iv) Carrying out Inventory and detailed condition surveys for bridges & cross drainage structures (along with Photographs thereof) including recommendation for either strengthening/rehabilitation or reconstruction.

v) 24 hrs. Axle load survey along with axle load spectrum analysis for rigid pavement of the project corridor at one location, wherever applicable (7-day traffic count to be provided by client)

vi) Test pits required @ every 10 km interval along the Project corridor.

vii) Carrying out necessary laboratory tests to determine the CBR value of the subgrade materials to be obtained from potential borrow pits and the quality of the aggregates from potential quarries for the pavement layers, concrete etc. The existing ground which will support the embankment and pavement must be tested for its adequacy, particularly in silty or clayey water-logged areas.

viii) Carrying out deflection test by Falling Weight Deflect meter (FWD) for existing pavement as per relevant IRC code at the rate of 5 points in km in each direction making it 10 points for both directions in the damaged stretches as well as fair stretches.

ix) Availability of construction materials as per required specification to be confirmed. Detailed Logistic plan showing the locations of the potential Borrow pits, Quarries, etc.

x) Report on existing condition of Toll Plazas and its associated facilities and proposal for their improvement.

xi) Preparation of Maintenance (Routine, Periodic and Major) costs to be incurred over the period of the concession keeping in mind the requirements of the draft Concession Agreement like adequate resources, maintenance of Cranes, Ambulance, etc.,

xii) Independently develop a bottom-up forecast of Operating expenses for each project, with detailed break-up of each type of operating expense, along with underlying assumptions

1.4 DATA COLLECTION AND REVIEW

In brief, following were covered

- ✓Review of Concession Agreement & Schedules,
- ✓Review of Detailed Project Report prepared by NHAI
- ✓ Review of As-built drawings, Plan and profiles, Structural drawings & Detailed Project Reports and Designs where available
- ✓Review of O&M costs as presented in DPR reports
- ✓Review of MPR provided by NHAI
- ✓Review of Latest NSV and FWD data provided by PIU, NHAI

1.5 PAVEMENT DESIGN REVIEW

As per Schedule-B

Flexible Pavement shall be provided for minimum design traffic of 60 MSA or 20 years design traffic whichever is maximum for main carriageway. Whereas, service road shall be designed for 10MSA and 30MSA.

Considering CTSB, Consultants have suggested as an option the following thicknesses has been arrived as follows.

		CBR: 8%, Va-3.5 & Vb-10.5 with VG-40		
S No	**Layers**	**10 MSA**	**30 MSA**	**60 MSA**
1	**BC in mm**	40	40	**40**
2	**DBM in mm**	-	50	**90**
3	**WMM in mm**	150	150	**150**
4	**CTSB in mm**	200	200	**200**
	Total in mm	**390**	**440**	**480**

However, as TCS cross section drawings are showing conventional layers so an attempt has been made with design of conventional layers thicknesses as below.

S No	**Layers**	**Conventional - Option**			
		CBR-10%			
		10 MSA	**30 MSA**	**60 MSA**	**110 / 115 MSA**
		Va-4.5 & Vb-10.5	**Va-3.5 & Vb-10.6**	**Va-3.2 & Vb-10.6**	**Va-3.2 & Vb-10.6**
1	BC in mm	30	40	40	50
2	DBM in mm	50	95	115	130
3	WMM in mm	250	250	250	250
4	GSB in mm	200	200	200	200

S No	Layers	Conventional - Option			
		CBR-10%			
		10 MSA	30 MSA	60 MSA	110 / 115 MSA
		Va-4.5 & Vb-10.5	Va-3.5 & Vb-10.6	Va-3.2 & Vb-10.6	Va-3.2 & Vb-10.6
	Total in mm	530	585	605	630

DPR has suggested the following conventional thicknesses has been arrived as follows

S No	Layers	10 MSA	30 MSA	60 MSA
1	BC in mm	30	40	50
2	DBM in mm	50	85	70
3	WMM in mm	250	250	150
4	GSB in mm	200	200	
5	CTSB in mm			200
	Total in mm	530	575	470

CHAPTER 2. SURVEYS AND INVESTIGATIONS

2.1 INTRODUCTION

The main objective of undertaking Surveys and Investigations is to appreciate the existing engineering features along the project corridor and to understand the present condition of the various elements of the project road and to prepare required inputs for various rehabilitation and maintenance strategies.

Following Survey and Investigations have been undertaken as a part of study with an objective to understand the present condition of the road and there by access the quality of construction and as well to prepare requisite rehabilitation/corrective designs where necessary.

- Road Inventory Surveys
- Pavement Condition using NSV
- FWD Surveys
- Roughness Surveys using NSV
- Pavement Composition surveys (Test Pits)
- Subgrade Investigations & Laboratory testing
- Material Investigations
- Core Cutting Investigation
- Axle Load Survey
- Structure Inventory and Condition Surveys

2.2 ROAD INVENTORY

The project corridor has combination of both Flexible and Rigid pavement, with 7.5m wide carriageway including shyness flanked by 1.5m paved shoulder plus 1.0 m to 1.5 m earthen shoulder on each side expect at Structure Approach locations. The length of Rigid and flexible pavement is presented below.

Description	LHS (km)	RHS (km)
Before Improvement Works		
Rigid Pavement	56.085	62.52
Flexible Pavement	25.652	19.217
Project Length	81.737	81.737
After Improvement Works		
Rigid Pavement	55.185	61.620
Flexible Pavement	26.552	20.117
Project Length	81.737	81.737

The road has 4m wide raised median and at few locations it has depressed median of 10.8m width.

The project corridor generally runs in plain terrain. The land use along the project road is mostly Agricultural. It passes through urban settlements like, sagra, Gana village, Bagri, Halki Village, Rampur Village, Banjari Villege, Sanai dongari Village.

In general, road embankments are in the range of 0.5-2.5m height. Embankments higher than 2.5m are observed mainly in the approaches of CD-Structures and Underpass locations.

Typical View of Project Road is shown below:

A view of the Project Corridor at Km 883.200

A view of the Project Road at km 888.500

A view of the Project Road at km 890.000

A view of the Project Road at km 1364.500

A view of the Project Road at km 1371.110

A view of the Project Road at km 1383.800

The Project Road has 19 Nos. of major junctions and 68 Nos. of minor junctions along its length. Photographs showing the Major Junctions and minor junctions are presented below:

Major Junction at km 881.516 BHS

Major Junction at km 884.110 BHS

Minor Junction at km 886.460 RHS

Minor Junction at km 889.870 LHS

Minor Junction at km 1366.240 RHS

Minor Junction at km 1410.080 RHS

High mast observed at 16 Nos. of locations near major Junction and Toll Plaza locations, whereas, Highway lighting is observed 11.700 Kms length of along the project road near urban locations. Few photos showing High masts & lighting are presented below:

A view of High Mast Lighting at km 1402.000 LHS

A view of Single Arm lighting at km 881.600 LHS

A view of Double Arm lighting at km 1386.000 Median

A view of SA & DA lighting at km 1413.000 RHS

Project Road has provided with 29 Nos. of Bus bays with shelters & 13 Nos. of Bus Shelters along the project road. Few photos taken at the Bus Bays and Bus Shelters are presented below:

Bus shelter @ Km 883.980 LHS

Bus Bay with Bus shelter @ 888.990 Km RHS

The Project Road has 2 Nos. of Truck lay byes (BHS) along the project corridor. These truck laybyes have been provided with Rigid and paver blocks and the condition appears to be fair. Toilet blocks was provided and also fair in condition. Separator is provided between main carriageway and Truck lay bye portion. Lighting in the form of single arm poles have been provided on the shoulder side of the truck lay bye. On each side, 11 nos. of 1-arm lights are observed and almost all are found to be in good condition.

Few photos depicting the truck lay bye portion are presented below:

A view of Truck Lay Bye at Km 1385.260-LHS

A view of Truck Lay Bye at Km 1395.795 - LHS

The Project Road has 1 Nos. of Toll Plaza at Km 1362+780(NH-34). Rigid pavement exists at the toll plaza location. The condition of the toll plaza appears to be fair. It has 4+1 lanes on each side. High mast lighting of 4 Nos. have been provided at Toll Plaza approaches and double arm lighting has been provided on median.

A view of the Existing Toll Plaza near km 1362+780 (Boharipar Toll plaza)

A view of the Admin Building at Toll Plaza

A view of the Static weigh Bridge at Toll plaza

A view of Toll plaza Tunnel

Ambulance - Toll plaza

Service road/slip roads of carriageway width of 7.0 m have been observed in the Project Corridor with flexible pavement for a length of 14.585 km. Photos depicting the service/slip road pavement surface type, condition and the other associated features like drain. Few photos taken at service/slip road locations are presented below:

Service road at km 881.200 LHS

Service road at km 881.200 RHS

Service road at km 1413.100 RHS	Service road at km 1412.700 RHS

The collected Road Inventory Data is presented in **Appendix 1** of this Report

2.3 PAVEMENT CONDITION SURVEYS

The present Pavement condition data has been collected using **Network Survey Vehicle (NSV)**. The Pavement Condition report covering the data collection for each km length in each direction has been presented in **Appendix 2** of this Report.

The photographs showing the pavement condition of the Project Road is presented below.

Ravelling @ km 880.950 LHS	Transverse Crack @ Km 881.050LHS	Longitudinal Wide Joint @ km 881.260 LHS
Longitudinal Cracks @ Km 890.060 LHS	Longitudinal Cracks @ km 1400.150 LHS	Delamination @ km 1428.450 RHS

Wide crack sealing @ Km 1423.800 RHS	Panel Replacement @ km 1414.000 RHS	Transverse Cracks @ Km 1411.520 RHS
Longitudinal Crack @ Km 884.440 RHS	BT in Fair Condition @ Km 1378.250 LHS	BT in Fair Condition @ Km 1376.000 RHS

✓ **Standards and Specifications of IRC:82-2015 (for Flexible Pavement)**

The Pavement condition survey may be undertaken by the visual assessment of the surface by identifying the type, location and magnitude of the distress and the rating of the Pavement may be assignment as per the criteria given in Table 5.1 of IRC: 82-2015 as below:

Defects (type)	**Ranges of Distress**		
Cracking (%)	>10	5 to 10	<5
Ravelling (%)	>10	1 to 10	<1
Potholes (%)	>1	0.1 to 1	<0.1
Shoving (%)	>1	0.1 to 1	<0.1
Patching (%)	>10	1 to 10	<1
Settlement and Depression (%)	>5	1 to 5	<1
Rut depth (mm) using 3m straight edge	>10	5 to 10	<5
Rating	1	1.1 - 2	2.1 - 3
Condition	**Poor**	**Fair**	**Good**

For the calculation of the Weighted Rating Value of each individual parameter, the following fixed weightages have been assigned.

S.No.	Parameter	Weightage (Fixed) (Multiplier Factor)
1	Cracking	1.00
2	Raveling	0.75
3	Potholes	0.50
4	Shoving	1.00
5	Patching	0.75
6	Settlement	0.75
7	Rut depth	1.00

The Final Rating Value is calculated by taking the average of the Weighted Rating Values of all parameters viz: cracking, raveling, potholes, shoving, patching, settlement and rut depth.

It may be noted the acceptable/desirable level of service mentioned under IRC 82-2015 indicates at condition rating in terms of 1-3, <=1 being the poor and >2.1-3 being the good condition.

- ✓ **Standards and Specifications of IRC:SP: 83-2018 (for Rigid Pavement)**

  Pavement Condition Survey with various distresses like (cracking pop outs, raveling, settled panels damaged panels etc.) are identified. For identified distresses, based on the Severity and Extent of distress, suggested following various treatments as per IRC SP 83-2018 guidelines

Treatment Proposed	Distress Identified	Severity and
Panel Replacement	Multiple cracks (>30)	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Alligator Cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Transverse Cracks	5 .>6mm wide
	Longitudinal Crack	5. >12mm wide
Partial Panel Replacement	Multiple cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Alligator Cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Transverse Cracks	4. 3mm-6mm wide
	Longitudinal Crack	4. 6mm-12mm wide
Stitching and stapling	Multiple cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Alligator Cracks	3. 0.5mm-3 mm wide
		4. 3mm-6mm wide
		5 .>6mm wide
	Transverse Cracks	3. 0.5mm-3 mm wide
	Longitudinal Crack	2. 0.5mm-3mm wide
		3. 3mm-6mm wide

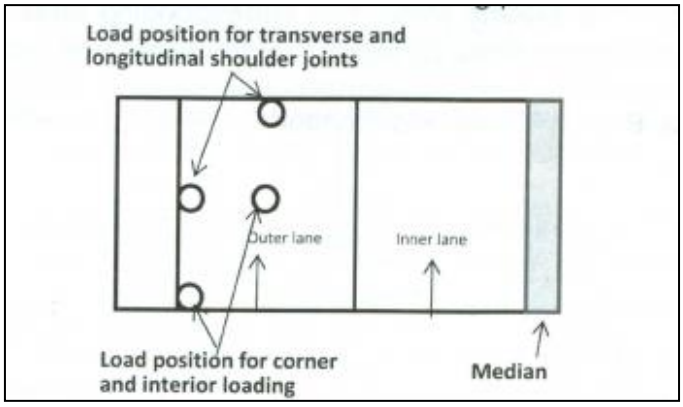
2.4 FALLING WEIGHT DEFLECTOMETER (FWD) SURVEYS

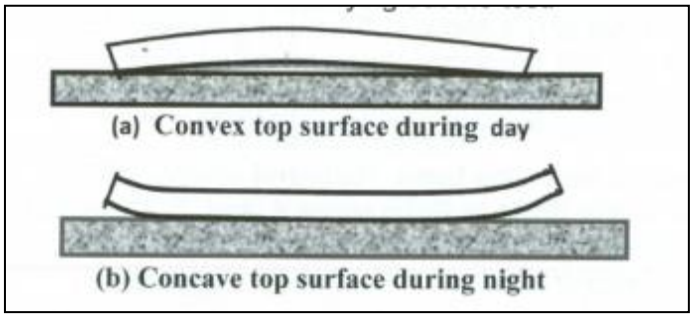
2.4.1.Pavement Evaluation Using FWD - Rigid Pavement

Structural condition of in-service rigid pavement can be evaluated using Falling Weight Deflectometer as per IRC 117 guidelines. FWD surveys are done at interior of panel to determine the Strength of Concrete and Subgrade Support and to detect voids for loss of support FWD has been done in Wheel path.

For Evaluation of Modulus of Subgrade reaction and Strength of Concrete i.e., "Interior" loading case is done when temp gradient is zero or Negative (Top Surface is Cooler than Bottom), i.e., in the Early Morning or night time has been done.

Corner loading has no indirect measure from the test, FWD test to be done when pavement is not in curled position and Deflections measured along wheel paths to get void locations. Load position for various cases has been presented below:





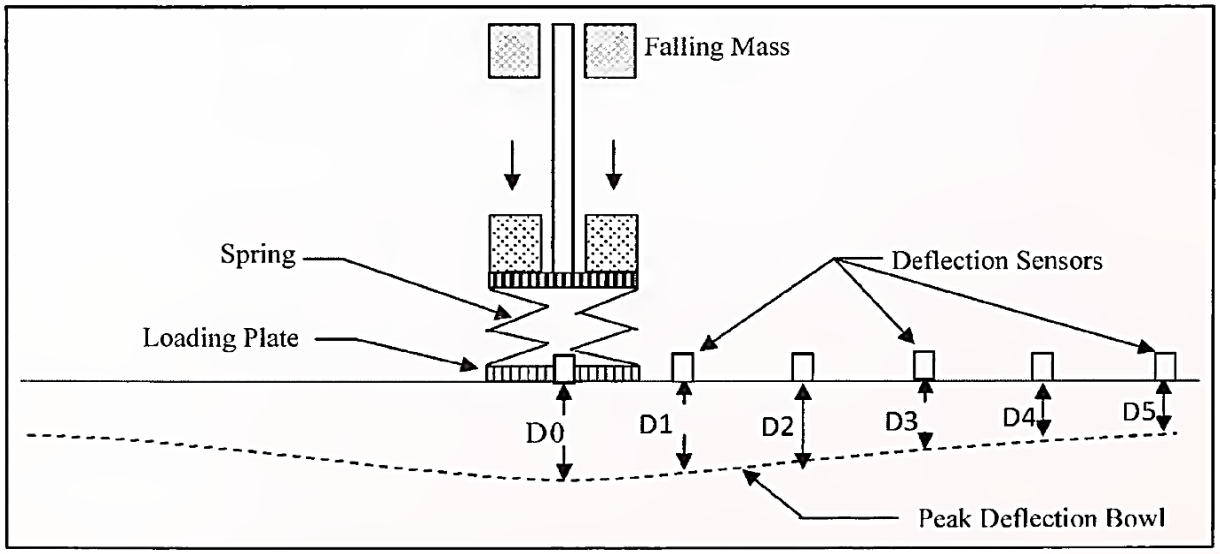
Among equipment available for structural evaluation of pavements, the Falling Weight Deflectometer (FWD) is extensively used world-wide because it simulates, to a large extent, the actual loading conditions of the pavement. When a moving wheel load passes over the pavement it produces load pulses. Normal stresses (vertical as well as horizontal) at a location in the pavement will increase in magnitude from zero to a peak value as the moving wheel load approaches the location. The time taken for the stress pulse to vary from zero to peak value is termed as 'rise time of the pulse'. As the wheel moves away from the location, magnitude of stress reduces from peak value to zero. The time period during which the magnitude of stress pulse varies from 'zero-to-peak-to-zero' is the pulse

duration. Peak load and the corresponding pavement responses are of interest for pavement evaluation.

Working Principle of Falling Weight Deflectometer

Falling Weight Deflectometer (FWD) is an impulse-loading device in which a transient load is applied to the pavement and the deflected shape of the pavement surface is measured. The working principle of a typical FWD is illustrated in Fig below. D0, D1, etc., are surface deflections measured at different radial distances. Impulse load is applied by means of a falling mass, which is allowed to drop vertically on a system of springs placed over a circular loading plate. The deflected shape of the pavement surface is measured using displacement sensors which are placed at different radial distances starting with the center of the load plate.

A mass of weights is dropped from a pre-determined height onto a series of springs / buffers placed on top of a loading plate. The corresponding peak load and peak vertical surface deflections at different radial locations are measured and recorded.



Basically, the FWD generates a transient, of different magnitudes of impulse load by selection of a suitable mass and an appropriate height of fall. Under the application of the impulse load, the pavement deflects. Velocity transducers are placed on the pavement surface at different radial locations to measure surface deflections. Geophones or seismometers are used as displacement transducers. Load and deflection data are acquired with the help of a data acquisition system.

FWD includes a circular loading plate of 300 to 450mm diameter, in the present survey 300mm diameter load plate is used. A falling mass in the range of 50 to 350 kg is dropped from a height of fall in the range of 100mm to 600mm to produce load pulses of desired peak load and duration. The target peak load in the range of 40KN to 60KN or Higher may be applied on Concrete Pavement to get a reasonable deflection of the order of 0.15 mm since pavements of major highways in India consisting of 150mm DLC and 300mm PQC are very stiff and a higher load may be required to get a deflection of about

0.15mm. In the present case target peak load as high as 150 KN is also used to get a reasonable deflection on concrete pavement.

In present study, Falling Weight Deflectometer (FWD) Test system has been used to generate the requisite NDT load-deflection data which was analyzed and is presented in this report. Surface deflections were measured at the center of the 300mm diameter loading plate and at the radial distances shown in the below table:

Sl. No	Geophone Ref No	Radial distance measured from center of load plate (mm)
1	D0	0
2	D1	300
3	D2	600
4	D3	900

Methodology adopted for carrying the survey

1. The FWD Surveys are carried out as per IRC:117-2014
2. The project road has two longitudinal joint one at center and other paved shoulder. Panel size is nearly 4.5x3.5m
3. Interior points at a distance of 2.25m from edge (1.5m paved shoulder+0.75m for wheel path). These points will also act as under wheel path for detection of voids. Testing was done at two interior points in at 200m and 600m. Three points @ 0, 400 and 800 in inner lane to know strength/subgrade support. (These have been taken at night)

The collected FWD Data and Analysis is presented in **Appendix 3** of this Report.

2.4.2. Falling Weight Deflectometer Survey (Flexible Pavement)

In order to evaluate the structural strength of the existing pavement, Falling Weight Deflectometer (FWD) survey has been carried out along the project road as per IRC 115 guidelines. The collected FWD Data and Analysis is presented in **Appendix 3** of this Report.

Few photos taken during the progress of FWD Surveys are presented below:

Deflection Measurement in progress

Deflection Measurement in progress

The homogenous sections in each direction of traffic (i.e., LHS & RHS) for the project stretch have been identified and are given in the below table followed by graphical representation of the same.

Table 2: FWD Data – Summary of Homogenous Section of Main Carriageway – LHS

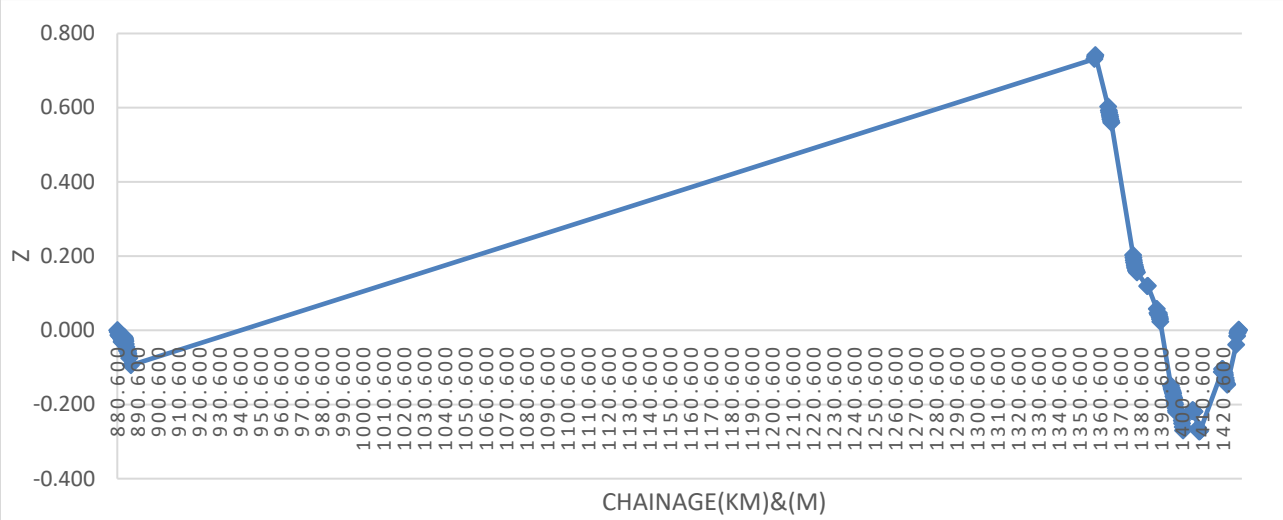
S. No	From	To	Length (m)	Remarks
1	880.60	881.68	1.1	
2	881.68	881.92	0.2	Rigid Pavement
3	881.92	883.80	1.9	
4	883.80	887.30	3.5	
5	887.30	1358.00	4.5	Rigid Pavement
6	1358.00	1358.40	0.4	
7	1358.40	1364.70	6.3	Rigid Pavement
8	1364.70	1366.20	1.5	
9	1366.20	1376.80	10.6	Rigid Pavement
10	1376.80	1378.80	2.0	
11	1378.80	1383.70	4.9	Rigid Pavement
12	1383.70	1384.13	0.4	
13	1384.13	1388.50	4.4	Rigid Pavement
14	1388.50	1390.20	1.7	
15	1390.20	1395.32	5.1	Rigid Pavement
16	1395.32	1395.81	0.5	
17	1395.81	1398.23	2.4	
18	1398.23	1400.25	2.0	Rigid Pavement
19	1400.25	1401.33	1.1	
20	1401.33	1405.60	4.3	Rigid Pavement
21	1405.60	1406.90	1.3	
22	1406.90	1408.68	1.8	Rigid Pavement
23	1408.68	1409.48	0.8	
24	1409.48	1420.11	10.6	Rigid Pavement
25	1420.11	1421.80	1.7	
26	1421.80	1422.85	1.0	
27	1422.85	1427.21	4.4	Rigid Pavement
28	1427.21	1428.56	1.3	
	Total Length		**81.7**	

Table 3: FWD Data – Summary of Homogenous Section of Main Carriageway – RHS

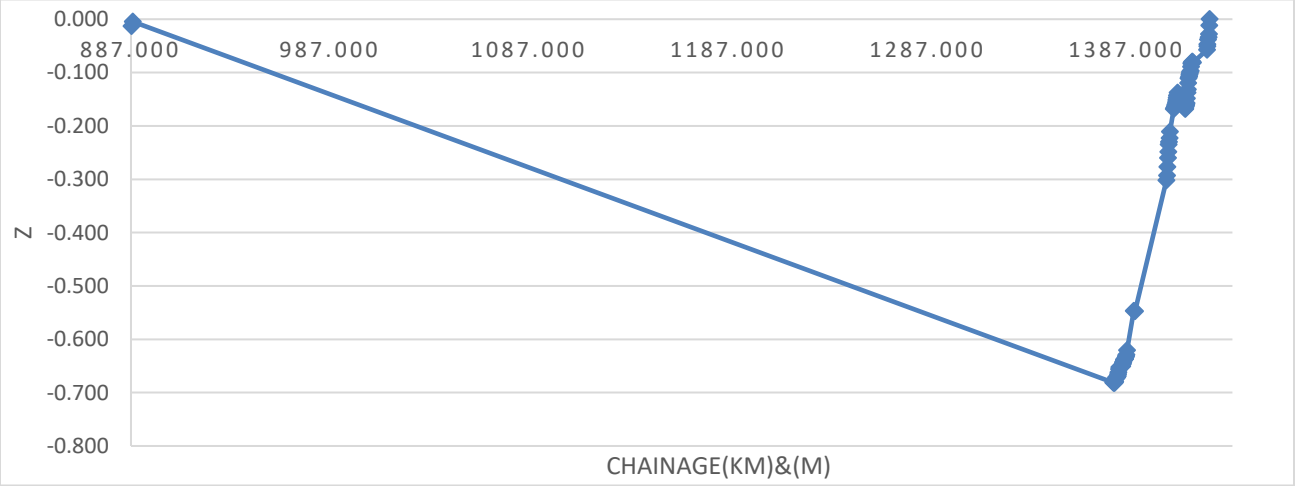
S. No	Homo sections	From	To	Length (m)	Remarks
1	1	881.680	886.190	4.51	Rigid Pavement
2	2	886.19	887.98	1.8	
3	3	887.98	891.78	3.8	Rigid Pavement
4	4	1358.00	1380.18	22.2	Rigid Pavement
5	5	1380.18	1383.22	3.0	
6	6	1383.22	1384.67	1.5	Rigid Pavement
7	7	1384.67	1387.07	2.4	
8		1387.07	1390.50	3.4	Rigid Pavement
9		1390.50	1391.10	0.6	
10	8	1391.10	1406.88	15.8	Rigid Pavement
11	9	1406.88	1408.69	1.8	
12		1408.69	1410.53	1.8	Rigid Pavement
13		1410.53	1412.47	1.9	
14	10	1412.47	1416.13	3.7	Rigid Pavement
15	11	1416.13	1419.00	2.9	
16	12	1419.00	1420.17	1.2	
17		1420.17	1427.21	7.0	Rigid Pavement
18		1427.21	1428.55	1.3	
		Total Length		**80.61**	

Cumulative Difference Approach (CDA) has been used for the identification of homogeneous sections on the basis of Surface Curvature Index (SCI). SCI is calculated as the difference between D_0 and D_{300}, where D_0 and D_{300} are the peak deflections (mm) measured at the centre of loading plate and at a radial distance of 300mm

The homogenous sections in each direction of traffic (i.e., LHS & RHS) for the project stretch have been identified for Main carriageway and Slip Road are given in the below tables followed by graphical representation of the same.



Delineation of Homogeneous Section - LHS



Delineation of Homogeneous Section - RHS

2.5 ROUGHNESS SURVEYS

The Roughness data has been collected using **Network Survey Vehicle** and analyzed in terms of International Roughness Index (IRI), separately for each lane, for both direction of travel. Pavement Roughness report covering the data collection and methodology, computation of IRI for each km length in each direction is presented in **Appendix 4** of this Report.

As per Schedule-F of TOT, the desirable level of service for Roughness values for bituminous pavement surface is considered to less than 2000 mm/Km and the acceptable limits are less than 2400mm/Km.

As per Schedule-F of TOT, the desirable level of service for Roughness values for rigid pavement surface is considered to less than 2200 mm/Km and the acceptable limits are less than 2400mm/Km.

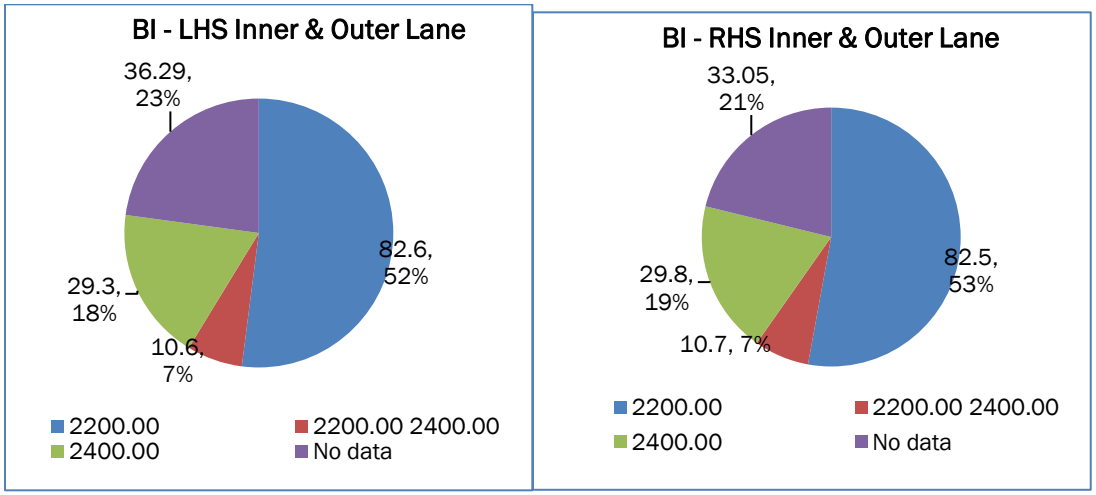
However, as per EPC Contract, Schedule-E, Roughness values should not exceed 2200mm/Km.

Average UI values along the corridor were grouped in to four categories, Pie chart showing the range of UI values in each carriageway of the project road have been presented below:

Roughness >2200 mm/km:

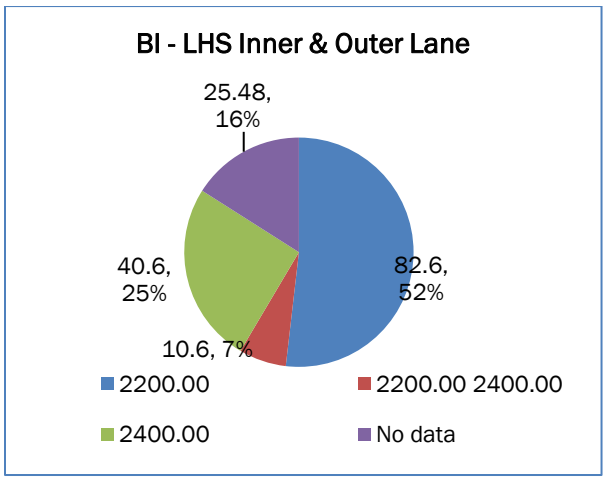
Rectification suggested based on moving average method for values >2200mm/km (based on EPC agreement)

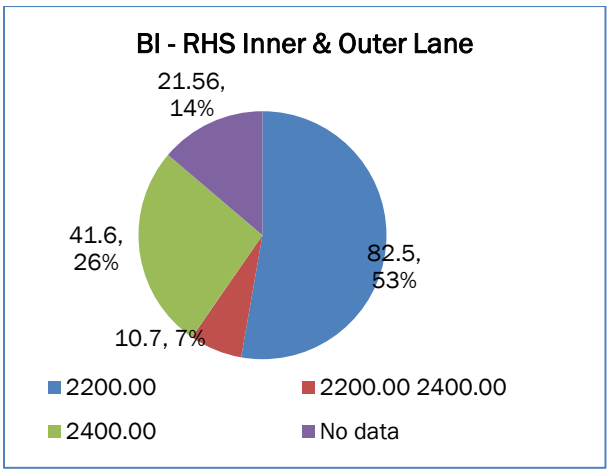
The 10m point data captured has been summed upto 100 points so as to make 1km length in moving average method for consecutive points. The high values (10m points) of the captured data has be discarded so as maintain the roughness (<2200mm/km).The following pie chart shows the summed up individual 10m points data including deleted 10m point data are as presented below



Roughness >2400 mm/km:

The same compared based on moving average method for values >2400mm/km (based on TOT agreement)





Finally, Considered the Roughness criteria with 2200mm/km (EPC), It can be seen from the above pie charts, that about 52% & 53% of the Lane km length of the Project Road has fair riding quality (UI<2200 mm/km) in LHS carriageway and RHS carriageway respectively.

2.6 PAVEMENT COMPOSITION SURVEYS (TEST PITS)

The composition of the existing pavement crust has been noted from test pit surveys. Thus, a total of 18 Nos. of pits have been dug along the corridor and the data on composition of pavement has been noted. 16 out of 18 pits done on Main Carriageway edge and remaining 2 test pits done on Service Road edge. Photographs have been taken at all test pit locations depicting the crust thickness and nature of material in the pavement.

Results of the test pit survey showing average thickness of pavement layers are presented in the Table below.

Table 4: Pavement Composition of Existing Pavement along Project Road

Sl No	Test Pit No	Existing Chainage	Direction	BT (mm)	PQC (mm)	DLC (mm)	WMM (mm)	GSB (mm)	Total (mm)	Remarks
1	JL-TP-1	882+200	LHS	170	-	-	210	230	**610**	
2	JL-TP-2	1358+600	LHS	-	280	160	-	270	**710**	
3	JL-TP-3	1369+600	LHS	-	270	100	-	250	**520**	
4	JL-TP-4	1378+200	LHS	145	-	-	190	130	**465**	
5	JL-TP-5	1388+600	LHS	170	-	-	210	180	**560**	
6	JL-TP-6	1398+050	LHS	130	-	-	230	170	**530**	
7	JL-TP-7	1408+100	LHS	-	260	160	-	200	**620**	
8	JL-TP-8	1418+100	LHS	-	250	140	-	150	**540**	
9	JL-TP-9	1424+800	RHS	-	250	150	-	150	**550**	

Sl No	Test Pit No	Existing Chainage	Direction	BT (mm)	PQC (mm)	DLC (mm)	WMM (mm)	GSB (mm)	Total (mm)	Remarks
10	JL-TP-10	1413+900	RHS	-	260	160	-	190	**610**	
11	JL-TP-11	1404+500	RHS	-	220	150	-	120	**490**	
12	JL-TP-12	1394+600	RHS	-	260	150	-	150	**560**	
13	JL-TP-13	1384+700	RHS	120	-	-	220	250	**590**	
14	JL-TP-14	1374+100	RHS	-	160	150	-	150	**460**	
15	JL-TP-15	1364+850	RHS	-	250	120	-	150	**520**	
16	JL-TP-16	888+000	RHS	-	260	150	-	200	**610**	
17	JL-SR-TP-1	1420+500	RHS	70	-	-	150	160	**380**	
18	JL-SR-TP-2	1407+400	LHS	80	-	-	150	200	**430**	

The flexible pavement consists of BT (120mm to 170mm)+ WMM(190mm to 230mm)+ GSB(130mm to 250mm) , with total thickness of 465mm to 610mm.

The Rigid pavement consists of PQC (160mm to 260mm)+ DLC(100mm to 160mm)+ GSB(120mm to 270mm) , with total thickness of 460mm to 710mm

The service road of flexible pavement consists of BT (70mm to 80mm)+ WMM(100mm)+ CTSB (50mm)+GSB(160mm to 200mm) , with total thickness of 380mm to 430mm

2.7 SUBGRADE INVESTIGATIONS & LABORATORY TESTING

Sub-grade Investigations have been carried out to examine the subgrade soil characteristics along the project road. A total number of 18 test pits have been carefully dug from the pavement surface up to sub-grade level. 16 out of 18 pits done on Main Carriage way edge and remaining 2 test pits done on Service road edge. Field density tests have been conducted for subgrade samples and a small quantity of sample has also been collected in airtight containers for determining the field moisture content. Upon completion of the field density test, representative sample of sub-grade soil has been collected in bulk, in gunny bags, from each test pit for laboratory testing.

The soil samples collected have been tested for the following properties to assess the existing sub-grade soil properties.

- Sieve analysis
- Atterberg limits
- Heavy compaction
- Four (4) days soaked CBR as per IS standards at 97% of MDD as applicable for sub-grade (Heavy Compaction)
- Free swelling index

JL-TP-1	JL-TP-2
JL-TP-3	JL-TP-4
JL-TP-5	JL-TP-6
JL-TP-7	JL-TP-8

JL-TP-9	JL-TP-10
JL-TP-11	JL-TP-12
JL-TP-13	JL-TP-14
JL-TP-15	JL-TP-16

2.8 BORROW AREAS

Potential borrow areas identified at 9 Nos. of locations within the vicinity of the project corridor for sub-grade/ embankment within economic haulage leads have been identified. The sources identified as potential borrow sources are shown in Table below and certain useful information such as distance from the project road, location, village name, etc., have also been presented in this table below.

Table 5: Borrow Area Samples Details

Sl. No	Borrow Area No	Chainage (km)	Side	Offset	Village and contact person	Quantity	Rate	Remarks	Co-ordinate
1	JL-BP-1	1358+700	RHS	2.0 km	Vill- Manegoan Name-Rajkumar Yadav Mob no-9340654956	50 Acres* 10 feet	Not told	Pvt. Land	23.069333 79.905190
2	JL-BP-2	1364+100	LHS	1.6 km	Vill- Khahariya Name- Narmada Yadav Mob no- 8085668483	100 Acres* 10 feet	Rs - 500/- Per 500 cft	Pvt. Land	23.019777 79.896518
3	JL-BP-3	1375+700	RHS	1.2 km	Vill- Tinshi Name- Kallu Yadav Mob no-	11 Acres* 5 feet	Not told	Pvt. Land	22.958715 79.844843
4	JL-BP-4	1394+100	LHS	2.5	Vill- Samthal Sarpanch - Moti Lal Kakodiya Mob no-8120184587	30 Acres* 5 feet	Not told	Govt. Land	22.835584 79.779305
5	JL-BP-5	1371+000	RHS	9.7 km	Vill- Jamariya Name- Jatan Jha Mob no- 8989141007	150Acres* 5 feet	Rs - 800/- Per 500 cft	Pvt. Land	23.026792 79.832945
6	JL-BP-6	1389+500	RHS	500m	Vill- Siluwa Name- Harilal Swayam Mob no-8305115088	7Acres* 5 feet	Not told	Pvt. Land	22.857615 79.772026
7	JL-BP-7	1398+600	LHS	1.0km	Vill- Dhapatha Name- Ramlal Mob no-9770638298	20Acres* 5 feet	Not told	Govt. Land	22.790957 79.748164
8	JL-BP-8	1411+600	LHS	1.4 km	Vill- Makarjhir Name-Baderi prasad Yadav Mob no-9755689793	15Acres* 5 feet	Not told	Pvt. Land	22.683395 79.692020
9	JL-BP-9	1425+400	LHS	600m	Vill- Lakhnadon Name-Vinod Mob no-9098174505	25Acres* 5 feet	Not told	Govt. Land	22.592853 79.620435

Soil samples from these borrow sources have been collected in bulk by excavating test pits down up to 1.0m depth from the existing ground surface. The top organic soil layer of approximately 150mm thickness was removed before sampling. The samples collected from these identified borrow pits/ gravel quarries have been tested for the suitability of utilizing them as embankment fill/ sub-grade. The sample photos of borrow area locations are as presented below.

JL-BP-1

JL-BP-2

JL-BP-3	JL-BP-4
JL-BP-5	JL-BP-6
JL-BP-7	JL-BP-8
JL-BP-9	

2.9 AGGREGATE SAMPLES

Aggregates samples from 6 Nos. of sources from crusher/quarry have identified for the use of sub-base, base, surface courses and concrete works have been collected. The locations, estimated quantity, basic cost of material and the approximate distance from each source to the nearest point on the project corridor are compiled in Tables below.

JL-AQ-1	JL-AQ-2
JL-AQ-3	JL-AQ-4
JL-AQ-5	JL-AQ-6

Table 6: Aggregate Samples Details

sample No.	Ex Chainage (Km.)	Left/ Right	Name of Village	Name of Source/ Crusher	Lead from Nearest Ex. Chainage (Km.)	Approximate Quantity (ton)	Basic cost of the material (Rs.)	Remarks	Co-ordinate
JL-AQ-1	1358+700	RHS	Manegoan	Cusher - Giriraj Stone Name: Nandakisor Sharma Mob no-6263002127	500m	Plenty	20mm-Rs 18/- per cft 10mm-Rs 8/- Per cft 6mm - Rs 8/- Per cft Dust - Rs 14/- Per cft	Royalty: Rs 180/- Per Cum and GST 5%	23.073431 79.905221
JL-AQ-2	1358+600	RHS	Manegoan	Cusher - Murali Stone Name:Muralidhara Badeja Mob no-7974352953, 9826110971	100 M	Plenty	20mm-Rs 20/- per cft 10mm-Rs 15/- Per cft 6mm - Rs 12/- Per cft Dust - Rs 15/- Per cft	Royalty: Rs 180/- Per Cum and GST 5%	23.082163 79.909070

sample No.	Ex Chainage (Km.)	Left/ Right	Name of Village	Name of Source/ Crusher	Lead from Nearest Ex. Chainage (Km.)	Approximate Quantity (ton)	Basic cost of the material (Rs.)	Remarks	Co-ordinate
JL-AQ-3	1359+800	LHS	Manegoan	Cusher - Upashini Stone Name: Pankaj Khatri Mob no-9229980000	1.2km	Plenty	40mm-Rs 14/- per cft 20mm-Rs 18/- per cft 10mm-Rs 8/- Per cft 6mm - Rs 8/- Per cft Dust - Rs 15/- Per cft	Royalty: Rs 180/- Per Cum and GST 5%	22.080020 79.915572
JL-AQ-4	1371+000	RHS	Jamariya	Cusher - Narmadachal Mineral Name: Kuldeep Sharma Mob no-9826649666	8.3 km	Plenty	40mm-Rs 11/- per cft 20mm-Rs 14/- per cft 10mm-Rs 7/- Per cft 6mm - Rs 6/- Per cft Dust - Rs 11/- Per cft	Royalty: Rs 165/- Per Cum and GST 5%	23.026690 79.839487
JL-AQ-5	1427+400	RHS	Kasai	Cusher - Vardaman Stone Name: Rahul Jain Mob no-9424757477	10.6 km	Plenty	40mm-Rs 17/- per cft 20mm-Rs 24/- per cft 10mm-Rs 10/- Per cft 6mm - Rs 6/- Per cft Dust - Rs 14/- Per cft	Royalty: Rs 160/- Per Cum and GST 5%	22.636994 79.546360
JL-AQ-6	1427+400	RHS	Kasai	Cusher - Jain Stone Name: Yesh Jain Mob no-7000499965	10.6 km	Plenty	40mm-Rs 17/- per cft 20mm-Rs 23/- per cft 10mm-Rs 12/- Per cft 6mm - Rs 9/- Per cft M-Sand - Rs 25/- Per cft	Royalty: Rs 160/- Per Cum and GST 5%	22.637426 79.543758

2.10 SAND SAMPLES

River Sand samples of 1 Nos. and M-sand samples of 1 Nos. have been collected from the source and tested. The location of this sand quarry along with lead to the Project Road is presented in the following table.

JL-SAND-1

Table 7: Sand Samples Details

Sand Source	Village & Name	Name of river & Village	Chainage	side	Offset	Rate	Remarks
JL-SQ-1	Vill -Gotegaon Suplier Name - Surendra Mob-9131735315	Narmada (Jhansighat)	881+500	RHS	50km	Rs 25000/- Per 600 Cft With Transport	with Royalty and GST
JL-M-SAND-1	Manegoan	Cusher - Upashini Stone Name: Pankaj Khatri Mob no-9229980000	1359+800	LHS	1.2km	-	-

2.11 CORE CUTTING INVESTIGATION

The objective of the core cutting is examining the engineering properties of the materials relevant to the project as per specification. As a first step, Details of sections are identified with good, fair and poor locations. The locations have been identified with the help of Visual observation of existing Road condition and Past condition. Thereafter the Location has been identified for core cutting as visual observation of the existing road condition of Flexible and rigid Pavement, 10 cores were cut in Main carriageway. Out of 10 cores, 7 no cores have been taken in rigid Pavement and 3 cores cutting on Flexible Pavement Location. After noting the condition such as location, cracks, rutting, depth of core etc the core samples were properly packed and sent for laboratory testing for its properties

JL-C-1	JL-C-2
JL-C-3	JL-C-4
JL-C-5	JL-C-6

JL-C-7	JL-C-8
JL-C-9	JL-C-10

Table 8: Core Cutting Samples Details

S.NO	Core Id	Existing Chainage (km)	Direction	Carriage Way	Offset From median in (M)	Core Thickness (MM)	Hole Thickness (mm)	Road Condition	Remark
1	JL-C-1	882+200	LHS	Outer	6.6	**165**	165	Good	Flexible
2	JL-C-2	1368+100	LHS	Outer	6.4	**253**	255	Poor (Crack Section)	Rigid (Crack top to Bottom)
3	JL-C-3	1369+600	LHS	Inner	1.5	**270**	270	Good	Rigid
4	JL-C-4	1388+600	LHS	Outer	6.6	**150**	160	Good	Flexible
5	JL-C-5	1408+100	LHS	Inner	1.5	**250**	255	Good	Rigid
6	JL-C-6	1424+800	RHS	Outer	6.4	**230**	230	Good	Rigid
7	JL-C-7	1404+500	RHS	Inner	4.2	**220**	225	Good	
8	JL-C-8	1384+700	RHS	Outer	6.6	**130**	130	Good	Flexible
9	JL-C-9	1364+850	RHS	Inner	1.5	**230**	235	Good	Rigid
10	JL-C-10	1362+250	RHS	Inner	4.2	**270**	270	Poor (Crack Section)	Rigid (Crack top to Bottom)

2.12 AXLE LOAD SURVEYS

Traffic loading has a significant impact on pavement performance and design. This is because the damage that vehicles create to a road depends very strongly on the axle loads of the vehicles. The exact relationship is influenced by the type of road structure and the way the road deteriorates but a "fourth power" damage law gives a good approximation.

Axle load study has been conducted using portable axle load pads. The survey was conducted near toll plaza at km 1365+700 on date 23.11.2022 for 24 hrs duration. The survey has been conducted in both the directions. The measurements have been made on random sampling basis. The collected axle load data and analysis is presented in **Appendix 5** of this Report.

The vehicle damage factors have been calculated using the standard axle loadings given in IRC: 37-2018. The standard axle loadings adopted have been presented in the following table

Table 9: Details of Standard Axles Used

Axle Configuration	Standard Axle load (Tonnes)*/ KN	Remarks
Single Wheel, Single Axle	6.60/65	As per IRC 37-2018
Dual Wheel, Single Axle	8.16/80	As per IRC 37-2018
Dual Wheel, Tandem Axle group	15.10/148	As per IRC 37-2018
Dual Wheel, Tridem Axle group	22.90/224	As per IRC 37-2018

Few photographs illustrating the survey locations and axle load measurements are presented below.

Survey in Progress

Survey in Progress

Direction wise VDF for each mode of commercial traffic has been estimated. Results of axle load surveys have been presented in the following table.

Table 10: VDF Values Estimated at the Toll Plaza Locations

Vehicle Type	Boharipar Toll plaza at Km 1362+780	
	UP	DN
BUS	1.26	0.5
2-Axle	2.26	1.5
3-Axle	4.95	4.76
M Axle	16.4	10.54
LCV	0.68	1.54

The Vehicle Damage Factor of MAV is high in LHS direction compared to RHS direction, due to high loading of iron & goods carrying from Jabalpur to Nagpur

CHAPTER 3. VALIDATION OF EXECUTED WORKS

3.1 ROAD WORKS

The project road has been closely inspected to verify the executed works on ground. The scope works to be executed by the Concessionaire/Contractor as envisaged in CA is compared with the executed work on the Ground. As a part of the validation, the available as-built drawings and the inventory data received from the Concessionaire were also referred. Each structure has been inspected to note down its structural configuration and condition. The following table highlights the scope comparison of the executed works on ground.

Table 11: Scope Comparison of Executed works

Sl. No.	Particulars	Length/ Nos.	Total for O&M Estimation	As per Schedule-B	As per Schedule-A	As per Site	Remarks
1	Start Chainage (Km)	Km	880.600	880.600	880.600	880.600	
2	End chainage (Km)	Km	1428.557	1428.557	1428.557	1428.557	
3	Length of the Project Corridor	Kms	81.737	81.737	81.737	81.737	
4	Service Road / Slip Road	Kms	23.105	8.520		14.585	
5	Bypass Length	Kms	11.240			11.240	
6	Toll Plaza	Nos.	1			1	
7	No. of Lanes (Both side)	Nos.	10			10	4+1 Lanes on Both sides
8	ROBs	Nos.	2		2	2	
9	Flyovers	Nos.	1		1	1	
10	Uni Directional Flyovers	Nos.	1			1	
11	Over Passes	Nos.	2			2	
12	VUPs	Nos.	5	2	4	3	
13	PUP's/CUP's	Nos.	4		4	4	
14	Viaducts	Nos.	1			1	
15	Major Bridges	Nos.	2		2	2	
16	Minor Bridges	Nos.	26	2	24	24	
17	Culverts (Pipe)	Nos.	126	14	108	112	
18	Culvert (Slab/Box)	Nos.	69	10	58	59	
19	Major Junctions	Nos.	19		19	19	
20	Minor junctions	Nos.	68		93	68	
21	Embankment	Kms	1.240			1.240	
22	Stone Pitching	Kms	1.030			1.030	
23	RCC wall with Stone pitching	Kms	0.920			0.920	
24	RCC wall with Embankment	Kms	0.280			0.280	
25	RCC Wall	Kms	0.730			0.730	
26	RE wall with PCC Lining	Kms	0.970			0.970	
27	RE wall	Kms	1.510			1.510	

Sl. No.	Particulars	Length/ Nos.	Total for O&M Estimation	As per Schedule-B	As per Schedule-A	As per Site	Remarks
28	Concrete Lining	Kms	0.270			0.270	
29	Bus Bays with Shelter	Nos.	29		26	29	
30	Bus Shelters	Nos.	13		13	13	
31	Truck Lay bye	Nos.	2		2	2	
32	Rest Areas	Nos.	1		1	1	
33	High Mast Lights	Nos.	18	2		16	
34	Highway Lighting (length only)	Kms	24.540	12.84		11.700	
35	Single Arm Lightings	Nos.	757	112		645	
36	Double Arm Lightings	Nos.	636	436		200	
37	Solar Blinkers	Nos.	78			78	
38	RCC Cover Drain	Kms	10.350	8.52	3.034	1.830	
39	RCC Open Lined Drain	Kms	6.815		47.212	6.815	
40	Earthen Drain	Kms	154.829			154.829	
41	Median drain	Kms	5.670			5.670	
42	Median Cuts	Nos.	1134			1134	
43	Chutes	Nos.	53			53	
44	Median Opening	Nos.	39		39	39	
45	Median Kerb Damages	Kms	0.037			0.037	
46	Median Plantation Functional	Kms	13687			13687	
47	Median Plantation-Functional	Kms	56460			56460	
48	No Median	Kms	1400			1400	
49	Road Markings	Kms	81.737			81.737	
50	W-Beam Safety Barriers	Kms	60.705			60.705	
51	Double faced W-Beam Safety Barriers	Kms	49.71	49.71		-	
52	Rigid Concrete Barriers	Kms	24.707			24.707	
53	Concrete Railing	Kms	2.340			2.340	
54	Pedestrian Guard Rails	Kms	8.396	6.38		2.016	
55	Kilometer Stones	Nos.	164			164	
56	Hectometer Stones	Nos.	654			654	
57	Boundary Stones	Nos.	1635			1635	
58	Road Signs	Nos.	4280	3068		1212	
59	Gantry Sign Boards	Nos.	8	2		6	
60	Cantilever Sign Boards	Nos.	30	12		18	
61	Varying Message Signs (VMS)	Nos.	6			6	
62	Emergency Call Box	Nos.	54			54	
63	Advanced Traffic Management System (ATMS)	Nos.	12			12	

The project corridor appears to have been constructed with the cross-sectional elements matching to those given in the manual at the time of execution. The carriageway width of 7.0m plus paved shoulders of 1.5m, shyness of 0.25m and earth shoulder of 2.0 m has been provided over the entire length except at structures.

In the project stretch, the Service Roads/Slip Roads with an overall length of km 14.585 km. have been observed. The service roads having the width of 7.0m with flexible pavement. The Location of service roads and slip roads are listed as below:

Table 12: Details of Service Roads/Slip Roads along Project Road

S.No.	Existing Chainage		SR without tapers		Side	Pavement Type	As Per Site (m)	Width (m)
	From (km)	To (km)	From (km)	To (km)				
1	880+600	886+250	880+600	886+250	LHS	Flexible	5650	7.0
2	880+600	882+030	880+600	881+920	RHS	Flexible	1320	7.0
3	889+610	890+420	889+730	890+420	LHS	Flexible	690	7.0
4	1358+450	1360+270	1358+450	1360+140	LHS	Flexible	1690	7.0
5	1358+480	1360+050	1358+600	1359+930	RHS	Flexible	1330	7.0
6	1370+320	1370+780	1370+320	1370+660	LHS	Flexible	340	7.0
7	1374+980	1375+735	1374+980	1375+615	LHS	Flexible	635	7.0
8	1375+600	1375+700	1375+600	1375+700	RHS	Flexible	100	7.0
9	1405+500	1406+100	1405+500	1405+980	LHS	Flexible	480	7.0
10	1407+150	1407+720	1407+350	1407+600	LHS	Flexible	250	7.0
11	1412+280	1413+340	1412+400	1413+200	LHS	Flexible	800	7.0
12	1412+300	1413+330	1412+400	1413+200	RHS	Flexible	800	7.0
13	1420+230	1420+970	1420+350	1420+850	RHS	Flexible	500	7.0
As per Site Total Length of Service/Slip Road (km)							**14.585**	

RCC Lined Covered drains are exist along the project road. Covered slab was missing & damage observed above the lined drain locations, cleaning need to be required. These sections are presented in the Table below.

Table 13: RCC Covered Drains

S. No	Existing Chainage (Km)		Side	Length (km)	Width (m)	Cover Missing (m)	Cover Damage(m)	Remarks
	From	To						
1	880+600	880+750	LHS	150	0.70			
2	880+600	880+750	RHS	150	0.70			
3	1423+850	1424+600	RHS	750	0.70	2		
4	1423+820	1424+600	LHS	780	0.70			
Total Length of RCC covered Drain(km)				**1.830**		**2**		

RCC Open Lined drains are exist along the project road. Drain damage is observed in some locations, cleaning need to be required. These sections are presented in the Table below

S. No	Design Chainage (Km)		Side	Length (m)	Spacing (m)	Depth (m)	Condition	Damage (m)	Remarks
	From	To							
1	890+843	891+378	LHS	535	0.7	0.6	Fair	6	
2	891+700	890+200	RHS	1500	0.7	0.6	Fair		
3	1383+650	1383+950	RHS	300	0.7	0.6	Fair		
4	1383+700	1383+930	LHS	230	0.7	0.6	Fair	2	
5	1387+080	1387+700	RHS	620	0.7	0.6	Fair		
6	1389+700	1389+950	RHS	250	0.7	0.6	Fair		
7	1390+100	1391+200	LHS	1100	0.7	0.6	Fair	8	
8	1393+520	1393+600	LHS	80	0.7	0.6	Fair		
9	1393+520	1393+700	RHS	180	0.7	0.6	Fair	2	
10	1414+100	1414+900	LHS	800	0.7	0.6	Fair	2	
11	1414+200	1414+850	RHS	650	0.7	0.6	Fair	1	
12	1427+450	1427+800	RHS	350	0.7	0.6	Fair		
13	1427+780	1428+000	LHS	220	0.7	0.6	Fair		
Total Length of Open lined Drain(m)				**6815**				**20**	

Partial RCC walls, Partial RE walls and Full Height RE walls are found in approaches of some of the underpass, High embankment, Minor Bridges along the Project Corridor which account for a Total length of 6.950 Km. The summary of the slope protection table was presented below:

Table 14: Summary of Slope Protection along Project Road

S.no	Existing Chainage (km)		Length (Km)	Side	Embankment	Stone Pitching	RCC wall with Stone pitching	RCC wall with Embankment	RE Wall	RE wall with PCC Lining	RCC Wall	Concrete lining	Remarks
	From	To											
1	881+090	881+390	0.300	LHS-A1					Yes				
2	881+860	882+100	0.240	LHS-A2					Yes				Slight Bulging of Panels Observed
3	881+090	881+390	0.300	RHS-A1					Yes				
4	881+860	882+100	0.240	RHS-A2					Yes				
5	887+250	887+430	0.180	LHS								Yes	
6	889+890	890+170	0.280	LHS-A1					Yes				
7	890+690	890+750	0.060	LHS-A2							Yes		
8	890+200	890+320	0.120	RHS							Yes		
9	1368+520	1368+580	0.060	LHS-A1		Yes							

S.no	Existing Chainage (km)		Length (Km)	Side	Embankment	Stone Pitching	RCC wall with Stone pitching	RCC wall with Embankment	RE Wall	RE wall with PCC Lining	RCC Wall	Concrete lining	Remarks
	From	To											
10	1368+600	1368+680	0.080	LHS-A2		Yes							
11	1368+680	1368+930	0.250	LHS-A2			Yes						
12	1368+680	1368+930	0.250	RHS			Yes						
13	1368+930	1369+100	0.170	LHS-A2		Yes							
14	1368+950	1369+000	0.050	RHS				Yes					
15	1370+160	1370+200	0.040	RHS-A1					Yes				
16	1370+160	1370+200	0.040	LHS-A1	Yes								
17	1370+230	1370+340	0.110	RHS-A1					Yes				
18	1370+230	1370+340	0.110	LHS-A1			Yes						
19	1370+360	1370+600	0.240	RHS-A2	Yes								
20	1370+360	1370+550	0.190	LHS-A2							Yes		
21	1374+350	1374+980	0.630	LHS-A1						Yes			
22	1374+970	1375+200	0.230	RHS						Yes			
23	1375+030	1375+140	0.110	LHS-A2						Yes			
24	1375+140	1375+200	0.060	LHS-A2		Yes							
25	1375+200	1375+290	0.090	RHS								Yes	
26	1379+200	1379+600	0.400	LHS-A1	Yes								
27	1379+610	1379+850	0.240	LHS-A2	Yes								
28	1387+470	1387+580	0.110	LHS			Yes						
29	1387+490	1387+590	0.100	LHS		Yes							
30	1390+240	1390+320	0.080	RHS							Yes		
31	1390+520	1390+580	0.060	RHS							Yes		
32	1390+660	1390+740	0.080	RHS							Yes		
33	1390+960	1391+020	0.060	RHS							Yes		
34	1391+020	1391+100	0.080	RHS							Yes		Ghat Section
35	1391+950	1392+080	0.130	RHS		Yes							
36	1412+380	1412+600	0.220	LHS-A1	Yes								
37	1412+600	1412+750	0.150	LHS-A1				Yes					
38	1412+700	1412+900	0.200	RHS			Yes						
39	1412+760	1412+840	0.080	LHS-A2				Yes					
40	1412+840	1412+940	0.100	LHS-A2	Yes								
41	1423+500	1423+700	0.200	RHS		Yes							
42	1425+250	1425+480	0.230	RHS		Yes							
Total Length (Km)			**6.950**										

In general, the median width is 10.8m with depressed median and also has raised median of 4.0m in project road. As per site 39 No of Median openings are observed in that 18 Nos. of Normal Lane & 21 No's of Reserved Lane Median Openings are Observed. For the reserve lane locations, the width of the reserved lane is 4.0m. The location wise details are presented in the table below.

Table 15: Details of Median Openings along Project Road

S. No.	Existing Chainage (km)	Median Width (m)	Opening Length (m)	Reserve lane
1	880+550	5.5	20	No
2	884+100	4	20	Yes
3	885+920	4	30	No
4	887+493	4	30	Yes
5	888+865	4	30	No
6	1359+525	4	30	No
7	1361+320	1.5	30	No
8	1365+120	12	30	Yes
9	1367+220	1.5	30	Yes
10	1369+520	12	30	Yes
11	1371+110	4	30	Yes
12	1373+485	4	30	No
13	1375+880	12	30	Yes
14	1378+900	12	30	Yes
15	1379+990	12	30	Yes
16	1381+680	12	30	Yes
17	1384+640	4	30	No
18	1386+420	4	30	No
19	1389+475	2.75	30	No
20	1392+720	1.5	30	No
21	1394+850	4	30	Yes
22	1396+525	12	30	No
23	1398+910	12	30	No
24	1401+065	12	30	No
25	1402+050	12	30	No
26	1402+650	12	30	Yes
27	1404+265	12	15	Yes
28	1405+480	12	20	Yes
29	1405+780	12	20	No
30	1407+420	12	30	Yes
31	1409+450	12	30	Yes
32	1411+700	12	20	Yes
33	1415+595	1.5	30	No

S. No.	Existing Chainage (km)	Median Width (m)	Opening Length (m)	Reserve lane
34	1418+200	12	30	Yes
35	1420+720	12	30	No
36	1423+450	12	30	Yes
37	1425+455	12	30	No
38	1426+480	12	15	Yes
39	1426+800	4	30	Yes

The Project Road has 19 Nos. of Major Junctions and 64 Nos. of Minor Junctions. The List of Major & Minor junctions are provided with location wise are presented in table below:

Table 16: List of Major Junctions

SR. No.	Design Chainage (km)	Cross roads Hits (MCW/SR)	Side	Name of Access Road		Surface Type of Access Road		Width of Access Road (m)		Remarks
				LHS	RHS	LHS	RHS	LHS	RHS	
1	881516	MCW	BHS	Jabalpur	Bhamki	BT	BT	19.4	43.9	
2	884110	MCW	BHS	Aadarsh Cooperative Housing	Lamheta Ghat	CC	CC	13	14.5	
3	887480	MCW	RHS		Ghunsor		BT		7	
4	888300	MCW	LHS			CC		4.5		
5	890441	MCW	BHS			BT	BT	7.5	7.5	
6	1358060	MCW	LHS	Saliwada		BT		18.5		
7	1370310	MCW	BHS	Chourai	Bargi	BT	BT	7.5	7.5	
8	1378945	MCW	LHS	Sukari		BT		7.5		
9	1379975	MCW	LHS	Sukari		BT		7.5		
10	1402100	MCW	LHS	Dhuma		BT		7.5		
11	1402625	MCW	BHS	Dhuma	Samthal	BT	BT	7.5	7.5	
12	1405425	MCW	LHS	Dhuma		BT		7.5		
13	886170	MCW	LHS			BT		7.5		
14	1424415	MCW	BHS			BT	BT	7.5	7.5	
15	1427700	MCW	RHS				BT		4 lane	
16	1423460	MCW	RHS		Lakhnadon		BT		7	
17	1368545	MCW	BHS			BT	BT	7.5	7.5	
18	1370310	MCW	BHS			BT	BT	7.5	7.5	
19	1426780	MCW	RHS		Lakhnadon		BT		7.5	

Table 17: List of Minor Junctions

SR. No.	Design Chainage (km)	Side	Merging into (MCW/SR)	Surface Type of Access Road		Width of Access Road (m)		Remarks
				LHS	RHS	LHS	RHS	
1	885+480	LHS	MCW	BT		3.5		
2	886+460	BHS	MCW	CC	BT	7	5.5	
3	887+307	BHS	MCW	BT	BT	4.5	4.5	
4	889+870	LHS	MCW	BT		4.5		
5	890+380	LHS	MCW	BT		4.5		
6	891+650	LHS	MCW	BT		3.5		
7	1358+330	RHS	MCW		BT	4		
8	1358+460	LHS	MCW	BT		4		
9	1359+465	LHS	MCW	BT		4		
10	1359+825	LHS	MCW	BT		4.5		

SR. No.	Design Chainage (km)	Side	Merging into (MCW/SR)	Surface Type of Access Road		Width of Access Road (m)		Remarks
				LHS	RHS	LHS	RHS	
11	1360+111	LHS	MCW	BT		5		
12	1361+655	BHS	MCW	BT	BT	4	4	
13	1362+365	BHS	MCW	BT	BT	4	4	
14	1363+980	LHS	MCW	BT		5		
15	1365+105	LHS	MCW	BT		3.5		
16	1366+240	RHS	MCW		BT	4.5		
17	1366+615	LHS	MCW	BT		7		
18	1371+030	RHS	MCW		BT	4.5		
19	1375+905	RHS	MCW		BT	4.5		
20	1377+915	BHS	MCW	BT	BT	4	4	
21	1379+595	RHS	MCW		BT		3.5	
22	1380+815	LHS	MCW	BT		4		
23	1381+690	BHS	MCW	BT	BT	4	4	
24	1383+260	LHS	MCW	BT		3.5		
25	1383+950	LHS	MCW	BT		4		
26	1384+030	RHS	MCW		BT		4	
27	1384+870	RHS	MCW		BT		3.5	
28	1386+110	RHS	MCW		BT		3.5	
29	1388+760	RHS	MCW		BT		3.5	
30	1389+675	RHS	MCW		BT		3.5	
31	1390+085	LHS	MCW	BT		3.5		
32	1394+500	LHS	MCW	BT		3.5		
33	1394+885	BHS	MCW	BT	BT	3.5	3.5	
34	1395+515	LHS	MCW	BT		3		
35	1396+985	LHS	MCW	Earthen		3		
36	1397+775	RHS	MCW		BT		3.5	
37	1398+575	LHS	MCW	BT		4		
38	1398+655	RHS	MCW		BT		4	
39	1400+290	RHS	MCW		BT		4	
40	1401+295	LHS	MCW	BT		3		
41	1401+261	RHS	MCW		BT		3	
42	1401+395	BHS	MCW	BT	BT			
43	1402+615	BHS	MCW	BT	BT	4	4	
44	1403+500	BHS	MCW	BT	BT	3.5	3.5	
45	1404+370	BHS	MCW	BT	BT	3.5	3.5	
46	1405+960	LHS	MCW	BT		4		
47	1406+744	LHS	MCW	Earthen		3		
48	1407+350	LHS	MCW	CC		3.5		
49	1407+560	LHS	MCW	CC		3		
50	1409+465	BHS	MCW	BT	BT	3.5	3.5	
51	1410+080	RHS	MCW		BT		4	
52	1410+895	RHS	MCW		BT		4	
53	1411+665	LHS	MCW	BT		3.5		
54	1411+735	LHS	MCW	BT		3.5		
55	1413+000	LHS	MCW	BT		3.5		
56	1413+070	RHS	MCW		BT		4	
57	1416+925	LHS	MCW	Earthen		3.5		
58	1417+300	LHS	MCW	BT		7.5		
59	1418+270	LHS	MCW	BT		3.5		
60	1419+360	RHS	MCW		BT		4	
61	1419+590	LHS	MCW	BT		3.5		
62	1420+345	RHS	MCW		BT		4	
63	1420+630	RHS	MCW		BT		4	

SR. No.	Design Chainage (km)	Side	Merging into (MCW/SR)	Surface Type of Access Road		Width of Access Road (m)		Remarks
				LHS	RHS	LHS	RHS	
64	1420+845	RHS	MCW		BT		4	
65	1421+795	BHS	MCW	BT	BT	4.5	4.5	
66	1424+642	RHS	MCW		BT		3.5	
67	1425+455	BHS	MCW	BT	BT	5.5	4.5	
68	1426+465	BHS	MCW	BT	BT	4.5	4.5	

Safety Barriers are provided at Minor Bridges, Culverts and Underpasses (VUP, PUP and LVUP), approach Locations and Built-Up Areas. The table below shows the summary of Safety Barriers provided along the project corridor and the location wise details are provided below:

Table 18: Summary of Safety Barriers

S. No.	Description	Length (Kms)
1	W-Beam Safety Barriers	60.705
2	Concrete Crash Barriers	24.707
3	Pedestrian Guard Railings	2.016

Table 19: W-Beam Safety Barriers

S. No	Design Chainage (km)		Side/Location	Length (km)	Condition	Gaps Observed (m)	Damage (m)	Remarks
	From	To						
1	880.980	882.170	RHS-Shoulder	1.190	Fair	4.0		
2	883.150	883.250	RHS-Shoulder	0.100	Fair			
3	883.550	883.700	RHS-Shoulder	0.150	Fair			
4	884.010	884.100	RHS-Shoulder	0.090	Fair			
5	884.150	884.830	RHS-Shoulder	0.680	Fair	2.0		
6	884.410	884.600	LHS-Shoulder	0.190	Fair			
7	884.425	884.580	LHS-Shoulder	0.155	Fair			
8	884.850	885.170	LHS-Shoulder	0.320	Fair		70	
9	884.900	885.850	RHS-Shoulder	0.950	Fair	2.0		
10	885.650	885.900	LHS-Shoulder	0.250	Fair			
11	886.180	886.230	Median	0.050	Fair			
12	886.200	886.250	LHS-Shoulder	0.050	Fair			
13	886.990	887.350	RHS-Shoulder	0.360	Fair	3.0		
14	887.070	887.250	LHS-Shoulder	0.180	Fair			
15	887.070	887.540	LHS-Median	0.470	Fair			
16	887.260	887.270	LHS-Shoulder	0.010	Fair			
17	887.360	887.500	RHS-Shoulder	0.140	Fair			
18	887.600	887.670	RHS-Shoulder	0.070	Fair			
19	887.650	887.750	LHS-Shoulder	0.100	Fair			
20	888.100	888.250	LHS-Shoulder	0.150	Fair			
21	888.100	888.380	Median	0.280	Fair			
22	888.400	888.520	Median	0.120	Fair			
23	888.450	888.520	LHS-Shoulder	0.070	Fair			
24	888.650	888.670	RHS-Shoulder	0.020	Fair			
25	888.810	888.850	RHS-Shoulder	0.040	Fair			
26	889.170	889.400	LHS-Median	0.230	Fair			
27	889.270	889.600	RHS-Shoulder	0.330	Fair			
28	889.550	889.750	LHS-Shoulder	0.200	Fair		10	
29	890.100	890.190	RHS-Shoulder	0.090	Fair			
30	890.600	890.620	Median	0.020	Fair			
31	890.790	890.870	Median	0.080	Fair			

S. No	Design Chainage (km)		Side/Location	Length (km)	Condition	Gaps Observed (m)	Damage (m)	Remarks
	From	To						
32	1357.030	1357.400	RHS-Shoulder	0.370	Fair	4.0		
33	1358.100	1358.300	LHS-Median	0.200	Fair			
34	1358.100	1358.300	LHS-Shoulder	0.200	Fair			
35	1358.370	1358.390	LHS-Shoulder	0.020	Fair			
36	1358.400	1358.450	RHS-Shoulder	0.050	Fair			
37	1358.420	1358.430	LHS-Shoulder	0.010	Fair			
38	1358.420	1358.430	LHS-Shoulder	0.010	Fair			
39	1358.900	1359.400	RHS-Shoulder	0.500	Fair			
40	1359.000	1359.380	LHS-Median	0.380	Fair			
41	1359.620	1360.000	LHS-Shoulder	0.380	Fair		20	
42	1359.650	1360.010	Median	0.360	Fair			
43	1360.330	1360.340	LHS-Shoulder	0.010	Fair			
44	1360.370	1360.760	LHS-Shoulder	0.390	Fair		40	
45	1360.420	1360.450	RHS-Shoulder	0.030	Fair			
46	1360.750	1361.080	RHS-Shoulder	0.330	Fair			
47	1361.100	1361.150	RHS-Shoulder	0.050	Fair			
48	1361.430	1361.500	RHS-Shoulder	0.070	Fair			
49	1361.450	1361.500	Median	0.050	Fair			
50	1361.530	1361.550	Median	0.020	Fair			
51	1361.580	1361.600	LHS-Shoulder	0.020	Fair		10	
52	1362.000	1362.070	RHS-Shoulder	0.070	Fair			
53	1362.470	1362.480	RHS-Shoulder	0.010	Fair			
54	1362.500	1362.530	RHS-Shoulder	0.030	Fair			
55	1362.520	1362.530	LHS-Shoulder	0.010	Fair			
56	1362.550	1362.600	RHS-Shoulder	0.050	Fair			
57	1362.700	1362.730	RHS-Shoulder	0.030	Fair			
58	1363.000	1363.020	LHS-Shoulder	0.020	Fair			
59	1363.050	1363.060	LHS-Shoulder	0.010	Fair			
60	1363.070	1364.300	RHS-Shoulder	1.230	Fair			
61	1363.300	1363.750	RHS-Shoulder	0.450	Fair			
62	1363.930	1363.940	LHS-Shoulder	0.010	Fair			
63	1363.990	1364.240	LHS-Median	0.250	Fair			
64	1364.100	1364.770	LHS-Shoulder	0.670	Fair	35.0		
65	1364.340	1364.420	LHS-Median	0.080	Fair			
66	1364.350	1364.780	Median	0.430	Fair			
67	1364.400	1364.430	RHS-Shoulder	0.030	Fair			
68	1364.450	1364.780	RHS-Shoulder	0.330	Fair			
69	1366.150	1366.200	RHS-Shoulder	0.050	Fair		5	
70	1366.250	1366.500	RHS-Shoulder	0.250	Fair		5	
71	1367.430	1367.570	LHS-Shoulder	0.140	Fair			
72	1367.450	1367.570	RHS-Shoulder	0.120	Fair			
73	1367.590	1367.660	LHS-Shoulder	0.070	Fair			
74	1367.590	1368.380	RHS-Shoulder	0.790	Fair	15.0		
75	1368.070	1368.250	LHS-Shoulder	0.180	Fair			
76	1368.310	1368.320	LHS-Shoulder	0.010	Fair			
77	1368.400	1368.470	LHS-Median	0.070	Fair			
78	1368.400	1368.530	RHS-Median	0.130	Fair			
79	1368.430	1368.450	RHS-Shoulder	0.020	Fair			
80	1368.480	1368.530	RHS-Shoulder	0.050	Fair		10	
81	1368.550	1369.200	RHS-Shoulder	0.650	Fair	1.0		
82	1368.580	1369.200	LHS-Shoulder	0.620	Fair			
83	1368.620	1368.750	Median	0.130	Fair			
84	1368.850	1369.200	Median	0.350	Fair			

S. No	Design Chainage (km)		Side/Location	Length (km)	Condition	Gaps Observed (m)	Damage (m)	Remarks
	From	To						
85	1370.100	1370.170	RHS-Shoulder	0.070	Fair			
86	1370.160	1370.175	LHS-Shoulder	0.015	Fair			
87	1370.200	1370.270	RHS-Shoulder	0.070	Fair			
88	1370.210	1370.340	LHS-Shoulder	0.130	Fair			
89	1370.300	1370.550	RHS-Shoulder	0.250	Fair			
90	1370.360	1370.550	LHS-Shoulder	0.190	Fair			
91	1370.360	1370.550	RHS-Shoulder	0.190	Fair			
92	1371.650	1372.180	Median	0.530	Fair			
93	1371.700	1372.200	RHS-Shoulder	0.500	Fair	3.0		
94	1372.280	1372.310	LHS-Shoulder	0.030	Fair		14	
95	1372.310	1372.330	RHS-Shoulder	0.020	Fair			
96	1372.350	1372.900	LHS-Shoulder	0.550	Fair			
97	1372.360	1372.400	RHS-Shoulder	0.040	Fair			
98	1372.360	1372.720	Median	0.360	Fair		10	
99	1372.650	1373.010	RHS-Shoulder	0.360	Fair		20	
100	1372.680	1372.830	RHS-Shoulder	0.150	Fair			
101	1372.750	1372.900	Median	0.150	Fair	2		
102	1373.130	1373.180	RHS-Shoulder	0.050	Fair			
103	1373.870	1373.900	RHS-Shoulder	0.030	Fair			
104	1373.950	1373.970	RHS-Shoulder	0.020	Fair			
105	1374.420	1374.800	RHS-Shoulder	0.380	Fair			
106	1374.900	1375.250	Median	0.350	Fair		10	
107	1374.900	1374.950	RHS-Shoulder	0.050	Fair			
108	1374.930	1374.970	LHS-Shoulder	0.040	Fair			
109	1374.970	1375.500	LHS-Shoulder	0.530	Fair			
110	1374.980	1375.600	RHS-Shoulder	0.620	Fair			
111	1376.000	1376.090	LHS-Shoulder	0.090	Fair			
112	1376.000	1376.100	RHS-Shoulder	0.100	Fair			
113	1376.030	1376.040	LHS-Shoulder	0.010	Fair			
114	1377.750	1377.770	LHS-Shoulder	0.020	Fair			
115	1377.750	1377.770	RHS-Shoulder	0.020	Fair			
116	1377.750	1377.950	RHS-Shoulder	0.200	Fair			
117	1378.700	1378.850	Median	0.150	Fair			
118	1378.950	1379.000	LHS-Shoulder	0.050	Fair	1		
119	1379.080	1379.950	RHS-Shoulder	0.870	Fair			
120	1379.100	1379.510	RHS-Shoulder	0.410	Fair			
121	1379.160	1379.620	Median	0.460	Fair		10	
122	1379.300	1379.620	LHS-Shoulder	0.320	Fair			
123	1379.550	1379.800	RHS-Shoulder	0.250	Fair			
124	1379.620	1379.900	LHS-Shoulder	0.280	Fair			
125	1379.680	1379.820	Median	0.140	Fair			
126	1379.750	1379.900	RHS-Shoulder	0.150	Fair			
127	1380.040	1380.250	Median	0.210	Fair			
128	1380.230	1380.600	LHS-Shoulder	0.370	Fair			
129	1380.610	1390.650	LHS-Shoulder	10.040	Fair			
130	1380.610	1380.630	RHS-Shoulder	0.020	Fair			
131	1380.650	1380.700	RHS-Shoulder	0.050	Fair			
132	1380.780	1380.790	LHS-Shoulder	0.010	Fair			
133	1381.520	1381.540	LHS-Shoulder	0.020	Fair			
134	1381.550	1381.570	RHS-Shoulder	0.020	Fair			
135	1381.570	1381.600	LHS-Shoulder	0.030	Fair			
136	1381.600	1381.650	RHS-Shoulder	0.050	Fair			
137	1383.010	1383.570	Median	0.560	Fair	3		

S. No	Design Chainage (km)		Side/Location	Length (km)	Condition	Gaps Observed (m)	Damage (m)	Remarks
	From	To						
138	1383.065	1383.230	LHS-Shoulder	0.165	Fair		20	
139	1383.310	1383.570	LHS-Shoulder	0.260	Fair			
140	1384.150	1384.200	LHS-Shoulder	0.050	Fair			
141	1384.170	1384.200	RHS-Shoulder	0.030	Fair			
142	1384.200	1384.230	RHS-Shoulder	0.030	Fair			
143	1384.220	1384.230	LHS-Shoulder	0.010	Fair			
144	1384.650	1384.670	LHS-Shoulder	0.020	Fair			
145	1384.650	1384.680	RHS-Shoulder	0.030	Fair			
146	1384.685	1384.700	LHS-Shoulder	0.015	Fair			
147	1384.700	1384.740	RHS-Shoulder	0.040	Fair			
148	1384.800	1385.000	LHS-Shoulder	0.200	Fair			
149	1385.520	1385.540	RHS-Shoulder	0.020	Fair			
150	1385.550	1385.600	RHS-Shoulder	0.050	Fair			
151	1385.570	1385.580	LHS-Shoulder	0.010	Fair			
152	1385.570	1385.580	RHS-Shoulder	0.010	Fair			
153	1386.660	1386.690	LHS-Shoulder	0.030	Fair			
154	1386.680	1386.700	RHS-Shoulder	0.020	Fair			
155	1386.720	1386.750	RHS-Shoulder	0.030	Fair			
156	1386.730	1386.750	LHS-Shoulder	0.020	Fair			
157	1387.030	1387.400	LHS-Shoulder	0.370	Fair			
158	1387.400	1387.800	RHS-Shoulder	0.400	Fair		10	
159	1387.450	1387.480	LHS-Shoulder	0.030	Fair			
160	1387.500	1387.520	LHS-Shoulder	0.020	Fair			
161	1387.995	1388.010	LHS-Shoulder	0.015	Fair			
162	1388.000	1388.090	RHS-Shoulder	0.090	Fair			
163	1388.030	1388.050	LHS-Shoulder	0.020	Fair			
164	1388.060	1388.100	RHS-Shoulder	0.040	Fair			
165	1388.420	1388.570	LHS-Shoulder	0.150	Fair	4.0		
166	1388.500	1388.530	RHS-Shoulder	0.030	Fair			
167	1388.550	1388.570	RHS-Shoulder	0.020	Fair			
168	1388.610	1388.630	LHS-Shoulder	0.020	Fair			
169	1389.600	1389.650	RHS-Shoulder	0.050	Fair			
170	1389.670	1390.050	RHS-Shoulder	0.380	Fair			
171	1390.120	1391.200	RHS-Shoulder	1.080	Fair		20	
172	1391.900	1391.995	RHS-Shoulder	0.095	Fair			
173	1392.230	1392.250	LHS-Shoulder	0.020	Fair			
174	1392.265	1392.370	LHS-Shoulder	0.105	Fair			
175	1392.320	1392.500	RHS-Shoulder	0.180	Fair			
176	1392.440	1392.500	LHS-Shoulder	0.060	Fair			
177	1393.200	1393.250	LHS-Shoulder	0.050	Fair			
178	1393.200	1393.320	RHS-Shoulder	0.120	Fair			
179	1393.700	1393.790	RHS-Shoulder	0.090	Fair			
180	1393.735	1393.750	LHS-Shoulder	0.015	Fair			
181	1393.765	1393.780	LHS-Shoulder	0.015	Fair			
182	1393.800	1393.850	RHS-Shoulder	0.050	Fair			
183	1393.820	1394.020	LHS-Shoulder	0.200	Fair			
184	1394.080	1394.120	LHS-Shoulder	0.040	Fair			
185	1394.220	1394.350	RHS-Shoulder	0.130	Fair			
186	1394.300	1394.380	LHS-Shoulder	0.080	Fair			
187	1394.360	1394.550	RHS-Shoulder	0.190	Fair			
188	1394.395	1394.430	LHS-Shoulder	0.035	Fair			
189	1395.650	1395.700	RHS-Shoulder	0.050	Fair			
190	1396.500	1396.570	RHS-Shoulder	0.070	Fair			

S. No	Design Chainage (km)		Side/Location	Length (km)	Condition	Gaps Observed (m)	Damage (m)	Remarks
	From	To						
191	1396.850	1396.980	RHS-Shoulder	0.130	Fair			
192	1397.000	1397.040	RHS-Shoulder	0.040	Fair			
193	1397.340	1397.380	RHS-Shoulder	0.040	Fair			
194	1397.420	1398.780	RHS-Shoulder	1.360	Fair			
195	1398.755	1398.810	RHS-Shoulder	0.055	Fair			
196	1399.140	1399.250	RHS-Shoulder	0.110	Fair			
197	1399.150	1399.250	LHS-Shoulder	0.100	Fair			
198	1400.200	1400.240	RHS-Shoulder	0.040	Fair			
199	1401.750	1402.000	Median	0.250	Fair			
200	1401.770	1402.030	LHS-Shoulder	0.260	Fair			
201	1402.130	1402.200	LHS-Shoulder	0.070	Fair			
202	1402.150	1402.210	Median	0.060	Fair			
203	1403.420	1403.500	RHS-Shoulder	0.080	Fair			
204	1403.540	1403.570	RHS-Shoulder	0.030	Fair			
205	1406.150	1406.230	RHS-Shoulder	0.080	Fair			
206	1406.550	1406.600	RHS-Shoulder	0.050	Fair			
207	1408.040	1408.110	LHS-Shoulder	0.070	Fair			
208	1410.050	1410.570	LHS-Shoulder	0.520	Fair	44.0		
209	1410.450	1410.540	RHS-Shoulder	0.090	Fair			
210	1410.565	1410.580	RHS-Shoulder	0.015	Fair			
211	1410.650	1416.620	RHS-Shoulder	5.970	Fair			
212	1411.050	1411.580	Median	0.530	Fair			
213	1412.020	1412.900	RHS-Shoulder	0.880	Fair			
214	1412.420	1412.650	RHS-Shoulder	0.230	Fair			
215	1412.450	1412.650	LHS-Shoulder	0.200	Fair			
216	1412.670	1413.150	LHS-Shoulder	0.480	Fair			
217	1412.670	1413.150	RHS-Shoulder	0.480	Fair			
218	1415.950	1416.000	RHS-Shoulder	0.050	Fair			
219	1415.980	1416.005	LHS-Shoulder	0.025	Fair			
220	1416.010	1416.030	LHS-Shoulder	0.020	Fair			
221	1416.070	1416.170	RHS-Shoulder	0.100	Fair			
222	1416.400	1416.800	RHS-Shoulder	0.400	Fair			
223	1416.680	1416.900	LHS-Shoulder	0.220	Fair	6.0		
224	1417.030	1417.330	LHS-Shoulder	0.300	Fair	2.0		
225	1417.630	1417.700	RHS-Shoulder	0.070	Fair			
226	1420.490	1420.590	RHS-Shoulder	0.100	Fair			
227	1420.550	1420.650	LHS-Shoulder	0.100	Fair			
228	1420.890	1420.990	RHS-Shoulder	0.100	Fair			
229	1421.240	1421.270	LHS-Shoulder	0.030	Fair			
230	1421.480	1421.580	RHS-Shoulder	0.100	Fair			
231	1422.450	1422.550	LHS-Shoulder	0.100	Fair			
232	1422.450	1422.650	RHS-Shoulder	0.200	Fair	3.0		
233	1422.570	1422.780	LHS-Shoulder	0.210	Fair	2.0		
234	1422.680	1422.800	RHS-Shoulder	0.120	Fair	3.0		
235	1423.230	1423.400	LHS-Median	0.170	Fair			
236	1423.270	1423.400	RHS-Shoulder	0.130	Fair	3.0		
237	1423.480	1423.700	LHS-Median	0.220	Fair			
238	1423.560	1423.770	RHS-Shoulder	0.210	Fair	25.0		
239	1424.750	1424.820	LHS-Shoulder	0.070	Fair			
240	1424.850	1424.970	LHS-Median	0.120	Fair			
241	1424.850	1424.875	RHS-Shoulder	0.025	Fair			
242	1424.900	1424.975	RHS-Shoulder	0.075	Fair			
243	1424.985	1425.130	LHS-Shoulder	0.145	Fair			

S. No	Design Chainage (km)		Side/Location	Length (km)	Condition	Gaps Observed (m)	Damage (m)	Remarks
	From	To						
244	1424.990	1425.200	RHS-Shoulder	0.210	Fair			
245	1425.250	1425.390	RHS-Shoulder	0.140	Fair			
246	1425.300	1425.350	LHS-Shoulder	0.050	Fair			
247	1425.795	1426.050	LHS-Shoulder	0.255	Fair			
248	1426.350	1426.480	RHS-Shoulder	0.130	Fair	3.0		
249	1426.680	1426.710	Median	0.030	Fair			
250	1426.830	1427.000	Median	0.170	Fair			
251	1426.900	1426.980	RHS-Shoulder	0.080	Fair			
252	1426.970	1427.000	LHS-Shoulder	0.030	Fair			
253	1427.000	1427.020	RHS-Shoulder	0.020	Fair			
254	1427.020	1427.100	Median	0.080	Fair			
255	1427.020	1427.050	LHS-Shoulder	0.030	Fair			
As per Site Total Length of W-Beam Barriers (km)				**60.705**		**170**	**284**	

Table 20: Concrete Crash Barriers along Project Road

Concrete Crash Barriers as per Site						
S. No.	Design Chainage		Length (km)	Side	Condition	Remarks
	From (km)	To (km)				
1	881.000	881.990	0.990	LHS-Shoulder	Fair	
2	881.000	881.990	0.990	RHS-Shoulder	Fair	
3	881.400	881.800	0.400	LHS-Median	Fair	
4	881.400	881.800	0.400	Median	Fair	
5	886.150	886.250	0.100	LHS-Median	Fair	
6	886.250	887.070	0.820	LHS-Shoulder	Fair	
7	886.250	887.070	0.820	LHS-Median	Fair	
8	887.250	887.260	0.010	LHS-Shoulder	Fair	
9	889.400	891.700	2.300	LHS-Median	Fair	
10	889.900	890.780	0.880	LHS-Shoulder	Fair	
11	1358.000	1358.100	0.100	LHS-Median	Fair	
12	1358.000	1358.100	0.100	LHS-Shoulder	Fair	
13	1358.390	1358.420	0.030	LHS-Shoulder	Fair	
14	1358.380	1358.390	0.010	LHS-Median	Fair	
15	1358.380	1358.390	0.010	Median	Fair	
16	1358.530	1358.540	0.010	LHS-Shoulder	Fair	
17	1358.530	1358.540	0.010	RHS-Shoulder	Fair	
18	1360.150	1361.300	1.150	Median	Fair	
19	1360.340	1360.370	0.030	LHS-Shoulder	Fair	
20	1361.130	1361.140	0.010	LHS-Shoulder	Fair	
21	1361.330	1361.500	0.170	Median	Fair	
22	1361.600	1361.630	0.030	LHS-Median	Fair	
23	1361.600	1361.630	0.030	LHS-Shoulder	Fair	
24	1362.040	1362.070	0.030	LHS-Shoulder	Fair	
25	1362.040	1362.070	0.030	RHS-Shoulder	Fair	
26	1362.050	1362.060	0.010	LHS-Median	Fair	
27	1362.050	1362.060	0.010	Median	Fair	
28	1362.530	1362.540	0.010	LHS-Shoulder	Fair	
29	1363.020	1363.050	0.030	LHS-Shoulder	Fair	
30	1363.020	1363.050	0.030	RHS-Shoulder	Fair	
31	1363.030	1363.040	0.010	LHS-Median	Fair	
32	1363.030	1363.040	0.010	Median	Fair	
33	1363.630	1363.650	0.020	LHS-Shoulder	Fair	
34	1363.630	1363.650	0.020	RHS-Shoulder	Fair	
35	1363.940	1363.990	0.050	LHS-Shoulder	Fair	

Concrete Crash Barriers as per Site						
S. No.	Design Chainage		Length (km)	Side	Condition	Remarks
	From (km)	To (km)				
36	1363.940	1363.990	0.050	LHS-Median	Fair	
37	1363.940	1363.990	0.050	RHS-Shoulder	Fair	
38	1363.940	1363.990	0.050	Median	Fair	
39	1364.770	1364.790	0.020	LHS-Shoulder	Fair	
40	1364.770	1364.790	0.020	RHS-Shoulder	Fair	
41	1365.770	1365.800	0.030	LHS-Shoulder	Fair	
42	1365.770	1365.800	0.030	RHS-Shoulder	Fair	
43	1365.790	1365.8	0.010	LHS-Median	Fair	
44	1365.790	1365.8	0.010	Median	Fair	
45	1366.100	1367.250	1.150	Median	Fair	
46	1366.370	1366.430	0.060	LHS-Shoulder	Fair	
47	1367.280	1367.920	0.640	LHS-Median	Fair	
48	1367.570	1367.590	0.020	LHS-Shoulder	Fair	
49	1367.570	1367.590	0.020	RHS-Shoulder	Fair	
50	1367.910	1367.920	0.010	LHS-Shoulder	Fair	
51	1367.910	1367.920	0.010	RHS-Shoulder	Fair	
52	1368.250	1368.310	0.060	LHS-Shoulder	Fair	
53	1368.250	1368.310	0.060	RHS-Shoulder	Fair	
54	1368.530	1368.580	0.050	LHS-Shoulder	Fair	
55	1368.530	1368.580	0.050	LHS-Shoulder	Fair	
56	1369.430	1369.445	0.015	LHS-Shoulder	Fair	
57	1369.430	1369.445	0.015	LHS-Shoulder	Fair	
58	1370.175	1370.210	0.035	LHS-Shoulder	Fair	
59	1370.175	1370.210	0.035	RHS-Shoulder	Fair	
60	1370.200	1370.210	0.010	LHS-Median	Fair	
61	1370.200	1370.210	0.010	LHS-Median	Fair	
62	1370.340	1370.360	0.020	LHS-Shoulder	Fair	
63	1370.340	1370.360	0.020	RHS-Shoulder	Fair	
64	1372.310	1372.350	0.040	LHS-Shoulder	Fair	
65	1372.310	1372.350	0.040	LHS-Shoulder	Fair	
66	1372.320	1372.350	0.030	LHS-Median	Fair	
67	1372.320	1372.350	0.030	Median	Fair	
68	1372.900	1372.910	0.010	LHS-Shoulder	Fair	
69	1372.900	1372.910	0.010	RHS-Shoulder	Fair	
70	1374.870	1374.930	0.060	LHS-Shoulder	Fair	
71	1376.010	1376.030	0.020	RHS-Shoulder	Fair	
72	1376.010	1376.030	0.020	LHS-Shoulder	Fair	
73	1376.010	1376.030	0.020	LHS-Median	Fair	
74	1376.010	1376.030	0.020	Median	Fair	
75	1376.450	1376.465	0.015	LHS-Shoulder	Fair	
76	1376.450	1376.465	0.015	RHS-Shoulder	Fair	
77	1376.760	1376.775	0.015	LHS-Shoulder	Fair	
78	1376.760	1376.775	0.015	RHS-Shoulder	Fair	
79	1377.770	1377.785	0.015	LHS-Shoulder	Fair	
80	1377.770	1377.785	0.015	RHS-Shoulder	Fair	
81	1379.620	1379.680	0.060	LHS-Shoulder	Fair	
82	1379.620	1379.680	0.060	RHS-Shoulder	Fair	
83	1379.630	1379.680	0.050	LHS-Median	Fair	
84	1379.630	1379.680	0.050	Median	Fair	
85	1380.500	1380.515	0.015	LHS-Shoulder	Fair	
86	1380.500	1380.515	0.015	LHS-Shoulder	Fair	
87	1380.790	1380.810	0.020	LHS-Shoulder	Fair	
88	1380.790	1380.810	0.020	RHS-Shoulder	Fair	

Concrete Crash Barriers as per Site						
S. No.	Design Chainage		Length (km)	Side	Condition	Remarks
	From (km)	To (km)				
89	1380.790	1380.810	0.020	LHS-Median	Fair	
90	1380.790	1380.810	0.020	Median	Fair	
91	1380.900	1380.920	0.020	LHS-Shoulder	Fair	
92	1380.900	1380.920	0.020	RHS-Shoulder	Fair	
93	1381.540	1381.570	0.030	LHS-Shoulder	Fair	
94	1381.540	1381.570	0.030	RHS-Shoulder	Fair	
95	1381.540	1381.570	0.030	LHS-Median	Fair	
96	1381.540	1381.570	0.030	Median	Fair	
97	1382.940	1382.960	0.020	LHS-Shoulder	Fair	
98	1382.940	1382.960	0.020	RHS-Shoulder	Fair	
99	1384.200	1384.220	0.020	LHS-Shoulder	Fair	
100	1384.200	1384.220	0.020	RHS-Shoulder	Fair	
101	1384.670	1384.685	0.015	LHS-Shoulder	Fair	
102	1384.670	1384.685	0.015	RHS-Shoulder	Fair	
103	1385.540	1385.560	0.020	LHS-Shoulder	Fair	
104	1385.930	1385.940	0.010	LHS-Shoulder	Fair	
105	1385.930	1385.940	0.010	RHS-Shoulder	Fair	
106	1386.700	1386.730	0.030	LHS-Shoulder	Fair	
107	1386.700	1386.730	0.030	RHS-Shoulder	Fair	
108	1386.710	1386.720	0.010	LHS-Median	Fair	
109	1386.710	1386.720	0.010	Median	Fair	
110	1387.010	1387.025	0.015	LHS-Shoulder	Fair	
111	1387.030	1388.150	1.120	LHS-Median	Fair	
112	1387.480	1387.500	0.020	LHS-Shoulder	Fair	
113	1387.480	1387.500	0.020	RHS-Shoulder	Fair	
114	1388.010	1388.030	0.020	LHS-Shoulder	Fair	
115	1388.010	1388.030	0.020	RHS-Shoulder	Fair	
116	1388.570	1388.610	0.040	LHS-Shoulder	Fair	
117	1388.570	1388.610	0.040	LHS-Shoulder	Fair	
118	1388.570	1388.610	0.040	RHS-Shoulder	Fair	
119	1388.570	1388.610	0.040	Median	Fair	
120	1389.600	1392.730	3.130	LHS-Median	Fair	
121	1392.250	1392.265	0.015	LHS-Shoulder	Fair	
122	1392.250	1392.265	0.015	RHS-Shoulder	Fair	
123	1392.760	1394.300	1.540	LHS-Median	Fair	
124	1393.380	1393.400	0.020	LHS-Shoulder	Fair	
125	1393.380	1393.400	0.020	RHS-Shoulder	Fair	
126	1393.750	1393.765	0.015	LHS-Shoulder	Fair	
127	1393.750	1393.765	0.015	RHS-Shoulder	Fair	
128	1394.380	1394.395	0.015	LHS-Shoulder	Fair	
129	1394.380	1394.395	0.015	RHS-Shoulder	Fair	
130	1395.200	1395.220	0.020	LHS-Shoulder	Fair	
131	1395.200	1395.220	0.020	RHS-Shoulder	Fair	
132	1396.970	1396.995	0.025	LHS-Shoulder	Fair	
133	1396.970	1396.995	0.025	RHS-Shoulder	Fair	
134	1398.780	1398.800	0.020	LHS-Shoulder	Fair	
135	1398.780	1398.800	0.020	RHS-Shoulder	Fair	
136	1399.620	1399.640	0.020	LHS-Shoulder	Fair	
137	1399.620	1399.640	0.020	RHS-Shoulder	Fair	
138	1400.240	1400.255	0.015	LHS-Shoulder	Fair	
139	1401.120	1401.135	0.015	LHS-Shoulder	Fair	
140	1402.260	1402.275	0.015	LHS-Shoulder	Fair	
141	1402.260	1402.275	0.015	RHS-Shoulder	Fair	

Concrete Crash Barriers as per Site						
S. No.	Design Chainage		Length (km)	Side	Condition	Remarks
	From (km)	To (km)				
142	1403.000	1403.015	0.015	LHS-Shoulder	Fair	
143	1403.000	1403.015	0.015	RHS-Shoulder	Fair	
144	1404.202	1404.213	0.011	LHS-Shoulder	Fair	
145	1404.202	1404.213	0.011	RHS-Shoulder	Fair	
146	1404.550	1404.565	0.015	LHS-Shoulder	Fair	
147	1404.550	1404.565	0.015	RHS-Shoulder	Fair	
148	1405.410	1405.430	0.020	LHS-Shoulder	Fair	
149	1405.410	1405.430	0.020	RHS-Shoulder	Fair	
150	1406.950	1406.965	0.015	LHS-Shoulder	Fair	
151	1406.950	1406.965	0.015	RHS-Shoulder	Fair	
152	1408.520	1408.550	0.030	LHS-Shoulder	Fair	
153	1408.520	1408.550	0.030	RHS-Shoulder	Fair	
154	1408.530	1408.540	0.010	LHS-Median	Fair	
155	1408.530	1408.540	0.010	Median	Fair	
156	1409.540	1409.565	0.025	LHS-Shoulder	Fair	
157	1409.540	1409.565	0.025	RHS-Shoulder	Fair	
158	1411.540	1411.565	0.025	LHS-Shoulder	Fair	
159	1411.540	1411.565	0.025	RHS-Shoulder	Fair	
160	1412.650	1412.670	0.020	LHS-Shoulder	Fair	
161	1412.650	1412.670	0.020	RHS-Shoulder	Fair	
162	1414.150	1414.900	0.750	Median	Fair	
163	1414.900	1415.450	0.550	LHS-Median	Fair	
164	1414.900	1415.450	0.550	Median	Fair	
165	1415.450	1415.600	0.150	Median	Fair	
166	1415.630	1417.720	2.090	Median	Fair	
167	1415.750	1415.765	0.015	LHS-Shoulder	Fair	
168	1415.750	1415.765	0.015	RHS-Shoulder	Fair	
169	1416.005	1416.025	0.020	LHS-Shoulder	Fair	
170	1416.005	1416.025	0.020	RHS-Shoulder	Fair	
171	1416.030	1416.075	0.045	LHS-Shoulder	Fair	
172	1416.030	1416.075	0.045	RHS-Shoulder	Fair	
173	1418.540	1418.555	0.015	LHS-Shoulder	Fair	
174	1418.540	1418.555	0.015	RHS-Shoulder	Fair	
175	1419.920	1419.945	0.025	LHS-Shoulder	Fair	
176	1419.920	1419.945	0.025	RHS-Shoulder	Fair	
177	1421.270	1421.285	0.015	LHS-Shoulder	Fair	
178	1421.270	1421.285	0.015	RHS-Shoulder	Fair	
179	1422.550	1422.570	0.020	LHS-Shoulder	Fair	
180	1422.550	1422.570	0.020	RHS-Shoulder	Fair	
181	1422.550	1422.570	0.020	LHS-Median	Fair	
182	1422.550	1422.570	0.020	Median	Fair	
183	1424.820	1424.835	0.015	LHS-Shoulder	Fair	
184	1424.820	1424.835	0.015	RHS-Shoulder	Fair	
185	1424.970	1424.985	0.015	LHS-Shoulder	Fair	
186	1424.970	1424.985	0.015	LHS-Shoulder	Fair	
187	1424.970	1424.985	0.015	LHS-Median	Fair	
188	1424.970	1424.985	0.015	LHS-Median	Fair	
189	1426.230	1426.245	0.015	LHS-Shoulder	Fair	
190	1426.230	1426.245	0.015	RHS-Shoulder	Fair	
191	1427.000	1427.020	0.020	LHS-Shoulder	Fair	
192	1427.000	1427.020	0.020	RHS-Shoulder	Fair	
As per Site Total Concrete Crash Barrier(km)			**24.707**			

Pedestrian Guard Railing (PGR) were observed on the separator between the Carriageway and Service Road. Along the project corridor, location wise details are presented below:

Table 21: List of Pedestrian Guard Rails

Pedestrian Guard Rails							
S.no	Design Chainage(km)		Length (m)	Side	Condition	Damage (m)	Gaps observed (m)
	From	To					
1	880.600	880.660	60	LHS-Shoulder	Fair		
2	880.600	880.850	250	RHS-Shoulder	Fair	4	
3	887.980	888.570	590	LHS-Median	Fair	20	
4	1385.700	1386.200	500	Median	Fair		
5	1388.340	1388.530	190	Median	Fair		4
6	1394.770	1394.830	60	Median	Fair		
7	1394.860	1395.230	370	Median	Fair		
As per Site Total length of PGR's			2016			24	4

Road furniture in the form of High masts, Highway Lighting and Sign boards have been provided along the project road. The list of all road items have been furnished in **Appendix-6** of this report.

The tables below depict the summary of few Road Furniture items and the location wise details are provided.

Table 22: Locations of Highmast lighting

Highmast Lighting-as per site					
S.No.	Ex. Chainage (Km)	Facility, if any	Location / Side	Condition	Remarks
1	881+000	1	RHS	Fair	Highmast
2	887+050	1	RHS	Fair	Highmast
3	1362+550	1	LHS	Fair	Highmast
4	1362+780	1	Toll Plaza	Fair	Highmast
5	1362+780	1	Toll Plaza	Fair	Highmast
6	1362+780	1	Toll Plaza	Fair	Highmast
7	1362+780	1	Toll Plaza	Fair	Highmast
8	1362+950	1	LHS	Fair	Highmast
9	1371+100	1	RHS	Fair	Highmast
10	1378+900	1	Median	Fair	Highmast
11	1379+900	1	Median	Fair	Highmast
12	1402+000	1	LHS	Fair	Highmast
13	1402+650	1	Median	Fair	Highmast
14	1405+480	1	Median	Fair	Highmast
15	1423+450	1	Median	Fair	Highmast
16	1428+480	1	RHS	Fair	Highmast

Table 23: Locations of Highway Lighting

Highway Lighting-as per site								
S.No.	Chainage (km)		Location	Length (m)	No. of Light poles		Damage (Nos)	Remarks
	From	To			Single arm	Double arm		
1	880+850	881+250	Median	400		14		
2	881+100	881+000	RHS	100	12			service road
3	881+130	882+020	LHS	890	24			service road
4	881+250	881+650	LHS	400	16			
5	881+250	880+770	RHS	480	16			
6	881+650	881+950	Median	300		10		
7	883+040	883+250	LHS	210	7			service road
8	885+750	885+900	LHS	150	7		1	Bulb
9	885+890	886+040	LHS	150				service road
10	886+250	887+050	LHS Median	800	33		2	Bulb
11	886+540	885+800	RHS Median	740	33			
12	887+050	887+290	Median	240		8		
13	887+750	888+350	Median	600		20		
14	889+550	890+650	LHS Median	1100	39			
15	1358+800	1359+150	LHS Median	350	14			
16	1362+300	1362+550	Median	250		11		
17	1363+000	1363+400	Median	400		4		
18	1363+000	1363+400	LHS Median	400	18			
19	1363+700	1363+800	LHS	100	7			
20	1368+200	1368+650	Median	450		15		
21	1369+250	1369+350	Rest Area	100	29			
22	1369+400	1369+550	LHS	150	5			
23	1369+600	1369+800	LHS	200	7			
24	1370+200	1370+600	Median	400		21	1	Pole
25	1370+300	1370+600	LHS	300	10			service road
26	1374+300	1374+800	Median	500		17		
27	1374+900	1375+000	LHS	100	4			
28	1374+900	1374+750	RHS	150	5			
29	1374+950	1375+400	Median	450		17		
30	1385+050	1385+220	Truck Lay Bye	170	11			
31	1385+500	1385+270	Truck Lay Bye	230	11			
32	1385+700	1386+200	Median	500		17		
33	1388+250	1388+360	Median	110		7		
34	1394+700	1394+120	LHS	580		14		
35	1395+600	1395+900	Truck Lay Bye	300	11			
36	1396+300	1396+000	Truck Lay Bye	300	11			
37	1412+380	1413+150	LHS	770	26			service road
38	1412+600	1413+400	Median	800		25	2	Bulb
							1	Arm
39	1413290	1412550	RHS	740	28			service road
40	1415000	1415450	LHS	450	23			
41	1415450	1415000	RHS	450	23			
42	1421500	1421710	LHS	210	7			
43	1424570	1424480	RHS	90	5			
Total				11700	**442**	**200**	**7**	

Table 24: Details of Road Signs along Project Road

Description	LHS (Nos.)	RHS (Nos.)	Junctions (Nos.)	Total (Nos.)
Octagonal	0	1	40	41
Circular	57	103	40	200
Triangular	87	116	26	229
Rectangular	58	66	16	140
Facility informatory	2	7	0	9
Chevron	72	81	0	153
Hazard	139	151	85	375
Route Marker	9	13	1	23
Safety Boards	0	0	0	0
Toll Boards	6	6	0	12
Cantilever Gantry	10	8	0	18
Over Head Gantry	3	3	0	6
Variable Message Sign	3	3	0	6
Project Descriptive	0	0	0	0
Total	**446**	**558**	**208**	**1212**

The project road has total 42 Nos. of Bus Bays & Bus shelters on Highway. In that 29 Nos. are Bus Bay with shelters & 13 Nos. are Bus Shelters. Facilities like Highway lighting was observed. The pavement in the Bus bay with shelters is in fair condition, the details were presented in below.

Table 25: Details of Bus Bays with Shelters

Bus Bays & Bus Shelters as per Site							
S. No.	Existing Chainage (km)	Side	As per Site	Facilities Provided		Separator	Remarks
				PGR	Single arm Lightings (Nos.)		
1	881+330	RHS	Bus Shelter			No	
2	881+575	LHS	Bus Shelter			No	
3	883+925	RHS	Bus Bay with shelter		7	No	
4	883+980	LHS	Bus Shelter			No	
5	885+980	LHS	Bus Shelter			No	
6	888+375	LHS	Bus Shelter			No	
7	888+990	LHS	Bus Bay with shelter		7	No	
8	888+990	RHS	Bus Bay with shelter		7	No	
9	890+340	RHS	Bus Shelter			No	
10	1359+400	RHS	Bus Shelter			No	
11	1359+525	LHS	Bus Shelter			No	
12	1363+775	LHS	Bus Bay with shelter		7	No	
13	1363+825	RHS	Bus Bay with shelter		7	No	
14	1369+640	RHS	Bus Bay with shelter		7	No	
15	1369+775	LHS	Bus Bay with shelter		7	No	
16	1375+775	RHS	Bus Bay with shelter		7	No	
17	1375+875	LHS	Bus Bay with shelter		7	No	
18	1378+050	LHS	Bus Bay with shelter		7	No	

Bus Bays & Bus Shelters as per Site							
S. No.	Existing Chainage (km)	Side	As per Site	Facilities Provided		Separator	Remarks
				PGR	Single arm Lightings (Nos.)		
19	1378+050	RHS	Bus Bay with shelter		7	No	
20	1384+025	LHS	Bus Bay with shelter		7	No	
21	1384+160	RHS	Bus Bay with shelter		7	No	
22	1386+275	LHS	Bus Bay with shelter		7	No	
23	1386+275	RHS	Bus Bay with shelter		7	No	
24	1388+340	LHS	Bus Bay with shelter		7	No	
25	1388+360	RHS	Bus Bay with shelter		7	No	
26	1394+625	LHS	Bus Bay with shelter		7	No	
27	1394+775	RHS	Bus Bay with shelter		7	No	
28	1398+470	RHS	Bus Bay with shelter		7	No	
29	1398+720	LHS	Bus Bay with shelter		7	No	
30	1401+570	LHS	Bus Bay with shelter		7	No	
31	1401+660	RHS	Bus Bay with shelter		7	No	1 Bulb Damaged
32	1402+450	RHS	Bus Bay with shelter		7	No	
33	1402+610	LHS	Bus Shelter			No	
34	1402+825	LHS	Bus Bay with shelter		7	No	
35	1409+105	RHS	Bus Shelter			No	
36	1411+760	RHS	Bus Bay with shelter		7	No	
37	1412+000	LHS	Bus Bay with shelter		7	No	
38	1413+160	LHS	Bus Shelter			No	
39	1413+200	RHS	Bus Shelter			No	
40	1421+675	RHS	Bus Bay with shelter		7	No	
41	1421+680	LHS	Bus Bay with shelter		7	No	
42	1426+470	LHS	Bus Shelter			No	

The Project Road has 4 Nos. Truck laybyes in two locations on either side of Highway. The Truck lay bye has been provided with rigid pavement and the condition appears to be fair to poor. Separator is provided between main carriageway and truck lay bye portion and details are as follows.

Table 26: Details of Truck laybyes

Truck Lay byes											
S. No.	Chainage(km)	Length (m)	Side	Type of Road	Width (m)	Separator Details				Toilet blocks	Rest room
						Length (m)	Width (m)	Kerb Height	Kerb width		
1	1385.260	240	BHS	Rigid	7.5	100	1.4	0.25	0.13	Yes	Yes
2	1395.795	240	BHS	Rigid	7.2	100	1.0	0.2	0.11	Yes	Yes

3.2. Structures

List of Major Structures found during the inventory surveys along the corridor are as follows:

Table 27: Details of Major Structures along Project Road

S No.	Chainage	Type of Str	Side	Structure on	Age of Structure	Span Arrangement (No x Length)	No. of Decks	Deck width	Remarks
1	881+433	FLYOVER	LHS	MCW	New	14 x 30	1	12.50	-
2	881+433	FLYOVER	RHS	MCW	New	14 x 30	1	12.50	-
3	886+656	MJB	LHS	MCW	New	22 x 38.5	1	12.50	-
4	886+656	MJB	RHS	MCW	Old	6 x 19.97 + 1 x 37.9 + 17 x 38.5 + 1 x 37.9 + 4 x 19.97	1	10.50	-
5	887+303	VUP	LHS	MCW	New	1 x 10	1	12.50	-
6	887+303	VUP	RHS	MCW	New	1 x 10	1	12.50	-
7	890+430	Viaduct	LHS	MCW	New	7 x 30 + 1 x 15 + 1 x 56 + 1 x 15 + 7 x 30	1	12.50	-
8	890+430	MNB	RHS	MCW	Old	3 x 8.0	1	8.00	-
9	1358+000	VUP	LHS	MCW	New	2 x 30	1	12.50	-
10	1358+376	MNB	LSR	SR	New	1 x 8.0	0	15.00	-
11	1358+376	MNB	LHS	MCW	New	1 x 8.0	1	15.00	-
12	1358+376	MNB	RHS	MCW	New	1 x 8.0	1	12.50	-
13	1360+363	MNB	LHS	MCW	New	1 x 8.3	1	12.50	-
14	1360+363	MNB	RHS	MCW	New	1 x 8.3	1	12.50	-
15	1361+625	MNB	LHS	MCW	Old	3 x 10	1	8.50	-
16	1361+625	MNB	RHS	MCW	New	1 x 38	1	12.50	-
17	1362+075	MNB	LHS	MCW	New	2 x 11.1	1	12.50	-
18	1362+075	MNB	RHS	MCW	New	2 x 11.1	1	12.50	-
19	1363+024	MNB	LHS	MCW	New	1 x 10.7	1	19.00	-
20	1363+024	MNB	RHS	MCW	New	1 x 10.7	1	19.00	-
21	1363+943	MNB	LHS	MCW	Old	3 x 10	1	8.50	-
22	1363+943	MNB	RHS	MCW	New	1 x 38.5	1	12.50	-
23	1365+770	MNB	LHS	MCW	New	1 x 14	1	12.50	-
24	1365+770	MNB	RHS	MCW	New	1 x 14	1	12.50	-
25	1368+296	ROB	LHS	MCW	New	2 x 9.1	1	18.00	-
26	1368+296	ROB	RHS	MCW	New	2 x 9.1	1	18.00	-
27	1368+545	VUP	LHS	MCW	New	1 x 13.8	1	12.50	-
28	1368+545	VUP	RHS	MCW	New	1 x 13.8	1	12.50	-
29	1370+160	MNB	LHS	MCW	New	1 x 30	1	12.50	-
30	1370+160	MNB	RHS	MCW	New	1 x 30	1	12.50	-
31	1370+320	VUP	LHS	MCW	New	1 x 13.8	1	12.50	-
32	1370+320	VUP	RHS	MCW	New	1 x 13.8	1	12.50	-
33	1372+370	MNB	LHS	MCW	New	3 x 15	1	12.50	-
34	1372+370	MNB	RHS	MCW	New	3 x 15	1	12.50	-

S No.	Chainage	Type of Str	Side	Structure on	Age of Structure	Span Arrangement (No x Length)	No. of Decks	Deck width	Remarks
35	1373+880	MNB	LHS	MCW	New	1 x 38.5	1	12.50	-
36	1373+880	MNB	RHS	MCW	New	1 x 38.5	1	12.50	-
37	1374+900	ROB	LHS	MCW	New	3 x 40.6	1	12.50	-
38	1374+900	ROB	RHS	MCW	New	3 x 40.6	1	12.50	-
39	1375+050	PUP	LHS	MCW	New	1 x 8.8	1	14.00	-
40	1375+050	PUP	RHS	MCW	New	1 x 8.8	1	14.00	-
41	1376+020	MNB	LHS	MCW	New	3 x 10.5	1	12.50	-
42	1376+020	MNB	RHS	MCW	New	3 x 10.5	1	12.50	-
43	1379+595	PUP	LHS	MCW	New	1 x 8.5	1	12.50	-
44	1379+595	PUP	RHS	MCW	New	1 x 8.5	1	12.50	-
45	1380+637	MNB	LHS	MCW	New	1 x 8.0	1	12.50	-
46	1380+637	MNB	RHS	MCW	New	1 x 8.0	1	12.50	-
47	1381+552	MNB	LHS	MCW	New	1 x 11.3	1	12.50	-
48	1381+552	MNB	RHS	MCW	New	1 x 11.3	1	12.50	-
49	1384+256	MNB	LHS	MCW	New	1 x 7.0	1	12.50	-
50	1384+256	MNB	RHS	MCW	New	1 x 7.0	1	12.50	-
51	1384+492	MNB	LHS	MCW	New	1 x 10.0	1	12.50	-
52	1384+492	MNB	RHS	MCW	New	1 x 10.0	1	12.50	-
53	1385+478	MNB	LHS	MCW	New	1 x 14.0	1	12.50	-
54	1385+478	MNB	RHS	MCW	New	1 x 14.0	1	12.50	-
55	1386+720	MNB	LHS	MCW	New	1 x 7.5	1	12.50	-
56	1386+720	MNB	RHS	MCW	New	1 x 7.5	1	12.50	-
57	1388+032	MNB	LHS	MCW	New	1 x 7.3	1	13.00	-
58	1388+032	MNB	RHS	MCW	New	1 x 7.3	1	13.00	-
59	1388+563	MNB	LHS	MCW	New	4 x 10.25	1	12.50	-
60	1388+563	MNB	RHS	MCW	New	4 x 10.25	1	12.50	-
61	1408+470	MNB	LHS	MCW	New	1 x 8.0	1	12.50	-
62	1408+470	MNB	RHS	MCW	New	1 x 8.0	1	16.00	-
63	1412+700	PUP	LHS	MCW	New	1 x 8.0	1	14.00	-
64	1412+700	PUP	RHS	MCW	New	1 x 8.0	1	14.00	-
65	1415+180	MJB	LHS	MCW	New	13 x 38.5	1	12.50	-
66	1415+180	MJB	RHS	MCW	New	13 x 38.5	1	12.50	-
67	1415+954	MNB	LHS	MCW	New	1 x 15	1	12.50	-
68	1415+954	MNB	RHS	MCW	New	1 x 15	1	12.50	-
69	1422+600	MNB	LHS	MCW	New	3 x 9.7	1	12.50	-
70	1422+600	MNB	RHS	MCW	New	3 x 9.7	1	12.50	-
71	1424+415	VOP	BHS	MCW	New	2 x 16	2	12.50	-
72	1425+005	PUP	LHS	MCW	New	1 x 7.4	1	12.50	-
73	1425+005	PUP	RHS	MCW	New	1 x 7.4	1	12.50	-
74	1427+000	MNB	LHS	MCW	New	3 x 8.0	1	12.50	-
75	1427+000	MNB	RHS	MCW	New	3 x 8.0	1	12.50	-

S No.	Chainage	Type of Str	Side	Structure on	Age of Structure	Span Arrangement (No x Length)	No. of Decks	Deck width	Remarks
76	1427+700	VOP	LHS	MCW	New	1 x 40	1	12.50	-
77	1427+700	VOP	RHS	MCW	New	1 x 40	1	12.50	-

Table 28: List of structures proposed as per Sch-B:

S. No	Existing Km	Side	Type of str	Span (m)	Deck Width (m)	Improvement Proposal As per Sch-B
1	882+640	BHS	Pipe	1 x 1.2	-	Widening
2	883+010	BHS	Pipe	1 x 1.2	-	Widening
3	883+552	BHS	Box	1 x 2.5	-	Widening
4	884+422	BHS	Pipe	1 x 1.2	-	Widening
5	885+120	BHS	Pipe	2 x 1.2	-	Widening
6	885+840	BHS	Pipe	1 x 1.2	-	Widening
7	1361+625	LHS	MNB	1 x 43	1 x 12.5	New / Rec
8	1363+943	LHS	MNB	1 x 38.5	1 x 12.5	New / Rec
9	1370+570	BHS	Box	1 x 2.5	-	Widening
10	1370+740	BHS	Pipe	1 x 1.2	-	Widening
11	1394+394	BHS	Box	1 x 4	-	Widening
12	1394+561	BHS	Pipe	1 x 1.0	-	Widening
13	1394+710	BHS	Pipe	1 x 1.0	-	Widening
14	1395+189	BHS	Box	1 x 2.5	-	Widening
15	1395+596	BHS	Pipe	2 x 0.9	-	Widening
16	1402+273	BHS	Box	1 x 2.5	-	Widening
17	1402+273	BHS	Box	1 x 2.5	-	New / Rec
18	1402+574	BHS	Pipe	1 x 1.2	-	Widening
19	1402+625	BHS	VUP	1 x 20	2 x 14.5	New / Rec
20	1402+870	BHS	Pipe	1 x 1.2	-	Widening
21	1402+981	BHS	Box	1 x 2.5	-	Widening
22	1402+981	BHS	Box	1 x 2.5	-	New / Rec

4.1 EMBANKMENT & SUBGRADE

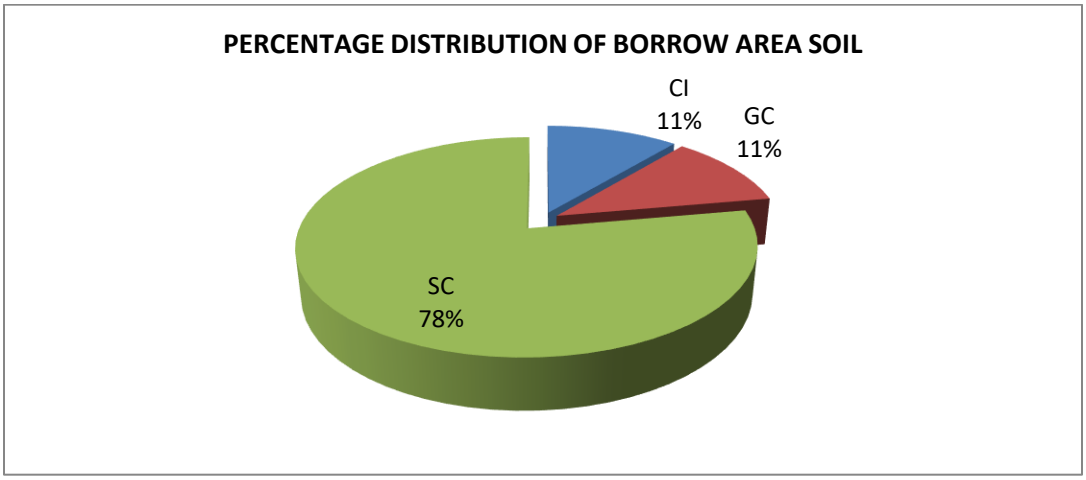
The embankment for project road has been constructed with available soils from nearby areas. No major settlements or depressions have been noted even at high embankment locations. There are no marshy/water logging areas along the length of project road.

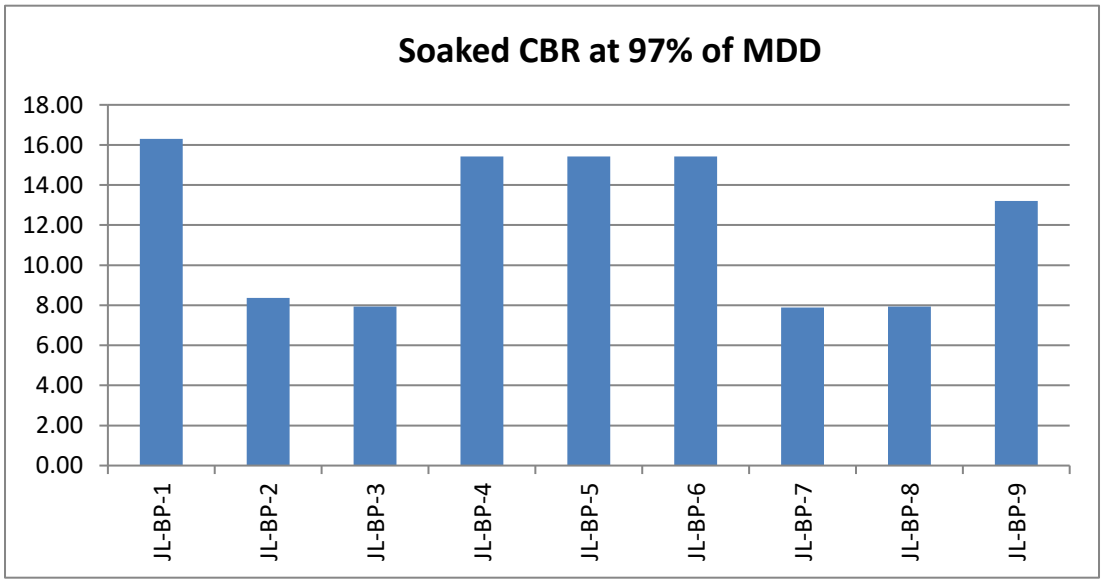
Borrow pits sample reveal that the soil collected primarily belong to coarse grain soil type. Out of 7 samples 4 samples belongs to GC type of soil, 2 samples belong to SC type of soil and 1 sample belongs to CL type of soil. The test results of borrow area soils related to soil classification, Atterberg limits and other properties are as presented below.

Table 29: Test Results of Borrow area Samples Details

Lab Sample No	Site Identification		Grain Size Analysis					Atterberg Limits (%)			Soil Class	MDD (gm/cc)	OMC (%)	Dry Density at 97% MDD	Soaked CBR 97% MDD	Free Swelling Index (%)
	Location (km)	Up/Dn	Percentage passing from													
			4.75 mm IS Sieve	425 mic IS Sieve	75 mic IS Sieve	Gravel %	Sand %	LL	PL	PI						
JL-BP-1	1358+700	RHS	65.14	45.66	32.97	34.86	32.17	48	30	18	GC	1.85	16.60	1.79	16.30	18.00
JL-BP-2	1364+100	LHS	66.15	31.25	16.91	33.85	49.24	49	36	13	SC	1.79	14.00	1.74	8.37	23.00
JL-BP-3	1375+700	RHS	64.78	38.34	31.61	35.22	33.17	49	33	16	SC	1.78	15.00	1.73	7.93	33.00
JL-BP-4	1394+100	LHS	72.39	38.75	29.59	27.61	42.8	48	30	18	SC	1.75	17.50	1.70	15.42	36.00
JL-BP-5	1371+000	RHS	63.42	29.2	23.63	36.58	39.79	48	37	11	SC	1.76	19.00	1.71	15.42	38.00
JL-BP-6	1389+500	RHS	90.80	50.62	34.51	9.2	56.29	52	30	22	SC	1.75	17.80	1.70	15.42	20.00
JL-BP-7	1398+600	LHS	84.43	68.57	58.53	15.57	25.9	44	30	14	CI	1.75	17.40	1.70	7.88	27.00
JL-BP-8	1411+600	LHS	76.84	35.12	19.97	23.16	56.87	51	34	17	SC	1.78	13.70	1.73	7.93	22.00
JL-BP-9	1425+400	LHS	74.47	43.63	33.99	25.53	40.48	49	30	19	SC	1.78	19.60	1.73	13.21	27.00

Pie Chart showing the percentage distribution of soil classification of Borrow area sample is presented below:

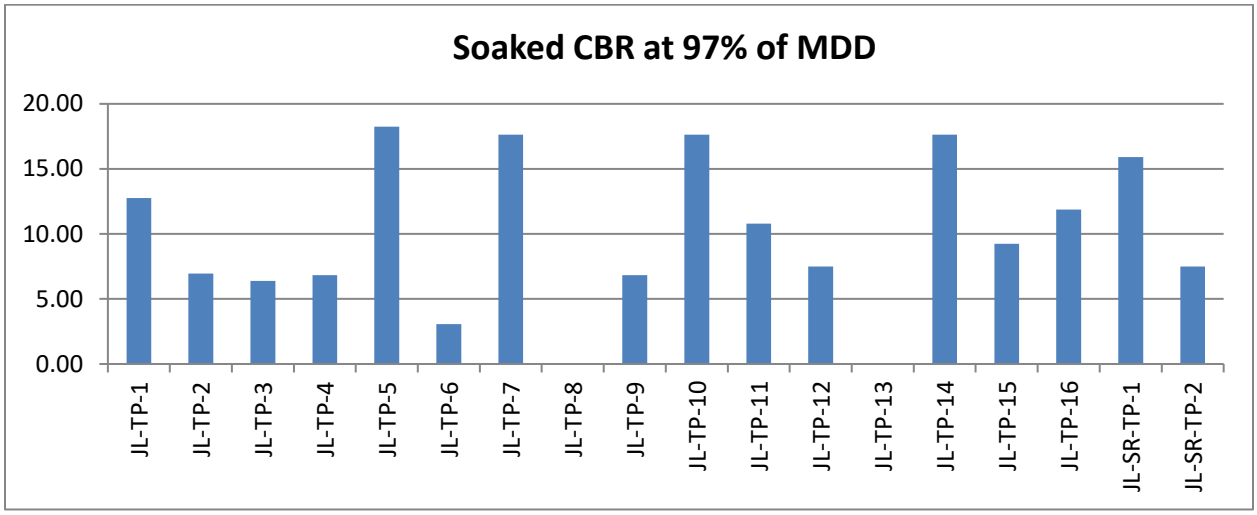




Laboratory test results indicate that all the Subgrade soil samples collected belongs to Coarse Grained Soil. Out of 18 samples, 14 samples belongs to SC type of soil, 2 samples belongs to CI type of soil, 1 sample belongs to GC type of soil and 1 sample belongs to CH type of soil.

The subgrade of the project road appears to be in good condition as revealed by test pit investigations. Soil classification has been done according to IS Classification of Soils (ISC) as detailed in IS 1498 - 1978.The percentage distribution of existing subgrade soil, soaked CBR values and other properties are presented below

Lab Sample No	Site Identification		Grain Size Analysis					Atterberg Limits (%)			Soil Class	MDD (gm/cc)	OMC (%)	FDD (gm/cc)	COMPACTION (%)	Dry Density at 97% MDD	Soaked CBR 97% MDD	Free Swelling Index (%)
			Percentage passing from															
	Location (km)	Up/Dn	4.75 mm IS Sieve	425 mic IS Sieve	75 mic IS Sieve	Gravel %	Sand %	LL	PL	PI								
JL-TP-1	882+200	LHS	81.58	46.96	34.98	18.42	46.6	47	26	21	SC	1.78	17.00	1.65	93	1.73	12.75	13
JL-TP-2	1358+600	LHS	77.37	46.85	37.38	22.63	39.99	49	32	17	SC	1.75	18.00	1.53	87	1.70	6.94	23
JL-TP-3	1369+600	LHS	84.06	47.3	28.37	15.94	55.69	42	31	11	SC	1.75	17.60	1.61	92	1.70	6.39	17
JL-TP-4	1378+200	LHS	73.65	33.99	26.86	26.35	46.79	41	28	13	SC	1.82	16.50	1.64	90	1.77	6.83	17
JL-TP-5	1388+600	LHS	60.31	39.85	27.49	39.69	32.82	35	25	10	GC	2.19	9.80	1.98	90	2.12	18.25	30
JL-TP-6	1398+050	LHS	94.88	85.94	76.8	5.12	18.08	50	28	22	CH	1.75	14.60	1.56	89	1.70	3.07	50
JL-TP-7	1408+100	LHS	80.75	56.74	41.78	19.25	38.97	43	26	17	SC	1.99	10.50	1.80	90	1.93	17.62	17
JL-TP-8	1418+100	LHS	93.99	61.34	51.15	6.01	42.84	44	27	17	CI	1.66	18.20	1.53	92	1.61	NA	39
JL-TP-9	1424+800	RHS	60.89	39.03	29.37	39.11	31.52	47	30	17	SC	1.81	16.50	1.69	93	1.76	6.83	36
JL-TP-10	1413+900	RHS	56.72	25.51	20.23	43.28	36.49	52	33	19	SC	1.98	12.60	1.80	91	1.92	17.62	24
JL-TP-11	1404+500	RHS	60.84	33.56	22.78	39.16	38.06	35	25	10	SC	1.91	15.00	1.73	91	1.85	10.80	19
JL-TP-12	1394+600	RHS	57.88	36.35	27.68	42.12	30.2	42	26	16	SC	1.84	12.30	1.68	91	1.78	7.49	17
JL-TP-13	1384+700	RHS	84.70	72.23	62.34	15.3	22.36	44	25	19	CI	1.70	16.00	1.62	95	1.65	NA	35
JL-TP-14	1374+100	RHS	75.31	38.3	23.11	24.69	52.2	29	21	8	SC	1.99	12.50	1.78	89	1.93	17.62	24
JL-TP-15	1364+850	RHS	65.32	31.73	24.15	34.68	41.17	38	24	14	SC	1.90	18.40	1.74	91	1.84	9.25	18
JL-TP-16	888+000	RHS	96.96	85.25	36.08	3.04	60.88	27	15	12	SC	1.95	13.00	1.79	92	1.89	11.87	18
JL-SR-TP-1	1420+500	RHS	78.55	45.07	34.18	21.45	44.37	44	30	14	SC	2.07	14.20	1.87	90	2.01	15.90	36
JL-SR-TP-2	1407+400	LHS	73.32	49.96	39.33	26.68	33.99	47	31	16	SC	1.84	16.10	1.70	92	1.78	7.49	48



Pie Chart showing the percentage distribution of soil classification of existing subgrade sample is presented below:

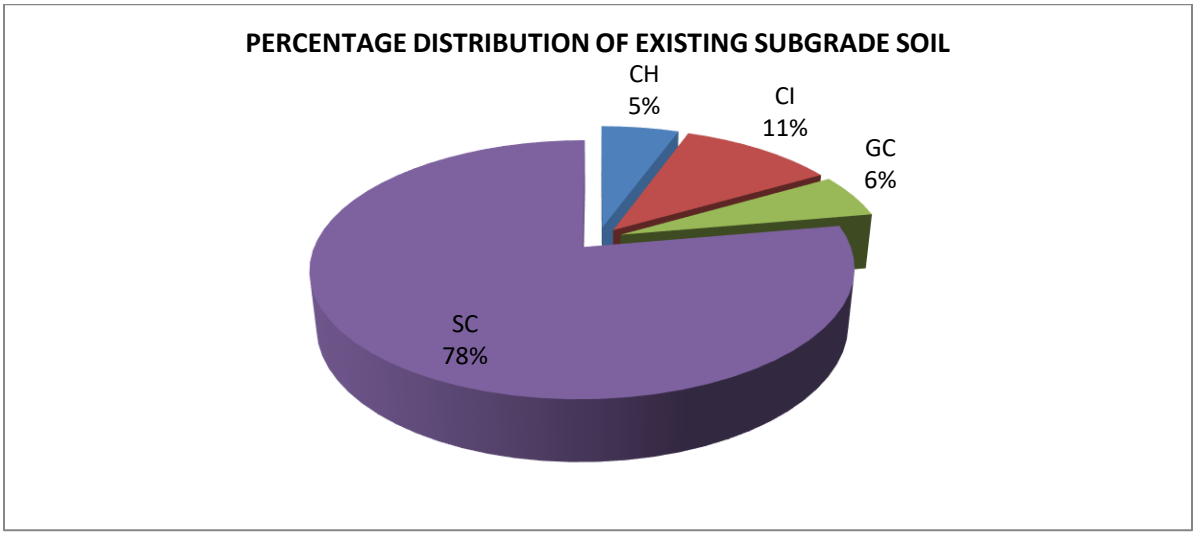


Table 30: Test results of Existing Subgrade Soils

The following observations can be made from the above test results conducted on of existing subgrade samples

- Maximum Dry Density for all subgrade samples varies between 1.75 and 2.19 gm/cc. except 2 sample remaining 16 samples satisfying the MDD criterion (MDD>=1.75 gm/cc).
- OMC for existing subgrade samples varies in between 9.8% to 18.4%.
- Free Swelling Index for existing subgrade samples varies in between 0% to 50%. All 18 samples satisfying the FSI criterion (FSI<=50%)
- Compaction levels are lower than the standard value of 97% of MDD

- CBR Values are varying from 3% to 18%.

Material related tests reports are provided in **Appendix-7** of this report.

Aggregates to be used for sub-base, base, surface courses and concrete works have been collected from the crushers under operation from the existing quarries. The Table below represents the test results of the Aggregate and Sand Samples

Table 31: Test Results of Aggregate Samples Details

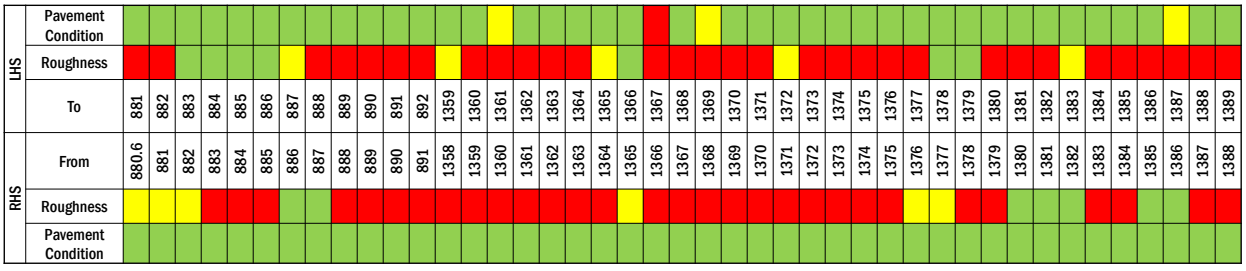
S. No	Sample	Location (km)	Up/Dn	A.I.V (%)	Water Absorption (%)	Specific Gravity	Remark
1	JL-AQ-1	1358+700	RHS	6.46	0.23	2.93	
2	JL-AQ-2	1358+700	RHS	9.09	0.27	2.93	
3	JL-AQ-3	1359+800	LHS	9.78	0.38	2.91	
4	JL-AQ-4	1371+000	RHS	9.85	0.32	2.89	
5	JL-AQ-5	1427+400	RHS	9.30	0.25	2.93	
6	JL-AQ-6	1427+400	RHS	8.98	0.32	2.94	

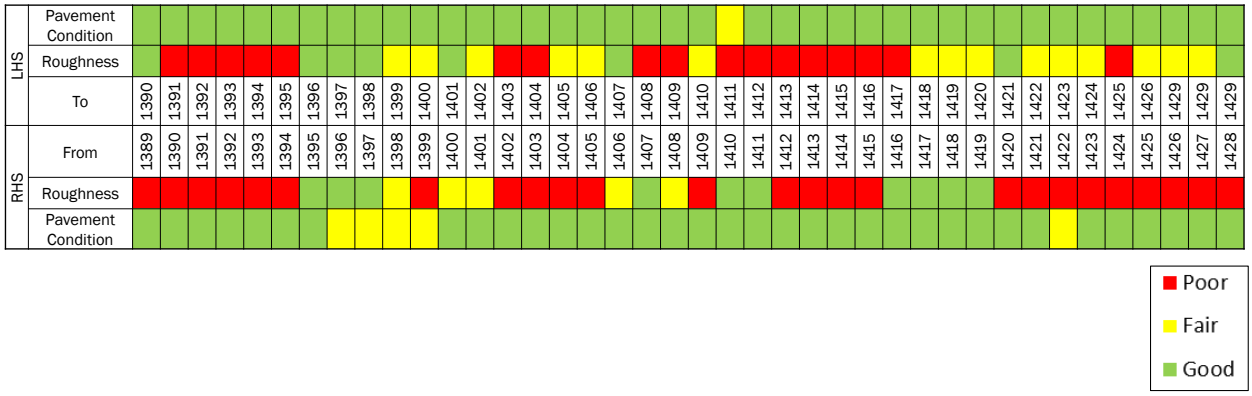
Table 32: Test Results of Sand Samples Details

Sl No	Sample No	CHAINAGE (KM)	SIDE	10 mm Passing %	4.75 mm Passing %	2.36 mm Passing %	1.18mm Passing %	600mm Passing %	300mm Passing %	150mm Passing %	FM	ZONE
1	JL-SQ-1	881+500	RHS	100	91	80	63	42	9	1	**3.15**	**ZONE -II**
2	JL-M-SAND-1	1359+800	LHS	100	99	75	37	21	12	7	**3.49**	**ZONE -I**

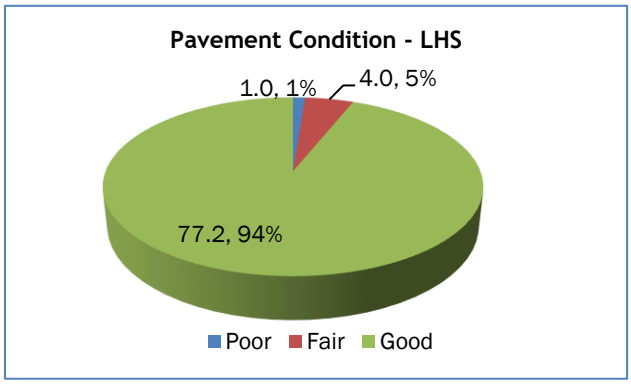
4.2 PAVEMENT CONDITION

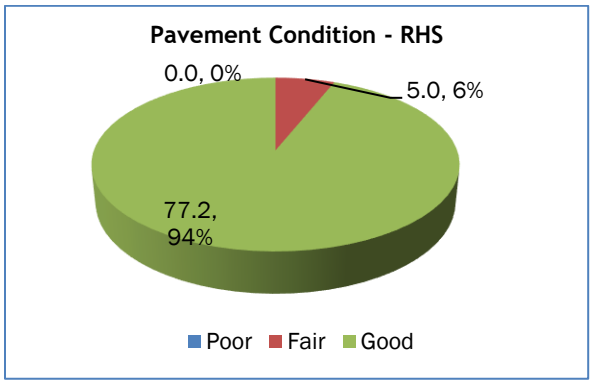
The distresses in bituminous surface have been captured on the project corridor for each lane separately by using the Network Survey Vehicle (NSV).





The overall pavement condition of the project corridor is a presented below.





Pavement Condition report covering the data collection for each km length in each direction has been presented in the **Annexure-2.**

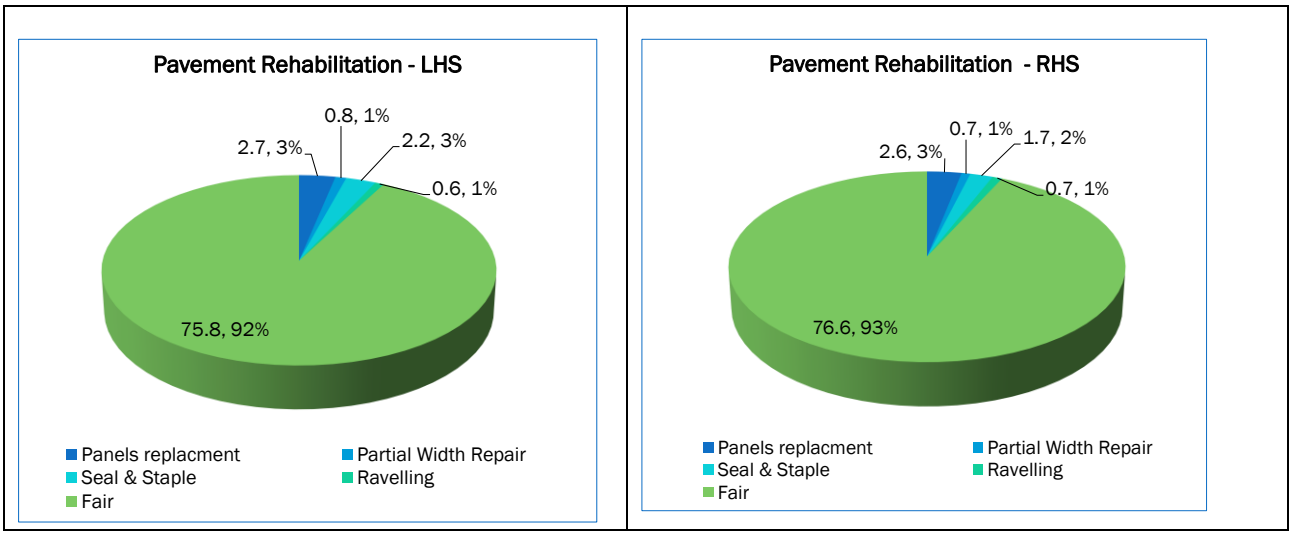
Based on IRC: SP: 83-2018 guidelines the summary of the pavement distresses the following rehabilitation measures for rigid panels have be considered.

The suggested Pavement rehabilitation in terms of No. of panels based on visual pavement condition are as:

LHS	Overall																																								
	Ravelling	1	1	0	0	0	0	0	1	3	7	3	3	7	8	4	1	0	1	0	0	2	3	4	0	0	0	0	1	1	5	0	0	3	1	4	1	0	4	3	2	1
	Seal & Staple	0	3	0	0	0	0	0	9	23	5	2	8	3	4	14	4	18	25	8	0	13	8	32	6	11	5	8	6	13	8	3	0	0	6	12	16	3	7	11	15	17
	Partial Width Repair	1	5	0	0	0	0	0	1	4	3	0	1	0	2	4	3	1	8	0	0	4	2	6	1	1	2	5	3	0	0	1	0	0	1	9	3	3	0	8	6	4
	Panels replacment	1	2	0	0	0	0	0	4	5	2	0	1	21	1	24	5	1	4	9	0	69	20	29	8	2	1	3	1	1	3	1	0	0	4	12	17	28	7	4	20	33
	To	**881**	**882**	**883**	**884**	**885**	**886**	**887**	**888**	**889**	**890**	**891**	**891.8**	**1359**	**1360**	**1361**	**1362**	**1363**	**1364**	**1365**	**1366**	**1367**	**1368**	**1369**	**1370**	**1371**	**1372**	**1373**	**1374**	**1375**	**1376**	**1377**	**1378**	**1379**	**1380**	**1381**	**1382**	**1383**	**1384**	**1385**	**1386**	**1387**
RHS	**From**	**880.6**	**881**	**882**	**883**	**884**	**885**	**886**	**887**	**888**	**889**	**890**	**891**	**1358**	**1359**	**1360**	**1361**	**1362**	**1363**	**1364**	**1365**	**1366**	**1367**	**1368**	**1369**	**1370**	**1371**	**1372**	**1373**	**1374**	**1375**	**1376**	**1377**	**1378**	**1379**	**1380**	**1381**	**1382**	**1383**	**1384**	**1385**	**1386**
	Panels replacment	0	0	1	1	2	3	1	0	3	7	0	1	2	1	3	1	8	4	1	2	22	10	8	14	4	8	4	6	1	4	1	4	31	13	0	0	0	0	0	0	0
	Partial Width Repair	0	0	4	33	2	1	0	0	5	2	1	1	1	3	6	1	4	3	5	2	0	2	2	0	3	0	0	0	0	1	0	0	4	3	0	0	0	2	1	0	0
	Seal & Staple	0	1	4	7	6	8	2	0	13	11	6	4	2	4	1	5	2	8	15	8	5	7	35	9	8	14	2	4	6	6	0	3	6	12	0	0	0	1	0	0	0
	Ravelling	4	4	3	1	5	7	1	0	10	17	0	0	1	0	0	0	1	1	0	4	0	1	4	1	0	3	0	1	2	0	1	0	0	0	0	0	0	11	0	0	0
	Overall																																								

LHS	Overall																																						
	Ravelling	0	1	0	3	3	0	5	6	0	0	0	0	0	0	3	2	8	1	1	2	1	3	1	2	2	0	3	3	3	2	0	1	2	0	0	2	0	5	4	0	0	0
	Seal & Staple	5	2	0	2	14	2	15	4	0	0	0	1	3	1	2	2	12	10	5	6	12	4	3	6	4	5	9	1	0	3	9	2	16	0	0	0	0	1	1	8	2	0
	Partial Width Repair	0	5	0	0	7	1	4	0	2	0	0	1	0	7	0	3	2	1	0	2	2	0	3	10	3	3	2	5	4	2	1	4	9	0	0	0	0	1	2	2	1	0
	Panels replacment	6	0	0	0	4	0	1	1	0	0	0	0	2	7	14	7	11	18	10	0	21	9	15	28	8	14	0	3	3	8	25	23	7	0	0	0	1	5	0	4	0	0
	To	**1388**	**1389**	**1390**	**1391**	**1392**	**1393**	**1394**	**1395**	**1396**	**1397**	**1398**	**1399**	**1400**	**1401**	**1402**	**1403**	**1404**	**1405**	**1406**	**1407**	**1408**	**1409**	**1410**	**1411**	**1412**	**1413**	**1414**	**1415**	**1416**	**1417**	**1418**	**1419**	**1420**	**1421**	**1422**	**1423**	**1424**	**1425**	**1426**	**1429**	**1428**	**1429**
RHS	**From**	**1387**	**1388**	**1389**	**1390**	**1391**	**1392**	**1393**	**1394**	**1395**	**1396**	**1397**	**1398**	**1399**	**1400**	**1401**	**1402**	**1403**	**1404**	**1405**	**1406**	**1407**	**1408**	**1409**	**1410**	**1411**	**1412**	**1413**	**1414**	**1415**	**1416**	**1417**	**1418**	**1419**	**1420**	**1421**	**1422**	**1423**	**1424**	**1425**	**1426**	**1427**	**1428**
	Panels replacment	0	3	8	3	5	1	1	5	5	73	50	39	35	3	1	0	7	0	10	30	0	11	2	5	0	1	3	2	0	3	0	0	0	25	4	49	1	3	1	8	0	0
	Partial Width Repair	0	0	1	1	7	0	1	0	3	0	0	1	5	2	0	0	1	0	1	4	0	2	8	3	0	0	0	1	1	1	0	0	0	2	1	4	2	1	0	0	0	0
	Seal & Staple	0	7	3	6	11	11	0	5	1	0	10	10	10	7	2	2	10	6	5	4	0	4	3	2	0	0	4	1	6	3	0	0	0	9	1	2	0	3	0	1	3	0
	Ravelling	5	1	1	0	1	5	2	2	0	3	6	2	6	1	0	2	4	2	1	4	0	3	3	4	0	1	2	0	0	1	0	0	0	0	4	2	7	1	3	1	0	0
	Overall																																									

The pie chart showing the %distribution of distress rectification measures for this package are as follows

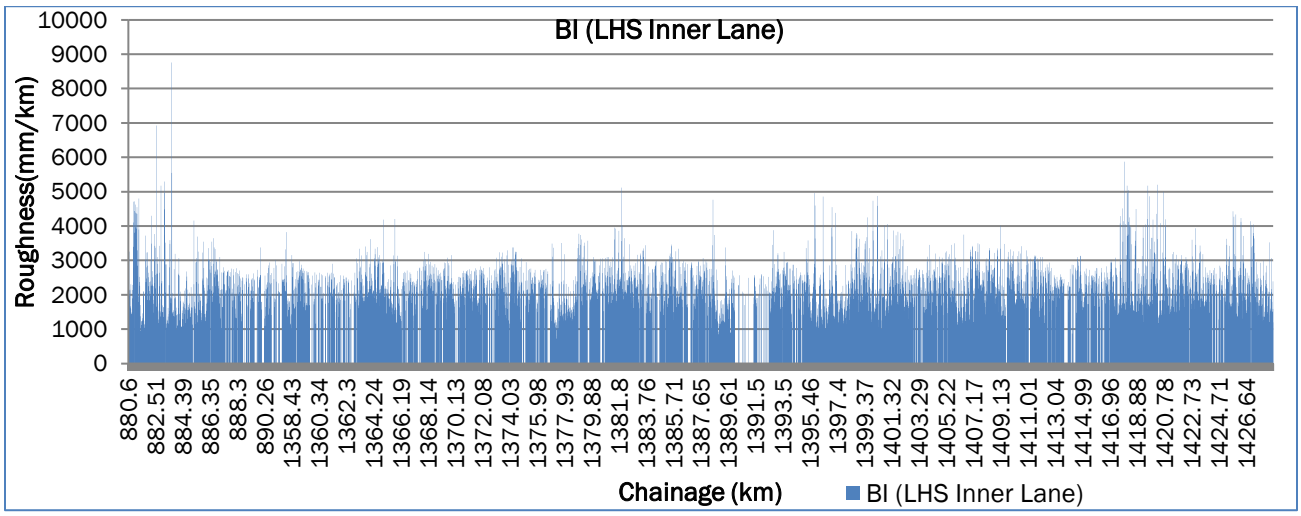


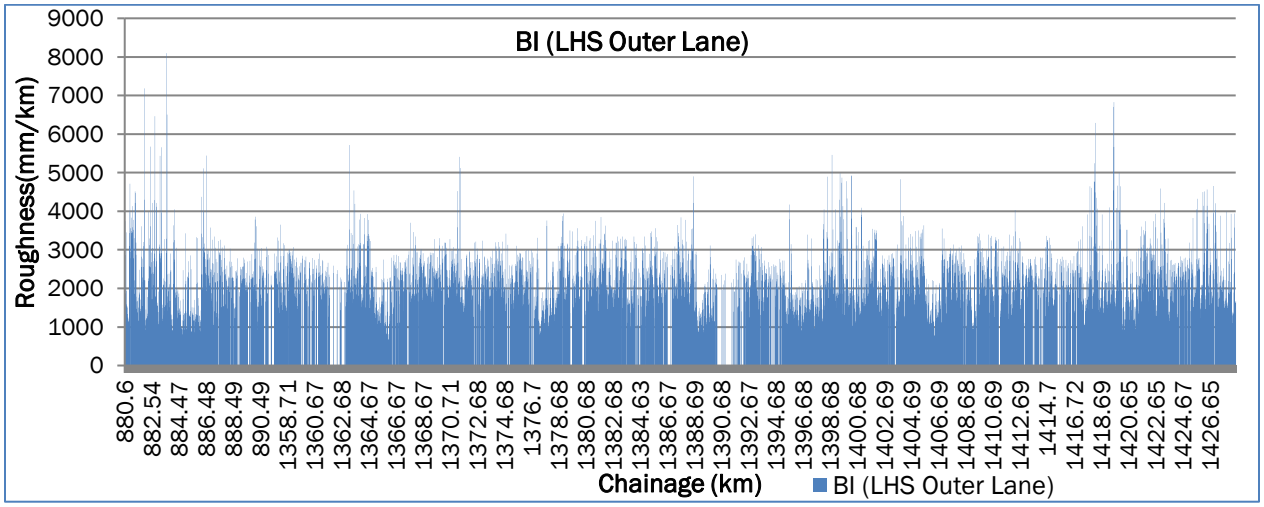
Following panel rectification measured are considered for the rigid pavement.

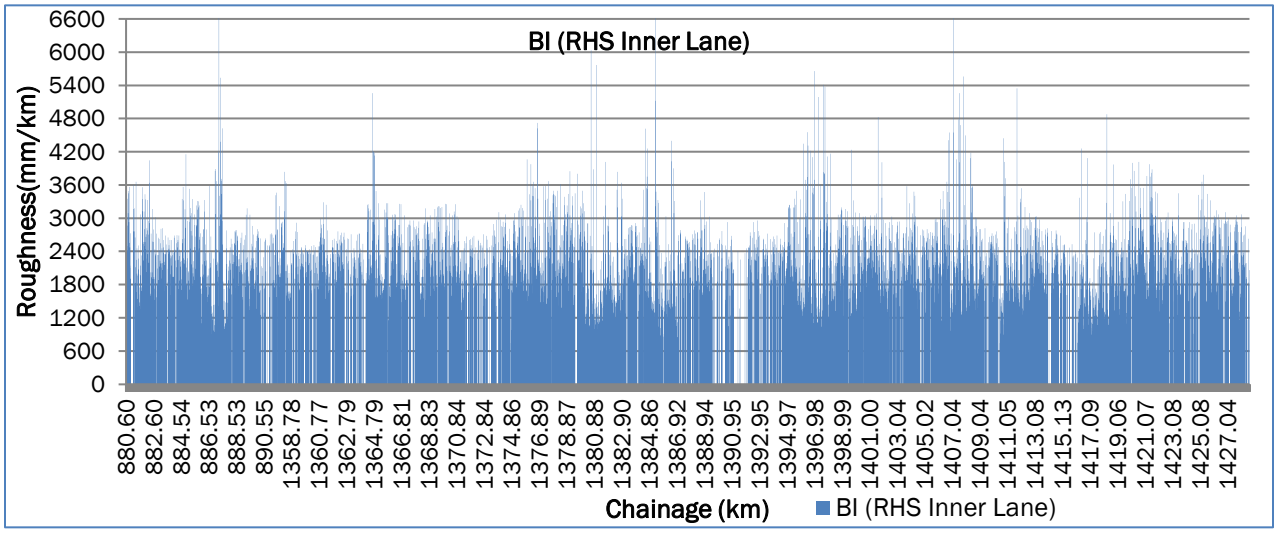
S No	Package	Total Panels for replacement (Nrs.)	Partial 1m Full Depth Repair (Nrs.)	Seal & Staple (in Panels(Nrs.)	Ravelling in Number of Panels (Nrs.)	Corner Break in Panel (Nrs.)
1	Package-JL, LHS	598	181	498	144	51
2	Package-JL, RHS	568	145	377	163	54

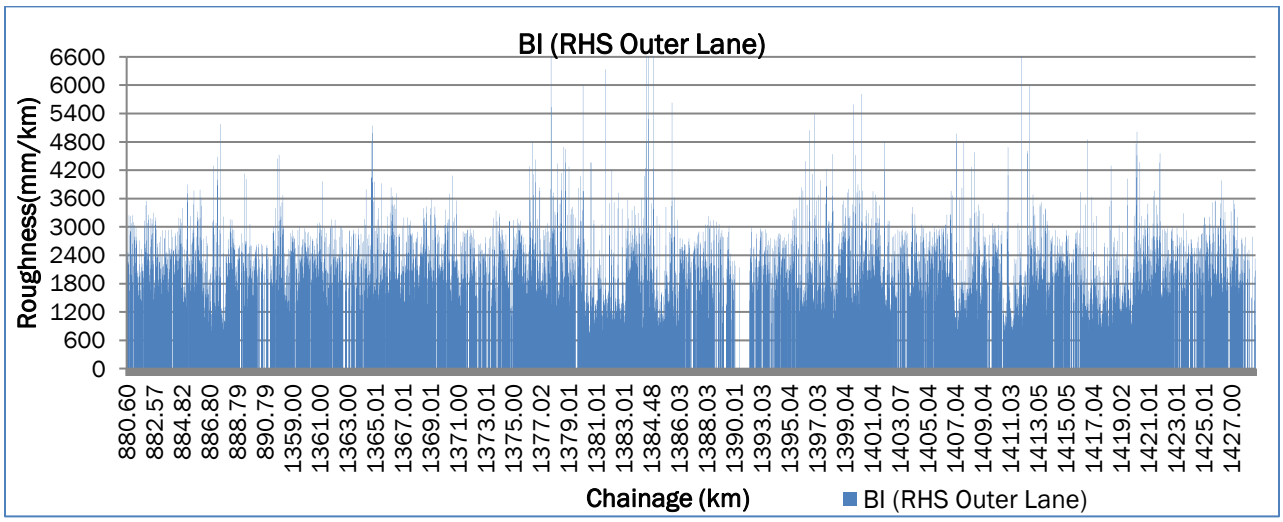
4.3 ROUGHNESS

The roughness surveys conducted along the corridor indicate average to fair riding quality over the length of project corridor. Bar diagrams showing the Kilometer wise roughness along the project road are presented below:









Based on the above, considering the Km-stone reference system the summary of Lane-km having varying roughness values are as presented below

>=Roughness (mm/km)	<Roughness (mm/km)	LHS Inner (Lane Km)	LHS Outer (Lane Km)	RHS Inner (Lane Km)	RHS Outer (Lane Km)	TOTAL (Lane Km)
	2200	39.91	43.10	39.72	43.39	166.12
2200	2400	5.26	5.31	5.56	5.22	21.35
2400	3000	12.17	10.97	12.86	11.76	47.76
3000		22.95	20.59	21.88	17.73	83.15

An alternate exercise with moving average method has been adopted considering 10m point interval roughness data. With this criteria, considering roughness threshold limit (<2200mm/km), the combined lane-km lengths with varying roughness values are as presented below

>=Roughness (mm/km)	<Roughness (mm/km)	LHS Inner & Outer (Lane Km)	RHS Inner & Outer (Lane Km)
	2200	82.6	82.5
2200	2400	10.6	10.7
2400		29.3	29.8
Lengths for rectification considered		36.29	33.05

By attending the rectification of 36.29 lane-km length in LHS, at identified locations, the roughness values can bring down to required threshold value(<2200m/km) by considering moving average method for roughness values in km-length. However, still there will be accumulated length of 29.3 lane-km at scattered points having roughness higher than threshold value (>2400m/km) and these values may have no impact and nullified while considering average in a km-length..

Similarly in RHS, by attending the rectification of 33.05 lane-km length at identified locations, the roughness values can bring down to required threshold value(<2200m/km) by considering moving average method for roughness values in km-length. However, still there will be accumulated length of 29.8 lane-km at scattered points having roughness higher than threshold value (>2400m/km) and these values may have no impact and nullified while considering average in a km-length.

4.4 FWD ANALYSIS

4.4.1 Flexural strength of Concrete Rigid Pavement (Rigid)

FWD deflections shall be measured and recorded for radial distances at 0 mm, 300 mm, 600 mm and 900 mm from the centre of loading point.

The area parameter of deflection basin should be calculated using the equation 2 of IRC 117-2014.

From area of deflection basin, Radius of relative stiffness (l) can be evaluated from the charts. The excel sheet provided with the guidelines used to get the value of Radius of relative stiffness (l).

After finding the Radius of relative stiffness, normalized deflections (d) are calculated using various equations formed from the charts. The excel sheet directly gives the values of the normalized deflections.

Subgrade modulus values can be found by using the equation 3 of IRC 117-2014 for different normalized deflections and average of all should be taken as subgrade modulus.

Elastic Modulus (MPa) of concrete can be found by using the equation 4 of IRC 117-2014.

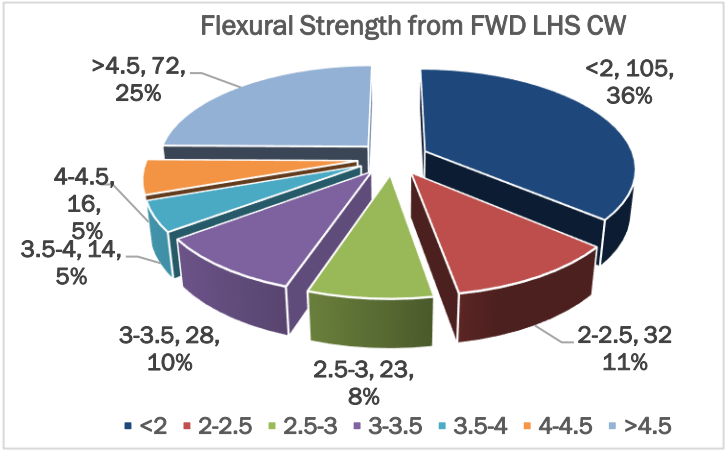
Strength of the concrete and Flexural strength can be determined from the value of Ec from the equation 5 & 6 of IRC 117-2014.

The fck values calculated for the rigid pavement are presented in **Appendix-3** of the report.

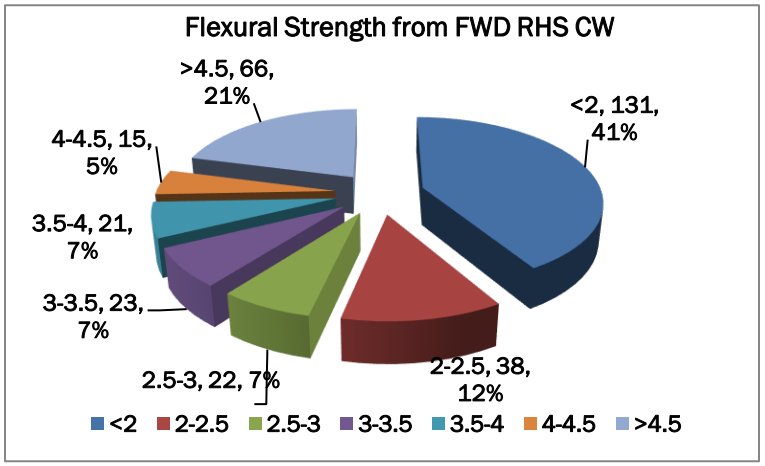
Pie charts showing the variation of the Flexural Strength estimated from FWD Surveys are presented below:

Table 33: FWD Data - Summary of Homogenous Section – LHS & RHS

Flexural strength (Mpa) CW		
Range	**LHS**	**RHS**
<2.0	105	131
2.0-2.5	32	38
2.5-3.0	23	22
3.0-3.5	28	23
3.5-4.0	14	21
4.0-4.5	16	15
>4.5	72	66
Total	290	316



RKJL_JL



RKJL_JL

Flexural Strength of the PQC estimated from FWD Surveys indicates that:

a) More than 25% of samples in LHS Carriageway and 21% of samples in RHS Carriageway are having values greater than 4.5 Mpa.

b) 5% of samples in LHS Carriageway and 5% of samples in RHS Carriageway are having values between 4 – 4.5 MPa.

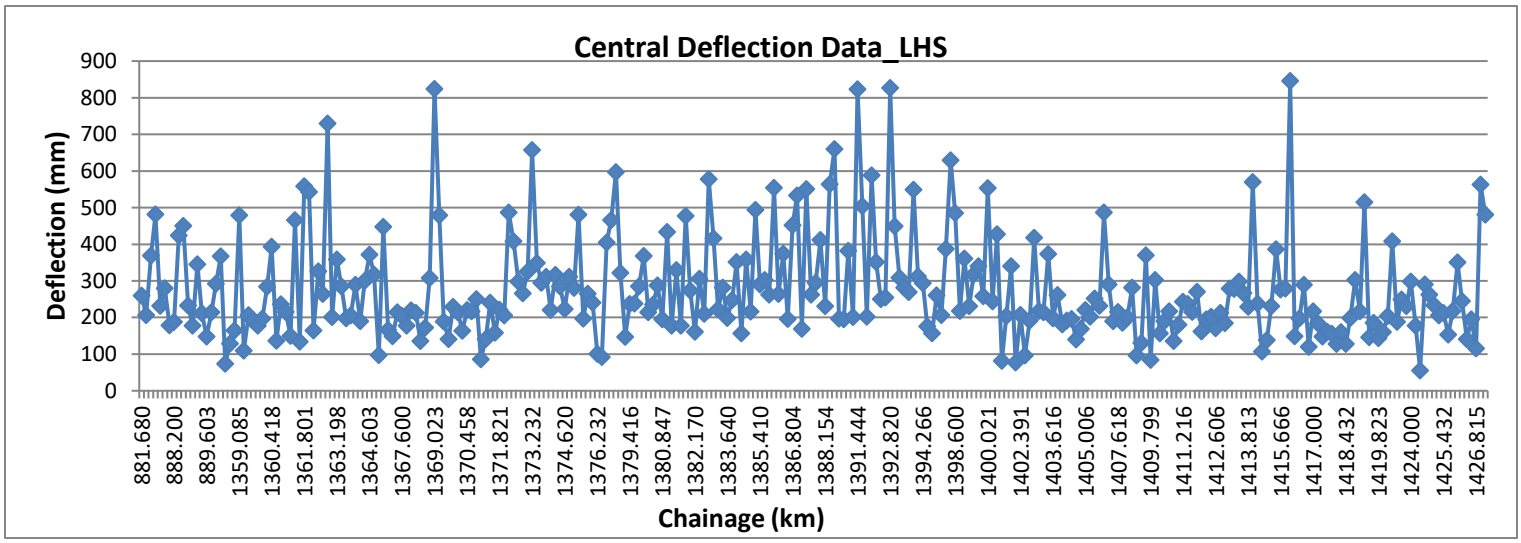
c) 5% of samples in LHS Carriageway and 7% of samples in RHS Carriageway are having values between 3.5 – 4.0 Mpa.

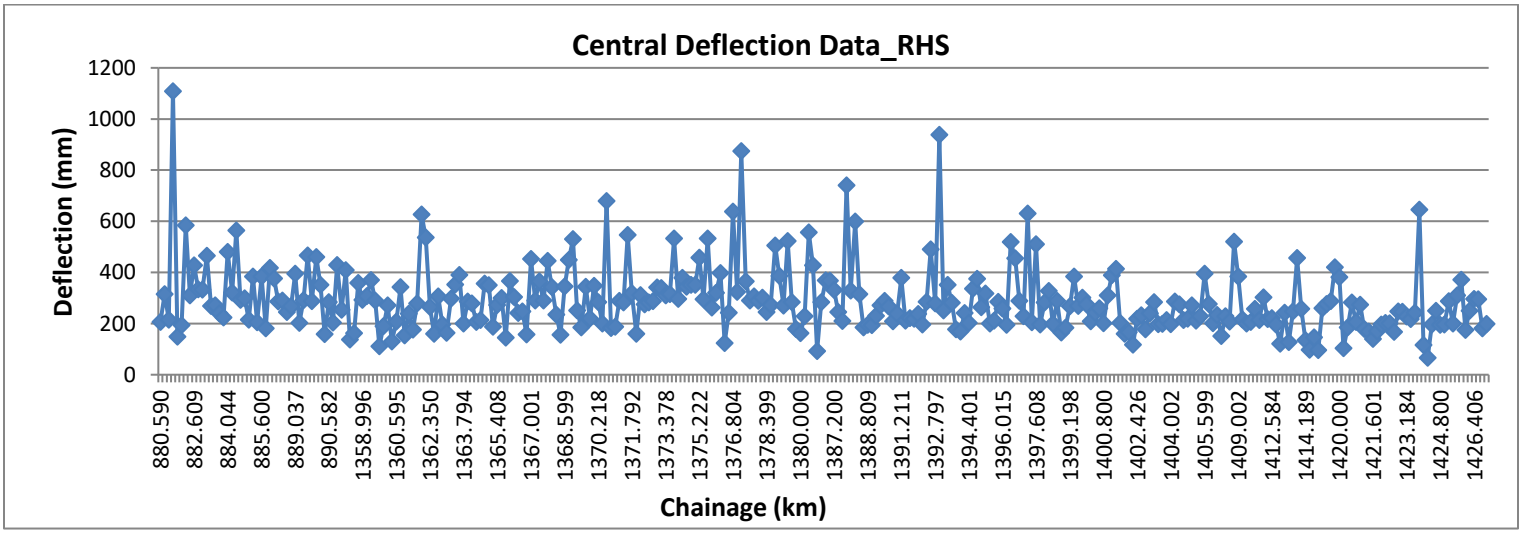
d) 10% of samples in LHS Carriageway and 7% of samples in RHS Carriageway are having values between 3 – 3.5 Mpa.

e) 55% of samples in LHS Carriageway and 60% of samples in RHS Carriageway are having values less than 3 Mpa.

4.4.2 Detection of Voids underneath the Rigid Pavement

- Deflection of Voids below a pavement slab can be easily be done by a FWD. Deflections are measured along the wheel path and a plot of central deflections versus distance has to be made.
- The locations where the deflections are much higher than the normal may indicate presence of voids. Sample is shown in below





From the above graph, voids underneath the pavement are identified as 85 points in LHS, 105 points in RHS. For quantification, every point is considered for 150m length in lane width.

4.4.3 FWD Analysis and Assessment of Overlay Requirement (Flexible)

The FWD data collected has been analyzed as per IRC-115 guidelines with the suggested ranges for in-service pavements

- Subgrade Modulus---------- 5 CBR to 20 CBR
- Granular Layer Modulus---------- 100 Mpa to 500 MPa
- Bituminous Layers –Thick without distress--- 750 Mpa to 3000 MPa
- Bituminous Layers in distressed condition----- 400 Mpa to 1500 MPa

The above suggested ranges for guidance only and pavement engineer shall use his judgment based on available data while fixing the above ranges. By looking at the age and condition and performance of the pavement following different set of ranges have been used while finalizing the modulus values:

Layer	Bituminous Layers	Granular Layer Modulus	Subgrade
Modulus Value (MPa)	750-3000	100-500	50-100

Bituminous layer Moduli obtained from back calculations shall be corrected for a standard pavement temperature of 35°C using given equations. Whereas, for back calculated moduli values obtained for granular and subgrade layer shall be corrected for seasonal variations (using winter and summer equations). As FWD tests, performed, during the winter, accordingly seasonal correction factor is applied for granular and subgrade layer. The design moduli (15th percentile moduli) of in-service layers for each homogenous section are given in table below.

Table 34: Summary of Design Moduli of different layers – LHS CW

S No	From (km)	To (km)	Length (km)	15th Percentile MR values (MPa)		
				MR for BT	MR for Granular	MR for Subgrade
1	880.60	881.68	1.1	2030	189	70
2	881.68	881.92	0.2			
3	881.92	883.80	1.9			
4	883.80	887.30	3.5	2030	347	84
5	887.30	1358.00				
6	1358.00	1358.40	0.4	2018	347	84
7	1358.40	1364.70	6.3			
8	1364.70	1366.20	1.5			
9	1366.20	1376.80	10.6			
10	1376.80	1378.80	2.0	2017	337	86
11	1378.80	1383.70	4.9			
12	1383.70	1384.13	0.4			
13	1384.13	1388.50	4.4			
14	1388.50	1390.20	1.7	2163	386	87
15	1390.20	1395.32	5.1			
16	1395.32	1395.81	0.5			
17	1395.81	1398.23	2.4	2154	335	87
18	1398.23	1400.25	2.0			
19	1400.25	1401.33	1.1	2151	237	87
20	1401.33	1405.60	4.3			
21	1405.60	1406.90	1.3			

S No	From (km)	To (km)	Length (km)	15th Percentile MR values (MPa)		
				MR for BT	MR for Granular	MR for Subgrade
22	1406.90	1408.68	1.8			
23	1408.68	1409.48	0.8	2154	258	87
24	1409.48	1420.11	10.6			
25	1420.11	1421.80	1.7			
26	1421.80	1422.85	1.0	2151	270	85
27	1422.85	1427.21	4.4			
28	1427.21	1428.56	1.3			

Table 35: Summary of Design Moduli of different layers – RHS CW

S No	From (km)	To (km)	Length	15th Percentile MR values (MPa)		
				MR for BT	MR for Granular	MR for Subgrade
1	886.19	887.98	1.8	2310	343	87
2	887.98	891.78	3.8	rigid		
3	1358.00	1380.18	22.2	rigid		
4	1380.18	1383.22	3.0	2303	337	87
5	1383.22	1384.67	1.5	rigid		
6	1384.67	1387.07	2.4	1950	386	86
7	1387.07	1390.50	3.4			
8	1390.50	1391.10	0.6			
9	1391.10	1406.88	15.8	rigid		
10	1406.88	1408.69	1.8	1929	199	87
11	1408.69	1410.53	1.8			
12	1410.53	1412.47	1.9			
13	1412.47	1416.13	3.7	rigid		
14	1416.13	1419.00	2.9	1932	278	87
15	1419.00	1420.17	1.2	1902	363	87
16	1420.17	1427.21	7.0			
17	1427.21	1428.55	1.3			

Observations on FWD Results

It can be noticed from the above table that the layer moduli for the three layers are varying along the length and direction. The MR value for BT layer is 2017 MPa to 2163 MPa in LHS & 1902 MPa to 2309 MPa in RHS Carriageway. The MR value for Granular Layers is 189 MPa to 386 MPa in LHS & 199 MPa to 386 MPa in RHS Carriageway. Similarly, the MR value for Subgrade Layer is 70 MPa to 87 MPa in LHS & 86 MPa to 87 MPa in RHS Carriageway.

4.5 PAVEMENT COMPOSITION

a) Main Carriageway Crust

	BT (mm)	PQC (mm)	DLC (mm)	WMM (mm)	GSB (mm)	Total (mm)
Minimum	120	160	100	190	120	460
Maximum	170	280	160	230	270	710
Average	150	250	145	210	185	560

b) Service Road Crust

	BT (mm)	WMM (mm)	GSB (mm)	Total (mm)
Minimum	70	150	160	380
Maximum	80	150	200	430
Average	75	150	180	405

4.6 CORE STRENGTH

The core strength of the samples is presented below.

S No.	Chainage	SIDE	Core ID	Corrected Strength of core	Equivalent Cube Strength (N/mm^2) 13x1.25.	F_{CK} 0.7*SQRT(B)	REMARK
				A	B = 1.25*A		
1	1368+100	LHS	JL-C-2	29.9	37.3	4.28	Outer
2	1369+600	LHS	JL- C-3	21.16	26.45	3.60	Inner
3	1408+100	LHS	JL-C-5	37.6	47.1	4.80	Inner
4	1424+800	RHS	JL- C-6	43.55	54.43	5.16	Outer
5	1404+500	RHS	JL-C-7	30.2	37.8	4.30	Inner
6	1364+850	RHS	JL- C-9	41.74	52.17	5.06	Inner
7	1362+250	RHS	JL-C-10	34.0	42.4	4.56	Inner

Above core strength results showing more than 4.0 fck,

S No	Chainage	SIDE	Core Fck, MPa		FWD point, Chainage	FWD Fck MPa
31	1368+100	LHS	4.28		1368.0	3.41
32	1369+600	LHS	3.60		1369.6	5.68
33	1408+100	LHS	4.80		1408.0	4.46
34	1424+800	RHS	5.16		1424.8	3.25
35	1404+500	RHS	4.30		1404.6	1.92
36	1364+850	RHS	5.06		1364.8	1.60
37	1362+250	RHS	4.56		1362.4	3.97

- Fck values at same chainage are compared above with Cores Vs FWD,
- it is prudent to increase about 30% fck values obtained through FWD survey

Accordingly, FWD-fck values has been increased by 30%. Further fck values less than 3 MPa fck were considered for rehabilitation in MMR.

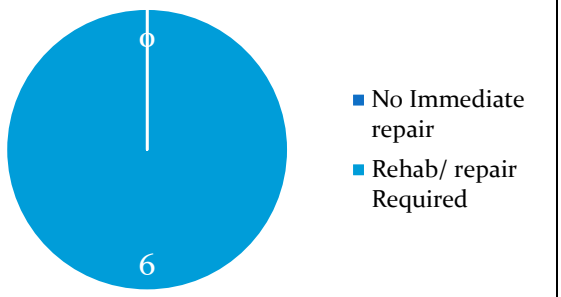
4.7 STRUCTURES

Inventory and asset condition of all the existing structures falling within project road have been verified as per IRC: SP-35 procedures and guidelines with following field surveys

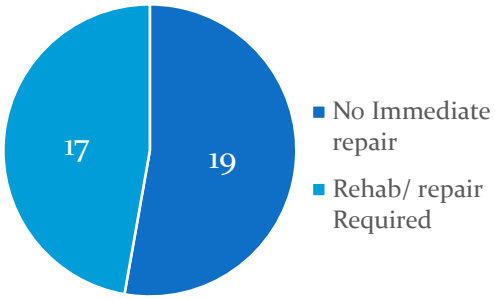
- Inventory of existing highway bridges / structures
- MBIU/Visual condition survey of existing highway bridges / structures

Inventory of all the structures is presented in **Appendix 8** of this report.

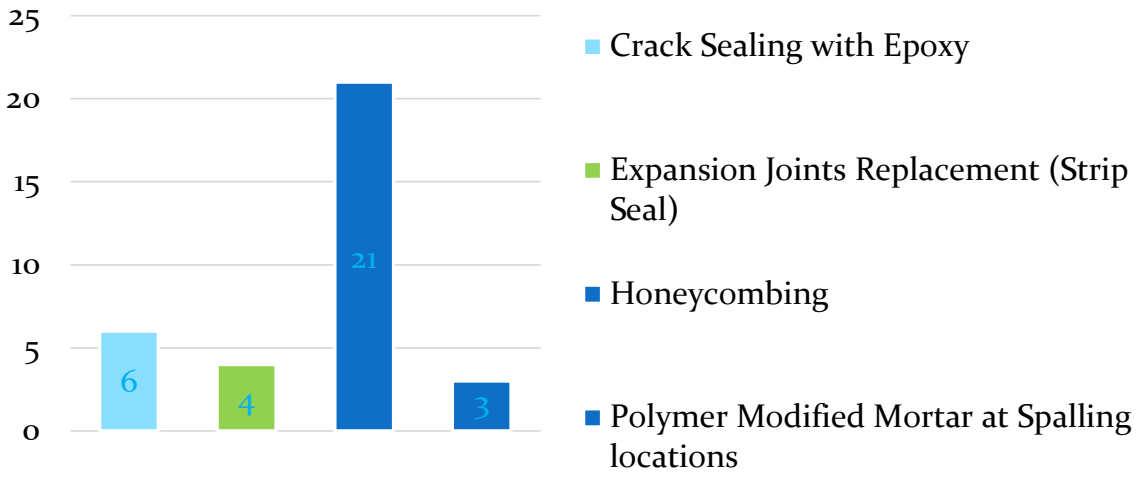
Based on these surveys following structural rehabilitation measures have been considered.



Major Structures



Minor Structures



Rectification of structural Distress in terms of number of locations

List of Bridges found during the inventory surveys along the corridor are as follows

Summary of Structures

S. No	Type of Str	No. of Structures			Total No. of Str's	Total No. of Locations
		LHS	RHS	BHS		
1	ROB	2	2	-	4	2
2	MJB	2	2	-	4	2
3	MNB	26	24	-	50	24
4	Flyover	1	1	-	2	1
5	VUP	5	4	-	9	5
6	PUP	4	4	-	8	4
7	Viaduct	1	-	-	1	1
8	VOP	2	1	-	3	2
9	BC	-	-	-	56	56
10	PC	-	-	-	106	106

Age of Structures

S. No.	Type of Str	LHS		RHS		BHS		Total (Nos)		Total no. of Str's
		Old	New	Old	New	Old	New	Old	New	
1	ROB	-	2	-	2	-	-	-	4	4
2	MJB	-	2	1	1	-	-	1	3	4
3	MNB	2	24	1	23	-	-	3	47	50
4	Flyover	-	1	-	1	-	-	-	2	2
5	VUP	-	5	-	4	-	-	-	9	9
6	PUP	-	4	-	4	-	-	-	8	8
7	Viaduct	-	1	-	-	-	-	-	1	1
8	VOP	-	2	-	1	-	1	-	3	3

Summary of Expansion joints & Bearings

S. No	Type of Str	Expansion joints		Bearings				
				Pot PTFE		Elastomeric		Metallic
		Old	New	Old	New	Old	New	Old
1	ROB	-	8	-	84	-	-	-
2	MJB	-	51	-	384	204	-	114
3	MNB	-	12	-	48	-	-	-
4	Flyover	-	16	-	224	-	-	-
5	VUP	-	2	-	16	-	-	-
6	PUP	-	-	-	-	-	-	-
7	Viaduct	-	11	-	132	-	-	-
8	VOP	-	6	-	8	-	16	-
TOTAL		**0**	**106**	**0**	**896**	**204**	**16**	**114**
		106		**896**		**220**		**114**
				1230				

Summary of Superstructures

S. No	Type of Str	PSC Box Girder	RCC Box	RCC Girder	PSC Girder	Steel Girder	RCC slab	PSC Girder + PSC Box Girder + RCC Girder	Total no. of Structures
1	ROB	-	2	-	-	2	-	-	4
2	MJB	1	-	-	3	-	-	-	4
3	MNB	-	39	-	6	-	3	-	48
4	Flyover	-	-	-	2	-	-	-	2
5	VUP	-	6	-	1	-	-	-	7
6	PUP	-	8	-	-	-	-	-	8
7	Viaduct	-	-	-	-	-	-	1	1
8	VOP	2	-	1	-	-	-	-	3

Summary of Substructures

S. No	Type of Str	ABUTMENT			PIER			
		Trestle type	RCC Box	RCC wall type	RCC Box	RCC wall type	Single circular column type	Trestle type
1	ROB	2	2	-	2	-	-	2
2	MJB	-	-	4	-	1	3	-
3	MNB	-	39	9	12	3	-	-
4	Flyover	-	-	2	-	2	-	-
5	VUP	-	6	1	-	1	-	-
6	PUP	-	8	-	-	-	-	-
7	Viaduct	-	-	1	-	1	-	-
8	VOP	2	-	1	-	1	-	-

Details of Major Structures

S. No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
1	881+433	FLYOVER	LHS	MCW	New	14 x 30	12.5	11.5	Open	RCC wall type	RCC wall type	PSC Girder	Pot PTFE
2	881+433	FLYOVER	RHS	MCW	New	14 x 30	12.5	11.5	Open	RCC wall type	RCC wall type	PSC Girder	Pot PTFE
3	886+656	MJB	LHS	MCW	New	22 x 38.5	12.5	11.5	Pile	RCC wall type	Single circular column type	PSC Girder	Pot PTFE
4	886+656	MJB	RHS	MCW	Old	6 x 19.97 + 1 x 37.9 + 17 x 38.5 + 1 x 37.9 + 4 x 19.97	10.5	7.5	Well	RCC wall type	RCC wall type	PSC Box Girder	Elastomeric & Metallic
5	1415+180	MJB	LHS	MCW	New	13 x 38.5	12.5	9.5	Open	RCC wall type	Single circular column type	PSC Girder	Pot PTFE
6	1415+180	MJB	RHS	MCW	New	13 x 38.5	12.5	9.5	Open	RCC wall type	Single circular column type	PSC Girder	Pot PTFE
7	890+430	MNB	RHS	MCW	Old	3 x 8.0	8	7	Open	RCC wall type	RCC wall type	RCC slab	-
8	1358+376	MNB	LSR	SR	New	1 x 8.0	15	7	Raft	RCC Box	-	RCC Box	-
9	1358+376	MNB	LHS	MCW	New	1 x 8.0	15	10.5	Raft	RCC Box	-	RCC Box	-
10	1358+376	MNB	RHS	MCW	New	1 x 8.0	12.5	10.5	Raft	RCC Box	-	RCC Box	-
11	1360+363	MNB	LHS	MCW	New	1 x 8.3	12.5	11.5	Raft	RCC Box	-	RCC Box	-
12	1360+363	MNB	RHS	MCW	New	1 x 8.3	12.5	11.5	Raft	RCC Box	-	RCC Box	-
13	1361+625	MNB	LHS	MCW	Old	3 x 10	8.5	7.5	Not Visible	RCC wall type	RCC wall type	RCC slab	-
14	1361+625	MNB	RHS	MCW	New	1 x 38	12.5	11.5	Not Visible	RCC wall type	-	PSC Girder	Pot PTFE
15	1362+075	MNB	LHS	MCW	New	2 x 11.1	12.5	11.5	Raft	RCC Box	RCC Box	RCC Box	-
16	1362+075	MNB	RHS	MCW	New	2 x 11.1	12.5	11.5	Raft	RCC Box	RCC Box	RCC Box	-

S. No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
17	1363+024	MNB	LHS	MCW	New	1 x 10.7	19	18	Raft	RCC Box	-	RCC Box	-
18	1363+024	MNB	RHS	MCW	New	1 x 10.7	19	18	Raft	RCC Box	-	RCC Box	-
19	1363+943	MNB	LHS	MCW	Old	3 x 10	8.5	7.5	Not Visible	RCC wall type	RCC wall type	RCC slab	-
20	1363+943	MNB	RHS	MCW	New	1 x 38.5	12.5	11.5	Not Visible	RCC wall type	-	PSC Girder	Pot PTFE
21	1365+770	MNB	LHS	MCW	New	1 x 14	12.5	11.5	Raft	RCC Box	-	RCC Box	-
22	1365+770	MNB	RHS	MCW	New	1 x 14	12.5	11.5	Raft	RCC Box	-	RCC Box	-
23	1370+160	MNB	LHS	MCW	New	1 x 30	12.5	11.5	Not Visible	RCC wall type	-	PSC Girder	Pot PTFE
24	1370+160	MNB	RHS	MCW	New	1 x 30	12.5	11.5	Not Visible	RCC wall type	-	PSC Girder	Pot PTFE
25	1372+370	MNB	LHS	MCW	New	3 x 15	12.5	11.5	Raft	RCC Box	RCC Box	RCC Box	-
26	1372+370	MNB	RHS	MCW	New	3 x 15	12.5	11.5	Raft	RCC Box	RCC Box	RCC Box	-
27	1373+880	MNB	LHS	MCW	New	1 x 38.5	12.5	11.5	Not Visible	RCC wall type	-	PSC Girder	Pot PTFE
28	1373+880	MNB	RHS	MCW	New	1 x 38.5	12.5	11.5	Not Visible	RCC wall type	-	PSC Girder	Pot PTFE
29	1376+020	MNB	LHS	MCW	New	3 x 10.5	12.5	11.5	Raft	RCC Box	RCC Box	RCC Box	-
30	1376+020	MNB	RHS	MCW	New	3 x 10.5	12.5	11.5	Raft	RCC Box	RCC Box	RCC Box	-
31	1380+637	MNB	LHS	MCW	New	1 x 8.0	12.5	11.5	Raft	RCC Box	-	RCC Box	-
32	1380+637	MNB	RHS	MCW	New	1 x 8.0	12.5	11.5	Raft	RCC Box	-	RCC Box	-
33	1381+552	MNB	LHS	MCW	New	1 x 11.3	12.5	11.5	Raft	RCC Box	-	RCC Box	-
34	1381+552	MNB	RHS	MCW	New	1 x 11.3	12.5	11.5	Raft	RCC Box	-	RCC Box	-
35	1384+256	MNB	LHS	MCW	New	1 x 7.0	12.5	11.5	Raft	RCC Box	-	RCC Box	-
36	1384+256	MNB	RHS	MCW	New	1 x 7.0	12.5	11.5	Raft	RCC Box	-	RCC Box	-
37	1384+492	MNB	LHS	MCW	New	1 x 10.0	12.5	11.5	Raft	RCC Box	-	RCC Box	-
38	1384+492	MNB	RHS	MCW	New	1 x 10.0	12.5	11.5	Raft	RCC Box	-	RCC Box	-
39	1385+478	MNB	LHS	MCW	New	1 x 14.0	12.5	11.5	Raft	RCC Box	-	RCC Box	-

S. No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
40	1385+478	MNB	RHS	MCW	New	1 x 14.0	12.5	11.5	Raft	RCC Box	-	RCC Box	-
41	1386+720	MNB	LHS	MCW	New	1 x 7.5	12.5	11.5	Raft	RCC Box	-	RCC Box	-
42	1386+720	MNB	RHS	MCW	New	1 x 7.5	12.5	11.5	Raft	RCC Box	-	RCC Box	-
43	1388+032	MNB	LHS	MCW	New	1 x 7.3	13	11.5	Raft	RCC Box	-	RCC Box	-
44	1388+032	MNB	RHS	MCW	New	1 x 7.3	13	11.5	Raft	RCC Box	-	RCC Box	-
45	1388+563	MNB	LHS	MCW	New	4 x 10.25	12.5	11.5	Raft	RCC Box	RCC Box	RCC Box	-
46	1388+563	MNB	RHS	MCW	New	4 x 10.25	12.5	11.5	Raft	RCC Box	RCC Box	RCC Box	-
47	1408+470	MNB	LHS	MCW	New	1 x 8.0	12.5	11.5	Raft	RCC Box	-	RCC Box	-
48	1408+470	MNB	RHS	MCW	New	1 x 8.0	16	9	Raft	RCC Box	-	RCC Box	-
49	1415+954	MNB	LHS	MCW	New	1 x 15	12.5	11.5	Raft	RCC Box	-	RCC Box	-
50	1415+954	MNB	RHS	MCW	New	1 x 15	12.5	11.5	Raft	RCC Box	-	RCC Box	-
51	1422+600	MNB	LHS	MCW	New	3 x 9.7	12.5	11.5	Raft	RCC Box	RCC Box	RCC Box	-
52	1422+600	MNB	RHS	MCW	New	3 x 9.7	12.5	11.5	Raft	RCC Box	RCC Box	RCC Box	-
53	1427+000	MNB	LHS	MCW	New	3 x 8.0	12.5	11.5	Raft	RCC Box	RCC Box	RCC Box	-
54	1427+000	MNB	RHS	MCW	New	3 x 8.0	12.5	11.5	Raft	RCC Box	RCC Box	RCC Box	-
55	1375+050	PUP	LHS	MCW	New	1 x 8.8	14	11.5	Raft	RCC Box	-	RCC Box	-
56	1375+050	PUP	RHS	MCW	New	1 x 8.8	14	11.5	Raft	RCC Box	-	RCC Box	-
57	1379+595	PUP	LHS	MCW	New	1 x 8.5	12.5	11.5	Raft	RCC Box	-	RCC Box	-
58	1379+595	PUP	RHS	MCW	New	1 x 8.5	12.5	11.5	Raft	RCC Box	-	RCC Box	-
59	1412+700	PUP	LHS	MCW	New	1 x 8.0	14	11.5	Raft	RCC Box	-	RCC Box	-
60	1412+700	PUP	RHS	MCW	New	1 x 8.0	14	11.5	Raft	RCC Box	-	RCC Box	-
61	1425+005	PUP	LHS	MCW	New	1 x 7.4	12.5	11.5	Raft	RCC Box	-	RCC Box	-
62	1425+005	PUP	RHS	MCW	New	1 x 7.4	12.5	11.5	Raft	RCC Box	-	RCC Box	-

S. No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Carriage way Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
63	1368+296	ROB	LHS	MCW	New	2 x 9.1	18	13.5	Raft	RCC Box	RCC Box	RCC Box	-
64	1368+296	ROB	RHS	MCW	New	2 x 9.1	18	15	Raft	RCC Box	RCC Box	RCC Box	-
65	1374+900	ROB	LHS	MCW	New	3 x 40.6	12.5	11.5	Not Visible	Trestle type	Trestle type	Steel Girder	Pot PTFE
66	1374+900	ROB	RHS	MCW	New	3 x 40.6	12.5	11.5	Not Visible	Trestle type	Trestle type	Steel Girder	Pot PTFE
67	890+430	Viaduct	LHS	MCW	New	7 x 30 + 1 x 15 + 1 x 56 + 1 x 15 + 7 x 30	12.5	11.5	Open	RCC wall type	RCC wall type & Single circular column type	PSC Girder + PSC Box Girder + RCC Girder	Pot PTFE
68	1424+415	VOP	BHS	MCW	New	2 x 16	12.5	10.5	Not Visible	RCC wall type	RCC wall type	RCC Girder	Elastomeric
69	1427+700	VOP	LHS	MCW	New	1 x 40	12.5	11.5	Not Visible	Trestle type	-	PSC Box Girder	Pot PTFE
70	1427+700	VOP	RHS	MCW	New	1 x 40	12.5	11.5	Not Visible	Trestle type	-	PSC Box Girder	Pot PTFE
71	887+303	VUP	LHS	MCW	New	1 x 10	12.5	11.5	Raft	RCC Box	-	RCC Box	-
72	887+303	VUP	RHS	MCW	New	1 x 10	12.5	11.5	Raft	RCC Box	-	RCC Box	-
73	1358+000	VUP	LHS	MCW	New	2 x 30	12.5	11.5	Open	RCC wall type	RCC wall type	PSC Girder	Pot PTFE
74	1368+545	VUP	LHS	MCW	New	1 x 13.8	12.5	11.5	Raft	RCC Box	-	RCC Box	-
75	1368+545	VUP	RHS	MCW	New	1 x 13.8	12.5	11.5	Raft	RCC Box	-	RCC Box	-
76	1370+320	VUP	LHS	MCW	New	1 x 13.8	12.5	11.5	Raft	RCC Box	-	RCC Box	-
77	1370+320	VUP	RHS	MCW	New	1 x 13.8	12.5	11.5	Raft	RCC Box	-	RCC Box	-

Visual inspection with MBIU in following locations

S. No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m) As per Site	Total Length (m)	Type of Superstructure	Type of Bearings	MBIU Required
1	881+433	FLYOVER	LHS	MCW	New	14 x 30	420 m	PSC Girder	Pot PTFE	YES
2	881+433	FLYOVER	RHS	MCW	New	14 x 30	420 m	PSC Girder	Pot PTFE	YES
3	886+656	MJB	LHS	MCW	New	22 x 38.5	847 m	PSC Girder	Pot PTFE	YES
4	886+656	MJB	RHS	MCW	Old	6 x 19.97 + 1 x 37.9 + 17 x 38.5 + 1 x 37.9 + 4 x 19.97	930 m	PSC Box Girder	Elastomeric & Metallic	YES
5	890+430	Viaduct	LHS	MCW	New	7 x 30 + 1 x 15 + 1 x 56 + 1 x 15 + 7 x 30	506 m	PSC Girder + PSC Box Girder + RCC Girder	Pot PTFE	YES
6	1361+625	MNB	RHS	MCW	New	1 x 38	38 m	PSC Girder	Pot PTFE	YES
7	1363+943	MNB	RHS	MCW	New	1 x 38.5	39 m	PSC Girder	Pot PTFE	YES
8	1370+160	MNB	LHS	MCW	New	1 x 30	30 m	PSC Girder	Pot PTFE	YES
9	1370+160	MNB	RHS	MCW	New	1 x 30	30 m	PSC Girder	Pot PTFE	YES

Few photos taken during the MBIU survey areas presented below:

Details of Culverts

S. No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Pitching (Yes/No)		Observations
						LHS	RHS	LHS	RHS	
1	880+632	Pipe	BHS	1 x 1.0	56	No	No	No	No	> Culvert is in fair condition.
2	881+880	Pipe	BHS	1 x 0.9	-	0	0	0	0	> Culvert not found at site Widening of the > Culvert proposed as per Sch-B on RHS.
3	882+640	Pipe	BHS	1 x 1.2	-	No	No	No	No	> Culvert found only on service road.
4	883+010	Pipe	BHS	1 x 1.2	50	No	No	No	No	Partially buried on RHS, widening of the > Culvert proposed as per Sch-B on RHS.
5	883+552	Box	BHS	1 x 2.5 x 1.5	42	No	No	Yes	Yes	> Culvert is in fair condition, widening of the > Culvert proposed as per Sch-B on RHS.
6	884+422	Pipe	BHS	1 x 1.2	54	No	No	No	No	> Culvert is in fair condition, widening of the > Culvert proposed as per Sch-B on RHS.
7	885+120	Pipe	BHS	2 x 1.2	12	No	No	No	No	>> Culvert is found only on service road, widening of the > Culvert proposed as per Sch-B on RHS.
8	885+840	Pipe	BHS	1 x 1.2	-	0	0	0	0	> Culvert not found at site, widening of the > Culvert proposed as per Sch-B on RHS.
9	887+292	Pipe	BHS	2 x 1.2	40	No	No	Yes	No	> Culvert buried on RHS.
10	887+657	Box	BHS	1 x 4 x 2	60	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
11	888+443	Pipe	BHS	1 x 1.2	-	0	0	0	0	> Culvert not found at site
12	888+705	Pipe	BHS	1 x 1.2	28	No	No	No	Yes	> Culvert is in fair condition.
13	889+131	Pipe	BHS	1 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
14	889+551	Pipe	BHS	1 x 1.2	-	0	0	0	0	> Culvert not found at site, widening of the, Culvert proposed as per Sch-B on RHS.
15	889+704	Box	BHS	1 x 3 x 2	32	No	No	Yes	Yes	> Culvert is in fair condition.
16	889+873	Pipe	BHS	2 x 1.2	32	No	No	Yes	Yes	> Culvert is in fair condition.
17	890+185	Box	BHS	1 x 4.5 x 2	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
18	890+652	Box	BHS	1 x 2 x 2	12	No	Yes	No	Yes	> Culvert is in fair condition.
19	890+992	Box	BHS	1 x 1.5 x 1.0	24	No	No	Yes	Yes	> Culvert is in fair condition.
20	891+934	Box	BHS	1 x 1.5 x 1.5	0	0	0	0	0	> Culvert not found at site
21	1358+177	Box	BHS	1 x 1.5 x 1.5	-	No	No	Yes	Yes	> Culvert is in fair condition.
22	1358+524	Box	BHS	1 x 2.5 x 3	-	0	0	0	0	> Culvert not found at site
23	1358+547	Box	BHS	1 x 2 x 2	60	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
24	1358+659	Box	BHS	1 x 3 x 2	60	No	No	Yes	Yes	> Culvert is in fair condition.
25	1358+949	Pipe	BHS	1 x 1.0	60	No	No	Yes	Yes	> Culvert is in fair condition.
26	1359+217	Pipe	BHS	1 x 1.2	60	No	No	No	No	> Culvert is in fair condition.
27	1359+890	Box	BHS	1 x 2.5 x 2	60	No	No	Yes	Yes	> Culvert is in fair condition.
28	1360+951	Box	BHS	1 x 2.5 x 2	-	0	0	0	0	> Culvert not found at site
29	1361+117	Box	BHS	1 x 3 x 2	24	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
30	1362+200	Pipe	BHS	1 x 0.6	12	No	No	No	No	> Culvert is in fair condition, Additional found at site not given in Schedule-A or B
31	1362+524	Box	BHS	1 x 3 x 2	24	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
32	1363+582	Box	BHS	1 x 3 x 2	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.

S. No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Pitching (Yes/No)		Observations
						LHS	RHS	LHS	RHS	
33	1364+147	Pipe	BHS	1 x 1.0	-	0	0	0	0	> Culvert not found at site
34	1364+793	Box	BHS	2 x 2.5 x 3	24	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
35	1366+415	Pipe	BHS	2 x 0.9	40	No	No	Yes	Yes	> Culvert is in fair condition.
36	1366+667	Pipe	BHS	3 x 0.9	30	No	No	Yes	Yes	> Culvert is in fair condition.
37	1366+692	Pipe	BHS	1 x 1.2	-	0	0	0	0	> Culvert not found at site
38	1366+764	Pipe	BHS	2 x 0.9	30	No	No	Yes	Yes	> Culvert is in fair condition.
39	1367+557	Box	BHS	1 x 2.5 x 2	24	No	No	Yes	Yes	> Culvert is in fair condition.
40	1367+888	Box	BHS	1 x 2.5 x 2	24	No	No	Yes	Yes	> Culvert is in fair condition.
41	1368+195	Pipe	BHS	1 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition.
42	1369+040	Pipe	BHS	1 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition.
43	1369+400	Box	BHS	1 x 2.5 x 2	34	No	No	Yes	Yes	> Culvert is in fair condition.
44	1369+820	Pipe	BHS	1 x 1.2	-	0	0	0	0	> Culvert not found at site
45	1370+570	Box	BHS	1 x 2.5 x 2.5	54	No	No	No	Yes	> Culvert is in fair condition, widening of the Culvert proposed as per Sch-B on RHS.
46	1370+740	Pipe	BHS	1 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition, widening of the, Culvert proposed as per Sch-B on RHS
47	1371+313	Pipe	BHS	2 x 1.0	30	Yes	No	Yes	Yes	> Culvert is in fair condition.
48	1371+596	Pipe	BHS	1 x 1.0	24	No	No	Yes	Yes	> Culvert is in fair condition.
49	1372+868	Box	BHS	1 x 2.5 x 2	50	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
50	1373+262	Pipe	BHS	1 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
51	1373+548	Pipe	BHS	1 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
52	1374+327	Pipe	BHS	1 x 1.2	-	0	0	0	0	> Culvert not found at site
53	1375+135	Pipe	BHS	1 x 1.2	-	0	0	0	0	> Culvert not found at site
54	1375+358	Pipe	BHS	1 x 1.2	70	No	No	Yes	Yes	> Culvert is in fair condition.
55	1376+432	Box	BHS	1 x 2.5 x 2	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
56	1376+767	Box	BHS	1 x 2.5 x 2	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
57	1377+494	Pipe	BHS	2 x 1.0	36	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
58	1377+777	Box	BHS	1 x 3 x 2	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
59	1378+511	Pipe	BHS	2 x 1.0	44	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
60	1378+854	Pipe	BHS	2 x 1.0	52	No	No	No	No	> Culvert is in fair condition.
61	1379+183	Pipe	BHS	1 x 1.2	40	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
62	1379+763	Pipe	BHS	1 x 1.2	52	No	No	Yes	Yes	> Culvert is in fair condition.
63	1380+000	Pipe	BHS	2 x 1.2	50	No	No	Yes	Yes	> Culvert is in fair condition.
64	1380+412	Box	BHS	1 x 5 x 3	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
65	1380+827	Box	BHS	1 x 3 x 3	32	No	No	Yes	Yes	> Culvert is in fair condition.
66	1381+055	Pipe	BHS	2 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
67	1381+982	Pipe	BHS	2 x 1.0	36	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
68	1382+325	Pipe	BHS	2 x 1.2	40	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
69	1382+497	Pipe	BHS	2 x 1.2	38	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
70	1382+938	Box	BHS	1 x 5 x 3	24	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
71	1383+146	Pipe	BHS	2 x 1.0	40	No	No	Yes	Yes	> Culvert is in fair condition.
72	1383+410	Pipe	BHS	2 x 1.2	40	No	No	Yes	Yes	> Culvert buried on RHS.
73	1384+985	Box	BHS	1 x 4 x 2	24	No	No	Yes	Yes	> Culvert is in fair condition.
74	1385+861	Box	BHS	1 x 3 x 2	28	No	No	Yes	Yes	> Culvert is in fair condition.
75	1386+142	Pipe	BHS	2 x 1.0	32	No	No	Yes	Yes	> Culvert is in fair condition.
76	1386+483	Pipe	BHS	2 x 1.2	42	No	No	Yes	Yes	> Culvert is in fair condition.
77	1387+027	Box	BHS	1 x 3 x 4	24	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
78	1387+491	Box	BHS	1 x 2.5 x 2.5	24	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
79	1389+357	Pipe	BHS	1 x 1.2	28	No	No	Yes	Yes	> Culvert is in fair condition.
80	1389+974	Pipe	BHS	1 x 1.2	34	No	No	Yes	Yes	> Culvert is in fair condition.
81	1390+100	Pipe	BHS	1 x 1.2	60	No	No	Yes	Yes	> Culvert buried on RHS.

S. No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Pitching (Yes/No)		Observations
						LHS	RHS	LHS	RHS	
82	1390+140	Pipe	BHS	1 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition.
83	1390+865	Box	BHS	1 x 4 x 4	32	No	No	No	No	> Culvert is in fair condition.
84	1391+155	Pipe	BHS	1 x 1.2	-	0	0	0	0	> Culvert not found at site
85	1391+694	Pipe	BHS	1 x 1.0	60	No	No	Yes	Yes	> Culvert is in fair condition.
86	1391+946	Pipe	BHS	2 x 1.0	32	No	No	Yes	No	> Culvert is buried on RHS.1 x 0.6 pipe found on LHS.
87	1392+186	Pipe	BHS	1 x 1.0	30	No	No	No	No	> Culvert is in fair condition.
88	1392+289	Box	BHS	1 x 5 x 3	24	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
89	1392+783	Pipe	BHS	2 x 1.0	32	No	No	Yes	Yes	> Culvert is in fair condition.
90	1393+364	Box	BHS	1 x 3 x 3	24	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
91	1393+780	Box	BHS	1 x 3 x 4	24	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
92	1394+394	Box	BHS	1 x 4 x 2	24	Yes	Yes	Yes	Yes	> Culvert is in fair condition, widening of the, Culvert proposed as per Sch-B on BHS.
93	1394+561	Pipe	BHS	1 x 1.0	40	No	No	Yes	Yes	> Culvert is in fair condition. Widening of the, Culvert proposed as per Sch-B on BHS.
94	1394+710	Pipe	BHS	1 x 1.0	24	No	No	No	No	> Culvert is in fair condition. Widening of the, Culvert proposed as per Sch-B on BHS.
95	1395+189	Box	BHS	1 x 2.5 x 2	24	Yes	Yes	Yes	Yes	> Culvert is in fair condition. Widening of the, Culvert proposed as per Sch-B on BHS.
96	1395+596	Pipe	BHS	2 x 0.9	50	No	No	No	No	> Culvert is in fair condition, widening of the, Culvert proposed as per Sch-B on BHS.
97	1396+088	Pipe	BHS	1 x 1.0	50	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
98	1396+513	Pipe	BHS	1 x 1.0	60	No	No	Yes	Yes	> Culvert is in fair condition.
99	1396+986	Box	BHS	1 x 2.5 x 2	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
100	1397+435	Pipe	BHS	2 x 1.0	40	No	No	Yes	Yes	> Culvert is in fair condition.
101	1397+623	Pipe	BHS	2 x 1.0	40	No	No	Yes	Yes	> Culvert is in fair condition.
102	1398+292	Pipe	BHS	1 x 1.0	36	No	No	Yes	Yes	> Culvert is in fair condition.
103	1398+790	Box	BHS	1 x 2.5 x 2.5	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
104	1399+169	Pipe	BHS	2 x 1.0	50	No	No	Yes	Yes	> Culvert is in fair condition.
105	1399+465	Pipe	BHS	2 x 1.0	42	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
106	1399+653	Box	BHS	1 x 2 x 2	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
107	1400+221	Box	BHS	1 x 5 x 2.5	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
108	1400+964	Pipe	BHS	1 x 1.2	34	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
109	1401+131	Box	BHS	1 x 3 x 2	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
110	1401+719	Pipe	BHS	1 x 1.2	32	No	No	Yes	Yes	> Culvert is in fair condition.
111	1402+273	Box	BHS	1 x 2.5 x2.5	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition. Widening of the, Culvert proposed as per Sch-B on BHS.
112	1402+574	Pipe	BHS	1 x 1.2	50	No	No	Yes	Yes	> Culvert is in fair condition. Widening of the, Culvert proposed as per Sch-B on BHS.
113	1402+870	Pipe	BHS	1 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition. Widening of the, Culvert proposed as per Sch-B on BHS
114	1402+981	Box	BHS	1 x 2.5 x2.5	42	No	No	Yes	Yes	> Culvert is in fair condition. Widening of the, Culvert proposed as per Sch-B on BHS
115	1403+450	Pipe	BHS	1 x 1.2	60	No	No	No	No	> Culvert is in fair condition.

S. No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Pitching (Yes/No)		Observations
						LHS	RHS	LHS	RHS	
116	1403+892	Pipe	BHS	1 x 1.2	36	No	No	Yes	Yes	> Culvert is in fair condition.
117	1404+169	Box	BHS	1 x 2.5 x 3	32	No	No	Yes	Yes	> Culvert is in fair condition.
118	1404+050	Pipe	BHS	1 x 1.2	36	No	No	Yes	Yes	> Culvert is in fair condition. Additional found at site not given in Schedule-A or B.
119	1404+550	Box	BHS	1 x 2 x 2	42	Yes	Yes	Yes	Yes	> Culvert is in fair condition. Additional found at site not given in Schedule-A or B.
120	1404+980	Pipe	BHS	1 x 1.2	36	No	No	Yes	Yes	> Culvert is in fair condition.
121	1405+159	Pipe	BHS	1 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
122	1405+379	Box	BHS	1 x 2.5 x 2	-	No	No	Yes	Yes	> Culvert is in fair condition.
123	1406+173	Pipe	BHS	1 x 0.9	42	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
124	1406+647	Pipe	BHS	2 x 1.0	40	No	No	Yes	Yes	> Culvert is in fair condition.
125	1406+911	Box	BHS	1 x 5 x 2	34	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
126	1407+159	Pipe	BHS	2 x 1.0	44	No	No	Yes	Yes	> Culvert is in fair condition.
127	1407+944	Pipe	BHS	1 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
128	1408+824	Pipe	BHS	2 x 1.0	36	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
129	1408+000	Pipe	BHS	2 x 1.0	36	Yes	Yes	Yes	Yes	> Culvert is in fair condition. Additional found at site not given in Schedule-A or B.
130	1409+140	Pipe	BHS	3 x 1.0	20	No	No	Yes	Yes	> Culvert is in fair condition.
131	1409+453	Box	BHS	1 x 2.5 x 2	40	No	No	Yes	Yes	> Culvert is in fair condition.
132	1410+112	Pipe	BHS	2 x 1.0	32	No	No	Yes	Yes	> Culvert is in fair condition.
133	1410+841	Pipe	BHS	1 x 1.2	40	No	No	Yes	Yes	> Culvert is in fair condition.
134	1411+526	Box	BHS	1 x 5.1 x 2	32	No	No	Yes	Yes	> Culvert is in fair condition.
135	1411+830	Pipe	BHS	3 x 1.0	40	No	No	Yes	Yes	> Culvert is in fair condition.
136	1412+057	Pipe	BHS	1 x 1.2	40	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
137	1412+515	Pipe	BHS	3 x 1.0	60	No	No	Yes	Yes	> Culvert is in fair condition.
138	1412+669	Pipe	BHS	3 x 1.0	60	No	No	Yes	Yes	> Culvert is in fair condition.
139	1413+287	Pipe	BHS	2 x 1.0	50	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
140	1413+732	Pipe	BHS	2 x 1.0	40	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
141	1413+999	Box	BHS	1 x 2	-	0	0	0	0	> Culvert not found at site
142	1415+645	Pipe	BHS	1 x 1.2	46	No	No	No	No	> Culvert buried on LHS.
143	1415+753	Box	BHS	1 x 2.5 x 2	24	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
144	1416+026	Box	BHS	1 x 2.5 x 2	24	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
145	1416+278	Pipe	BHS	1 x 1.0	28	No	No	Yes	Yes	> Culvert is in fair condition.
146	1416+396	Pipe	BHS	1 x 1.0	30	No	No	Yes	Yes	> Culvert is in fair condition.
147	1416+627	Pipe	BHS	2 x 1.0	30	No	No	Yes	Yes	> Culvert is in fair condition.
148	1416+776	Pipe	BHS	2 x 1.0	26	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
149	1417+272	Pipe	BHS	1 x 1.0	30	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
150	1417+621	Pipe	BHS	2 x 1.0	50	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
151	1417+884	Pipe	BHS	1 x 1.2	50	No	No	Yes	Yes	> Culvert is in fair condition.
152	1418+077	Pipe	BHS	1 x 1.0	50	No	No	Yes	Yes	> Culvert is in fair condition.
153	1418+525	Box	BHS	1 x 2 x 2	32	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
154	1418+774	Pipe	BHS	2 x 1.0	50	No	No	Yes	Yes	> Culvert is in fair condition.
155	1419+133	Pipe	BHS	1 x 1.0	32	No	No	Yes	Yes	> Culvert is in fair condition.
156	1419+794	Pipe	BHS	1 x 1.0	40	No	No	Yes	Yes	> Culvert is in fair condition.
157	1419+946	Box	BHS	1 x 3 x 2	32	No	No	Yes	Yes	> Culvert is in fair condition.
158	1420+554	Pipe	BHS	3 x 1.0	10	No	No	Yes	Yes	> Culvert not found on main Carriageway, Culvert found on RHS service road with 1 x 0.6.
159	1420+978	Pipe	BHS	1 x 1.0	50	No	No	Yes	Yes	> Culvert is in fair condition.
160	1421+371	Box	BHS	1 x 5 x 4	42	No	No	Yes	Yes	> Culvert is in fair condition.

S. No.	Design Chainage (Km)	Type of Culvert As per Site	Side	Span Arrangement (No x Length)	Deck Width (m)	Floor Protection (Yes/No)		Quadrant Pitching (Yes/No)		Observations
						LHS	RHS	LHS	RHS	
161	1421+894	Pipe	BHS	2 x 1.0	40	No	No	Yes	Yes	> Culvert is in fair condition.
162	1422+063	Pipe	BHS	2 x 1.0	40	No	No	Yes	Yes	> Culvert is in fair condition.
163	1423+522	Pipe	BHS	3 x 1.2	60	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
164	1423+783	Pipe	BHS	2 x 1.2	34	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
165	1424+855	Box	BHS	1 x 5 x 3	32	No	No	Yes	Yes	> Culvert is in fair condition.
166	1425+232	Pipe	BHS	1 x 1.2	60	No	No	Yes	Yes	> Culvert is in fair condition.
167	1425+742	Pipe	BHS	2 x 1.2	40	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
168	1426+377	Box	BHS	1 x 5 x 3	36	No	No	Yes	Yes	> Culvert is in fair condition.
169	1426+682	Pipe	BHS	1 x 1.2	52	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
170	1427+383	Pipe	BHS	2 x 1.0	28	Yes	Yes	No	No	> Culvert buried in LHS.

Sample photos of Box culverts

Box culvert 883+552

Box culvert 890+185

Box culvert 1392+289

Box culvert 1363+582

Box culvert 1416+026

Box culvert 1426+377

Sample photos of Pipe culverts

Pipe culvert 887+292

Pipe culvert 1358+949

Pipe culvert 1389+357

Pipe culvert 1392+783

Pipe culvert 1400+964

Pipe culvert 1406+647

4.8 DRAINAGE AND SLOPE PROTECTION

- ✓ Lined Covered drains observed at urban locations and at service road Locations along the corridor.
- ✓ No major damages observed at covered drain locations.

4.9 TRAFFIC SAFETY AND ROAD FURNITURE

- ✓ Metal beam crash barriers provided along the project road appear to be intact over entire length except for few locations where it got damaged.
- ✓ Pedestrian guard rails installed on the median, Separator & appear to be intact over entire length except for few locations where it got damaged.
- ✓ Median Opening locations appear to be in good condition. The width of the existing standing lane median openings was observed for a width of 1.0m.
- ✓ Solar blinkers in Fair condition observed at median openings in the entire project corridor.
- ✓ Street lightings and High masts are observed at urban, Toll plaza, Junction Locations, at few locations' street lightings are got damaged and not functioning well, and those items are addressed in the initial cost.

4.10 ROAD USER FACILITIES

- ✓ The Bus Bay with Shelters and truck lay byes were provided along the corridor.

CHAPTER 5.REHABILITATION PLANS AND DESIGNS

5.1 DESIGN TRAFFIC LOADING

Design Traffic loading has been estimated by considering the latest traffic (given) and VDFs as estimated from the latest axle load survey data and with min. 5% growth rates for 10 years, 15 years and 20 years design period as below:

Table 36: Traffic Volume (AADT)- FY2023

Vehicle/Mode	Toll Plaza-1 (LHS)	Toll Plaza-1 (RHS)
BUS	70	70
2 Axle	299	299
3 Axle	123	123
M Axle	550	550
LCV	103	103

Table 37: Estimated Design traffic loading

Year	MSA Summary -5% Growth rates	
	UP	DN
10th year from Now	37	25
15th year from Now	63	43
20th year from Now	97	65

The computation of traffic loadings is presented in **Appendix 9** of this Report. The traffic loading on LHS direction is high compared to RHS direction. Design traffic corresponding to 10 years period has been considered for overlay design.

5.2 PAVEMENT REHABILITATION AND STRENGTHENING

5.2.1 Rigid Pavement Strengthening

Based on the FWD survey and their results it appears that about 45% in LHS, 40% in RHS of the flexural strength values ranges from 3.0MPa to more than 4.5 Mpa. The rigid pavement design period has been checked with various flexural strength values by considering the existing PQC & DLC thickness.

Number of axle load repetitions for each year of operation is estimated and cumulated for entire operation period of 20 years from now. Using IRC 58-2015 design charts, stress ratios corresponding each Flexural strength values ranging from 3.75MPa-4.5MPa have been estimated and number repetitions that existing pavement serves is also established.

The summary of the Design period satisfies for various flexural strength values as given below:

Flexural Strength (Mpa)	Existing Rigid Pavement Thickness satisfies to the design period in Years	
Side	LHS	RHS
3.52 / 3.59	10 Years	10 Years
3.71 / 3.78	20 Years	20 Years
3.75	23 Years	18 Years
4	30 Years	30 Years
4.5	30 Years	30 Years

From the FWD data analysis it is found that nearly 45% points in on LHS & 40% points in RHS were having flexural strength values more than 3Mpa. These are considered to be fair condition and requires minimal maintenance. Similarly, flexural strength values less than 3mpa were considered to be average to poor condition and are estimated nearly 55% of samples in on LHS & 60% sample in RHS of project road may require major rehabilitation measures during operation period. Thus, the same has been considered in cost estimates apart from routine and periodic maintenance of rigid pavement.

5.2.2 Flexible Pavement Strengthening

For Design the Overlay Thickness the following method as suggested in IRC: 115 has been used

- The existing pavement is considered as a 3-layer system consisting of subgrade, granular and bituminous layer. The remaining life of exiting pavement in terms of Fatigue and Rutting life (MSA) are estimated
- The remaining life is compared with design traffic loading. An overlay with assumed thickness is considered on exiting pavement where required.
- The Total system including the proposed Overlay (Trial thickness) is assumed as a four-layer system and considered the relevant MR values for all the four layers namely New BT layer, existing bituminous surface, total existing Granular layers and Subgrade layers.
- The MR value for the New BT is assumed as 3000 MPA (considering VG40 Bituminous grade) for Main Carriageway and 2000 MPA (considering VG30 Bituminous grade) for Service Road and for all the remaining three layers, the MR Values derived and finalized from the FWD Analysis are considered
- Critical Tensile strains and Vertical strains are found out by using the IIT PAVE Software at the bottom of existing bituminous layer and at the top of the subgrade layer respectively.
- The Fatigue and Rutting equations (equation given in the IRC: 115) have been used to estimate the Fatigue and Rutting Life of The Pavement system.
- The Obtained Fatigue and Rutting Life are compared with the required life for the assumed trial overlay thickness.

Remaining life of the existing pavement from the above analysis is presented in the following tables:

Table 38: Remaining life of the existing pavement on Both Carriageways

S No	From (km)	To (km)	Length (km)	15th Percentile MR values, MPa			Average Existing Crust (mm)		Total Crust (mm)	MR for BT (MPa)	Strains From IITPAVE		Nf- Fatigue life, MSA	Rutting life, MSA	Critical Life, MSA
				MR for BT	MR for Granular	MR for Subgrade	BC	Granular			Vertical strain at bottom, epZ	Tangential strain at top, epT			
LHS															
1	880.60	881.68	1.1								0.0003047	0.0002071	23	123	23
2	881.68	881.92	0.2	2030	189	70	170	440	610	2030					
3	881.92	883.80	1.9												
4	883.80	887.30	3.5	2030	347	84	145	320	465	2030	0.0003602	0.0001775	41	58	41
5	887.30	1358.00		Rigid											
6	1358.00	1358.40	0.4								0.0003606	0.0001779	41	57	41
7	1358.40	1364.70	6.3	2018	347	84	145	320	465	2018					
8	1364.70	1366.20	1.5												
9	1366.20	1376.80	10.	Rigid											
10	1376.80	1378.80	2.0								0.0003595	0.0001809	39	58	39
11	1378.80	1383.70	4.9	2017	337	86	145	320	465	2017					
12	1383.70	1384.13	0.4												
13	1384.13	1388.50	4.4	Rigid											
14	1388.50	1390.20	1.7								0.0002552	0.0001396	100	275	100
15	1390.20	1395.32	5.1	2163	386	87	168	384	552	2163					
16	1395.32	1395.81	0.5												
17	1395.81	1398.23	2.4	2154	335	87	167	391	558	2154	0.0002633	0.0001527	71	239	71
18	1398.23	1400.25	2.0	Rigid											
19	1400.25	1401.33	1.1								0.0003389	0.0002297	14	76	14
20	1401.33	1405.60	4.3	2151	237	87	130	400	530	2151					
21	1405.60	1406.90	1.3												
22	1406.90	1408.68	1.8	Rigid											
23	1408.68	1409.48	0.8								0.0003310	0.0002193	17	85	17
24	1409.48	1420.11	10.	2154	258	87	130	400	530	2154					
25	1420.11	1421.80	1.7												
26	1421.80	1422.85	1.0								0.0003308	0.0002140	19	85	19
27	1422.85	1427.21	4.4	2151	270	85	130	400	530	2151					
28	1427.21	1428.56	1.3												

S No	From (km)	To (km)	Length (km)	15th Percentile MR values, MPa			Average Existing Crust (mm)		Total Crust (mm)	MR for BT (MPa)	Strains From IITPAVE		Nf- Fatigue life, MSA	Rutting life, MSA	Critical Life, MSA
				MR for BT	MR for Granular	MR for Subgrade	BC	Granular			Vertical strain at bottom, epZ	Tangential strain at top, epT			
RHS															
1	886.19	887.98	1.8	2310	343	87	120	470	590	2310	0.0002604	0.0001896	29	251	29
2	887.98	891.78	3.8	Rigid											
3	1358.00	1380.18	22.2	Rigid											
4	1380.18	1383.22	3.0	2303	337	87	120	470	590	2303	0.0002623	0.0001920	27	243	27

S No	From (km)	To (km)	Length (km)	15th Percentile MR values, MPa			Average Existing Crust (mm)		Total Crust (mm)	MR for BT (MPa)	Strains From IITPAVE		Nf- Fatigue life, MSA	Rutting life, MSA	Critical Life, MSA
				MR for BT	MR for Granular	MR for Subgrade	BC	Granular			Vertical strain at bottom, epZ	Tangential strain at top, epT			
5	1383.22	1384.67	1.5	Rigid											
6	1384.67	1387.07	2.4	1950	386	86	120	470	590	1950	0.0002556	0.0001861	36	273	36
7	1387.07	1390.50	3.4												
8	1390.50	1391.10	0.6												
9	1391.10	1406.88	15.8	Rigid											
10	1406.88	1408.69	1.8	1929	199	87	120	470	590	1929	0.0003185	0.0002804	7	101	7
11	1408.69	1410.53	1.8												
12	1410.53	1412.47	1.9												
13	1412.47	1416.13	3.7	Rigid											
14	1416.13	1419.00	2.9	1932	278	87	120	470	590	1932	0.0002876	0.0002313	15	160	15
15	1419.00	1420.17	1.2	1902	363	87	120	470	590	1902	0.0002613	0.0001957	30	247	30
16	1420.17	1427.21	7.0												
17	1427.21	1428.55	1.3												

It can be seen from the above tables, the minimum remaining life of the existing pavement is 7 MSA in LHS Direction, which is less than 10yrs design loading 37 MSA, Hence 10.2 Kms in LHS direction requires Strengthening Overlay.

In RHS direction, minimum remaining life of the existing pavement is 7 MSA in LHS Direction, which is less than 10yrs design loading 26 MSA, Hence 6.6 Kms length requires Strengthening Overlay.

Accordingly, an overlay thickness of 40mm to 50mm BT has assumed for the sections where there is requirement of an overlay and pavement life of these sections have been worked out and presented in the Table below.

Table 39: Design of overlay for LHS & RHS MCW

Sections	From (km)	To (km)	Length (km)	Existing - BT, MR value, MPa	Existing - Granular MR value, MPa	Existing - Subgrade MR value, MPa	Existing BT Thickness (mm)	Existing Granular layer(mm)	Proposed BT (mm)	Total BT thickness (mm)	Total Crust (mm)	E- BT layer, MPa	ver. Strain (Ev)	tan. Strain (Et)	Nf- Fatigue life, MSA	Rutting life, MSA	Critical Life, MSA
LHS																	
1	880.60	881.68	1.1	2030	189	70	170	440	40	210	610	2030	0.000242	0.000162	59	347	59
3	881.92	883.80	1.9														
19	1400.25	1401.33	1.1	2151	237	87	130	400	40	170	530	2151	0.000267	0.0001775	39	221	39
21	1405.60	1406.90	1.3														
23	1408.68	1409.48	0.8	2154	258	87	130	400	40	170	530	2154	0.0002628	0.0001702	46	241	46
25	1420.11	1421.80	1.7														
26	1421.80	1422.85	1.0	2151	270	85	130	400	40	170	530	2151	0.0002633	0.0001666	51	239	51
28	1427.21	1428.56	1.3														
Total			**10.2**														
RHS																	
10	1406.88	1408.69	1.8	1929	199	87	120	470	50	170	590	1929	0.0002387	0.0001973	29	372	29
12	1410.53	1412.47	1.9														
14	1416.13	1419.00	2.9	1932	278	87	120	470	40	160	590	1932	0.0002321	0.0001779	43	423	43
Total			**6.6**														

Input data used and the output from the IIT Pave software has been presented as screen shots for ready reference in **Appendix 10** of this Report.

5.3 STRUCTURAL REHABILITATION

All the structure found to be in good condition except minor treatment like repair of stone pitching, cleaning of drainage spouts, cleaning of vegetation etc. may be required. Detailed structural rehabilitation quantities have been worked out based on the prevailing condition of existing structures. This methodology describes in detail the procedure for the execution of each item of rehabilitation work of the Existing Bridges of the project.

The scope of this methodology covers the items mentioned below for rehabilitation work of all the existing Bridges.

- Repair/ Replacement of Existing Bearings
- Repair / Replacement of Existing Expansion Joints
- Repair / Replacement of Existing Wearing Coat

- Profile Correction for Existing Deck Slab by Cement Concrete
- Sealing of Cracks for Bridges by Epoxy Resin
- Replacement of Spalled Concrete of ECW by Epoxy Mortar
- Cement Grouting for Repair of Existing Bridges
- Guniting / Shotcrete for Repair of Existing Bridges
- Providing & Fixing of Drainage Spouts
- Repair of Substructure Component
- Repair / Replacement of Railing & Crash Barrier
- Epoxy Bonding between New and Old Concrete.

About 9 Nos. of locations, Structures are closely monitored by use of Mobile Bridge Inspection Unit (MBIU). Details of these structures where MBIU is used are presented in the following table

Table 40: Locations of MBIU survey

S.No.	Chainage (km)	Type of Structure	Side
1	881+443	Flyover	LHS
2	881+443	Flyover	RHS
3	886+656	MJB	LHS
4	886+656	MJB	RHS
5	890+430	Viaduct	LHS
6	1361+625	MNB	RHS
7	1363+943	MNB	RHS
8	1370+160	MNB	LHS
9	1370+160	MNB	RHS

Based on the Visual Inspection, as the structures are in fair condition there is no necessity of NDT tests to evolve rehabilitation strategies for the following structures.

5.4 DEVELOPMENT ZONES (Schedule-B PROVISIONS)

5.4.1 Maintenance Works

Schedule B stipulates the obligation of immediate maintenance which is to be done by the incoming Concessionaire. However, NHAI has represented to NHIT that they will undertake the immediate maintenance themselves, confirming to CA obligations, before handing over the asset to NHIT

- **Overlay on Existing Flexible Pavement for Main Carriageway**

S.N.	Existing Kilometer (Km)		Side	Minimum Overlay
	From	To		
1	1427+820	1428+557	LHS	40 mm BC + 50 mm DBM

- **For Service Road:** Existing service road shall be provided with overlay at following locations for 30 MSA by carrying FWD.

Sn	Location		One Side Length	Side	Minimum Overlay
	From	To			
1	880+600	881+900	1300	BHS	40 mm BC + 50 mm DBM

Sn	Location		One Side Length	Side	Minimum Overlay
	From	To			
2	1358+000	1360+095	2095	LHS	

-Overlay shall also be carried out Entry / Exit portion as well.

5.4.7 Project Facilities

✓ **RE Wall Painting**

All surface area of existing and new RE wall shall be painted reflecting local cultural heritage in consultation with IE and Authority

5.4.8 Completion Schedule For Improvement Proposals

Completion schedule for Scope mentioned in Schedule-B shall be as below.

S. No.	Description of Work	Date of Completion
1	Incident Management (9.7, 9.8 and 9.9)	From Appointed Date / O & M Handover Date, whichever is later
2	Installation / Rectification of road furniture related items (Section 10) Landscaping and Tree Plantation (Section 9.4)	9 months from Appointed Date
3	Maintenance and Rehabilitation (Section 4)	6 months from Appointed Date / O&M Handover Date, whichever is later
4	Toll Plaza and other facilities at Toll Plaza (Section 9.1, 9.11,9.12)	6 months from Appointed Date
5	ATMS (Section 9.10)	18 months from Appointed Date ***(pre-bid reply dtd 11.10.2023, annexure-2, S.No3: Installation, operation and maintenance of the ATMS shall be done by NHAI)***
6	Other Improvements (Section 1, 2, 3, 5, 6, 7, 8, 9.2, 9.3, 9.5, 9.6 and 9.13)	18 months from Appointed Date

CHAPTER 6.OPERATION AND MAINTENANCE

6.1 INTRODUCTION

Looking at the contractual requirements of maintaining project road under specified level of roughness it is felt that roughness is the most important criterion for finalizing the O&M schedule for the project. Accordingly, the methodology adopted by present consultants includes predicting the roughness year by year under the traffic using a well acknowledged HDM-4 model developed for developing countries like India after lot of research by World Bank. The said model is widely prescribed by MORTH and NHAI during the preparation of detailed project reports for several projects in doing economic analysis for the projects. The economic analysis mainly consists of two parts:

1. Predicting the road deterioration and estimating VOC
2. Estimating Benefits

Considering its importance and present use in India, consultants felt prudent to use the first part, i.e. estimating road deterioration and predicting roughness in HDM 4 model to finalize the O&M schedule for the project. This approach is more scientific as it does not assume hypothetical deflection values at 10th and 20th year and includes main criterion of maintaining roughness at 2400 mm/Km as per Schedule-F.

6.2 CA SPECIFICATIONS FOR MAJOR MAINTENANCE

- Schedule F of CA specifies that Roughness values exceeds 2400 mm/km in a length of KM, needs to be corrected within 180 days.
- FWD test to perform every year

6.3 RIGID PAVEMENT PERIODIC MAINTENANCE STRATEGY

Apart from the above requirements of Sch-F and maintaining the roughness and skid number for the rigid pavements, there are several other repair strategies included in Sch-K for rectification of defects in rigid pavement. These include following:

- Crack Seal
- Seal & Stitch
- Staple or Dowel Bar Retrofit
- Partial Depth Repair with Stapling
- Full Depth Repair: Dismantle and reconstruct affected Portion
- Diamond Grinding
- Joint Cleaning & Repair

Looking at the above requirements, it is felt necessary to consider following activities as part of periodic maintenance cycle apart from routine maintenance activities:

Description	%	Unit	Rate	Quantity	Amount
Length of Rigid Pavement		Kms		58.410	
PQC Qty		Cum		321727	
Total Area		Sqm		1072424	
No of Transverse Joints		no		25943	
No of Panels		no		52959	
Length of Transverse Joints		m		238316	
Longitudinal Joint		m		146025	233640
Repair of Transverse Joint @ 7 years	75.0%	m	64.50	178737	11528554
Repair of Longitudinal Joint @ 7 years	75.0%	m	64.50	109519	7063959
Replacement of Transverse Joint@ 7years	2.0%	m	833.00	4766	3970351
Replacement of Longitudinal Joint@ 7years	2.0%	m	833.00	2921	2432777
Ravelling surface @7years	3.0%	Sqm	935	32173	30081484
Crack sealing Surface @ 7years	5.0%	m	436	11682	5097090
Repair of Panels @ 7years	0.50%	No	9158	265	2426940
Removal of Panels @ 7years	1.50%	No	3411	794	2708016
Relaying of Panels @ 7years	1.50%	No	36380	794	28886092
Regrinding @ 7years	20%	Sqm	100	214485	21448473
Regrinding and Retexturing@ 7years	10%	Sqm	500	107242	53621183
Total Amount in Rs.					169498560
GST @ 18%					30509740
Periodic maintenance cost in Crores					19.973
Per Sqm per Cycle (Rs.)					**186**

The above are in addition to routine maintenance activities which include following for every year:

Longitudinal Cracks more than 1.5m	Li.m	0.50%
Longitudinal Cracks less than 1.5m	Li.m	0.50%
Transverse Cracks less than 1.5m	Li.m	0.50%
Transverse Cracks more than 1.5m	Li.m	0.50%
Longitudinal Crack full Depth	Cum	0.10%
Pothole	Sq.m	0.10%
Corner Cracks	cum	0.10%
Condition of Joints	Li.m	1.00%
Diagonal Cracking	Li.m	0.50%
Raveling of panel	Sq.m	0.25%

6.4 INPUTS FOR MM SCHEDULE(Flexible)

6.3.1 Project Sections

Since roughness is the main criterion for major maintenance, Project Corridor has been sub divided in to various Cases depending the present roughness values:

- Case 1: Roughness values (IRI) <2000 mm/Km
- Case 2: >=2000 mm/Km Roughness values (IRI) <2200 mm/Km
- Case 3: >=2200 mm/Km Roughness values (IRI) <2400 mm/Km
- Case 4: Roughness values (IRI)>=2400 mm/Km

6.3.2 Traffic (AADT)

The following traffic data has been used in the analysis is as below:

Vehicle/Mode	**Toll Plaza-1 (LHS)**	**Toll Plaza-1 (RHS)**
CAR	1226	1226
BUS	69	69
2 Axle	295	295
3 Axle	122	122
M Axle	535	535
LCV	101	101

6.3.3 Vehicle Damage Factors (VDF)

VDF values as obtained from axle load surveys are used for various sections are as given below:

Vehicle Type	**Boharipar Toll plaza at Km 1362+780**	
	UP	**DN**
BUS	1.26	0.5
2-Axle	2.26	1.5
3-Axle	4.95	4.76
M Axle	16.4	10.54
LCV	0.68	1.54

6.3.4 HDM Inputs

FWD and Roughness values are used as obtained from surveys and investigations as below:

LHS:	Case-1	Case-2	Case-3	Case-4
	<2000	>=2000 and <2200	>=2200 and <2400	>=2400
Length, km	16.8	3.7	2.9	1.1
Roughness	1625	2076	2318	2833
IRI	2.33	2.90	3.20	3.83
Deflection, mm	0.39	0.40	0.33	0.38
Cracking,%	0.0%	0.2%	0.0%	0.8%
Raveling,%	6.5%	5.6%	7.6%	6.7%
Patching,%	0.1%	0.0%	0.4%	3.3%
Rut Depth, mm	5.57	5.80	7.07	4.38
BT Crust, mm	152	144	157	143
Granular Crust, mm	388	358	398.00	413.33

RHS:	Case-1	Case-2	Case-3	Case-4
	<2000	>=2000 and <2200	>=2200 and <2400	>=2400
Length, km	15.527	0.47	0.67	1.68
Roughness	1757	2100	2381	2759
IRI	2.49	2.93	3.28	3.74
Deflection, mm	0.35	0.39	0.46	0.33
Cracking,%	0.0%	0.0%	0.0%	0.0%
Raveling,%	4.6%	5.0%	5.0%	5.0%

RHS:	Case-1	Case-2	Case-3	Case-4
	<2000	>=2000 and <2200	>=2200 and <2400	>=2400
Length, km	15.527	0.47	0.67	1.68
Patching,%	0.1%	0.0%	0.0%	0.0%
Rut Depth, mm	6.36	8.36	6.64	6.16
BT Crust, mm	120	120	120.0	120.0
Granular Crust, mm	470	470	470.0	470.0

6.3.5 Options for MM Schedules

Based on the requirements of CA, various options have been considered to be used as responsive overlays triggered at specified level of roughness of 2400 mm/km. Micro surfacing has also been considered to examine its feasibility for major maintenance.

In LHS & RHS directions following options were considered in the analysis:

- ✓ Base Case: MCS at Roughness of 2400mm/Km with regular maintenance
- ✓ Opt-1: Responsive Mill & Overlay of 30mm BC whenever roughness is >2400mm/KM with regular maintenance
- ✓ Opt-2: Responsive Mill & Overlay of 40mm BC whenever roughness is >2400mm/KM with regular maintenance

6.3.6 ROUGHNESS PROGRESSION

Roughness progression for each section under each alternative maintenance option has been done using the deterioration models in HDM-4. Following graphs represents the roughness progression for each alternative:

HDM - 4
HIGHWAY DEVELOPMENT & MANAGEMENT

Average Roughness by Project (Graph)

Study Name: RKJL_JL_LHS
Run Date: 02-01-2023

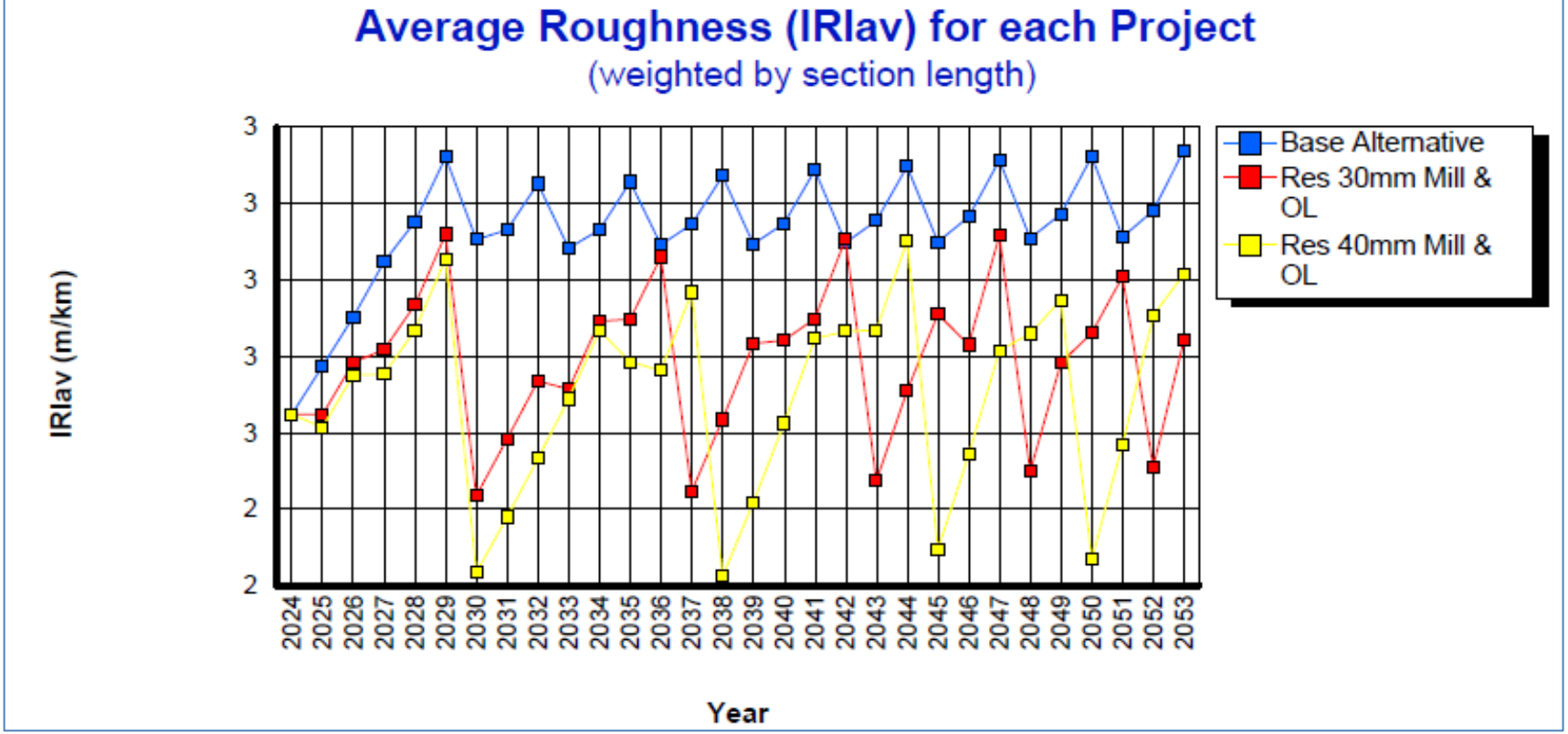


Figure 1: Average Roughness in LHS (UP) Carriageway

HDM - 4
HIGHWAY DEVELOPMENT & MANAGEMENT

Average Roughness by Project (Graph)

Study Name: RKJL_JL_RHS
Run Date: 02-01-2023

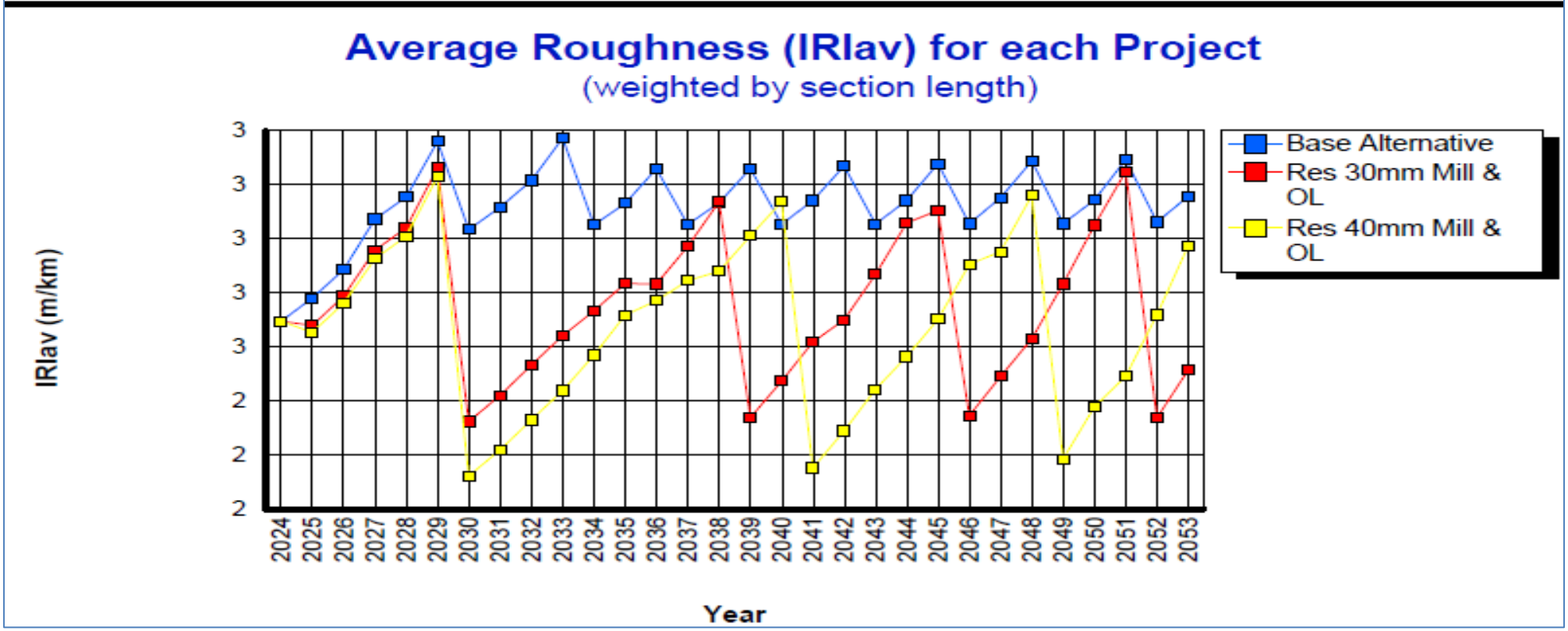


Figure 2: Average Roughness in LHS (UP) Carriageway

6.5 M&M SCHEDULE

Based on the forgoing discussions and inputs, the O&M schedule for the project for various options considered above for individual sections have been prepared for varying overlay thickness and Option with 40mm BC as overlay has been recommended for final application. Obtained & Adopted MM schedule for project is as below:

Table 41: MM schedule for project

LHS Carriageway

Obtained						Adjusted						
Base Year		Option-2 (Res 40mm mill & OL)				Base Year		Option-2 (Res 40mm mill & OL)				Remarks
	Criteria:	<2000	>=2000 and <2200	>=2200 and <2400mm	>=2400		Criteria:	<2000	>=2000 and <2200	>=2200 and <2400mm	>=2400	
	Length:	16.822	3.730	2.900	1.110		Length:	16.822	3.730	2.900	1.110	
	Financial Year	Case-1	Case-2	Case-3	Case-4		Financial Year	Case-1	Case-2	Case-3	Case-4	
0	2023					0	2023					
1	2024			40	40	1	2024					
2	2025					2	2025					
3	2026		40			3	2026					
4	2027					4	2027					
5	2028					5	2028					
6	2029	40				6	2029					
7	2030					7	2030	40	40	40	40	
8	2031					8	2031					
9	2032					9	2032					
10	2033					10	2033					
11	2034			40	40	11	2034					
12	2035		40			12	2035					
13	2036					13	2036	40	40	40	40	Add. 50 mm DBM for 10% length
14	2037	40				14	2037					
15	2038					15	2038					
16	2039					16	2039					
17	2040					17	2040					
18	2041			40	40	18	2041					

Obtained						Adjusted						
Base Year		Option-2 (Res 40mm mill & OL)				Base Year		Option-2 (Res 40mm mill & OL)				Remarks
	Criteria:	<2000	>=2000 and <2200	>=2200 and <2400mm	>=2400		Criteria:	<2000	>=2000 and <2200	>=2200 and <2400mm	>=2400	
	Length:	16.822	3.730	2.900	1.110		Length:	16.822	3.730	2.900	1.110	
	Financial Year	Case-1	Case-2	Case-3	Case-4		Financial Year	Case-1	Case-2	Case-3	Case-4	
19	2042		40			19	2042	40	40	40	40	
20	2043					20	2043					
21	2044	40				21	2044					
22	2045					22	2045					
23	2046					23	2046					
24	2047			40	40	24	2047	40	40	40	40	
25	2048		40			25	2048					
26	2049	40				26	2049					
27	2050					27	2050					
28	2051					28	2051					
29	2052			40	40	29	2052					
30	2053	40	40			30	2053	40	40	40	40	

RHS Carriageway

Obtained						Adjusted						
Base Year		Option-2 (Res 40mm mill & OL)				Base Year		Option-2 (Res 40mm mill & OL)				Remarks
	Criteria:	<2000	>=2000 and <2200	>=2200 and <2400mm	>=2400		Criteria:	<2000	>=2000 and <2200	>=2200 and <2400mm	>=2400	
	Length:	15.527	0.470	0.670	1.680		Length:	15.527	0.470	0.670	1.680	
	Financial Year	Case-1	Case-2	Case-3	Case-4		Financial Year	Case-1	Case-2	Case-3	Case-4	
0	2023					0	2023					
1	2024			40	40	1	2024					
2	2025					2	2025					
3	2026		40			3	2026					
4	2027					4	2027					
5	2028					5	2028					
6	2029	40				6	2029					

Obtained						Adjusted						
Base Year		Option-2 (Res 40mm mill & OL)				Base Year		Option-2 (Res 40mm mill & OL)				Remarks
	Criteria:	<2000	>=2000 and <2200	>=2200 and <2400mm	>=2400		Criteria:	<2000	>=2000 and <2200	>=2200 and <2400mm	>=2400	
	Length:	15.527	0.470	0.670	1.680		Length:	15.527	0.470	0.670	1.680	
	Financial Year	Case-1	Case-2	Case-3	Case-4		Financial Year	Case-1	Case-2	Case-3	Case-4	
7	2030					7	2030	40	40	40	40	
8	2031					8	2031					
9	2032					9	2032					
10	2033					10	2033					
11	2034					11	2034					
12	2035			40		12	2035					
13	2036		40			13	2036	40	40	40	40	Add. 50 mm DBM for 10% length
14	2037				40	14	2037					
15	2038					15	2038					
16	2039					16	2039					
17	2040	40				17	2040					
18	2041					18	2041					
19	2042					19	2042	40	40	40	40	
20	2043			40		20	2043					
21	2044		40			21	2044					
22	2045					22	2045					
23	2046				40	23	2046					
24	2047					24	2047	40	40	40	40	
25	2048	40				25	2048					
26	2049					26	2049					
27	2050		40	40		27	2050					
28	2051					28	2051					
29	2052					29	2052					
30	2053				40	30	2053	40	40	40	40	

6.6 STRUCTURAL PERIODIC MAINTENANCE STRATEGY

Expansion joints:

- Visual inspection is carried out to check for seal breakages, Armor angle, Weld failures, cracks between deck & Expansion joints concrete and Joints filled with debris. Such joints replaced immediately.
- Joint buried with debris shall be inspected for any distress, if any distress is shown it shall be replays immediately.
- During visual inspection it is seen that some Expansion joints are bad where as some are not showing any defects.
- Due to this it is considered provident to change the Expansion joints which are visibly damaged in initial stage.
- In the absence of records pertaining to Expansion joint replacements it is highly difficult to predict the date of replacement needed for compliance to IRC codal requirements. Balance joints which are not replaced initially will be replaced as on when defects are shown in the joints. This aspect is considered in BOQ.

Bearings:

- In order to identify the bearings requiring immediate replacement, the following strategy is adopted.
- Girder Bridges showing diagonal cracks at support, distress in the Pedestals and any form of distress in support location is regarded as a candidate for replacement. By visual inspection there are only a handful of such situations.
- Wherever pedestals are damaged either by cracking or spalling poisons confinement is proposed by Jacketing/MS plate bonding such procedure is very effective and common.
- All Metallic Bearings need to be taken up for servicing.

Wearing Coat:

It is necessary to replace the Wearing coat at every 15years interval, as wearing coat is a very weak component of the bridge structure which is subjected to severe deterioration due to Loading, Environment etc. As of now, we have considered sealing of cracks by Fog Seal and for which does not show any distress other than cracking by viz. Pot holes, abrading etc. Based on this aspect, this cost has been considered in highway O&M cost.

Periodic Maintenance strategy for Replacement of Bearings & Expansion joint:

Below strategy has been considered for periodic major maintenance of the structures.

S no	Description	Bridge components
1	Old structure	Structures which are older than 15years as of now
2	New Structure	Structures which are Not older than 15years as of now

Age	Description	Item	structures-Assumption-MMR							
			% of Replacement of Major components							
			2024	2028	2033	2038	2043	2048	2053	2052
New	Super structure lifting with Pot bearings	Pot	0%	10%	50%	25%	50%	25%	25%	0%
New	Super structure lifting with Elastomeric bearings	Ela	0%	10%	50%	50%	50%	25%	50%	0%
New	Super structure lifting with Rocker bearings	Rocker	0%	0%	0%	0%	0%	0%	0%	0%
Old	Super structure lifting with Pot bearings	Pot	50%	25%	25%	25%	25%	25%	50%	0%
Old	Super structure lifting with Elastomeric bearings	Ela	50%	25%	25%	25%	25%	25%	50%	0%
Old	Super structure lifting with Rocker bearings	Rocker	25%	10%	25%	10%	25%	25%	25%	0%
New	Pot bearing cost	Pot	0%	10%	50%	25%	50%	25%	25%	0%
New	Elastomeric bearing cost	Ela	0%	10%	50%	50%	50%	25%	50%	0%
New	Rocker bearing cost	0	0%	0%	0%	0%	0%	0%	0%	0%
Old	Pot bearing cost	Pot	50%	25%	25%	25%	25%	25%	50%	0%
Old	Elastomeric bearing cost	Ela	50%	25%	25%	25%	25%	25%	50%	0%
Old	Rocker bearing cost	0	25%	10%	25%	10%	25%	25%	25%	0%
New	Expansion joint Replacement	0	0%	20%	50%	50%	50%	25%	50%	0%
Old	Expansion joint Replacement	0	75%	25%	25%	25%	50%	25%	50%	0%
New	Others	0	0%	20%	50%	25%	25%	25%	50%	0%
Old	Others	0	75%	25%	25%	25%	25%	25%	50%	0%

Cost Component for various items and activities have been worked out by considering the Best Industry practice and most appropriate methods. Detailed quantities for work items have been estimated based on the details presented in previous chapters for various heads.

The List of the cost components considered are presented below:

- Immediate Repair's Cost
- Routine Maintenance Cost
- Incident Management Cost
- Periodic Maintenance Cost
- Operations Cost
- Year by Year total O&M Costs

7.1 RATE ANALYSIS

Detailed rate analysis has been carried out based on MORTH guidelines to arrive at the unit rates of various items. Material rates and their leads from the project corridor are considered as per the material investigations done on the project road. Summary of unit rates arrived at are presented in table below:

Table 42: Unit Rates of Basic material

S No	Description	Units	Source	Basic Rate in Rs. (Excluding transportation & GST	Lead in Kms
1	Good earth	Cum	BA	35	5.34
2	40 mm	Cum	Crusher	524	11.14
3	20 mm	Cum	Crusher	693	11.14
4	12 mm	Cum	Crusher	409	11.14
5	6 mm	Cum	Crusher	308	11.14
6	Dust	Cum	Crusher	484	11.14
7	M sand	Cum	Crusher	888	11.14
8	Flyash	Cum	Nearest Plant	0	1388.19
9	Boulders	Cum	Quarry	136	1.00
10	Sand source to Plant	Cum	River	888	12.00
11	Sand source to working site	Cum	Stock yard	888	8.00
12	Bitumen 60/70	MT	Mathura	48566	677.00
13	Bitumen 80/100	MT	Mathura	47806	677.00
14	VG-40	MT	Mathura	48000	677.00
15	CRMB-55	MT	Mathura	49516	677.00
16	PMB	MT	Mathura	53200	677.00
17	SS1	MT	Mathura	50000	677.00
18	Steel	MT	Jabalpur	63633	0.00
19	HTS Strands	MT	Jabalpur	70000	1077.00
20	Cement	MT	Jabalpur	5313	0.00
21	Structural Steel	MT	Jabalpur	65633	55.00
22	RCC Pipe NP 4 heavy duty non pressure pipe 1000 mm dia	RM	Jabalpur	4500	90.00

S No	Description	Units	Source	Basic Rate in Rs. (Excluding transportation & GST	Lead in Kms
23	RCC Pipe NP 4 heavy duty non pressure pipe 1200 mm dia.	RM	Jabalpur	5500	90.00
24	RCC Pipe NP 4 heavy duty non pressure pipe 900 mm dia.	RM	Jabalpur	3500	90.00

Table 43: Major Material Cost

Sl.no	Item	Unit	Rate (INR) Excluding GST
1	Embankment - borrow	Cum	277
2	Embankment - Excavation	Cum	80
3	SG	Cum	283
4	GSB G-2	Cum	1406
5	WMM	Cum	1474
6	Prime Coat	Sqm	42
7	Tack coat on granular	Sqm	14
8	DBM G-1	Cum	8004
9	Tack coat on bituminous surface	Sqm	13
10	BC - G1	Cum	9616
11	Road Marking	Sqm	531
12	RE wall	Sqm	4751
13	Select Fill	Cum	311
14	Filter Media	Cum	1316
15	M15	Cum	5210
16	M20	Cum	5759
17	M25	Cum	6221
18	M30	Cum	6170
19	M35	Cum	6389
20	M40	Cum	6508
21	PSC M45	Cum	7835
22	HYSD	MT	91550
23	HT strand	MT	143718

7.2 INITIAL COSTING

Costs associated with initial improvements are estimated based on the detailed asset inventory and condition assessment surveys, Pavement condition and structural condition assessment surveys. Items which are not executed as part of scope or in damaged condition have been considered for immediate costs as a part of 1-year Capex. Following items are mainly considered for Initial Improvement costs:

- Scope given in schedule-B
- Scope which is not executed
- Road work items
- Bridge Work Items
- Pavement Rehabilitation works
- Structural Rehabilitation works
- Drainage Works
- Slope Protection works

- Safety Works

Summary of Initial Improvement Costs are included in table below:

Table 44: Initial Improvement Cost

S.no	Description	Unit	Quantity	Rate (Rs.)	Amount (Rs.)
1	Initial Improvement works (Highway & Structures)-EPC	LS	1	4,23,43,972	4,23,43,972
2	TMS	LS	1	2,15,53,444	2,15,53,444
3	ATMS	LS	1	-	-
4	Revalidation surveys	LS	1	1,69,58,594	1,69,58,594
5	Pavement Rehabilitation	LS	1	13,33,96,049	13,33,96,049
Immediate Repair's - Structures					**70,15,533**
Total Cost excluding GST					**22,12,67,592**
GST at 18%					3,98,28,167
Total Cost including GST					**26,10,95,759**
Total Cost including GST IN Crores					**26.11**

Note: This above cost arrived is with due consideration of reply to pre-bid queries dtd 27.09.2023 annexure G

The structure approach lengths as given in the DPR has been redesigned with due verification at site and following revised lengths were considered in EPC cost estimations.

S No.	Package	Str_Chianage	Str. Type	As Per DPR, length in KM			Difference In Km	As Per Samarth,length in KM		
				From	To	Length		From	To	Length
1	JL	1402.625	VUP	1402.16	1403.06	0.9	0.099	1402.118	1403.117	0.999

7.3 ROUTINE MAINTENANCE & INCIDENT MANAGEMENT COSTS

Routine maintenance costs include general maintenance costs of road elements, bridge elements and road furniture and appurtenances. This can be mainly divided into two parts as:

- ✓ General Maintenance of Works
- ✓ Repairs to Highway & Bridge Elements

7.3.1 General Routine Maintenance

General Routine Maintenance of Roads generally include following items:

- Cleaning of Project facilities
- Structures cleaning,
- Cleaning of ROW
- Cleaning and Maintenance of Toll Plaza
- Unlined Drain Maintenance
- Lined Drain Maintenance
- Maintenance of Highway Lighting at Toll plaza and other project locations
- Median Plantation maintenance & Avenue plantation maintenance:
- Maintenance of Road Furniture
- Maintenance of Road Safety Items

The above items are estimated by considering the detailed break-up of following items:

- Manpower including Managers/Labour etc.
- Vehicles for Labour Transport/Water Tankers/Sweeping Machines etc.
- Resources/Equipment's such as grass cutters, tools, jet sprayers, hydraulic trimmers etc.

7.3.2 Repairs to Highway & Bridge Works

Repairs to highway and bridge works have been estimated based on the assumed quantities (Percentage basis) of execution for every year.

These items include the following:

1	Providing treatment for sealing of road surface / isolated cracks at scattered locations
	i) Covered with 6.7 mm size stone chipping @ 0.1 cum/ 10 sqm.
	ii) covered with dry coarse sand passing through 2.36 mm sieve and retained on 180 micron sieve @ 0.03 cum/10 sqm heated to 600 C
	iii) filling discrete cracks with slow curing bitumen emulsion as per Technical Specification Clause 3004.3.3
2	Providing treatment to bleeding bituminous surface at scattered locations
3	Providing localized repair to rutted portion and edge breaking of bituminous surface
4	Providing treatment and repair to pot-holes and patch work
5	Providing and laying dense bituminous macadam using bitumen grade VG 40 complete as per Technical Specification Clause 507
6	Proving and laying bituminous concrete (asphaltic concrete)
	(a) Using bitumen (VG-40) as per IRC: SP: 53
7	Road Roughness survey
8	Turfing on embankment slopes and at all other Project Facilities
9	Providing repair to stone pitching/apron at scattered locations
10	Rain Cuts Maintenance: Restoration of rain cuts soil, moorum, gravel or a mixture of these
11	Providing and laying apron/ stone pitching on slopes of guide bunds/ road embankment / other location
12	Providing and laying stone aggregate filter material (150 mm compacted thickness) underneath pitching
13	Unlined drain
14	Filling in median island with approved materials with all leads and lifts complete as per TS Clause No. 407

15	Replacing damaged / broken railing with new pre-cast / cast-in-situ, concrete railing to match with existing design and pattern.
24	Carrying out repair to road signs including strengthening resetting or otherwise repairing signs and delineators
	a) Road sign board mounted on single post
	b) Road sign board mounted on double post
	c) Overhead/ Gantry Sign boards
	d) Delineator
25	Supplying and fixing at site retro-reflectorized type **sign boards/signs**
	90cm Equilateral triangle
	60cm circular
	90 cm circular
	90cm high octagon
	80cm x 60cm rectangle
	Chevron signs 60cm x 45cm
	Place identification signs (Fig 15.7 of IRC 67)
	Providing and fixing Object Markers
	Providing and fixing of retro-reflectorized Route Marker signs (size 450mm x 600mm)
26	**Hazard Marker Sign :**
	a) size 90 x 30 cm
	b) size 30cm triangular side cluster of red reflectors (screen printed)
27	Cats Eyes/Raised pavement marker (NMC Nails Less)
28	Painting two coats on old surface after minor repairs to give an even and smooth surface and printing letters and figures with synthetic enamel paint
	a) Hectometer stones
	b) Kilometer Stone
	c) 5 Kilometer stone
	d) Boundary stone
	e) Guard stone
29	Providing painting lettering and fixing of distance measurement stones including dismantling of old damaged/ broken ones, confirming to TS Clause 804
	a) Hectometer stones
	b) Kilometer Stone
	c) 5 Kilometer stone
	d) Boundary stone
	e) Guard stone
30	Providing and fixing road delineators conforming to TS Clause No. 805 as directed by the Engineer.
31	Repainting the kerb stones and separation barrier with first quality synthetic enamel paint of approved brand
32	Painting all types of pavement markings including lines, dashes, arrows etc. on roads as per relevant IRC/MOST standards after cleaning the surface complete in all respects as directed by the Engineer.
	a) Hot applied Thermoplastic compound
	(i) Lane / Centre Line / Edge Line
	(ii) Direction Arrows
	(iii) Diagonal Chevrons Markings
33	Supplying and laying cast-in-situ cement concrete kerb without channel section
	a) by Manual/machine including formwork
34	Major repair / replacement of metal beam crash barrier (W profile guard rails)
35	Providing and fixing chain link/ welded mesh fencing / square bars fencing

36	Dismantling the old damaged chain link/welded mesh / square bars fencing and replacing it with new chain link/ welded mesh/square bars fencing
37	Provision of rumble strips
38	Shoulder Maintenance:
39	synthetic enamel paint of approved brand on metal pedestrian guard rail
40	Dismantling of wearing course

B. Structures

1. Wearing coat comprising of 50 mm thick BC.
2. Cleaning and adding rubber sealant near expansion joints.
3. Modular Expansion joints.
4. Replacement of Damaged Concrete Railing all complete as per Technical specifications and as directed by the Engineer
5. Provision of an RCC crash barrier (0.35sqm cross sectional area) constructed with M-40 grade concrete including reinforcement
6. Cleaning of rocker & roller bearing using high pressure water jet, free from rust scales, re-setting & greasing the bearings using graphite grease including cost of materials, labour etc., complete.
7. POT PTF Bearings greasing and maintaining (sand plastering).
8. Elastomeric Bearings and maintaining.
9. Cutting of groove of 15 mm x 15 mm along crack and sealing the same with epoxy putty including cost of material, labour etc.
10. Carrying out 50mm to 60mm thick short sheeting using a mix proportion of 1:2:2 (cement: sand:6 mm down aggregate) added with Polypropylene fibers at a dosage rate of 125 gms/bag of cement including cost of labour, material, scaffolding, equipment etc complete.
11. Repair of Floor Aprons, pitching and other protection works
12. Cleaning of Drainage Spouts
13. M-25 Concrete

7.3.3 Incident Management Cost

Incident Management & Safety items include the following:

- ✓ Regular patrolling & reaching accident/incident site,
- ✓ providing relief to injured persons including taking them to nearest hospital and attending to the safety requirements at the location (putting cones, safely guide & manage the traffic using signs, safety barricades, etc.),
- ✓ removal of accident /breakdown vehicles, removing of dead animals/birds lying on the highway and loading, unloading, transportation & disposal of surplus material left over by accidental vehicle or otherwise lying on road (on carriageway) and
- ✓ Encroachment prevention & removal with all lead & lifts complete with proper communication equipment,

- ✓ consumables, materials, suitable Towing vehicles, Ambulance, patrolling vehicles and manpower like drivers, helpers, para-medical staff, labour including deployment of crane and all works shall be done as per requirement and as directed by Client representative and as per Relevant Specifications as applicable.

7.4 OPERATIONS COSTS

Cost towards Operations include the following:

- Electricity Bill of lighting
- Toll Plaza Operation cost
- Operation and management costs of rest areas and lay byes
- Operation and management costs of Traffic & medical aid posts
- SPV Costs
- Survey Costs
- Insurance
- IE Fee
- Audit Charges
- Administrative Cost

Table 45: 1st year O&M Cost

S. No.	Particulars	Amount in Crs. (Including GST)
1	Tolling Operations	4.12
2	Incident Management	3.91
3	Routine Maintenance	5.72
4	Repairs	2.22
5	ATMS	-
6	Admin Expenses	4.49
7	Insurance	1.46
Total O&M Cost (FY 2024)		**21.93**
	For FY 2027, Additional cost towards special repairs is to be added	**5.07**
	TOTAL OPERATIONS COST(FY 2027)	**27.00**

Note: All the amounts are in Rs. Cr and is inclusive of GST, without escalation

7.5 PERIODIC MAINTENANCE COSTS

Cost towards major maintenance include following:

- ✓ Cost of Periodic maintenance of Pavement based on Finalized MM schedule
- ✓ Cost of Periodic Maintenance of Structures
- ✓ Cost of Periodic replacement of Toll Equipment's & Software

Table 46: Periodic Maintenance Cost

S. No	Year	Periodic Maintenance				
		Functional +Structural overlay MCW+ S/R	Major Maintenance of Rigid Pavement	R&R of **ATMS**	R&R of **TMS**	Structure specified repairs
-	2023					
1	2024	-	-			-
2	2025	-	-			-
3	2026	-	-			-
4	2027	0.70	2.46			-
5	2028	-	-			1.57
6	2029	-	-			-
7	2030	23.45	28.25			2.27
8	2031	-	-	-	1.27	-
9	2032	-	-			-
10	2033	0.70	2.46			1.92
11	2034	-	-			-
12	2035	-	-			-
13	2036	25.44	64.96			7.36
14	2037	-	-			-
15	2038	-	-	-	2.54	1.57
16	2039	0.70	2.46			-
17	2040	-	-			-
18	2041	-	-			-
19	2042	23.45	28.25			5.53
20	2043	-	-			1.92
21	2044	-	-			-
Total:		**74.46**	**128.86**	**0.00**	**3.81**	**22.14**
Major / Periodic Maintenance (For 20 years period)		**229.28**				

Note: All the Costs are in Crores, inclusive of GST, without escalation considering FY 2024 price

7.6 TOTAL OPERATION & MAINTENANCE COSTS

Year on year operation cost is summation of following:

- ✓ Immediate Costs
- ✓ Routine Maintenance & Incident Management
- ✓ Periodic Maintenance
- ✓ Operations Cost

Following table presents the summary of Operations & Maintenance cost for the project

Table 47: Cost Abstract

Calendar Year	SUMMARY OF VARIOUS EXPENSES in Rs. Crs					
	Immediate Repair's Cost	Toll Operation expenses	Routine Maintenance Expenses	Periodic Maintenance (Functional +Struc Overlay+ Toll collection system)	Total Cost (Rs. Cr.)	Additional Cost (For special repair) - Already included in routine maintenance expenses
-		-	-	-	-	
2023-2024	26.11	4.12	5.96	-	36.19	
2024-2025		4.12	17.81	-	21.93	
2025-2026		4.12	17.81	-	21.93	
2026-2027		4.12	22.88	3.17	30.17	5.07
2027-2028		4.12	17.81	1.57	23.50	
2028-2029		4.12	17.81	-	21.93	
2029-2030		4.12	17.81	53.98	75.91	
2030-2031		4.12	17.81	1.27	23.20	
2031-2032		4.12	17.81	-	21.93	
2032-2033		4.12	17.81	5.09	27.01	
2033-2034		4.12	17.81	-	21.93	
2034-2035		4.12	17.81	-	21.93	
2035-2036		4.12	17.81	97.77	119.69	
2036-2037		4.12	17.81	-	21.93	
2037-2038		4.12	17.81	4.11	26.04	
2038-2039		4.12	17.81	3.17	25.10	
2039-2040		4.12	17.81	-	21.93	
2040-2041		4.12	17.81	-	21.93	
2041-2042		4.12	17.81	57.24	79.17	
2042-2043		4.12	17.81	1.92	23.84	
2043-2044		1.03	7.81	-	8.84	
Total Cost:	***26.11***	***83.40***	***357.20***	***229.28***	**695.98**	

Note: All the Costs are in Crores, inclusive of GST, without escalation considering FY 2024 price

7.7 CAPACITY AUGMENTATION

The project has not envisaged the capacity augmentation during concession period.

8.1 DATA COLLECTION AND REVIEW TMS Works

8.1.1 CA Provisions for TMS works

- ✓ **Clause 10 of Schedule A**
  (a) Existing Boharipar Toll Plaza with 10 physical lanes at Km. 1362.780 i.e. 12 toll lanes with 2 reversible lanes with Hybrid ETC system is under operation.
- ✓ **Clause 9.1 of Schedule B**
  (b) Existing Toll Plaza at Km 1362+700 (Boharipar) and all toll booths are proposed to be retained. Any modification if required shall be done as per NHAI / Policy Guidelines / Management of Plaza / 2021 Policy Circular No. 17.5.82 Dated 25th May 2021. The Concessionaire shall modify / improve Toll Management System (TMS) as per latest Hybrid ETC system. Existing Toll Plaza Administration building shall be repaired/ rehabilitated as per the specifications and standards given in IRC: SP: 84-2019. Required numbers of parking bays are to be provided within the Toll Plaza premises in consultation with Independent Engineer. Toilet blocks and Water ATM (one in each direction) with adequate parking facility near Toll Plaza Area shall be provided / maintained as per the drawings and standards give in NHAI Circular dated 09-11-2017 (Ref. NHAI/GM(T)HO/Highway Nest (Mini)/2017/108290).

  (c) The Existing Toll Booths, Toll Plaza premises including all facilities, parking etc. shall be repaired, maintained, and upgraded for smooth toll operation as per IRC SP: 84-2019.

  (d) The Concessionaire shall be responsible to ensure toll plaza assets, TMS, equipment's and systems shall conform to the latest available technology / MORTH Specification / IRC / MORTH and NHAI Circular/ Policy as applicable and NO COS shall be admissible on this account for future amendments / upgradation.
- ✓ **Schedule C states as below:**
  - Engineering and safety improvements along the project highway shall conform to the IRC: SP: 84:2019, Manual of specifications & Standards for Four laning of Highways through Public Private Partnership published by IRC.
  - Clause 2 – Deviations from the manual - Section 10.

  (e) IRC SP: 84:2019 clause 10.6.2 – Not less than 2 middle toll lanes shall be capable of being used as reversible lane to meet the demand of tidal flow.
- ✓ **Present major issues at site:**
  - As AVC performance is very poor, new AVC system is recommended.
  - 6 Nos. UFD not working.
  - 3 Nos. ETC readers shortage.

8.2 DATA COLLECTION AND REVIEW ATMS Works

- ✓ **Nil-**

Pre-bid reply dtd 11.10.2023, annexure-2, S.No3: Installation, operation and maintenance of the ATMS shall be done by NHAI.

CHAPTER 9. CONCLUSIONS

Project is a Four-Lane divided Carriageway have a combination of flexible and rigid pavements comprising of 81.7 Km length. The length of Rigid and flexible pavement is presented below.

Description	LHS (km)	RHS (km)
Rigid Pavement	56.085	62.52
Flexible Pavement	25.652	19.217
Project Length	81.737	81.737

- Two Truck lay byes are provided in the Project Highway, the pavement condition of these lay byes is observed to be in fair condition.
- There are 13 Bus shelters & 29 Nos of Bus bay with bus shelters are observed along the project corridor. The pavement of bus bays is observed to be in fair condition.
- The project corridor has service road for a length of 10.535 kms on LHS and 4.050 kms length and RHS respectively and its pavement condition is fair.
- The Vehicle Damage Factor of MAV is high in LHS direction compared to RHS direction, due to high loading of iron & goods carrying from Jabalpur to Nagpur.
- From Roughness Consideration, moving average method has been adopted considering 10m point interval roughness data. In order to maintain roughness within threshold limit (<2200mm/km), rectification suggested at identified locations accumulated to 36.29 lane-km length in LHS, 33.05 lane-km length in RHS
- The Pavement Condition of the project appears to be fair in condition for most of the length. However, in rigid pavement longitudinal cracks, Raveling, Transverse Cracks and longitudinal wide joints are observed at few locations. Overall, total pane replacement suggested for 1837 Nos., partial 1m full depth repair for 438 Nos., staple and stich for 1630 Nos and raveling for 51347 sqm.
- From Structural (FWD) Consideration, the Project Road (Main Carriageway) requires overlay for a length of 10.2 Kms in LHS & 6.6 Kms in RHS direction.
- As per Site 68 nos. Solar Blinkers are observed at median opening locations, all are observed to be in fair condition, and at some median opening locations the same are missed.
- Highway lighting observed entire project corridor for a length of Km 11.7. At few locations Lightings were missed.
- There are 16 Nos of High Mast Lights, 200 Nos of double arm lights, 645 Nos of Single arm lightings are observed along the Project Corridor.
- The project corridor has Reinforced cover drain for a length of 1.83 kms, open lined drain for a length of 6.815 kms in this 20m damage has been observed.
- Median plantation is observed for a length of 13.687 kms in the entire project corridor.

- 82 No. of Kilometer stones and 546 No. of Hectometer stones are missing and the same shall be replaced with new one. the paint was damaged for 2 nos of kilometer stones and for 8 No of Hectometer stones and same shall be rectified.
- MCB's were observed for a length of 60.705 Kms and these are in fair condition. At few locations MCB were damaged for a length of 454m.
- Pedestrian Guard Railing were observed for a length of 2.061 Kms in the project corridor. At few locations PGRs were damaged for a length of 24m.
- There is one Toll Plaza in the entire project namely Boharipar Toll plaza with 4+1 lanes at Km 1362+780 (NH-34).
- The Project Stretch having different types of super structure for various structures such as PSC Box Girder, PSC Girders, RCC Girders, Steel girders, RCC Solid slab & RCC Box.
- As per site inventory it is understand from the structures, 1 No's of Flyovers are having PSC girder type super structure, 1 No of ROB is having Steel composite girder type super structure, 1 No of MJB is having PSC girder and PSC Box Girder type super structure, 1 No of Viaduct is having PSC Girder + PSC Box Girder + RCC Girder type super structure.
- The project stretch has 24 No's of MNBs, out of which 3 No's of MNBs having PSC Girder type super structure, 21 No's of MNBs having RCC box/solid slab type super structure.
- Underpasses which are of 01 VUP is having PSC girder type super structure, 03 VUPs, 04 PUPs are having RCC Box type structures and Overpass which are of 01 VUP is having PSC Box girder type super structure, 01 VUP is having RCC girder type super structure.
- Structures are having 106 No's of Strip Seal Expansion joints in the project stretch.
- In this project it is observed that Pot PTFE Bearings (896 No's), Metallic Bearings (114 No's) and Elastomeric bearings (220 No's) are provided for all girder type structures wherever required.
- Cleaning of expansion joints, drainage spouts need to be done regularly.
- Some structures are already repaired and it would be necessary to closely examine these structures for further distress during the maintenance period/Project duration, by way of close inspection and testing.
- All the structures appear to be in good condition. Few locations cracks and delamination of concrete have been noticed Soffit of deck slab. May require to undertake NDT to assess the actual structural condition.

SAMARTH INFRAENGG Technocrats Pvt. Ltd

SIT/PJRP/2411610/14
12th February 2024

Chief Operating Officer
National Highways Infra Investment Managers Pvt. Ltd.
G-5&6, Sector 10, Dwarka,
New Delhi – 110075

Sub: Submission of Supplementary Report for Final Reports for RKJL-Package-JL

Ref: Our letter reference SIT/PJRP/223607/067 dated 03.06.2023

K/A Mr. Shubhra Bhattacharya

In continuation to above reference, we are pleased to submit hereby the "Supplementary Report for Final Reports" in hard/soft copies for the following asset.

- ✓ Tolling, Operation, Maintenance & Transfer of Jabalpur Lakhandon (Km 880+600 to Km 891+780 of NH-30 & Km 1358+000 to Km 1428+557 of NH-34) in the State of Madhya Pradesh (MP) - RKJL-Package JL

Thanking you and assuring you best services all the time.

Yours Sincerely,
SAMARTH Infraengg Technocrats Pvt. Ltd.

D V Sridhar Murthy
Managing Director

Encl.: "Supplementary Report for Final Reports" for the above project in hard/soft copy.
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SUPPLEMENTARY REPORT FOR FINAL REPORT

1.1 INTRODUCTION

The Final Report was submitted on 1st Day of November 2023. Subsequent to this submission, the Operation Cost has been revised in due consultation with the Competent Authority. The following changes were made.

1. Operation Costs particularly Toll Operation Cost has been revised for Year FY 2027, FY 2028 and FY 2029 considering the reduction in Manpower. The same Operation Cost pertaining to FY2029 has been considered for rest of the Concession Period.
2. Abstract Cost has been updated in line with the above changes made in Operation Cost.
3. The updated Table-45 (O&M Cost) and Table-47 (Cost Abstract) have been presented below.
4. The Cost numbers presented in the following table supersedes cost numbers presented in the respective tables of the earlier submitted report

1.2 OPERATIONS COSTS

Table 45: O&M Cost

S.No	Particulars	FY-25	FY-26	FY-27	FY-28	FY-29
A1.1	Tolling Operations	4.118	4.118	3.483	3.483	3.146
A1.2	Incident Management	3.908	3.908	3.908	3.908	3.908
A2.1	Routine Maintenance	5.719	5.719	5.719	5.719	5.719
A2.2	Repairs	2.224	2.224	2.224	2.224	2.224
A2.3	ATMS	0.000	0.000	0.000	0.000	0.000
B	Admin Expenses	5.017	5.017	5.017	5.017	5.017
		20.987	**20.987**	**20.351**	**20.351**	**20.014**
	For FY 2027, Additional cost towards special repairs.	-	-	**5.070**	-	-
	Total Operation Cost	**20.987**	**20.987**	**25.421**	**20.351**	**20.014**

Note: All the amounts are in Rs. Cr and is inclusive of GST, without escalation

1.3 TOTAL COSTS

Year on year operation cost is summation of following:

- ✓ Immediate Costs
- ✓ Routine Maintenance & Incident Management
- ✓ Periodic Maintenance
- ✓ Operations Cost

Following table presents the Cost Abstract for the project

Table 1: Cost Abstract

Project Years	Calendar Year	SUMMARY OF VARIOUS EXPENSES in Rs. Crs					Remarks
		Immediate Repair's Cost	Toll Collection Expenses and Patrolling expenses	Routine Maintenance Expenses	Periodic Maintenance (Functional +Struc. Overlay+ Toll collection system)	Total Cost (Rs. Cr.)	
1	2023-2024	26.11	4.12	5.02	-	35.25	
2	2024-2025		4.12	16.87	-	20.99	
3	2025-2026		4.12	16.87	-	20.99	
4	2026-2027		3.48	21.94	3.17	28.59	5.070 Cr. Special repair cost added in RM
5	2027-2028		3.48	16.87	1.57	21.92	
6	2028-2029		3.15	16.87	-	20.01	
7	2029-2030		3.15	16.87	53.98	73.99	
8	2030-2031		3.15	16.87	1.27	21.29	
9	2031-2032		3.15	16.87	-	20.01	
10	2032-2033		3.15	16.87	5.09	25.10	
11	2033-2034		3.15	16.87	-	20.01	
12	2034-2035		3.15	16.87	-	20.01	
13	2035-2036		3.15	16.87	97.77	117.78	
14	2036-2037		3.15	16.87	-	20.01	
15	2037-2038		3.15	16.87	4.11	24.13	
16	2038-2039		3.15	16.87	3.17	23.18	
17	2039-2040		3.15	16.87	-	20.01	
18	2040-2041		3.15	16.87	-	20.01	
19	2041-2042		3.15	16.87	57.24	77.25	
20	2042-2043		3.15	16.87	1.92	21.93	
21	2043-2044		0.78	6.87	-	7.66	
	Total Cost:	**26.11**	**67.30**	***337.46***	**229.28**	**660.14**	

Note: All the Costs are in Crores, inclusive of GST, without escalation considering FY 2024 price

FINAL TECHNICAL DUE-DILIGENCE REPORT

Technical Consultant Services for National Highways Infra Trust

Kochugaon to Rakhaldubi and Rakhaldubi to Kaljhar Section of NH-27 in the State of Assam

October 2023

egis India
Consulting engineers pvt. ltd.

Document Name	Final Technical Due-Diligence Report
Document Number	EIRH1HR011/Assam/FTDD/06(I&II)
Project Name	Technical Consultant Services for National Highways Infra Trust Kochugaon to Kaljhar, Patacharkuchi to Amingaon (Guwahati) and Amingaon (Guwahati) to Nagaon Section of NH-27 in the State of Assam
Project Number	EIRH1HR011

Document Authentication

	Name	Designation
Prepared by	Nilesh Rana Uddipon Bora Jagdish Prasad Rajesh Kant Bhardwaj	Highway Engineer Quantity Surveyor Bridge Engineer Systems Expert
Reviewed by	Kumar Reetesh T. Someswar Rao	Project Coordinator/Quantity Surveyor Highway Pavement Engineer
Approved by	Sanjay Kumar	Team Leader

History of Revisions

Version	Date	Description of Change(s)
R0	29/05/2023	First Submission
R1	31/10/2023	Change in Capex, O&M, MMR cost due to changes in Schedules issued by NHAI

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Acronyms and Abbreviations

BC	Bituminous Concrete
BOQ	Bill of Quantities
C/W	Carriageway
CA	Concession Agreement
COD	Commercial Operation Date
CVPD	Commercial Vehicles Per Day
DLP	Digital Laser Profile
EGIS	Egis India Consulting Engineers Pvt. Ltd.
EPC	Engineering Procurement and Construction
FWD	Falling Weight Deflectometer
IM	Investment Manager
InvIT	National Highways Infra Trust
IRC	Indian Road Congress
Km	Kilometer (Chainage)
km	Kilometer (Length)
LHS	Left Hand Side
MBIU	Mobile Bridge Inspection Unit
MJB	Major Bridge
MNB	Minor Bridge
MPD	Mean Profile Depth
MSA	Million Standard Axles
NH	National Highway
NHAI	National Highways Authority of India
NHIIMPL	National Highways Infra Investment Managers Private Limited
NSV	Network Survey Vehicle
O&M	Operation and Maintenance
RCC	Reinforced Cement Concrete
RHS	Right Hand Side
ROB	Road over Bridge
SH	Stage Highway
SMTD	Sensor Measured Texture Depth
SPV	Special Purpose Vehicle
VDF	Vehicle Damage Factor
VUP	Vehicular Underpass

Section 1: Executive Summary

1.1 Introduction

1.1.1 Background

NHAI has set up an Infrastructure Investment Trust namely National Highways Infra Trust ("InvIT") and is acting as its Sponsor to the said InvIT. National Highways Infra Investment Managers Private Limited ("NHIIMPL") has been appointed as the Investment Manager to the InvIT.

NHIIMPL appointed M/s Egis India Consulting Engineers Private Limited, as Technical Consultant to conduct the due diligence on the proposed Assets. The Letter of Empanelment (LOE) was received on 3rd November 2022 and Letter of Award (LoA) for the subject Project was received on 11th November 2022 by Egis India and the services commenced immediately thereafter.

The project stretches details are listed below:

Table 1.1: Detail of Project Stretches

Sr. No.	Name of Stretches	Toll Plaza	Chainage (Km)		Length (km)
			From	To	
1	Kochugaon - Rakhaldubi	Patgaon	30+000	92+671/962+100	62.671
2	Rakhaldubi - Kaljhar	Dahalpura	961+500	1013+000	51.500

1.1.2 Objectives

The main objectives of the present assignment is to

1. review project documents and understanding schedule B requirements for improvement works for the assessment of Capex and Opex during the concession period.
2. conduct field investigations to assess the existing asset condition and future deterioration.
3. validate executed works with respect to schedule A and assessment of improvement Works
4. review quality of construction based on available data, design and drawings.
5. undertake designs for rehabilitation requirements of different assets based on field investigation data and available documents.
6. assess operation and maintenance cost including major maintenance expected to be incurred during the concession period.

1.2 Site Visit

The Technical Consultant visited site from 22nd November 2022 to 15th December 2022. The important aspects of the project road were noted in the detailed site reconnaissance along with various field investigations. These included general description about the project road, site features, structures, junctions, pavement characteristics, road safety. Field investigation for NSV, FWD test,

axle load survey, trail pits, MBIU and drone videography survey were also conducted by Technical Consultant to assess the present condition of the project road.

1.2.1 Salient Features

Chainage (Km)		Contractor During 4 Lanning	Date of Commencement	Date of Completion
From	To			
Kochugaon - Rakhaldubi				
30+000	60+000	M/s Gayatri-ECI (JV)	19.08.2005	31.03.2016
60+000	92+671	M/s Gayatri-ECI (JV)	19.08.2005	31.08.2016
Rakhaldubi - Kaljhar				
961+500	1013+000	M/s Punj Llyod	03.11.2005	31.03.2014

Asset-wise details of Project assets are given below:

Table 1.2: Detail of Assets

S. No.	Description			Kochugaon - Rakhaldubi	Rakhaldubi - Kaljhar
1	Total Project Length (km)			62.671	51.500
2	Service Roads/ Slip Roads (km)			16.140	13.270
3	Pavement (km)	Flexible	LHS	18.000	46.09
			RHS	28.260	5.620
		Rigid	LHS	44.450	5.410
			RHS	33.990	45.88
4	Bus Shelters (no.)			-	8
	Bus bays with Shelters (no.)			21	8
	Bus bays (no.)			9	4
5	Truck Lay-bays (no.)			-	-
6	Toll Plaza (no.)			1	1
7	Major Bridge (no.)			6	4
8	Minor Bridge (no.)			42	16
9	ROB/RUB			2	-
10	Culverts (no.)		Box	45	-
			Slab	13	34
			Pipe	4	-
11	At grade Intersections(no.)		Major	4	6
			Minor	98	94
12	Underpasses(no.)		VUP/SVUP	1	-
			LVUP	-	-
			PUP	3	2
13	Flyover (no.)			-	-
14	Viaduct (no.)			-	-

1.3 Surveys and Investigations

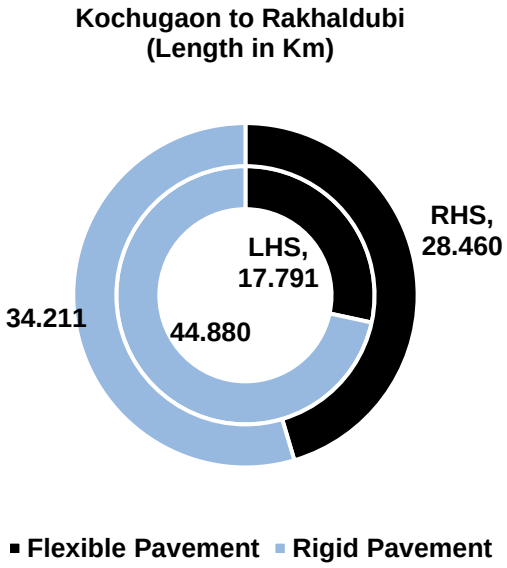
1.3.1 Network Survey Vehicle (NSV)

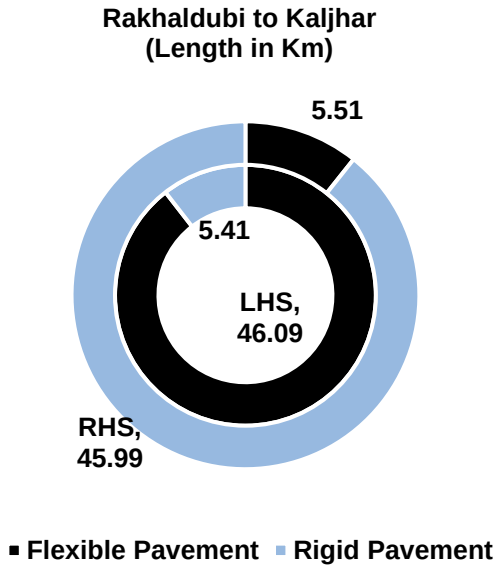
The Network Survey Vehicle, which is the latest survey technique which utilizes Lasers, Global Positioning System and Video image processing tools, is used for automatic data collection pertains to pavement condition and road inventory data. The NSV survey has been carried out along the

project corridor from 22/11/2022 to 05/12/2022 for collection of field data pertains to pavement condition and road inventory. Summary of findings of NSV survey is given in preceding sections.

1.3.1.1 Pavement Type

Summary of pavement types in terms of length in km are given below:



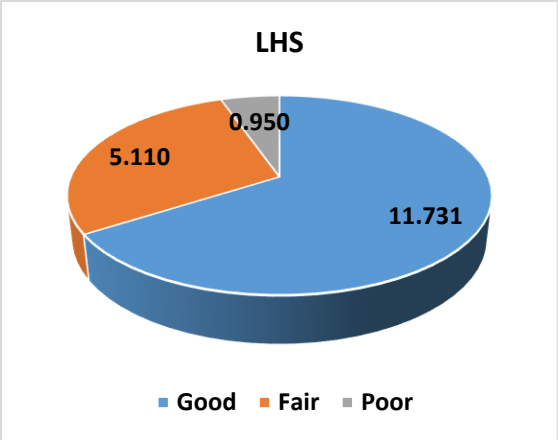


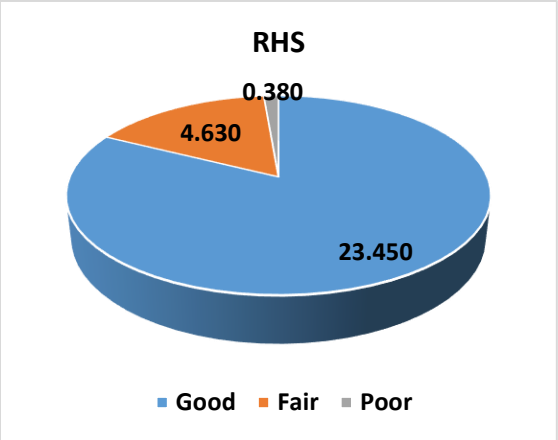
1.3.1.2 Pavement Distresses

The summary of pavement distresses in terms of length in km for both flexible and rigid pavement are presented below.

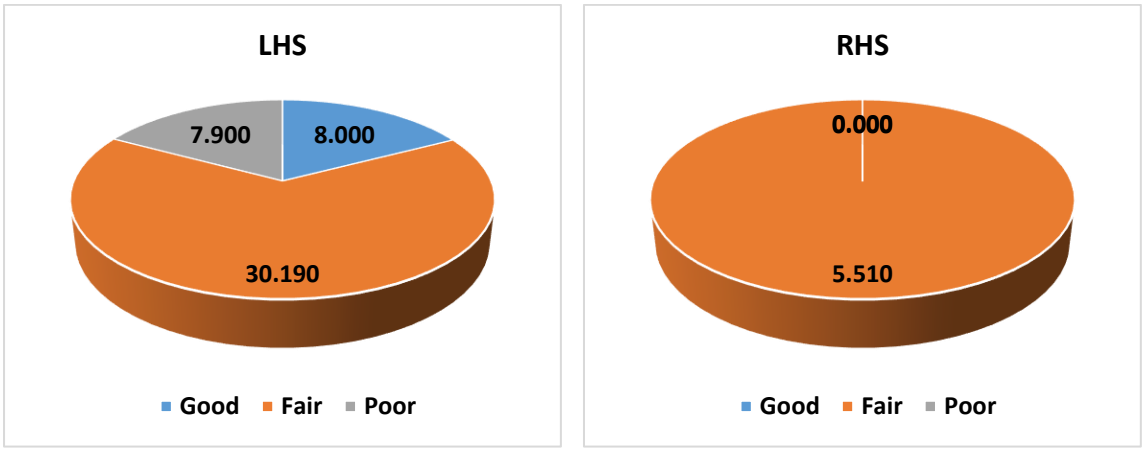
Flexible Pavement (length in km)

Kochugaon to Rakhaldubi



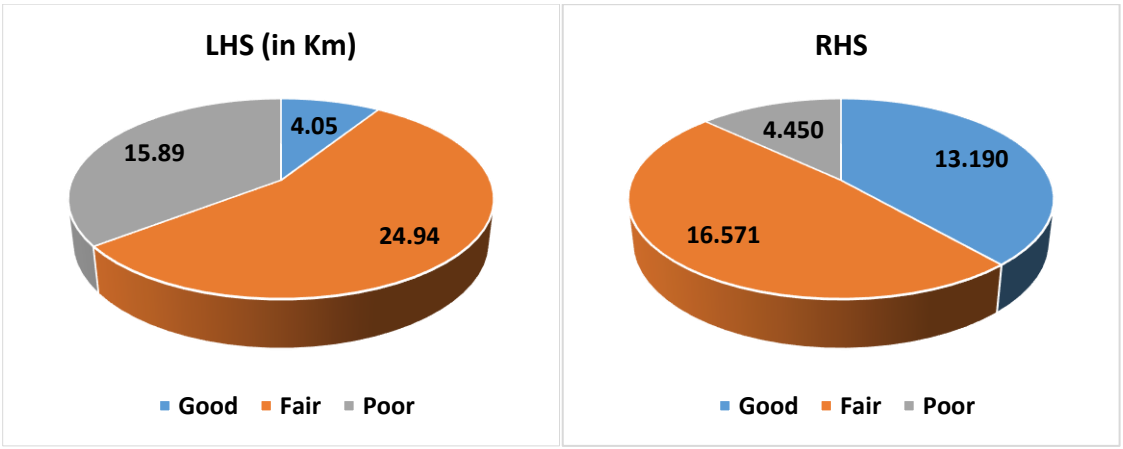


Rakhaldubi to Kaljhar



Rigid Pavement (length in km)

Kochugaon to Rakhaldubi



Rakhaldubi to Kaljhar

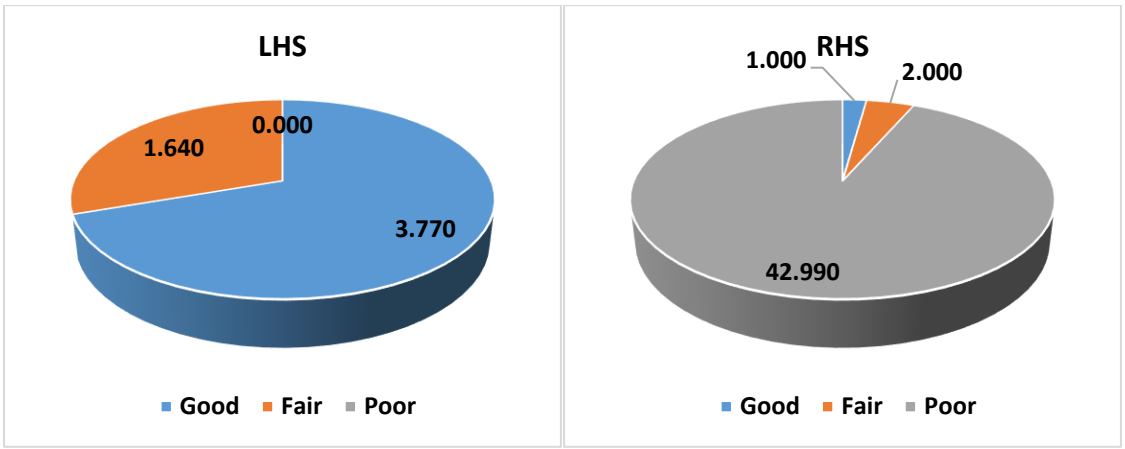


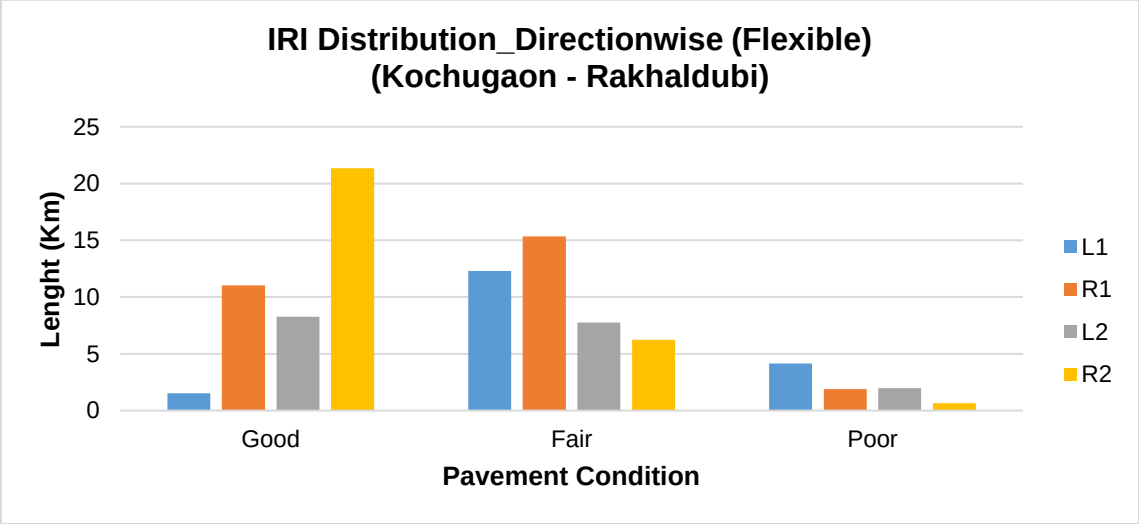
Figure 1.1: Summary of Pavement Distress

1.3.1.3 Pavement Roughness

The summary of Roughness values are presented in table below.

Table 1.3: Kochugaon - Rakhaldubi Section: Summary of Pavement Roughness

Condition	BI (mm/km)	LHS				RHS			
		Inner (L1)		Outer (L2)		Inner (R1)		Outer (R2)	
		Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)
Flexible Pavement									
Good	<1800	1.540	8.6	8.270	45.9	11.020	39.0	21.360	75.6
Fair	1800-2400	12.300	68.3	7.750	43.1	15.340	54.3	6.250	22.1
Poor	>2400	4.160	23.1	1.980	11.0	1.900	6.7	0.650	2.3
Length (km)		18.000	100.0	18.000	100.0	28.260	100.0	28.260	100.0
Rigid Pavement									
Good	<2000	0.000	0.0	1.050	2.4	2.000	5.9	3.000	8.8
Fair	2000-2400	15.040	33.8	20.940	47.1	5.580	16.4	6.600	19.4
Poor	>2400	29.410	66.2	22.460	50.5	26.410	77.7	24.390	71.8
Length (Km)		44.450	100.0	44.450	100.0	33.990	100.0	33.990	100.0



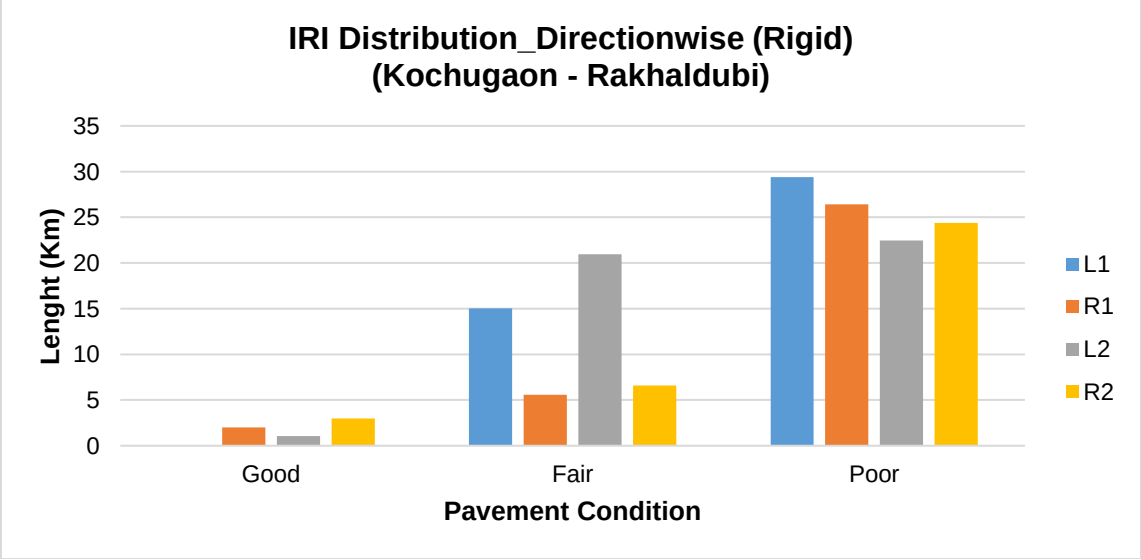
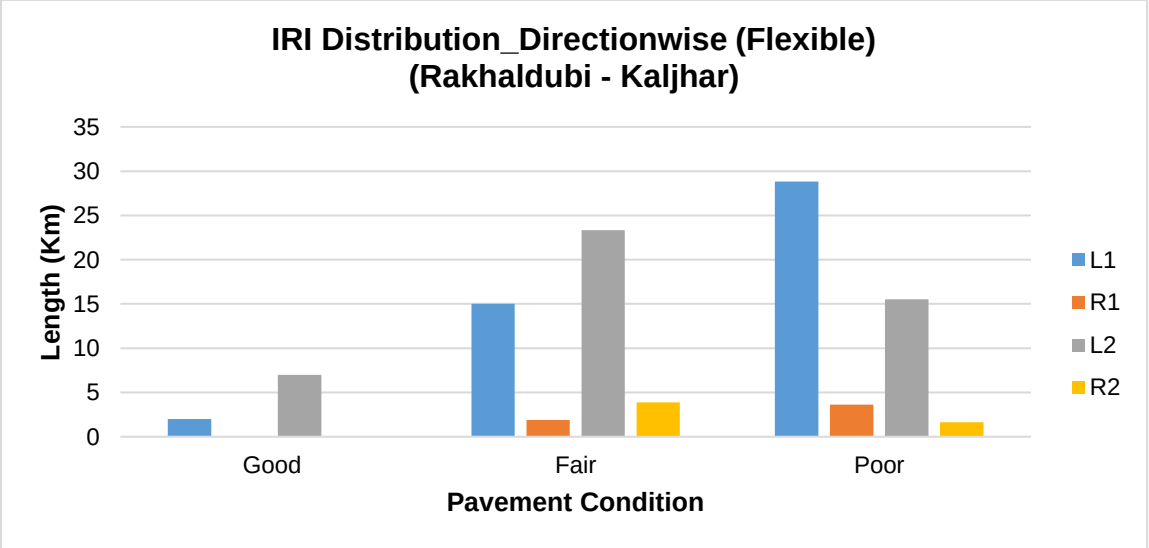
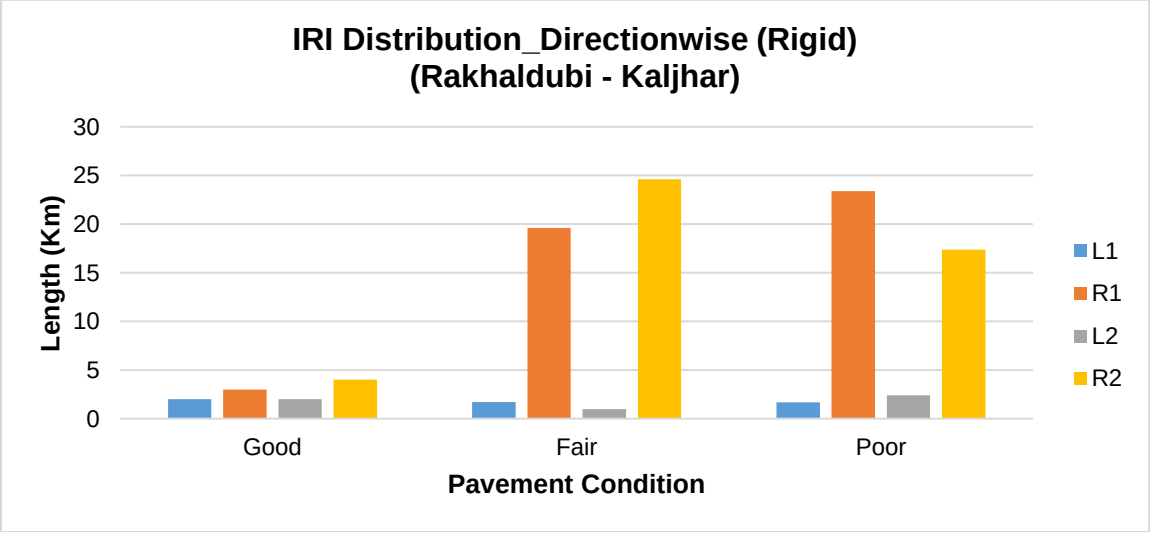


Table 1.4: Rakhaldubi - Kaljhar Section: Summary of Pavement Roughness

Condition	BI (mm/km)	LHS				RHS			
		Inner (L1)		Outer (L2)		Inner (R1)		Outer (R2)	
		Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)
Flexible Pavement									
Good	<1800	2.000	4.4	7.000	15.3	0.000	0.0	0.000	0.0
Fair	1800-2400	15.000	32.7	23.330	50.9	1.890	34.3	3.890	70.6
Poor	>2400	28.840	62.9	15.510	33.8	3.620	65.7	1.620	29.4
Length (km)		45.840	100.0	45.840	100.0	5.510	100.0	5.510	100.0
Rigid Pavement									
Good	<2000	2.000	37.0	2.000	37.0	3.000	6.5	4.000	8.7
Fair	2000-2400	1.720	31.8	1.000	18.5	19.610	42.6	24.610	53.5
Poor	>2400	1.690	31.2	2.410	44.5	23.380	50.8	17.380	37.8
Length (Km)		5.410	100.0	5.410	100.0	45.990	100.0	45.990	100.0





1.3.1.4 Rutting

Rutting in pavement as captured during NSV survey are given below separately.

Table 1.5: Kochugaon - Rakhaldubi Section: Summary of Pavement Rutting

Condition	Rutting, mm	LHS				RHS			
		Inner		Outer		Inner		Outer	
		Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)
Good	< 5	2.830	15.7	13.120	72.9	2.830	15.7	13.120	72.9
Fair	5 to 10	13.670	75.9	4.780	26.6	13.670	75.9	4.780	26.6
Poor	> 10	1.500	8.3	0.100	0.6	1.500	8.3	0.100	0.6

Table 1.6: Rakhaldubi - Kaljhar Section: Summary of Pavement Rutting

Condition	Rutting, mm	LHS				RHS			
		Inner		Outer		Inner		Outer	
		Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)
Good	< 5	5.110	11.1	22.060	48.1	0.520	9.4	5.010	90.9
Fair	5 to 10	25.380	55.4	22.280	48.6	4.610	83.7	0.420	7.6
Poor	> 10	15.350	33.5	1.500	3.3	0.380	6.9	0.080	1.5

Observations:

The condition of pavement in respect of pavement rutting is fair to poor in most of the stretches, and there will be further increase of rut depth if any delay in rectifying these defects through timely periodic maintenance and hence the areas showing these higher order rut depth needs to be rectified immediately.

1.3.2 Test Pit Investigations

Kochugaon - Rakhaldubi Section:

The subgrade soils are generally consistent throughout the project road and is predominantly Silty sand with clayey sands of dual in nature and Silty sands. Because of this soil type, Liquid Limit (LL) is ranging between 20-32 %, and these values are within the limit as per MoRTH specifications (<50%). The obtained maximum Plasticity Index of the subgrade soils is NP-7.0 % and the degree of free swell is 0.0-15.0 %. All the measured PI and FSI values are also within the acceptable limits as per MoRTH guidelines of 25% and 50% respectively.

Further, the MDD values is ranging between 90.9 % - 98.9 %. The 4-days soaked CBR and is ranging from 7.2 % to 8.4 % with an average value of 7.8 %, which is in line with design CBR adopted during 4-lane construction.

Rakhaldubi - Kaljhar Section:

The subgrade soils are generally consistent throughout the project road and is predominantly Gravels and clayey sands. Because of this soil type, Liquid Limit (LL) is ranging between 24-33 %, and these values are within the limit as per MoRTH specifications (<50%). The obtained maximum Plasticity Index of the subgrade soils is NP-10 % and the degree of free swell is 0.0-25.0 %. All the measured PI and FSI values are also within the acceptable limits as per MoRTH guidelines, of 25% and 50% respectively.

Further, the MDD values is ranging between 91.31 % - 97.98 %. The 4-days soaked CBR and is ranging from 6.50 % to 7.90 % with an average value of 7.60 % which is in line with design CBR adopted during 4-lane construction.

1.3.3 Axle Load Survey

Axle load survey has been conducted in compliance with IRC 37 2018 for 24 hours in both directions at the existing toll plaza locations. Obtained VDF values comparing the values adopted at the time of pavement design during construction summarized in table below.

Table 1.7: Vehicle Damage Factors (VDF)

Toll Plaza	Direction	Vehicle Damage factors				
		Bus	LCV	2-Axle	3-Axle	MAV
Patgaon (km 49+600)	Kochugaon-Guwahati (LHS)	1.37	1.40	3.08	5.72	13.84
	Guwahati-Kochugaon (RHS)	0.60	1.14	2.56	5.36	8.37
Dahalapara Toll Plaza (Km.971+200)	Kochugaon-Guwahati (LHS)	1.44	1.16	2.88	5.55	14.83
	Guwahati-Kochugaon (RHS)	0.91	0.81	2.19	4.89	8.11

1.3.4 Falling Weight Deflectometer

Remaining Life Estimation for Flexible Pavement

The detailed remaining life analysis is done using 90 percent reliability equation of IRC: 115-2014 is presented in tables below for LHS and RHS carriageway.

S. No	Chainage		15th Percentile E Value			Obtained strains through IITPAVE		Remaining Life of Existing Pavement (MSA)		
	From	To	Bituminous Layer	Granular Layer	Subgrade	Fatigue Strain (mm)	Rutting Strain (mm)	Fatigue Residual Life	Rutting Residual Life	Remaining Life
Kochugaon - Rakhaldubi Section: LHS										
1	30.500	31.990	1111.14	80.28	93.00	0.0001868	0.0001788	56.90	1379.94	56.90
2	37.990	43.100	804.39	73.86	69.28	0.0002012	0.0002165	56.17	579.63	56.17
3	47.480	49.000	1679.08	118.94	90.05	0.0001486	0.0001699	97.39	1739.37	97.39
4	49.000	52.010	1124.01	77.41	74.77	0.0002208	0.0002197	29.40	542.33	29.40
5	62.020	63.730	540.65	77.12	69.50	0.0003111	0.0002896	14.47	155.01	14.47
6	78.130	78.920	491.70	73.54	64.75	0.0003361	0.0002968	11.62	138.68	11.62
7	83.180	84.000	567.07	78.81	79.70	0.0002979	0.0002458	16.45	326.02	16.45
8	84.000	85.810	632.09	74.63	59.04	0.0002865	0.0002900	17.45	154.04	17.45
9	89.690	91.000	1155.40	156.63	100.58	0.0001824	0.0001814	60.38	1292.51	60.38
10	91.000	92.671	578.75	80.16	51.75	0.0003610	0.0003556	7.66	61.11	7.66
Kochugaon - Rakhaldubi Section: RHS										
1	30.000	30.510	789.96	90.49	104.04	0.0001885	0.0001795	73.51	1355.71	73.51
2	43.070	47.440	771.74	156.74	104.00	0.0001909	0.0001769	71.39	1448.42	71.39
3	52.100	53.250	720.92	172.03	104.00	0.0001913	0.0001972	75.05	885.11	75.05
3	55.100	56.000	868.29	179.56	103.99	0.0001697	0.0001858	102.04	1159.44	102.04
4	56.000	64.000	839.08	117.51	103.95	0.0002149	0.0001972	41.93	885.11	41.93
5	65.000	72.000	981.72	138.17	103.95	0.0001965	0.0001908	51.94	1027.92	51.94

S. No	Chainage		15th Percentile E Value			Obtained strains through IITPAVE		Remaining Life of Existing Pavement (MSA)		
	From	To	Bituminous Layer	Granular Layer	Subgrade	Fatigue Strain (mm)	Rutting Strain (mm)	Fatigue Residual Life	Rutting Residual Life	Remaining Life
6	73.000	78.120	1125.25	97.79	103.22	0.0001939	0.0001763	48.69	1470.91	48.69
7	80.930	83.200	1017.04	125.11	103.82	0.0001929	0.0001864	54.16	1142.61	54.16
8	92.330	92.671	1231.94	188.19	104.04	0.0001493	0.0001713	124.57	1675.84	124.57
Rakhaldubi - Kaljhar Section: LHS										
1	961.500	965.320	703.21	89.31	103.86	0.0002468	0.0001841	28.46	1208.77	28.46
2	970.000	970.890	766.63	156.36	103.99	0.0002680	0.0002162	19.19	583.29	19.19
3	971.600	974.000	1083.35	245.03	103.86	0.0001817	0.0001841	64.76	1208.77	64.76
4	974.000	976.000	567.76	126.95	104.00	0.0003456	0.0002370	9.22	384.61	9.22
5	976.000	992.000	948.38	384.61	103.87	0.0001592	0.0001603	121.33	2264.19	121.33
6	992.000	995.000	1264.98	190.33	104.04	0.0001871	0.0001939	50.62	955.49	50.62
7	995.000	996.000	930.62	354.33	103.85	0.0001597	0.0001788	121.81	1379.94	121.81
8	996.000	1000.000	957.75	171.61	103.91	0.0002128	0.0002005	38.91	820.96	38.91
9	1000.000	1008.000	914.03	213.86	103.95	0.0001922	0.0001903	60.17	1040.23	60.17
10	1008.000	1009.000	1560.93	217.02	103.99	0.0001415	0.0001515	125.39	2924.71	125.39
11	1009.000	1012.810	939.14	185.90	103.78	0.0002012	0.0001767	49.21	1455.87	49.21
Rakhaldubi - Kaljhar Section: RHS										
1	965.140	966.000	873.03	259.89	103.37	0.0001773	0.0001512	85.66	2951.11	85.66
2	966.000	970.000	1089.90	195.02	103.93	0.0001810	0.0001541	65.40	2707.56	65.40
3	970.000	970.020	593.98	111.08	103.75	0.0003232	0.0001906	11.51	1032.82	11.51
4	1000.920	1001.630	284.24	74.79	67.79	0.0002250	0.0003150	88.40	105.88	88.40

FWD data Analysis for Rigid Pavement

The range of Elastic Modulus, other PQC parameters and their percentage of length and Load Transfer Efficiency (LTE) is presented in table below.

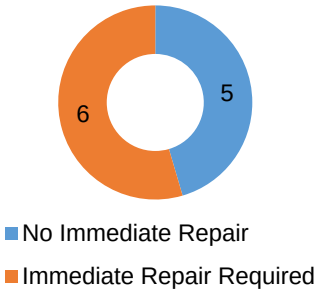
Table 1.8:Summary of Flexural Strength and Elastic Modulus

Pavement layer	Range	Percentage of Project Road	
		LHS	RHS
Kochugaon - Rakhaldubi Section			
Elastic Modulus of PQC Layer (Mpa)	> 30000	29.17%	33.67%
	30000 - 10000	70.83%	66.33%
Flexural Strength of PQC Layer (Mpa)	> 4.5	16.27%	23.76%
	4.5 - 3.0	59.50%	57.43%
	<3.0	24.23%	18.81%
Rakhaldubi - Kaljhar Section			
Elastic Modulus of PQC Layer (Mpa)	> 30000	22.22%	27.94%
	30000 - 10000	77.78%	72.06%
Flexural Strength of PQC Layer (Mpa)	> 4.5	16.67%	14.71%
	4.5 - 3.0	55.56%	63.97%
	<3.0	27.78%	21.32%

1.3.5 Structure Inventory and Condition Survey

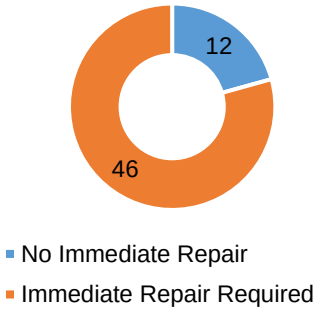
There are deficiencies noted in the structures and relevant repair-rehabilitation measures are suggested. Requirement of immediate repairs for major structures (length > 60m) and minor structures are presented below.

Major Structures



- Repairing of honeycombing using low viscous injection grouting
- Repairing of cracks using low viscous injection grouting
- Repairing of pier caps cracks using low viscous injection grouting and confining it with carbon fiber rap
- Replacement of damaged bearings.
- Treating all spalling surface as per CPWD guidelines.

Minor Structures



- Repairing of major work of honeycombing using low viscous injection grouting
- Repairing of cracks using low viscous injection grouting
- Repairing of pier caps cracks using low viscous injection grouting and confining it with carbon fiber rap
- Replacement of Expansion joint
- Treating all spalling surface as per CPWD guidelines.
- Bearing Replacement

1.4 Key Technical Issues

1.4.1 Deviations from Schedule-A

TC team has verified the provisions given in original schedule A while doing the inventory and condition survey of the project roads. Later it was found that few deviations initially found were not there in the revised schedule A. These deviations are mainly regarding type of rigid/flexible pavement, number of bus-bays, number of culverts and classification of underpasses.

1.4.2 Deviations from Schedule-B

Major deviations from the provisions of schedule-B along with assessment for the same by TC team are given below.

S. No	Project Elements	Schedule B Provisions	TDD Assessment
1	Flexible Pavement	Improvements for flexible pavement in the both the project corridors has been proposed with 30mm BC.	As noted from technical surveys and detailed reconnaissance, there is significant drop in quality and routine maintenance and hence

S. No	Project Elements	Schedule B Provisions	TDD Assessment
			improvement may be required with 30mm BC, 40mm BC and strengthening by 40mm BC+50mm DBM where the sections are structurally inadequate to cater for design traffic.
2	Rigid Pavement	Improvement proposals for rigid pavement consists of Panel replacement, repair of corner breaks and spalling of joints	It observed that more number of panels requires rehabilitation and repairs than schedule B provisions. It also requires the replacement of joint sealant, repair of joint separation, pop out, ravelling etc.
3	Service Road	No improvement proposal for service road pavement was mentioned	As there is no maintenance works done so far for the service road pavements and hence proposed with 30mm BC as a periodic immediate maintenance works to improve the serviceability.
4	Structures	General repair works are proposed like epoxy grouting for treatment of spalling of concrete, clearing of vegetation, cleaning of drainage spouts, removal of debris from expansion joints, providing RCC crash barrier, filling pot holes etc.	Specific rehabilitation and repair work proposed for the structures in distressed conditions as observed during condition survey. These works are like repair of cracks and honeycombing in superstructure & substructure using low viscus injection grouting, repairing of pier cap cracks using low viscus injection grouting and confining with carbon wrap, Lubrication of bearings and replacement of expansion joints & bearings.

1.4.3 Under-construction Structures

NHAI has indicated in revised sch A that it is going to construct 3 flyovers, 1 trumpet interchange, 2 LVUPs. It also states that construction of these structures shall be completed by September 2024 and shall be operated and maintained by the TOT concessionaire. It is further mentioned that works such as service road construction, junction improvement, minor bridge, culverts etc. will also constructed by NHAI and same shall be maintained by TOT concessionaire.

There is no more detail available for the above work for accurate assessment of the maintenance cost of above assets during the entire concession period. As these assets are to be constructed and handed over by September 2024, NHAI should have at least the basic layout/planning if not the detailed design/drawings. Same may be made available for better understanding as these are to be maintained by the concessionaire for the entire concession period.

1.5 Capital Expenditure (CapEx) Requirement

1.5.1 New Construction

Schedule B of each stretch specifies the requirements of new construction which the concessionaire has to construct after the appointment date.

New construction Scope specified for each stretch is tabulated below:

Table 1.9: New Construction Requirements

S. No.	Description		Unit	Kochugaon to Rakhaldubi	Rakhaldubi to Kaljhar
1	Service Roads/ Slip Roads		Km	-	-
2	Exit/ Entry Arrangements	New	No	-	-
		Existing	No	-	-

S. No.	Description		Unit	Kochugaon to Rakhaldubi	Rakhaldubi to Kaljhar
3	Drain Improvement/ Proposal		Km	-	-
4	Pedestrian Guard Rail		Km	-	-
5	Truck Lay-bays		No	-	-
6	Toilet Block in Truck Lay-bays		No	-	-
7	Median Opening	New Opening	Km	0.02	0.04
		Close Opening	Km	0.12	0.09
8	Storage lane on existing Median Opening		Km	0.02	0.025
9	Rainwater Harvesting		No	124	103
10	Blackspot Rectification		No	2	9
11	At grade Intersections	Redesign	No	5	4
		New	No	9	8
12	Curve Improvements				
i)	Chevron Sign		No	521	86
ii)	No Overtaking		No	59	61
iii)	Curve Ahead		No	55	54
iv)	Solar Studs		No	3206	2646
v)	Cats Eye		No	21706	28672
13	Chute Drain in median		Km	-	-
14	Admin Building at Toll Plaza		No	1	-

Time to complete above construction works is 12 months from the Appointed Date.

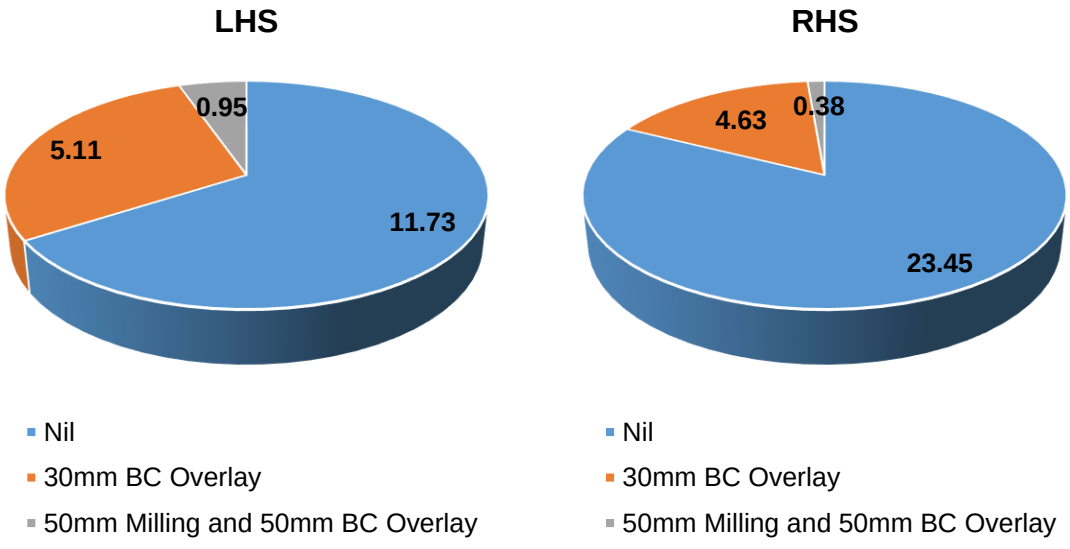
1.5.2 Immediate Maintenance Requirements

1.5.2.1 Pavements

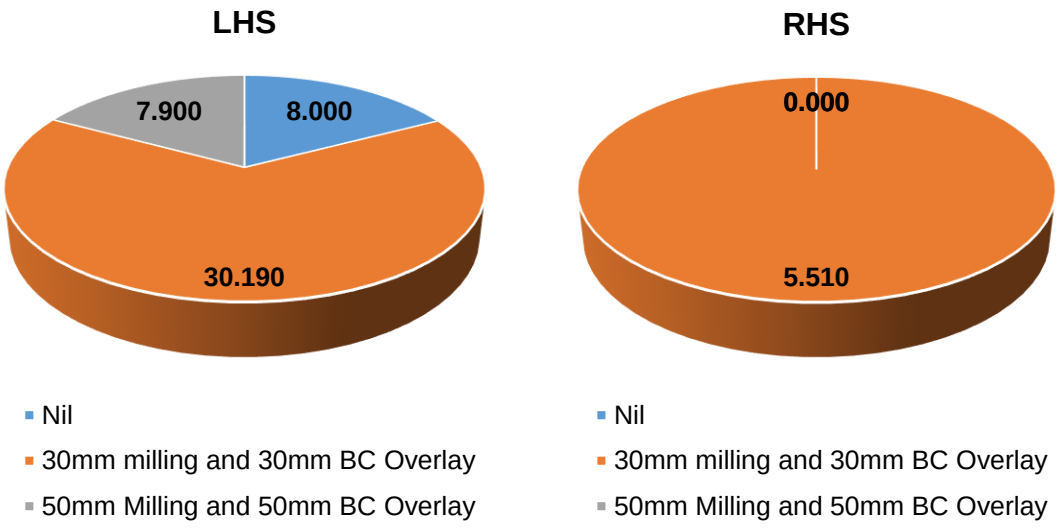
Quantum of pavement rehabilitation for the project length for both flexible and rigid pavements in terms of length in km are presented below:

Flexible Pavement (length in km)

Kochugaon to Rakhaldubi

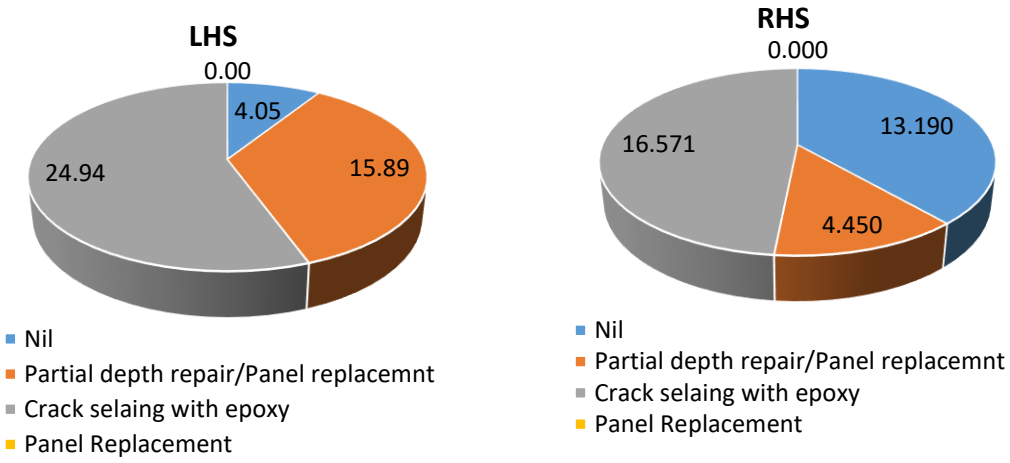


Rakhaldubi to Kaljhar

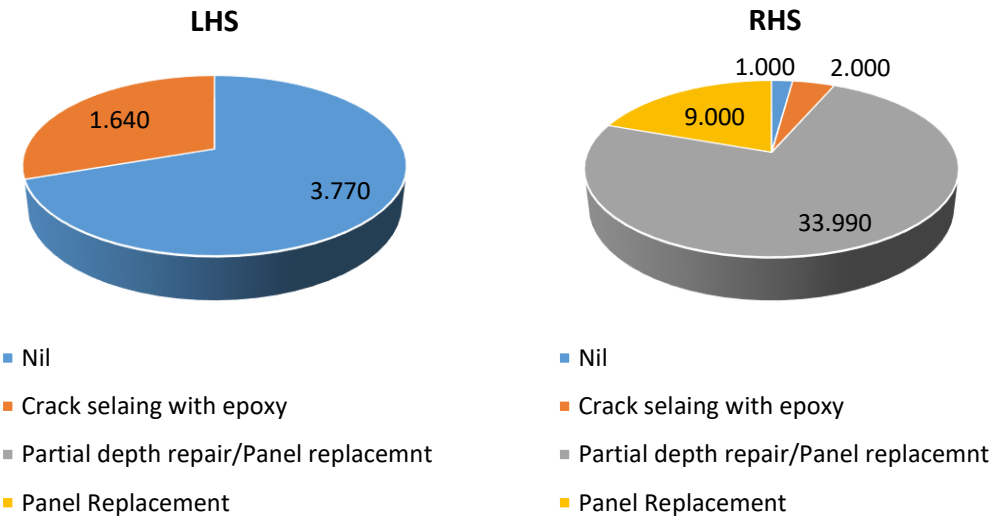


Rigid Pavement (length in km)

Kochugaon to Rakhaldubi



Rakhaldubi to Kaljhar



1.5.2.2 Structures

Immediate maintenance requirements as remedial measures against the identified defects for the structures are given below.

i) Replacement of bearings
ii) Replacement of expansion joints
iii) Cracks repair
iv) Shear cracks repair
v) Repair of honeycombing
vi) Repair of spalling
vii) Repair of exposed reinforcement

Details of above repair works are given in the relevant section of this report.

1.6 O&M Cost Estimation

1.6.1 Recommended MM Cycles for Pavement

Considering the initial pavement design period and crust, remaining life data, anticipated traffic loading during the concession period, and in compliance to the provisions of schedule B, the following cycles of Major maintenance is proposed for satisfactory performance of the pavement during operation period for both functionally and structurally.

Table 1.10: Proposed Major Maintenance Cycles for Balance Concession period

Year of Concession	O & M Year	Kochugaon - Rakhaldubi	Rakhaldubi - Kaljhar	Service Road
1 (Immediate) *As NHAI is doing the immediate maintenance before handing over the asset to NHIT, assessed immediate maintenance requirement is not considered in the cost*	**2023-24**	**Flexible Pavement:** LHS: 40mm BC Overlay for 32% length, 50mm BC overlay for 45% length and 13% with NIL RHS: 40mm BC Overlay for 41% length and 59% length with NIL **Rigid Pavement:** As per the pavement condition and its distress rating as presented in chapter titled Surveys and Investigations.	**Flexible Pavement:** 30mm BC overlay for entire length after milling to a depth of 30mm except for the following stretches where requires strengthening by 50mm BC after milling to a depth of 50mm. LHS: km 970-971, km 974-976, km 980-981, km 996-997 and km 1000-1001 **Rigid Pavement:** As per the pavement condition and its distress rating as presented in chapter titled Surveys and Investigations.	30mm BC for the entire length of service road for all 5 stretches.
7	2029-30	**Flexible Pavement:** 40mm BC Overlay for 80% length and 50mm BC overlay for 20% length **Rigid Pavement:** Sealant replacement for 100% length, 1% for pothole filling and 0.5% for panel replacement. Diamond grinding to improve the riding quality for 100% length.	**Flexible Pavement:** 40mm BC Overlay for 80% length and 50mm BC overlay for 20% length **Rigid Pavement:** Sealant replacement for 100% length, 1% for pothole filling and 0.5% for panel replacement. Diamond grinding to improve the riding quality for 100% length.	30mm BC for the entire length of service road for all 5 stretches.
13	2035-36	**Flexible Pavement:** 40mm BC overlay using RAP from milling for 75% length and 50mm BC overlay using RAP from milling for 25% length **Rigid Pavement**: Sealant replacement for 100% length, 0.5% for pothole filling and 0.5% for panel replacement. Diamond grooving to improve the skid resistance for 100%	**Flexible Pavement:** 40mm BC overlay using RAP from milling for 75% length and 50mm BC overlay using RAP from milling for 25% length **Rigid Pavement**: Sealant replacement for 100% length, 0.5% for pothole filling and 0.5% for panel replacement. Diamond grooving to improve the skid resistance for 100%	30mm BC for the entire length of Service road except for the stretches where capacity augmentation construction is in progress.
19	2041-42	**Flexible Pavement:** 40mm BC overlay for full length **Rigid Pavement:** Sealant replacement for 100%, 0.5% for panel replacement and 0.5% for repair of corner breaks.	**Flexible Pavement:** 40mm BC overlay for full length **Rigid Pavement:** Sealant replacement for 100%, 0.5% for panel replacement and 0.5% for repair of corner breaks.	30mm BC for the entire length of service road for all 5 stretches.

1.6.1.1 Structures

As no NDT reports are available and neither design documents stating design life are available it's not feasible to assess life expectancy of existing structures. However, based on the past experiences regarding working life of different structure elements, replacement cycles and major maintenance cost of structures is analysed based on the following:

- Wearing coat replacement every 6th years
- Expansion joint replacement every 12th years
- Elastomeric bearing replacement every 12th years
- POT PTFE Bearing every 20th years

1.6.2 Estimate (CapEx and O&M)

1.6.2.1 Capital Expenditure (CapEx) Requirement

Cost of capital expenditure (CapEx) are presented below.

Table 1.11: Cost of Capital Expenditure (CapEx)

Description	INR in Crores (EGIS Cost)	
	Kochugaon - Rakhaldubi	Rakhaldubi - Kaljhar
Rigid Pavements	-	-
Junction Improvement	3.812	4.105
Median Improvement	0.146	0.207
Service Road Improvement	2.439	0.213
Black Spot	0.227	1.780
Road Lighting	16.707	18.335
Road Safety Furniture	2.874	1.645
Structure Improvement & Repair	-	-
Toll Plaza	1.616	2.694
Miscellaneous	4.851	3.654
Total without GST	**32.672**	**32.634**
Total including GST (18%)	**38.55**	**38.51**

1.6.2.2 Cost of Operation & Maintenance

Cost of Operation & Maintenance per annum are presented below.

Table 1.12: Cost of Operation & Maintenance (per annum)

Description	INR in Crores (EGIS Cost)	
	Kochugaon - Rakhaldubi	Rakhaldubi - Kaljhar
Tolling Operations	3.24	4.21
Incident Management	2.23	2.21
Routine Maintenance	3.28	3.14
Repairs	1.98	1.67

Description	INR in Crores (EGIS Cost)	
	Kochugaon - Rakhaldubi	Rakhaldubi - Kaljhar
ATMS	-	-
Admin Expenses	4.48	4.48
Insurance	1.43	1.05
Total	**16.64**	**16.76**

1.6.2.3 Periodic Maintenance

Cost of Periodic Maintenance (Base year 2024) including GST, but excluding escalation are presented below.

Table 1.13: Cost of Periodic Maintenance (Kochugaon – Rakhaldubi)

Year	Periodic Maintenance (INR in Crores)				
	Functional +Structural overlay MCW+ S/R	Major Maintenance of Rigid Pavement	Replacement of ATMS	Replacement of TMS	Structure specified repairs
2023-2024					
2024-2025					
2025-2026					
2026-2027					
2027-2028					
2028-2029					
2029-2030	46.11	15.13			25.34
2030-2031				0.95	
2031-2032					
2032-2033					
2033-2034					
2034-2035					
2035-2036	38.80	8.87			8.37
2036-2037					
2037-2038				1.91	
2038-2039					
2039-2040					
2040-2041					
2041-2042	44.93	4.28			8.37
2042-2043					
2043-2044					
Total	**129.84**	**28.28**	**-**	**2.86**	**42.08**
Grand Total					**203.04**

Table 1.14: Cost of Periodic Maintenance (Rakhaldubi - Kaljhar)

Year	Periodic Maintenance (INR in Crores)				
	Functional +Structural overlay MCW+ S/R	Major Maintenance of Rigid Pavement	Replacement of ATMS	Replacement of TMS	Structure specified repairs
2023-2024					
2024-2025					
2025-2026					
2026-2027					
2027-2028					
2028-2029					
2029-2030	43.92	21.42			21.57
2030-2031				1.59	
2031-2032					
2032-2033					
2033-2034					
2034-2035					
2035-2036	28.40	21.07			-
2036-2037					
2037-2038				3.18	
2038-2039					
2039-2040					
2040-2041					
2041-2042	32.31	21.07			-
2042-2043					
2043-2044					
Total	**104.63**	**63.56**	**-**	**4.77**	**21.57**
Grand Total					**194.51**

1.7 Conclusion

The 4-lane construction of project highway has been completed on EPC basis and at present toll is being collected by Toll Collection Agency appointed by NHAI. The 4-lane construction was completed on different dates during 30.06.2008 being the first completed stretch (Pachim Nagaon-Nagaon (Borghat) Section) whereas 31.08.2016 is the date of lastly completed stretch (Kochugaon - Rakhaldubi Section). Even after 7-14 years of completion of 4-lane construction, there is no such major maintenance works has been carried out neither for pavement nor structure/other element of the highway, there is a drop in asset quality and condition. it appears that some of the heavily distressed are being repaired manually by applying thin bituminous overlays. As part of present study, various physical testing and visual site inspections were conducted to evaluate the asset condition and to establish the required maintenance and rehabilitation measures/decisions. Based on the site reconnaissance, it is appraised that majority of the locations, the LHS carriageway is distressed due to overloading of truck traffic compared to RHS where distresses potholes, cracks, patches, joint failures are noted predominantly. Based on the results of physical testing, condition assessment, review of available reports/data, analysis of remaining life data, the project stretch would require immediate overlay and accordingly suitable major maintenance and rehabilitation

measures are suggested under immediate major maintenance requirement. The period maintenance by functional/structural overlays are required at every 6th year would be sufficient to keep the project stretch in good condition and hence the suitable measures of major maintenance for periodic renewals as required during the concession period has also been suggested.

Schedule B stipulates the obligation of immediate maintenance which is to be done by the incoming Concessionaire. However, NHAI has represented to NHIT that they will undertake the immediate maintenance themselves, confirming to CA obligations, before handing over the asset to NHIT.

Based upon the site visit for assessment of condition of CD structures including MJB, MNBs, ROB, VUPs, Culverts and toll plaza buildings in the project corridor and observations submitted in various chapters of this report it is concluded that there are requirements of major repairs in few major structures in terms of repairs of honeycombing, repair of cracks, replacement of damaged bearings and treatment of spalling. Repair and rehabilitation measures are proposed in this report, and it is advised to conduct NDT test before doing repair-rehabilitation works to verify these rehabilitation proposal.

Section 2: Introduction

2.1 Background

NHAI has set up an Infrastructure Investment Trust namely National Highways Infra Trust ("InvIT") and is acting as its Sponsor to the said InvIT. National Highways Infra Investment Managers Private Limited ("NHIIMPL") has been appointed as the Investment Manager to the InvIT.

National Highways Infra Projects Private Limited ("NHIPPL"), a wholly owned subsidiary of InvIT has entered into concession agreements with NHAI for 5 road projects. Currently, NHIPPL is operating and managing these 5 road projects under the supervision of InvIT & NHIIMPL. In addition, InvIT is in the process of acquiring 3 additional road projects from NHAI subject to requisite approvals.

Further, InvIT would be evaluating acquisition opportunities going forward. NHAI has recently offered 5 additional road projects (with aggregate length of ~470 km) to InvIT for potential acquisition subject to requisite approvals. In this context, NHIIMPL (on behalf of InvIT & NHIPPL) has created a panel of Technical Consultants for undertaking technical due diligence of its assets and acquisition opportunities.

NHIIMPL appointed M/s Egis India Consulting Engineers Private Limited, as Technical Consultant to conduct the due diligence on the proposed Assets. The Letter of Empanelment (LOE) was received on 3rd November 2022 and Letter of Award (LoA) for the subject Project was received on 11th November 2022 by Egis India and the services commenced immediately thereafter.

The project stretches detail as per LoA are listed below.

Table 2.1: Detail of Project Stretches

Sr. No.	Stretches	Toll Plaza	NH No.	Length (km)
1	Kochugoan to Kaljhar	Patgaon & Dahalpura	NH-27	141.90
2	Kaljar to Amingaon (Guwahati)*	Madanpur & Galia	NH-27	91.00
3	Amingaon (Guwahati) to Nagaon	Nazirakhat & Raha	NH-27	132.19
Total				**365.09**

* *Before the commencement of field surveys, NHIIMPL informed on 21st November 2022 that Galia toll plaza is being removed from their list. The stretch falls under Galia toll plaza jurisdiction is from km 1013+000 to km 1040+300. Consultant was instructed not to commence any work on this portion of road.*

2.2 Objectives

The main objectives of the present assignment is to

review project documents and understanding schedule B requirements for improvement works for the assessment of Capex and Opex during the concession period.

1. conduct field investigations to assess the existing asset condition and future deterioration.
2. validate executed works with respect to schedule A and assessment of improvement works

3. review quality of construction based on available data, design and drawings.
4. undertake designs for rehabilitation requirements of different assets based on field investigation data and available documents.
5. assess operation and maintenance cost including major maintenance expected to be incurred during the concession period.

2.3 Technical Consultant Team

The Technical Consultant commenced its services from 14th November 2022 and the team comprising of Highway, Pavement & Structure Engineers and Experts have conducted site visit from 22nd November 2022 to 15th December 2022 to appreciate the project corridor characteristics. This report highlights the findings from visual assessment, available documents shared with the consultant, discussion with NHAI officials involved with the maintenance and operation of project road at site and other local enquiries. Analysis of data as obtained from various survey and investigations conducted at site are present in this report.

Date-wise various field activities at site are shown below in bar chart form in **Figure 2.1.**

Name of Surveys	Days																		
	22-Nov	23-Nov	24-Nov	25-Nov	26-Nov	27-Nov	28-Nov	29-Nov	30-Nov	01-Dec	02-Dec	03-Dec	04-Dec	05-Dec	06-Dec	07-Dec	08-Dec	09-Dec	30-Dec
FWD Survey																			
NSV Survey																			
Videogaphic Survey																			
Axle Load Survey																			
Test Pits																			
MBIU for Major Structures (Length > 60m)																			

Figure 2.1: Project ActivitiesSchedule

2.4 Disclaimer

The information and documents received from the Client are being reviewed by the Consultant and have been used for preparing this report. Due care has been taken while reproduction of the information where required to avoid typographical or other errors.

2.5 Structure of the Report

The report has been structured into nine sections as follows:

Section 1: Executive Summary
Section 2: Introduction
Section 3: Inventory and Condition Assessment
Section 4: Surveys and Investigations

Section 5: Review of Documents
Section 6: Capital Expenditure (CapEx) Requirement
Section 7: Operation & Maintenance
Section 8: Analysis & Comparisons with Seller Data
Section 9: Conclusions

Section 3: Inventory and Condition Assessment

3.1 General

The Technical Consultant visited site from 22nd November 2022 to 15th December 2022. The important aspects of the project road were noted in the detailed site reconnaissance along with various field investigations. These included general description about the project road, site features, structures, junctions, pavement characteristics, road safety. Field investigation for NSV, FWD test, axle load survey, trail pits, MBIU and drone videography survey were also conducted by Technical Consultant to assess the present condition of the project road. This chapter elaborates various findings of these surveys and studies conducted by the Technical Consultant team in different sections.

3.2 Project Corridor

The project stretches details are listed below:

Table 3.1: Detail of Project Stretches

Sr. No.	Name of Stretches	Toll Plaza	Chainage (Km)		Length (km)
			From	To	
1	Kochugaon - Rakhaldubi	Patgaon	30+000	92+671/962+100	62.671
2	Rakhaldubi - Kaljhar	Dahalpura	961+500	1013+000	51.500
Total					**124.171**

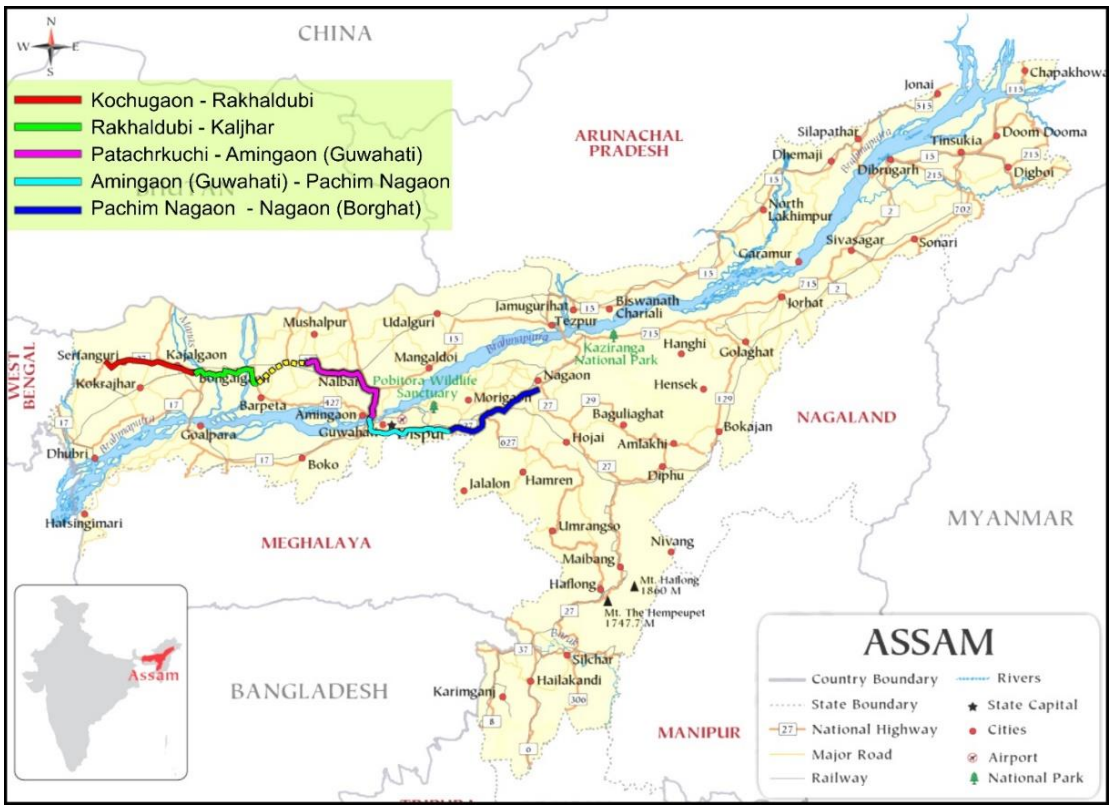


Figure 3.1: Project Location Map

3.3 Project Brief

3.3.1 Salient Features

Chainage (Km)		Contractor During 4 Lanning	Date of Commencement	Date of Completion
From	To			
Kochugaon - Rakhaldubi Section				
30+000	60+000	M/s Gayatri-ECI (JV)	19.08.2005	31.03.2016
60+000	92+671	M/s Gayatri-ECI (JV)	19.08.2005	31.08.2016
Rakhaldubi - Kaljhar Section				
961+500	1013+000	M/s Punj Llyod	03.11.2005	31.03.2014

Details of Assets:

S. No.	Description			Kochugaon - Rakhaldubi	Rakhaldubi - Kaljhar
1	Total Project Length (km)			62.671	51.500
2	Service Roads/ Slip Roads (km)			16.140	13.270
3	Pavement (km)	Flexible	LHS	18.000	46.09
			RHS	28.260	5.620
		Rigid	LHS	44.450	5.410
			RHS	33.990	45.88
4	Bus Shelters (no.)			-	8
	Bus bays with Shelters (no.)			21	8
	Bus bays (no.)			9	4
5	Truck Lay-bays (no.)			-	-
6	Toll Plaza (no.)			1	1
7	Major Bridge (no.)			6	4
8	Minor Bridge (no.)			42	16
9	ROB/RUB			2	-
10	Culverts (no.)	Box		45	-
		Slab		13	34
		Pipe		4	-
11	At grade Intersections(no.)	Major		4	6
		Minor		98	94
12	Underpasses(no.)	VUP/SVUP		1	-
		LVUP		-	-
		PUP		3	2
13	Flyover (no.)			-	-
14	Viaduct (no.)			-	-

3.4 Road Inventory and Condition Survey

3.4.1 Road Inventory

The Road Inventory is conducted to assess and list out the existing features of the project corridor and to validate that project road is conforming to the requirements of CA. It covers all the existing physical features such as terrain, land use, carriageway surfacing type, shoulder width, junctions, water bodies, roadside arboriculture, general drainage conditions, etc. It was carried out in accordance with the guidelines given in IRC: SP 19-2001, generally by visual means, and supplemented by simple tape measurement.

The road inventory data collected for the project highway is presented in the **Annexure 3.1.**

3.4.2 Terrain

The project highway falls in plain terrain except for the chainage from Km 165+300 to Km 174+900 where it falls in mountainous terrain.

3.4.3 Land Use

The land along the project highway is predominantly agricultural followed by built up, barren, forest, residential and commercial areas. Details of land use are given in the **Table 3.2**.

Table 3.2: Land Use

Description	Kochugaon to Rakhaldubi				Rakhaldubi to Kaljhar			
	Length (km)		%age		Length (km)		%age	
	LHS	RHS	LHS	RHS	LHS	RHS	LHS	RHS
Agriculture	43.664	46.090	69.67%	73.54%	34.779	28.369	67.53%	55.09%
Built-Up Area (Residential/Commercial/ Industrial)	15.903	14.469	25.38%	23.09%	14.062	21.346	27.30%	41.45%
Others (Water Bodies/ Forest etc.)	3.104	2.112	4.95%	3.37%	2.659	1.785	5.16%	3.47%
Total	62.671	62.671	100%	100%	51.500	51.500	100%	100%

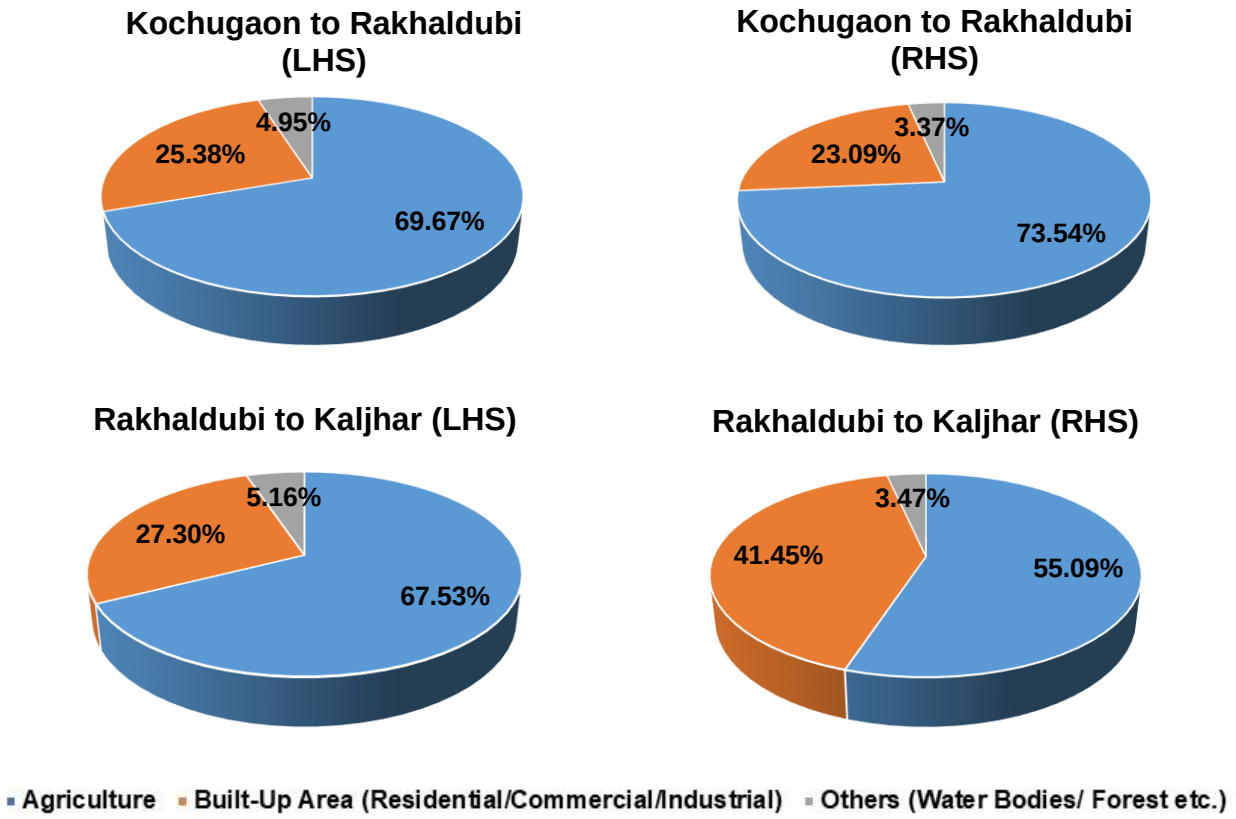


Figure 3.2: Land Use

3.4.4 Main Carriageway

The project highway is a four lane divided carriageway paved shoulder. The carriageway width is 7.25m and paved shoulder is 1.5m all along the project corridor except at toll plaza, Major Bridges and Flyover approaches of Guwahati Bypass. Details are show in **Table 3.3** and **Figure 3.3** below.

Table 3.3: Main Carriageway

Chainage (Km)		Length (Km)	Width (each direction)	Remarks
From	To			
Kochugaon - Rakhaldubi Section				
30+000	49+600	19.600	8.75	
49+600	49+775	0.175	8.75-19.00	Toll Plaza
49+775	92+671	42.896	8.75	
Total Length (km)		**62.671**		
Rakhaldubi - Kaljhar Section				
961+500	970+900	9.400	8.75	
970+900	971+460	0.560	8.75-31.5	Toll Plaza
971+460	1013+000	41.540	8.75	
Total Length (km)		**51.500**		

4 lane Carriageway

4 lane carriageway at Underpasses approaches

Figure 3.3: Main Carriageway

3.4.5 Service Road

Detail of service road are given below.

Table 3.4: Service Road

Service Road (LHS)			Service Road (RHS)		
Chainage (km)		Length (m)	Chainage (km)		Length (m)
From	To		From	To	
Kochugaon (WB Border) - Rakhaldubi					
39+790	40+690	900	39+790	40+690	900
76+270	77+980	1710	76+270	78+110	1840
78+980	80+950	1970	78+880	80+950	2070
80+950	83+130	2180	80+950	83+090	2140
87+240	88+390	1150	87+180	88+460	1280
Total		**7910**	**Total**		**8230**

Service Road (LHS)			Service Road (RHS)		
Chainage (km)		Length (m)	Chainage (km)		Length (m)
From	To		From	To	
Rakhaldubi - Kaljhar					
966+920	967+750	830	967+450	967+030	420
967+950	969+000	1050	968+250	968+030	220
969+570	969+970	400	969+800	969+240	560
977+050	978+620	1570	978+620	976+620	2000
981+580	981+760	180	981+760	980+860	900
991+500	991+680	180	992+510	991+940	570
991+920	992+510	590	1001+820	1001+080	740
1001+080	1001+910	830	1009+190	1008+140	1050
1007+920	1009+100	1180			
Total		**6810**	**Total**		**6460**

Service Road at Km 79+400 RHS

Service Road at Km 966+920 LHS

Figure 3.4: Service Road Carriageway

3.4.6 Towns and Built-Up-Areas

Major town along the project road is Bongegaon. Chainage-wise detail of towns and built-up areas are given below:

Table 3.5: Built Up Areas

Sr. No.	Chainage (km)		Length (m)	Side	Name of Settlement
	From	To			
Kochugaon - Rakhaldubi					
1	39+175	40+400	1225	LHS	Sarfanguri
2	39+250	40+800	1550	RHS	Kolobari
3	47+340	47+700	360	LHS	Patgaon
4	69+790	70+065	275	LHS	Kashikotra
5	76+250	77+000	750	LHS	Kajal Gaon
6	76+300	77+000	700	RHS	Kajal Gaon
7	77+330	77+560	230	RHS	Monglagaon
8	78+820	83+760	4940	LHS	Bongaigaon
9	78+820	83+760	4940	RHS	Bongaigaon
10	84+100	84+350	250	RHS	Dholaigaon
11	87+600	87+850	250	LHS	Nayapare
12	87+850	88+270	420	RHS	Nayapare

Sr. No.	Chainage (km)		Length (m)	Side	Name of Settlement
	From	To			
Rakhaldubi - Kaljhar					
1	962+670	962+900	230	LHS	Rakhaldubi
2	965+790	966+530	740	RHS	Kalgachia
3	981+020	981+310	290	RHS	Borbila
4	991+930	992+470	540	LHS	Sorbhog
5	991+970	992+490	520	RHS	Sorbhog
6	1000+250	1000+470	220	LHS	Balabhita
7	1000+080	1000+470	390	RHS	Balabhita
9	1001+010	1002+240	1230	RHS	Simlaguri
8	1001+310	1001+720	410	LHS	Simlaguri
10	1006+260	1007+430	1170	RHS	Howly
11	1007+220	1007+560	340	LHS	Howly
12	1008+270	1008+470	200	RHS	Howly

3.4.7 Major and Minor Junctions

3.4.7.1 Major Junction

There are 10 nos. of Major Junction. Some major junctions are with the channelizer Islands. Details of the major junction are given in the **Table 3.6** below:

Table 3.6: List of Major Junction

Sr. No.	Chainage (Km)	Type of	Side	Cross Road leads to	
				LHS	RHS
Kochugaon to Rakhaldubi					
1	60+260	X	BHS	Bhog Amguri	Kokrajhar
2	65+950	Y	LHS	Laorapara	
3	83+130	X	BHS	Bongaigaon	Birchilarai
4	92+671	T	LHS	Hapachara	
Rakhaldubi to Kaljhar					
1	962+200	T	LHS	Chaprakata	
2	980+830	T	RHS		Manikpur
3	982+410	Y	LHS	Patiladaha	
4	1001+270	X	BHS	Chandanpur	Simlaguri
5	1007+460	Y	RHS		Ambari
6	1008+680	Y	RHS		Howly

3.4.7.2 Minor Junction

There are minor junctions all along the project road at a very frequent interval. Summary of the minor junctions are given in the **Table 3.7** below:

Table 3.7: Summary of Minor Junction

Junction Type	Kochugaon to Rakhaldubi	Rakhaldubi to Kaljhar
T	70	74
X	14	2
Y	14	15
Total	**98**	**91**

3.4.8 Median

4.5 m wide median is there at most of project length except at few locations of Built-up Area, Flyovers, Underpasses and ROBs where the median width is in the range of 1.0-1.5m. In the mountainous section which is from Km 165+300 to Km 175+400, median width is 1.5m only. At location of few bridge approaches, median width goes up to 33m. Summary of the median width are given in the **Table 3.8** below:

Table 3.8: Median Width

S. No.	Median Width (m)	Length (km)	
		Kochugaon to Rakhaldubi	Rakhaldubi to Kaljhar
1	< 4.5	0.000	0.000
2	4.5	60.706	44.805
3	> 4.5	1.965	6.695

3.4.9 Earthen / Hard Shoulder

Earthen shoulders are provided on the outer side of the main carriageway. The width of these shoulders is 1.5m.

3.4.10 Drainage

Cover Drain is provided at built-up-area, flyovers and underpasses. Longitudinal lined drains are provided in mountainous stretch and in median at super-elevated stretches and split carriageway portions. Median cut drains are provided at super-elevated portion for efficiently draining out rain water. Package wise details of Drainage are given in the **Table 3.9** and shown in **Figure 3.5.**

Table 3.9: Drainage System

Description	Kochugaon - Rakhaldubi Section	Rakhaldubi - Kaljhar Section
Covered lined Drain (km)	12.757	3.665
Open Lined Drain (km)	0.255	7.456
Cut Drain (km)	7.364	5.625

General observation of drainage conditions during the site reconnaissance are:

- Cleaning and maintenance of roadside drainage needs improvement.
- Provision of chute drain at high embankment location is observed. Stone pitching all through the slope at high embankment location is there for the protection from erosion.
- No overtopping of road has been observed at any location.
- Median cut drains provided at horizontal curve locations are in good condition, however longitudinal drains provided at the median need to be cleaned.

Cover Drain at Service Road Location

Chute Drain at High Embankment Location

Lined Drain at Service Road

Median Cut with Longitudinal Median Drain

Figure 3.5: Drainage System

Covered drain provided in urban area are encroached and clogged at many places.

3.4.11 Road Furniture

3.4.11.1 W-Beam Crash Barrier, Concrete Crash Barrier and Pedestrian Guardrail

W-Beam Crash Barrier

W-beam Crash Barrier is provided at high embankment location, Median, near major structures and at outer side of sharp curves. Package wise length of W-Beam Crash Barrier are given in the **Table 3.10** and shown in **Figure 3.6.**

Table 3.10: W-Beam Crash Barrier

Description	Kochugaon- Rakhaldubi	Rakhaldubi - Kaljhar
W-Beam Crash Barrier (km)	24.186	4.365

Figure 3.6: W-Beam Crash Barrier near High Embankment and Median

Concrete Crash Barrier

Concrete Crash Barrier is provided at approaches of ROBs, Flyovers and Underpasses. New Jersey Crash Barrier are provided at Guwahati Bypass (6-lane work is in progress) and Mountainous section. Length of CC barrier are given in the **Table 3.11** and shown in **Figure 3.7.**

Table 3.11: Concrete Crash Barrier

Description	Kochugaon - Rakhaldubi	Rakhaldubi - Kaljhar
Concrete Crash Barrier (km)	8.401	12.343

Figure 3.7: Concrete Crash Barrier

Pedestrian Guardrails

There is no pedestrian guardrail observed along the project sections.

3.4.11.2 Sign Boards and Gantry

The project have sufficient numbers of signages and are in good condition. There are many ooverhead and cantilever gantry signs as well. Location of gantry signs are shown in **Table 3.12** and **Figure 3.8** below.

Table 3.12: Cantilever & Overhead Gantry

S. No.	Chainage (km)	Side	Type
Kochugaon - Rakhaldubi Section			
1	31+292	LHS	Portal
2	31+489	RHS	Portal

S. No.	Chainage (km)	Side	Type
3	49+169	RHS	Portal
4	49+527	LHS	Portal
5	60+132	LHS	Portal
6	60+779	RHS	Portal
7	65+379	RHS	Portal
8	65+440	LHS	Portal
9	75+844	LHS	Portal
10	76+913	RHS	Portal
11	83+106	LHS	Portal
12	83+347	RHS	Portal
13	90+771	RHS	Portal
14	91+812	LHS	Portal
Rakhaldubi - Kaljhar Section			
1	961+702	LHS	Portal
2	962+419	RHS	Portal
3	1000+842	LHS	Portal
4	1002+029	RHS	Portal

Portal Gantry at Project Stretch

Information Signboard at Junction

Chevron Signboards at Sharp Curve

Figure 3.8: Gantry & Signboards

In general, these appurtenances are in good condition.

3.4.11.3 5 km / Km / Hectometer Stones

5Km, Km & Hectometer stones are observed at shoulder & median. Most of stones are in good condition. Missing and damaged stone shall have to be restored.

5 Km stone at Shoulder

Km Stone at Shoulder

Figure 3.9: Kilometer Stones

3.4.12 Project Facilities

3.4.12.1 Bus Bays and Shelters

There are three types of facilities for boarding the bus by the road users. There are bus bay with shelters, only bus bay without shelters and only shelters without bays. Package-wise number of these facilities are given in **Table 3.13** and shown in **Figure 3.10** below.

Table 3.13: Bus Bays and Shelters

Description	Unit	Kochugaon- Rakhaldubi	Rakhaldubi - Kaljhar
Bus Shelter	Nos	0	8
Bus Bay with Shelter	Nos	21	8
Bus Bay	Nos	9	4

Bus Bay with Shelter

Bus Bay with Shelter

Figure 3.10: Bus Bay and Shelters

3.4.12.2 Truck Lay bye

No Truck Terminal along the project road.

3.4.12.3 Street Light

There are street lighting along the project roads at intermittent interval, mostly for small length. Package-wise length provided for street lighting is give in **Table 3.14** and few examples are shown in **Figure 3.11.**

Table 3.14: Highway Lighting

Description	Unit	Kochugaon - Rakhaldubi		Rakhaldubi - Kaljhar	
		Single Arm	Double Arm	Single Arm	Double Arm
At Median	Lm	405	155		
At Shoulder	Lm				
At Median & Shoulder	Lm	63			

Figure 3.11: Street Light

3.4.12.4 High Mast Light

High mast lights are provided at toll plazas and few major junctions. Details are show in **Table 3.15** below.

Table 3.15: High Mast Light

S. No.	Chainage (Km)	Numbers	Location
Rakhaldubi - Kaljhar Section			
1	1007+412	1	Median
2	1009+212	1	Median

3.5 Toll Plaza

The purpose of the Toll Plaza is to collect toll from road users of the Project highway with transparency in the system.

There are five toll plazas along the project road. TP1 in Section-I is located Km 49+600 called Patgaon which has 06 lanes. TP2 in section-II is located at Km 971+200 called Dahalpara Toll Plaza which has 10 lanes. All toll plazas are with electronic toll collection system.

The Concession Agreement (CA) Sl no 7 of deviation table given in schedule C specifies that existing toll plaza shall be retained with same nos. of toll lanes as present at site. Thus number of lanes are 06 (six) lanes for Section I and 10 (Ten) lanes for Section-II. Appropriate technology is recommended so that not more than 6 vehicles/lane queue up during peak hours.

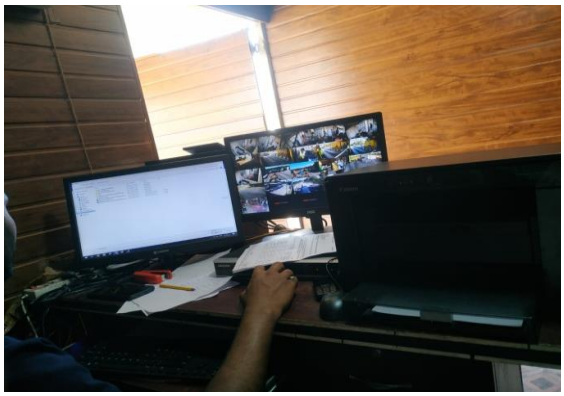
Patgaon Toll Plaza

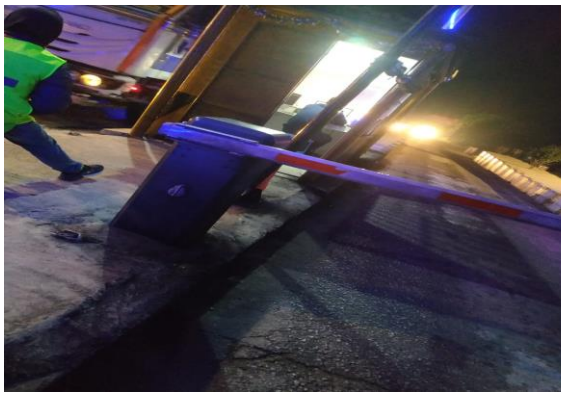
Figure 3.12: Toll Plaza

3.5.1 Toll Collection Equipment Status

3.5.1.1 Kochugaon - Rakhaldubi Section

Sr. No.	Particulars	Details
1	Toll Plaza Chainage	49+600
2	No. of Toll lane	6
3	No. of ETC lane	6
4	No. of Toll Booths	6
5	Toll Plaza control room building is not available	Pota cabin is being used as control room Permanent Building is not available for Toll Plaza
6	Static weigh bridge	Not available
7	High Mast	Not available
8	Tunnel	Not available, Lane equipment is installed in Toll booth
9	Medium Speed Weigh in Motion (MSWIM)	Not available
10	Canopy	Available





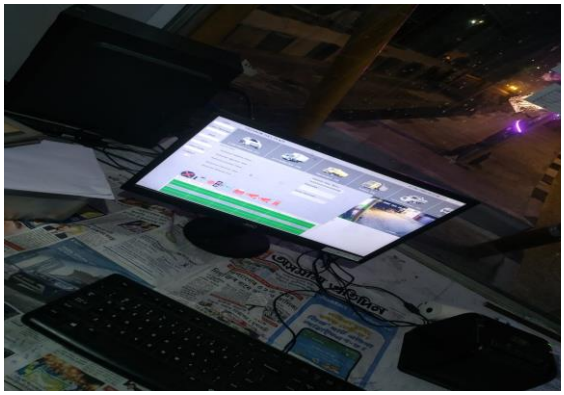


Figure 3.13: Toll Plaza at 49+600

Condition:

1. Toll lane equipment is installed in every lane was not in good condition, Maximum equipment found were not functioning properly.
2. There was no medium speed weigh in motion (MSWIM) found at any lane.
3. There was Monitor available for building surveillance camera. As per IRC code 55" LED screen is essential.
4. There was no High mast for lighting up plaza area as per IRC code.
5. The Static Weigh Bridge (SWB) was not installed.
6. 06 KVA UPS was available for control room equipment and all lane level equipment but need 10 KVA UPS with 4 hours back-up.
7. Some essential equipment were not found such as Master intercom at plaza control room, slave intercom at every lane for communication, AVC controller for vehicle classification, Loop with detector, Customize key board (presently normal key board available), Manual booth controller, Traffic lights, Fog light, User Fare Display (UFD) Violation light with alarm, Incident capture camera, PTZ camera for surveillance of plaza area, Overhead lane sign (OHLS) etc.
8. Automatic Boom barriers were not functioning properly, this can increase violation and revenue lose. There are to be upgraded.
9. AC is essential for every lane booth.
10. There was no proper cable routing. Cable routing is required with tagging.
11. Corrective and preventive maintenance needs to be done for system equipment life.

3.5.1.2 Rakhaldubi - Kaljhar Section

Sr. No.	Particulars	Details
1	Toll Plaza Chainage	971+200
2	No. of Toll lane	10
3	No. of ETC lane	10
4	No. of Toll Booths	10
5	Toll Plaza control room building	Available
6	Static weigh bridge	Not available
7	High Mast	Not available
8	Tunnel	Not available, Lane equipment installed in Toll booth

Sr. No.	Particulars	Details
9	Medium Speed Weigh in Motion (MSWIM)	Installed but not integrated with Plaza software
10	Canopy	Available

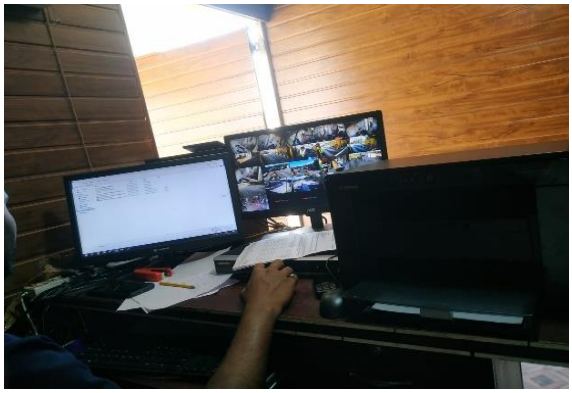
Figure 3.14: Toll Plaza at 971+200

Condition:

1. MSWIM found installed at entry lane, but not integrated with Plaza software.
2. There was Monitor available for building surveillance camera. As per IRC code 55" LED screen is essential.
3. There was no High mast for lighting up plaza area as per IRC code.
4. The Static Weigh Bridge (SWB) was not installed.
5. 01 KVA UPS was found installed per lane while 03 KVA UPS must be installed with 30 minutes back-up at every lane.
6. Some equipment was not found such as Traffic lights, Manual booth controller, User Fare Display (UFD), Fog light etc.
7. PTZ camera was available but installed on street light pole, must be installed on 12 Mtr Pole.
8. AC is essential for every lane booth.
9. Boom arms was found missing from some Automatic boom barriers.
10. There was no proper cable routing. Cable routing is required with tagging.
11. Corrective and preventive maintenance needs to be done for system equipment life.

3.5.2 Toll Plaza Administration Building

The Plaza administration building serves as the support structure for the operation and maintenance of the toll plaza. It is from here that utilities are distributed and controlled, employee amenities are maintained, the toll collection process overseen, revenues are processed & audited. Sale of local passes and recharge is done at Plaza building. Transfer of funds from toll booth to plaza building and from plaza building to bank are being facilitated/managed by administration and financial management functions are also conducted in the building.



TP I Admin Building (Pota Cabin)

TP II Admin Building (Pota cabin)

Figure 3.15: Toll Plaza Administration Building

There was no Plaza building at Patgaon however a plaza building is there at Dhalapara. Pota cabin is being used as Toll plaza control room. Toll Plaza Building available at site does not meet the standard design being opted if properly planned wherein usually a supervisor room cum control room is kept on the first floor in line of sight of toll booths for visual monitoring. The lane activities here in these plazas are monitored through CCTV Cameras installed in booths, lanes, and plaza level. Present condition of currently available toll plaza building at Dhalapara, as appears from the visual inspection is fair and does not warrant any major repair work in near future.

3.5.3 Toll Collection System

The Concession Agreement (CA) Sl no 7 of deviation table given in schedule C specifies that existing toll plaza shall be retained with same nos. of toll lanes as present at site. Appropriate technology shall be used so that service time should not take more than 10 second per vehicle at peak flow. Waiting time of the users should not exceed three minutes.

The purpose of Toll Management System is to collect smooth, fast processing of vehicle from toll plaza and maintain records of all the transactions at the lane level, auditing the lane collectors through AVC systems to prevent collection malfunctioning . All the statistical, configuration and financial / MIS reports being generated through the TMS.

Toll lane shall have lane equipment to regulate traffic movement form the Toll Plaza area. CCTV Cameras shall be installed for monitoring the traffic and lane activities. Automatic Vehicle Classification System along with incident capture camera that triggers and captures the image of outgoing vehicle when the AVC found a mismatch with the vehicle class assigned by the toll collector and the vehicle class classified by the automatic vehicle classification system. Lane

computers shall be installed in on the Booth for issuing the electronic tickets, RFID Transceiver installed to process FASTAG vehicle.

The outermost lane in each direction is for extra wide vehicular traffic and is bifurcated by temporary barriers to allow for non-fee paying traffic (two /three wheelers etc.) to pass through without disturbing the other lanes.

3.5.4 TMS Requirements

Toll Plaza shall follows relevant MoRTH standards an open system of toll collection shall provide equipment for registering of vehicle classification, ticket issuing, data processing, power supply and appropriate technology shall be used in this regard so that service time should not take more than 10 second per vehicle at peak flow. Waiting time of the users should not exceed three minutes.

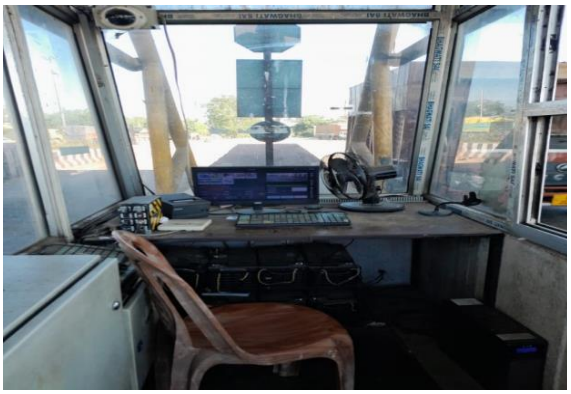
The purpose of Toll Management System is to collect smooth, fast processing of vehicle from toll plaza and maintain records of all the transactions at the lane level, auditing the lane collectors through AVC systems to prevent collection malfunctioning. All the statistical, configuration and financial / MIS reports being generated through the TMS.

Toll lane shall have lane equipment to regulate traffic movement form the Toll Plaza area. CCTV Cameras shall be installed for monitoring the traffic and lane activities. Automatic Vehicle Classification System along with incident capture camera that triggers and captures the image of outgoing vehicle when the AVC found a mismatch with the vehicle class assigned by the toll collector and the vehicle class classified by the automatic vehicle classification system. Lane computers shall be installed in on the Booth for issuing the electronic tickets, process FASTAG vehicles and controlling all the lane equipment.

TMS Equipment

Lane Equipment

Lane Equipment



Lane Equipment

Boom Barrier

TLC

Figure 3.16: TMS Equipments

3.6 Structure Inventory and Condition Survey

This section mainly presents the Site Inventory and Condition Survey of all existing Structures likes Culverts, Minor bridges & Major bridges, Flyovers/ Viaducts, VUP, LVUP, PUP, RUB and ROBs in along the project roads. The aim of the section is to present the details of existing structures, condition of existing structures and functioning of structures. The structure inventory has been done on the basis of visual assessment of each structure. MBIU has been used for visual assessment inspection of major structures having length greater than 60m.

Number of existing structures along the Project roads are given in the following table. Detailed inventory and condition data is presented in **Annexures – 3.2** and **3.3**.

Table 3.16: Number of Structures

S. No.	Description		Kochugaon - Rakhaldubi	Rakhaldubi - Kaljhar
1	Major Bridge (no.)		6	4
2	Minor Bridge (no.)		42	16
3	ROB/RUB		2	-
4	Culverts (no.)	Box	45	-
		Slab	13	34
		Pipe	4	-
5	At grade Intersections(no.)	Major	4	6
		Minor	98	94
6	Underpasses(no.)	VUP	1	-
		LVUP	-	-
		PUP	3	2

Section 4: Surveys and Investigations

4.1 Visual Pavement Condition Assessment

i) In general, the pavement condition is good to fair. Few of the locations, surface condition observed with poor particularly in rigid pavement locations.

ii) It is observed that there is a drop in quality of pavement surface due to absence of timely routine/periodic maintenance activities. Upon enquiry with local PIU teams, there is no maintenance history is available.

iii) Most of the structure approaches has got damaged extensively with higher order settlements leading to sudden bumps/discomfort to road users.

iv) Significant number of rigid pavement panels have got cracked longitudinally in majority of the locations in each of the contract package. The cracking may be rated as high severity based on the visual observations and these panels may require for full depth replacement.

v) The flexible pavement is experiencing the distress like hairline cracks, raveling, potholes and hungry surface with poor riding quality.

vi) The pavement performance for both functional and structural has been evaluated using various Engineering Surveys and Investigations and details are presented in subsequent sections of this report.

vii) Some of the photos showing condition of existing pavement is presented as under.

Kochugaon - Rakhaldubi Section

Flexible Pavement Condition (Raveling)

Rigid Pavement Condition (Longitudinal Cracks)

Rakhaldubi - Kaljhar Section

Flexible Pavement Condition (Surface Cracks)

Rigid Pavement Condition (Multiple Cracks)

Figure 4.1: Condition of Existing Pavement

4.2 Network Survey Vehicle (NSV)

The Network Survey Vehicle is the latest survey technique which utilizes Lasers, Global Positioning System and Video image processing tools. The survey vehicle is used for automatic data collection pertains to pavement condition and road inventory data, required for preparation of pavement maintenance and management proposals. It allows all the data to be collected in a single pass consequently minimising the time needed to complete the data collection. The measurement of surface distresses like cracking, ravelling, patching and pot holes etc. is done using the calibrated image processing methods. The description of NSV and the methodology adopted is provided in **Annexure-4.1.**

The NSV survey has been carried out along the project corridor from 01/12/2022 to 05/12/2022 for collection of field data pertains to pavement condition and road inventory. The data has been collected separately for each lane of the Carriageway. Some of the photographs of NSV testing is shown below.

Figure 4.2: NSV survey

The collected data has been processed, analysed and the summary of such analysis findings for each of the performance parameter is presented below.

4.2.1 Evaluation of Pavement Condition

NSV survey has been conducted for assessment of pavement condition and its distresses. The pavement surface images captured by NSV were processed in Survey board and all the images are geotagged with corresponding co-ordinates and chainage. By manual intervention with Survey Board, it was mapped/ identified various distresses showing distress type, location, magnitude and severity.

Flexible Pavement Distresses

The following Pavement distresses are considered for assessing the flexible pavement condition as per IRC: 82-2015 “Code of Practice for Maintenance of Bituminous Road Surfaces”.

- Cracking
  - Longitudinal cracks
  - Transverse cracks

  - Alligator cracks/ Crocodile cracks
  - Multiple cracks
- Raveling
- Shoving
- Bleeding
- Slippage/ Delamination
- Potholes
  - Area: Surface Area of the Pothole;
  - Numbers
- Edge break
- Patching
- Settlements, Depressions

Strip chart showing the observed pavement distresses is provided in **Annexure 4.2** separately for LHS and RHS directions along with rating of the pavement surface in terms of Good, Fair and Poor. Based on the pavement condition, suitable repair and rehabilitation strategy has been suggested and same shall be presented under the section of Major Maintenance of this report.

The summary of distress is presented in tables separately for each of the project package.

Table 4.1: Kochugaon - Rakhaldubi Section:Summary of Flexible Pavement Distresses

Distress	Rating		LHS Inner Lane		LHS Outer Lane		RHS Inner Lane		RHS Outer Lane	
		Severity (% of Area)	Length Effected (km)	% length	Length Effected (km)	% length	Length Effected (km)	% length	Length Effected (km)	% length
Cracking	Good	< 1%	8.500	47.2	15.840	88.0	27.320	96.7	27.170	96.1
	Fair	1% to 5%	2.150	11.9	1.100	6.1	0.650	2.3	0.700	2.5
	Poor	> 5%	7.350	40.8	1.060	5.9	0.290	1.0	0.390	1.4
Raveling	Good	< 1%	16.580	92.1	17.900	99.4	27.560	97.5	27.860	98.6
	Fair	1% to 5%	1.180	6.6	0.100	0.6	0.600	2.1	0.300	1.1
	Poor	> 5%	0.240	1.3	0.000	0.0	0.100	0.4	0.100	0.4
Potholes	Good	< 1%	18.000	100.0	18.000	100.0	28.160	99.6	28.010	99.1
	Fair	1% to 5%	0.000	0.0	0.000	0.0	0.100	0.4	0.250	0.9
	Poor	> 5%	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
Shoving	Good	< 0.1%	17.900	99.4	18.000	100.0	28.260	100.0	28.260	100.0
	Fair	0.1% to 1%	0.100	0.6	0.000	0.0	0.000	0.0	0.000	0.0
	Poor	> 1%	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
Patching	Good	< 1%	16.210	90.1	17.800	98.9	26.570	94.0	27.670	97.9
	Fair	1% to 10%	1.790	9.9	0.200	1.1	1.590	5.6	0.590	2.1
	Poor	> 10%	0.000	0.0	0.000	0.0	0.100	0.4	0.000	0.0

Table 4.2: Kochugaon - Rakhaldubi Section:Summary of Rigid Pavement Distresses

Severity	Longitudinal Cracks	Transverse/ Diagonal Cracks	Multiple Cracks	Corner Cracks/ Breaking	Joint Spalling/ Joint Damage	Joint Seal defects	Joint Separation	Faulting/ Stepping	Blow Up/ Buckling	Ravelling	Scaling	Pothole/ Popout
LHS-Inner Lane												
0	41.530	43.370	41.850	43.770	43.580	44.140	44.190	44.440	44.450	42.150	44.070	44.180
1	0.600	0.090	0.210	0.110	0.180	0.110	0.120	0.000	0.000	0.430	0.260	0.210
2	0.770	0.250	0.680	0.430	0.360	0.130	0.090	0.010	0.000	1.020	0.070	0.050
3	0.960	0.390	1.210	0.130	0.160	0.040	0.050	0.000	0.000	0.580	0.040	0.010
4	0.470	0.230	0.400	0.000	0.100	0.010	0.000	0.000	0.000	0.170	0.000	0.000
5	0.120	0.120	0.100	0.010	0.070	0.020	0.000	0.000	0.000	0.100	0.010	0.000
Total Length (Km)	**44.450**	**44.450**	**44.450**	**44.450**	**44.450**	**44.450**	**44.450**	**44.450**	**44.450**	**44.450**	**44.450**	**44.450**
LHS-Outer Lane												
0	38.660	43.810	42.780	44.270	43.910	44.020	44.390	44.450	44.450	43.480	44.110	44.390
1	2.260	0.110	0.120	0.040	0.160	0.070	0.040	0.000	0.000	0.130	0.280	0.030
2	1.860	0.280	0.820	0.110	0.300	0.270	0.020	0.000	0.000	0.420	0.040	0.020
3	1.270	0.150	0.540	0.030	0.070	0.020	0.000	0.000	0.000	0.280	0.020	0.010
4	0.310	0.100	0.130	0.000	0.000	0.070	0.000	0.000	0.000	0.130	0.000	0.000
5	0.090	0.000	0.060	0.000	0.010	0.000	0.000	0.000	0.000	0.010	0.000	0.000
Total Length (Km)	**44.450**	**44.450**	**44.450**	**44.450**	**44.450**	**44.450**	**44.450**	**44.450**	**44.450**	**44.450**	**44.450**	**44.450**
RHS-Inner Lane												
0	32.370	33.380	33.350	33.690	33.590	33.850	33.940	33.990	33.990	33.620	33.750	33.920
1	0.050	0.070	0.000	0.060	0.130	0.070	0.000	0.000	0.000	0.010	0.170	0.050
2	0.840	0.270	0.230	0.180	0.230	0.070	0.030	0.000	0.000	0.130	0.050	0.020
3	0.640	0.200	0.310	0.060	0.040	0.000	0.020	0.000	0.000	0.130	0.010	0.000
4	0.090	0.060	0.060	0.000	0.000	0.000	0.000	0.000	0.000	0.080	0.010	0.000
5	0.000	0.010	0.040	0.000	0.000	0.000	0.000	0.000	0.000	0.020	0.000	0.000
Total Length (Km)	**33.990**	**33.990**	**33.990**	**33.990**	**33.990**	**33.990**	**33.990**	**33.990**	**33.990**	**33.990**	**33.990**	**33.990**
RHS-Outer Lane												
0	31.460	33.420	32.930	33.790	33.600	33.910	33.840	33.990	33.990	33.390	33.720	33.770
1	1.180	0.220	0.650	0.090	0.230	0.050	0.060	0.000	0.000	0.100	0.250	0.200
2	0.720	0.110	0.200	0.070	0.080	0.030	0.060	0.000	0.000	0.360	0.020	0.000
3	0.520	0.170	0.160	0.040	0.040	0.000	0.030	0.000	0.000	0.130	0.000	0.000
4	0.090	0.060	0.040	0.000	0.030	0.000	0.000	0.000	0.000	0.010	0.000	0.000
5	0.020	0.010	0.010	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Length (Km)	**33.990**	**33.990**	**33.990**	**33.990**	**33.990**	**33.990**	**33.990**	**33.990**	**33.990**	**33.990**	**33.990**	**33.970**

Table 4.3: Rakhaldubi - Kaljhar Section:Summary of Flexible Pavement Distresses

Distress	Rating	Severity (% of Area)	LHS Inner Lane		LHS Outer Lane		RHS Inner Lane		RHS Outer Lane	
			Length Effected (km)	% length	Length Effected (km)	% length	Length Effected (km)	% length	Length Effected (km)	% length
Cracking	Good	< 1%	26.500	57.8	41.340	90.2	5.030	91.3	4.810	87.3
	Fair	1% to 5%	6.260	13.7	2.700	5.9	0.100	1.8	0.300	5.4
	Poor	> 5%	13.080	28.5	1.800	3.9	0.380	6.9	0.400	7.3

Distress	Rating	Severity (% of Area)	LHS Inner Lane		LHS Outer Lane		RHS Inner Lane		RHS Outer Lane	
			Length Effected (km)	% length	Length Effected (km)	% length	Length Effected (km)	% length	Length Effected (km)	% length
Raveling	Good	< 1%	45.440	99.1	45.240	98.7	5.310	96.4	5.510	100.0
	Fair	1% to 5%	0.200	0.4	0.500	1.1	0.200	3.6	0.000	0.0
	Poor	> 5%	0.200	0.4	0.100	0.2	0.000	0.0	0.000	0.0
Potholes	Good	< 1%	45.740	99.8	45.740	99.8	5.510	100.0	5.510	100.0
	Fair	1% to 5%	0.100	0.2	0.100	0.2	0.000	0.0	0.000	0.0
	Poor	> 5%	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
Shoving	Good	< 0.1%	45.840	100.0	45.840	100.0	5.410	98.2	5.410	98.2
	Fair	0.1% to 1%	0.000	0.0	0.000	0.0	0.100	1.8	0.100	1.8
	Poor	> 1%	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
Patching	Good	< 1%	41.890	91.4	44.340	96.7	5.030	91.3	5.110	92.7
	Fair	1% to 10%	3.550	7.7	1.500	3.3	0.480	8.7	0.400	7.3
	Poor	> 10%	0.400	0.9	0.000	0.0	0.000	0.0	0.000	0.0

Table 4.4: Rakhaldubi - Kaljhar Section:Summary of Rigid Pavement Distresses

Severity	Longitudinal Cracks	Transverse/ Diagonal Cracks	Multiple Cracks	Corner Cracks/ Breaking	Joint Spalling/ Joint Damage	Joint Seal defects	Joint Separation	Faulting/ Stepping	Blow Up/ Buckling	Ravelling	Scaling	Pothole/ Popout
LHS-Inner Lane												
0	4.130	5.380	3.090	5.410	5.380	5.410	5.410	5.410	5.410	5.400	5.400	5.410
1	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.010	0.000
2	0.060	0.000	0.080	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.460	0.010	0.450	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.570	0.020	1.610	0.000	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.170	0.000	0.180	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Length (Km)	5.410	5.410	5.410	5.410	5.410	5.410	5.410	5.410	5.410	5.410	5.410	5.410
LHS-Outer Lane												
0	3.530	5.390	4.140	5.380	5.400	5.410	5.400	5.410	5.410	5.410	5.400	5.410
1	0.280	0.000	0.130	0.010	0.000	0.000	0.010	0.000	0.000	0.000	0.010	0.000
2	0.810	0.020	0.590	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.460	0.000	0.420	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.270	0.000	0.080	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.060	0.000	0.050	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Length (Km)	5.410	5.410	5.410	5.410	5.410	5.410	5.410	5.410	5.410	5.410	5.410	5.410
RHS-Inner Lane												
0	31.750	45.760	23.240	45.970	45.760	45.980	45.990	45.990	45.990	45.850	45.750	45.890
1	0.470	0.010	1.090	0.010	0.060	0.000	0.000	0.000	0.000	0.030	0.240	0.040
2	5.390	0.130	7.300	0.010	0.060	0.010	0.000	0.000	0.000	0.050	0.000	0.020
3	5.710	0.080	9.880	0.000	0.070	0.000	0.000	0.000	0.000	0.060	0.000	0.040
4	1.910	0.010	4.260	0.000	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Severity	Longitudinal Cracks	Transverse/ Diagonal Cracks	Multiple Cracks	Corner Cracks/ Breaking	Joint Spalling/ Joint Damage	Joint Seal defects	Joint Separation	Faulting/ Stepping	Blow Up/ Buckling	Ravelling	Scaling	Pothole/ Popout
5	0.760	0.000	0.220	0.000	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Length (Km)	45.990	45.990	45.990	45.990	45.990	45.990	45.990	45.990	45.990	45.990	45.990	45.990
RHS-Outer Lane												
0	32.240	45.720	27.620	45.810	45.820	45.900	45.990	45.990	45.990	45.800	45.900	45.970
1	0.070	0.010	0.130	0.020	0.000	0.000	0.000	0.000	0.000	0.060	0.080	0.020
2	2.400	0.040	2.020	0.090	0.060	0.060	0.000	0.000	0.000	0.070	0.010	0.000
3	6.270	0.140	7.850	0.050	0.100	0.020	0.000	0.000	0.000	0.060	0.000	0.000
4	3.890	0.060	7.990	0.000	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000
5	1.120	0.020	0.380	0.020	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Length (Km)	45.990	45.990	45.990	45.990	45.990	45.990	45.990	45.990	45.990	45.990	45.990	45.990

4.2.2 Pavement Roughness

The roughness data was collected at 100m interval using NSV on each lane in-terms of IRI (International Roughness Index) value. In Indian context, the IRI values were converted to BI as per IRC: SP:16-2019 “Guidelines on Measuring Road Roughness and Norms” with the following equation;

$BI = 630*(IRI)^{\wedge 1.12}$

Where

BI = Bump Integrator Roughness in mm/km

IRI = International Roughness Index.

Roughness data of Flexible & Rigid Pavement (Toll Plaza Section) was collected through Digital Laser Profilers System (DLP) and the same is presented in **Annexure 4.3**. The summary of Roughness values is presented in tables below

Table 4.5: Kochugaon - Rakhaldubi Section: Summary of Pavement Roughness

Condition	BI (mm/km)	LHS				RHS			
		Inner		Outer		Inner		Outer	
		Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)
Flexible Pavement									
Good	<1800	1.540	8.6	8.270	45.9	11.020	39.0	21.360	75.6
Fair	1800-2400	12.300	68.3	7.750	43.1	15.340	54.3	6.250	22.1
Poor	>2400	4.160	23.1	1.980	11.0	1.900	6.7	0.650	2.3
Length (km)		18.000	100.0	18.000	100.0	28.260	100.0	28.260	100.0

Condition	BI (mm/km)	LHS				RHS			
		Inner		Outer		Inner		Outer	
		Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)
Rigid Pavement									
Good	<2000	0.000	0.0	1.050	2.4	2.000	5.9	3.000	8.8
Fair	2000-2400	15.040	33.8	20.940	47.1	5.580	16.4	6.600	19.4
Poor	>2400	29.410	66.2	22.460	50.5	26.410	77.7	24.390	71.8
Length (Km)		44.450	100.0	44.450	100.0	33.990	100.0	33.990	100.0

Table 4.6: Rakhaldubi - Kaljhar Section: Summary of Pavement Roughness

Condition	BI (mm/km)	LHS				RHS			
		Inner		Outer		Inner		Outer	
		Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)
Flexible Pavement									
Good	<1800	2.000	4.4	7.000	15.3	0.000	0.0	0.000	0.0
Fair	1800-2400	15.000	32.7	23.330	50.9	1.890	34.3	3.890	70.6
Poor	>2400	28.840	62.9	15.510	33.8	3.620	65.7	1.620	29.4
Length (km)		45.840	100.0	45.840	100.0	5.510	100.0	5.510	100.0
Rigid Pavement									
Good	<2000	2.000	37.0	2.000	37.0	3.000	6.5	4.000	8.7
Fair	2000-2400	1.720	31.8	1.000	18.5	19.610	42.6	24.610	53.5
Poor	>2400	1.690	31.2	2.410	44.5	23.380	50.8	17.380	37.8
Length (Km)		5.410	100.0	5.410	100.0	45.990	100.0	45.990	100.0

4.2.3 Rutting

Rutting data of Flexible Pavement has been collected through Digital Laser Profilers System (DLP) of NSV and the same is presented in **Annexure 4.4**. The summary of pavement rutting is provided in tables below separately for each of the project package.

Table 4.7: Kochugaon - Rakhaldubi Section: Summary of Pavement Rutting

Condition	Rutting, mm	LHS				RHS			
		Inner		Outer		Inner		Outer	
		Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)
Good	< 5	2.830	15.7	13.120	72.9	2.830	15.7	13.120	72.9
Fair	5 to 10	13.670	75.9	4.780	26.6	13.670	75.9	4.780	26.6
Poor	> 10	1.500	8.3	0.100	0.6	1.500	8.3	0.100	0.6

Table 4.8: Rakhaldubi - Kaljhar Section: Summary of Pavement Rutting

Condition	Rutting, mm	LHS				RHS			
		Inner		Outer		Inner		Outer	
		Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)
Good	< 5	5.110	11.1	22.060	48.1	0.520	9.4	5.010	90.9
Fair	5 to 10	25.380	55.4	22.280	48.6	4.610	83.7	0.420	7.6
Poor	> 10	15.350	33.5	1.500	3.3	0.380	6.9	0.080	1.5

Observations:

The condition of pavement in respect of pavement rutting is fair to poor in most of the stretches, and there will be further increase of rut depth if any delay in rectifying these defects through timely periodic maintenance and hence the areas showing these higher order rut depth needs to be rectified immediately.

4.2.4 Test Pit Investigations

Test pit investigations have been carried out at every 5km in a staggered manner ascertain the existing pavement composition (pavement course, material type, and thickness). The summary of existing pavement crust thickness is presented in table and some of the photographs showing the pavement crust thickness are shown as below.

Table 4.9: Summary of Existing Pavement Crust Thickness

S. No	Location (Km.)	Side (LHS/RHS)	Existing Crust details			
			Bituminous Layer	PQC	Granular	Total Thickness (mm)
Kochugaon to Rakhaldubi section						
1	30+000	LHS	-	300	410	710
2	35+000	RHS	-	340	360	700
3	40+000	LHS	-	340	400	740
4	45+000	RHS	300	-	450	750
5	50+000	LHS	270	-	450	720
6	55+000	RHS	-	300	400	700
7	60+200	LHS	-	300	400	700
8	65+000	RHS	270	-	420	690
9	71+000	LHS	-	230	460	690
10	75+000	RHS	280	-	430	710
11	81+700	LHS	-	300	430	730
12	85+000	RHS	-	280	420	700
13	90+000	LHS	260	-	460	720
Rakhaldubi - Kaljhar Section						
1	962+500	LHS	300	-	450	750
2	967+000	RHS	250	-	550	800
3	972+000	LHS	230	-	470	700
4	979+000	RHS	-	300	400	700
5	982+000	LHS	210	-	530	740
6	987+000	RHS	-	470	230	700
7	991+500	LHS	260	-	500	760
8	997+000	RHS	-	480	210	690
9	1003+000	LHS	-	250	450	700
10	1007+000	RHS	-	210	450	660
11	1012+000	LHS	250	-	500	750

Figure 4.3: Pavement Composition & Thickness Measurement

Observations and Conclusions:

- The existing pavement along the project corridor is a combination of both flexible and rigid type. The pavement composition comprises of bituminous layer, granular base/sub-base on subgrade for flexible pavement whereas PQC, DLC and granular layer for rigid pavement.
- Throughout the project road, it is found that the consistent bituminous/ granular layer thickness with an average thickness of more than of 250mm in each of the project package over an average granular thickness of more than 420mm, whereas for rigid pavement average thickness of PQC is 290mm. In few of the test pit locations, the thickness of PQC is 230mm, which is a concern to cater the heaver axle loads flying on the project road.

During the above investigations, the existing subgrade soils samples were collected and tested in the laboratory to understand the properties of these foundation soils. The test results are presented in **Annexure 4.9.** The observations from test results are given below for each of the package.

Observations and Conclusions

Kochugaon - Rakhaldubi Section:

The subgrade soils are generally consistent throughout the project road and is predominantly Silty sand with clayey sands of dual in nature and Silty sands. Because of this soil type, Liquid Limit (LL) is ranging between 20-32 %, and these values are within the limit as per MoRTH specifications (<50%). The obtained maximum Plasticity Index of the subgrade soils is NP-7.0 % and the degree of free swell is 0.0-15.0 %. All the measured PI and FSI values are also within the acceptable limits as per MoRTH guidelines, of 25% and 50% respectively.

Further, the MDD values is ranging between 90.9 % - 98.9 %. The 4-days soaked CBR and is ranging from 7.2 % to 8.4 % with an average value of 7.8 %, which is in line with design CBR adopted during 4-lane construction.

Rakhaldubi - Kaljhar Section:

The subgrade soils are generally consistent throughout the project road and is predominantly Gravels and clayey sands. Because of this soil type, Liquid Limit (LL) is ranging between 24-33 %, and these values are within the limit as per MoRTH specifications (<50%). The obtained maximum

Plasticity Index of the subgrade soils is NP-10 % and the degree of free swell is 0.0-25.0 %. All the measured PI and FSI values are also within the acceptable limits as per MoRTH guidelines, of 25% and 50% respectively.

Further, the MDD values is ranging between 91.31 % - 97.98 %. The 4-days soaked CBR and is ranging from 6.50 % to 7.90 % with an average value of 7.60 % which is in line with design CBR adopted during 4-lane construction.

4.3 Axle Load Survey

Vehicle axle loading has a significant impact on pavement performance and design. Thus, an axle load survey has been conducted from 24th Nov-2022 to 01st Dec-2022 in compliance with IRC 37 2018 and such survey was conducted for 48 hours (2 normal days) in both directions at the existing toll plaza locations in each of the 5 project packages.

The type of vehicle considered for axle load survey along with its axle configurations are presented in below. Few of the survey photographs were shown in Photos as below:

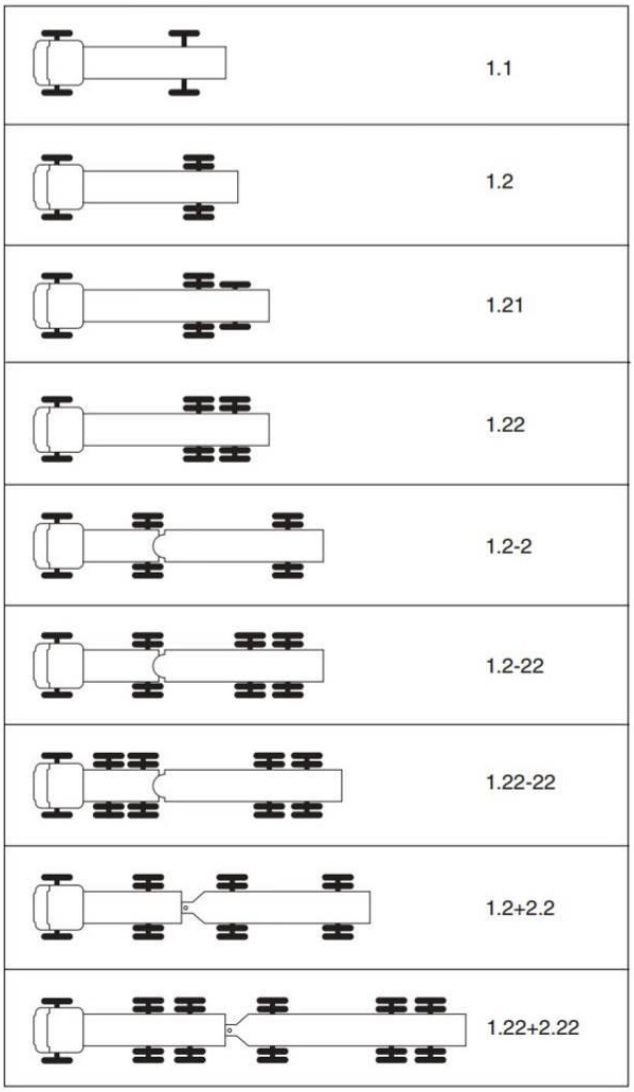


Figure 4.4: Axle Load Survey

The VDF analysis was carried out in line with section 4.4 of IRC: 37-2018 based on the axle load data. The equations for computing equivalency factor for single, tandem and tridem axles given below is used as directed in the IRC:37-2018 for converting different axle load repetitions into equivalent standard axle load repetitions;

- Single axle with single wheel on either side = {axle load in kN / 65}4
- Single axle with dual wheel on either side = {axle load in kN / 80}4
- Tandem axle with single wheel on either side = {axle load in kN /148}4
- Tridem axle with dual wheel on either side = {axle load in kN /224}4

With the stated above procedure, the Vehicle Damage Factor for each class of commercial vehicle on both the directions were calculated separately for empty and loaded vehicles. The Axle load data format and VDF analysis are presented in **Annexure 4.5** and obtained VDF values comparing the values adopted at the time of pavement design during construction summarized in table below.

Table 4.10: Vehicle Damage Factors (VDF)

Toll Plaza	Direction	Vehicle Damage factors				
		Bus	LCV	2-Axle	3-Axle	MAV
Patgaon (km 49+600)	Kochugaon-Guwahati (LHS)	1.37	1.40	3.08	5.72	13.84
	Guwahati-Kochugaon (RHS)	0.60	1.14	2.56	5.36	8.37
Dahalapara Toll Plaza (Km.971+200)	Kochugaon-Guwahati (LHS)	1.44	1.16	2.88	5.55	14.83
	Guwahati-Kochugaon (RHS)	0.91	0.81	2.19	4.89	8.11

From the above, it is seen that there is a significant difference in axle loads of commercial vehicles flying in the two directions of traffic, where vehicles in the LHS direction has been overloaded than that of RHS direction.

4.4 Falling Weight Deflectometer (FWD)

The structural evaluation of pavement has been carried out in accordance with IRC: 115-2014, “Guidelines for Structural Evaluation and Strengthening of Flexible Road Pavements Using Falling Weight Deflectometer (FWD) Technique” to determine the remaining life of the pavement structure.

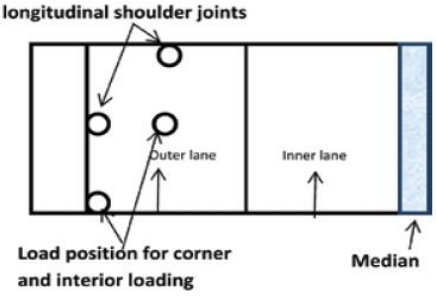
The principle and description of FWD and its methodology is provided in **Annexure 4.6.**

FWD deflection measurement has been carried out for each direction and the measurement has been carried out at a test point along outer wheel path of each direction which is at an offset of 1m from the outer edge of outer lane as specified in section 5.4.5 of IRC: 115-2014. At every measurement location, four drops were made, such that the first drop was the '**seating drop'** and with the remaining three drops deflections were recorded. Field survey photographs is shown below.

Figure 4.5: FWD Survey at Project Site

The deflection testing has been carried out on the existing pavement as per IRC Codes at the rate of 5 points per km as stipulated in TOR of the Consultant.

Adopted deflection measurement scheme is as under.

Adopted Measurement Scheme	Maximum Spacing(m) for test points along selected wheel path (Flexible Pavement)	Rigid Pavement
(i) measurement along outer wheel paths of outer lanes (3 points)	200	Load position for transverse and longitudinal shoulder joints 
(ii) measurement along the outer wheel path of inner lane (2 points)	400	

4.4.1 Back-calculation of Layer Moduli for Flexible Pavement

Layer moduli have been back-calculated using KGPBACK program. The pavement has been modelled as a three-layer system with bituminous layer, granular layer and subgrade. The following inputs have been provided for back analysis.

i) Single wheel load 40 kN and contact pressure 0.56 MPa
ii) No. of deflection sensors: 9
iii) Radial Distances of the Geophones i.e., 0,200, 300,450, 600, 900 and 1500mm
iv) Measured Surface Deflections normalized to 40kN in mm
v) Pavement Layer Thicknesses (as measured from Trial Pits)
vi) Poisson's ratio for different layers i.e., 0.35 for bituminous, granular and subgrade

vii) Range of Possible modulus value (Min.- Max.) of bituminous layer, granular layer and subgrade.

Ranges of different layer moduli have been given as input to KGPBACK for back-calculation. These ranges have been selected judiciously by experienced pavement engineering taking into considerations the approximate age of pavement, visual assessment of the condition of bituminous layer, climatic conditions prevailing at the time of deflection measurements and information available from test pits, and laboratory tests conducted as detailed below:

Range of modulus value of existing subgrade:

The range of moduli of existing subgrade is taken based on the subgrade CBR values for the analysis.

Range of modulus value of existing granular layers i.e., base and sub base:

The range of moduli of existing granular layers is based on Appendix III.8.4 of IRC 115-2014.The range for combined (base and sub-base) is taken as 100-500 MPa.

Range of modulus value of existing thick bituminous layers:

The range of moduli of existing thick bituminous layer has been determined on the basis of condition data. If the road condition is good the range is considered as 750 MPa to 3000 MPa, for sections with pavement condition is Fair- Poor, the range specified for thick bituminous layer 400 MPa to 1500 MPa as stipulated in Appendix III.8.4 of IRC: 115-2014 has been taken into consideration.

4.4.1.1 Correction for Temperature

Back-calculated moduli values of the bituminous layers evaluated by FWD survey are influenced by the pavement temperature. The standard pavement temperature for India is recommended as 35°C, hence the back-calculated moduli obtained at temperatures other than the identified standard temperature will have to be corrected using a suitable correction factor using equations 4 and 5 of IRC:115-2014 and the same is extracted below for ready reference.

$$E_{T1} = \lambda E_{T2} \ldots\ldots \textbf{(4)}$$

Where,

λ temperature correction factor, is given as

$$\lambda = \frac{(1-0.238 \ln T_1)}{(1-0.238 \ln T_1)} \ldots\ldots \textbf{(5)}$$

Where,

E_{T1} = Back-calculated modulus (MPa) at temperature $T_1^0\ C$

E_{T2} = Back-calculated modulus (MPa) at temperature $T_2^0\ C$

However, in few sections, after applying the temperature correction the E value of bituminous layers are coming more than 3000MPa. As the project road was constructed with VG-30/VG-40 grade

bitumen, it is restricted to keep the maximum E value of 3000MPa, wherever it is exceeding. In these locations, the temperature correction factor was applied as 1.

4.4.1.2 Correction for Seasonal Variation

Moisture content affects the strength of subgrade and granular sub base/base layers. Therefore, the back-calculated moduli of subgrade and granular layers should be taken from field moduli using seasonal corrections. Seasonal correction equations 7 and 8 of IRC: 115-2014 has been extracted below for ready reference.

$$E_{sub\_mon=}\ 3.351 * \left(E_{sub\_win}\right)^{0.7688} - 28.9 \ldots (6)$$

$$E_{sub\_mon} = 0.8554 * (E_{sub\_sum}) - 8.461 \ldots (7)$$

where,

E_{sub_mon} = subgrade modulus in monsoon (MPa)

E_{sub_sum} = subgrade modulus in Summer (MPa)

E_{sub_win} = subgrade modulus in Winter (MPa)

$$E_{gran\_mon=}\ -0.0003 * \left(E_{gran\_sum}\right)^{2} + 0.9584 * \left(E_{gran\_sum}\right) - 32.989 \ldots (8)$$

$$E_{gran\_mon=}\ 10.5523 * \left(E_{gran\_win}\right)^{0.624} - 113.857 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

where,

E_{gran_mon} = granular layer modulus in monsoon (MPa)

E_{gran_sum} = granular layer modulus in Summer (MPa)

E_{gran_win} = granular layer modulus in Winter (MPa)

Since the deflection measurements have been carried out in the month of December hence seasonal correction factor is applicable.

The 15th percentile value (as the same has been recommended by IRC: 115-2014 for purpose of design) of back-calculated & corrected layer moduli of each identified homogeneous sub-sections of both directions separately are presented next.

4.4.1.3 Results of Back Calculated Modulii (E) of Pavement Layer

The summary of back calculated E values is presented in **Annexure 4.7**.

4.4.1.4 Remaining Life Estimation for Flexible Pavement

The in-service three-layer pavement system has been analysed with the back-calculated corrected layer moduli and layer thicknesses. The critical strains have been calculated by IITPAVE program. From the performance criteria equations, the residual/remaining rutting and fatigue life have been estimated.

Performance Criteria

The layer moduli of in-service pavement back calculated from FWD deflection data are used to analyse the pavement for critical strains which are indicators of pavement performance in terms of rutting and fatigue cracking. The following approach is proposed for design of bituminous overlays for existing flexible pavements. The mechanistic criteria (fatigue and rutting) adopted in the IRC:37-2018 "Guidelines for the Design of Flexible Pavements", forms the basis for the overlay design method. Performance models adopted in these guidelines are given below.

a) Fatigue in Bituminous layer:

As it specified in IRC: 115-2014, the fatigue model for 90 percent reliability was used as below

$$N_f = 0.711 * 10^{-04} \times [1/\varepsilon_t]^{3.89} * [1/M_R]^{0.854}$$

As it specified in IRC: 37-2012, the fatigue model for 80 percent reliability was used as below

$$N_f = 2.21 * 10^{-04} \times [1/\varepsilon_t]^{3.89} * [1/M_R]^{0.854}$$

Where,

N_f = fatigue life in number of standard axles,

ε_t = Maximum Tensile strain at the bottom of the bituminous layer

M_R= resilient modulus of the bituminous layer.

b) Rutting in Subgrade:

Rutting model for 90 percent reliability level as specified in IRC: 115-2014 was used as below;

$$N = 1.41 \times 10^{-08} [1/\varepsilon_v]^{4.5337}$$

As it specified in IRC: 37-2012, the rutting model for 80 percent reliability was used as below

$$N = 4.1656 \times 10^{-08} [1/\varepsilon_v]^{4.5337}$$

Where,

N= Number of cumulative standard axles, and

ε_v= Vertical strain in the subgrade

The detailed remaining life analysis is done using 90 percent reliability equation of IRC: 115-2014 is presented in tables below for LHS and RHS carriageway.

Table 4.11: Package Wise Pavement Remaining life

S. No	Chainage		15th Percentile E Value			Obtained strains through IITPAVE		Remaining Life of Existing Pavement (MSA)		
	From	To	Bituminous Layer	Granular Layer	Subgrade	Fatigue Strain (mm)	Rutting Strain (mm)	Fatigue Residual Life	Rutting Residual Life	Remaining Life
Kochugaon - Rakhaldubi Section: LHS										
1	30.500	31.990	1111.14	80.28	93.00	0.0001868	0.0001788	56.90	1379.94	56.90
2	37.990	43.100	804.39	73.86	69.28	0.0002012	0.0002165	56.17	579.63	56.17
3	47.480	49.000	1679.08	118.94	90.05	0.0001486	0.0001699	97.39	1739.37	97.39

S. No	Chainage		15th Percentile E Value			Obtained strains through IITPAVE		Remaining Life of Existing Pavement (MSA)		
	From	To	Bituminous Layer	Granular Layer	Subgrade	Fatigue Strain (mm)	Rutting Strain (mm)	Fatigue Residual Life	Rutting Residual Life	Remaining Life
4	49.000	52.010	1124.01	77.41	74.77	0.0002208	0.0002197	29.40	542.33	29.40
5	62.020	63.730	540.65	77.12	69.50	0.0003111	0.0002896	14.47	155.01	14.47
6	78.130	78.920	491.70	73.54	64.75	0.0003361	0.0002968	11.62	138.68	11.62
7	83.180	84.000	567.07	78.81	79.70	0.0002979	0.0002458	16.45	326.02	16.45
8	84.000	85.810	632.09	74.63	59.04	0.0002865	0.0002900	17.45	154.04	17.45
9	89.690	91.000	1155.40	156.63	100.58	0.0001824	0.0001814	60.38	1292.51	60.38
10	91.000	92.671	578.75	80.16	51.75	0.0003610	0.0003556	7.66	61.11	7.66
Kochugaon - Rakhaldubi Section: RHS										
1	30.000	30.510	789.96	90.49	104.04	0.0001885	0.0001795	73.51	1355.71	73.51
2	43.070	47.440	771.74	156.74	104.00	0.0001909	0.0001769	71.39	1448.42	71.39
3	52.100	53.250	720.92	172.03	104.00	0.0001913	0.0001972	75.05	885.11	75.05
3	55.100	56.000	868.29	179.56	103.99	0.0001697	0.0001858	102.04	1159.44	102.04
4	56.000	64.000	839.08	117.51	103.95	0.0002149	0.0001972	41.93	885.11	41.93
5	65.000	72.000	981.72	138.17	103.95	0.0001965	0.0001908	51.94	1027.92	51.94
6	73.000	78.120	1125.25	97.79	103.22	0.0001939	0.0001763	48.69	1470.91	48.69
7	80.930	83.200	1017.04	125.11	103.82	0.0001929	0.0001864	54.16	1142.61	54.16
8	92.330	92.671	1231.94	188.19	104.04	0.0001493	0.0001713	124.57	1675.84	124.57
Rakhaldubi - Kaljhar Section: LHS										
1	961.500	965.320	703.21	89.31	103.86	0.0002468	0.0001841	28.46	1208.77	28.46
2	970.000	970.890	766.63	156.36	103.99	0.0002680	0.0002162	19.19	583.29	19.19
3	971.600	974.000	1083.35	245.03	103.86	0.0001817	0.0001841	64.76	1208.77	64.76
4	974.000	976.000	567.76	126.95	104.00	0.0003456	0.0002370	9.22	384.61	9.22
5	976.000	992.000	948.38	384.61	103.87	0.0001592	0.0001603	121.33	2264.19	121.33
6	992.000	995.000	1264.98	190.33	104.04	0.0001871	0.0001939	50.62	955.49	50.62
7	995.000	996.000	930.62	354.33	103.85	0.0001597	0.0001788	121.81	1379.94	121.81
8	996.000	1000.000	957.75	171.61	103.91	0.0002128	0.0002005	38.91	820.96	38.91
9	1000.000	1008.000	914.03	213.86	103.95	0.0001922	0.0001903	60.17	1040.23	60.17
10	1008.000	1009.000	1560.93	217.02	103.99	0.0001415	0.0001515	125.39	2924.71	125.39
11	1009.000	1012.810	939.14	185.90	103.78	0.0002012	0.0001767	49.21	1455.87	49.21
Rakhaldubi - Kaljhar Section: RHS										
1	965.140	966.000	873.03	259.89	103.37	0.0001773	0.0001512	85.66	2951.11	85.66
2	966.000	970.000	1089.90	195.02	103.93	0.0001810	0.0001541	65.40	2707.56	65.40
3	970.000	970.020	593.98	111.08	103.75	0.0003232	0.0001906	11.51	1032.82	11.51
4	1000.920	1001.630	284.24	74.79	67.79	0.0002250	0.0003150	88.40	105.88	88.40

4.4.1.5 FWD data Analysis for Rigid Pavement

As per IRC: 117-2015, the collected FWD data for the rigid pavement has been analysed to determine the following parameters.

- Modulus of subgrade reaction k (MPa/m)
- Elastic modulus of concrete E_c (MPa)

- Flexural Strength of concrete f_{mr} (MPa)
- Load Transfer Efficiency (LTE) of Joints (%)

The detailed analysis of the parameter for PQC and Load Transfer Efficiency is presented in **Annexure 4.7** for both LHS and RHS directions respectively.

From the test results the observations were draw-down. The range of Elastic Modulus, other PQC parameters and their percentage of length and Load Transfer Efficiency (LTE) is presented in table below.

Table 4.12:Summary of Flexural Strength and Elastic Modulus

Pavement layer	Range	Percentage of Project Road	
		LHS	RHS
Kochugaon - Rakhaldubi Section			
Elastic Modulus of PQC Layer (Mpa)	> 30000	29.17%	33.67%
	30000 - 10000	70.83%	66.33%
Flexural Strength of PQC Layer (Mpa)	> 4.5	16.27%	23.76%
	4.5 - 3.0	59.50%	57.43%
	<3.0	24.23%	18.81%
Rakhaldubi - Kaljhar Section			
Elastic Modulus of PQC Layer (Mpa)	> 30000	22.22%	27.94%
	30000 - 10000	77.78%	72.06%
Flexural Strength of PQC Layer (Mpa)	> 4.5	16.67%	14.71%
	4.5 - 3.0	55.56%	63.97%
	<3.0	27.78%	21.32%

Table 4.13: Summary of Joint Load Transfer Efficiency

Direction	Load Transfer Efficiency (LTE)					
	Transverse Joint			Longitudinal Joint		
	> 90%	90%-50%	< 50%	> 90%	90%-40%	< 40%
Kochugaon - Rakhaldubi Section						
LHS	29.41%	67.69%	2.90%	23.51%	76.49%	0.00%
RHS	51.51%	48.49%	0.00%	45.45%	54.55%	0.00%
Rakhaldubi - Kaljhar Section						
LHS	50.00%	50.00%	0.00%	50.00%	50.00%	0.00%
RHS	53.33%	46.67%	0.00%	48.89%	51.11%	0.00%

- Due to the presence of longitudinal cracks. Corner breaks, multiple cracks, there is loss of flexural strength of PQC slab. Considering the same, suitable repair and rehabilitation measures recommended as per the present performance of the pavement.
- Load Transfer Efficiency (LTE) for Transverse joints is more than 50% for both LHS & RHS direction except few locations on LHS.
- Load Transfer Efficiency (LTE) for Longitudinal joints is more than 40% for both LHS & RHS direction so, the joint system is adequate in load transfer.

4.5 Mobile Bridge Inspection Unit (MBIU)

4.5.1 Specification

The Mobile Bridge Inspection Unit (referred as (MBIU) is an electro-mechanically driven articulated structure mounted on a vehicle (a truck) as an aid towards proper inspection of bridges or similar infrastructures by enabling an inspection team of 2-3 persons carrying instruments access to the underside of bridge decks over flowing rivers or gorges. The present version is the truck mounted system. As per TOR condition survey of existing structures greater than 60m shall be carried using MBIU.

The overall objective of the condition survey is to identify the need for structural maintenance, rehabilitation and replacement. Signs of distress such as spalling, scaling, cracking, leaching, excessive deflection, inadequate cover, settlement, exposed reinforcement, corrosion in the reinforcement; shear cracks etc. are identified during this exercise. Special emphasis is given on expansion joints and bearing. Also the condition of the Approaches, water way and bed protection is examined. The survey identify the bridges which are more distressed and require testing for their evaluation and rehabilitation measures. Also bridges which require general measures for rehabilitation. Inspection report is prepared in accordance with IRC: SP-35. The report provides recommendation whether a bridge is acceptable to continue in use, whether it can be repaired and/or modified e.g. widened or a new structure.

Figure 4.6: Mobile Bridge Inspection Unit used for Structure Condition Assessment

The structure inventory and condition assessment are given in **Annexure 4.8.** The following structures have been inspected using MBIU machine.

Table 4.14: List of Inspected Structures using MBIU

Sr. No.	Chainage (Km)	Side		Remark
		LHS	RHS	
Kochugaon (Chainage 30+000) to Rakhaldubi (Chainage 92+671/ 962+200				
1	34+084	LHS	RHS	Major Bridge
2	41+294	LHS	RHS	Major Bridge
3	45+177	LHS	RHS	Major Bridge
4	45+522	LHS	RHS	Major Bridge

Sr. No.	Chainage (Km)	Side		Remark
		LHS	RHS	
5	46+950	LHS	RHS	Major Bridge
6	62+830	LHS	RHS	Major Bridge
7	87+840	LHS	RHS	ROB
Rakhaldubi (Chainage 961+500) to Kaljhar (Chainage 1013+000)				
8	963+868	LHS	RHS	Major Bridge
9	975+251	LHS	RHS	Major Bridge
10	986+300	LHS	RHS	Major Bridge
11	996+120	LHS	RHS	Major Bridge

4.5.2 Working Principle

The work of condition survey requires use of Mobile Bridge Inspection Unit at the various bridge sites on the National Highways to overcome the accessibility problems. MBIU increases the accessibility for inspection of underside of high level bridge decks and helps in continuous inspection of throughout the span of bridge. It has five folded arms. All of them are electro-mechanically operated.

Once the platform is erected by certified person, Inspection and maintenance experts can inspect underside of bridge, note observations as per IRC SP-35 & IRC SP-52 and take photographs for reference.

4.5.3 Advantages

- A large operating range
- A high level of working comfort
- Maximum operational safety
- The shortest possible setting up and dismantling times
- Full mobility in inspection operation without stabilizer supports
- An optimum weight/performance ratio

Figure 4.7: MBUI Survey

4.6 Drone Videography of Entire Stretch

Videography of entire Project Stretch is captured through Drone cameras flown at about 50m above ground. This shall be useful for observing various features of Project Stretch from bird's eye level.

Section 5: Review of Documents

5.1 General

Technical Consultant (TC), since the start of technical due diligence study, has requested for various documents from the Client. A list of documents required were shared with the Client before TC team started the study which was appended with few more queries after the conclusion of the site visit once the project site is appraised. Most of the queries were also discussed with the Client in many meetings. This section of the report deals with the documents requested by TC and its review along with highlighting major issues found during this review.

5.2 Documents Collected and Reviewed

List of documents requested, received and reviewed are given below:

S. No.	List of Documents	Status of Documents	Remarks on Review
DOCUMENTS RELATED TO CURRENT ACQUISITION			
1.	Concession Agreement	Available	Concession Agreement used at the time of round 2 acquisition is made available to the Consultant with the direction that same terms and conditions may be used for round 3 acquisition. Later on, a word copy of the CA applicable for round 3 project were shared on 30th January 2023. Article 14 of the same CA is referred to assess the requirements regarding capacity augmentation. Expected impact of this on the instant projects are addressed in a separate section in this chapter. Article 15 of this CA deals with the operation and maintenance requirements for the project roads. Article 15.8 specifies about damages for breach of O&M obligations by the Concessionaire which would be higher of (a) 0.5% of Performance Security and (b) 0.1% of the cost of such repair or rectification as estimated by the Independent Engineer.
2.	Schedules	Technical Schedule Available	Draft schedules were shared with TC in on 18th Nov – 2022. Later revised technical schedule were shared on 19th Jan – 2023. These schedules are modified from the standard provisions given in manual as below: Sch A: Existing features Sch B: Scope of Work including facilities to be provided Sch C: Specifications and Standards Sch F: Maintenance Requirements Table 1 of Sch F provides maintenance criteria for pavements which has performance parameter, desirable and acceptable level of service, frequency of inspection and time limit for rectification/repair.

S. No.	List of Documents	Status of Documents	Remarks on Review
			Sch F specifies roughness value as 2000 mm/km desirable and 2400mm/km acceptable for flexible pavement. These values are 2200mm/km and 2400 mm/km respectively for rigid pavement. Sch B states that the concessionaire shall carry out the periodic maintenance in full length of the project stretch including main carriageway, service/slip Road, ramps and at facilities etc. either in every sixth year or in the year in which roughness index exceeds the limit as given in schedule F whichever comes earlier. Above schedules were modified by NHAI which were made available to us on 27-07-2023. Major change in this schedule from the above one was removing the initial construction work from the scope of the Concessionaire.
3.	Final Feasibility Report	Available	Final feasibility report done by M/s Chaitanya Projects Consultancy Pvt Ltd for NHAI in June – 2022 are made available for all five stretches. The reports specify about new constructions in terms of service road and associated CC drains etc. for all five stretches and construction of flyovers and underpasses. All these scopes are removed from the technical schedule. Thus these reports does not match with the requirements specified in technical schedules.
4.	FWD data	Available	The reports of FWD done by M/S Sterling Indo tech Consultants in April-2022 were available as a reference documents for TC.
5.	Latest MPRs	Partially available	MPRs are available only for the stretches from Kochugaon to Rakhaldubi Km 30+000 to Km 92+671, contract package As-08 Km 983+000 to Km 1013+000 and Guwahati bypass Km 146+172 to 162+620.These MPRs are prepared by the maintenance agency and for the month of July-August 2021 and provide details of minor maintenance work done during that time. MPR for Assam Bypass prepared by Authority Engineer is available for the August-2022 which provide details of ongoing construction work.
6.	Maintenance History	Not available	There is no maintenance history of the project road post completion of 4-laining. It is also understood that no major maintenance has been done on the project after the completion of 4-laning.
7.	O&M Agreement	Not available	NHAI is doing the maintenance and toll collection. No maintenance agreement was made available,
8.	NSV data	Available	The reports of NSV done by M/S Sterling Indo tech Consultants in April-2022 were available as a reference documents for TC.
9.	AADT for each section and Growth rate	Available	AADT along with traffic projections for the project roads have been provided by Client vide NHIIPL email dated 18.01.2023.
10.	Details of flyovers/ROB proposed by NHAI which is under implementation stage and its construction and maintenance schedule.	Partially available	Revised schedule A provides span details of structures which are supposed to be constructed by NHAI. It also states that construction of these structures shall be completed by September 2024 and shall be operated and maintained by the TOT concessionaire. However, there is no details

S. No.	List of Documents	Status of Documents	Remarks on Review
			available for the service road, junction improvement etc. TC team has assumed
11.	Concession Period	Not available	TC has adopted 20 years concession period with reference to round 2 CA.
12.	Projected Escalation factor	Not available	In absence of projected escalation factor, all cost are given at the present rate as per direction of the Client.
DOCUMENTS RELATED TO 4-LANING			
13.	Concession Agreement at the time of 4 laning	Not available	
14.	Supplementary agreements (if any) at the time of 4 lanning	Not available	
15.	As built drawings	Partially available	As built drawings are available except for the stretch under Patgaon toll plaza. These drawing are not easily readable. As built drawing for the stretch under Dhalapara toll plaza is having as-built cross-sections whereas for the remaining stretches, it is as-built plan-profile only. There is no as-built drawings for the structures
16.	DPR Pavement design report of 4-lane highway	Not available	
17.	Existing ROW detail	Available	Chainage-wise existing ROW details are provided in revised Sch A.
18.	TMS Equipment Details	Not available	
19.	Highway lighting details	Not available	
DOCUMENTS RELATED TO MAINTENANCE OF EXISTING ASSETS			
20.	IC inspection report, if applicable	Not applicable	
21.	Maintenance and Rehabilitation details for existing 4-lane pavement	Not available	
22.	History of maintenance cost	Not available	
23.	Historical data of Roughness and Deflections (Pavement evaluation studies so far conducted)	Not available	No such data is available. It could have been helpful in close analysis of the pavement for its deterioration if such tests are conducted and data made available.
24.	Manpower O&M	Not available	
25.	Source of construction materials	Not available	Detail information about source of construction material is not there in DPR except information of Crusher. During our investigation it is found that there are several source for crushed aggregate along the project length within the vicinity of 30 km from the proposed plant location for different packages. Lead chart showing these locations are appended in **Annexure – 5.1.**

5.3 Key Technical Issues

5.3.1 Deviations from Schedule-A

TC team has verified the provisions given in original schedule A while doing the inventory and condition survey of the project roads. Later it was found that few deviations initially found were not there in the revised schedule A. These deviations are mainly regarding type of rigid/flexible pavement, number of bus-bays, number of culverts and classification of underpasses. Deviations from revised schedule-A are given below:

Table 5.1: Deviations from Schedule-A

S. No.	Description			Kochugaon to Rakhaldubi		Rakhaldubi to Kaljhar	
				Sch-A	At Site	Sch-A	At Site
1	Total Project Length (km)			62.671	62.671	51.5	51.5
2	Service Roads/ Slip Roads (km)			16.14	16.14	13.27	13.27
3	Pavement (km)	Flexible	LHS	21.051	18	46.09	46.09
			RHS	28.931	28.26	5.62	5.62
		Rigid	LHS	41.626	44.45	5.41	5.41
			RHS	33.714	33.99	45.88	45.88
4	Bus Shelters (no.)			14	-	5	8
	Bus bays with Shelters (no.)			16	21	6	8
	Bus bays (no.)			-	9	5	4
5	Truck Lay-bays (no.)			-	-	-	-
6	Toll Plaza (no.)			1	1	1	1
7	Major Bridge (no.)			6	6	4	4
8	Minor Bridge (no.)			42	42	16	16
9	ROB/RUB			2	2	-	-
10	Culverts (no.)	Box		43	45	23	-
		Slab		4	13	10	34
		Pipe		9	4	-	-
11	At grade Intersections(no.)	Major		4	4	6	6
		Minor		98	98	94	94
12	Underpasses(no.)	VUP/SVUP		1	1	1	-
		LVUP		-	-	-	-
		PUP		1	3	1	2
13	Flyover (no.)			-	-	-	-
14	Viaduct (no.)			-	-	-	-

5.3.2 Deviations from Schedule-B

Deviations from revised schedule-B are given below.

S. No	Project Elements	Schedule B Provisions	TDD Assessment
1	Flexible Pavement	Improvements for flexible pavement in the all the project corridors has been proposed with 30mm BC.	As noted from technical surveys and detailed reconnaissance, there is significant drop in quality and routine maintenance and hence improvement may be required with 30mm BC, 40mm BC and strengthening by 40mm BC+50mm DBM where the sections are structurally inadequate to cater for design traffic.
2	Rigid Pavement	Improvement proposals for rigid pavement consists of Panel replacement, repair of corner breaks and spalling of joints	It observed that more number of panels requires rehabilitation and repairs than schedule B provisions. It also requires the replacement of joint sealant, repair of joint separation, pop out, ravelling etc.
3	Service Road	No improvement proposal for service road pavement was mentioned	As there is no maintenance works done so far for the service road pavements and hence proposed with 30mm BC as a periodic immediate maintenance works to improve the serviceability.
4	Structures	General repair works are proposed like epoxy grouting for treatment of spalling of concrete, clearing of vegetation, cleaning of drainage spouts, removal of debris from expansion joints, providing RCC crash barrier, filling pot holes etc.	Specific rehabilitation and repair work proposed for the structures in distressed conditions as observed during condition survey. These works are like repair of cracks and honeycombing in superstructure & substructure using low viscus injection grouting, repairing of pier cap cracks using low viscus injection grouting and confining with carbon wrap, Lubrication of bearings, replacement of expansion joints & bearings.

5.3.3 Under-construction Structures

NHAI has indicated in revised sch A that it is going to construct 3 flyovers, 1 trumpet interchange, 2 LVUPs. It also states that construction of these structures shall be completed by September 2024 and shall be operated and maintained by the TOT concessionaire. It is further mentioned that works such as service road construction, junction improvement, minor bridge, culverts etc. will also constructed by NHAI and same shall be maintained by TOT concessionaire.

There is no more detail available for the above work for accurate assessment of the maintenance cost of above assets during the entire concession period. As these assets are to be constructed and handed over by September 2024, NHAI should have at least the basis layout/planning if not the detailed design/drawings. Same may be made available for better understanding as these are to be maintained by the concessionaire for the entire concession period.

Section 6: Capital Expenditure (CapEx) Requirement

6.1 New Construction

Schedule B of each stretch specifies the requirements of new construction which the concessionaire has to construct after the appointment date. Major works and reference used to quantify these construction requirements are listed below:

- Exit-entry ramps for existing SR: Ref. Fig. 2.1C of IRC: SP:84-2019
- Median opening: New opening, closing of existing median opening and construction of storage lane for existing median opening as per Sch-B. [Ref. Cl. 2.14 of IRC: SP:84-2019
- Rainwater harvesting: Considered at 500m staggered interval
- Curve improvement: Additional signages and studs are considered as per Sch-B.
- Truck lay-bye & toilet blocks: 2 nos. considered for Kochugaon to Rakhaldubi as per Sch-B. [Ref. Fig 12.2 of IRC: SP:84-2019.
- Admin building and toll plaza: Though this requirement is not specified in Sch B, it is considered for all toll plazas in place of pota cabin except at Dahalpara toll plaza where admin building already exist. This is done in concurrence with the Client.

New construction Scope specified for each stretch is tabulated below:

Table 6.1: New Construction Requirements

S. No.	Description		Unit	Kochugaon to Rakhaldubi	Rakhaldubi to Kaljhar
1	Service Roads/ Slip Roads		Km	-	-
2	Exit/ Entry Arrangements	New	No	-	-
		Existing	No	-	-
3	Drain Improvement/ Proposal		Km	-	-
4	Pedestrian Guard Rail		Km	-	-
5	Truck Lay-bays		No	-	-
6	Toilet Block in Truck Lay-bays		No	-	-
7	Median Opening	New Opening	Km	0.02	0.04
		Close Opening	Km	0.12	0.09
8	Storage lane on existing Median Opening		Km	0.02	0.025
9	Rainwater Harvesting		No	124	103
10	Blackspot Rectification		No	2	9
11	At grade Intersections	Redesign	No	5	4
		New	No	9	8
12	Curve Improvements				
i)	Chevron Sign		No	521	86
ii)	No Overtaking		No	59	61
iii)	Curve Ahead		No	55	54
iv)	Solar Studs		No	3206	2646
v)	Cats Eye		No	21706	28672

S. No.	Description	Unit	Kochugaon to Rakhaldubi	Rakhaldubi to Kaljhar
13	Chute Drain in median	Km	-	-
14	Admin Building at Toll Plaza	No	1	-

Time to complete above construction works is 12 months from the Appointed Date.

6.2 Immediate Maintenance Requirements

6.2.1 Pavements

Based on the pavement condition and distress identification as explained in above sections of this report, immediate maintenance is required for repair and rehabilitation of existing pavement. Quantum of pavement rehabilitation for the entire project length for both flexible and rigid pavements in terms of length in km are presented below:

Table 6.2: Quantum of Pavement Rehabilitation (length in km)

Immediate **Maintenance**	Kochugaon to Rakhaldubi		Rakhaldubi – Kaljhar	
	LHS	RHS	LHS	RHS
Rigid Pavement				
No Immediate Maintenance Required	4.050	13.190	3.770	1.000
Crack sealing with epoxy	24.940	16.571	1.640	2.000
Partial depth repair/Panel replacement	15.890	4.450	0.000	33.990
Panel Replacement	0.000	0.000	0.000	9.000
Flexible Pavement				
No Immediate Maintenance Required	11.731	23.450	8.000	0.000
30mm BC Overlay	5.110	4.630	0.000	0.000
30mm milling and 30mm BC Overlay	0.000	0.000	30.190	5.510
50mm Milling and 50mm BC Overlay	0.950	0.380	7.900	0.000
50mm Milling with 50mm DBM and 40mm BC Overlay	0.000	0.000	0.000	0.000

Schedule B stipulates the obligation of immediate maintenance which is to be done by the incoming Concessionaire. However, NHAI has represented to NHIT that they will undertake the immediate maintenance themselves, confirming to CA obligations, before handing over the asset to NHIT.

6.2.2 Structures

TC team consists of structure audit team and bridge engineers have done the visual inspection of each and every structure. MBIU is used for the visual assessment of major structures having length greater than 60m. The team has also gone through the immediate rehabilitation measures for structures provisioned in Schedule B. Existing structure condition is presented in details in **Annexures 3.2, 3.3** and **4.8**. Immediate maintenance requirements as remedial measures against these defects are as below.

i) Replacement of bearings: The replacement of bridge bearings is a complex and specialized process that requires careful planning and execution to ensure the continued safety and stability of the bridge. In most cases, the bridge will need to be lifted in order to remove the old bearing and install the new one. This will involve the use of hydraulic jacks or cranes. Once

the bridge has been lifted, the old bearing can be removed using specialized tools. The new bearing is then installed in the same location as the old bearing. This may involve the use of epoxy or grout to secure the bearing in place. Once the new bearing is in place, the bridge can be lowered back into position. The new bearing should be tested to ensure that it is functioning properly and can safely support the weight of the bridge.

ii) Replacement of expansion joints: The old expansion joint is to be removed using specialized tools, such as a diamond blade saw or jackhammers. The area where the new joint is to be installed shall be cleaned and prepared to ensure a secure and stable installation. The new expansion joint shall be installed in the prepared area using specialized materials, such as silicone or neoprene. It shall be secured in place using bolts, clamps, or other fasteners. The new expansion joint should be tested to ensure that it is functioning properly and can safely accommodate the movement of the bridge deck.

iii) Cracks:-crack problem need to treated using low vicious injection grouting. Pack all the crack area both side and other loose area from outer using high strength mortar. Leave the mortar to set as per product description. Make holes in concrete using drill machine of 14mm diameter bit at depth of 75mm at an angle of 45 degree on both side of the cracks. These drill to be done at 300mm interval staggered. Fix 12mm diameter NRV steel nozzle and pack it with grout material from all sides. Leave the grout material to set as per product description. Once grout is set pump the epoxy based low vicious grouting with a pressure of 2kg/cm2 to 3kg/cm2. When pumping was complete leave the epoxy to set and after that cut the nozzles using grinder.

iv) Shear Cracks:- these cracks need to be packed first with high strength mortar from outside and then drill 45 degree both side of cracks for low vicious injection grouting. The injection grouting need to be done from top to bottom side.

v) Honeycombing:-Pack all the honeycombing area and other loose area from outer using high strength mortar. Leave the mortar to set as per product description. Make holes in concrete using drill machine of 14mm diameter bit at depth of 75mm at an angle of 45 degree. These drill to be done at 300mm interval staggered. Fix 12mm diameter NRV steel nozzle and pack it with grout material from all sides. Leave the grout material to set as per product description. Once grout is set pump the epoxy based low vicious grouting with a pressure of 2kg/cm2 to 3kg/cm2. When pumping was complete leave the epoxy to set and after that cut the nozzles using grinder.

vi) Honeycombing / spalling:-Pack all the honeycombing/ spalling area and other loose area from outer using high strength mortar. Leave the mortar to set as per product description. Make holes in concrete using drill machine of 14mm diameter bit at depth of 75mm at an angle of 45 degree. These drill to be done at 300mm interval staggered. Fix 12mm diameter NRV steel nozzle and pack it with grout material from all sides. Leave the grout material to set as per product description. Once grout is set pump the epoxy based low vicious grouting with a pressure of 2kg/cm2 to 3kg/cm2. When pumping was complete leave the epoxy to set and after that cut the nozzles using grinder.

vii) Reinforcement Exposed:- Remove the loose concrete manually (300mm extra all sides), remove rust from the reinforcement. If diameter is lost more than 30% then overlap new bars of same diameter, apply bonding agent to old concrete, fill the gap with proper cover using micro-concrete.

6.3 Capital Expenditure (CapEx)

Cost of capital expenditure (CapEx) are presented below.

Table 6.3: Cost of Capital Expenditure (CapEx)

Description	INR in Crores (EGIS Cost)	
	Kochugaon - Rakhaldubi	Rakhaldubi - Kaljhar
Rigid Pavements	-	-
Junction Improvement	3.812	4.105
Median Improvement	0.146	0.207
Service Road Improvement	2.439	0.213
Black Spot	0.227	1.780
Road Lighting	16.707	18.335
Road Safety Furniture	2.874	1.645
Structure Improvement & Repair	-	-
Toll Plaza	1.616	2.694
Miscellaneous	4.851	3.654
Total without GST	**32.672**	**32.634**
Total including GST (18%)	**38.55**	**38.51**

Section 7: Operation & Maintenance

7.1 General

The O & M requirements for the project facilities are specified in the Concession Agreement (CA) mainly under following Articles/ Schedules:

- Article 15 - Operation and Maintenance
- Article 16 - Monitoring and supervising during Operations
- Article 17 – Traffic Regulation
- Article 18 and Schedule H – Safety Requirements
- Schedule F- Maintenance Requirements

7.2 Requirement as per Concession Agreement

Schedule F of the Concession Agreement sets out the Operation and Maintenance requirements for the Project. As per this schedule, scope for Operation and Maintenance includes but not limited to following obligations:

- ✓ **Improvement** – This includes improvement of the existing assets as per requirement of this Agreement and safety audit.
- ✓ **Maintenance of Civil Works and Assets** – this includes maintenance of civil works and all assets as per requirement of this agreement.
- ✓ **Road Maintenance** – This includes routine maintenance, preventive maintenance, periodic maintenance as per IRC:82-2015, Design overlay as per Manual of 4- laning/6-laning, disaster maintenance, exigencies, and inspections.
- ✓ **Traffic Management** – This includes enforcement of regulations together with the relevant authorities. This also includes hazard response, information gathering and dissemination, Road patrols and ATMS surveillance etc.
- ✓ **Safety** – This includes accident prevention, after care, user education, enforcement, data collection and analysis.
- ✓ **Facility Management** – This includes periodic inspections, routine maintenance, Rehabilitation, and expansion planning.
- ✓ **Road property management** – This includes management of access, encroachment, and ribbon development.
- ✓ **General responsibilities** – This includes budgeting, compliance with legal and accounting requirements, and public relations.
- ✓ Maintaining public relations unit to interface with and attend to suggestions from users of the highway, the media, Govt. agencies and other external agencies.

Routine Maintenance: These are maintenance needs required on daily, weekly, monthly and annual basis for the smooth and efficient running of traffic and includes the activities of minor repairs of all project elements, cleaning of road furnitures, replacement of consumables, horticulture

maintenance, keeping the project site /project facilities clean, tidy and orderly condition free of litters and debris, preventing unauthorized entry and exit including any encroachment etc.

Preventive Maintenance: Preventive maintenance shall include the activities related to each element and the system as a whole of the Project Highway to ensure that during the Concession Period and at its end is in sound, durable and functional condition. In other words Preventive maintenance are a planned strategy of cost-effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system (without significantly increasing the structural capacity).

Periodic Maintenance: These are maintenance needs required on periodic annual basis. The periodic maintenance can be further divided into two sub heads namely (i) functional overlay to improve the riding quality and (ii) structural overlay to improve the structural strength of the pavement.

Factor influencing periodic maintenance: performance parameter for flexible pavement in terms of roughness as given in Schedule F is 2000 mm/km as desirable and 2400 mm/km as acceptable. Clause 4 (III) of Schedule B states that periodic maintenance shall be carried out in full length of the project stretch including main carriageway, service/slip road and at facilities etc. either in every six years or in the year in which roughness index exceeds the limit given in schedule F, whichever comes earier.

7.3 O&M Cost Estimation

7.3.1 Routine maintenance

This is a day to day work that is necessary to preserve and keep a pavement as close to as constructed condition and to ensure smooth and functional conditions all the times. The item in this subhead include maintenance of earthen shoulder, restoration of rain cuts, maintenance of slope protection works, cleaning of road side drains, cleaning of carriageway, maintenance of structures, repairs of road surface such as filling of potholes, repairing of cracks and patch works, carrying out of Road roughness survey, FWD test etc.

7.3.2 Repair/Maintenance

Repair/maintenance covers the minor repair which are required on day to day maintenance to maintain the assets in good condition. This is sub-divided in two categories as below:

a) **Preventive Maintenance:** The preventive maintenance is required to be done for further improve or extend the functional life of pavement surface whist in fair to good condition. Any of the treatment under preventive maintenance does not significantly increasing the structural capacity of pavement rather which decreases rate of surface deterioration, which may result in saving of pavement from leading to poor condition where major maintenance could be inevitable.

   Future preventive maintenance on the project road depends largely on routine inspection of the pavement with careful observation of specific distress and to take a decision at that time and suitable type of preventive maintenance treatment and its timing. All the narrow and wide surface cracks must be arrested immediately after identification with fog/slurry

seals as the most recommend preventive type maintenance measure for the in-service flexible pavement.

Based on the condition and distress identification survey as explained above paragraph, preventive maintenance treatments have to be taken up immediately to reduce rate of further damage to the surface and for enhance the pavement performance to the condition similar to non-distressed surface condition.

b) **Road Property Maintenance:** The items in this subhead covers the plantation/ maintenance of shrubs, turfing, replacement/ repair of damaged railing, crash barrier, kerbs, road delineators, signage, Road marking and painting etc.

7.3.3 Toll Management System

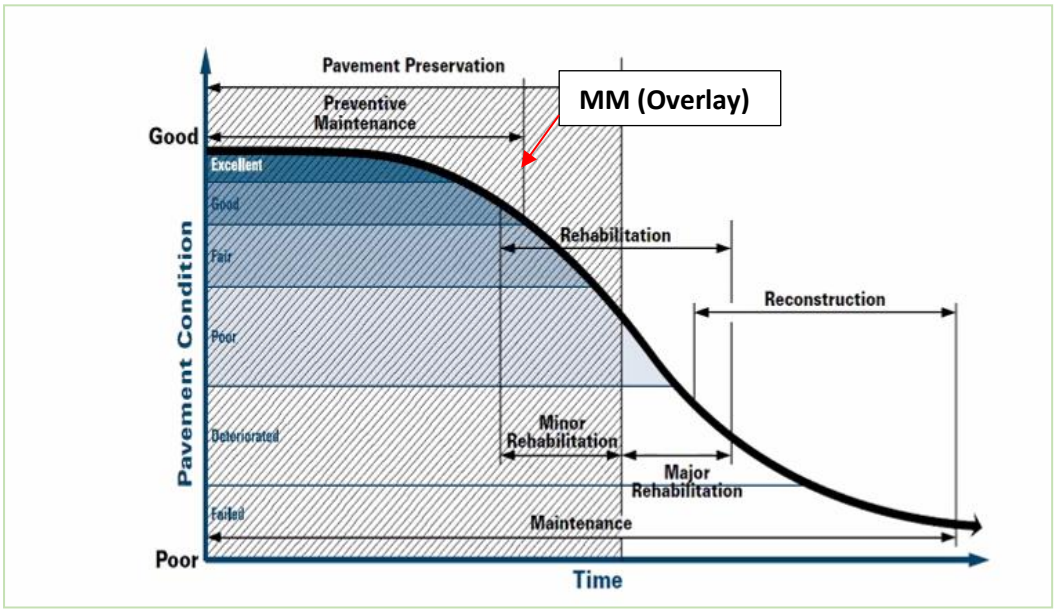
Cost estimate for Toll Management System was worked out by TC. Same was presented and deliberated during the investor meet on 6th of February where it was decided to adopt the rationalised cost finalized by IM.

7.3.4 Corridor Management

Incident Management: The items in this subhead include minimize the effects of incident and restore normal capacity and safety levels to all affected road facilities as efficiently as possible and. repair/ replacement of removing the dead animals & broken-down vehicles etc.

7.4 Major Maintenance

The pavement deteriorates with time caused by traffic movement and weather conditions. The rate of deterioration depends on the original design, type of maintenance being done/undertaken and time of application. Therefore, timely and appropriate maintenance of bituminous surface using suitable materials is essential to increase the pavement service life to a greater extent. Any delay in maintenance of the pavement substantially increase severity of the distresses, which results into poor condition of pavement as depicted in figure below and thereby increase in maintenance costs to bring the surface to a good condition.



Therefore, timely maintenance of the pavement is required for its satisfactory performance both in terms of functionally and structurally during the pavement service life.

Schedule F of the Concession Agreement set out the maintenance requirements in the Project. The performance parameters are indicated in schedule F descripting the nature of defect/deficiency along with time limits for repair/rectification for roads and bridges.

Schedule F, Pavement Roughness Value (Functional Overlay): The Periodic maintenance is required to be provided as and when performance parameters in terms of cracking, roughness and rutting etc. exceeded the limits as indicated in the schedule F anytime during the service life of the pavement. As per the provisions of Concession agreement, Surface roughness value is the major governing factor for selection of an appropriate pavement maintenance treatment required to bring the roughness value below the prescribed limit of 2000mm/km.

Pavement Strengthening (Structural Overlay): When the pavement is structurally deficient having high severity alligator/fatigue cracks, rutting and other associated distresses, then the structural overlay is required to be provided for strengthening of the pavement to cater for the anticipated design traffic. The pavement strengthening may be required when the

- Remaining life of the in-service pavement as evaluated using Falling Weight Deflectometer (FWD) is less the design traffic as calculated till end of the concession.
- Before expiry of initial design traffic as adopted at the time of asset construction.

7.4.1.1 Review of Pavement Design (4-lane Construction)

The Pavement design for Main Carriageway (combination of flexible and rigid type adopted along the project length) has been designed as per IRC-37-2001 for flexible pavement and IRC:58-2002 for rigid pavement. The flexible type pavement was adopted for service roads.

There are no records made available to pavement design report of 4-lane construction neither in As-built drawings nor other information shared by NHIIPL. However, the based on the information available from the source of IE documents at the time of 4-lane construction, the following composition and thickness has been adopted for 4-lane construction.

Main Carriageway (MCW): Flexible Pavement

BC:50mm, DBM:125mm, BM:75mm, WMM:250mm, GSB:250mm and subgrade:500mm, designed for 150MSA.

Service Roads (SR): Flexible Pavement

BC:25mm, BM:75mm, WMM:200mm, GSB:230mm and subgrade:500mm, designed for 2 MSA traffic.

Toll Plaza Rigid pavement

PQC: 300mm M40, DLC 150mm M15 and GSB 200mm with a subgrade of 500mm.

7.4.1.2 Review of Major Maintenance History

There are no details available regarding type of maintenance/rehabilitation that has been carried out so far in the project after completion of construction.

As per the discussion with local site teams, there is no such major maintenance works has been carried out neither the pavement nor structure/other element of the highway. From the site reconnaissance by the present consultant's, it appears that some of the heavily distressed are being repaired manually by applying thin bituminous overlays. As the project assets are not being maintained to the desired level of serviceability, therefore, there is a drop in asset quality in general.

7.4.1.3 Design Traffic during the Concession Period

The design traffic in terms of MSA during the concession period has been calculated based on the current traffic pattern and data shared by the NHIIPL. The Vehicle Damage Factors (VDF) has been adopted as obtained from the present survey. The summary of design traffic during the concession period is as under.

Table 7.1: Summary of Design Traffic during Concession Period

Project Stretch	Direction	Design Traffic in MSA	
		10 years (FY32)	10 years (FY42)
Kochugaon - Rakhaldubi Section	LHS	60	152
	RHS	40	100
Rakhaldubi - Kaljhar Section	LHS	66	166
	RHS	40	99

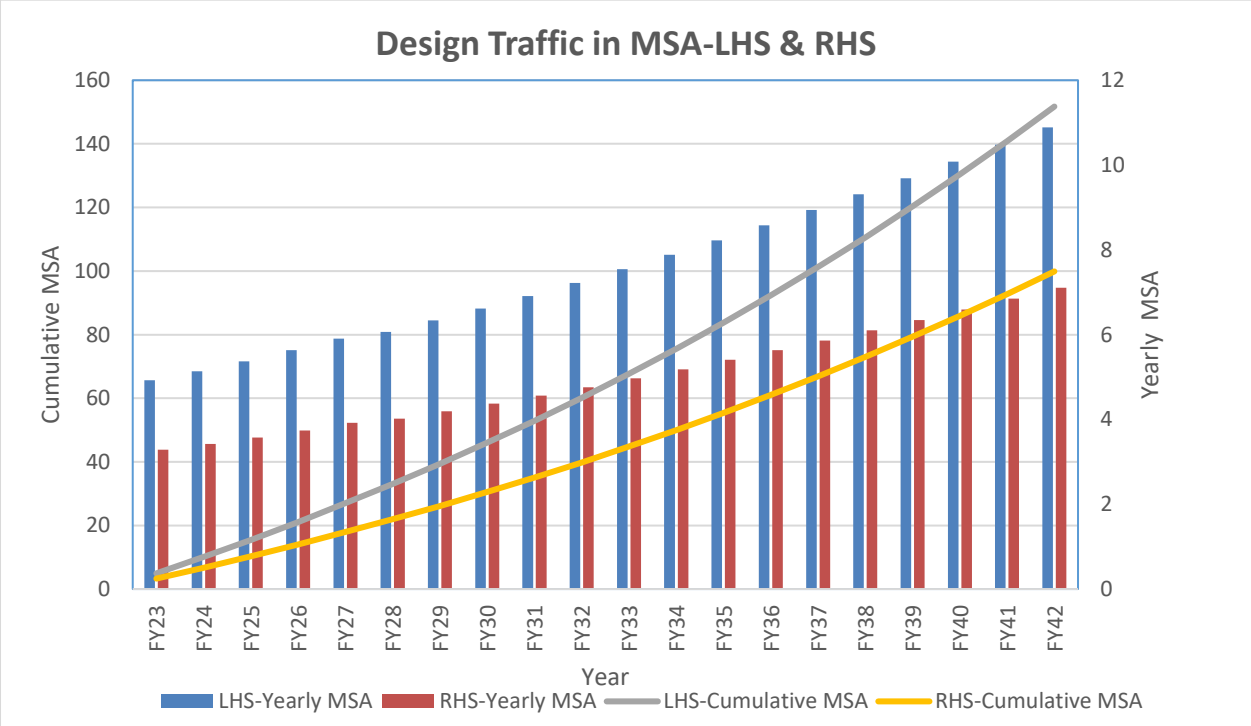


Figure 7.1: Design Traffic in MSA (Kochugaon - Rakhaldubi Section)

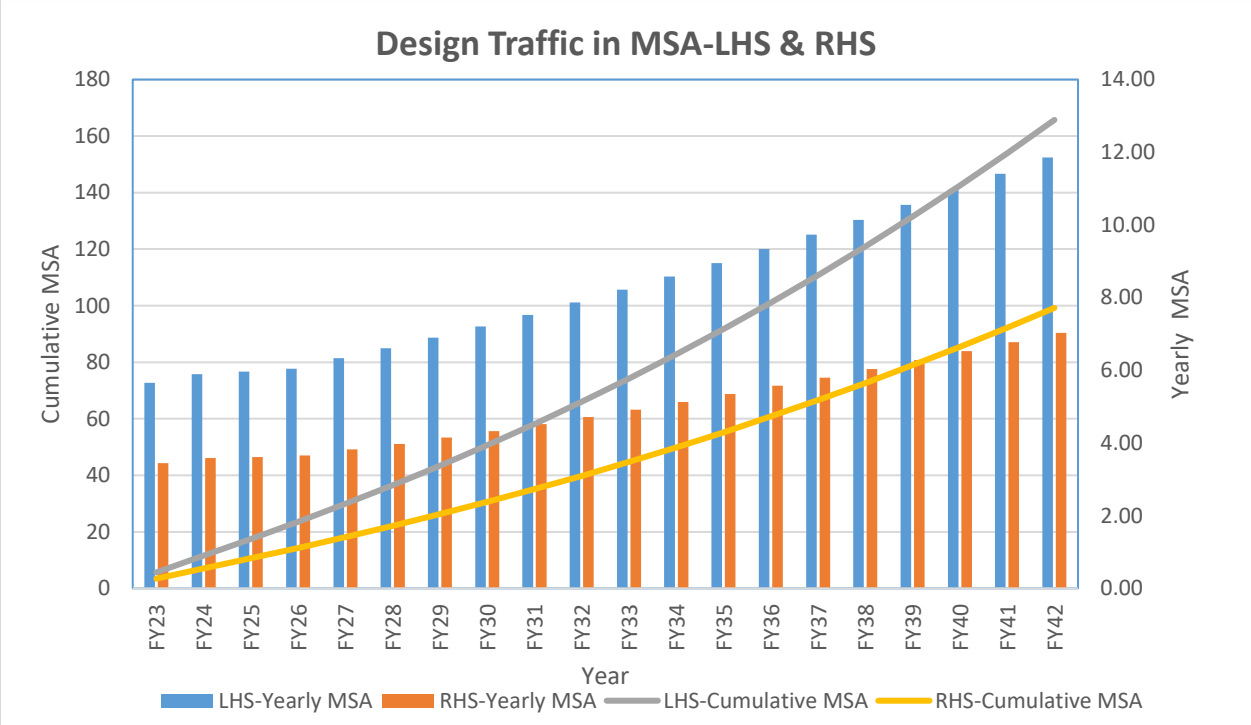


Figure 7.2: Design Traffic in MSA (Rakhaldubi - Kaljhar Section)

In combination of above anticipated design traffic patterns, remaining life of the existing pavement as explained under surveys and investigation chapter, the pavement condition for distresses and roughness, the existing pavement is requiring repair and rehabilitation to be carried out by the TOT concessionaire to bring the pavement surface to the desired level of serviceability.

7.4.1.4 Immediate Pavement Rehabilitation Measures

Based on the pavement distress identification and after its functional and structural evaluation, the following immediate rehabilitation measures is suggested to improve the pavement condition to the desired level of serviceability for the present and projected traffic patterns in the project highway.

Flexible Pavement:

Description	Suggested Rehabilitation Measure	Rated Pavement Condition
Good condition for both Distress and Roughness	Nil	Good
Good condition for Distress and Fair Condition for Roughness	40mm BC Overlay	Fair
Good condition for Distress and Poor Condition for Roughness	40mm BC Overlay	Fair
Fair Condition for Distress and Good Condition of Roughness	Nil	Good
Fair Condition for both Distress and Roughness	40mm BC Overlay	Fair
Fair Condition for Distress and Poor Condition of Roughness	40mm BC Overlay	Fair
Poor Condition for Distress and Good Condition for Roughness	Nil	Good
Poor Condition for Distress and Fair Condition for Roughness	40mm BC Overlay	Fair
Poor Condition for both Distress and Roughness and high Remaining Life	50mm Milling and 50mm BC Overlay	Poor
Poor Condition for both Distress and Roughness and lower Remaining Life	50mm Milling with 50mm DBM and 40mm BC Overlay	Poor

Rigid Pavement:

Distress Severity	Suggested Rehabilitation Measure	Rated Pavement Condition
0	Nil	Good
1	Crack sealing with epoxy	Fair
2	Partial depth repair/Panel replacement	Poor
3	Partial depth repair/Panel replacement	Poor
4	Panel Replacement	Poor
5	Panel Replacement	Poor

Complete treatment proposals suggested for repair and rehabilitation of rigid pavement is provided in table below.

S. No	Distress type	Distress Severity	Treatment
1	Longitudinal Cracks	0	No action, but need to be monitored
		1	Sealing with epoxy
		2	Sealing with epoxy
		3	Partial depth repair
		4	Partial depth repair
		5	Panel replacement
2	Transverse cracks	0	No action, but need to be monitored
		1	Sealing with epoxy
		2	Sealing with epoxy
		3	Panel Replacement
		4	Panel Replacement
		5	Panel Replacement
3	Multiple Cracks	0	No action, but need to be monitored
		1	Seal with epoxy
		2	Seal with epoxy
		3	Full depth repair
		4	
		5	
4	Corner Breaks	0	No action, but need to be monitored
		1	Sealing with epoxy
		2	Sealing with epoxy
		3	Full depth repair
		4	Full depth repair
		5	Full depth repair with subbase
5	Joint Damage/Spalling	0	No action, but need to be monitored
		1	Sealing with epoxy
		2	Sealing with epoxy
		3	Repair up to 50mm thickness
		4	Repair up to 50mm thickness
		5	Repair up to 100mm thickness
6	Joint Sealant Defects	0	No action, but need to be monitored
		1	Cleaning
		2	Cleaning
		3	Sealant replacement
		4	Sealant replacement
		5	Sealant replacement
7	Joint Separation	0	No action, but need to be monitored
		1	No action, but need to be monitored
		2	No action, but need to be monitored
		3	No action, but need to be monitored

S. No	Distress type	Distress Severity	Treatment
		4	No action, but need to be monitored
		5	Fill the joint with M40 concrete
8	Joint Faulting	0	No action
		1	Monitoring
		2	Diamond grinding
		3	Diamond grinding
		4	Panel replacement
		5	Panel replacement
9	Blow ups	0	No action
		1	No action
		2	No action
		3	Full depth repair
		4	Full depth repair
		5	Panel replacement
10	Ravelling	0	No action
		1	Repair with epoxy
		2	Repair with epoxy
		3	Repair with epoxy
		4	Repair with epoxy
		5	Panel replacement
11	Scaling	0	No action
		1	Repair with epoxy
		2	Repair with epoxy
		3	Repair with epoxy
		4	Repair with epoxy
		5	Panel replacement
12	Potholes/Popouts	0	No action
		1	Partial depth repair up to 65mm
		2	Partial depth repair up to 100 mm
		3	Partial depth repair up to 100 mm
		4	Partial depth repair up to 100 mm
		5	Full depth repair

7.4.1.5 Immediate and Future Major Maintenance Requirement

Major maintenance is required in order to comply with provisions of concession agreement and to maintain performance levels as defined in schedule F throughout the operation and maintenance period.

As per schedule B, the TOT concessionaire shall carryout the periodic maintenance in full length of the project stretch including main carriageway, service roads and facilities in every 6th year or the year in which roughness index exceeds the limits given in schedule F, whichever comes earlier.

Therefore, considering the initial pavement design period and crust, remaining life data, anticipated traffic loading during the concession period, and in compliance to the provisions of schedule B, the following cycles of Major maintenance is proposed for satisfactory performance of the pavement during operation period for both functionally and structurally.

Table 7.2: Proposed Major Maintenance Cycles for Balance Concession period

Year of Concession	O & M Year	Kochugaon - Rakhaldubi	Rakhaldubi - Kaljhar	Service Road
1 (Immediate) *As NHAI is doing the immediate maintenance before handing over the asset to NHIT, assessed immediate maintenance requirement is not considered in the cost.*	2023-24	**Flexible Pavement:** LHS: 40mm BC Overlay for 32% length, 50mm BC overlay for 45% length and 13% with NIL RHS: 40mm BC Overlay for 41% length and 59% length with NIL **Rigid Pavement:** As per the pavement condition and its distress rating as presented in chapter titled Surveys and Investigations.	**Flexible Pavement:** 30mm BC overlay for entire length after milling to a depth of 30mm except for the following stretches where requires strengthening by 50mm BC after milling to a depth of 50mm. LHS: km 970-971, km 974-976, km 980-981, km 996-997 and km 1000-1001 **Rigid Pavement:** As per the pavement condition and its distress rating as presented in chapter titled Surveys and Investigations.	30mm BC for the entire length of service road for all 5 stretches.
6	2029-30	**Flexible Pavement:** 40mm BC Overlay for 40% length, 40mm BC overlay for 40% length and 50mm BC overlay for 20% length **Rigid Pavement:** Sealant replacement for 100% length, 1% for pothole filling and 0.5% for panel replacement. Diamond grinding to improve the riding quality for 100% length.	**Flexible Pavement:** 40mm BC Overlay for 40% length, 40mm BC overlay for 40% length and 50mm BC overlay for 20% length **Rigid Pavement:** Sealant replacement for 100% length, 1% for pothole filling and 0.5% for panel replacement. Diamond grinding to improve the riding quality for 100% length.	30mm BC for the entire length of service road for all 5 stretches.
12	2035-36	**Flexible Pavement:** 40mm BC overlay using RAP from milling for 75% length and 50mm BC overlay using RAP from milling for 25% length **Rigid Pavement**: Sealant replacement for 100% length, 0.5% for pothole filling and 0.5% for panel replacement. Diamond grooving to improve the skid resistance for 100%	**Flexible Pavement:** 40mm BC overlay using RAP from milling for 75% length and 50mm BC overlay using RAP from milling for 25% length **Rigid Pavement**: Sealant replacement for 100% length, 0.5% for pothole filling and 0.5% for panel replacement. Diamond grooving to improve the skid resistance for 100%	30mm BC for the entire length of Service road except for the stretches where capacity augmentation construction is in progress.
18	2041-42	**Flexible Pavement:** 40mm BC overlay for full length **Rigid Pavement:** Sealant replacement for 100%, 0.5% for panel replacement and 0.5% for repair of corner breaks.	**Flexible Pavement:** 40mm BC overlay for full length **Rigid Pavement:** Sealant replacement for 100%, 0.5% for panel replacement and 0.5% for repair of corner breaks.	30mm BC for the entire length of service road for all 5 stretches.

7.4.1.6 Structures

As no NDT reports are available and neither design documents stating design life are available it's not feasible to assess life expectancy of existing structures. However, based on the past experiences regarding working life of different structure elements, replacement cycles and major maintenance cost of structures is analysed based on the following:

- Wearing coat replacement every 6th years
- Expansion joint replacement every 12th years
- Elastomeric bearing replacement every 12th years
- POT PTFE Bearing every 20th years.

7.4.1.7 Cost of Operation & Maintenance

Cost of Operation & Maintenance per annum are presented below.

Table 7.3: Cost of Operation & Maintenance (per annum)

Description	INR in Crores (EGIS Cost)	
	Kochugaon - Rakhaldubi	Rakhaldubi - Kaljhar
Tolling Operations	3.24	4.21
Incident Management	2.23	2.21
Routine Maintenance	3.28	3.14
Repairs	1.98	1.67
ATMS	-	-
Admin Expenses	4.48	4.48
Insurance	1.43	1.05
Total	**16.64**	**16.76**

Table 7.4: Cost of Operation & Maintenance (entire concession period)

Year of Concession	O & M Year	Kochugaon – Rakhaldubi (in Cr.)			Rakhaldubi – Kaljhar (in Cr.)		
		O & M Cost	Special Repair	Total O&M Cost	O & M Cost	Special Repair	Total O&M Cost
1	2023-24	16.64		16.64	16.76		16.76
2	2024-25	16.64		16.64	16.76		16.76
3	2025-26	16.64		16.64	16.76		16.76
4	2026-27	16.64		16.64	16.76		16.76
5	2027-28	16.64	12.35 *	28.99	16.76	10.15 *	26.91
6	2028-29	16.64		16.64	16.76		16.76
7	2029-30	16.64		16.64	16.76		16.76
8	2030-31	16.64		16.64	16.76		16.76
9	2031-32	16.64		16.64	16.76		16.76
10	2032-33	16.64		16.64	16.76		16.76
11	2033-34	16.64		16.64	16.76		16.76
12	2034-35	16.64		16.64	16.76		16.76
13	2035-36	16.64		16.64	16.76		16.76
14	2036-37	16.64		16.64	16.76		16.76

Year of Concession	O & M Year	Kochugaon – Rakhaldubi (in Cr.)			Rakhaldubi – Kaljhar (in Cr.)		
		O & M Cost	Special Repair	Total O&M Cost	O & M Cost	Special Repair	Total O&M Cost
15	2037-38	16.64		16.64	16.76		16.76
16	2038-39	16.64		16.64	16.76		16.76
17	2039-40	16.64		16.64	16.76		16.76
18	2040-41	16.64		16.64	16.76		16.76
19	2041-42	16.64		16.64	16.76		16.76
20	2042-43	16.64		16.64	16.76		16.76

** A cost provision is done to undertake unforeseen repair works.*

7.4.1.8 Periodic Maintenance

Cost of Periodic Maintenance (Base year 2024) including GST, but excluding escalation are presented below.

Table 7.5: Cost of Periodic Maintenance (Kochugaon – Rakhaldubi)

Year	Periodic Maintenance (INR in Crores)				
	Functional +Structural overlay MCW+ S/R	Major Maintenance of Rigid Pavement	Replacement of ATMS	Replacement of TMS	Structure specified repairs
2023-2024					
2024-2025					
2025-2026					
2026-2027					
2027-2028					
2028-2029					
2029-2030	46.11	15.13			25.34
2030-2031				0.95	
2031-2032					
2032-2033					
2033-2034					
2034-2035					
2035-2036	38.80	8.87			8.37
2036-2037					
2037-2038				1.91	
2038-2039					
2039-2040					
2040-2041					
2041-2042	44.93	4.28			8.37
2042-2043					
2043-2044					
Total	**129.84**	**28.28**	**-**	**2.86**	**42.08**
Grand Total					**203.04**

Table 7.6: Cost of Periodic Maintenance (Rakhaldubi - Kaljhar)

Year	Periodic Maintenance (INR in Crores)				
	Functional +Structural overlay MCW+ S/R	Major Maintenance of Rigid Pavement	Replacement of ATMS	Replacement of TMS	Structure specified repairs
2023-2024					
2024-2025					
2025-2026					
2026-2027					
2027-2028					
2028-2029					
2029-2030	43.92	21.42			21.57
2030-2031				1.59	
2031-2032					
2032-2033					
2033-2034					
2034-2035					
2035-2036	28.40	21.07			-
2036-2037					
2037-2038				3.18	
2038-2039					
2039-2040					
2040-2041					
2041-2042	32.31	21.07			-
2042-2043					
2043-2044					
Total	**104.63**	**63.56**	**-**	**4.77**	**21.57**
Grand Total					**194.51**

Section 8: Analysis & Comparisons with Seller Data

The cost estimates have been prepared for each stretch of the project road which includes cost of immediate maintenance work, new service road and allied works, road furniture, toll plazas improvement & ATMS etc. CapEX and O&M cost estimated as described in above chapters are compared with the estimate prepared by the Consultant of NHAI. Outcome of this comparison is presented in this chapter.

8.1 CapEx

CapEx requirements are in terms of immediate maintenance requirements assessed with the help of various survey and investigations by Technical Consultant team. Detailed quantification and costing of new works are also done as provisioned in schedule B. These costs are then compared with the estimate prepared by NHAI consultant. Comparison of CapEx cost with NHAI is presented below in **Table 8.1**.

Table 8.1: Comparison of CapEX with NHAI Estimate

Description	INR in Crores			
	Kochugaon - Rakhaldubi		Rakhaldubi - Kaljhar	
	NHAI Cost	EGIS Cost	NHAI Cost	EGIS Cost
Rigid Pavements	0.173	-	0.388	-
Junction Improvement	3.349	3.812	2.733	4.105
Median Improvement	0.515	0.146	0.606	0.207
Service Road Improvement	2.500	2.439	0.247	0.213
Black Spot	0.424	0.227	4.748	1.780
Road Lighting	2.749	16.707	3.026	18.335
Road Safety Furniture	2.631	2.874	1.652	1.645
Structure Improvement & Repair	6.595	-	2.616	-
Toll Plaza	-	1.616	-	2.694
Miscellaneous	-	4.851	-	3.654
Total without GST	18.937	32.672	16.017	32.634
Total including GST (18%)	**22.35**	**38.55**	**18.90**	**38.51**

8.2 O&M Cost

Operational and routine maintenance cost are also compared with that of NHAI estimate. Comparison of operational expenses in terms of number of toll booths and routine maintenance cost in terms of per km length is presented below in **Table 8.2**.

Table 8.2: O&M Cost Comparison (Cost incl. GST)

Description	INR in Crores			
	Kochugaon - Rakhaldubi		Rakhaldubi - Kaljhar	
	NHAI Cost	EGIS Cost	NHAI Cost	EGIS Cost
Tolling Operations	3.00	3.24	2.93	4.21
Incident Management	5.67	2.23	4.68	2.21

Description	INR in Crores			
	Kochugaon - Rakhaldubi		Rakhaldubi - Kaljhar	
	NHAI Cost	EGIS Cost	NHAI Cost	EGIS Cost
Routine Maintenance		3.28		3.14
Repairs		1.98		1.67
ATMS	2.36	-	2.05	-
Admin Expenses	5.28	4.48	5.28	4.48
Insurance	1.01	1.43	1.01	1.05
Total	**17.32**	**16.64**	**15.96**	**16.76**

8.3 Major Maintenance and Total Cost Comparison

Major maintenance cost for any project is specific to the site condition such as traffic, climate, overloading, asset condition, workmanship during initial construction etc. Cost given in NHAI DPR is compared with the estimate prepared by TC. This comparison for major maintenance is presented below in **Table 8.3**.

Table 8.3: Maintenance Cost (Cost incl. GST)

Particulars	INR in Crores			
	Kochugaon - Rakhaldubi		Rakhaldubi - Kaljhar	
	NHAI Cost	EGIS Cost	NHAI Cost	EGIS Cost
Cycle 1				
Functional +Structural overlay MCW+ S/R	28.95	46.11	29.96	43.92
Major Maintenance of Rigid Pavement		15.13		21.42
Replacement of **ATMS**		-		-
Replacement of **TMS**		0.95		1.59
Structure specified repairs		25.34		21.57
Total		**87.53**		**88.50**
Cycle 2				
Functional +Structural overlay MCW+ S/R	28.95	38.80	29.96	28.40
Major Maintenance of Rigid Pavement		8.87		21.07
Replacement of **ATMS**		-		-
Replacement of **TMS**		1.91		3.18
Structure specified repairs		8.37		-
Total		**57.95**		**52.65**
Cycle 3				
Functional +Structural overlay MCW+ S/R	28.95	44.93	29.96	32.31
Major Maintenance of Rigid Pavement		4.28		21.07
Replacement of **ATMS**		-		-
Replacement of **TMS**		-		-
Structure specified repairs		8.37		-
Total		**57.58**		**53.37**

Section 9: Conclusion

The 4-lane construction of project highway has been completed on EPC basis and at present toll is being collected by Toll Collection Agency appointed by NHAI. Even after so many years of completion of 4-lane construction, there is no major maintenance works carried out neither for pavement nor structure/other element of the highway, there is a drop in asset quality and condition. it appears that some of the heavily distressed are being repaired manually by applying thin bituminous overlays. As part of present study, various physical testing and visual site inspections were conducted to evaluate the asset condition and to establish the required maintenance and rehabilitation measures/decisions. Based on the site reconnaissance, it is appraised that majority of the locations, the LHS carriageway is distressed due to overloading of truck traffic compared to RHS where distresses potholes, cracks, patches, joint failures are noted predominantly. Based on the results of physical testing, condition assessment, review of available reports/data, analysis of remaining life data, the project stretch would require immediate overlay and accordingly suitable major maintenance and rehabilitation measures are suggested under immediate major maintenance requirement. The period maintenance by functional/structural overlays are required at every 6th year would be sufficient to keep the project stretch in good condition and hence the suitable measures of major maintenance for periodic renewals as required during the concession period has also been suggested.

Based upon the site visit for assessment of condition of CD structures including MJB, MNBs, ROB, VUPs, Culverts and toll plaza buildings in the project corridor and observations submitted in various chapters of this report it is concluded that there are requirements of major repairs in few major structures in terms of repairs of honeycombing, repair of cracks, replacement of damaged bearings and treatment of spalling. Repair and rehabilitation measures are proposed in this report, and it is advised to conduct NDT test before doing repair-rehabilitation works to verify these rehabilitation proposal.

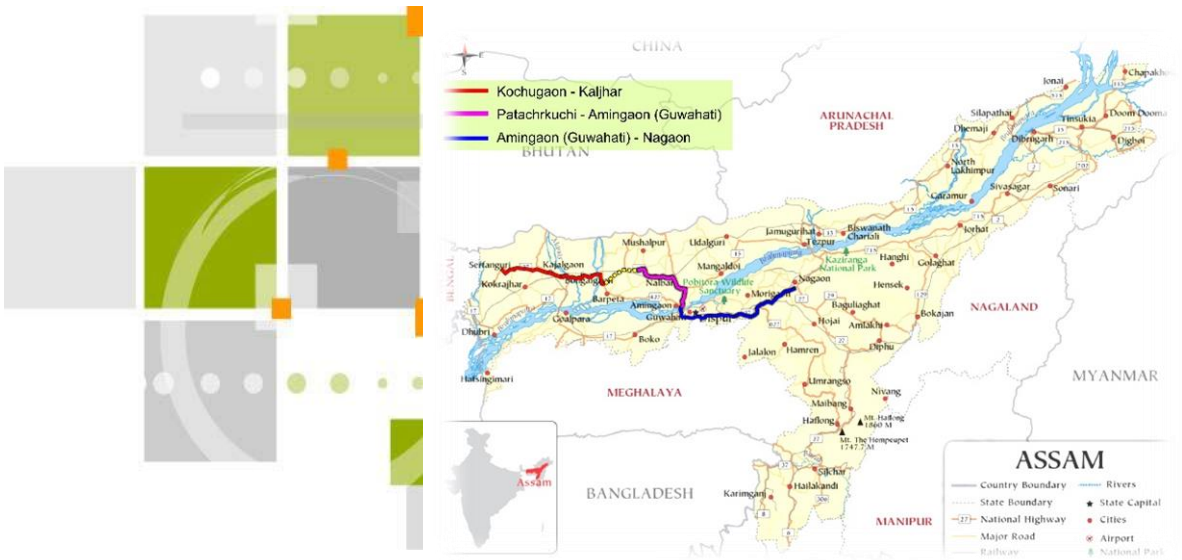
Schedule B stipulates the obligation of immediate maintenance which is to be done by the incoming Concessionaire. However, NHAI has represented to NHIT that they will undertake the immediate maintenance themselves, confirming to CA obligations, before handing over the asset to NHIT.

FINAL TECHNICAL DUE-DILIGENCE REPORT

(Annexures)

Technical Consultant Services for National Highways Infra Trust

Kochugaon to Rakhaldubi and Rakhaldubi to Kaljhar Section of NH-27 in the State of Assam



October 2023

egis India
Consulting engineers pvt. ltd.

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Road Inventory

Road Inventory (Part-I)

Road Name: NH-27_ Kochugaon to Rakhaldubi Pkg-I | **Date : 30/11/2022 to 01/12/2022**

Direction: BHS | **Weather :**

Chainage (km)		Land Use[2]	Chainage (km)		Land Use[2]	Chainage (km)		Carriageway Surface LHS				Chainage (km)		Carriageway Surface RHS				Chainage (km)		Shoulder/Seperator LHS		Shoulder/Seperator RHS	
								Main Carriageway		Paved Shoulder				Main Carriageway		Paved Shoulder							
From	To	LHS	From	To	RHS	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[4]	Width (m)	Type[4]	Width (m)
30.016	30.110	Water Bodies	92.439	92.390	Agriculture	30.010	30.510	CC	7.0	cc	1.5	30.210	30.480	BT	7.0	BT	1.5	30.000	39.834	Earthen	1.5		
30.122	30.262	Agriculture	92.379	92.330	Residential	30.510	32.010	BT	7.0	BT	1.5	30.480	43.110	CC	7.0	CC	1.5	39.834	40.740	Seperator			
30.271	30.302	Water Bodies	92.319	92.170	Commercial	32.010	38.010	CC	7.0	CC	1.5	43.110	46.010	BT	7.0	BT	1.5	40.740	76.370	Earthen	1.5		
30.319	30.330	Water Bodies	92.153	91.480	Agriculture	38.010	39.540	BT	7.0	BT/ES	1.5	46.010	46.420	CC	7.0	CC	1.5	76.370	78.090	Seperator			
30.347	30.467	Agriculture	91.463	91.380	Water Bodies	39.540	39.760	CC	7.0	CC/ES	1.59	46.420	47.510	BT	7.0	BT	1.5	78.090	79.115	Earthen	1.5		
30.482	30.521	Agriculture	91.363	90.300	Agriculture	39.760	40.750	CC	7.0	CC	1.5	47.510	52.100	CC	7.0	CC	1.5	79.115	83.230	Seperator			
30.490	30.510	Mixed	90.281	89.410	Commercial	40.750	43.170	BT	7.0	BT	1.5	52.100	53.250	BT	7.0	BT	1.5	83.230	87.335	Earthen	1.5		
30.552	30.850	Agriculture	89.393	89.100	Agriculture	43.170	44.560	CC	7.0	CC	1.5	53.250	55.100	CC	7.0	CC	1.5	87.335	88.480	Seperator			
30.870	30.880	Agriculture	89.088	88.840	Commercial	44.560	44.960	CC	7.0	CC/ES	1.5	55.100	62.040	BT	7.0	BT	1.5						
30.900	32.210	Agriculture	88.829	87.620	Agriculture	44.960	47.580	CC	7.0	CC	1.5	62.040	63.760	CC	7.0	CC	1.5	88.525	87.240			Seperator	
32.227	32.237	Water Bodies	87.609	87.540	Industrial	47.580	52.140	BT	7.0	BT	1.5	63.760	76.090	BT	7.0	BT	1.5	87.240	83.125			Earthen	1.5
32.246	32.350	Water Bodies	87.528	87.380	Commercial	52.140	62.050	CC	7.0	CC	1.5	76.090	76.820	CC	7.0	CC	1.5	83.125	78.890			Seperator	
32.367	32.480	Agriculture	87.379	87.250	Agriculture	62.050	63.780	BT	7.0	BT	1.5	76.820	78.120	BT	7.0	BT	1.5	78.890	78.103			Earthen	1.5
32.497	32.510	Mixed	87.239	87.110	Commercial	63.780	78.280	CC	7.0	CC	1.5	78.120	79.000	CC	7.0	CC	1.5	78.103	76.280			Seperator	
32.526	32.580	Agriculture	87.094	87.060	Water Bodies	78.280	79.050	BT	7.0	BT	1.5	79.000	79.930	CC	7.0	CC	1.5	76.280	40.680			Earthen	1.5
32.597	32.620	Water Bodies	87.044	86.900	Agriculture	79.050	79.170	CC	7.0	CC	1.5	79.930	80.950	CC	7.0	CC	1.5	40.680	39.790			Seperator	
32.638	33.588	Agriculture	86.884	86.790	Commercial	79.170	80.050	CC	10.5	CC	1.5	80.950	83.200	BT	7.0	BT	1.5	39.790	30.000			Earthen	1.5
33.592	33.660	Mixed	86.774	86.500	Agriculture	80.050	83.240	CC	7.0	CC	1.5	83.200	87.280	CC	7.0	CC	1.5						
33.675	34.010	Agriculture	86.483	86.450	Water Bodies	83.240	85.620	BT	7.0	BT	1.5	87.280	88.430	CC	7.0	CC	1.5						
34.011	34.130	Water Bodies	86.433	86.330	Agriculture	85.620	85.760	BT	7.0	BT/ES	1.5	88.430	92.440	CC	7.0	CC	1.5						
34.146	34.186	Agriculture	86.329	86.280	Agriculture	85.760	85.900	BT	7.0	BT	1.5												
34.191	34.400	Agriculture	86.262	85.640	Agriculture	85.900	87.340	CC	7.0	CC	1.5												

Chainage (km)		Land Use[2]	Chainage (km)		Land Use[2]	Chainage (km)		Carriageway Surface LHS				Chainage (km)		Carriageway Surface RHS				Chainage (km)		Shoulder / Seperator LHS		Shoulder / Seperator RHS	
								Main Carriageway		Paved Shoulder				Main Carriageway		Paved Shoulder							
From	To	LHS	From	To	RHS	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[4]	Width (m)	Type[4]	Width (m)
34.416	35.030	Agriculture	85.629	85.570	Commercial	87.340	88.460	CC	10.5	CC	1.5												
35.041	35.170	Agriculture	85.550	85.530	Water Bodies	88.460	89.810	CC	7.0	CC	1.5												
35.172	35.250	Mixed	85.513	84.850	Agriculture	89.810	92.550	BT	7.0	BT	1.5												
35.261	36.010	Agriculture	84.832	84.680	Commercial																		
36.025	36.040	Water Bodies	84.661	83.790	Agriculture																		
36.055	36.820	Agriculture	83.778	83.560	Commercial																		
36.837	37.180	Water Bodies	83.558	82.990	Mixed																		
37.196	37.340	Agriculture	82.978	82.870	Agriculture																		
37.355	37.370	Water Bodies	82.859	79.980	Commercial																		
37.386	37.470	Agriculture	79.969	79.660	Agriculture																		
37.477	37.560	Water Bodies	79.648	78.830	Commercial																		
37.578	37.640	Agriculture	78.819	78.740	Agriculture																		
37.650	37.690	Water Bodies	78.728	78.680	Water Bodies																		
37.702	38.030	Agriculture	78.663	78.470	Agriculture																		
38.015	38.155	Agriculture	78.454	78.410	Commercial																		
38.165	38.310	Agriculture	78.394	78.360	Agriculture																		
38.322	38.450	Agriculture	78.341	78.100	Commercial																		
38.452	38.570	Commercial	78.088	77.950	Agriculture																		
38.581	38.610	Mixed	77.939	77.290	Commercial																		
38.621	38.740	Agriculture	77.278	77.080	Agriculture																		
38.742	38.770	Mixed	77.069	77.040	Commercial																		
38.782	38.920	Agriculture	77.028	76.960	Residential																		
38.922	38.950	Water Bodies	76.948	76.770	Commercial																		
38.969	39.230	Agriculture	76.758	76.638	Residential																		

Chainage (km)		Land Use[2]	Chainage (km)		Land Use[2]	Chainage (km)		Carriageway Surface LHS				Chainage (km)		Carriageway Surface RHS				Chainage (km)		Shoulder / Seperator LHS		Shoulder / Seperator RHS	
								Main Carriageway		Paved Shoulder				Main Carriageway		Paved Shoulder							
From	To	LHS	From	To	RHS	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[4]	Width (m)	Type[4]	Width (m)
39.245	39.380	Residential	76.629	76.250	Mixed																		
39.382	39.670	Mixed	76.239	75.160	Agriculture																		
39.685	39.750	Agriculture	75.148	75.110	Commercial																		
39.765	40.000	Mixed	75.099	74.840	Agriculture																		
40.011	40.020	Mixed	74.823	74.780	Water Bodies																		
40.022	40.090	Mixed	74.762	74.400	Agriculture																		
40.102	40.430	Mixed	74.382	74.360	Water Bodies																		
40.441	40.580	Agriculture	74.340	74.270	Water Bodies																		
40.581	40.880	Mixed	74.251	74.000	Commercial																		
40.892	40.900	Agriculture	73.982	73.680	Commercial																		
40.901	40.920	Water Bodies	73.662	73.060	Agriculture																		
40.931	41.050	Agriculture	73.042	72.860	Industrial																		
41.062	41.100	Water Bodies	72.842	72.770	Agriculture																		
41.111	41.220	Agriculture	72.754	72.750	Water Bodies																		
41.231	41.330	Water Bodies	72.733	72.540	Agriculture																		
41.342	41.490	Agriculture	72.525	72.410	Commercial																		
41.502	41.670	Mixed	72.398	72.258	Commercial																		
41.681	43.340	Agriculture	72.249	72.210	Water Bodies																		
43.352	43.670	Mixed	72.195	72.090	Agriculture																		
43.681	44.240	Agriculture	72.074	72.070	Water Bodies																		
44.252	44.290	Water Bodies	72.054	71.150	Agriculture																		
44.301	45.140	Agriculture	71.138	71.020	Commercial																		
45.155	45.180	Agriculture	71.008	70.350	Agriculture																		
45.181	45.290	Water Bodies	70.338	70.190	Commercial																		

Chainage (km)		Land Use[2]	Chainage (km)		Land Use[2]	Chainage (km)		Carriageway Surface LHS				Chainage (km)		Carriageway Surface RHS				Chainage (km)		Shoulder / Seperator LHS		Shoulder / Seperator RHS	
								Main Carriageway		Paved Shoulder				Main Carriageway		Paved Shoulder							
From	To	LHS	From	To	RHS	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[4]	Width (m)	Type[4]	Width (m)
45.291	45.530	Agriculture	70.178	70.000	Agriculture																		
45.541	45.640	Water Bodies	69.989	69.890	Commercial																		
45.651	46.220	Agriculture	69.873	69.820	Water Bodies																		
46.221	46.450	Industrial	69.802	69.480	Agriculture																		
46.452	46.930	Agriculture	69.469	69.420	Water Bodies																		
46.952	47.080	Water Bodies	69.400	68.680	Agriculture																		
47.092	47.450	Agriculture	68.664	68.620	Water Bodies																		
47.452	47.820	Mixed	68.603	68.130	Agriculture																		
47.831	47.910	Agriculture	68.113	68.030	Industrial																		
47.922	48.080	Mixed	68.012	67.782	Agriculture																		
48.011	48.350	Agriculture	67.770	67.760	Water Bodies																		
48.352	48.460	Commercial	67.754	67.750	Water Bodies																		
48.462	48.670	Mixed	67.733	66.940	Agriculture																		
48.681	50.570	Agriculture	66.920	66.840	Commercial																		
50.572	50.740	Water Bodies	66.820	66.610	Agriculture																		
50.752	50.800	Agriculture	66.599	66.540	Commercial																		
50.801	50.920	Water Bodies	66.521	66.090	Agriculture																		
50.931	53.360	Agriculture	66.073	65.860	Commercial																		
53.371	53.400	Water Bodies	65.842	65.620	Agriculture																		
53.411	55.050	Agriculture	65.609	65.520	Commercial																		
55.011	55.080	Agriculture	65.519	65.240	Agriculture																		
55.081	55.230	Mixed	65.228	65.200	Water Bodies																		
55.231	55.240	Agriculture	65.189	63.920	Agriculture																		
55.252	55.290	Water Bodies	63.985	63.380	Agriculture																		

Chainage (km)		Land Use[2]	Chainage (km)		Land Use[2]	Chainage (km)		Carriageway Surface LHS				Chainage (km)		Carriageway Surface RHS				Chainage (km)		Shoulder / Seperator LHS		Shoulder / Seperator RHS	
								Main Carriageway		Paved Shoulder				Main Carriageway		Paved Shoulder							
From	To	LHS	From	To	RHS	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[4]	Width (m)	Type[4]	Width (m)
55.301	58.820	Agriculture	63.368	62.800	Agriculture																		
58.822	58.880	Water Bodies	62.781	62.680	Water Bodies																		
58.892	60.180	Agriculture	62.658	61.710	Agriculture																		
60.181	60.360	Mixed	61.699	61.630	Commercial																		
60.371	60.400	Mixed	61.618	61.450	Agriculture																		
60.418	62.590	Agriculture	61.438	61.380	Commercial																		
62.602	62.810	Water Bodies	61.364	61.250	Mixed																		
62.825	62.910	Agriculture	61.239	61.230	Agriculture																		
62.911	62.940	Water Bodies	61.218	61.160	Water Bodies																		
62.960	63.610	Agriculture	61.148	60.480	Agriculture																		
63.625	63.700	Water Bodies	60.468	60.270	Commercial																		
63.716	67.930	Agriculture	60.258	60.200	Water Bodies																		
67.946	67.970	Water Bodies	60.188	60.070	Agriculture																		
67.988	69.590	Agriculture	60.059	59.860	Commercial																		
69.606	69.690	Water Bodies	59.849	59.800	Agriculture																		
69.708	69.94	Agriculture	59.788	59.730	Water Bodies																		
69.951	70.13	Residential	59.718	58.960	Agriculture																		
70.148	70.2	Agriculture	58.949	58.908	Water Bodies																		
70.216	70.23	Water Bodies	58.885	58.850	Water Bodies																		
70.247	70.25	Agriculture	58.833	58.340	Agriculture																		
70.266	70.32	Residential	58.328	58.309	Commercial																		
70.352	70.49	Commercial	58.295	57.640	Agriculture																		
70.501	70.61	Agriculture	57.629	57.590	Commercial																		
70.621	71	Commercial	57.578	57.560	Water Bodies																		

Chainage (km)		Land Use[2]	Chainage (km)		Land Use[2]	Chainage (km)		Carriageway Surface LHS				Chainage (km)		Carriageway Surface RHS				Chainage (km)		Shoulder / Seperator LHS		Shoulder / Seperator RHS	
								Main Carriageway		Paved Shoulder				Main Carriageway		Paved Shoulder							
From	To	LHS	From	To	RHS	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[4]	Width (m)	Type[4]	Width (m)
71.015	71.06	Agriculture	57.548	57.530	Commercial																		
71.078	71.23	Commercial	57.519	55.280	Agriculture																		
71.242	71.33	Industrial	57.209	57.140	Water Bodies																		
71.341	71.51	Agriculture	57.119	56.810	Agriculture																		
71.522	71.55	Industrial	56.788	56.740	Commercial																		
71.561	71.59	Agriculture	56.721	56.530	Agriculture																		
71.602	71.63	Industrial	56.519	56.240	Agriculture																		
71.647	71.66	Agriculture	55.269	55.100	Commercial																		
71.677	71.71	Water Bodies	55.079	53.630	Agriculture																		
71.729	72.31	Agriculture	53.613	53.600	Water Bodies																		
72.329	72.38	Water Bodies	53.589	53.150	Agriculture																		
72.399	73.54	Agriculture	53.139	53.120	Water Bodies																		
73.552	73.63	Commercial	53.108	52.280	Agriculture																		
73.648	74.26	Agriculture	52.269	52.240	Water Bodies																		
74.277	74.41	Commercial	52.218	51.920	Agriculture																		
74.425	74.63	Agriculture	51.908	51.760	Commercial																		
74.645	74.66	Water Bodies	51.739	51.200	Agriculture																		
74.675	74.72	Agriculture	51.188	51.170	Water Bodies																		
74.739	74.78	Water Bodies	51.153	50.910	Agriculture																		
74.798	76.01	Agriculture	50.898	50.860	Water Bodies																		
76.031	76.1	Residential	50.841	50.800	Agriculture																		
76.112	76.36	Agriculture	50.788	50.670	Water Bodies																		
76.371	77.05	Commercial	50.644	50.620	Water Bodies																		
77.061	77.21	Residential	50.604	50.390	Agriculture																		

Chainage (km)		Land Use[2]	Chainage (km)		Land Use[2]	Chainage (km)		Carriageway Surface LHS				Chainage (km)		Carriageway Surface RHS				Chainage (km)		Shoulder / Seperator LHS		Shoulder / Seperator RHS	
								Main Carriageway		Paved Shoulder				Main Carriageway		Paved Shoulder							
From	To	LHS	From	To	RHS	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[4]	Width (m)	Type[4]	Width (m)
77.222	77.4	Commercial	49.985	49.790	Agriculture																		
77.421	77.73	Agriculture	49.771	49.750	Mixed																		
77.742	78.42	Commercial	49.732	49.030	Agriculture																		
78.431	78.47	Agriculture	49.019	48.970	Water Bodies																		
78.481	78.53	Commercial	48.959	48.930	Agriculture																		
78.541	78.66	Residential	48.985	48.71	Agriculture																		
78.681	78.83	Commercial	48.699	48.43	Mixed																		
78.848	78.89	Water Bodies	48.416	48.39	Commercial																		
78.907	78.93	Agriculture	48.375	48.25	Agriculture																		
78.942	79.55	Commercial	48.239	48.13	Commercial																		
79.561	79.71	Residential	48.115	48.05	Agriculture																		
79.722	83.24	Commercial	48.034	47.96	Commercial																		
83.171	83.73	Commercial	47.944	47.87	Agriculture																		
83.742	83.95	Agriculture	47.858	47.78	Commercial																		
83.962	84.02	Commercial	47.769	47.6	Agriculture																		
84.031	84.24	Agriculture	47.589	47.34	Commercial																		
84.251	84.35	Commercial	47.328	47.09	Agriculture																		
84.367	84.69	Agriculture	47.078	46.92	Water Bodies																		
84.722	85.35	Commercial	46.908	45.58	Agriculture																		
85.362	85.48	Agriculture	45.569	45.54	Water Bodies																		
85.492	85.99	Commercial	45.529	45.258	Mixed																		
86.001	86.39	Agriculture	45.248	44.879	Agriculture																		
86.401	86.46	Residential	44.868	44.85	Commercial																		
86.477	86.54	Water Bodies	44.839	43.74	Agriculture																		

Chainage (km)		Land Use[2]	Chainage (km)		Land Use[2]	Chainage (km)		Carriageway Surface LHS				Chainage (km)		Carriageway Surface RHS				Chainage (km)		Shoulder / Seperator LHS		Shoulder / Seperator RHS	
								Main Carriageway		Paved Shoulder				Main Carriageway		Paved Shoulder							
From	To	LHS	From	To	RHS	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[4]	Width (m)	Type[4]	Width (m)
86.555	86.74	Agriculture	43.718	43.58	Water Bodies																		
86.751	86.85	Commercial	43.569	43.5	Agriculture																		
86.862	87.07	Agriculture	43.489	43.37	Commercial																		
87.082	87.57	Commercial	43.358	43.3	Agriculture																		
87.582	87.79	Agriculture	43.288	43.27	Water Bodies																		
87.802	88.28	Commercial	43.258	41.38	Agriculture																		
88.291	88.35	Water Bodies	41.368	41.27	Water Bodies																		
88.362	88.76	Agriculture	41.258	40.91	Agriculture																		
88.772	88.78	Residential	40.898	40.87	Water Bodies																		
88.791	88.97	Residential	40.858	40.84	Agriculture																		
88.981	89.16	Water Bodies	40.819	40.81	Mixed																		
89.171	89.19	Commercial	40.798	39.18	Mixed																		
89.201	89.25	Agriculture	39.169	36.01	Agriculture																		
89.261	89.28	Water Bodies	35.994	35.95	Water Bodies																		
89.296	89.51	Agriculture	35.935	35.93	Agriculture																		
89.522	89.7	Commercial	35.902	35.37	Agriculture																		
89.712	89.75	Water Bodies	35.358	35.32	Water Bodies																		
89.761	89.95	Agriculture	35.309	34.19	Agriculture																		
89.962	90.13	Commercial	34.178	34.09	Water Bodies																		
90.146	90.16	Agriculture	34.078	33.37	Agriculture																		
90.178	90.19	Water Bodies	33.358	33.32	Water Bodies																		
90.208	90.28	Agriculture	33.301	32.92	Agriculture																		
90.297	90.51	Commercial	32.908	32.868	Water Bodies																		
90.522	90.53	Agriculture	32.858	32.85	Water Bodies																		

Chainage (km)		Land Use[2]	Chainage (km)		Land Use[2]	Chainage (km)		Carriageway Surface LHS				Chainage (km)		Carriageway Surface RHS				Chainage (km)		Shoulder/Seperator LHS		Shoulder/Seperator RHS	
								Main Carriageway		Paved Shoulder				Main Carriageway		Paved Shoulder							
From	To	LHS	From	To	RHS	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[4]	Width (m)	Type[4]	Width (m)
90.548	90.8	Residential	32.834	32.5	Agriculture																		
90.819	91.21	Agriculture	32.485	32.3	Mixed																		
91.23	91.49	Water Bodies	32.288	30.69	Agriculture																		
91.501	91.58	Agriculture	30.648	30.38	Commercial																		
91.591	91.65	Residential	30.363	30.31	Water Bodies																		
91.668	91.89	Agriculture	30.293	30.21	Agriculture																		
91.91	92	Residential																					
92.011	92.55	Commercial																					

1. Terrain : P- Plain(0-10%) , R- Rolling(10-25%) , M- Mountainous(25-60%), S - Steep(>60%)
2. Land use: A- Agricultural, B - Barren, F - Forest, SU- Semi Urban, R - Residential, C - Commercial, I - Industrial
3. Surface Type : BT - Bitumen, CC - Concrete, G – Gravel
4. Shoulder Type : G – Gravel, E – Earthen

Road Inventory (Part-II)

Road Name: NH-27_ Kochugaon to Rakhaldubi Pkg-I | **Date : 30/11/2022 to 01/12/2022**

Direction: BHS | **Weather :**

Chainage (km)		Median Width (m)	Service Road LHS		Service Road RHS		Road side Drain/Foot path LHS				Road side Drain/Foot path RHS				Remarks
From	To		Type[5]	Width	Type[5]	Width	Type[6]	Width	Depth	Condt[7]	Type[6]	Width	Depth	Condt[7]	
30.015	30.440	4.5					Unlined/Earthen			Covered with					
30.210	38.627	4.5									Unlined/Earthen			Covered with	
30.465	30.540	4.5					Unlined/Earthen			Covered with					
30.556	34.400	4.5					Unlined/Earthen			Covered with					
34.415	35.050	4.5					Unlined/Earthen			Covered with					
35.066	35.130	4.5					Unlined/Earthen			Covered with					
35.146	36.310	4.5					Unlined/Earthen			Covered with					
36.330	38.030	4.5					Unlined/Earthen			Covered with					
38.015	38.160	4.5					Unlined/Earthen			Covered with					
38.305	38.460	4.5					Unlined/Earthen			Covered with					
38.627	39.350	4.5					Unlined/Earthen			Covered with					
38.820	39.383	4.5									Unlined/Earthen		Covered with Vegetation		
39.300	39.304	4.5									CC			Good	
39.665	39.770	4.5					Unlined/Earthen			Covered with					
39.670	39.703	4.5									CC			Good	
39.780	39.994	4.5									Cut Drain				
39.790	40.680	4.5			BT	7.5									
39.834	40.740	4.5	BT	7.5											
39.837	40.000	4.5					Cut Drain								
39.940	39.960	4.5					Cut Drain								
40.015	40.060	4.5					Cut Drain								
40.030	40.273	4.5									CC			Good	

Chainage (km)		Median Width (m)	Service Road LHS		Service Road RHS		Road side Drain/Foot path LHS				Road side Drain/Foot path RHS				Remarks
From	To		Type[5]	Width	Type[5]	Width	Type[6]	Width	Depth	Condt[7]	Type[6]	Width	Depth	Condt[7]	
40.200	40.379	4.5									Unlined/Earthen		Covered with Vegetation		
40.280	40.673	4.5									Cut Drain				
40.358	40.730	4.5					Cut Drain								
40.408	40.690	4.5					Unlined/Earthen			Covered with					
40.700	43.424	4.5									Unlined/Earthen			Covered with	
40.888	41.640	4.5					Unlined/Earthen			Covered with					
41.250	41.330	4.5									CC			Good	
41.685	42.400	4.5					Unlined/Earthen			Covered with					
42.050	42.074	4.5									CC			Good	
42.456	43.540	4.5					Unlined/Earthen			Covered with					
42.760	42.761	4.5									CC			Good	
43.460	47.763	4.5									Unlined/Earthen			Covered with	
43.665	44.530	4.5					Unlined/Earthen			Covered with					
44.595	46.220	4.5					Unlined/Earthen			Covered with					
45.224	45.290	4.5					CC			Good					
45.562	45.650	4.5					CC			Good					
46.435	47.510	4.5					Unlined/Earthen			Covered with					
46.952	47.130	4.5					CC			Good					
47.766	48.080	4.5					Unlined/Earthen			Covered with					
47.850	48.374	4.5									Unlined/Earthen			Covered with	
48.075	48.360	4.5					Unlined/Earthen			Covered with					
48.240	48.269	4.5									CC			Good	
48.510	48.705	4.5									Unlined/Earthen			Covered with	
48.687	49.660	4.5					Unlined/Earthen			Covered with					

Chainage (km)		Median Width (m)	Service Road LHS		Service Road RHS		Road side Drain/Foot path LHS				Road side Drain/Foot path RHS				Remarks
From	To		Type[5]	Width	Type[5]	Width	Type[6]	Width	Depth	Condt[7]	Type[6]	Width	Depth	Condt[7]	
48.750	48.984	4.5									Unlined/Earthen		Covered with Vegetation		
48.930	49.985	4.5									Unlined/Earthen		Covered with Vegetation		
49.736	51.540	4.5					Unlined/Earthen			Covered with					
49.970	51.783	4.5									Unlined/Earthen			Covered with	
51.556	51.620	4.5					Unlined/Earthen			Covered with					
51.636	55.040	4.5					Unlined/Earthen			Covered with					
51.830	55.103	4.5									Unlined/Earthen			Covered with	
55.066	55.100	4.5					Unlined/Earthen			Covered with					
55.156	57.610	4.5					Unlined/Earthen			Covered with					
55.260	57.594	4.5									Unlined/Earthen			Covered with	
57.640	59.915	4.5									Unlined/Earthen			Covered with	
57.656	59.930	4.5					Unlined/Earthen			Covered with					
59.945	60.040	4.5					Unlined/Earthen			Covered with					
60.056	60.240	4.5					Unlined/Earthen			Covered with					
60.090	60.223	4.5									Unlined/Earthen		Covered with Vegetation		
60.310	61.344	4.5									Unlined/Earthen			Covered with	
60.366	61.350	4.5					Unlined/Earthen			Covered with					
61.436	61.680	4.5					Unlined/Earthen			Covered with					
61.450	61.630	4.5									Unlined/Earthen		Covered with Vegetation		
61.760	63.175	4.5									Unlined/Earthen		Covered with Vegetation		
61.816	63.230	4.5					Unlined/Earthen			Covered with					
62.610	62.786	4.5									CC			Good	
63.380	63.631	4.5									Unlined/Earthen			Covered with	
63.405	64.120	4.5					Unlined/Earthen			Covered with					

Chainage (km)		Median Width (m)	Service Road LHS		Service Road RHS		Road side Drain/Foot path LHS				Road side Drain/Foot path RHS				Remarks
From	To		Type[5]	Width	Type[5]	Width	Type[6]	Width	Depth	Condt[7]	Type[6]	Width	Depth	Condt[7]	
63.680	63.985	4.5									Unlined/Earthen			Covered with	
63.920	64.225	4.5									Unlined/Earthen			Covered with	
64.196	64.450	4.5					Unlined/Earthen			Covered with					
64.330	65.523	4.5									Unlined/Earthen		Covered with Vegetation		
64.586	65.520	4.5					Unlined/Earthen			Covered with					
65.607	65.980	4.5					Unlined/Earthen			Covered with					
65.620	65.875	4.5									Lined & Uncovered		Covered with Vegetation		
66.080	66.545	4.5									Unlined/Earthen			Covered with	
66.167	66.640	4.5					Unlined/Earthen			Covered with					
66.590	66.674	4.5									Unlined/Earthen			Covered with	
66.807	69.980	4.5					Unlined/Earthen			Covered with					
66.890	67.995	4.5									Unlined/Earthen			Covered with	
68.110	69.872	4.5									Unlined/Earthen			Covered with	
69.980	70.184	4.5									Unlined/Earthen			Covered with	
70.075	70.300	4.5					Unlined/Earthen			Covered with					
70.316	70.370	4.5					Unlined/Earthen			Covered with					
70.340	71.005	4.5									Unlined/Earthen			Covered with	
70.426	70.970	4.5					Unlined/Earthen			Covered with					
71.006	71.070	4.5					Unlined/Earthen			Covered with					
71.120	72.272	4.5									Unlined/Earthen			Covered with	
71.175	72.480	4.5					Unlined/Earthen			Covered with					
72.390	72.892	4.5									Unlined/Earthen			Covered with	
72.598	73.510	4.5					Unlined/Earthen			Covered with					
73.030	74.214	4.5									Unlined/Earthen			Covered with	

Chainage (km)		Median Width (m)	Service Road LHS		Service Road RHS		Road side Drain/Foot path LHS				Road side Drain/Foot path RHS				Remarks
From	To		Type[5]	Width	Type[5]	Width	Type[6]	Width	Depth	Condt[7]	Type[6]	Width	Depth	Condt[7]	
73.635	74.290	4.5					Unlined/Earthen			Covered with					
74.260	75.995	4.5									Unlined/Earthen			Covered with	
74.426	76.380	4.5					Unlined/Earthen			Covered with					
76.030	76.245	4.5									Unlined/Earthen			Covered with	
76.280	78.103	4.5			BT	7.5									
76.370	78.090	4.5	BT	7.5											
76.820	77.244	4.5									Cut Drain				
76.890	78.064	4.5									Unlined/Earthen			Covered with	
77.008	77.860	4.5					Unlined/Earthen			Covered with					
77.137	78.080	4.5					Cut Drain								
77.290	78.065	4.5									Cut Drain				
78.176	78.300	4.5					Unlined/Earthen			Covered with					
78.330	78.854	4.5									Unlined/Earthen			Covered with	
78.436	78.620	4.5					Unlined/Earthen			Covered with					
78.676	78.750	4.5					Unlined/Earthen			Covered with					
78.805	78.960	4.5					Unlined/Earthen			Covered with					
78.890	83.125	4.5			BT	7.5									
79.115	83.230	4.5	BT	7.5											
79.530	79.590	4.5									CC			Good	
80.038	80.430	4.5					Lined & Covered	1.5		Good					
80.465	80.660	4.5					Unlined/Earthen			Covered with					
80.751	81.780	4.5					Unlined/Earthen			Covered with					
80.830	81.864	4.5									Unlined/Earthen			Covered with	
80.858	81.780	4.5					Cut Drain								

Chainage (km)		Median Width (m)	Service Road LHS		Service Road RHS		Road side Drain/Foot path LHS				Road side Drain/Foot path RHS				Remarks
From	To		Type[5]	Width	Type[5]	Width	Type[6]	Width	Depth	Condt[7]	Type[6]	Width	Depth	Condt[7]	
81.040	81.895	4.5									Cut Drain				
81.920	82.132	4.5									Cut Drain				
81.966	82.270	4.5					Cut Drain								
81.987	82.190	4.5					Unlined/Earthen			Covered with					
82.210	82.393	4.5									Lined & Covered	7.5		Good	
82.210	82.734	4.5									Cut Drain				
82.336	83.240	4.5					Cut Drain								
82.800	83.094	4.5									Cut Drain				
82.906	83.020	4.5					Unlined/Earthen			Covered with					
83.540	83.635	4.5									Unlined/Earthen		Covered with Vegetation		
83.598	85.590	4.5					Unlined/Earthen			Covered with					
83.780	84.735	4.5									Unlined/Earthen		Covered with Vegetation		
84.830	85.555	4.5									Unlined/Earthen		Covered with Vegetation		
85.626	87.100	4.5					Unlined/Earthen			Covered with					
85.630	87.103	4.5									Unlined/Earthen		Covered with Vegetation		
87.206	87.370	4.5					Unlined/Earthen			Covered with					
87.240	88.525	4.5			BT	7.5									
87.335	88.480	4.5	BT	7.5											
87.830	87.907	4.5									CC			Fair	
88.416	88.540	4.5					Unlined/Earthen			Covered with					
88.540	88.805	4.5									Unlined/Earthen		Covered with Vegetation		
88.556	90.010	4.5					Unlined/Earthen			Covered with					
88.920	88.975	4.5									Unlined/Earthen		Covered with Vegetation		
89.090	89.972	4.5									Unlined/Earthen		Covered with Vegetation		

Chainage (km)		Median Width (m)	Service Road LHS		Service Road RHS		Road side Drain/Foot path LHS				Road side Drain/Foot path RHS				Remarks
From	To		Type[5]	Width	Type[5]	Width	Type[6]	Width	Depth	Condt[7]	Type[6]	Width	Depth	Condt[7]	
90.020	90.144	4.5									Unlined/Earthen		Covered with Vegetation		
90.146	90.320	4.5					Unlined/Earthen			Covered with					
90.260	92.262	4.5									Unlined/Earthen		Covered with Vegetation		
90.395	92.020	4.5					Unlined/Earthen			Covered with					
92.096	92.540	4.5					Unlined/Earthen			Covered with					
92.320	92.434	4.5									Unlined/Earthen		Covered with Vegetation		
NOTE: At following locations median width varies from 4.5 m to 12.0 m															
33+920	34+000	4.5-12.00													
34+000	34+250	4.5-12.00													
41+160	41+415	4.5-12.00													
45+000	45+600	4.5-11.00													
46+640	47+000	4.5-6.5													
47+000	47+120	4.5-6.5													
62+000	63+000	4.5-11.00													

5. Surface Type : B - Bitumen, C - Concrete, G – Gravel
6. Road Side Drain : CD- Covered Drain / Foot Path, LD- Lined Drain, UD- Unlined Drain, NO- No Drain
7. Condition of Drain : FC - Fully Choked, FD - Damaged, G – Good condition

Road Inventory (Part-III)						
Road Name: NH-27_ Kochugaon to Rakhaldubi Pkg-I						**Date : 30/11/2022 to 01/12/2022**
Direction : BHS						**Weather:**
Road/Rail Details & Built-up Area						**Remarks / (Submergence Stretch) & (Draw Cross-Section For Service Road Stretch)[10]**
Chainage (km)		**Location / Village Name**	**Shape[9]**	**Destination**		
				Left	**Right**	
30.461		LHS	T	LHS		
30.927		LHS	T	LHS		
31.963		RHS	T		RHS	
32.579		LHS/RHS	X	LHS	RHS	
32.997		LHS	T	LHS		
35.122		RHS	T		RHS	
35.682		RHS	T		RHS	
36.637		RHS	T		RHS	
37.591		RHS	T		RHS	
39.118		LHS	Y	LHS		
39.223		LHS	T	LHS		
39.299		LHS	T	LHS		
39.586		LHS	T	LHS		
40.940		LHS	T	LHS		
41.151		RHS	T		RHS	
41.218		LHS	T	LHS		
41.669		LHS/RHS	X	LHS	RHS	

Road/Rail Details & Built-up Area						Remarks / (Submergence Stretch) & (Draw Cross-Section For Service Road Stretch)[10]
Chainage (km)		Location / Village Name	Shape[9]	Destination		
				Left	Right	
42.413		LHS	Y	LHS		
43.120		RHS	Y		RHS	
44.434		RHS	T		RHS	
45.253		RHS	Y		RHS	
45.748		LHS	T	LHS		
46.671		RHS	T		RHS	
47.194		RHS	T		RHS	
47.286		LHS	T	LHS		
47.542		RHS	T		RHS	
47.621		LHS/RHS	X	LHS	RHS	
48.020		RHS	T		RHS	
48.021		LHS	T	LHS		
48.662		LHS	T	LHS		
48.741		RHS	T		RHS	
48.896		LHS	T	LHS		
50.243		LHS	T	LHS		
50.480		RHS	T		RHS	
51.449		LHS	T	LHS		
51.868		LHS/RHS	X	LHS	RHS	

Road/Rail Details & Built-up Area						Remarks / (Submergence Stretch) & (Draw Cross-Section For Service Road Stretch)[10]
Chainage (km)		Location / Village Name	Shape[9]	Destination		
				Left	Right	
52.583		LHS	T	LHS		
53.536		RHS	T		RHS	
55.112		LHS/RHS	X	LHS	RHS	
55.241		RHS	T		RHS	
56.779		LHS/RHS	X	LHS	RHS	
56.790		LHS/RHS	X	LHS	RHS	
57.633		LHS	T	LHS		
57.765		RHS	T		RHS	
59.582		LHS	T	LHS		
60.384		LHS	T	LHS		
61.687		LHS	T	LHS		
62.100		RHS	T		RHS	
62.163		RHS	T		RHS	
63.126		RHS	T		RHS	
63.230		RHS	T		RHS	
63.713		RHS	T		RHS	
63.758		LHS	Y	LHS		
64.133		LHS	T	LHS		
65.116		LHS	Y	LHS		

Road/Rail Details & Built-up Area						Remarks / (Submergence Stretch) & (Draw Cross-Section For Service Road Stretch)[10]
Chainage (km)		Location / Village Name	Shape[9]	Destination		
				Left	Right	
65.684		LHS	T	LHS		
66.322		RHS	T		RHS	
66.471		LHS	T	LHS		
67.854		LHS	T	LHS		
68.673		RHS	T		RHS	
68.727		LHS	T	LHS		
68.978		RHS	T		RHS	
69.592		LHS	T	LHS		
69.659		RHS	Y		RHS	
70.093		RHS	Y		RHS	
70.213		LHS	T	LHS		
70.401		LHS/RHS	X	LHS	RHS	
71.121		LHS	T	LHS		
71.600		LHS	Y	LHS		
72.061		RHS	Y		RHS	
72.148		RHS	T		RHS	
72.571		LHS/RHS	X	LHS	RHS	
73.052		LHS	T	LHS		
73.406		LHS	T	LHS		

Road/Rail Details & Built-up Area						Remarks / (Submergence Stretch) & (Draw Cross-Section For Service Road Stretch)[10]
Chainage (km)		Location / Village Name	Shape[9]	Destination		
				Left	Right	
73.972		LHS	T	LHS		
73.994		RHS	T		RHS	
74.352		LHS/RHS	X	LHS	RHS	
74.397		RHS	T		RHS	
74.574		RHS	T		RHS	
74.588		LHS	T	LHS		
75.306		LHS	T	LHS		
75.836		RHS	T		RHS	
76.099		LHS	T	LHS		
77.430		LHS	T	LHS		
77.757		LHS	T	LHS		
78.300		RHS	T		RHS	
81.524		RHS	T		RHS	
82.282		LHS/RHS	X	LHS	RHS	
83.212		LHS/RHS	+	LHS	RHS	
84.137		RHS	T		RHS	
85.609		LHS/RHS	X	LHS	RHS	
86.316		RHS	T		RHS	
86.360		LHS	T	LHS		

Road/Rail Details & Built-up Area						Remarks / (Submergence Stretch) & (Draw Cross-Section For Service Road Stretch)[10]
Chainage (km)		Location / Village Name	Shape[9]	Destination		
				Left	Right	
89.603		LHS	T	LHS		
89.915		LHS	T	LHS		
90.584		RHS	T		RHS	
90.843		RHS	T		RHS	
91.323		RHS	T		RHS	

8. Road side Trees per section : N - Nil, F - Few(0 - 10Nos), M – Medium(10-50 Nos), L - Large(>50 Nos)
9. For Road : T - T-intersection, Y - Y intersection, IV - 4 Road
   ROB/RUB – Over bridge/ Underpass
10. Remarks : In addition to general remarks, Location of Retaining structures, water bodies to be specified
11. Girth of Tree: A- (0.3-0.6 m) ,B- (0.6-0.9 m) C- (0.9-1.8 m) D- (> 1.8 m)

Road Inventory (Part-IV)										
Road Name: NH-27_ Kochugaon to Rakhaldubi Pkg-I							**Date : 30/11/2022 to 01/12/2022**			
Direction: BHS							**Weather:**			
Crash Barrier				**Gantry,VMS Board, HTMS**			**Bus Bays / Truck lay Byes**			
Chainage (km)		**Placement Location[14]**	**Type[15]**	**Location**	**Side**	**Type[16]**	**Location**	**Side**	**Length**	**Type[17]**
From	**To**									
30.260	30.310	LHS	W Beam	31.292	LHS	Over Head	30.489	LHS	60	RCC/Masonry
30.260	30.276	RHS	W Beam	31.489	RHS	Over Head	30.613	RHS	50	RCC/Masonry
30.320	30.373	RHS	W Beam	49.169	RHS	Over Head	35.072	LHS	60	-
30.355	30.400	LHS	W Beam	49.527	LHS	Over Head	35.203	RHS	50	-
30.400	30.842	RHS	W Beam	60.132	LHS	Over Head	38.547	LHS	50	-
30.667	30.916	LHS	W Beam	60.779	RHS	Over Head	38.722	RHS	50	-
30.860	30.883	RHS	W Beam	65.379	RHS	Over Head	44.429	LHS	60	RCC/Masonry
30.942	-	LHS	W Beam	65.440	LHS	Over Head	44.531	RHS	50	RCC/Masonry
31.880	32.281	RHS	W Beam	75.844	LHS	Over Head	48.377	LHS	60	RCC/Masonry
32.272	32.310	LHS	W Beam	76.913	RHS	Over Head	48.564	RHS	50	RCC/Masonry
32.350	32.408	RHS	W Beam	83.106	LHS	Over Head	51.574	LHS	50	-
32.385	32.430	LHS	W Beam	83.347	RHS	Over Head	51.713	RHS	50	-
32.705	32.995	LHS	W Beam	90.771	RHS	Over Head	55.015	LHS	50	-
33.008	33.120	LHS	W Beam	91.812	LHS	Over Head	55.218	RHS	50	-
33.670	33.975	RHS	W Beam				59.989	LHS	50	RCC/Masonry
33.727	34.010	LHS	W Beam				60.049	RHS	50	RCC/Masonry
34.025	34.180	LHS	CC				63.310	RHS	60	RCC/Masonry
34.025	34.180	Median	CC				63.372	LHS	50	RCC/Masonry
34.160	34.389	RHS	W Beam				65.989	RHS	60	RCC/Masonry
34.300	34.400	LHS	W Beam				66.132	LHS	60	RCC/Masonry
34.415	34.460	LHS	W Beam				70.239	RHS	50	RCC/Masonry
34.730	34.889	RHS	W Beam				70.332	LHS	60	RCC/Masonry
35.430	35.672	RHS	W Beam				72.359	RHS	60	RCC/Masonry

Crash Barrier				Gantry,VMS Board, HTMS			Bus Bays / Truck lay Byes			
Chainage (km)		Placement Location[14]	Type[15]	Location	Side	Type[16]	Location	Side	Length	Type[17]
From	To									
35.890	36.186	RHS	W Beam				72.548	LHS	50	RCC/Masonry
35.955	36.155	LHS	W Beam				78.190	RHS	40	-
37.486	37.646	LHS	W Beam				78.240	LHS	50	RCC/Masonry
39.667	39.718	LHS	W Beam				83.349	RHS	60	RCC/Masonry
39.710	39.734	RHS	W Beam				83.393	LHS	50	RCC/Masonry
39.755	39.785	LHS	W Beam				88.806	LHS	60	RCC/Masonry
40.000	40.015	RHS	W Beam				88.879	RHS	50	RCC/Masonry
40.030	40.273	Median	CC							
40.055	40.070	LHS	W Beam							
40.077	40.320	LHS	CC							
40.280	40.301	RHS	W Beam							
40.330	40.357	LHS	W Beam							
41.058	41.238	RHS	W Beam							
41.195	41.210	LHS	W Beam							
41.225	41.300	LHS	W Beam							
41.250	41.331	RHS	CC							
41.250	41.332	Median	CC							
41.334	41.344	RHS	W Beam							
41.367	41.787	RHS	W Beam							
41.396	41.567	LHS	W Beam							
42.010	42.042	RHS	W Beam							
42.046	42.090	LHS	W Beam							
42.090	42.139	RHS	W Beam							
42.136	42.160	LHS	W Beam							
44.124	44.184	RHS	W Beam							
44.197	44.240	LHS	W Beam							

Crash Barrier				Gantry,VMS Board, HTMS			Bus Bays / Truck lay Byes			
Chainage (km)		Placement Location[14]	Type[15]	Location	Side	Type[16]	Location	Side	Length	Type[17]
From	To									
44.291	44.310	LHS	W Beam							
44.910	45.065	RHS	W Beam							
44.975	45.215	LHS	W Beam							
45.224	45.300	LHS	CC							
45.224	45.300	Median	CC							
45.224	45.484	RHS	W Beam							
45.306	45.310	LHS	W Beam							
45.334	45.560	LHS	W Beam							
45.563	46.183	RHS	W Beam							
45.571	45.640	LHS	CC							
45.571	45.640	Median	CC							
45.656	45.730	LHS	W Beam							
45.758	46.258	LHS	W Beam							
46.370	46.524	RHS	W Beam							
46.446	46.946	LHS	W Beam							
46.533	46.663	RHS	W Beam							
46.689	46.859	RHS	W Beam							
46.955	47.130	LHS	CC							
46.955	47.130	Median	CC							
47.050	47.230	RHS	W Beam							
47.136	47.326	LHS	W Beam							
47.574	47.774	RHS	W Beam							
48.156	48.246	LHS	W Beam							
48.199	48.229	RHS	W Beam							
48.270	48.320	RHS	W Beam							
48.275	48.315	LHS	W Beam							

Crash Barrier				Gantry,VMS Board, HTMS			Bus Bays / Truck lay Byes			
Chainage (km)		Placement Location[14]	Type[15]	Location	Side	Type[16]	Location	Side	Length	Type[17]
From	To									
48.683	48.693	RHS	W Beam							
48.695	48.710	LHS	W Beam							
48.724	48.734	RHS	W Beam							
48.756	48.800	LHS	W Beam							
48.758	48.809	RHS	W Beam							
48.944	49.024	RHS	W Beam							
49.035	49.100	LHS	W Beam							
49.060	49.134	RHS	W Beam							
49.145	49.220	LHS	W Beam							
50.601	50.651	RHS	W Beam							
50.660	50.710	LHS	W Beam							
50.690	50.732	RHS	W Beam							
50.735	50.775	LHS	W Beam							
50.800	50.845	RHS	W Beam							
50.846	50.890	LHS	W Beam							
50.873	50.923	RHS	W Beam							
50.926	50.960	LHS	W Beam							
52.000	52.200	RHS	W Beam							
52.156	52.250	LHS	W Beam							
52.260	52.368	RHS	W Beam							
52.299	52.480	LHS	W Beam							
52.410	52.449	RHS	W Beam							
52.859	53.029	RHS	W Beam							
53.086	53.100	LHS	W Beam							
53.125	53.150	LHS	W Beam							
53.270	53.510	RHS	W Beam							

Crash Barrier				Gantry,VMS Board, HTMS			Bus Bays / Truck lay Byes			
Chainage (km)		Placement Location[14]	Type[15]	Location	Side	Type[16]	Location	Side	Length	Type[17]
From	To									
53.336	53.626	LHS	W Beam							
53.544	53.564	RHS	W Beam							
53.620	53.783	RHS	W Beam							
53.670	53.820	LHS	W Beam							
54.465	54.968	LHS	W Beam							
54.683	54.993	RHS	W Beam							
55.233	55.283	RHS	W Beam							
55.250	55.280	LHS	W Beam							
55.330	55.379	RHS	W Beam							
55.335	55.375	LHS	W Beam							
57.072	57.122	RHS	W Beam							
57.085	57.135	LHS	W Beam							
57.180	57.223	RHS	W Beam							
57.195	57.245	LHS	W Beam							
58.772	58.822	RHS	W Beam							
58.794	58.830	LHS	W Beam							
58.885	58.935	RHS	W Beam							
58.906	59.320	LHS	W Beam							
60.143	60.193	RHS	W Beam							
60.310	60.404	RHS	W Beam							
60.314	60.324	LHS	W Beam							
60.400	60.630	LHS	W Beam							
60.443	60.473	RHS	W Beam							
61.893	62.093	RHS	W Beam							
62.103	62.153	RHS	W Beam							
62.175	62.405	RHS	W Beam							

Crash Barrier				Gantry,VMS Board, HTMS			Bus Bays / Truck lay Byes			
Chainage (km)		Placement Location[14]	Type[15]	Location	Side	Type[16]	Location	Side	Length	Type[17]
From	To									
62.295	62.610	LHS	W Beam							
62.455	62.605	RHS	W Beam							
62.620	62.790	RHS	CC							
62.620	62.791	Median	CC							
62.794	63.123	RHS	W Beam							
62.807	62.810	LHS	W Beam							
62.847	63.227	LHS	W Beam							
63.148	63.188	RHS	W Beam							
65.629	65.778	RHS	W Beam							
65.728	65.750	LHS	W Beam							
65.765	65.995	LHS	W Beam							
66.046	66.070	LHS	W Beam							
66.395	66.455	RHS	W Beam							
66.499	66.528	RHS	W Beam							
66.507	66.560	LHS	W Beam							
66.603	66.620	LHS	W Beam							
67.815	67.835	RHS	W Beam							
67.926	67.940	LHS	W Beam							
67.982	68.420	LHS	W Beam							
68.103	68.303	RHS	W Beam							
68.332	68.622	RHS	W Beam							
68.448	68.728	LHS	W Beam							
68.668	68.678	RHS	W Beam							
68.736	68.740	LHS	W Beam							
68.776	68.800	LHS	W Beam							
69.314	69.394	RHS	W Beam							

Crash Barrier				Gantry,VMS Board, HTMS			Bus Bays / Truck lay Byes			
Chainage (km)		Placement Location[14]	Type[15]	Location	Side	Type[16]	Location	Side	Length	Type[17]
From	To									
69.439	69.599	RHS	W Beam							
69.505	69.530	LHS	W Beam							
69.556	69.696	LHS	W Beam							
69.668	69.678	RHS	W Beam							
69.761	69.780	LHS	W Beam							
69.813	69.830	LHS	W Beam							
70.279	70.280	LHS	W Beam							
70.366	70.566	RHS	W Beam							
70.419	70.440	LHS	W Beam							
70.456	70.480	LHS	W Beam							
70.492	70.510	LHS	W Beam							
70.588	70.609	RHS	W Beam							
71.285	71.305	RHS	W Beam							
71.338	71.359	RHS	W Beam							
71.382	71.420	LHS	W Beam							
71.449	71.470	LHS	W Beam							
71.558	71.768	LHS	W Beam							
71.617	71.637	RHS	W Beam							
71.647	71.837	RHS	W Beam							
71.775	71.840	LHS	W Beam							
71.855	72.055	RHS	W Beam							
72.079	72.138	RHS	W Beam							
72.094	72.244	LHS	W Beam							
72.250	72.264	RHS	W Beam							
72.260	72.290	LHS	W Beam							
72.361	72.440	LHS	W Beam							

Crash Barrier				Gantry,VMS Board, HTMS			Bus Bays / Truck lay Byes			
Chainage (km)		Placement Location[14]	Type[15]	Location	Side	Type[16]	Location	Side	Length	Type[17]
From	To									
72.520	72.528	RHS	W Beam							
72.540	72.551	RHS	W Beam							
72.548	72.578	RHS	W Beam							
72.627	72.650	LHS	W Beam							
72.678	72.778	LHS	W Beam							
73.228	73.249	RHS	W Beam							
73.258	73.288	RHS	W Beam							
73.308	73.489	RHS	W Beam							
73.332	73.360	LHS	W Beam							
73.387	73.390	LHS	W Beam							
73.435	73.450	LHS	W Beam							
73.833	73.863	RHS	W Beam							
73.902	73.920	LHS	W Beam							
74.330	74.359	RHS	W Beam							
74.377	74.387	RHS	W Beam							
74.508	74.520	LHS	W Beam							
74.702	74.762	RHS	W Beam							
74.748	74.880	LHS	W Beam							
74.823	74.993	RHS	W Beam							
74.945	75.265	LHS	W Beam							
75.160	75.178	RHS	W Beam							
75.170	75.177	RHS	W Beam							
75.315	75.365	LHS	W Beam							
75.853	75.863	RHS	W Beam							
75.870	75.880	RHS	W Beam							
75.890	75.914	RHS	W Beam							

Crash Barrier				Gantry,VMS Board, HTMS			Bus Bays / Truck lay Byes			
Chainage (km)		Placement Location[14]	Type[15]	Location	Side	Type[16]	Location	Side	Length	Type[17]
From	To									
75.973	75.990	LHS	W Beam							
76.010	76.032	RHS	W Beam							
76.015	76.155	LHS	W Beam							
76.099	76.258	RHS	W Beam							
76.225	76.375	LHS	W Beam							
76.279	76.369	RHS	W Beam							
76.390	76.829	RHS	CC							
76.409	76.499	LHS	W Beam							
76.498	76.940	LHS	CC							
77.000	77.015	RHS	W Beam							
78.709	78.749	RHS	W Beam							
78.773	78.863	RHS	W Beam							
78.836	78.860	LHS	W Beam							
78.898	79.038	RHS	W Beam							
78.901	78.971	LHS	W Beam							
79.050	80.678	RHS	CC							
79.116	79.146	LHS	W Beam							
79.156	79.650	LHS	CC							
79.655	79.720	Median	CC							
79.667	80.800	LHS	CC							
80.456	80.660	LHS	W Beam							
80.716	81.260	LHS	W Beam							
80.879	80.948	RHS	W Beam							
80.948	81.088	RHS	W Beam							
81.094	81.124	RHS	W Beam							
83.235	83.250	LHS	W Beam							

Crash Barrier				Gantry,VMS Board, HTMS			Bus Bays / Truck lay Byes			
Chainage (km)		Placement Location[14]	Type[15]	Location	Side	Type[16]	Location	Side	Length	Type[17]
From	To									
83.975	84.065	RHS	W Beam							
84.016	84.166	LHS	W Beam							
84.073	84.123	RHS	W Beam							
84.409	84.428	RHS	W Beam							
84.446	84.556	LHS	W Beam							
84.448	84.508	RHS	W Beam							
84.570	84.580	LHS	W Beam							
86.321	86.411	RHS	W Beam							
86.376	86.466	LHS	W Beam							
86.439	86.499	RHS	CC							
86.519	86.648	RHS	W Beam							
86.534	86.560	LHS	W Beam							
86.655	86.705	RHS	W Beam							
86.723	86.893	RHS	W Beam							
86.913	87.013	RHS	W Beam							
87.299	87.349	RHS	W Beam							
87.335	87.370	LHS	W Beam							
87.350	88.379	RHS	CC							
87.381	88.400	LHS	CC							
87.859	87.939	Median	CC							
87.898	87.970	Median	CC							
88.379	88.428	RHS	W Beam							
88.410	88.500	LHS	W Beam							
89.228	89.299	RHS	W Beam							
89.266	89.335	LHS	W Beam							
89.588	89.629	RHS	W Beam							

Crash Barrier				Gantry,VMS Board, HTMS			Bus Bays / Truck lay Byes			
Chainage (km)		Placement Location[14]	Type[15]	Location	Side	Type[16]	Location	Side	Length	Type[17]
From	To									
89.626	89.726	LHS	W Beam							
89.648	89.758	RHS	W Beam							

12.Protection Works Type: Retaining Wall, RE Wall, Toe wall, Breast wall, Stone picthing

13. Material Type: RCC, PCC, RR-Random Rubble

14. Placement location: LHS, RHS, Both , Median Single , Medain Both Sides

15. Crash Barrier Type: W-beam, CC-Concrete, NJ-New Jersy

16.Gantry Type: C-Cantilever, P- Portal, ECB- Emergency Call Box

17.Lay Byes : BB-Bus Bays ,TB-Truck Lay Byes

Road Inventory (Part-I)

Road Name: NH-27_Rakhaldubi to Kaljhar Pkg-II | **Date : 01/12/2022 to 02/12/2022**

Direction: BHS | **Weather :**

Chainage (km)		Land Use[2]	Chainage (km)		Land Use[2]	Chainage (km)		Carriageway Surface LHS				Chainage (km)		Carriageway Surface RHS				Chainage (km)		Shoulder/Seperator LHS		Chainage (km)		Shoulder/Seperator RHS	
								Main Carriageway		Paved Shoulder				Main Carriageway		Paved Shoulder									
From	To	LHS	From	To	RHS	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[4]	Width (m)	From	To	Type[4]	Width (m)
961.516	961.870	Agriculture	961.570	961.619	Agriculture	961.510	961.730	BT	7.0	BT	1.5	961.590	965.090	CC	7.5	CC	1.5	961.500	966.962	Eartehn Shoulder	1.5	961.500	969.108	Eartehn Shoulder	1.5
961.885	961.900	Water Bodies	961.630	962.218	Industrial	961.730	962.470	BT	10.5	BT	1.5	965.090	969.900	BT	7.5	BT	1.5	966.962	967.800	Seperator		969.108	969.698	Seperator	
961.926	961.930	Water Bodies	962.230	962.428	Agriculture	962.470	965.370	BT	7.5	BT	1.5	969.900	1000.910	CC	7.5	CC	1.5	967.800	968.001	Eartehn Shoulder	1.5	969.698	976.529	Eartehn Shoulder	1.5
961.946	962.010	Agriculture	962.440	962.895	Mixed	965.370	970.070	CC	7.5	CC	1.5	1000.910	1001.620	BT	7.5	BT	1.5	968.001	969.000	Seperator		976.529	978.538	Seperator	
962.265	962.325	Agriculture	962.910	962.938	Water Bodies	970.070	970.950	BT	7.5	BT	1.5	1001.620	1007.250	CC	7.0	CC	1.5	969.000	977.042	Eartehn Shoulder	1.5	978.538	980.800	Eartehn Shoulder	1.5
962.337	962.620	Agriculture	962.950	963.159	Industrial	970.950	971.670	CC	7.5	CC	1.5	1007.250	1007.570	CC	10.5	CC	1.5	977.042	978.620	Seperator		980.800	981.707	Seperator	
962.639	962.650	Residential	963.170	963.818	Agriculture	971.670	1013.010	BT	7.5	BT	1.5	1007.570	1012.990	CC	7.5	CC	1.5	978.620	991.506	Eartehn Shoulder	1.5	981.707	991.930	Eartehn Shoulder	1.5
962.669	962.707	Commercial	963.830	964.139	Water Bodies													991.506	992.550	Seperator		991.930	992.483	Seperator	
962.716	962.930	Commercial	964.150	965.279	Agriculture													992.550	1001.184	Eartehn Shoulder	1.5	992.483	1001.080	Eartehn Shoulder	1.5
962.946	962.960	Water Bodies	965.290	966.389	Commercial													1001.184	1001.984	Seperator		1001.080	1001.785	Seperator	
962.977	962.990	Commercial	966.400	967.038	Commercial													1001.984	1007.958	Eartehn Shoulder	1.5	1001.785	1008.120	Eartehn Shoulder	1.5
963.006	963.226	Agriculture	967.050	967.348	Commercial													1007.958	1009.149	Seperator		1008.120	1009.115	Seperator	
963.236	963.620	Agriculture	967.360	967.568	Agriculture																				
963.636	963.710	Water Bodies	967.580	967.678	Commercial																				
963.727	963.740	Agriculture	967.690	968.675	Mixed																				
963.757	964.177	Water Bodies	968.690	968.739	Water Bodies																				
964.185	964.200	Water Bodies	968.750	968.985	Agriculture																				
964.216	964.950	Agriculture	968.890	971.279	Agriculture																				
964.966	964.980	Water Bodies	971.290	971.374	Commercial																				
964.996	965.610	Agriculture	971.390	971.395	Agriculture																				
965.627	965.650	Water Bodies	971.410	971.443	Water Bodies																				
965.667	966.670	Agriculture	971.460	972.889	Agriculture																				
966.688	966.760	Commercial	972.900	973.359	Commercial																				
966.782	966.860	Water Bodies	973.370	973.443	Water Bodies																				
966.875	967.060	Agriculture	973.460	973.643	Agriculture																				
967.075	967.180	Commercial	973.660	973.832	Commercial																				
967.195	967.650	Agriculture	973.850	974.119	Agriculture																				
967.665	967.770	Commercial	974.130	974.249	Commercial																				
967.786	968.170	Agriculture	974.260	974.304	Agriculture																				
968.185	968.840	Commercial	974.320	974.354	Water Bodies																				
968.851	968.880	Agriculture	974.370	975.064	Agriculture																				
968.896	968.920	Commercial	975.080	975.245	Water Bodies																				
968.938	969.380	Mixed	975.260	979.014	Agriculture																				
969.398	969.470	Agriculture	979.030	979.065	Water Bodies																				
969.486	970.010	Commercial	979.080	979.928	Agriculture																				
970.026	970.880	Agriculture	979.940	979.968	Water Bodies																				
970.900	-	Water Bodies	979.980	980.159	Agriculture																				
970.918	971.010	Agriculture	980.170	980.218	Commercial																				
971.027	971.040	Commercial	980.240	981.985	Agriculture																				

Chainage (km)		Land Use[2]	Chainage (km)		Land Use[2]	Chainage (km)		Carriageway Surface LHS				Chainage (km)		Carriageway Surface RHS				Chainage (km)		Shoulder/Seperator LHS		Chainage (km)		Shoulder/Seperator RHS	
								Main Carriageway		Paved Shoulder				Main Carriageway		Paved Shoulder									
From	To	LHS	From	To	RHS	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[4]	Width (m)	From	To	Type[4]	Width (m)
971.052	971.320	Commercial	982.000	982.185	Commercial																				
971.361	971.500	Agriculture	982.200	982.609	Agriculture																				
971.532	971.771	Agriculture	982.620	982.675	Water Bodies																				
971.790	971.800	Agriculture	982.690	984.395	Agriculture																				
971.812	973.460	Agriculture	984.410	984.454	Commercial																				
973.476	973.520	Commercial	984.470	986.235	Agriculture																				
973.535	973.690	Agriculture	986.250	986.399	Water Bodies																				
973.705	973.790	Commercial	986.410	987.149	Agriculture																				
973.805	973.880	Agriculture	987.160	987.288	Commercial																				
973.891	973.970	Commercial	987.300	988.318	Agriculture																				
973.981	974.070	Mixed	988.330	988.425	Commercial																				
974.085	975.090	Agriculture	988.440	988.683	Agriculture																				
975.015	975.120	Agriculture	988.700	988.724	Water Bodies																				
975.137	975.230	Water Bodies	988.740	989.859	Agriculture																				
975.249	975.420	Agriculture	989.870	990.415	Commercial																				
975.437	975.490	Water Bodies	990.430	990.644	Agriculture																				
975.509	975.930	Agriculture	990.660	991.139	Commercial																				
975.953	976.030	Mixed	991.149	991.889	Agriculture																				
976.045	976.850	Agriculture	991.900	992.588	Commercial																				
976.867	977.000	Agriculture	992.600	992.698	Agriculture																				
977.011	977.070	Residential	992.710	995.409	Agriculture																				
977.082	977.320	Agriculture	995.420	995.695	Water Bodies																				
977.335	977.520	Residential	995.710	995.928	Agriculture																				
977.535	978.470	Agriculture	995.940	996.338	Water Bodies																				
978.486	978.670	Mixed	996.350	997.818	Commercial																				
978.684	979.110	Agriculture	997.830	1001.308	Commercial																				
979.125	979.160	Water Bodies	1001.320	1002.249	Commercial																				
979.176	979.460	Agriculture	1002.260	1002.448	Agriculture																				
979.471	979.570	Commercial	1002.460	1002.749	Commercial																				
979.582	979.670	Agriculture	1002.760	1002.889	Agriculture																				
979.688	979.740	Mixed	1002.910	1003.985	Commercial																				
979.751	980.810	Agriculture	1003.930	1004.859	Mixed																				
980.822	981.030	Residential	1004.870	1005.144	Commercial																				
981.047	981.170	Water Bodies	1005.160	1005.688	Agriculture																				
981.195	981.240	Water Bodies	1005.700	1009.399	Commercial																				
981.256	981.548	Commercial	1009.410	1009.692	Agriculture																				
981.555	981.570	Residential	1009.710	1010.134	Commercial																				
981.591	981.650	Agriculture	1010.150	1010.435	Agriculture																				
981.662	981.780	Residential	1010.450	1010.485	Water Bodies																				
981.792	981.910	Agriculture	1010.500	1010.585	Agriculture																				
981.926	981.950	Water Bodies	1010.600	1010.808	Commercial																				

Chainage (km)		Land Use[2]	Chainage (km)		Land Use[2]	Chainage (km)		Carriageway Surface LHS				Chainage (km)		Carriageway Surface RHS				Chainage (km)		Shoulder/Seperator LHS		Chainage (km)		Shoulder/Seperator RHS	
								Main Carriageway		Paved Shoulder				Main Carriageway		Paved Shoulder									
From	To	LHS	From	To	RHS	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[4]	Width (m)	From	To	Type[4]	Width (m)
981.966	982.310	Agriculture	1010.820	1011.019	Agriculture																				
982.325	982.350	Water Bodies	1011.030	1011.125	Water Bodies																				
982.365	982.390	Agriculture	1011.140	1011.405	Commercial																				
982.402	982.560	Commercial	1011.420	1011.928	Agriculture																				
982.575	982.660	Agriculture	1011.940	1012.808	Commercial																				
982.677	982.790	Water Bodies	1012.820	1012.924	Agriculture																				
982.806	982.900	Agriculture	1012.940	1012.964	Commercial																				
982.917	982.970	Water Bodies																							
982.995	983.040	Commercial																							
983.055	983.760	Agriculture																							
983.775	983.820	Commercial																							
983.835	985.950	Agriculture																							
985.966	986.060	Water Bodies																							
986.077	986.227	Agriculture																							
986.237	986.370	Water Bodies																							
986.387	986.410	Agriculture																							
986.428	986.500	Commercial																							
986.517	988.730	Agriculture																							
988.746	988.870	Water Bodies																							
988.886	988.890	Water Bodies																							
988.906	990.160	Agriculture																							
990.177	990.940	Agriculture																							
990.956	991.220	Residential																							
991.238	992.018	Agriculture																							
992.021	992.890	Mixed																							
992.902	995.020	Agriculture																							
995.032	995.110	Water Bodies																							
995.125	995.180	Agriculture																							
995.192	995.270	Commercial																							
995.285	995.37	Agriculture																							
995.387	995.39	Commercial																							
995.407	995.79	Water Bodies																							
995.807	996.31	Water Bodies																							
996.326	996.35	Agriculture																							
996.366	996.38	Water Bodies																							
996.397	996.48	Water Bodies																							
996.498	996.76	Agriculture																							
996.777	997.24	Mixed																							
997.256	998.09	Agriculture																							
998.116	998.72	Commercial																							
998.736	998.87	Mixed																							

Chainage (km)		Land Use[2]	Chainage (km)		Land Use[2]	Chainage (km)		Carriageway Surface LHS				Chainage (km)		Carriageway Surface RHS				Chainage (km)		Shoulder/Seperator LHS		Chainage (km)		Shoulder/Seperator RHS	
								Main Carriageway		Paved Shoulder				Main Carriageway		Paved Shoulder									
From	To	LHS	From	To	RHS	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[3]	Width (m)	Type[3]	Width (m)	From	To	Type[4]	Width (m)	From	To	Type[4]	Width (m)
998.885	999.61	Agriculture																							
999.621	1002.07	Commercial																							
1002.011	1002.03	Agriculture																							
1002.042	1002.91	Commercial																							
1002.922	1003.34	Agriculture																							
1003.351	1004.96	Mixed																							
1004.971	1005.76	Agriculture																							
1005.771	1006.21	Agriculture																							
1006.227	1006.23	Water Bodies																							
1006.247	1007.84	Agriculture																							
1007.858	1010.11	Mixed																							
1010.121	1010.14	Water Bodies																							
1010.152	1010.21	Agriculture																							
1010.221	1010.3	Mixed																							
1010.312	1013.01	Agriculture																							

1. Terrain : P- Plain(0-10%) , R- Rolling(10-25%) , M- Mountainous(25-60%), S - Steep(>60%)
2. Land use: A- Agricultural, B - Barren, F - Forest, SU- Semi Urban, R - Residential, C - Commercial, I - Industrial
3. Surface Type : BT - Bitumen, CC - Concrete, G – Gravel
4. Shoulder Type : G – Gravel, E – Earthen

Road Inventory (Part-II)

Road Name: NH-27_Rakhaldubi to Kaljhar Pkg-II | **Date : 01/12/2022 to 02/12/2022**

Direction: BHS | **Weather :**

Chainage (km)		Median Width (m)	Service Road LHS		Service Road RHS		Road side Drain/Foot path LHS				Road side Drain/Foot path RHS				Remarks
From	To		Type[5]	Width	Type[5]	Width	Type[6]	Width	Depth	Condt[7]	Type[6]	Width	Depth	Condt[7]	
961.516	962.010	4.5					Unlined/Earthen			Covered with Vegetation					
961.570	962.093	4.5									Unlined/Earthen			Covered with Vegetation	
962.220	962.704	4.5									Unlined/Earthen			Covered with Vegetation	
962.268	962.680	4.5					Unlined/Earthen			Covered with Vegetation					
962.900	963.681	4.5									Unlined/Earthen			Covered with Vegetation	
962.900	962.935	4.5									CC			Good	
962.940	965.980	4.5					Unlined/Earthen			Covered with Vegetation					
963.680	964.022	4.5									CC			Good	
964.040	964.998	4.5									Unlined/Earthen			Covered with Vegetation	
965.100	965.518	4.5									Unlined/Earthen			Covered with Vegetation	
965.570	965.644	4.5									Unlined/Earthen			Covered with Vegetation	
965.710	965.764	4.5									Unlined/Earthen			Covered with Vegetation	
966.106	966.160	4.5					Unlined/Earthen			Covered with Vegetation					
966.249	966.330	4.5					Unlined/Earthen			Covered with Vegetation					
966.540	966.683	4.5									Unlined/Earthen			Covered with Vegetation	
966.577	966.670	4.5					Unlined/Earthen			Covered with Vegetation					
966.740	966.753	4.5									Unlined/Earthen			Covered with Vegetation	
966.755	968.180	4.5					Unlined/Earthen			Covered with Vegetation					
966.920	967.750	4.5	BT	5.5											
967.030	967.450	4.5			BT	5.5									
967.450	967.660	4.5									Unlined/Earthen			Covered with Vegetation	
967.750	967.934	4.5									Unlined/Earthen			Covered with Vegetation	
967.950	969.000	4.5	BT	5.5											
968.030	968.250	4.5			BT	5.5									
968.250	968.317	4.5									Unlined/Earthen			Covered with Vegetation	
968.530	968.841	4.5									Unlined/Earthen			Covered with Vegetation	
968.563	969.500	4.5					Unlined/Earthen			Covered with Vegetation					

Chainage (km)		Median Width (m)	Service Road LHS		Service Road RHS		Road side Drain/Foot path LHS				Road side Drain/Foot path RHS				Remarks
From	To		Type[5]	Width	Type[5]	Width	Type[6]	Width	Depth	Condt[7]	Type[6]	Width	Depth	Condt[7]	
968.900	969.395	4.5									Unlined/Earthen			Covered with Vegetation	
968.980	968.983	4.5									Unlined/Earthen			Covered with Vegetation	
969.240	969.800	4.5			BT	5.5									
969.420	969.465	4.5									Lined & Uncovered			Chocked	
969.570	969.970	4.5	BT	5.5											
969.970	971.038	4.5									Unlined/Earthen			Covered with Vegetation	
969.666	971.020	4.5					Unlined/Earthen			Covered with Vegetation					
970.390	970.412	4.5									CC			Good	
971.390	972.059	4.5									Unlined/Earthen			Covered with Vegetation	
971.486	971.680	4.5					Unlined/Earthen			Covered with Vegetation					
971.737	973.900	4.5					Unlined/Earthen			Covered with Vegetation					
972.160	973.238	4.5									Unlined/Earthen			Covered with Vegetation	
973.370	973.654	4.5									Unlined/Earthen			Covered with Vegetation	
973.870	974.170	4.5									Unlined/Earthen			Covered with Vegetation	
973.995	975.090	4.5					Unlined/Earthen			Covered with Vegetation					
974.250	975.023	4.5									Unlined/Earthen			Covered with Vegetation	
974.290	974.306	4.5									CC			Good	
974.484	974.500	4.5					CC			Good					
975.018	977.030	4.5					Unlined/Earthen			Covered with Vegetation					
975.040	975.259	4.5									CC			Good	
975.250	980.152	4.5									Unlined/Earthen			Covered with Vegetation	
976.410	976.438	4.5									CC			Good	
976.491	976.510	4.5					CC			Good					
976.529	978.529	4.5			BT	5.5									
977.050	978.620	4.5	BT	5.5											
977.077	979.460	4.5					Unlined/Earthen			Covered with Vegetation					
979.090	979.129	4.5									CC			Good	
979.556	982.410	4.5					Unlined/Earthen			Covered with Vegetation					
979.930	979.953	4.5									CC			Good	
980.220	980.713	4.5									Unlined/Earthen			Covered with Vegetation	

Chainage (km)		Median Width (m)	Service Road LHS		Service Road RHS		Road side Drain/Foot path LHS				Road side Drain/Foot path RHS				Remarks
From	To		Type[5]	Width	Type[5]	Width	Type[6]	Width	Depth	Condt[7]	Type[6]	Width	Depth	Condt[7]	
980.800	981.700	4.5			BT	5.5									
980.830	982.598	4.5									Unlined/Earthen			Covered with Vegetation	
981.880	981.918	4.5									CC			Good	
981.580	981.760	4.5	BT	5.5			CC			Good					
982.486	982.680	4.5					Unlined/Earthen			Covered with Vegetation					
982.610	982.667	4.5									CC			Good	
982.680	986.134	4.5									Unlined/Earthen			Covered with Vegetation	
982.686	982.750	4.5					CC			Good					
982.687	991.340	4.5					Unlined/Earthen			Covered with Vegetation					
983.550	983.578	4.5									CC			Good	
984.280	984.318	4.5									CC			Good	
985.180	985.206	4.5									CC			Good	
985.261	985.290	4.5					CC			Good					
986.150	986.369	4.5									CC			Good	
986.360	990.295	4.5									Unlined/Earthen			Covered with Vegetation	
988.690	988.704	4.5									CC			Good	
988.768	988.790	4.5					CC			Good					
990.390	991.884	4.5									Unlined/Earthen			Covered with Vegetation	
991.500	991.680	4.5	BT	5.5											
991.506	992.550	4.5					Unlined/Earthen			Covered with Vegetation					
991.555	991.940	4.5					Unlined/Earthen			Covered with Vegetation					
991.910	992.184	4.5									Lined & Covered	1.5		Good	
991.920	992.510	4.5	BT	5.5											
991.940	992.510				BT	7.5									
991.971	992.192	4.5					Lined & Covered	1.5		Good					
992.234	992.544	4.5									Lined & Covered	1.5		Good	
992.435	992.560	4.5					Lined & Covered	1.5		Good					
992.560	995.892	4.5									Unlined/Earthen			Covered with Vegetation	
992.577	994.930	4.5					Unlined/Earthen			Covered with Vegetation					
994.995	995.980	4.5					Unlined/Earthen			Covered with Vegetation					

Chainage (km)		Median Width (m)	Service Road LHS		Service Road RHS		Road side Drain/Foot path LHS				Road side Drain/Foot path RHS				Remarks
From	To		Type[5]	Width	Type[5]	Width	Type[6]	Width	Depth	Condt[7]	Type[6]	Width	Depth	Condt[7]	
996.310	996.774	4.5									Unlined/Earthen			Covered with Vegetation	
996.406	996.820	4.5					Unlined/Earthen			Covered with Vegetation					
996.897	997.090	4.5					Unlined/Earthen			Covered with Vegetation					
997.130	997.740	4.5									Unlined/Earthen			Covered with Vegetation	
997.197	998.960	4.5					Unlined/Earthen			Covered with Vegetation					
997.840	998.430	4.5									Unlined/Earthen			Covered with Vegetation	
998.600	999.194	4.5									Unlined/Earthen			Covered with Vegetation	
999.088	999.200	4.5					Unlined/Earthen			Covered with Vegetation					
999.310	1000.231	4.5									Unlined/Earthen			Covered with Vegetation	
999.471	999.630	4.5					Unlined/Earthen			Covered with Vegetation					
999.906	999.980	4.5					Unlined/Earthen			Covered with Vegetation					
1000.148	1000.430	4.5					Unlined/Earthen			Covered with Vegetation					
1000.340	1000.614	4.5									Unlined/Earthen			Covered with Vegetation	
1000.537	1001.220	4.5					Unlined/Earthen			Covered with Vegetation					
1000.670	1000.934	4.5									Unlined/Earthen			Covered with Vegetation	
1001.080	1001.820	4.5			BT	5.5									
1001.130	1001.954	4.5									Lined & Covered	1.5		Good	
1001.080	1001.910	4.5	BT	5.5											
1001.228	1002.070	4.5					Lined & Covered	1.5		Good					
1002.016	1002.040	4.5					Unlined/Earthen			Covered with Vegetation					
1002.240	1002.602	4.5									Unlined/Earthen			Covered with Vegetation	
1002.316	1002.440	4.5					Unlined/Earthen			Covered with Vegetation					
1002.525	1002.610	4.5					Unlined/Earthen			Covered with Vegetation					
1002.760	1002.814	4.5									Unlined/Earthen			Covered with Vegetation	
1002.880	1002.908	4.5									Unlined/Earthen			Covered with Vegetation	
1003.070	1003.095	4.5									Unlined/Earthen			Covered with Vegetation	
1003.120	1003.941	4.5									Unlined/Earthen			Covered with Vegetation	
1003.125	1003.150	4.5					Unlined/Earthen			Covered with Vegetation					
1003.167	1003.290	4.5					Unlined/Earthen			Covered with Vegetation					
1003.734	1003.750	4.5					Lined & UnCovered			Chocked					

Chainage (km)		Median Width (m)	Service Road LHS		Service Road RHS		Road side Drain/Foot path LHS				Road side Drain/Foot path RHS				Remarks
From	To		Type[5]	Width	Type[5]	Width	Type[6]	Width	Depth	Condt[7]	Type[6]	Width	Depth	Condt[7]	
1003.777	1003.810	4.5					Unlined/Earthen			Covered with Vegetation					
1003.835	1003.900	4.5					Unlined/Earthen			Covered with Vegetation					
1003.920	1003.960	4.5					Unlined/Earthen			Covered with Vegetation					
1003.970	1004.294	4.5									Unlined/Earthen			Covered with Vegetation	
1004.047	1004.220	4.5					Unlined/Earthen			Covered with Vegetation					
1004.370	1006.424	4.5									Unlined/Earthen			Covered with Vegetation	
1004.457	1004.500	4.5					Unlined/Earthen			Covered with Vegetation					
1004.546	1004.610	4.5					Unlined/Earthen			Covered with Vegetation					
1004.709	1004.820	4.5					Unlined/Earthen			Covered with Vegetation					
1004.834	1004.890	4.5					Unlined/Earthen			Covered with Vegetation					
1004.909	1005.140	4.5					Unlined/Earthen			Covered with Vegetation					
1005.160	1005.210	4.5					Unlined/Earthen			Covered with Vegetation					
1005.306	1006.800	4.5					Unlined/Earthen			Covered with Vegetation					
1006.110	1006.139	4.5									CC			Good	
1006.835	1006.870	4.5					Unlined/Earthen			Covered with Vegetation					
1006.886	1006.920	4.5					Unlined/Earthen			Covered with Vegetation					
1006.937	1006.980	4.5					Unlined/Earthen			Covered with Vegetation					
1007.210	1007.229	4.5									CC			Good	
1007.450	1008.070	4.5									Unlined/Earthen			Covered with Vegetation	
1007.516	1008.310	4.5					Unlined/Earthen			Covered with Vegetation					
1007.920	1009.100	4.5	BT	5.5											
1008.140	1009.190	4.5			BT	5.5									
1008.130	1008.244	4.5									Lined & Covered	1.5		Good	
1008.527	1008.770	4.5					Lined & Covered	1.5		Good					
1008.798	1009.130	4.5					Unlined/Earthen			Covered with Vegetation					
1009.157	1009.180	4.5					Unlined/Earthen			Covered with Vegetation					
1009.190	1009.334	4.5									Unlined/Earthen			Covered with Vegetation	
1009.199	1009.550	4.5					Unlined/Earthen			Covered with Vegetation					
1009.390	1010.184	4.5									Unlined/Earthen			Covered with Vegetation	
1009.567	1009.580	4.5					Unlined/Earthen			Covered with Vegetation					

Chainage (km)		Median Width (m)	Service Road LHS		Service Road RHS		Road side Drain/Foot path LHS				Road side Drain/Foot path RHS				Remarks
From	To		Type[5]	Width	Type[5]	Width	Type[6]	Width	Depth	Condt[7]	Type[6]	Width	Depth	Condt[7]	
1009.611	1009.980	4.5					Unlined/Earthen			Covered with Vegetation					
1010.066	1010.080	4.5					Unlined/Earthen			Covered with Vegetation					
1010.098	1010.810	4.5					Lined & Covered	1.5		Good					
1010.210	1010.592	4.5									Unlined/Earthen			Covered with Vegetation	
1010.450	1010.483	4.5									CC			Good	
1010.810	1010.851	4.5									Unlined/Earthen			Covered with Vegetation	
1010.820	1010.850	4.5					Unlined/Earthen			Covered with Vegetation					
1010.867	1010.910	4.5					Unlined/Earthen			Covered with Vegetation					
1010.934	1011.020	4.5					Unlined/Earthen			Covered with Vegetation					
1010.940	1011.253	4.5									Unlined/Earthen			Covered with Vegetation	
1011.046	1011.110	4.5					Unlined/Earthen			Covered with Vegetation					
1011.126	1011.140	4.5					Unlined/Earthen			Covered with Vegetation					
1011.186	1011.340	4.5					Unlined/Earthen			Covered with Vegetation					
1011.320	1011.344	4.5									Unlined/Earthen			Covered with Vegetation	
1011.420	1011.671	4.5									Lined & Uncovered			Chocked	
1011.750	1011.923	4.5									Unlined/Earthen			Covered with Vegetation	
1011.767	1011.810	4.5					Unlined/Earthen			Covered with Vegetation					
1011.824	1011.830	4.5					Unlined/Earthen			Covered with Vegetation					
1011.890	1011.920	4.5					Unlined/Earthen			Covered with Vegetation					
1012.008	1012.080	4.5					Unlined/Earthen			Covered with Vegetation					
1012.090	1012.151	4.5									Unlined/Earthen			Covered with Vegetation	
1012.167	1012.610	4.5					Unlined/Earthen			Covered with Vegetation					
1012.310	1012.932	4.5									Unlined/Earthen			Covered with Vegetation	
1012.580	1012.622	4.5									CC			Fair	
1012.666	1013.000	4.5					Unlined/Earthen			Covered with Vegetation					

Chainage (km)		Median Width (m)	Service Road LHS		Service Road RHS		Road side Drain/Foot path LHS				Road side Drain/Foot path RHS				Remarks
From	To		Type[5]	Width	Type[5]	Width	Type[6]	Width	Depth	Condt[7]	Type[6]	Width	Depth	Condt[7]	
NOTE: At following locations median width varies from 4.5 m to 33.0 m															
963+170	964+000	4.5-22.5													
964+000	964+700	4.5-22.5													
974+800	976+000	4.5-33.0													
985+700	986+665	4.5-11.64													
995+000	997+000	4.5-22.50													
1012+000	1013+000	4.5-12.30													

Other than chainages mentioned above median width is 1.0 m at median opening and junction locations wherever storage lane have been proposed.

5. Surface Type : B - Bitumen, C - Concrete, G – Gravel

6. Road Side Drain : CD- Covered Drain / Foot Path, LD- Lined Drain, UD- Unlined Drain, NO- No Drain

7. Condition of Drain : FC - Fully Choked, FD - Damaged, G – Good condition

Road Inventory (Part-III)						
Road Name: NH-27_Rakhaldubi to Kaljhar Pkg-II						**Date : 01/12/2022 to 02/12/2022**
Direction : BHS						**Weather:**
Road/Rail Details & Built-up Area						**Remarks / (Submergence Stretch) & (Draw Cross-Section For Service Road Stretch)[10]**
Chainage (km)		**Location / Village Name**	**Shape[9]**	**Destination**		
				Left	**Right**	
962.280		RHS	T	LHS		
963.600		LHS	T		RHS	
964.432		RHS	T		RHS	
964.852		RHS	T		RHS	
964.945		LHS	T	LHS		
965.217		LHS	T	LHS		
966.234		RHS	T		RHS	
966.907		RHS	T		RHS	
967.179		LHS	T	LHS		
968.333		RHS	T		RHS	
968.452		LHS	T	LHS		
969.602		LHS/RHS	X	LHS	RHS	
970.143		LHS	Y	LHS		
972.168		LHS/RHS	X	LHS	RHS	
972.516		LHS	T	LHS		
973.227		LHS	T	LHS		

Road/Rail Details & Built-up Area						Remarks / (Submergence Stretch) & (Draw Cross-Section For Service Road Stretch)[10]
Chainage (km)		Location / Village Name	Shape[9]	Destination		
				Left	Right	
973.321		RHS	T		RHS	
974.210		LHS	T	LHS		
974.938		RHS	Y		RHS	
975.064		LHS	T	LHS		
975.663		RHS	Y		RHS	
976.479		RHS	T		RHS	
976.562		LHS	T	LHS		
976.780		RHS	T		RHS	
978.546		RHS	T		RHS	
978.718		RHS	T		RHS	
979.603		RHS	Y		RHS	
981.222		RHS	T		RHS	
982.724		RHS	T		RHS	
983.886		RHS	T		RHS	
986.039		RHS	T		RHS	
986.640						
986.699		LHS	T	LHS		
987.161		RHS	T		RHS	

Road/Rail Details & Built-up Area						Remarks / (Submergence Stretch) & (Draw Cross-Section For Service Road Stretch)[10]
Chainage (km)		Location / Village Name	Shape[9]	Destination		
				Left	Right	
987.612		RHS	T		RHS	
987.679		LHS	T	LHS		
987.805		RHS	T		RHS	
987.822		LHS	T	LHS		
988.727		LHS	T	LHS		
989.133		RHS	T		RHS	
989.441		LHS	T	LHS		
989.454		RHS	T		RHS	
990.042		RHS	T		RHS	
990.049		LHS	T	LHS		
990.729		RHS	T		RHS	
990.816		RHS	T		RHS	
991.361		RHS	T		RHS	
991.597		LHS	T	LHS		
991.638		LHS	T	LHS		
993.679		RHS	T		RHS	
994.737		LHS	T	LHS		
995.837		LHS	T	LHS		

Road/Rail Details & Built-up Area						Remarks / (Submergence Stretch) & (Draw Cross-Section For Service Road Stretch)[10]
Chainage (km)		Location / Village Name	Shape[9]	Destination		
				Left	Right	
996.503		RHS	T		RHS	
996.621		LHS	T	LHS		
997.106		LHS	T	LHS		
998.186		LHS	T	LHS		
998.396		LHS	T	LHS		
999.424		RHS	T		RHS	
999.446		LHS	T	LHS		
1000.303		RHS	T		RHS	
1000.389		LHS	T	LHS		
1000.504		RHS	T		RHS	
1000.660		LHS	T	LHS		
1001.351		LHS/RHS	+	LHS	RHS	
1001.689		LHS	T	LHS		
1002.228		RHS	T		RHS	
1003.119		RHS	T		RHS	
1003.935		RHS	T		RHS	
1004.671		LHS	T	LHS		
1004.799		RHS	T		RHS	

Road/Rail Details & Built-up Area						Remarks / (Submergence Stretch) & (Draw Cross-Section For Service Road Stretch)[10]
Chainage (km)		Location / Village Name	Shape[9]	Destination		
				Left	Right	
1004.909		RHS	T		RHS	
1005.311		RHS	T		RHS	
1005.543		RHS	T		RHS	
1006.066		LHS	T	LHS		
1006.292		LHS	T	LHS		
1007.417		RHS	Y		RHS	
1007.671		LHS	T	LHS		
1007.818		LHS	T	LHS		
1008.112		RHS	T		RHS	
1008.217		LHS	T	LHS		
1008.331		RHS	T		RHS	
1008.368		LHS	T	LHS		
1009.195		LHS	T	LHS		
1009.286		LHS	T	LHS		
1009.713		LHS	T	LHS		
1009.780		RHS	T		RHS	
1010.013		RHS	T		RHS	
1010.405		LHS	T	LHS		

Road/Rail Details & Built-up Area						Remarks / (Submergence Stretch) & (Draw Cross-Section For Service Road Stretch)[10]
Chainage (km)		Location / Village Name	Shape[9]	Destination		
				Left	Right	
1011.312		RHS	T		RHS	
1012.388		LHS	T	LHS		
1012.514		RHS	T		RHS	
1012.539		LHS	T	LHS		
1012.737		LHS	T	LHS		
1012.773		RHS	T		RHS	

8. Road side Trees per section : N - Nil, F - Few(0 - 10Nos), M – Medium(10-50 Nos), L - Large(>50 Nos)

9. For Road : T - T-intersection, Y - Y intersection, IV - 4 Road

   ROB/RUB – Over bridge/ Underpass

10. Remarks : In addition to general remarks, Location of Retaining structures, water bodies to be specified

11. Girth of Tree: A- (0.3-0.6 m) ,B- (0.6-0.9 m) C- (0.9-1.8 m) D- (> 1.8 m)

Road Inventory (Part-IV)										
Road Name: NH-27_Rakhaldubi to Kaljhar Pkg-II							**Date : 01/12/2022 to 02/12/2022**			
Direction: BHS							**Weather:**			
Crash Barrier				**Gantry,VMS Board, HTMS**			**Bus Bays / Truck lay Byes**			
Chainage (km)		**Placement Location[14]**	**Type[15]**	**Location**	**Side**	**Type[16]**	**Location**	**Side**	**Length**	**Type[17]**
From	**To**									
961.922	961.940	LHS	CC	961.702	LHS	Over Head	966.482	LHS	20	-
961.932	961.940	LHS	CC	962.419	RHS	Over Head	968.404	RHS	20	-
963.212	963.700	LHS	W Beam	1000.842	LHS	Over Head	969.466	RHS	20	RCC/Masonry
963.709	963.750	LHS	CC	1002.029	RHS	Over Head	969.532	LHS	20	RCC/Masonry
964.106	964.156	LHS	CC				980.641	RHS	20	RCC/Masonry
964.174	964.630	LHS	W Beam				980.751	LHS	20	RCC/Masonry
966.110	966.120	LHS	CC				985.530	LHS	-	RCC/Masonry
966.846	966.860	LHS	CC				986.070	LHS	-	RCC/Masonry
966.962	967.790	LHS	CC				988.720	LHS		RCC/Masonry
967.924	967.940	LHS	CC				989.410	LHS		RCC/Masonry
968.001	969.490	LHS	NJC				990.430	RHS	-	RCC/Masonry
969.120	969.403	RHS	CC				990.840	RHS	-	RCC/Masonry
969.530	969.676	RHS	CC				995.300	LHS	-	RCC/Masonry
969.641	970.042	Median	CC				994.660	LHS	-	RCC/Masonry
970.390	970.413	RHS	CC				1001.890	RHS	20	RCC/Masonry
970.390	970.406	Median	CC				1001.950	LHS		RCC/Masonry
970.584	970.610	LHS	CC				1002.834	RHS	30	-
970.587	970.600	LHS	CC				1002.839	LHS	20	-
972.290	972.296	RHS	CC				1007.030	LHS	20	RCC/Masonry

Crash Barrier				Gantry,VMS Board, HTMS			Bus Bays / Truck lay Byes			
Chainage (km)		Placement Location[14]	Type[15]	Location	Side	Type[16]	Location	Side	Length	Type[17]
From	To									
972.486	972.490	LHS	CC				1007.160	RHS	20	RCC/Masonry
972.840	972.845	RHS	CC							
972.902	972.920	LHS	CC							
973.032	973.050	LHS	CC							
973.170	973.175	RHS	CC							
973.351	973.370	LHS	CC							
973.910	973.915	RHS	CC							
973.910	973.913	Median	CC							
974.082	974.110	Median	CC							
974.290	974.304	Median	CC							
974.290	974.304	RHS	CC							
974.471	974.500	LHS	CC							
974.471	974.500	Median	CC							
974.527	974.917	Median	W Beam							
974.732	975.080	LHS	W Beam							
974.950	974.974	RHS	W Beam							
974.980	975.245	RHS	CC							
975.016	975.060	LHS	W Beam							
975.030	975.244	Median	CC							
975.062	975.120	LHS	CC							
975.250	975.295	RHS	CC							
975.300	975.305	RHS	W Beam							
975.330	975.645	RHS	W Beam							

Crash Barrier				Gantry,VMS Board, HTMS			Bus Bays / Truck lay Byes			
Chainage (km)		Placement Location[14]	Type[15]	Location	Side	Type[16]	Location	Side	Length	Type[17]
From	To									
975.345	975.380	LHS	CC							
975.386	975.750	LHS	W Beam							
976.400	976.438	RHS	CC							
976.400	976.422	Median	CC							
976.481	976.510	LHS	CC							
977.042	978.620	LHS	NJC							
977.430	978.239	RHS	CC							
979.030	979.081	RHS	W Beam							
979.090	979.129	RHS	CC							
979.090	979.110	Median	CC							
979.105	979.180	LHS	W Beam							
979.120	979.203	Median	W Beam							
979.176	979.200	LHS	CC							
979.176	979.200	Median	CC							
979.206	979.280	LHS	W Beam							
979.930	979.952	RHS	CC							
979.930	979.946	Median	CC							
980.420	980.435	RHS	CC							
980.430	980.432	Median	CC							
980.491	980.510	Median	CC							
980.491	980.510	LHS	CC							
981.870	981.918	RHS	CC							
981.870	981.898	Median	CC							

Crash Barrier				Gantry,VMS Board, HTMS			Bus Bays / Truck lay Byes			
Chainage (km)		Placement Location[14]	Type[15]	Location	Side	Type[16]	Location	Side	Length	Type[17]
From	To									
981.932	981.970	Median	CC							
981.942	981.970	LHS	CC							
982.580	982.604	RHS	W Beam							
982.610	982.664	RHS	CC							
982.610	982.663	Median	CC							
982.659	982.690	LHS	W Beam							
982.670	982.713	RHS	W Beam							
982.682	982.750	Median	CC							
982.692	982.750	LHS	CC							
982.756	982.820	LHS	W Beam							
983.130	983.149	RHS	CC							
983.219	983.230	LHS	CC							
983.530	983.544	RHS	W Beam							
983.550	983.578	RHS	CC							
983.550	983.578	Median	CC							
983.570	983.588	RHS	W Beam							
983.627	983.640	LHS	W Beam							
983.656	983.670	LHS	W Beam							
984.260	984.279	RHS	W Beam							
984.270	984.318	Median	CC							
984.270	984.318	RHS	CC							
984.341	984.361	LHS	W Beam							
985.170	985.176	RHS	W Beam							

Crash Barrier				Gantry,VMS Board, HTMS			Bus Bays / Truck lay Byes			
Chainage (km)		Placement Location[14]	Type[15]	Location	Side	Type[16]	Location	Side	Length	Type[17]
From	To									
985.180	985.205	RHS	CC							
985.180	985.205	Median	CC							
985.210	985.224	RHS	W Beam							
985.251	985.270	LHS	W Beam							
985.276	985.300	LHS	CC							
985.277	985.300	Median	CC							
985.305	985.310	LHS	W Beam							
985.560	985.588	RHS	CC							
985.652	985.670	LHS	CC							
986.040	986.090	RHS	W Beam							
986.100	986.149	RHS	CC							
986.140	986.369	RHS	CC							
986.140	986.369	Median	CC							
986.141	986.172	LHS	W Beam							
986.176	986.220	LHS	CC							
986.360	986.389	RHS	CC							
986.410	986.468	RHS	W Beam							
986.445	986.490	LHS	CC							
986.495	986.540	LHS	W Beam							
986.910	986.928	RHS	CC							
987.090	987.098	RHS	CC							
987.680	987.698	RHS	CC							
988.670	988.684	RHS	W Beam							

Crash Barrier				Gantry,VMS Board, HTMS			Bus Bays / Truck lay Byes			
Chainage (km)		Placement Location[14]	Type[15]	Location	Side	Type[16]	Location	Side	Length	Type[17]
From	To									
988.690	988.702	Median	CC							
988.690	988.702	RHS	CC							
988.710	988.729	RHS	W Beam							
988.741	988.760	LHS	W Beam							
988.769	988.790	Median	CC							
988.770	988.790	LHS	CC							
988.795	988.810	LHS	W Beam							
989.370	989.383	RHS	CC							
990.610	990.624	RHS	CC							
990.662	990.690	LHS	CC							
990.679	990.690	Median	CC							
991.220	991.239	RHS	CC							
991.261	991.280	LHS	CC							
991.740	991.759	RHS	CC							
991.920	992.484	RHS	CC							
991.985	992.550	LHS	CC							
992.200	992.212	Median	CC							
992.260	992.270	Median	CC							
992.780	992.798	RHS	CC							
993.510	993.538	RHS	CC							
993.712	993.750	LHS	W Beam							
995.310	995.328	RHS	CC							
995.351	995.370	LHS	CC							

Crash Barrier				Gantry,VMS Board, HTMS			Bus Bays / Truck lay Byes			
Chainage (km)		Placement Location[14]	Type[15]	Location	Side	Type[16]	Location	Side	Length	Type[17]
From	To									
995.770	995.823	RHS	W Beam							
995.830	995.895	RHS	CC							
995.856	995.900	LHS	W Beam							
995.900	996.295	Median	CC							
995.900	996.295	RHS	CC							
995.905	995.970	LHS	NJC							
996.300	996.364	RHS	CC							
996.370	996.428	RHS	W Beam							
996.391	996.440	LHS	CC							
996.448	996.490	LHS	W Beam							
997.010	997.029	RHS	CC							
997.085	997.100	LHS	CC							
998.750	998.769	RHS	CC							
998.750	998.769	Median	CC							
999.090	999.096	RHS	CC							
1000.590	1000.604	RHS	CC							
1000.668	1000.680	LHS	CC							
1002.410	1002.415	RHS	CC							
1003.080	1003.098	RHS	CC							
1003.830	1003.844	RHS	CC							
1005.230	1005.236	RHS	CC							
1006.100	1006.125	RHS	CC							
1006.100	1006.125	Median	CC							

Crash Barrier				Gantry,VMS Board, HTMS			Bus Bays / Truck lay Byes			
Chainage (km)		Placement Location[14]	Type[15]	Location	Side	Type[16]	Location	Side	Length	Type[17]
From	To									
1006.130	1006.144	RHS	W Beam							
1006.171	1006.180	LHS	W Beam							
1006.206	1006.220	LHS	W Beam							
1007.210	1007.239	RHS	CC							
1007.210	1007.226	Median	CC							
1007.230	1007.240	RHS	W Beam							
1007.275	1007.280	LHS	W Beam							
1007.963	1008.090	LHS	CC							
1008.120	1008.615	RHS	W Beam							
1008.127	1008.740	LHS	CC							
1008.438	1008.460	Median	CC							
1008.772	1008.950	LHS	CC							
1008.986	1009.130	LHS	CC							
1010.430	1010.442	RHS	W Beam							
1010.450	1010.478	Median	CC							
1010.450	1010.476	RHS	CC							
1010.479	1010.490	LHS	W Beam							
1010.490	1010.509	Median	W Beam							
1010.500	1010.530	LHS	W Beam							
1010.535	1010.560	LHS	W Beam							
1011.140	1011.153	RHS	CC							
1011.182	1011.200	LHS	CC							
1012.460	1012.519	RHS	W Beam							

Crash Barrier				Gantry,VMS Board, HTMS			Bus Bays / Truck lay Byes			
Chainage (km)		Placement Location[14]	Type[15]	Location	Side	Type[16]	Location	Side	Length	Type[17]
From	To									
1012.530	1012.578	RHS	CC							
1012.570	1012.619	Median	CC							
1012.570	1012.619	RHS	CC							
1012.589	1012.610	LHS	W Beam							
1012.630	1012.698	RHS	CC							
1012.668	1012.690	LHS	CC							
1012.696	1012.736	LHS	W Beam							
1012.700	1012.744	RHS	W Beam							
1012.745	1012.795	LHS	W Beam							

12.Protection Works Type: Retaining Wall, RE Wall, Toe wall, Breast wall, Stone picthing

13. Material Type: RCC, PCC, RR-Random Rubble

14. Placement location: LHS, RHS, Both , Median Single , Medain Both Sides

15. Crash Barrier Type: W-beam, CC-Concrete, NJ-New Jersy

16.Gantry Type: C-Cantilever, P- Portal, ECB- Emergency Call Box

17.Lay Byes : BB-Bus Bays ,TB-Truck Lay Byes

Annexure – 3.2

Inventory and Condition of Structures

INVENTORY OF EXISTING BRIDGES

GENERAL														SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE		
																	Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used	
S.NO.	BRIDGE NO.	LOCATION (Km)	NAME OF RIVER/BRIDGE	YEAR OF CONSTRUCTION	NUMBER OF SPANS	SPAN ARRANGEMENT (EXPANSION JOINT TO EXPANSION JOINT) (m)	CLEAR SPANS (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	H/L OR SUBMERSIBLE	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET-TYPE & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1		30+327 (RHS)	Nallah	OLD	2	2 x 13.5	25	27	HL	7.5	2	8.25	-	RCC Girder + RCC SLAB	Elasto meric	RCC	H/R	BT	Strip Seal	40	Spill through abutment & Wall type pier	RCC	PCC
		30+327 (LHS)		NEW	1	1 x 27	26	27	HL	8.5	2	10.50	-	PSC Girder + RCC Slab	POT-PTFE	RCC	H/R	BT	Strip Seal	40	Spill through	RCC	N.A
2		30+880 (RHS)	Nallah	OLD	1	1 x 6.4	6	6.4	HL	7.5	2	8.25	-	Slab TYPE	-	RCC	H/R	BT	Buried	-	Wall	RCC	N.A
		30+880 (LHS)		NEW	1	1 x 6.4	6	6.4	HL	8.5	2	10.5	-	BOX TYPE	-	RCC	H/R	BT	Buried	-	Wall	RCC	N.A
3		32+335 (RHS)	Nallah	NEW	2	2X26.5	51	52	H/L	7.5	2	10.5	-	PSC I-Girder	POT-PTFE	RCC	H/R	BT	Strip Seal	-	Spill through abutment & Wall type pier	RCC	RCC
		32+335 (LHS)		OLD	2	2X26.5	51	52	H/L	8.5	2	8.25	-	RCC BOX	ROLLER	RCC	H/R	BT	Buried	-	Wall	RCC	PCC
4		35+920 (RHS)	Nallah	NEW	3	3x3.5	-	10.5	HL	7.5	2	10.5	-	RCC BOX	-	RCC	H/R	BT	Buried	-	Wall	RCC	RCC

GENERAL														SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE		
																	Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used	
S.NO.	BRIDGE NO.	LOCATION (Km)	NAME OF RIVER/BRIDGE	YEAR OF CONSTRUCTION	NUMBER OF SPANS	SPAN ARRANGEMENT (EXPANSION JOINT TO EXPANSION JOINT) (m)	CLEAR SPANS (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	H/L OR SUBMERSIBLE	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET-TYPE & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
4		35+920 (LHS)	Nallah	NEW	3	3x3.5	-	10.5	HL	8.5	2	8.25	-	RCC BOX	-	RCC	H/R	BT	Buried	-	Wall	RCC	RCC
5		39+639 (RHS)	Nallah	NEW	1	1x27	26	27	H/L	7.5	2	10.5	-	PSC I-Girder	POT-PTFE	RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
		39+693 (LHS)		OLD	2	2x13.5	25	27	H/L	8.5	2	8.25	-	RCC SLAB	-	RCC	H/R	BT	Strip Seal	-	Wall	RCC	PCC
6		42+057 (RHS)	Nallah	NEW	1	1x21	20	21	H/L	7.5	2	10.5	-	PSC I-Girder	POT-PTFE	RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
		42+057 (LHS)		OLD	2	2x10.5	20	21	H/L	8.5	2	8.25	-	RCC SLAB	-	RCC	H/R	BT	Strip Seal	-	Wall	RCC	PCC
7		44+201 (RHS)	Nallah	OLD	2	2X13.5	26	27	H/L	7.5	2	8.25	-	RCC SLAB	-	RCC	H/R	BT	Strip Seal	-	Spill through abutment & Wall type pier	RCC	PCC
		44+201 (LHS)		NEW	1	1X27	26	27	H/L	8.5	2	10.5	-	PSC I-Girder		RCC	H/R	BT	Strip Seal	-	Spill through abutment	RCC	N.A
		48+231 (RHS)		NEW	1	1X14.5	13.5	14.5	H/L	7.5	2	10.5	1.5	PSC I-Girder		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A

GENERAL														SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE		
																	Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used	
S.NO.	BRIDGE NO.	LOCATION (Km)	NAME OF RIVER/BRIDGE	YEAR OF CONSTRUCTION	NUMBER OF SPANS	SPAN ARRANGEMENT (EXPANSION JOINT TO EXPANSION JOINT) (m)	CLEAR SPANS (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	H/L OR SUBMERSIBLE	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET-TYPE & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
8		48+231 (LHS)	Nallah	OLD	1	1X14.5	13.5	14.5	H/L	7	2	7.5	-	RCC SLAB		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
9		48+696 (RHS)	Nallah	NEW	1	1X14.5	13.5	14.5	H/L	8.5	2+PS	10	-	RCC I-GIRDER	POT-PTFE	RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
		48+696 (LHS)		OLD	1	1X14.5	13.5	14.5	H/L	7.5	2	8.25	-	RCC GIRDER+SLAB		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
		49+096 (RHS)		NEW	1	1X21	20	21	H/L	7.5	2+PS	10	-	PSC I-Girder		RCC	H/R	BT	Strip Seal	-	Spill through abutment & Wall type pier	RCC	N.A
10		49+096 (LHS)	Nallah	OLD	2	2X10.5	20	21	H/L	7.5	2	8.25	-	RCC GIRDER+SLAB	-	RCC	H/R	BT	Strip Seal	-	Spill through abutment	RCC	PCC
11		50+681 (RHS)	Nallah	NEW	1	1X10.5	9.5	10.5	H/L	8.5	2	10	-	RCC GIRDER+SLAB		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
		50+681 (RHS)		OLD	1	1X10.5	9.5	10.5	H/L	7.5	2	8.25	-	RCC GIRDER+SLAB	-	RCC	H/R	BT	Buried	-	Wall	RCC	N.A
		50+870 (RHS)		NEW	1	1X14.5	13.5	14.5	H/L	8.5	2	10	-	PSC I-Girder	-	RCC	H/R	BT	Strip Seal	-	Spill through abutment & Wall type pier	RCC	N.A

GENERAL														SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE		
																	Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used	
S.NO.	BRIDGE NO.	LOCATION (Km)	NAME OF RIVER/BRIDGE	YEAR OF CONSTRUCTION	NUMBER OF SPANS	SPAN ARRANGEMENT (EXPANSION JOINT TO EXPANSION JOINT) (m)	CLEAR SPANS (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	H/L OR SUBMERSIBLE	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET-TYPE & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
12		50+870 (LHS)	Nallah	OLD	1	1X14.5	13.5	14.5	H/L	7.5	2	8.25	-	GIRDER+Solid Slab	-	RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
13		52+229 (RHS)	Nallah	NEW	3	3x10	28.5	30	H/L	8.5	2	10	-	GIRDER+Solid Slab	-	RCC	H/R	BT	Strip Seal	-	Spill through abutment & Wall type pier	RCC	RCC
		52.229 (LHS)		OLD	3	3x10	28.5	30	H/L	7.5	2	8.25	-	GIRDER+Solid Slab	-	RCC	H/R	BT	Buried	-	Wall	RCC	PCC
14		53+594 (RHS)	Nallah	OLD	1	1X26.5	25.5	26.5	H/L	7.5	2	8.25	-	RCC GIRDER+Solid Slab		RCC	H/R	BT	Buried	-	Wall	RCC	N.A
		53+594 (LHS)		NEW	1	1X26.5	25.5	26.5	H/L	8.5	2	10	-	PSC I-Girder		RCC	H/R	BT	Buried	-	Wall	RCC	N.A
15		55+302 (RHS)	Nallah	OLD	2	2X13.75	26.5	27.5	H/L	7.5	2	8.25	-	RCC I-GIRDER+SLAB		RCC	H/R	BT	Strip Seal	30	Wall	RCC	PCC
		55+302 (LHS)		NEW	1	1X27.5	26.5	27.5	H/L	8.5	2+PS	10.5	-	PSC I-Girder+SLAB		RCC	H/R	BT	Strip Seal	-	Circular	RCC	N.A

GENERAL														SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE		
																	Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used	
S.NO.	BRIDGE NO.	LOCATION (Km)	NAME OF RIVER/BRIDGE	YEAR OF CONSTRUCTION	NUMBER OF SPANS	SPAN ARRANGEMENT (EXPANSION JOINT TO EXPANSION JOINT) (m)	CLEAR SPANS (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	H/L OR SUBMERSIBLE	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET-TYPE & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
16		57+152 (RHS)	Nallah	OLD	2	2x20.5	40	41	H/L	7.5	2	8.25	-	RCC I-GIRDER+SLAB	Elastomeric	RCC	H/R	BT	Strip Seal	-	Wall	RCC	PCC
		57+152 (LHS)		NEW	2	2x20.5	40	41	H/L	8.5	2	10	-	PSC I-Girder+SLAB	POT-PTFE	RCC	H/R	BT	Strip Seal	-	Circular	RCC	RCC
17		58+855 (RHS)	Nallah	OLD	2	2x26.5	52	53	H/L	7.5	2	8.25	-	PHOTO	ROLLER	RCC	H/R	BT	Strip Seal	-	Wall	RCC	PCC
		58+855 (LHS)		NEW	2	2x26.5	52	53	H/L	8.5	2	10.5	-	PSC I-Girder	POT-PTFE	RCC	H/R	BT	Buried	-	Circular	RCC	RCC
18		60+210 (RHS)	Nallah	OLD	2	2X10.25	19	20.5	H/L	7.5	2	8.25	-	PHOTO		RCC	H/R	BT	Strip Seal	-	Wall	RCC	PCC
		60+201 (LHS)		NEW	1	1X20.4	19	20.4	H/L	8.5	2	10	-	PSC I-Girder	POT-PTFE	RCC	H/R	BT	Strip Seal	-	Circular	RCC	N.A
19		60+420 (RHS)	Nallah	NEW	4	4X5.75	21	23	H/L	8.5	2	10	-	RCC BOX		RCC	H/R	BT	Buried	-	Wall	RCC	RCC
		60+420. (LHS)		OLD	4	4X5.75	21	23	H/L	7.5	2	8.25	-	RCC BOX		RCC	H/R	BT	Buried	-	Wall	RCC	PCC
20		60+610 (RHS)	Nallah	NEW	1	1x7.5	6.5	7.5	H/L	7.5	2	10	-	RCC BOX	-	RCC	Perapet	BT	Buried	-	Wall	RCC	N.A
		60+610 (LHS)		OLD	1	1x7.5	6.5	7.5	H/L	7.5	2	8.25	-	RCC BOX	-	RCC	Perapet	BT	Buried	-	Wall	RCC	N.A

GENERAL														SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE		
																	Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used	
S.NO.	BRIDGE NO.	LOCATION (Km)	NAME OF RIVER/BRIDGE	YEAR OF CONSTRUCTION	NUMBER OF SPANS	SPAN ARRANGEMENT (EXPANSION JOINT TO EXPANSION JOINT) (m)	CLEAR SPANS (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	H/L OR SUBMERSIBLE	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET-TYPE & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
21		66+510 (RHS)	Nallah	OLD	2	2x10.8	21	21.6	H/L	7.5	2	8.25	-	RCC I-GIRDER		RCC	H/R	BT	Strip Seal	-	Wall	RCC	PCC
		66+510 (LHS)		NEW	1	1x20.4	20	20.4	H/L	9	2	10.5	-	PSC I-GIRDER		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
22		67+880 (RHS)	Nallah	OLD	2	2x10.25	19	20.5	H/L	7.5	2	8.25	-	RCC I-GIRDER		RCC	H/R	BT	Strip Seal	-	Wall	RCC	PCC
		67+880 (LHS)		NEW	1	1x20.4	19	20.4	H/L	9	2	10.5	-	PSC I-GIRDER		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
23		68+350 (RHS)	Nallah	OLD	1	1X10.5	9.5	10.5	H/L	7.5	2	8.25	-	SLAB		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
		68+350 (LHS)		NEW	1	1X10.5	9.5	10.5	H/L	8.5	2	10.5	1.5	SLAB		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
24		68+690 (RHS)	Nallah	OLD	2	2X10.25	19	20.5	H/L	7.5	2	8.25	-	RCC I-GIRDER		RCC	H/R	BT	Strip Seal	-	Wall	RCC	PCC
		68+690 (LHS)		NEW	1	1X20.4	19	20.4	H/L	9	2	10.5	-	PSC I-GIRDER		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
25		68+980 (RHS)	Nallah	OLD	1	1X7.9	7	7.9	H/L	7.5	2	8.5	-	RCC SLAB		RCC	Perapet	BT	Buried		Wall	RCC	N.A
		68+980 (LHS)		NEW	1	1X7.9	7	7.9	H/L	9	2	10.5	-	RCC SLAB		RCC	H/R	BT	Buried		Wall	RCC	N.A

GENERAL														SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE		
																	Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used	
S.NO.	BRIDGE NO.	LOCATION (Km)	NAME OF RIVER/BRIDGE	YEAR OF CONSTRUCTION	NUMBER OF SPANS	SPAN ARRANGEMENT (EXPANSION JOINT TO EXPANSION JOINT) (m)	CLEAR SPANS (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	H/L OR SUBMERSIBLE	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET-TYPE & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
26		69+460 (RHS)	Nallah	OLD	1	1X14.5	13.5	14.5	H/L	7.5	2	8.5	-	RCC I-GIRDER		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
		69+460 (LHS)		NEW	1	1X14.5	13.5	14.5	H/L	9	2	10.5	-	RCC I GIRDER		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
27		69+720 (RHS)	Nallah	OLD	1	1X10.5	9.5	10.5	H/L	7.5	2	8.5	-	SOLID SLAB		RCC	H/R	BT	Buried	-	Wall	RCC	N.A
		69+720 (LHS)		NEW	1	1X10.5	9.5	10.5	H/L	9	2	10.5	-	SOLID SLAB		RCC	H/R	BT	Buried	-	Wall	RCC	N.A
28		70+170 (RHS)	Nallah	OLD	4	4X10.5	40	42	H/L	7.5	2	8.5	-	RCC I-GIRDER+ SLAB		RCC	H/R	BT	Strip Seal	-	Wall	RCC	PCC
		70+170 (LHS)		NEW	2	2X20.4	40	40.8	H/L	9	2	10.5	-	PSC I-GIRDER		RCC	H/R	BT	Strip Seal	-	Wall	RCC	RCC

GENERAL														SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE		
																	Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used	
S.NO.	BRIDGE NO.	LOCATION (Km)	NAME OF RIVER/BRIDGE	YEAR OF CONSTRUCTION	NUMBER OF SPANS	SPAN ARRANGEMENT (EXPANSION JOINT TO EXPANSION JOINT) (m)	CLEAR SPANS (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	H/L OR SUBMERSIBLE	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET-TYPE & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
29		70+380 (RHS)	Nallah	OLD	2	2X13.5	26	27	H/L	7.5	2	8.5	-	RCC SLAB	Old Sliding/ Rocker	RCC	H/R	BT	Strip Seal	-	Wall	RCC	PCC
		70+380 (LHS)		NEW	1	1X27	26	27	H/L	9	2	10.5	-	PSC I-GIRDER		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
30		71+340 (RHS)	Nallah	OLD	1	1X14.5	13.5	14.5	H/L	7.5	2	8.5	-	RCC I-GIRDER		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
		71+340 (LHS)		NEW	1	1X14.5	13.5	14.5	H/L	9	2	10.5	-	RCC I-GIRDER		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
31		72+230 (RHS)	Nallah	OLD	2	2X26.5	52	53	H/L	7.5	2	8.25	-	PSC I-GIRDER		RCC	H/R	BT	Strip Seal	-	Wall	RCC	PCC
		72+230 (LHS)		NEW	2	2X26.5	52	53	H/L	8.5	2	10.5	-	PSC I-GIRDER		RCC	H/R	BT	Strip Seal	-	Wall	RCC	RCC
32		72+570 (RHS)	Nallah	OLD	1	1X14.5	13.5	14.5	H/L	7.5	2	8.25	-	RCC I-GIRDER		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
		72+570 (LHS)		NEW	1	1X14.5	13.5	14.5	H/L	8.5	2	10.5	-	PSC I-GIRDER		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A

GENERAL														SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE		
																	Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used	
S.NO.	BRIDGE NO.	LOCATION (Km)	NAME OF RIVER/BRIDGE	YEAR OF CONSTRUCTION	NUMBER OF SPANS	SPAN ARRANGEMENT (EXPANSION JOINT TO EXPANSION JOINT) (m)	CLEAR SPANS (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	H/L OR SUBMERSIBLE	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET-TYPE & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
33		73+310 (RHS)	Lined Canal	OLD	1	1X10.5	9.5	10.5	H/L	7.5	2	8.25	-	SOLID SLAB		RCC	H/R	BT	Buried	-	Wall	RCC	N.A
		73+310 (LHS)		NEW	1	1X10.5	9.5	10.5	H/L	8.5	2	10.5	-	SOLID SLAB		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
34		73+840 (RHS)	Nallah	OLD	1	1X14.5	13.5	14.5	H/L	7.5	2	8.25	-	RCC I-GIRDER		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
		73+840 (LHS)		NEW	1	1X26.5	25.5	26.5	H/L	8.5	2	10.5	-	PSC I-GIRDER		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
35		74+380 (RHS)	Nallah	OLD	2	2X10.5	20	21	H/L	7.5	2	8.25	-	RCC I-GIRDER +SOLID SALB		RCC	H/R	BT	Strip Seal	-	Wall	RCC	PCC
		74+380 (LHS)		NEW	2	2X10.5	20	21	H/L	7.5	2	9.5	-	RCC I-GIRDER +SOLID SALB		RCC	H/R	BT	Strip Seal	-	Wall	RCC	RCC
36		74+800 (RHS)	Nallah	OLD	1	1x39.4	38.5	39.4	H/L	7.5	2	8.25	-	PSC I-GIRDER		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A

GENERAL														SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE		
																	Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used	
S.NO.	BRIDGE NO.	LOCATION (Km)	NAME OF RIVER/BRIDGE	YEAR OF CONSTRUCTION	NUMBER OF SPANS	SPAN ARRANGEMENT (EXPANSION JOINT TO EXPANSION JOINT) (m)	CLEAR SPANS (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	H/L OR SUBMERSIBLE	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET-TYPE & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
		74+800 (LHS)		NEW	1	1x39.4	38.5	39.4	H/L	8.5	2	10.5	1.5	PSC I-GIRDER		RCC	H/R	BT	Strip Seal	-	Wall COUNTERFORT	RCC	N.A
37		75+160 (RHS)	Nallah	OLD	1	1x14.5	13.5	14.5	H/L	7.5	2	8.25	-	RCC I GIRDER		RCC	H/R	BT	Strip Seal	50	Wall	RCC	N.A
		75+160 (LHS)		NEW	1	1x26.5	25.5	26.5	H/L	8.5	2	10.5	-	RCC I GIRDER		RCC	H/R	BT	Strip Seal	20	Wall COUNTERFORT	RCC	N.A
38		75+885 (RHS)	Nallah	OLD	1	1x10.5	9.5	10.5	H/L	7.5	2	8.25	-	RCC BOX		RCC	H/R ALL 4 SIDE+ACROSS MEDIAN	BT	Strip Seal	-	Wall	RCC	N.A
		75+885 (LHS)		NEW	1	1x10.5	9.5	10.5	H/L	8.5	2	10.5	-	RCC BOX		RCC	H/R ALL 4 SIDE+ACROSS MEDIAN	BT	Buried	-	Wall	RCC	N.A
39		76+060 (RHS)	Nallah	OLD	1	1X41.5	40.5	41.5	H/L	7.5	2	8.25	-	PSC I-GIRDER		RCC	H/R ALL 4 SIDE	BT	Strip Seal	-	N.V	RCC	N.A
		76+060 (LHS)		NEW	1	1X41.5	40.5	41.5	H/L	8.5	2	10.5	-	PSC I-GIRDER		RCC	H/R ALL 4 SIDE	BT	Strip Seal	-	N.V	RCC	N.A
40		77+010 (RHS)	Nallah	NEW	1	1X10	9	10	H/L	2+PS	2+SR	9.5	-	SOLID SLAB		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
		77+010 (LHS)		NEW	1	1X10	9	10	H/L	2+PS	2+SR	9.5	-	SOLID SLAB		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A

GENERAL														SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE		
																	Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used	
S.NO.	BRIDGE NO.	LOCATION (Km)	NAME OF RIVER/BRIDGE	YEAR OF CONSTRUCTION	NUMBER OF SPANS	SPAN ARRANGEMENT (EXPANSION JOINT TO EXPANSION JOINT) (m)	CLEAR SPANS (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	H/L OR SUBMERSIBLE	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET-TYPE & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
41		77+560 (RHS)	Nallah	NEW	1	1X13.5	12.5	13.5	H/L	2+PS	2+SR	9.5	-	SOLID SLAB		RCC	H/R	BT	Buried	-	Wall	RCC	N.A
		77+560 (LHS)		NEW	1	1X13.5	12.5	13.5	H/L	2+PS	2+SR	9.5	-	SOLID SLAB		RCC	H/R	BT	Buried	-	Wall	RCC	N.A
42		78+760 (RHS)	Nallah	NEW	1	1X21.0	20	21	H/L	7.5	2	10.5	-	PSC I-GIRDER		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
		78+760 (LHS)		OLD	2	2X10.5	20	21	H/L	2+PS	2+SR	8.25	-	RCC I-GIRDER		RCC	H/R	BT	Strip Seal	-	Spill through abutment & Wall type pier	RCC	PCC
43		80+940 (RHS)	Nallah	OLD	1	1X9.9	9	9.9	H/L	2	2	8.25	-	RCC solid slab		RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
		80+940 (LHS)		NEW	3	3X3.3	9	9.9	H/L	2	2	10.5	-	RCC BOX		RCC	H/R	BT	Buried	-	Wall	RCC	RCC
44		83+190 (RHS)	Nallah	OLD	1	1X9.9	9	9.9	H/L	2	2	8.25	-	RCC SOLID SLAB	N.V.	RCC	H/R	BT	Strip Seal	-	Wall	RCC	N.A
		83+190 (LHS)		NEW	1	1X9.9	9	9.9	H/L	2+PS	2	10.5	-	RCC SOLID SLAB	N.V.	RCC	H/R	BT	Buried	-	Wall	RCC	N.A
45		86+415 (RHS)	Nallah	NEW	2	2X25.9	51	51.8	H/L	8.5	2	10.5	-	GIRDER		RCC	H/R	BT	Buried	-	Wall	RCC	RCC
		86+415 (LHS)		OLD	2	2X25.9	51	51.8	H/L	7.5	2	8.25	-	GIRDER		RCC	H/R	BT	Buried	-	Wall	RCC	PCC

INVENTORY OF EXISTING BRIDGES

			FOUNDATION							PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS								VERTICAL CLEARANCE	REMARKS
			Pier		Abutment		Protection Work												
S.NO.	BRIDGE NO.	LOCATION (Km)	TYPE	MATERIAL	TYPE	MATERIAL	BED PROTECTION WORK	BANK PROTECTION	RIVER TRAINING WORKS	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET	PROTECTION WORK	EXPANSION JOINTS		
1	2	3	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
1		30+327 (RHS)	N.V	N.V	N.V	N.V	CC FLOORING UP TO WING WALL END	SCOUR	-	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Fair	4	1. R/F of end diaphragm and main girders exposed near Abutment location. 2.Bearings are damaged and not visible, some wooden blocks are kept below end cross girder. Hence new bearings need to be provided. 3. RCC railing of 5m length is damaged. 4. The bridge needs immediate repair work. The pier need to be strengthen.
		30+327 (LHS)	N.A	N.A	N.V	N.V	CC FLOORING UP TO WING WALL END	-	-	Good	-	Good	Fair	Fair	Good	Fair	Fair	4	1. Bridge is good condition. The wearing coat need to replace. 2. Rusting of bearing plate has been obseved.
2		30+880 (RHS)	N.A	N.A	N.V	N.V	-	-	-	Fair	-	Fair	Poor	-	Good	-	-	4	1. The bridge is in good condition. Wearing coat and kerb of median need to be repaired.
		30+880 (LHS)	N.A	N.A	N.V	N.V	-	-	-	Good	-	Good	Good	-	Good	-	-	3	1. The bridge is in good condition
3		32+335 (RHS)	WELL	RCC	Well	RCC	-	STONE PITCHING	-	Good	Fair	Good	Good	Fair	Good		Fair	-	1. The bridge is in good condition
		32+335 (LHS)	WELL	RCC	Well	RCC	-	STONE PITCHING	-	Good	Fair	Good	Poor	Poor	Poor		-	-	1. RCC Railing on RHS side is dameged for about 5m length 2. Rusting of bearing plate has been obseved. Bearings over abutment and pier seems to be in poor condition, need to be rapaired or replaced. 3. Growth of vegetation and accumulation of soil over abutment cap and pier cap has been observed . 4. Wearing coat need to be replaced.
4		35+920 (RHS)	N.V	N.V	N.V	N.V	-	-	-	Good	Good	Good	Good	-	Good		-	-	1. Good Condition Vagitation in wering Condition

			FOUNDATION							PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS								VERTICAL CLEARANCE	REMARKS
			Pier		Abutment		Protection Work												
S.NO.	BRIDGE NO.	LOCATION (Km)	TYPE	MATERIAL	TYPE	MATERIAL	BED PROTECTION WORK	BANK PROTECTION	RIVER TRAINING WORKS	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET	PROTECTION WORK	EXPANSION JOINTS		
1	2	3	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
4		35+920 (LHS)	N.V	N.V	N.V	N.V	-	-	-	Good	Good	Good	Good	-	Good		-	-	1. Good Condition Vagitation in wering Condition
5		39+639 (RHS)	N.A	N.A	Well	RCC	-	-	-	Good	-	Good	Fair	Fair	Good		Fair	-	
		39+693 (LHS)	N.V	N.V	Well	RCC	-	-	-	Fair	Fair	Fair	Poor	Fair	Fair		Fair	-	1. Good Condition Vagitation in wering Condition
6		42+057 (RHS)	N.A	N.A	N.V	N.V	-	-	-	Good	-	Good	Poor	Poor	Poor	-	Fair	-	1. Lot of vegitation has been observed near bridge location. 2. Sadimentaion of sand below bridge has been observed, need to be cleared. 3. Growth of vegetation and accumulation of soil over abutment cap and pier cap has been observed . 4. Rusting of bearing plate has been obseved. Bearings over abutment and pier seems to be in poor condition, need to be replaced. 5. Expension joint need to be repaired on LHS. 6. Wearing coat need to be replaced.
		42+057 (LHS)	-	-	N.V	N.V	-	-	-	Good	Fair	Good	Poor	Good	Fair	-	Poor	-	
7		44+201 (RHS)	N.V	N.V	N.V	N.V	-	-	-	Fair	Fair	Fair	Fair		Fair		Fair		1. Lot of vegitation has been observed near bridge location. 2. expansion joint requires routine maintenance.
		44+201 (LHS)	N.A	N.A	N.V	N.V	-	-	-	Good	-	Good	Good		Good		Fair		
8		48+231 (RHS)	N.A	N.A	WELL	RCC	-	-	-	Good	-	Good	Good		Good		Fair		1. Lot of vegitation has been observed near bridge location.

			FOUNDATION							PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS								VERTICAL CLEARANCE	REMARKS
			Pier		Abutment		Protection Work												
S.NO.	BRIDGE NO.	LOCATION (Km)	TYPE	MATERIAL	TYPE	MATERIAL	BED PROTECTION WORK	BANK PROTECTION	RIVER TRAINING WORKS	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET	PROTECTION WORK	EXPANSION JOINTS		
1	2	3	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
8		48+231 (LHS)	N.A	N.A	WELL	RCC	-	-	-	Fair	-	Fair	Fair		Poor		Fair		1. Lot of vegitation has been observed near bridge location. 2. Crash barrier Damaged, Dirt wall damaged. 3. Expansion joint requires routine maintenance.
9		48+696 (RHS)	N.A	N.A	WELL	RCC	-	-	-	Good	-	Good	Poor		Fair		Fair		1. Wearing coat need to be replaced.
		48+696 (LHS)	N.A	N.A	Wall	RCC	-	-	-	Fair	-	Fair	Poor		Fair		Fair		1. Expansion joint require maintenance. 2. Wearing coat need to be replaced.
10		49+096 (RHS)	N.A	N.A	Well	RCC	-	-	-	Good	-	Fair	Fair		Good		Fair		1.The bridge is in good condition.
		49+096 (LHS)	N.V	N.V	Wall	RCC	-	-	-	Fair	Poor	Fair	Fair	Poor	Fair		Fair		1. Scouring at pier location has been observed. Also the pier deteriorated. Hence requires strengthening. 2. Growth of vegetation and accumulation of soil over abutment cap and pier cap has been observed . 3. Bearings need to be provided.
11		50+681 (RHS)	N.A	N.A	OPEN	RCC	-	STONE PITCHING AROUND ABUTMENT	-	Good	-	Fair	Poor		Poor		Fair		1. RCC railing requires repair. 2. Wearing coat need to be replaced.
		50+681 (RHS)	N.A	N.A	OPEN	RCC	-	STONE PITCHING AROUND ABUTMENT	-	Fair	-	Fair	Poor		Poor		-		
		50+870 (RHS)	N.A	N.A	Well	RCC	-	-	-	Good	-	Good	Fair	Fair	Fair		Fair		1. The Bridge is in good condition. Expansion joint and bearing requires routine maitnance

			FOUNDATION							PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS								VERTICAL CLEARANCE	REMARKS
			Pier		Abutment		Protection Work												
S.NO.	BRIDGE NO.	LOCATION (Km)	TYPE	MATERIAL	TYPE	MATERIAL	BED PROTECTION WORK	BANK PROTECTION	RIVER TRAINING WORKS	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET	PROTECTION WORK	EXPANSION JOINTS		
1	2	3	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
12		50+870 (LHS)	N.A	N.A	Wall	RCC	-	-	-	Fair	-	Fair	Fair	Fair	Fair		Fair		1. Lot of vegitation has been observed near bridge location. 2. Sadimentaion of sand below bridge has been observed, need to be cleared. 3. Growth of vegetation and accumulation of soil over abutment cap has been observed . 4. Bearings over abutment seems to be in poor condition, need to be replaced.
13		52+229 (RHS)	N.V	N.V	Wall	RCC	-	-	-	Good	Fair	Good	Fair	Fair	Good		Fair		1. The Bridge is in good condition. Expansion joint and bearing requires routine maitnance
		52.229 (LHS)	N.V	N.V	Wall	RCC	-	-	-	Fair	Poor	Fair	Fair	Poor	Fair		-		1. Vegitation has been observed near bridge location. 2. Growth of vegetation and accumulation of soil over abutment cap and pier cap has been observed . 3. Bearings over abutment seems to be in poor condition, need to be replaced. 4. Piers are in poor condition need to be strenghthen.
14		53+594 (RHS)	N.A	N.A	Wall	RCC	-	STONE PITCHING AROUND ABUTMENT	-	Fair	-	Fair	Poor	Fair	Poor		-		1. Vegitation has been observed near bridge location. 2. Growth of vegetation and accumulation of soil over abutment cap has been observed . 4. Bearings over abutmentrequires maintenace. 5. RCC railing for about 12m has damaged.
		53+594 (LHS)	N.A	N.A	Wall	RCC	-	STONE PITCHING AROUND ABUTMENT	-	Good	-	Good	Poor	Fair	Fair		-		1. The Bridge is in good condition. Expansion joint and bearing requires routine maitnance
15		55+302 (RHS)	N.V	N.V	Wall	RCC	-	-	-	Fair		Fair	Fair		Fair		Fair	6	1. Vegitation has been observed near bridge location. 2. Growth of vegetation and accumulation of soil over abutment cap has been observed . 3. Bearings over abutment and pier requires maintenace.
		55+302 (LHS)	N.A	N.A	Well	RCC	-	-	-	Good	-	Good	Fair		Fair		Fair	6	1. The Bridge is in good condition. Expansion joint and bearing requires routine maitnance

			FOUNDATION							PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS								VERTICAL CLEARANCE	REMARKS
			Pier		Abutment		Protection Work												
S.NO.	BRIDGE NO.	LOCATION (Km)	TYPE	MATERIAL	TYPE	MATERIAL	BED PROTECTION WORK	BANK PROTECTION	RIVER TRAINING WORKS	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET	PROTECTION WORK	EXPANSION JOINTS		
1	2	3	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
16		57+152 (RHS)	RCC	RCC	Wall	RCC	-	-	-	Fair		Fair	Fair		Good		Poor	5.5	1. Lot of vegitation has been observed near bridge location. 2. Growth of vegetation and accumulation of soil over abutment cap and pier cap has been observed . 3. Bearings over abutment and pier seems to be in poor condition, need to be replaced. 4. Expension joint need to be repaired. 5. Wearing coat need to be replaced. 6. Scouring at pier location is observed and PCC pier has been deteriorated for some extent which needs repair.
		57+152 (LHS)	RCC	RCC	Well	RCC	-	-	-	Good		Good	Fair		Good		Fair	5.5	1. The Bridge is in good condition.
17		58+855 (RHS)	N.V	N.V	Wall	RCC	-	STONE PITCHING	-	Fair		Fair	Poor	Poor	Good		Fair	4	1. Wearing coat need to be replaced. 2. Rusting of bearing plate has been obseved.
		58+855 (LHS)	N.V	N.V	Well	RCC	-	STONE PITCHING	-	Good		Good	Poor		Good		-	4	1. Wearing coat need to be replaced.
18		60+210 (RHS)	N.V	N.V	N.V	N.V	-	-	-	Fair		Fair	Fair		Good		Fair	4	1. Wearing coat need to be replaced. 2. Clearing of sand accumulated over deck and over pier cap is rquired. 3. Expansion joint requires routine maintenance.
		60+201 (LHS)	N.A	N.A	N.V	N.V	-	-	-	Good	-	Good	Fair		Good		Fair	4	
19		60+420 (RHS)	N.V	N.V	Wall	RCC	-	-	-	Good		Good	Fair		Poor		-		1. RCC railing has damaged, nneds repair.
		60+420. (LHS)	N.V	N.V	Wall	RCC	-	-	-	Fair		Fair	Fair		Good		-		1. Vegitation growth has been observed near bridge location. 2. Growth of vegetation and accumulation of soil over abutment cap has been observed . 3. Bearings over abutmentrequires maintenace. 4. RCC railing has damaged, needs repair.
20		60+610 (RHS)	N.A	N.A	N.V	N.V	-	-	-	-	-	-	-	-	Fair	-	-	-	1. Vegitation growth has been observed near bridge location 2. RCC hand railing or RCC crash barrier to be propose on both side.
		60+610 (LHS)	N.A	N.A	N.V	N.V	-	-	-	-	-	-	-	-	Fair	-	-	-	

			FOUNDATION							PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS								VERTICAL CLEARANCE	REMARKS
			Pier		Abutment		Protection Work												
S.NO.	BRIDGE NO.	LOCATION (Km)	TYPE	MATERIAL	TYPE	MATERIAL	BED PROTECTION WORK	BANK PROTECTION	RIVER TRAINING WORKS	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET	PROTECTION WORK	EXPANSION JOINTS		
1	2	3	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
21		66+510 (RHS)	N.V	N.V	N.V	N.V	-	-	-	Fair		Fair	Poor		Good		Fair	2.5	1. Expansion joint requires routine maintenance ands cleaning 2. WATER WAY CLEAR, FULL JUNGLE 3. Wearing coat need to be replaced.
		66+510 (LHS)	N.A	N.A	N.V	N.V	-	-	-	Good	-	Good	Poor		Good		Fair	2.5	
22		67+880 (RHS)	N.V	N.V	N.V	N.V	-	-	-	Fair		Fair	Poor	Good	Good		Fair	3.25	1. Lot of vegitation has been observed near bridge location. 2. Growth of vegetation and accumulation of soil over abutment cap has been observed .
		67+880 (LHS)	N.A	N.A	N.V	N.V	-	-	-	Good	-	Good	Fair	Good	Good		Fair	3.25	
23		68+350 (RHS)	N.A	N.A	Wall	RCC	-	-	-	Fair	-	Fair	Fair		Poor		Fair	3.25	1. Expansion joint requires maintenance and cleaning. 2. Wearing coat need to be replaced. 3. WING WALL BHS L=5M
		68+350 (LHS)	N.A	N.A	Wall	RCC	CC FLOORING END TO END	-	-	Good	-	Good	Poor		Good		Fair	3.25	1. Expansion joint requires maintenance and cleaning. 2. Wearing coat need to be replaced.
24		68+690 (RHS)	N.V	N.V	N.V	N.V	-	-	-	Fair		Fair	Fair	Fair	Poor		Fair	3.5	1. Vegitation growth has been observed near bridge location. 2. Growth of vegetation and accumulation of soil over abutment cap has been observed . 3. Bearings over abutmentrequires maintenace. 4. RCC railing has damaged, needs repair. 5. Expansion joint requires maintenance and cleaning. 6. Wearing coat need to be replaced.
		68+690 (LHS)	N.A	N.A	Wall	RCC	-	-	-	Good	-	Good	Fair		Good		Fair	3.5	
25		68+980 (RHS)	N.A	N.A	N.V	N.V	-	-	-	Fair	-	Fair	Fair		-		-	2.5	1. No parapet/railing has been provided. Hence provision of Crash barrier shall be provided for safty purpose. 2. clearing of vegetation arround the bridge need to be done.
		68+980 (LHS)	N.A	N.A	N.V	N.V	CC FLOORING END TO END	-	-	Good	-	Good	Fair				-	2.5	1. clearing of vegetation arround the bridge need to be done.

			FOUNDATION							PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS								VERTICAL CLEARANCE	REMARKS
			Pier		Abutment		Protection Work												
S.NO.	BRIDGE NO.	LOCATION (Km)	TYPE	MATERIAL	TYPE	MATERIAL	BED PROTECTION WORK	BANK PROTECTION	RIVER TRAINING WORKS	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET	PROTECTION WORK	EXPANSION JOINTS		
1	2	3	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
26		69+460 (RHS)	N.A	N.A	Wall	RCC	-	-	-	Fair	-	Fair	Fair	Poor	Poor		Fair	2	1. Vegitation growth has been observed near bridge location. 2. Growth of vegetation over abutment cap and pier cap has been observed . 3. Bearings over abutment need to be replaced/repaired. 4. Expension joint need to be cleaned. 5. Wearing coat need to be replaced. 6. Railing near approach slab on one side has been damaged
		69+460 (LHS)	N.A	N.A	Well	RCC	-	-	-	Good	-	Good	Poor		Fair		Fair	2	1. Wearing coat need to be replaced.
27		69+720 (RHS)	N.A	N.A	OPEN	RCC	-	-	-	Fair	-	Fair	Fair		Poor		-	2.5	1. The wearing coat need to be repaired/replaced. 2. damaged part of RCC Railing need to repaired.
		69+720 (LHS)	N.A	N.A	OPEN	RCC	-	-	-	Good	-	Good	Fair		Fair		-	2.5	
28		70+170 (RHS)	N.V	N.V	N.V.	N.V.	-	-	-	Fair		Fair	Fair		Fair		Fair	2	1. Vegitation growth has been observed near bridge location. 2. Accumulation of soil over abutment cap and pier cap has been observed. need to be cleaned. 3. Bearings over abutment and pier seems to be in poor condition, need to be replaced/repaired. 4. Expension joint need to be cleaned. 5. Wearing coat need to be replaced. 6. Damaged part of Railing need to be repaired 10m.
		70+170 (LHS)	N.V	N.V	N.V.	N.V.	-	-	-	Good		Good	Poor		Fair		Fair	2	New Bridge is in good condition. Routine maintenance of expansion joint is required.

			FOUNDATION							PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS								VERTICAL CLEARANCE	REMARKS
			Pier		Abutment		Protection Work												
S.NO.	BRIDGE NO.	LOCATION (Km)	TYPE	MATERIAL	TYPE	MATERIAL	BED PROTECTION WORK	BANK PROTECTION	RIVER TRAINING WORKS	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET	PROTECTION WORK	EXPANSION JOINTS		
1	2	3	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
29		70+380 (RHS)	N.V	N.V	N.V.	N.V.	-	-	-	Fair		Fair	Fair		Fair		Fair	4	1. Accumulation of soil over abutment cap and pier cap has been observed. need to be cleaned. 2. Bearings over abutment and pier seems to be in poor condition, need to be replaced/repaired. 3. Expension joint need to be cleaned. 4. Damaged part of Railing need to be repaired 5m.
		70+380 (LHS)	N.A	N.A	N.V.	N.V.	-	-	-	Good	-	Good	Fair		Fair		Fair	4	New Bridge is in good condition. Routine maintenance of expansion joint is required.
30		71+340 (RHS)	N.A	N.A	N.V.	N.V.	-	-	-	Fair	-	Fair	Poor		Fair		Fair		1. Vegitation growth has been observed near bridge location. 2. Bearings over abutment and pier seems to be in poor condition, need to be replaced/repaired. 3. Expension joint need to be cleaned and maintained. 4. Wearing coat need to be replaced. 5. Damaged part of Railing need to be repaired 3m.
		71+340 (LHS)	N.A	N.A	Well	RCC	-	-	-	Good	-	Good	Poor		Fair		Fair		1. New Bridge is in good condition. Routine maintenance of expansion joint is required.
31		72+230 (RHS)	WALL	RCC	Well	RCC	-	STONE PITCHING	-	Fair		Fair	Poor		Poor		Poor		1. Expension joint need to be cleaned and maintained. 2. Wearing coat need to be replaced. 3. Damaged part of Railing need to be repaired 10m.
		72+230 (LHS)	WALL	RCC	Well	RCC	-	STONE PITCHING	-	Good		Good	Fair		Fair		Fair		1. New Bridge is in good condition. Routine maintenance of expansion joint is required. 2. Wearing coat need to be replaced.
32		72+570 (RHS)	N.A	N.A	Well	RCC	-	STONE PITCHING	-	Fair	-	Fair	Fair		Poor		Fair		1. Expension joint need to be cleaned and maintained. 2. Wearing coat need to be replaced. 3. Damaged part of Railing need to be repaired/reconstructed.
		72+570 (LHS)	N.A	N.A	Well	RCC	-	STONE PITCHING	-	Good	-	Good	Fair		Fair		Fair		1. New Bridge is in good condition. Routine maintenance of expansion joint is required.

			FOUNDATION							PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS								VERTICAL CLEARANCE	REMARKS
			Pier		Abutment		Protection Work												
S.NO.	BRIDGE NO.	LOCATION (Km)	TYPE	MATERIAL	TYPE	MATERIAL	BED PROTECTION WORK	BANK PROTECTION	RIVER TRAINING WORKS	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET	PROTECTION WORK	EXPANSION JOINTS		
1	2	3	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
33		73+310 (RHS)	N.A	N.A	N.V.	N.V.	-	CC PITCHING	-	Fair	-	Fair	Fair	Poor	Poor		-		1. Wearing coat need to be replaced. 2. Damaged part of Railing need to be repaired / reconstrcted.
		73+310 (LHS)	N.A	N.A	N.V.	N.V.	-	-	-	Good	-	Good	Fair		Poor		Fair		
34		73+840 (RHS)	N.A	N.A	Wall	RCC	-	-	-	Fair	-	Fair	Fair	Poor	Good		Fair		1. Vegitation growth has been observed near bridge location. 2. Bearings over abutment and pier seems to be in poor condition, need to be replaced/repaired. 3. Expension joint need to be cleaned and maintained. 4. Wearing coat need to be replaced. 5. Damaged part of Railing need to be repaired.
		73+840 (LHS)	N.A	N.A	Wall	RCC	CC PITCHING	CC PITCHING	-	Good	-	Good	Fair				Fair		1. Wearing coat need to be replaced. 2. Damaged part of Railing need to be repaired.
35		74+380 (RHS)	N.V.	N.V.	N.V.	N.V.	FOUNDATION PROTECTION WITH WELL ON BOTH ABUTMENT	-	-	Fair		Fair	Fair	Poor	Poor		Fair	4	1. Vegitation growth has been observed near bridge location. 2. Bearings over abutment and pier seems to be in poor condition, need to be replaced/repaired. 3. filler type Expension joint need to be cleaned and maintained. 4. Wearing coat need to be replaced. 5. Damaged part of Railing need to be repaired.
		74+380 (LHS)	N.V.	N.V.	N.V.	N.V.	ONLY STONE PITCHING	-	-	Good		Good	Fair		Fair		Fair	4	1. Expension joint need to be cleaned and maintained.
36		74+800 (RHS)	N.A	N.A	N.V.	N.V.	FOUNDATION PROTECTION WITH WELL ON BOTH ABUTMENT	-	-	Fair	-	Fair	Fair		Poor		Fair	3.5	1. Vegitation growth has been observed near bridge location. 2. Bearings over abutment and pier seems to be in poor condition, need to be replaced/repaired. 3. Expension joint need to be cleaned and maintained. 4. Wearing coat need to be replaced. 5. Damaged part of Railing need to be repaired.

			FOUNDATION							PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS								VERTICAL CLEARANCE	REMARKS
			Pier		Abutment		Protection Work												
S.NO.	BRIDGE NO.	LOCATION (Km)	TYPE	MATERIAL	TYPE	MATERIAL	BED PROTECTION WORK	BANK PROTECTION	RIVER TRAINING WORKS	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET	PROTECTION WORK	EXPANSION JOINTS		
1	2	3	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
		74+800 (LHS)	N.A	N.A	N.V.	N.V.	ONLY STONE PITCHING	-	-	Good	-	Good	Fair		Fair		Fair	3.5	1. LHS FOOTPATH 2. Expension joint need to be cleaned and maintained.
37		75+160 (RHS)	N.A	N.A	Wall	RCC	FOUNDATION PROTECTION WITH WELL ON BOTH ABUTMENT	-	-	Fair	-	Fair	Fair		Fair		Fair	2.5	1. Vegitation growth has been observed near bridge location. 2. Bearings over abutment and pier seems to be in poor condition, need to be replaced/repaired. 3.Expension joint need to be cleaned 4. Wearing coat need to be replaced. 5. Damaged part of Railing need to be repaired approximately damaged lentg is 5m.
		75+160 (LHS)	N.A	N.A	Wall	RCC	ONLY STONE PITCHING	-	-	Good	-	Good	Fair		Fair		Fair	2.5	1. Expension joint need to be cleaned and maintained.
38		75+885 (RHS)	N.A	N.A	WELL	RCC	-	-	-	Fair	-	Fair	Poor	Poor	Fair		Poor		1. Vegitation growth has been observed near bridge location. 2. Bearings over abutment and pier seems to be in poor condition, need to be replaced/repaired. 3.Expension joint need to be repaired. 4. Wearing coat need to be replaced.
		75+885 (LHS)	N.A	N.A	OPEN	RCC	CC FLOORING UPTO WING WALL	-	-	Good	-	Good	Poor		Fair		Poor		1.Expension joint need to be repaired. 2. Wearing coat need to be replaced.
39		76+060 (RHS)	N.A	N.A	N.V.	N.V.	-	-	-	Fair	-	Fair	Poor	Poor	Fair		Poor		1. Vegitation growth has been observed near bridge location. 2.Expension joint need to be repaired. 3. Wearing coat need to be replaced.
		76+060 (LHS)	N.A	N.A	N.V.	N.V.	-	-	-	Good	-	Good	Poor		Fair		Poor		1.Expension joint need to be repaired. 2. Wearing coat need to be replaced.
40		77+010 (RHS)	N.A	N.A	OPEN	RCC	CC FLOORING UPTO END OF WING WALL B.S.	-	-	Good	-	Good	Fair		Fair		Poor		Good condition. Thewearing coat near expansion joint shall be repaired
		77+010 (LHS)	N.A	N.A	OPEN	RCC	CC FLOORING UPTO END OF WING WALL B.S.	-	-	Good	-	Good	Fair		Fair		Poor		Good condition. Thewearing coat near expansion joint shall be repaired

			FOUNDATION							PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS								VERTICAL CLEARANCE	REMARKS
			Pier		Abutment		Protection Work												
S.NO.	BRIDGE NO.	LOCATION (Km)	TYPE	MATERIAL	TYPE	MATERIAL	BED PROTECTION WORK	BANK PROTECTION	RIVER TRAINING WORKS	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET	PROTECTION WORK	EXPANSION JOINTS		
1	2	3	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
41		77+560 (RHS)	N.A	N.A	OPEN	RCC	CC APRON FROM ON B.S. WING WLL 1=6	-	-	Good	-	Good	Poor		Fair		-		Good condition. The vegetation around the bridge shall be cleared.
		77+560 (LHS)	N.A	N.A	OPEN	RCC	CC APRON FROM ON B.S. WING WLL 1=6	-	-	Good	-	Good	Poor		Fair		-		Good condition. The vegetation around the bridge shall be cleared.
42		78+760 (RHS)	N.A	N.A	N.V.	N.V.	-	-	-	Good	-	Good	Poor	Fair	Good		Poor	4.5	Good condition. Thewearing coat near expansion joint shall be repaired
		78+760 (LHS)	N.V.	N.V.	N.V.	N.V.	-	-	-	Fair	Good	Fair	Poor	Fair	Good		Poor	4.5	1. Lot of vegitation growth near abutment has been observed. 2. Growth of vegetation and accumulation of soil over abutment cap has been observed . 3. Expension joint need to be repaired. 4. Wearing coat need to be replaced.
43		80+940 (RHS)	N.A	N.A	N.V.	N.V.	-	-	-	Fair	-	Fair	Fair		Fair		Fair		Good Condition. Expansion joints requires routine maintenance and cleanning. Vegetation around the bridge shall be cleared.
		80+940 (LHS)	N.V.	N.V.	N.V.	N.V.	-	-	-	Good	Good	Good	Fair	Fair	Good		-		Good Condition.
44		83+190 (RHS)	N.A	N.A	N.V.	N.V.	-	-	-	Fair	-	Fair	Poor		Fair		Fair	4	Wearing coat is in poor condition shall be replaced, vegetation around the bridge shall be cleared.
		83+190 (LHS)	N.A	N.A	N.V.	N.V.	-	-	-	Good	-	Good	Poor		Fair		-	4	
45		86+415 (RHS)	WALL	RCC	N.V	N.V	-	-	-	Good	Good	Good	Fair		Fair		Fair	4.5	
		86+415 (LHS)	WALL	RCC	N.V	N.V	-	-	-	Fair	Fair	Fair	Fair		Fair		Fair	4.5	

INVENTORY OF EXISTING LIGHT VEHICULAR UNDERPASSES

GENERAL										SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE			FOUNDATION				PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS						VERTICAL CLEARANCE	REMARKS
													Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used		Pier		Abutment									
S.NO.	BRIDGE NO.	LOCATION (Km)	YEAR OF CONSTRUCTION	CLEAR SPAN ARRANGEMENT (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET- TYPE & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER	TYPE	MATERIAL	TYPE	MATERIAL	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	ROB	79+560 (LHS)	-	3x19.8	61.5	10.75	3 Lane	13.5	-	RCC I-GIRDER	POT-PTFE	RCC	Crash Barrier- RCC & 0.9	BT	Strip Seal	-	Wall/ Circuler	RCC	RCC	-	-	-	-	Good	Good	Good	Fair	Fair	Fair	5.5	1) ROB both approches egetation in RE panel, need to be cleaned
		79+560 (RHS)	-	3x19.8	61.5	12	3 Lane	13.5	1.5	RCC I-GIRDER	POT-PTFE	RCC	Crash Barrier- RCC & 0.9	BT	Strip Seal	-	Wall/ Circuler	RCC	RCC	-	-	-	-	Good	Good	Good	Fair	Fair	Fair	5.5	
1	ROB	87+840 (LHS)	-	1x42+1x19	61		3 Lane	13.5	-	RCC I-GIRDER	POT-PTFE	RCC	Crash Barrier- RCC & 0.9	BT	Strip Seal	-	Wall/ Circuler	RCC	RCC	-	-	-	-	Good	Good	Good	Fair	Fair	Fair	5.5	1) ROB both approches egetation in RE panel, need to be cleaned
		87+840 (RHS)	-	1x42+1x19	61		3 Lane	13.5	1.5	RCC I-GIRDER	POT-PTFE	RCC	Crash Barrier- RCC & 0.9	BT	Strip Seal	-	Wall/ Circuler	RCC	RCC	-	-	-	-	Good	Good	Good	Fair	Fair	Fair	5.5	
					122.5																										

INVENTORY OF EXISTING LIGHT VEHICULAR UNDERPASSES

GENERAL										SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE			FOUNDATION				PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS						VERTICAL CLEARANCE
													Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used		Pier		Abutment								
S.NO.	BRIDGE NO.	LOCATION (Km)	YEAR OF CONSTRUCTION	CLEAR SPAN ARRANGEMENT (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET- TYPE & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER	TYPE	MATERIAL	TYPE	MATERIAL	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	VUP	76+600 (LHS)	-	2x8	9.5	8.75	2 Lane	11.25	1.5+1.0	Box	NA	RCC	Crash Barrier- RCC & 0.9	BT	NA	NA	Wall	RCC	RCC	Box	RCC	Box	RCC	Good	Good	Good	Fair	-	-	4.5
		76+600 (RHS)	-	2x8	9.5	8.75	2 Lane	11.25	1.5+1.0	Box	NA	RCC	Crash Barrier- RCC & 0.9	BT	NA	NA	Wall	RCC	RCC	Box	RCC	Box	RCC	Good	Good	Good	Fair	-	-	4.5

INVENTORY OF EXISTING PEDESTRAIN UNDERPASSES

GENERAL										SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE			FOUNDATION				PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS						VERTICAL CLEARANCE
													Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used		Pier		Abutment								
S.NO.	BRIDGE NO.	LOCATION (Km)	YEAR OF CONSTRUCTION	CLEAR SPAN ARRANGEMENT (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET- TYPE & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER	TYPE	MATERIAL	TYPE	MATERIAL	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	PUP	40+160 (LHS)	-	1X7.0	8	8.75	2-Lane	9.5	-	RCC Box	-	RCC	Crash Barrier- RCC & 0.9	BT	-	-	Wall	RCC	-	-	-	Box	RCC	Good	-	Good	Fair	-	Good	3.5
		40+160 (RHS)	-	1X7.0	8	8.75	2-Lane	9.5	-	RCC Box	-	RCC	Crash Barrier- RCC & 0.9	BT	-	-	Wall	RCC	-	-	-	Box	RCC	Good	-	Good	Fair	-	Good	3.5
2	PUP	87+770 (LHS)	-	1X3.0	3.8	8.75	2-Lane	13.5	-	RCC Box	-	RCC	Crash Barrier- RCC & 0.9	Rigid	-	-	Wall	RCC	-	-	-	Box	RCC	Good	-	Good	Fair	-	Good	3.5
		87+770 (RHS)		1X3.0	3.8	8.75	2-Lane	13.5	-	RCC Box	-	RCC	Crash Barrier- RCC & 0.9	Rigid	-	-	Wall	RCC	-	-	-	Box	RCC	Good	-	Good	Fair	-	Good	3.5
3	PUP	88+170 (LHS)	-	1X3.0	3.8	8.75	2-Lane	13.5	-	RCC Box	-	RCC	Crash Barrier- RCC & 0.9	Rigid	-	-	Wall	RCC	-	-	-	Box	RCC	Good	-	Good	Fair	-	Good	3.5
		88+170 (RHS)		1X3.0	3.8	8.75	2-Lane	13.5	-	RCC Box	-	RCC	Crash Barrier- RCC & 0.9	Rigid	-	-	Wall	RCC	-	-	-	Box	RCC	Good	-	Good	Fair	-	Good	3.5

INVENTORY OF EXISTING BRIDGES

GENERAL														SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE		
																	Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used	
S.NO.	BRIDGE NO.	LOCATION (Km)	NAME OF RIVER/BRIDGE	YEAR OF CONSTRUCTION	NUMBER OF SPANS	SPAN ARRANGEMENT (EXPANSION JOINT TO EXPANSION JOINT) (m)	CLEAR SPANS (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	H/L OR SUBMERSIBLE	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET-TYPE, THICKNESS & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1		962+934 (RHS)	Nallah	NEW	4	4X7.3	28	29.2	H/L	7.5	2	10	1.5	RCC SOLID SLAB	N.V	RCC	RCC Crach Barrier+H/R	BT	Buried		WALL	RCC	RCC
		962+934 (LHS)	Nallah	OLD	4	4X7.3	28	29.2	H/L	7.5	2	8.5	-	RCC SOLID SLAB	N.V	RCC	H/R	BT	Buried		WALL	RCC	RCC
2		970+531 (RHS)	Nallah	NEW	2	2X9.4	18	18.8	H/L	7.5	2	9.5	1.5	RCC SOLID SLAB	N.A.	RCC	2 RCC Crach Barrier+H/R	BT	Buried		WALL	RCC	RCC
		970+531 (LHS)	Nallah	OLD	2	2X9.4	18	18.8	H/L	7.5	2	9.5	-	RCC SOLID SLAB	N.A.	RCC	H/R	BT	Buried		WALL	RCC	RCC
		974+411 (RHS)	Nallah	NEW	2	2X7.4	14	14.8	H/L	7.5	2	10	1.5	RCC SOLID SLAB	N.A.	RCC	2 RCC Crach Barrier+H/R	BT	Buried		WALL	RCC	RCC

GENERAL														SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE		
																	Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used	
S.NO.	BRIDGE NO.	LOCATION (Km)	NAME OF RIVER/BRIDGE	YEAR OF CONSTRUCTION	NUMBER OF SPANS	SPAN ARRANGEMENT (EXPANSION JOINT TO EXPANSION JOINT) (m)	CLEAR SPANS (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	H/L OR SUBMERSIBLE	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET-TYPE, THICKNESS & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
3		974+411 (LHS)	Nallah	NEW	2	2X7.4	14	14.8	H/L	7.5	2	10	1.5	RCC SOLID SLAB	N.A.	RCC	2 RCC Crach Barrier+H/R	BT	Buried		WALL	RCC	RCC
4		976+502 (RHS)	Nallah	NEW	2	2X7.4	14	14.8	H/L	7.5	2	10	1.5	RCC SOLID SLAB		RCC	2 RCC Crach Barrier+H/R	BT	Buried		WALL	RCC	RCC
		976+502 (LHS)	Nallah	NEW	2	2X7.4	14	14.8	H/L	7.5	2	10	1.5	RCC SOLID SLAB		RCC	2 RCC Crach Barrier+H/R	BT	Buried		WALL	RCC	RCC
5		979+176 (RHS)	Nallah	NEW	2	2X7.4	14	14.8	H/L	7.5	2	9.5	1.5	PSC GIRDER		RCC	2 RCC Crach Barrier+H/R	BT	STRIP SEAL		WALL	RCC	RCC
		979+176 (LHS)	Nallah	OLD	2	2X7.4	14	14.8	H/L	7.5	2	8.5	1.5	RCC GIRDER		RCC	RCC Crach Barrier+H/R	BT	STRIP SEAL		WALL	RCC	RCC

GENERAL														SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE		
																	Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used	
S.NO.	BRIDGE NO.	LOCATION (Km)	NAME OF RIVER/BRIDGE	YEAR OF CONSTRUCTION	NUMBER OF SPANS	SPAN ARRANGEMENT (EXPANSION JOINT TO EXPANSION JOINT) (m)	CLEAR SPANS (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	H/L OR SUBMERSIBLE	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET-TYPE, THICKNESS & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
6		980+012 (RHS)	Nallah	NEW	2	2X9	17	18	H/L	7.5	2	9.5	1.5	SOLID SLAB		RCC	2 RCC Crach Barrier+H/R	BT	Buried		WALL	RCC	RCC
		980+012 (LHS)	Nallah	OLD	2	2X9	17	18	H/L	7.5	2	8.5	-	SOLID SLAB		RCC	H/R	BT	Buried		WALL	RCC	RCC
7		981+948 (RHS)	Nallah	NEW	3	3X9.4	27	28.2	H/L	7.5	2	9.5	1.5	SOLID SLAB		RCC	2 RCC Crach Barrier+H/R	BT	Buried		WALL	RCC	RCC
		981+948 (LHS)	Nallah	NEW	3	3X9.4	27	28.2	H/L	7.5	2	9.5	1.5	SOLID SLAB		RCC	2 RCC Crach Barrier+H/R	BT	Buried		WALL	RCC	RCC
8		982+702 (RHS)	Nallah	NEW	3	3X18.61	55	55.83	H/L	7.5	2	10	1.5	RCC GIRDER	METTA LIC	RCC	2 RCC Crach Barrier+H/R	BT	STRIP SEAL		WALL	RCC	RCC
		982+702 (LHS)	Nallah	NEW	3	3X18.61	55	55.83	H/L	7.5	2	10	1.5	RCC GIRDER	METTA LIC	RCC	2 RCC Crach Barrier+H/R	BT	STRIP SEAL		WALL	RCC	RCC

GENERAL														SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE		
																	Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used	
S.NO.	BRIDGE NO.	LOCATION (Km)	NAME OF RIVER/BRIDGE	YEAR OF CONSTRUCTION	NUMBER OF SPANS	SPAN ARRANGEMENT (EXPANSION JOINT TO EXPANSION JOINT) (m)	CLEAR SPANS (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	H/L OR SUBMERSIBLE	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET-TYPE, THICKNESS & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
9		983+620 (RHS)	Nallah	NEW	1	1X14.5	13.5	14.5	H/L	7.5	2	9.5	1.5	RCC GIRDER	N.V	RCC	2 RCC Crach Barrier+H/R	BT	STRIP SEAL		WALL	RCC	-
		983+620 (LHS)	Nallah	OLD	2	2X7.25	13.5	14.5	H/L	8	2	8.5	-	SOLID SLAB	N.V	RCC	H/R	BT	Buried		WALL	RCC	RCC
10		984+350 (RHS)	Nallah	NEW	2	2X12.5	13.5	14.5	H/L	7.5	2	10	1.5	SOLID SLAB	N.V	RCC	2 RCC Crach Barrier+H/R	BT	Buried		WALL	RCC	RCC
		984+350 (LHS)	Nallah	OLD	2	2X12.5	13.5	14.5	H/L	7.5	2	7.5	-	SOLID SLAB	N.V	RCC	H/R	BT	Buried		WALL	RCC	RCC
11		985+249 (RHS)	Nallah	NEW	2	2X8.5	16	17	H/L	7.5	2	10	1.5	SOLID SLAB	N.V	RCC	2 RCC Crach Barrier+H/R	BT	Buried		WALL	RCC	RCC
		985+249 (LHS)	Nallah	NEW	2	2X8.5	16	17	H/L	7.5	2	10	1.5	SOLID SLAB	N.V	RCC	2 RCC Crach Barrier+H/R	BT	Buried		WALL	RCC	RCC

GENERAL														SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE		
																	Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used	
S.NO.	BRIDGE NO.	LOCATION (Km)	NAME OF RIVER/BRIDGE	YEAR OF CONSTRUCTION	NUMBER OF SPANS	SPAN ARRANGEMENT (EXPANSION JOINT TO EXPANSION JOINT) (m)	CLEAR SPANS (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	H/L OR SUBMERSIBLE	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET-TYPE, THICKNESS & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
12		988+740 (RHS)	Nallah	NEW	2	2X9 (EXP TO EXP)	17	18	H/L	7.5	2	10.5	1.5	SOLID SLAB	T.P	RCC	2 RCC Crach Barrier+H/R	BT	Buried		WALL	RCC	RCC
		988+740 (LHS)	Nallah	NEW	2	2X9 (EXP TO EXP)	17	18	H/L	7.5	2	10.5	1.5	SOLID SLAB	T.P	RCC	2 RCC Crach Barrier+H/R	BT	Buried		WALL	RCC	RCC
13		1006+155 (RHS)	Nallah	NEW	2	2X9	17	18	H/L	7.5	2	9.5	1.5	SOLID SLAB		RCC	2 RCC Crach Barrier+H/R	BT	Buried		WALL	RCC	RCC
		1006+155 (LHS)	Nallah	OLD	2	2X9	17	18	H/L	7.5	2	7.5	-	SOLID SLAB		RCC	H/R	BT	Buried		WALL	RCC	RCC
14		1007+252 (RHS)	Nallah	NEW	2	2X7.5	14	15	H/L	7.5	2	9.5	1.5	SOLID SLAB		RCC	2 RCC Crach Barrier+H/R	BT	Buried		WALL	RCC	RCC
		1007+252 (LHS)	Nallah	OLD	2	2X7.5	14	15	H/L	7.5	2	7.5	-	SOLID SLAB		RCC	H/R	BT	Buried		WALL	RCC	RCC

GENERAL														SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE		
																	Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used	
S.NO.	BRIDGE NO.	LOCATION (Km)	NAME OF RIVER/BRIDGE	YEAR OF CONSTRUCTION	NUMBER OF SPANS	SPAN ARRANGEMENT (EXPANSION JOINT TO EXPANSION JOINT) (m)	CLEAR SPANS (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	H/L OR SUBMERSIBLE	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET-TYPE, THICKNESS & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
15		1010+466 (RHS)	Nallah	NEW	4	4X7	27	28	H/L	7.5	2	10	1.5	SOLID SLAB		RCC	2 RCC Crach Barrier+H/R	BT	Buried		WALL	RCC	RCC
		1010+466 (LHS)	Nallah	OLD	4	4X7	27	28	H/L	7.5	2	8	-	SOLID SLAB	T.P	RCC	H/R	BT	Buried		WALL	RCC	RCC
16		1012+588 (RHS)	Nallah	NEW	1	1X41.5	40.5	41.5	H/L	7.5	2	10.5	1.5	PSC GIRDER		RCC	2 RCC Crach Barrier+H/R	BT	STRIP SEAL		WALL	RCC	-
		1012+588 (LHS)	Nallah	OLD	1	1X41.5	40.5	41.5	H/L	7.5	2	8	-	PSC GIRDER		RCC	H/R	BT	STRIP SEAL		WALL	RCC	-

INVENTORY OF EXISTING BRIDGES

			FOUNDATION							PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS								VERTICAL CLEARANCE	REMARKS
			Pier		Abutment		Protection Work												
S.NO.	BRIDGE NO.	LOCATION (Km)	TYPE	MATERIAL	TYPE	MATERIAL	BED PROTECTION WORK	BANK PROTECTION	RIVER TRAINING WORKS	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET	PROTECTION WORK	EXPANSION JOINTS		
1	2	3	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
1		962+934 (RHS)	N.V	N.V	N.V	N.V	N.V	N.V	-	Good	Good	Good	Poor		Good		-	2.5	1.Wearing coat need to be replaced.
		962+934 (LHS)	N.V	N.V	N.V	N.V	N.V	N.V	-	Fair	Fair	Fair	Poor		Good		-	2	1.Wearing coat need to be replaced. 2. The accumulation of oil below bridge need to be cleared.
2		970+531 (RHS)	WALL	RCC	OPEN	RCC	-	-	-	Good	Good	Good	Fair		Good		-	3.25	
		970+531 (LHS)	WALL	RCC	OPEN	RCC	-	Stone Pitching	-	Fair	Fair	Fair	Fair		Good		-	3.25	
		974+411 (RHS)	N.V	N.V	OPEN	RCC	-	-	-	Good	Good	Good	Poor		Good		-	2.53	1.Wearing coat need to be replaced.

			FOUNDATION							PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS								VERTICAL CLEARANCE	REMARKS
			Pier		Abutment		Protection Work												
S.NO.	BRIDGE NO.	LOCATION (Km)	TYPE	MATERIAL	TYPE	MATERIAL	BED PROTECTION WORK	BANK PROTECTION	RIVER TRAINING WORKS	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET	PROTECTION WORK	EXPANSION JOINTS		
1	2	3	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
3		974+411 (LHS)	N.V	N.V	OPEN	RCC	-	-	-	Good	Good	Good	Poor		Good		-	2.53	1.Wearing coat need to be replaced.
4		976+502 (RHS)	N.V	N.V	OPEN	RCC	-	-	-	Good	Good	Good	Poor		Good		-	3	1. Wearing coat need to be replaced.
		976+502 (LHS)	N.V	N.V	OPEN	RCC	-	-	-	Good	Good	Good	Poor		Good		-	3	1. Wearing coat need to be replaced.
5		979+176 (RHS)	N.V	N.V	N.V	N.V	-	-	-	Good	Good	Good	Poor		Good		Poor	2	1.Expension joint need to be repaired. 2.Wearing coat need to be replaced.
		979+176 (LHS)	N.V	N.V	N.V	N.V	-	-	-	Fair	Fair	Fair	Fair		Good		Fair	2	1.Expansion joint require maintenance.

			FOUNDATION							PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS								VERTICAL CLEARANCE	REMARKS
			Pier		Abutment		Protection Work												
S.NO.	BRIDGE NO.	LOCATION (Km)	TYPE	MATERIAL	TYPE	MATERIAL	BED PROTECTION WORK	BANK PROTECTION	RIVER TRAINING WORKS	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET	PROTECTION WORK	EXPANSION JOINTS		
1	2	3	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
6		980+012 (RHS)	N.V	N.V	N.V	N.V	-	-	-	Good	Good	Good	Fair		Good		-	2.5	
		980+012 (LHS)	N.V	N.V	N.V	N.V	CC FLOORING	-	-	Fair	Fair	Fair	Fair		Good		-	2.5	
7		981+948 (RHS)	N.V	N.V	OPEN	RCC	-	-	-	Good	Good	Good	Fair		Good		-	3	
		981+948 (LHS)	N.V	N.V	OPEN	RCC	-	-	-	Good	Good	Good	Fair		Good		-	3	
8		982+702 (RHS)	N.V	N.V	N.V	N.V	-	-	-	Good	Good	Good	Fair		Good		Fair	2	1.Expansion joint require maintenance.
		982+702 (LHS)	N.V	N.V	N.V	N.V	-	-	-	Good	Good	Good	Fair		Good		Fair	2	1.Expansion joint require maintenance.

			FOUNDATION							PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS								VERTICAL CLEARANCE	REMARKS
			Pier		Abutment		Protection Work												
S.NO.	BRIDGE NO.	LOCATION (Km)	TYPE	MATERIAL	TYPE	MATERIAL	BED PROTECTION WORK	BANK PROTECTION	RIVER TRAINING WORKS	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET	PROTECTION WORK	EXPANSION JOINTS		
1	2	3	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
9		983+620 (RHS)	N.V	N.V	N.V	N.V	-	-	-	Good	-	Good	Fair		Good		Poor	2	1.Expension joint need to be repaired.
		983+620 (LHS)	N.V	N.V	N.V	N.V	-	-	-	Fair	Fair	Fair	Fair		Good		-	2	
10		984+350 (RHS)	N.V	N.V	N.V	N.V	-	-	-	Good	Good	Good	Poor		Good		-	2.5	
		984+350 (LHS)	N.V	N.V	N.V	N.V	-	-	-	Fair	Fair	Fair	Poor		Good		-	2.5	1. Wearing coat need to be replaced. 2. Outer H/R 7m damaged need to repaired.
11		985+249 (RHS)	N.V	N.V	N.V	N.V	-	-	-	Good	Good	Good	Poor		Good		-	2	1. Wearing coat need to be replaced.
		985+249 (LHS)	N.V	N.V	N.V	N.V	-	-	-	Good	Good	Good	Poor		Good		-	2.5	1. Wearing coat need to be replaced.

			FOUNDATION							PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS								VERTICAL CLEARANCE	REMARKS
			Pier		Abutment		Protection Work												
S.NO.	BRIDGE NO.	LOCATION (Km)	TYPE	MATERIAL	TYPE	MATERIAL	BED PROTECTION WORK	BANK PROTECTION	RIVER TRAINING WORKS	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET	PROTECTION WORK	EXPANSION JOINTS		
1	2	3	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
12		988+740 (RHS)	N.V	N.V	N.V	N.V	-	-	-	Good	Good	Good	Fair		Good		-	3	
		988+740 (LHS)	N.V	N.V	N.V	N.V	-	-	-	Good	Good	Good	Fair		Good		-	3	
13		1006+155 (RHS)	N.V	N.V	N.V	N.V	-	-	-	Good	Good	Good	Poor	DAMAGE	Good		-	2.5	1. Wearing coat need to be replaced.
		1006+155 (LHS)	N.V	N.V	N.V	N.V	-	-	-	Fair	Fair	Fair	Poor		Poor		-	2.5	1. Wearing coat need to be replaced. 2 Hand Railling damaged need to proposed.
14		1007+252 (RHS)	N.V	N.V	N.V	N.V	-	-	-	Good	Good	Good	Poor		Good		-	2.5	1. Wearing coat need to be replaced.
		1007+252 (LHS)	N.V	N.V	N.V	N.V	-	-	-	Fair	Fair	Fair	Fair		Good		-	2.5	

			FOUNDATION							PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS								VERTICAL CLEARANCE	REMARKS
			Pier		Abutment		Protection Work												
S.NO.	BRIDGE NO.	LOCATION (Km)	TYPE	MATERIAL	TYPE	MATERIAL	BED PROTECTION WORK	BANK PROTECTION	RIVER TRAINING WORKS	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET	PROTECTION WORK	EXPANSION JOINTS		
1	2	3	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
15		1010+466 (RHS)	N.V	N.V	N.V	N.V	CC FLOORING	-	-	Good	Good	Good	Poor		Good		-	3	1. Wearing coat need to be replaced.
		1010+466 (LHS)	N.V	N.V	N.V	N.V	CC FLOORING	-	-	Fair	Fair	Fair	Fair		Fair		-	3	
16		1012+588 (RHS)	-	-	Well	RCC	-	-	-	Good	-	Good	Poor		Good		Fair	4.5	1. Wearing coat need to be replaced. 2. Expansion joint require maintenance.
		1012+588 (LHS)	-	-	Well	RCC	-	-	-	Fair	-	Fair	Fair		Good		Fair	4.5	1. Expansion joint require maintenance.

INVENTORY OF EXISTING PEDESTRAIN UNDERPASSES

GENERAL										SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE			FOUNDATION				PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS						VERTICAL CLEARANCE	REMARKS
													Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used		Pier		Abutment									
S.NO.	BRIDGE NO.	LOCATION (Km)	YEAR OF CONSTRUCTION	CLEAR SPAN ARRANGEMENT (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET- TYPE & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER	TYPE	MATERIAL	TYPE	MATERIAL	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	PUP	992+228 (LHS)	-	1X7.5	8.5	8.75	2-Lane	11.75	1+1	RCC Box	-	RCC	Crash Barrier- RCC & 0.9	BT	Buried	-	Wall	RCC	-	-	-	Box	RCC	Good	-	Good	Fair	N.A	Good	3	Good Condition
		992+228 (RHS)	-	1X7.5	8.5	8.75	2-Lane	11.75	1+1	RCC Box	-	RCC	Crash Barrier- RCC & 0.9	BT	Buried	-	Wall	RCC	-	-	-	Box	RCC	Good	-	Good	Fair	N.A	Good	3	Good Condition
2	PUP	1008+400 (LHS)	-	2X7.5	16.5	8.75	2-Lane	11.75	1+1 & 1+1	RCC Box	-	RCC	Crash Barrier- RCC & 0.9	BT	Buried	-	Wall	RCC	RCC	-	-	Box	RCC	Good	Good	Good	Fair	N.A	Good	3	Good Condition
		1008+400 (RHS)		2X7.5	16.5	8.75	2-Lane	11.75	1+1 & 1+1	RCC Box	-	RCC	Crash Barrier- RCC & 0.9	BT	Buried	-	Wall	RCC	RCC	-	-	Box	RCC	Good	Good	Good	Fair	N.A	Good	3	Good Condition

Annexure – 3.3

Inventory and Condition of Culverts

INVENTORY AND CONDITION SURVEY FOR CULVERTS

SL. No.	Location (Km)	Type of Structure (Pipe / Slab / Box / Arch)	Span Arrangement (No. x Slab Length) (m)	Super-structure		Sub-structure		Vent Height (m)	Median Width (m)	Carriageway Width (m)	Fill (m)	Formation Width (m)	Width of Culvert (m)	Length of Wing/Return Wall (m)		Parapet / Head Wall / CB				Condition of various Components of Culvert							Bed protections		Remarks
				Type	Thick	Type	Thick							Length (m)	Material	Height (m)	Width (m)	Length (m)	Material	Pipe/ Slab/ Box/ Arch	Head Wall	Abut ment Wall	Pier Wall	Wing Wall	Return Wall	Parapet / Hand Rail	U/S	D/S	
1	32+890	BC	1 X 3.8	RCC	0.250	RCC	0.250	3.00	4.50	17.50	-		-	-	-	MBCB (LHS)	-	4.00	-	Fair	-	Fair	N.A	Fair	-	Poor	-	-	1.Vegetation. 2.Hand railling/Parapet wall not found on RHS & Inner side at medain on LHS. 3.Wearing coat damaged, need to replaced.
2	33+165	SC	1 X 3	RCC	0.500	RCC	0.500	3.00	4.50	17.50	-	-	-	-	-	Hand Railing 1.2 (RHS)	-	3.50	RCC	Fair	-	Fair	N.A	Fair	-	Poor	CC Flooring	CC Flooring	1.Corner edge damaged and reinforcement exposed at slab bottom. 2.Vegetation 3.Wearing coat damaged, need to replaced. 4.Hand railling/Parapet wall not found on LHS.
3	34+860	BC	1 X 3.5	RCC	0.250	RCC	0.250	2.50	4.50	17.50			-	-	-	Hand Railing 1.2 (LHS)	-	3.50	RCC	Fair	-	-	N.A	Fair	-	Poor	CC Flooring	CC Flooring	1.Vegetation 2.Hand railling/Parapet wall not found on RHS.
4	35+340	RHS - SC	1 X 4	RCC	0.250	RCC	0.250	3.00	4.50	8.75	-		-	-	-	-	-	4.00	RCC	Fair	-	-	N.A	Fair	-	-	CC Flooring	CC Flooring	1.Vegetation 2.Hand railling/Parapet wall not found on RHS.
		LHS - BC	1 X 4	RCC	0.250	RCC	0.250	3.00		8.75						Hand Railing		4.00	RCC	Good		Good	N.A	Fair		Fair	CC Flooring	CC Flooring	
5	35+565	BC	1 X 3.5	RCC	0.250	RCC	0.250	-	4.50	17.50	-	-	-	-	-	MBCB (RHS)	-	3.50	-	N.V	N.V	N.V	N.A	-	-	-	N.V	N.V	1.Vegetation 2.Hand railling/Parapet wall not found on LHS.
6	36+635	RHS - BC	1 X 3	RCC	0.250	RCC	0.250	2.00	4.50	8.75	-	-	-	3.00	PCC	Hand Railing	-	3.00	RCC	Good	-	Good	N.A	Good	-	Good	-	-	
		LHS - SC	1 X 3	RCC	0.350	RCC	0.350	2.00	4.50	8.75	-	-	-	3.00	PCC	-	0.2	2.50	RCC	Fair	-	Fair	N.A	Fair	-	Fair	NA	NA	1.Vegetation 2.Hand railling/Parapet wall not found on LHS.
7	37+575	LHS - SC	1 X 2.8	RCC	0.350	RCC	0.350	2.00	4.50	8.75	-	-	-	-	-	-	0.3	4.00	RCC	Fair	-	Fair	N.A	NV	-	NV	-	-	1.Vegetation 2.Hand railling/Parapet wall not found on LHS.
		RHS - BC	1 X 2.8	RCC	0.250	RCC	0.250	2.00	4.50	8.75	-	-	-	WW-3.5	RCC	Hand Railing	-	4.50	RCC	Good	-	Good	N.A	-	-	-	-	-	
8	38+390	LHS - SC	1 X 2.8	RCC	0.250	RCC	0.250	-	4.50	8.75	-	-	-	WW-3.5	RCC	-	-	4.00	RCC	Fair	-	Fair	N.A	Fair	-	-	-	-	1.Vegetation 2.Hand railling/Parapet wall not found on LHS.
		RHS - BC	1 X 2.8	RCC	0.250	RCC	0.250	-	4.50	8.75	-	-	-	WW-3.5	RCC	Hand Railing	-	4.00	RCC	Good	-	Good	N.A	Good	-	Fair	-	-	
9	39+190	LHS - SC	1 X 2.65	RCC	0.250	RCC	0.250	-	4.50	8.75	-	-	-	WW-3.5	RCC		-	4.00	RCC	Fair	-	Fair	N.A	Fair	-	Good	-	-	1.Vegetation 2.Hand railling/Parapet wall not found on RHS.
		RHS - BC	1 X 2.65	RCC	0.250	RCC	0.250	-	4.50	8.75	-	-	-	WW-3.5	RCC	Hand Railing	-	4.00	RCC	Good	-	Good	N.A	Good	-	-	-	-	
10	39+303	LHS - SC	1 X 2.5	RCC	0.250	RCC	0.250	-	4.50	8.75	-	-	-	-	-	-	-	-	-	Fair	-	Fair	N.A	-	-	-	-	-	1.Vegetation 2.Hand railling/Parapet wall not found on LHS.
		RHS - BC	1 X 2.5	RCC	0.250	RCC	0.250	-	4.50	8.75	-	-	-	-	-	Hand Railing	-	2.50	RCC	Good	-	Good	N.A	-	-	-	-	-	
11	40+070	BC (EXTENDED UPTO S/R)	1 X 4.0	RCC	0.250	RCC	0.250			17.50				R/W 4.5	RCC	-		4.00		Fair		Fair		-	Fair	-	-	-	1.Hand railing/Parapet wall not found on BHS. 2.Chowked with garbage 3.Vagetation on above the slab. 4.RCC Box culvert extend upto Service Road on BHS
12	40+320	BC (EXTENDED UPTO S/R)	1 X 2.9	RCC	0.250	RCC	0.250	-	4.50	17.50	-	-	-	R/W 3.0	RCC	Head Wall 0.2 (BHS)	0.3	2.90	RCC	Good	-	-	N.A	-	-	-	-	-	1.Hand railing/Parapet wall not found on BHS. 2.Chowked with garbage 3.Vagetation. 4.RCC Box culvert extend upto Service Road on BHS
13	40+515	BC (EXTENDED UPTO S/R)	1 X 5.0	RCC	0.250	RCC	0.250	-	4.50	17.50	-	-	-	R/W 3.0	RCC	Head Wall 0.2 (BHS)	0.3	2.90	RCC	Good	-	-	N.A	-	-	-	-	-	1.Hand railing/Parapet wall not found on LHS. 2.Vagetation. 3.RCC Box culvert extend upto Service Road on BHS
14	42+760	LHS - SC	1 X 2.4	RCC	0.250	RCC	0.250	1.5-2	4.50	8.75	-	-	-	WW 2.5	RCC	Head Wall 0.15	0.2	3.00	RCC	Fair	-	-	N.A	-	-	-	-	-	1.Hand railing/Parapet wall not found on BHS. 2.Vagetation

SL. No.	Location (Km)	Type of Structure (Pipe / Slab / Box / Arch)	Span Arrangement (No. x Slab Length) (m)	Super-structure		Sub-structure		Vent Height (m)	Median Width (m)	Carriageway Width (m)	Fill (m)	Formation Width (m)	Width of Culvert (m)	Length of Wing/Return Wall (m)		Parapet / Head Wall / CB				Condition of various Components of Culvert							Bed protections		Remarks
				Type	Thick	Type	Thick							Length (m)	Material	Height (m)	Width (m)	Length (m)	Material	Pipe/ Slab/ Box/ Arch	Head Wall	Abut ment Wall	Pier Wall	Wing Wall	Return Wall	Parapet / Hand Rail	U/S	D/S	
14	42+700	RHS - BC	1 X 2.4	RCC	0.250	RCC	0.250	1.5-2	4.50	8.75	-	-	-	WW 2.5	RCC	Hand Railing	-	3.00	RCC	Good	-	-	N.A	-	-	-	-	-	
15	43+675	LHS - BC	1 X 3.5	RCC	0.250	RCC	0.250	-	4.50	8.75	-	-	-	-	-	Hand Railing	-	4.00	RCC	Good	-	-	N.A	-	-	-	-	-	1. Vegetation.
		RHS - SC	1 X 3.5	RCC	0.250	RCC	0.250	-	4.50	8.75	-	-	-	-	-	Head Wall 0.15	-	-	RCC	Fair	-	-	N.A	Poor	-	-	-	-	1.Wing wall condition not good. 2. Vegetation. 3.Hand railing/Parapet wall not found on RHS.
16	47+680	BC	1 X 3.5	RCC	0.250	RCC	0.250	2.0	4.50	17.50	-	-	-	WW-3.5	RCC	Head Wall 0.2	0.2	-	RCC	Good	-	Good	N.A	-	Good	Good	-	-	
17	47+785	BC	1 X 2.0	RCC	0.250	RCC	0.250	2.0	4.50	17.50	-	-	-	WW-3.5	RCC	Head Wall 0.2	0.2	-	RCC	Good	-	Good	N.A	-	Good	Good	-	-	
18	52+780 54/1	LHS - BC	1 X 7.9	RCC	0.250	RCC	0.250	3.0	4.50	8.75	-	-	-	WW- 4.0	RCC	Hand Railing	-	7.90	RCC	Good	-	Good	N.A	-	-	-	-	-	1. Vegetation.
		RHS - SC	1 X 7.9	RCC	0.250	RCC	0.250	3.0	4.50	8.75	-	-	-	N.V	-	Head Wall 0.15	-	7.90	RCC	Fair	-	Fair	N.A	-	-	-	-	-	1. Vegetation. 2.Hand railing/Parapet wall not found on RHS. 3.Expension joint poor condition need to repaired/replaced
19	53+065 54/3	LHS - BC	1 X 5.0	RCC	0.250	RCC	0.250	3.0	4.50	8.75	-	-	-	WW- 4.4	RCC	Hand Railing	-	5.00	RCC	Good	-	Good	N.A	-	-	-	-	-	1. Vegetation. 2.Hand railing/Parapet wall not found on RHS.
		RHS - SC	1 X 5.0	RCC	0.250	RCC	0.250	3.0	4.50	8.75	-	-	-	N.V	-	Head Wall 0.15	-	-	RCC	Fair	-	Fair	N.A	-	-	-	-	-	
20	54+020 59/2	LHS - BC	1 X 2.5	RCC	0.250	RCC	0.250	2.0	4.50	8.75	-	-	-	-	-	Hand Railing	-	-	RCC	Good	-	Good	N.A	-	-	-	-	-	1. Vegetation. 2.Hand railing/Parapet wall not found on RHS. 3.Chowked with soil on BHS
		RHS - SC	1 X 2.5	RCC	0.250	RCC	0.250	1.5	4.50	8.75	-	-	-	-	-	Head Wall 0.15	-	-	RCC	Fair	-	Fair	N.A	-	-	-	-	-	
21	54+350	LHS - BC	1 X 5.75	RCC	0.250	RCC	0.250	2.0	4.50	8.75	-	-	-	NV	-	Hand Railing	-	-	RCC	Good	-	Good	N.A	-	-	-	-	-	1.Hand railing/Parapet wall not found on RHS. 2.Vagetation
		RHS -SC	1 X 5.75	RCC	0.250	RCC	0.250	-	4.50	8.75	-	-	-	NV	-	N.V	-	NV	-	Fair	-	Fair	N.A	-	-	-	-	-	
22	60+470	LHS - BC	1 X 3.75	RCC	0.250	RCC	0.250	2.0	4.50	8.75	-	-	-	3.5	RCC	N.V	0.5	3.75	-	-	-	Good	N.A	-	-	-	-	-	1.Hand railing/Parapet wall not found on BHS. 2.Vagetation on LHS
		RHS - BC	1 X 3.75	RCC	0.250	RCC	0.250	-	4.50	8.75	-	-	-	NV	-	Head Wall 0.15	-	NV	RCC	-	-	Good	N.A	-	-	-	-	-	
23	60+970	BC	1 X 6.0	NV	-	N.A	N.A	-	4.50	17.50	-	-	-	-	-	-	-	-	-	-	-	Good	N.A	-	-	-	-	-	1.Hand railing/Parapet wall not found on BHS. 2.Vagetation on BHS
24	61+820	BC	1 X 3.5	NV	-	N.A	N.A	-	4.50	17.50	-	-	-	-	-	-	-	-	-	-	-	Good	N.A	-	-	-	-	-	1.Hand railing/Parapet wall not found on BHS. 2.Vagetation on BHS
25	63+780	SC	1 X 3.0	RCC	0.250	RCC	0.250	1.50	4.50	17.50	-	-	-	-	-	Head Wall 0.20	1.0	3.00	RCC	Fair	-	Fair	N.A	-	-	-	-	-	1.Hand railing/Parapet wall not found on BHS. 2.Vagetation
26	64+040	LHS - BC	1 X 2.5	RCC	0.250	RCC	0.250	1.5	4.50	8.75	-	-	-	2.50	RCC	-	-	-	-	Good	-	Good	N.A	-	-	-	-	-	1.Hand railing/Parapet wall not found on BHS. 2.Vagetation
		RHS - SC	1 X 2.5	RCC	0.250	RCC	0.250	-	4.50	8.75	-	-	-	2.50	RCC	-	-	-	-	Fair	-	Fair	N.A	-	-	-	-	-	
27	64+272	LHS - BC	1 X 2.4	RCC	0.250	RCC	0.250	1.5	4.50	8.75	-	-	-	2.50	RCC	-	-	-	-	Good	-	Good	N.A	-	-	-	-	-	1.Hand railing/Parapet wall not found on BHS. 2.Vagetation
		RHS - BC	1 X 2.4	RCC	0.250	RCC	0.250	1.5	4.50	8.75	-	-	-	2.50	RCC	-	-	-	-	Good	-	Good	N.A	-	-	-	-	-	
28	64+380	HPC	1 X 2.44	-	-	N.A	N.A	-	4.50	17.50	-	-	-	-	-	-	-	-	-	-	-	-	N.A	-	-	-	-	-	1. NOT FOUND AT SITE
29	64+430	LHS - BC	1 X 2	RCC	0.250	RCC	0.250	1.0	4.50	8.75	-	-	-	N.V	-	-	-	-	-	Good	-	Good	N.A	-	-	-	-	-	1.Hand railing/Parapet wall not found on BHS. 2.Chowked with soil 3.Vagetation
		RHS - BC	1 X 2	RCC	0.250	RCC	0.250	1.0	4.50	8.75	-	-	-	2.20	RCC	-	-	-	-	Fair	-	Good	N.A	-	-	-	-	-	

SL. No.	Location (Km)	Type of Structure (Pipe / Slab / Box / Arch)	Span Arrangement (No. x Slab Length) (m)	Super-structure		Sub-structure		Vent Height (m)	Median Width (m)	Carriageway Width (m)	Fill (m)	Formation Width (m)	Width of Culvert (m)	Length of Wing/Return Wall (m)		Parapet / Head Wall / CB				Condition of various Components of Culvert							Bed protections		Remarks
				Type	Thick	Type	Thick							Length (m)	Material	Height (m)	Width (m)	Length (m)	Material	Pipe/ Slab/ Box/ Arch	Head Wall	Abut ment Wall	Pier Wall	Wing Wall	Return Wall	Parapet / Hand Rail	U/S	D/S	
30	64+670	BC	1 X 3.4	RCC	0.250	RCC	0.250	-	4.50	17.50	-	-	-	-	-	Head Wall 0.20	0.2	-	RCC	Good	-	Good	N.A	-	-	-	-	-	1.Hand railing/Parapet wall not found on BHS.
31	64+795	BC	1 X 3.4	RCC	0.250	RCC	0.250	-	4.50	17.50	-	-	-	-	-	Head Wall 0.20	1.0	-	RCC	Good	-	Good	N.A	-	-	-	-	-	1.Hand railing/Parapet wall not found on BHS. 2.Chowked with soil 3.Vagetation
32	65+105	BC	1 X 2.0	RCC	0.250	RCC	0.250	-	4.50	17.50	-	-	-	-	-	Head Wall 0.20 (	0.2	-	RCC	Good	-	Good	N.A	-	-	-	-	-	1.Hand railing/Parapet wall not found on BHS. 2.Chowked with soil 3.Vagetation
33	65+240	BC	1 X 3.2	RCC	0.250	RCC	0.250	-	4.50	17.50	-	-	-	-	-	Head Wall 0.25 (BHS)	0.3	-	RCC	Good	-	Good	N.A	-	-	-	-	-	1.Hand railing/Parapet wall not found on BHS. 2.Chowked with soil 3.Vagetation
34	65+440	HPC	1 X 1.9	-	-	N.A	N.A	-	4.50	17.50	-	-	-	-	-	Head Wall 0.30 (LHS)	1.0	-	RCC	Fair	-	-	N.A	-	-	-	-	-	1.Hand railing/Parapet wall not found on RHS. 2.Chowked with soil 3.Vagetation
35	65+695	BC	1 X 4.2	RCC	0.250	RCC	0.250									Hand Railing (LHS)	-		RCC	Good		Good							1.Hand railing/Parapet wall not found on RHS. 2.Vagetation
36	65+910	HPC	1 X 1.7	-	-	N.A	N.A	-	4.50	17.50	-	-	-	-	-	-	-	-	-	-	-	-	N.A	-	-	-	-	-	1. Not visible due to heavy vegitation B/S. 2. Hand railing/Parapet wall not found on BHS.
37	66+140	SC	1 X 3.0	RCC	0.250	RCC	0.250	-	4.50	17.50	-	-	-	-	-	-	-	-	-	Fair	-	Fair	N.A	-	-	-	-	-	1. Not visible due to heavy vegitation B/S. 2. Hand railing/Parapet wall not found on BHS.
38	66+645	SC	1 X 2.4	RCC	0.250	RCC	0.250	-	4.50	17.50	-	-	-	-	-	-	-	-	-	Fair	-	Fair	N.A	-	-	-	-	-	1. Not visible due to heavy vegitation B/S. 2. Hand railing/Parapet wall not found on BHS.
39	67+030	SC	1 X 4.9	RCC	0.250	RCC	0.250	-	4.50	17.50	-	-	-	-	-	-	-	-	-	Fair	-	Fair	N.A	-	-	-	-	-	1. Not visible due to heavy vegitation B/S. 2. Hand railing/Parapet wall not found on BHS.
40	67+320	BC	1 X 2.0	RCC	0.250	RCC	0.250	-	4.50	17.50	-	-	-	-	-	-	-	-	-	Good	-	Good	N.A	-	-	-	-	-	1. Not visible due to heavy vegitation B/S. 2. Hand railing/Parapet wall not found on BHS.
41	67+590	SC	1 X 5.9	RCC	0.250	RCC	0.250	-	4.50	17.50	-	-	-	-	-	-	-	-	-	Fair	-	Fair	N.A	-	-	-	-	-	1. Not visible due to heavy vegitation B/S. 2. Hand railing/Parapet wall not found on BHS.
42	68+590	BC	1 X 2.8	RCC	0.250	RCC	0.250	-	4.50	17.50	-	-	-	-	-	-	-	-	-	Good	-	Good	N.A	-	-	-	-	-	1. Not visible due to heavy vegitation B/S. 2. Hand railing/Parapet wall not found on BHS.
43	71+445	BC	1 X 3.1	RCC	0.250	RCC	0.250	NV	4.50	17.50	-	-	-	2.50	RCC	Head Wall 0.25	0.3	-	RCC	Good	-	Good	N.A	-	-	-	-	-	1.Hand railing/Parapet wall not found on BHS. 2.Vagetation

SL. No.	Location (Km)	Type of Structure (Pipe / Slab / Box / Arch)	Span Arrangement (No. x Slab Length) (m)	Super-structure		Sub-structure		Vent Height (m)	Median Width (m)	Carriageway Width (m)	Fill (m)	Formation Width (m)	Width of Culvert (m)	Length of Wing/Return Wall (m)		Parapet / Head Wall / CB				Condition of various Components of Culvert							Bed protections		Remarks
				Type	Thick	Type	Thick							Length (m)	Material	Height (m)	Width (m)	Length (m)	Material	Pipe/ Slab/ Box/ Arch	Head Wall	Abut ment Wall	Pier Wall	Wing Wall	Return Wall	Parapet / Hand Rail	U/S	D/S	
44	71+680 73/1	SC	1 X 3 X 2.5	RCC	0.250	RCC	0.250	2.50	4.50	17.50	-	-	-	4.00	RCC	Hand Railing	-	-	RCC	Fair	-	Fair	N.A	WW	-	-	-	-	
45	72+060	LHS - BC	1 X 1.2	RCC	0.250	RCC	0.250	-	4.50	8.75	-	-	-	1.50	RCC	Head Wall 0.25	-	-	RCC	Good	-	Good	N.A	-	-	-	-	-	1.Chowked with soil. 2.Vagetation
		RHS - BC	1 X 1.2	RCC	0.250	RCC	0.250	-	4.50	8.75	-	-	-	1.50	RCC	Head Wall 0.25	-	-	RCC	Good	-	Good	N.A	-	-	-	-	-	
46	72+770	RHS -SC (OLD)	1 X 3.2	RCC	0.250	RCC	0.250	2.00	4.50	8.75	-	-	-	3.00	RCC	Head Wall 0.20	-	-	RCC	Fair	-	Fair	N.A	-	-	Fair	CC FLOOR PROTECTION UPTO FLORING OF WINGWALL		
		LHS - SC (NEW)	1 X 3.2	RCC	0.250	RCC	0.250	2.00	4.50	8.75	-	-	-	3.00	RCC	Head Wall 0.20	-	-	RCC	Good	-	Fair	N.A	-	-	Fair			
47	72+900	HPC	1 X 1.9	-										N.V	N.V	N.V	N.V	N.V	N.V	N.V	N.V	N.V	N.V	N.V	N.V	N.V	N.V	N.V	1. Not visible due to heavy vegitation B/S. 2. Hand railing/Parapet wall not found on BHS.
48	73+265	SC	1 X 6	RCC	0.250	N.A	N.A	-	4.50	17.50	-	-	-	5.00	RCC	-	-	-	-	Fair	-	Fair	N.A	Good	-	-	CC FLOOR PROTECTION UPTO FLORING OF WINGWALL MUD LAYER TO CLEANED		1. Not visible due to heavy vegitation B/S. 2. Hand railing/Parapet wall not found on BHS.
49	74+140	LHS- HPC (NEW)	1 X 1.2 DIA	-	-	N.A	N.A	3.00	4.50	8.75	-	-	-	-	-	-	-	-	-	-	-	-	N.A	-	-	Good	FLOOR & BAD	-	1.HPC FULL OF FILL DEPOSTION
		RHS - BC (OLD)	1.5 X 1.5	RCC	0.250	RCC	0.250	-	4.50	8.75	-	-	-	WW-1.5	-	N.V	-	-	-	Good	-	Good	N.A	-	-	Good	POOR	-	1. PARTIALLY FILL TO BE CLEAN
50	74+630	LHS - SC (NEW)	1 X 4	RCC	0.250	RCC	0.250	3.00	4.50	8.75	-	-	-	4.00	RCC	Head Wall 0.20	-	-	RCC	Fair	-	Fair	N.A	-	-	Good	FLOOR & BAD	-	
		RHS - SC (OLD)	1 X 4	RCC	0.250	RCC	0.250	2.00	4.50	8.75	-	-	-	2.00	RCC	Head Wall 0.30	-	-	RCC	Fair	-	Fair	N.A	-	-	Good	POOR	-	
51	74+990	LHS - SC (NEW)	1 X 4.9	RCC	0.250	RCC	0.250	3.00	4.50	8.75	-	-	-	3.40	RCC	Head Wall 0.15	-	-	RCC	Fair	-	Fair	N.A	-	-	-	FLOOR & BAD	-	
		RHS - SC (OLD)	1 X 4.9	RCC	0.250	RCC	0.250	2.00	4.50	8.75	-	-	-	1.50	RCC	Hand Railing	-	-	RCC	Fair	-	Fair	N.A	-	-	-	POOR	-	
52	76+625	HPC	1 X 1.2 DIA	-	-	N.A	N.A	-	4.50	8.75	-	-	-	-	-	-	-	-	-	-	-	-	N.A	-	-	-	-	-	1.FULL OF SLUSH AND BARREL CLEANING
		BC	1 X 1.2 WIDE	RCC	0.250	RCC	0.250	-	4.50	8.75	-	-	-	-	-	-	-	-	-	Good	-	Good	N.A	-	-	-	-	-	
53	79+840	RCC BOX EXTENDED UPTO S/R	1 X 4.0	RCC	0.250	RCC	0.250	2.00	4.50	17.50	-	-	-	WW-2.0	RCC	LHS SR MBCB NO GUARD STONE AND RHS SR GUARD INSTALLED ALONG RETURN	-	-	-	Good	-	Good	N.A	-	-	-	-	-	1.RCC Box culvert extend upto Service Road on BHS
54	80+415	LHS - BC EXTENDED UPTO S/R	2 X 2.75	RCC	0.250	RCC	0.250	2.50	4.50	8.75	-	-	-	R/W 3.5	RCC	LHS SR MBCB NO GUARD STONE	-	-	-	Good	-	Good	N.V	-	-	-	-	-	1.RCC Box culvert extend upto Service Road on BHS
		RHS - BC EXTENDED UPTO S/R	2 X 2.75	RCC	0.25	RCC	0.250	2.50	4.50	8.75	-	-	-	R/W 3.5	RCC	RHS SR GUARD INSTALLED ALONG RETURN WALL	-	-	-	Good	-	Good	N.V	-	-	-	-	-	
55	82+600	SC (NEW)	1 X 4.2	RCC	0.25	RCC	0.250	3.00	4.50	17.50	-	-	2 m GAP IN SEPRAT OR	-	-	Hand Railing	-	4.50	RCC	Good	-	Fair	N.A	NV	-	Good	-	-	
56	83+820	LHS - SC (OLD)	1 X 5.2	RCC	0.25	RCC	0.250	2.50	4.50	8.75	-	-	-	NV	NV	NV	-	-	-	Fair	-	Fair	N.A	-	NV	NV	NV	-	
		RHS - SC (NEW)	1 X 5.2	RCC	0.25	RCC	0.250	2.50	4.50	8.75	-	-	-	5.20	RCC	Hand Railing	-	-	RCC	Fair	-	Fair	N.A	-	Good	Good	CC FLOORING UPTO END OF WING WALL		
57	84+315	LHS - SC (OLD)	1 X 4	RCC	0.25	RCC	0.250	2.00	4.50	8.75	-	-	-	N.V	N.V	N.V	-	-	-	Fair	-	Fair	N.A	-	NV	NV	NV	-	1. Not visible due to heavy vegitation L/S.
		RHS - SC (NEW)	1 X 4	RCC	0.25	RCC	0.250	2.00	4.50	8.75	-	-	-	3.00	RCC	Hand Railing	-	-	RCC	Fair	-	Fair	N.A	-	Good	Good	CC FLOORING UPTO END OF WING WALL		
58	87+750	BC	1 X 3	RCC	0.25	RCC	0.250	3.00	4.50	17.50	-	-	-	3.00	RCC	Head Wall 0.20	0.4	3.00	RCC	Good	-	Good	N.A	-	-	-	-	-	1.Hand railing/Parapet wall not found on BHS. 2.Vagetation.

SL. No.	Location (Km)	Type of Structure (Pipe / Slab / Box / Arch)	Span Arrangement (No. x Slab Length) (m)	Super-structure		Sub-structure		Vent Height (m)	Median Width (m)	Carriageway Width (m)	Fill (m)	Formation Width (m)	Width of Culvert (m)	Length of Wing/Return Wall (m)		Parapet / Head Wall / CB				Condition of various Components of Culvert							Bed protections		Remarks
				Type	Thick	Type	Thick							Length (m)	Material	Height (m)	Width (m)	Length (m)	Material	Pipe/ Slab/ Box/ Arch	Head Wall	Abut ment Wall	Pier Wall	Wing Wall	Return Wall	Parapet / Hand Rail	U/S	D/S	
59	88+150	BC	1 X 3	RCC	0.25	RCC	0.250	3.00	4.50	17.50	-	-	-	3.00	RCC	Head Wall 0.20	0.4	3.00	RCC	Good	-	Good	N.A	-	-	-	-	-	1.Hand railing/Parapet wall not found on BHS. 2.Vagetation.
60	88+915	LHS - SC (OLD)	1 X 4.5	RCC	0.25	RCC	0.250	2.00	4.50	8.75	-	-	-	3.00	RCC	Parapet 0.6	0.1	5.50	RCC	Fair	-	Fair	N.A	-	-	Poor	-	-	1.DAMAGE FOUND IN PARAPET WALL ON BHS. 2. W.C. LAID OVER CULVERT FOUND IN BED SHAPE. 3.Chowked with soil on RHS
		RHS - SC (NEW)	1 X 4.5	RCC	0.25	RCC	0.250	2.00	4.50	8.75	-	-	-	3.00	RCC	Parapet 0.6	0.1	5.50	-	Fair	-	Fair	N.A	-	-	Poor	-	-	
61	90+095	BC	1 X 2	RCC	0.25	RCC	0.250	2.00	4.50	17.50	-	-	-	WW-2.0	RCC	Head Wall 0.20	0.2	2.00	-	Good	-	Good	N.A	-	-	-	-	-	1.Hand railing/Parapet wall not found on BHS. 2.Vagetation. 3.Chowked with soil.
62	91+700	BC	1 X 1.9	RCC	0.25	RCC	0.250	1.50	4.50	17.50	-	-	-	WW-2.0	RCC	Head Wall 0.25	0.2	2.00	-	Good	-	Good	N.A	-	-	-	-	-	1.Hand railing/Parapet wall not found on BHS. 2.Vagetation. 3.Chowked with soil.

INVENTORY AND CONDITION SURVEY FOR CULVERTS

SL. No.	Location (Km)	Type of Structure (Pipe / Slab / Box / Arch)	Span Arrangement (No. x Slab Length) (m)	Super-structure		Sub-structure		Vent Height (m)	Median Width (m)	Carriageway Width (m)	Fill (m)	Formation Width (m)	Width of Culvert (m)	Length of Wing/Return Wall (m)		Parapet / Head Wall / CB				Condition of various Components of Culvert						Bed protections		Remarks
				Type	Thick	Type	Thick							Length (m)	Material	Height (m)	Width (m)	Length (m)	Material	Pipe/ Slab/ Box/ Arch	Head Wall	Abut ment Wall	Wing Wall	Return Wall	Parapet / Hand Rail	U/S	D/S	
1	962+045	LHS-SC	1 X 5	RCC	0.300	RCC	0.300	N.V	4.50	12.75	-	-	13.75	-	-	CB 0.9	0.450	5.00	RCC	Fair	Fair	Fair	-	Fair	Good	-	-	1. MEDIAN CB = 5.0m, SIDE CB =5+3+3 2. MEDIAN OPEN TO SKY
		RHS-SC	1 X 5	RCC	0.300	RCC	0.300	N.V	4.50	10.50	-	-	11.50	-	-	CB-0.9	0.450	5.00	RCC	Fair	Fair	Fair	-	Fair	Good	-	-	
2	966+055	LHS-SC	1 X 6	RCC	0.300	RCC	0.300	N.V	4.50	8.75	-	-	10.50	-	-	CB-0.9	0.450	6.00	RCC	Good	Good	Good	-	-	Fair	-	-	1. OPEN TO SKY MEDIAN ACROSS HANDRAIL, 2. VEGETATION CLEANING BHS
		RHS-SC	1 X 6	RCC	0.300	RCC	0.300	N.V	4.50	8.75	-	-	10.50	-	-	CB-0.9	0.450	6.00	RCC	Good	-	Good	-	-	Fair	-	-	
3	966+790	LHS-SC	1 X 1.5	RCC	0.200	RCC	0.200	N.V	4.50	8.75	-	-	10.50	-	-	CB-0.9	0.450	2.00	RCC	Fair	-	Fair	-	-	Good	-	-	1. OUTSIDE CB LENGTH 2+2X2 AND MEDIAN SIDE 2X2 2. FULLY CHOWKED ACROSS THE MEDIAN HANDRAIL
		RHS-SC	1 X 1.5	RCC	0.200	RCC	0.200	N.V	4.50	8.75	-	-	10.50	-	-	CB-0.9	0.450	2.00	RCC	Fair	-	Fair	-	-	Good	-	-	
4	967+875	LHS-SC	1 X 6	RCC	0.300	RCC	0.300	2.50	4.50	8.75	-	-	10.50	-	-	CB-0.9	0.450	6.00	RCC	Fair	-	Fair	-	-	Fair	-	-	
		RHS-SC	1 X 6	RCC	0.300	RCC	0.300	2.50	4.50	8.75	-	-	10.50	-	-	CB-0.9	0.450	6.00	RCC	Fair	-	Fair	-	-	Fair	-	-	
5	972+410	LHS-SC	1 X 1.5	RCC	0.200	RCC	0.200	1.50	4.50	8.75	-	-	10.50	-	-	CB-0.9	0.450	4.50	RCC	Good	-	Good	-	Fair	Fair	-	-	1. CLEANING OF BARREL & VEGETATION 2. OUTSIDE CB EXTENDED UPTO APPROACH SLAB 3. LHS- X-HANDRAIL AT MEDIAN BROKEN 4. MEDIAN OPEN TO SKY
		LHS-SC	1 X 1.5	RCC	0.200	RCC	0.200	1.50	4.50	8.75	-	-	10.50	-	-	CB-0.9	0.450	4.50	RCC	Good	-	Good	-	Fair	Good	-	-	
6	972+830	LHS-SC	1 X 1.5	RCC	0.200	RCC	0.200	2.00	4.50	8.75	-	-	10.50	3.50	RCC	CB-0.9	0.450	3.50	RCC	Fair	-	Fair	-	-	Good	CC FLOORING AT INVERT LEVEL		1. CULVERT LOOKS GOOD 2. X-HANDRAIL AT MEDIAN. 3. MEDIAN OPEN TO SKY 4. VEGETATION TO BE CLEANED
		RHS-SC	1 X 1.5	RCC	0.200	RCC	0.200	2.00	4.50	8.75	-	-	10.50	3.50	RCC	CB-0.9	0.450	3.50	RCC	Fair	-	Fair	-	-	Good			
7	972+960	LHS-SC	1 X 1.5	RCC	0.200	RCC	0.200	N.V	4.50	8.75	-	-	-	3.50	RCC	CB-0.9	0.450	3.50	RCC	Fair	-	Fair	-	-	Good	-	-	1. CULVERT COMPLETELY CHOWKED 2. FULL OF VEGETATION. 3. HANDRAIL BOTH SIDE
		RHS-SC	1 X 1.5	RCC	0.200	RCC	0.200	N.V	4.50	8.75	-	-	-	3.50	RCC	CB-0.9	0.450	3.50	RCC	Fair	-	Fair	-	-	Good	-	-	
8	973+285	LHS-SC	1 X 1.5	RCC	0.200	RCC	0.200	N.V	4.50	8.75	-	-	-	3.50	RCC	CB-0.9	0.450	3.50	RCC	Good	-	Good	-	-	Fair	-	-	1. FULL OF VEGETATION. 2. WATER LOGGED
		RHS-SC	1 X 1.5	RCC	0.200	RCC	0.200	N.V	4.50	8.75	-	-	-	3.50	RCC	CB-0.9	0.450	3.50	RCC	Good	-	Good	-	-	Fair	-	-	
9	974+025	LHS-SC	1 X 6	RCC	0.300	RCC	0.300	N.V	4.50	8.75	-	-	-	3.50	RCC	CB-0.9	0.450	3.50	RCC	Fair	-	Fair	-	-	Good	-	-	
		RHS-SC	1 X 6	RCC	0.300	RCC	0.300	N.V	4.50	8.75	-	-	-	-	-	CB-0.9	0.450	3.50	RCC	Fair	-	Fair	-	-	Good	-	-	
10	980+495	LHS-SC	1 X 5.93	RCC	0.300	RCC	0.300	N.V	4.50	8.75	-	-	10.50	-	-	CB-0.9	0.450	3.50	RCC	Good	-	Good	-	-	Fair	-	-	1. VEGETATION CLEANING REQUIRED BHS. 2. MEDIAN OPEN TO SKY 3. X-HANDRAIL @ MEDIAN
		RHS-SC	1 X 5.93	RCC	0.300	RCC	0.300	N.V	4.50	8.75	-	-	10.50	-	-	CB-0.9	0.450	3.50	RCC	Good	-	Good	-	-	Fair	-	-	
11	983+185	LHS-BC	1 X 2	RCC	0.200	RCC	0.200	N.V	4.50	8.75	-	-	-	-	-	-	-	-	-	Good	-	Good	-	-	Good	-	-	1. NOT VISIBLE DUE TO JUNGLE 2. CB 4.5 + X-HANDRAIL @ MEDIAN
		RHS-BC	1 X 2	RCC	0.200	RCC	0.200	N.V	4.50	8.75	-	-	-	-	-	-	-	-	-	Good	-	Good	-	-	Good	-	-	
12	985+625	LHS-SC	1 X 1.4	RCC	0.200	RCC	0.200	1.5	4.50	8.75	-	-	10.50	RW	RCC	CB-0.9	0.450	3.50	RCC	Fair	-	Fair	-	-	Good	-	-	1. MEDIAN OPEN TO SKY BHS 2. CULVERT LOOKS GOOD 3. FULL OF VEGETATION
		RHS-SC	1 X 1.4	RCC	0.200	RCC	0.200	1.5	4.50	8.75	-	-	10.50	RW	RCC	CB-0.9	0.450	3.50	RCC	Fair	-	Fair	-	-	Good	-	-	
13	986+970	LHS-SC	1 X 5.75	RCC	0.300	RCC	0.300	2.5	4.50	8.75	-	-	10.50	RW	RCC	PW - 0.3	0.40	-	RCC	Fair	-	Fair	-	-	Good	-	-	
		RHS-SC	1 X 5.75	RCC	0.300	RCC	0.300	2.5	4.50	8.75	-	-	10.50	RW	RCC	CB-0.9	0.40	-	RCC	Fair	-	Fair	-	-	Good	-	-	

SL. No.	Location (Km)	Type of Structure (Pipe / Slab / Box / Arch)	Span Arrangement (No. x Slab Length) (m)	Super-structure		Sub-structure		Vent Height (m)	Median Width (m)	Carriageway Width (m)	Fill (m)	Formation Width (m)	Width of Culvert (m)	Length of Wing/Return Wall (m)		Parapet / Head Wall / CB				Condition of various Components of Culvert						Bed protections		Remarks
				Type	Thick	Type	Thick							Length (m)	Material	Height (m)	Width (m)	Length (m)	Material	Pipe/ Slab/ Box/ Arch	Head Wall	Abut ment Wall	Wing Wall	Return Wall	Parapet / Hand Rail	U/S	D/S	
14	987+150	LHS-SC	1 X 5.0	RCC	0.300	RCC	0.300	N.V	4.50	8.75	-	-	10.50	RW	RCC	PW - 0.3	0.40	-	RCC	Good	-	Good	-	-	Fair	-	-	
		RHS-SC	1 X 5.0	RCC	0.300	RCC	0.300	N.V	4.50	8.75	-	-	10.50	RW	RCC	CB-0.9	0.40	-	RCC	Good	-	Good	-	-	Fair	-	-	
15	987+737	LHS-SC	1 X 2.5	RCC	0.250	RCC	0.250	1.5	4.50	8.75	-	-	10.50	-	-	PW-0.5	0.500	-	RCC	Fair	-	Fair	-	-	Good	-	-	
		RHS-SC	1 X 2.5	RCC	0.250	RCC	0.250	1.5	4.50	8.75	-	-	10.50	-	-	CB-0.9	0.450	-	RCC	Fair	-	Fair	-	-	Good	-	-	
16	989+410	LHS-SC (OLD)	1 X 2.6	RCC	0.250	RCC	0.250	2.0	4.50	8.75	-	-	10.50	WW-2.0	RCC	-	-	-	-	Fair	-	Fair	-	-	Fair	-	-	1. CC FLOORING THERE ON RHS HOWEVER NOT. THER IS OLD ONE 2. MEDIAN OPEN TO SKY 3. HANDRAIL @ MEDIAN 4. CLEANING REQUIRED
		RHS-SC (NEW)	1 X 2.6	RCC	0.250	RCC	0.250	N.V	4.50	8.75	-	-	10.50	RW-3.50	RCC	CB-0.9	0.450		RCC	Good	-	Good	-	-	Fair	CC FLOORING AT INVERT LEVEL		
17	990+650	LHS-SC (NEW)	1 X 5.5	RCC	0.300	RCC	0.300	N.V	4.50	8.75	-	-	10.50	RW-3.2	RCC	CB-0.9	0.450	7.000	RCC	Good	-	Good	-	-	Good	CC FLOORING AT INVERT LEVEL		1. EXP. TO EXP. CC CV LENGTH 7.0m
		RHS-SC (NEW)	1 X 5.5	RCC	0.300	RCC	0.300	N.V	4.50	8.75	-	-	10.50	RW-3.2	RCC	CB-0.9	0.450	7.000	RCC	Good	-	Good	-	-	Good			
18	991+245	LHS-SC (NEW)	1 X 4.5	RCC	0.250	RCC	0.250	N.V	4.50	8.75	-	-	10.50	RW-4.2	RCC	CB-0.9	0.450	-	RCC	Good	-	Good	-	-	Fair	-	-	1. CULVERT CONDITION SEEMS GOOD. 2. VEGETATIONS TO BE CLEANED. 3. MISMATCHING OF SPAN 4.0m SPAN FOUND FROM EXP. TO EXP. 4. MEDIAN CLOSED CONTINEOUS SLAB 5. HANDRAIL MEDIAN
		RHS-SC (NEW)	1 X 4.5	RCC	0.250	RCC	0.250	N.V	4.50	8.75	-	-	10.50	RW-4.2	RCC	CB-0.9	0.450	-	RCC	Good	-	Good	-	-	Fair	-	-	
19	991+770	LHS-SC (OLD)	1 X 3.0	RCC	0.250	RCC	0.250	1.75	4.50	8.75	-	-	-	WW-2.0	RCC	PW-0.30	0.300	3.500	RCC	Fair	-	Fair	-	-	Good	CC FLOORING AT INVERT LEVEL		1. VEGETATION ON BHS TO BE CLEANED 2. W.C. TO BE REPLACED
		RHS-SC (NEW)	1 X 3.0	RCC	0.250	RCC	0.250	1.75	4.50	8.75	-	-	10.50	RW-4.0	RCC	CB-0.9	0.450	-	RCC	Good	-	Good	-	-	Good			
20	992+815	LHS-SC (OLD)	1 X 4.6	RCC	0.250	RCC	0.250	2.5	4.50	8.75	-	-	10.50	WW-NV	RCC	PW-0.50	0.250	-	RCC	Fair	-	Fair	-	-	Fair	-	-	1. BOTH FACES FULL OF VEGETATION
		RHS-SC (NEW)	1 X 4.6	RCC	0.250	RCC	0.250	2.5	4.50	8.75	-	-	10.50	RW-4.0	RCC	CB-0.9	0.450	-	RCC	Good	-	Good	-	-	Fair	-	-	
21	993+540	LHS-SC	1 X 5.9	RCC	0.300	RCC	0.300	6.5	4.50	8.75	-	-	18.00	WW-NV	RCC	PW-.35	0.350	-	RCC	Fair	-	Fair	-	-	Good	-	-	1. HANDRAIL ACROSS TO BE PROPOSED 2. RCC CB 3.0m DAMAGED INNER SIDE ON LHS 3. HALF OF STRUCTURE ON LHS LEFT WIDENING LEAVING INNER SIDE OF C/W MORE WIDE.
		RHS-SC	1 X 5.9	RCC	0.300	RCC	0.300	3.0	4.50	8.75	-	-	10.50	RW-4.0	RCC	CB-0.9	0.450	-	RCC	Fair	-	Fair	-	-	Good	-	-	
22	995+315	LHS-SC	1 X 5.3	RCC	0.300	RCC	0.300	2.5	21.00	8.75	-	-	10.50	RW-4.5	RCC	CB-0.9	0.450	-	RCC	Fair	-	Fair	-	-	Good	CC FLOORING AT INVERT LEVEL		1. VEGETATION TO BE CLEANED 2. CULVERT IN SKEW
		RHS-SC	1 X 5.3	RCC	0.300	RCC	0.300	2.5	21.00	8.75	-	-	10.50	RW-4.5	RCC	CB-0.9	0.450	-	RCC	Fair	-	Fair	-	-	Good			
23	997+045	LHS-SC	1 X 3.5	RCC	0.250	RCC	0.250	N.V	4.500	8.75	-	-	-	-	-	-	-	-	-	Fair	-	Fair	-	-	Fair	CC FLOORING AT INVERT LEVEL		1. VEGETATION TO BE CLEANED
		RHS-SC	1 X 3.5	RCC	0.250	RCC	0.250	N.V	4.500	8.75	-	-	-	-	-	-	-	-	-	Fair	-	Fair	-	-	Fair			
24	997+775	LHS-SC	1 X 5.5	RCC	0.300	RCC	0.300	2.0	4.500	8.75	-	-	10.50	RW-4.0	RCC	CB-0.9	0.450	-	RCC	Fair	-	Fair	-	-	Good	CC FLOORING AT INVERT LEVEL		1. VEGETATION TO BE CLEANED
		RHS-SC	1 X 5.5	RCC	0.300	RCC	0.300	2.0	4.500	8.75	-	-	10.50	RW-4.0	RCC	CB-0.9	0.450	-	RCC	Fair	-	Fair	-	-	Good			
25	998+785	LHS-SC	1 X 5.5	RCC	0.300	RCC	0.300	2.0	4.500	8.75	-	-	10.50	RW-3.5	RCC	PW-0.35	0.350	-	RCC	Fair	-	Fair	-	-	Good	-	-	1. VEGETATION TO BE CLEANED
		RHS-SC	1 X 5.5	RCC	0.300	RCC	0.300	2.0	4.500	8.75	-	-	10.50	WW-NV	RCC	CB-0.9	0.450	-	RCC	Fair	-	Fair	-	-	Good	-	-	
26	999+125	LHS-SC (OLD)	1 X 4.5	RCC	0.250	RCC	0.250	1.5	4.500	8.75	-	-	10.50	RW-4.0	RCC	PW-0.25	0.250	-	RCC	Fair	-	Fair	-	-	Fair	-	-	1. PARAPET DAMAGE 5.0m 2. VEGETATION TO BE CLEANED
		RHS-SC (NEW)	1 X 4.5	RCC	0.250	RCC	0.250	1.5	4.500	8.75	-	-	10.50	WW-2.0	RCC	CB-0.9	0.450	-	RCC	Good	-	Good	-	-	Fair	-	-	

SL. No.	Location (Km)	Type of Structure (Pipe / Slab / Box / Arch)	Span Arrangement (No. x Slab Length) (m)	Super-structure		Sub-structure		Vent Height (m)	Median Width (m)	Carriageway Width (m)	Fill (m)	Formation Width (m)	Width of Culvert (m)	Length of Wing/Return Wall (m)		Parapet / Head Wall / CB				Condition of various Components of Culvert						Bed protections		Remarks
				Type	Thick	Type	Thick							Length (m)	Material	Height (m)	Width (m)	Length (m)	Material	Pipe/ Slab/ Box/ Arch	Head Wall	Abut ment Wall	Wing Wall	Return Wall	Parapet / Hand Rail	U/S	D/S	
27	1000+605	LHS-SC	1 X 5.0	RCC	0.250	RCC	0.250	2.0	4.500	8.75	-	-	10.50	RW-5.5	RCC	CB-0.9	0.450	-	RCC	Fair	-	Fair	-	-	Good	-	-	1. MEDIAN OPEN TO SKY. 2. HANDRAIL ACROSS MEDIAN. 3. SOIL DEPOSITION & VEGETATION TO BE CLEANING.
		RHS-SC	1 X 5.0	RCC	0.250	RCC	0.250	2.0	4.500	8.75	-	-	10.50	RW-5.5	RCC	CB-0.9	0.450	-	RCC	Fair	-	Fair	-	-	Good	-	-	
28	1002+420	LHS-SC (OLD)	1 X 2.2	RCC	0.200	RCC	0.200	1.5-2	4.500	8.75	-	-	10.50	WW-1.5	RCC	PW	-	3.500	RCC	Fair	-	Fair	-	-	Good	-	-	1. CULVERT CONDITION IS GOOD. 2. X-HANDRAIL AT MEDIAN. 3. MEDIAN OPEN TO SKY. 4. VEGETATION TO BE CLEANED
		RHS-SC (NEW)	1 X 2.2	RCC	0.200	RCC	0.200	1.5-2	4.500	8.75	-	-	10.50	RW-4.50	RCC	CB-0.9	0.450	4.500	RCC	Good	-	Good	-	-	Good	-	-	
29	1003+080	LHS-SC (OLD)	1 X 1.6	RCC	0.200	RCC	0.200	N.V	4.500	8.75	-	-	-	WW-2.0	RCC	-	-	-	-	Fair	-	Fair	-	-	Fair	-	-	1. CULVERT CONDITION IS GOOD EXCEPT WING WALL
		RHS-SC (NEW)	1 X 1.6	RCC	0.200	RCC	0.200	N.V	4.500	8.75	-	-	-	RW-3.70	RCC	-	-	-	-	Good	-	Good	-	-	Fair	CC FLOORING SEEMS ON RHS WITH STONE APRON		
30	1003+840	LHS-SC (OLD)	1 X 2	RCC	0.200	RCC	0.200	2.5	4.50	10.50	-	-	-	WW-1.50	RCC	PW-0.3	0.250	2.000	RCC	Fair	-	Fair	-	-	Good	RCC BED FLOORING SEEMS ON RHS		1. NEW CULVERT LOOKING IN GOOD CONDITION. 2. CLEANING REQUIRED 3. ONLY WING WALL VISIBLE ON LHS.
		RHS-SC (NEW)	1 X 2	RCC	0.200	RCC	0.200	2.5	4.50	10.50	-	-	-	RW-4.50	RCC	CB-0.9	0.450	10.000	RCC	Good	-	Good	-	-	Good			
31	1005+290	LHS-SC (OLD)	1 X 2	RCC	0.200	RCC	0.200	2.0	4.50	10.50	-	-	-	WW-NV	RCC	PW- NV	-	-	RCC	Fair	-	Fair	-	-	Poor	-	-	1. W.C. RECTIFICATION REQUIRED 2. X-HANDRAIL BROKEN 1 m 3. CLEANING OF VEGETATION REQUIRED.
		RHS-SC (NEW)	1 X 2	RCC	0.200	RCC	0.200	2.0	4.50	10.50	-	-	-	RW-4.50	RCC	CB-0.9	0.450		RCC	Good	-	Good	-	-	Poor	-	-	
32	1007+825	LHS-SC (OLD)	1 X 2.2	RCC	0.200	RCC	0.200	1.5	4.50	8.75	-	-	12.50	-	-	PW- NV	-	-	-	Fair	-	Fair	-	-	-	-	-	1. MEDIAN OPEN TO SKY. 2. PARAPET WALL NOT VISIBLE DUE WATER LOGGED. 3. CLEANING OF BUSHES REQUIRED.
		RHS-SC (NEW)	1 X 2.2	RCC	0.200	RCC	0.200	1.5	4.50	8.75	-	-	12.50	-	-	CB-0.9	0.450	2.000	RCC	Good	-	Good	-	-	-	-	-	
33	1008+280	LHS-BC (NEW)	1 X 3.0	RCC	0.250	RCC	0.250	2.0	4.500	8.75	-	-	12.50	-	-	HW	-	-	-	Good	-	Good	-	-	Good	-	-	1. BOTH SIDE HEADWALL AND CULVERT FULLY CHOCKED . 2. THIS CULVERT HAVING IN VUP APPROACH
		RHS-BC (NEW)	1 X 3.0	RCC	0.250	RCC	0.250	2.0	4.500	8.75	-	-	12.50	-	-	HW	-	-	-	Good	-	Good	-	-	Good	-	-	
34	1011+145	LHS-BC (NEW)	1 X 2.2	RCC	0.200	RCC	0.200	2.0	4.500	8.75	-	-	12.50	RW - 3.5	RCC	CB-0.9	0.450	-	RCC	Good	-	Good	-	-	Good	-	-	1. MEDIAN OPEN TO SKY. 2. CULVRT IN GOOD CONDITION 3. CLEANING OF VEGETATION REQUIRED.
		RHS-BC (NEW)	1 X 2.2	RCC	0.200	RCC	0.200	2.0	4.500	8.75	-	-	12.50	RW - 6.0	RCC	CB-0.9	0.450	-	RCC	Good	-	Good	-	-	Good	-	-	

Annexure – 4.1

Methodology of NSV

1 NTWORK SURVEY VEHICLE (NSV)

The NSV was used for collection of condition data for the project highway. Road Runner (NSV) is a multi-faceted road survey equipment which could be configured to collect a wide range of pavement condition and asset inventory data.

Road Runner NSV is capable of collecting Road Roughness, Rutting, Pavement distresses, Asset Inventory along with GPS and Reference/ corresponding chainage simultaneously.

The main components which are integrated into Road Runner NSV are

a) Digital Laser Profilers (DLP) -Road roughness and rutting.
b) Digital Imaging System (DIS) -Pavement distresses and road assets data.
c) Differential Global Positioning System (DGPS).
d) High Resolution Distance Measuring Instrument (HRDMI).

Figure 1: Road Runner NSV

a) Digital Laser Profiler (DLP)

- DLP is integrated into the NSV consisting of eleven lasers to collect Road Roughness and Rutting.
- This inertial profiler is capable of recording the data continuously along each wheel path.

a) Roughness

Road Runner NSV equipment fitted with dual wheel path Laser Profilometer to collect Roughness data. The roughness data was collected and reported for 100 m interval.

The outputs of the lasers and accelerometers located in each wheel path (750 mm either side of the Centre line of the vehicle) are sampled every 15 mm of longitudinal travel and used to calculate the longitudinal profile of the road.

The profile is then passed through the Quarter Car model to calculate the International Roughness Index (IRI) lane roughness as per the methodologies specified in the ASTM E-950.

b) Rutting

Rutting will be measure and reported through DLP and the data will be recorded at every 100m interval on both the wheel paths.

b) Digital Imaging System (DIS)

Digital Imaging System (DIS) in Network Survey Vehicle (NSV) consist of 5 high resolution roof mounted cameras to capture pavement distresses and road assets data. These cameras are oriented in a certain configuration to ensure that the information of interest, such as inventory or condition, is being recorded in the camera field of view. Three cameras are forward facing and mounted on front side of vehicle (Left corner, Centre and Right corner), covers 160° angle images and are set to sample at every 10m interval. Another two cameras are mounted on back side of the vehicle (Left corner, Right corner) to capture the distress image of pavement 10m*4m (length*width) i.e., captures @10m interval.

Digital image system is capable of

- Collecting real time digital images.
- Achieving a sampling rate of at least one set per 2.5 meters for Distress camera's and one set per 10 meters for Asset cameras.
- Incorporating real time Differentially corrected GPS (DGPS).
- Capturing & recording at highway speeds.
- Providing real time on-screen displays for operator verification during collection.
- Storing images straight to PC's / NAS (Network Attached Storage).
- Linking into the client's referencing system via distance and GPS.

c) Geo Referencing (DGPS Data)

Road Runner NSV is equipped with DGPS system, and it do collect all the data and images with geo-reference. Reference that image against GPS co-ordinates by logging the latitude, longitude of the specific image.

d) Distance Measuring Instrument (DMI)

Road Runner NSV is equipped with DMI, and it is fitted to rear tyre of the Network survey vehicle. The Distance and speed measurement performed by the distance measuring instrument which is a distance transducer and highly accurate and GPS distance and speed can also be calculated.

Figure 2: Distance Measuring Instrument

Annexure – 4.2

Strip Chart for Pavement Distresses

From Km		30	31	31	32	33	34	35	36	37	38	39	40	40	41	41	42	43	43	44	45	46	47	48	49	50	51	52	52	53	54	55	56	57	58	59	60
To Km		31	31	32	33	34	35	36	37	38	39	40	40	41	41	42	43	48	44	45	46	47	48	49	50	51	52	52	53	54	55	56	57	58	59	60	61
Cracking	**Area %**	-	1%	1%	-	-	-	-	-	-	14%	8%	-	-	2%	15%	3%	2%	-	-	-	-	-	1%	2%	1%	3%	2%	-	-	-	-	-	-	-	-	-
	Rating	-			-	-	-	-	-	-			-	-					-	-	-	-	-						-	-	-	-	-	-	-	-	-
Patching	**Area %**	-	0%	0%	-	-	-	-	-	-	1%	0%	-	-	0%	0%	0%	0%	-	-	-	-	-	0%	0%	0%	0%	0%	-	-	-	-	-	-	-	-	-
	Rating	-			-	-	-	-	-	-			-	-					-	-	-	-	-						-	-	-	-	-	-	-	-	-
Rutting	**mm**	3	6	5	3	3	3	3	3	3	8	8	3	3	8	7	5	7	3	3	3	3	3	7	8	9	8	4	2	3	3	3	3	2	2	3	3
	Rating																																				
Roughness	**RI (mm/Km)**	2559	1908	1846	2403	2591	2639	2654	2670	2571	1824	1593	2630	2541	1828	2061	1976	1945	3122	2889	2846	2721	2859	1938	2174	2157	1837	2305	2636	2500	2420	2669	2368	2170	2243	2182	2639
	Rating																																				
Rigid Pavement Distress Severity	**Longitudinal cracks**	2	-	-	2	2	1	2	2	1	-	-	1	2	-	-	-	-	2	2	3	1	1	-	-	-	-	-	2	2	2	2	1	1	1	1	1
	Transverse cracks/ Diagonal cracks	1	-	-	1	1	1	1	0	0	-	-	1	2	-	-	-	-	1	1	2	1	0	-	-	-	-	-	0	2	1	1	1	0	1	1	1
	Mulitiple cracks	2	-	-	2	2	1	1	0	0	-	-	0	0	-	-	-	-	1	1	1	0	0	-	-	-	-	-	1	1	1	1	0	1	0	0	1
	Corner cracks	0	-	-	1	0	0	0	1	0	-	-	0	0	-	-	-	-	1	1	0	0	0	-	-	-	-	-	1	1	1	1	0	0	0	1	1
	Joint Separation	0	-	-	0	0	0	0	0	0	-	-	1	0	-	-	-	-	1	1	0	0	0	-	-	-	-	-	0	0	0	0	0	0	0	0	0
Condition based on Distress		-	Good	Good	-	-	-	-	-	-	Good	Fair	-	-	Good	Fair	Good	Good	-	-	-	-	-	Good	Good	Good	Good	Good	-	-	-	-	-	-	-	-	-
Condition based on Roughness		Poor	Good	Good	Poor	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good	Fair	Good	Good	Poor	Poor	Poor	Poor	Poor	Good	Fair	Fair	Good	Fair	Poor	Poor	Poor	Poor	Fair	Good	Fair	Good	Poor

GOOD
FAIR
POOR

From Km		61	62.1	63	64	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	78.2	79	80	81	82	83	83.3	84	85	86	87	88	89	90	90	91	92
To Km		62	63	64	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	78	79.1	80	81	82	83	83	84	85	86	87	88	89	90	90	91	92	92.45
Cracking	**Area %**	-	13%	2%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24%	-	-	-	-	-	36%	6%	9%	-	-	-	-	3%	7%	6%	7%
	Rating	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-				-	-	-	-				
Patching	**Area %**	-	1%	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0%	-	-	-	-	-	0%	0%	0%	-	-	-	-	2%	0%	0%	0%
	Rating	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-				-	-	-	-				
Rutting	**mm**	3	4	5	2	3	2	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	2	3	3	2	7	7	7	3	3	3	3	8	5	5	6
	Rating																																				
Roughness	**RI (mm/Km)**	2150	2858	2561	2354	2415	2482	2368	2354	2598	2379	2795	2265	2403	2310	2610	2435	2500	2619	2553	2170	2375	2388	2283	2170	2682	1805	1788	1572	2264	2309	2233	2146	2716	1785	1687	1798
	Rating																																				
Rigid Pavement Distress Severity	**Longitudinal cracks**	0	-	-	1	2	1	1	2	1	0	1	1	1	1	1	1	1	0	1	-	1	1	0	1	1	-	-	-	1	2	2	1	-	-	-	-
	Transverse cracks/ Diagonal cracks	0	-	-	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	1	-	0	0	0	0	0	-	-	-	0	2	0	1	-	-	-	-
	Mulitiple cracks	0	-	-	0	0	1	1	1	0	0	2	0	0	1	1	1	0	1	0	-	0	0	0	0	0	-	-	-	1	2	1	1	-	-	-	-
	Corner cracks	1	-	-	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	-	0	0	0	0	0	-	-	-	0	0	0	0	-	-	-	-
	Joint Separation	0	-	-	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	0	0	0	0	0	-	-	-	0	0	0	0	-	-	-	-
Condition based on Distress		-	Good	Good	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Fair	-	-	-	-	-	Good	Good	Good	-	-	-	-	Fair	Good	Good	Good
Condition based on Roughness		Good	Poor	Poor	Fair	Poor	Poor	Fair	Fair	Poor	Fair	Poor	Fair	Poor	Fair	Poor	Poor	Poor	Poor	Poor	Fair	Fair	Fair	Fair	Good	Poor	Good	Good	Good	Fair	Fair	Fair	Good	Poor	Good	Good	Good

GOOD
FAIR
POOR

From Km		92.45	92	91	90	89	88	87	86	85	84	83	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	64	64	63	63	63	62
To Km		92	91	90	89	88	87	86	85	84	83	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	64	64	63	63	63	62	61
Cracking	**Area %**	-	-	-	-	-	-	-	-	-	-	4%	2%	1%	-	-	-	1%	-	3%	1%	1%	4%	0%	1%	1%	1%	0%	0%	0%	0%	0%	-	-	0%	-	0%
	Rating	-	-	-	-	-	-	-	-	-	-				-	-	-		-													-	-		-	
Patching	**Area %**	-	-	-	-	-	-	-	-	-	-	1%	0%	0%	-	-	-	0%	-	1%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	-	-	0%	-	0%
	Rating	-	-	-	-	-	-	-	-	-	-				-	-	-		-													-	-		-	
Rutting	**mm**	2	2	3	2	2	2	2	2	2	2	9	5	7	2	2	2	7	2	4	5	5	4	5	4	5	4	5	4	6	7	6	2	3	4	2	5
	Rating																																				
Roughness	**RI (mm/Km)**	2657	1810	1881	2063	2260	2282	2572	2302	2444	3057	2732	1436	1431	2601	2825	2789	1758	2436	1805	2254	1790	2279	1484	1801	1517	1961	1552	1611	1495	1495	1902	2425	2412	3013	2255	1355
	Rating																																				
Rigid Pavement Distress Severity	**Longitudinal cracks**	1	0	0	0	0	0	0	0	0	1	-	-	-	1	0	0	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	-
	Transverse cracks/ Diagonal cracks	0	0	0	0	0	0	0	0	0	0	-	-	-	0	0	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	-	0	-
	Mulitiple cracks	0	0	0	0	0	0	0	0	0	0	-	-	-	1	0	0	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	-	0	-
	Corner cracks	0	0	0	0	0	0	0	0	0	0	-	-	-	0	0	0	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	-	0	-
	Joint Separation	0	0	0	0	0	0	0	0	0	0	-	-	-	0	0	0	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	-	0	-
Condition based on Distress		-	-	-	-	-	-	-	-	-	-	Fair	Good	Good	-	-	-	Good	-	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	-	-	Good	-	Good
Condition based on Roughness		Poor	Good	Good	Good	Fair	Fair	Poor	Fair	Poor	Poor	Poor	Good	Good	Poor	Poor	Poor	Good	Poor	Good	Fair	Good	Fair	Good	Good	Good	Good	Good	Good	Good	Good	Good	Poor	Poor	Poor	Fair	Good

GOOD
FAIR
POOR

From Km		61	60	59	58	57	56	55	54	53	53	52	51	50	49	48	48	47	46	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30
To Km		60	59	58	57	56	55	54	53	53	52	51	50	49	48	48	47	46	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	30
Cracking	**Area %**	2%	0%	0%	0%	0%	0%	-	-	0%	0%	-	-	-	-	-	0%	0%	-	1%	0%	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	0%
	Rating							-	-			-	-	-	-	-			-				-	-	-	-	-	-	-	-	-	-	-	-	-	
Patching	**Area %**	0%	0%	0%	0%	0%	0%	-	-	0%	0%	-	-	-	-	-	0%	0%	-	0%	0%	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	0%
	Rating							-	-			-	-	-	-	-			-				-	-	-	-	-	-	-	-	-	-	-	-	-	
Rutting	**mm**	5	4	5	9	6	8	3	3	5	5	3	2	3	3	2	13	6	3	4	7	12	3	3	2	2	3	2	2	3	2	3	3	2	2	5
	Rating																																			
Roughness	**RI (mm/Km)**	1826	1427	1866	1669	1800	2381	2694	2657	2268	1976	2522	2687	2570	2657	2573	1902	1918	2573	2219	1678	1769	2837	2797	2789	2521	2533	2421	2461	2490	2662	2499	2689	2728	3017	2814
	Rating																																			
Rigid Pavement Distress Severity	**Longitudinal cracks**	-	-	-	-	-	-	2	2	-	-	0	1	1	1	2	-	-	0	-	-	-	1	1	1	1	0	1	1	1	2	1	1	1	2	-
	Transverse cracks/ Diagonal cracks	-	-	-	-	-	-	1	1	-	-	0	0	0	0	2	-	-	2	-	-	-	0	1	1	1	0	1	1	1	0	0	1	0	1	-
	Mulitiple cracks	-	-	-	-	-	-	2	2	-	-	0	0	1	0	1	-	-	0	-	-	-	1	0	0	1	0	0	0	0	1	1	1	0	1	-
	Corner cracks	-	-	-	-	-	-	1	1	-	-	0	0	0	1	1	-	-	1	-	-	-	0	0	0	1	0	0	0	0	0	0	0	0	0	-
	Joint Separation	-	-	-	-	-	-	0	0	-	-	0	0	0	0	0	-	-	0	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	-
Condition based on Distress		Good	Good	Good	Good	Good	Good	-	-	Good	Good	-	-	-	-	-	Good	Good	-	Good	Good	Good	-	-	-	-	-	-	-	-	-	-	-	-	-	Good
Condition based on Roughness		Good	Good	Good	Good	Good	Fair	Poor	Poor	Fair	Good	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Fair	Good	Good	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor

GOOD
FAIR
POOR

From Km		961.5	962	962.25	963	964	965	965.36	966	967	968	969	970.05	970.95	971.67	972	973	974	975	976	977	978	979	980	981	982	983	984	985
To Km		962	962.25	963	964	965	965.36	966	967	968	969	970.05	970.95	971.67	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986
Cracking	Area %	0%	-	9%	10%	9%	2%	-	-	-	-	-	4%	-	6%	0%	3%	4%	24%	5%	2%	5%	6%	5%	5%	13%	0%	1%	0%
	Rating							-	-	-	-	-		-															
Patching	Area %	0%	-	0%	1%	1%	0%	-	-	-	-	-	0%	-	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Rating							-	-	-	-	-		-															
Rutting	mm	5	-	6	6	6	4	2	2	2	2	2	8	2	9	10	11	11	10	9	8	9	11	9	10	10	6	5	6
	Rating																												
Roughness	RI (mm/Km)	2880	-	3042	2677	2535	3110	2818	2103	1846	1966	2624	2871	2385	2493	2421	2661	2631	3131	2662	2304	2486	2534	2423	2682	2852	2277	1883	2235
	Rating																												
Rigid Pavement Distress Severity	Longitudinal cracks	-	-	-	-	-	-	1	1	0	0	0	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Transverse cracks/ Diagonal cracks	-	-	-	-	-	-	1	1	0	0	0	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mulitiple cracks	-	-	-	-	-	-	1	1	0	0	0	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Corner cracks	-	-	-	-	-	-	1	1	0	0	0	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Joint Separation	-	-	-	-	-	-	1	1	0	0	0	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Condition based on Distress		Good	-	Good	Good	Good	Good	-	-	-	-	-	Good	-	Fair	Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Good	Good	Fair	Good	Good	Good
Condition based on Roughness		Poor	-	Poor	Poor	Poor	Poor	Poor	Good	Good	Good	Poor	Poor	Fair	Poor	Poor	Poor	Poor	Poor	Poor	Fair	Poor	Poor	Poor	Poor	Poor	Fair	Good	Fair

GOOD
FAIR
POOR

From Km		986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012
To Km		987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013
Cracking	Area %	3%	0%	0%	0%	1%	1%	1%	0%	0%	2%	3%	3%	3%	4%	3%	17%	12%	18%	11%	26%	8%	16%	4%	12%	9%	1%	1%
	Rating																											
Patching	Area %	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%
	Rating																											
Rutting	mm	6	5	6	5	5	5	8	6	5	7	12	6	6	6	6	9	6	6	7	7	6	6	5	8	8	5	6
	Rating																											
Roughness	RI (mm/Km)	2351	1707	1928	1660	1879	1869	2494	1853	1947	2414	2935	1921	2036	2112	2327	3129	2848	2346	2375	2738	2035	2612	2446	2416	2372	2053	2483
	Rating																											
Rigid Pavement Distress Severity	Longitudinal cracks	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Transverse cracks/ Diagonal cracks	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mulitiple cracks	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Corner cracks	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Joint Separation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Condition based on Distress		Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Fair	Good	Fair	Fair	Fair	Good	Fair	Good	Fair	Fair	Good	Good
Condition based on Roughness		Fair	Good	Good	Good	Good	Good	Poor	Good	Good	Poor	Poor	Good	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Poor	Fair	Poor	Poor	Poor	Fair	Fair	Poor

GOOD
FAIR
POOR

From Km		1013	1012	1011	1010	1009	1008	1007	1006	1005	1004	1003	1002	1001.6	1000.9	1000	999	998	997	996	995	994	993	992	991	990	989	988
To Km		1012	1011	1010	1009	1008	1007	1006	1005	1004	1003	1002	1001.6	1000.9	1000	999	998	997	996	995	994	993	992	991	990	989	988	987
Cracking	Area %	-	-	-	-	-	-	-	-	-	-	-	-	27%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Rating	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Patching	Area %	-	-	-	-	-	-	-	-	-	-	-	-	1%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Rating	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rutting	mm	2	2	2	2	2	2	2	2	2	2	2	2	8	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	Rating																											
Roughness	RI (mm/Km)	2783	2625	2988	2827	3187	2983	2608	2469	2384	2615	2166	2784	3274	3059	2731	2440	2244	2733	2452	2283	2469	2421	2387	2211	1868	2064	2268
	Rating																											
Rigid Pavement Distress Severity	Longitudinal cracks	2	3	3	4	3	3	2	4	3	3	3	2	-	3	3	2	3	2	2	2	3	4	2	2	0	0	1
	Transverse cracks/ Diagonal cracks	0	0	0	0	0	0	0	1	0	1	0	2	-	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mulitiple cracks	1	2	3	3	3	3	3	4	3	4	4	3	-	3	3	2	3	2	2	3	4	3	3	1	0	0	0
	Corner cracks	0	0	0	1	0	0	0	0	0	0	0	1	-	0	0	0	0	0	0	0	0	0	0	0	0	1	1
	Joint Separation	0	0	0	0	0	0	0	0	0	0	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Condition based on Distress		-	-	-	-	-	-	-	-	-	-	-	-	Fair	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Condition based on Roughness		Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Fair	Poor	Good	Poor	Poor	Poor	Poor	Poor	Fair	Poor	Poor	Fair	Poor	Poor	Fair	Fair	Good	Good	Fair

GOOD
FAIR
POOR

From Km		987	986	985	984	983	982	981	980	979	978	977	976	975	974	973	972	971	969.89	969	968	967	966	965.08	964	963	962
To Km		986	985	984	983	982	981	980	979	978	977	976	975	974	973	972	971	969.89	969	968	967	966	965.08	964	963	962	961.5
Cracking	Area %	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0%	1%	1%	0%	2%	-	-	-	-
	Rating	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						-	-	-	-
Patching	Area %	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0%	0%	0%	0%	0%	-	-	-	-
	Rating	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						-	-	-	-
Rutting	mm	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	6	6	4	5	6	2	2	2	2
	Rating																										
Roughness	RI (mm/Km)	3014	2560	2168	2290	2260	2055	2036	2126	2068	2179	1978	2431	2060	2035	2144	1956	2191	2325	2427	2101	2423	2456	2689	2415	2319	2243
	Rating																										
Rigid Pavement Distress Severity	Longitudinal cracks	2	2	2	3	3	2	2	3	2	3	4	2	3	2	3	2	3	-	-	-	-	-	3	2	2	2
	Transverse cracks/ Diagonal cracks	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	0	0	0	0
	Mulitiple cracks	3	3	0	2	3	1	0	1	4	4	4	0	2	0	0	0	0	-	-	-	-	-	3	2	2	1
	Corner cracks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	0	0	0	0
	Joint Separation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	0	0	0	0
Condition based on Distress		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Good	Good	Good	Good	Good	-	-	-	-
Condition based on Roughness		Poor	Poor	Good	Fair	Fair	Good	Good	Good	Good	Good	Good	Poor	Good	Good	Good	Good	Good	Fair	Poor	Fair	Poor	Poor	Poor	Poor	Fair	Fair

GOOD
FAIR
POOR

Annexure – 4.3

Roughness Data

Roughness Analysis of Flexible Pavement on LHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)														
Chainage (km)			Inner Lane						Outer Lane					
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km
30.520	30.600	BT	48	3.35	3.11	3.23	2342.3		42	2.42	2.56	2.49	1750.2	
30.600	30.700	BT	52	3.45	2.90	3.18	2297.7		46	2.35	2.11	2.23	1546.8	
30.700	30.800	BT	53	2.52	3.08	2.80	1996.0		35	2.84	2.47	2.66	1880.6	
30.800	30.900	BT	52	2.54	2.66	2.60	1837.0		39	2.34	2.46	2.40	1679.5	
30.900	31.000	BT	48	2.72	2.89	2.81	2000.0	2095	43	2.46	2.51	2.49	1746.2	1721
31.000	31.100	BT	41	2.93	3.13	3.03	2180.5		47	2.36	2.17	2.27	1574.0	
31.100	31.200	BT	40	3.05	3.37	3.21	2326.1		42	2.21	2.42	2.32	1613.0	
31.200	31.300	BT	46	2.82	3.15	2.99	2144.3		42	2.42	2.32	2.37	1656.0	
31.300	31.400	BT	51	2.94	2.54	2.74	1948.1		46	2.00	2.15	2.08	1426.9	
31.400	31.500	BT	52	2.64	2.55	2.60	1833.1		49	2.36	2.72	2.54	1789.6	
31.500	31.600	BT	52	3.10	2.69	2.90	2072.0		50	2.35	2.06	2.21	1527.4	
31.600	31.700	BT	52	3.15	3.17	3.16	2285.5		48	1.90	2.06	1.98	1354.0	
31.700	31.800	BT	54	3.45	3.15	3.30	2399.3		51	2.21	2.27	2.24	1554.6	
31.800	31.900	BT	53	2.85	3.22	3.04	2184.5		52	1.93	2.27	2.10	1446.2	
31.900	32.000	BT	52	2.90	2.57	2.74	1944.2	2132	50	2.44	2.33	2.39	1667.7	1561
38.000	38.100	BT	53	2.46	2.47	2.47	1730.5		20	2.19	2.56	2.38	1659.9	
38.100	38.200	BT	54	2.35	2.17	2.26	1570.2		39	2.08	2.25	2.17	1496.4	
38.200	38.300	BT	53	2.46	2.55	2.51	1762.0		44	2.78	2.49	2.64	1864.7	
38.300	38.400	BT	54	2.46	2.66	2.56	1805.4		47	2.74	2.85	2.80	1992.0	
38.400	38.500	BT	55	2.94	2.90	2.92	2092.0		49	3.02	3.25	3.14	2265.3	
38.500	38.600	BT	55	2.62	2.96	2.79	1988.0		49	2.58	2.88	2.73	1940.2	
38.600	38.700	BT	55	2.58	2.64	2.61	1844.9		49	3.22	2.76	2.99	2148.3	
38.700	38.800	BT	55	2.59	2.69	2.64	1868.7		48	2.67	2.43	2.55	1797.5	
38.800	38.900	BT	54	2.45	2.60	2.53	1777.8		48	2.55	2.44	2.50	1754.1	
38.900	39.000	BT	55	2.26	2.22	2.24	1554.6	1799	45	2.39	2.10	2.25	1558.5	1848
39.000	39.100	BT	55	2.12	1.95	2.04	1396.2		41	2.43	2.36	2.40	1675.6	
39.100	39.200	BT	56	2.48	2.21	2.35	1636.4		43	1.96	2.30	2.13	1469.4	
39.200	39.300	BT	54	2.46	2.36	2.41	1687.3		43	2.01	2.19	2.10	1446.2	
39.300	39.400	BT	54	2.46	2.45	2.46	1722.7		43	2.28	2.19	2.24	1550.7	
39.400	39.540	BT	54	2.23	2.30	2.27	1574.0	1603	40	2.44	2.59	2.52	1769.9	1582
40.740	40.800	BT	46	3.14	3.79	3.47	2534.0		42	2.96	3.12	3.04	2188.6	
40.800	40.900	BT	49	1.97	1.85	1.91	1300.5		44	1.94	2.01	1.98	1350.1	
40.900	41.000	BT	52	2.51	2.65	2.58	1821.2	1885	43	2.61	2.43	2.52	1773.8	1771
41.000	41.100	BT	53	2.49	2.14	2.32	1613.0		46	1.82	2.15	1.99	1357.8	
41.100	41.200	BT	55	2.50	2.09	2.30	1597.4		51	2.07	1.85	1.96	1338.7	
41.200	41.300	BT	52	4.78	4.69	4.74	3595.0		46	3.94	4.31	4.13	3080.5	
41.300	41.400	BT	47	4.14	4.40	4.27	3202.0		27	4.79	4.44	4.62	3493.1	
41.400	41.500	BT	52	3.17	3.12	3.15	2273.4		31	2.96	3.07	3.02	2168.4	
41.500	41.600	BT	54	2.26	2.40	2.33	1624.7		43	1.86	1.92	1.89	1285.2	
41.600	41.700	BT	55	2.89	2.66	2.78	1976.0		48	2.05	2.15	2.10	1446.2	
41.700	41.800	BT	54	3.11	3.01	3.06	2204.7		48	2.10	1.89	2.00	1365.5	
41.800	41.900	BT	54	2.92	2.89	2.91	2080.0		43	2.79	2.65	2.72	1932.2	
41.900	42.000	BT	54	3.36	3.02	3.19	2309.9	2248	40	1.84	1.92	1.88	1277.6	1875
42.000	42.100	BT	52	3.35	3.88	3.62	2657.2		22	4.05	4.17	4.11	3067.9	
42.100	42.200	BT	52	3.48	3.34	3.41	2489.0		19	4.14	3.68	3.91	2901.2	
42.200	42.300	BT	55	2.95	3.11	3.03	2180.5		22	2.89	2.99	2.94	2108.1	
42.300	42.400	BT	56	3.01	2.88	2.95	2112.1		26	2.48	2.39	2.44	1706.9	
42.400	42.500	BT	55	1.97	1.88	1.93	1311.9		25	2.16	2.23	2.20	1519.7	
42.500	42.600	BT	55	2.18	1.97	2.08	1426.9		29	2.81	2.88	2.85	2031.9	
42.600	42.700	BT	55	2.53	2.33	2.43	1703.0		38	2.14	2.17	2.16	1488.7	
42.700	42.800	BT	55	2.73	2.92	2.83	2016.0		39	2.74	3.08	2.91	2084.0	
42.800	42.900	BT	54	2.31	2.20	2.26	1566.3		45	2.88	2.88	2.88	2060.0	
42.900	43.000	BT	54	3.51	2.94	3.23	2338.3		49	1.95	1.79	1.87	1270.0	
43.000	43.140	BT	53	3.50	2.70	3.10	2237.0	2003	50	1.79	1.73	1.76	1186.6	1948
47.570	47.700	BT	30	4.09	4.26	4.18	3122.3		46	4.91	5.16	5.04	3851.1	
47.700	47.800	BT	37	2.27	1.90	2.09	1434.6		48	1.89	1.90	1.90	1289.0	
47.800	47.900	BT	45	1.91	1.94	1.93	1311.9		48	1.82	1.77	1.80	1213.1	
47.900	48.000	BT	51	2.40	2.47	2.44	1706.9	1894	45	2.44	2.24	2.34	1632.5	1996
48.000	48.100	BT	52	2.17	2.13	2.15	1484.8		16	3.12	2.92	3.02	2172.4	
48.100	48.200	BT	52	2.72	2.45	2.59	1825.1		27	2.14	2.61	2.38	1659.9	
48.200	48.300	BT	50	4.58	4.25	4.42	3324.0		30	4.33	4.49	4.41	3319.8	
48.300	48.400	BT	48	2.40	2.23	2.32	1613.0		38	2.14	2.15	2.15	1480.9	
48.400	48.500	BT	55	1.96	2.15	2.06	1411.5		36	2.18	2.07	2.13	1465.5	
48.500	48.600	BT	54	1.93	2.04	1.99	1357.8		34	2.12	2.05	2.09	1434.6	
48.600	48.700	BT	54	2.11	1.87	1.99	1361.6		39	2.04	2.13	2.09	1434.6	
48.700	48.800	BT	53	4.70	4.17	4.44	3340.9		38	5.04	4.06	4.55	3438.1	
48.800	48.900	BT	54	2.56	2.70	2.63	1860.8		43	2.16	1.99	2.08	1426.9	
48.900	49.000	BT	57	2.54	2.86	2.70	1916.3	1950	47	2.07	2.07	2.07	1423.1	1926
49.000	49.100	BT	55	2.17	1.92	2.05	1403.8		48	2.19	2.10	2.15	1480.9	
49.100	49.200	BT	52	4.14	4.33	4.24	3172.6		46	3.93	4.13	4.03	3001.1	
49.200	49.300	BT	55	2.54	2.10	2.32	1616.9		49	2.11	2.02	2.07	1419.2	
49.300	49.400	BT	55	2.10	2.16	2.13	1469.4		48	1.82	1.77	1.80	1213.1	
49.400	49.500	BT	53	1.72	1.68	1.70	1141.4		46	2.29	2.16	2.23	1542.9	
49.500	49.600	BT	44	2.08	1.86	1.97	1346.3		32	4.72	4.25	4.49	3383.1	
49.600	49.700	BT	23	4.47	3.97	4.22	3160.0		15	4.10	4.51	4.31	3231.4	
49.700	49.800	BT	9	4.37	4.30	4.34	3256.6		21	4.55	4.33	4.44	3345.1	

Roughness Analysis of Flexible Pavement on LHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)														
Chainage (km)			Inner Lane						Outer Lane					
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km
49.800	49.900	BT	18	2.90	3.55	3.23	2338.3		38	2.47	2.24	2.36	1644.3	
49.900	50.000	BT	23	2.98	4.11	3.55	2599.6	2150	46	2.39	2.50	2.45	1714.8	2198
50.000	50.100	BT	28	2.68	3.75	3.22	2330.1		48	1.56	1.68	1.62	1081.4	
50.100	50.200	BT	33	1.99	3.69	2.84	2027.9		49	1.65	1.62	1.64	1092.6	
50.200	50.300	BT	36	1.81	2.02	1.92	1304.3		49	2.12	1.99	2.06	1411.5	
50.300	50.400	BT	37	2.12	2.48	2.30	1601.3		49	2.37	2.42	2.40	1675.6	
50.400	50.500	BT	40	3.02	5.62	4.32	3244.0		48	1.95	2.45	2.20	1523.5	
50.500	50.600	BT	42	3.63	5.50	4.57	3450.8		49	1.60	1.64	1.62	1081.4	
50.600	50.700	BT	42	2.49	2.54	2.52	1769.9		43	2.92	2.79	2.86	2039.9	
50.700	50.800	BT	37	4.37	4.23	4.30	3227.2		30	4.31	5.13	4.72	3582.2	
50.800	50.900	BT	33	2.66	3.02	2.84	2027.9		35	2.99	2.92	2.96	2120.1	
50.900	51.000	BT	31	4.80	4.20	4.50	3395.8	2438	35	3.87	4.56	4.22	3155.8	1876
51.000	51.100	BT	44	2.07	2.40	2.24	1550.7		44	2.11	2.14	2.13	1465.5	
51.100	51.200	BT	50	1.92	2.19	2.06	1411.5		47	2.10	1.98	2.04	1400.0	
51.200	51.300	BT	54	2.30	1.98	2.14	1477.1		49	2.47	2.40	2.44	1706.9	
51.300	51.400	BT	54	2.50	2.34	2.42	1695.2		49	2.23	2.16	2.20	1519.7	
51.400	51.500	BT	54	2.40	2.40	2.40	1679.5		49	2.38	2.33	2.36	1644.3	
51.500	51.600	BT	53	2.57	2.39	2.48	1742.3		50	2.11	2.18	2.15	1480.9	
51.600	51.700	BT	54	3.04	3.50	3.27	2374.8		44	2.21	2.41	2.31	1609.1	
51.700	51.800	BT	53	3.54	3.42	3.48	2546.3		41	4.47	4.50	4.49	3383.1	
51.800	51.900	BT	55	3.27	3.37	3.32	2415.5	1877	46	2.94	2.59	2.77	1968.1	1798
51.900	52.000	BT	55	3.79	3.39	3.59	2636.6		50	2.57	2.51	2.54	1789.6	
52.000	52.100	BT	55	3.69	3.84	3.77	2781.0		51	2.18	2.10	2.14	1477.1	
52.100	52.230	BT	55	3.59	4.08	3.84	2839.0	2752	50	3.17	3.20	3.19	2305.8	1857
62.050	62.100	BT	40	5.71	6.21	5.96	4651.7		50	4.27	4.40	4.34	3256.6	
62.100	62.200	BT	42	3.50	3.37	3.44	2509.4		49	3.16	3.47	3.32	2411.5	
62.200	62.300	BT	45	3.52	2.89	3.21	2322.0		49	2.29	2.17	2.23	1546.8	
62.300	62.400	BT	47	1.76	1.59	1.68	1122.6		48	1.89	1.88	1.89	1281.4	
62.400	62.500	BT	45	2.46	2.60	2.53	1781.7		47	1.92	2.07	2.00	1365.5	
62.500	62.600	BT	44	1.84	1.93	1.89	1281.4		43	1.80	1.91	1.86	1258.6	
62.600	62.700	BT	32	6.83	6.13	6.48	5108.6		28	6.59	6.13	6.36	5002.8	
62.700	62.800	BT	29	6.95	6.10	6.53	5148.4		26	5.93	6.24	6.09	4761.2	
62.800	62.900	BT	33	6.52	5.52	6.02	4704.2		32	4.94	5.27	5.11	3911.1	
62.900	63.000	BT	43	2.83	2.60	2.72	1928.2	3056	42	2.56	2.56	2.56	1805.4	2660
63.000	63.100	BT	48	2.50	2.15	2.33	1620.8		48	2.53	3.05	2.79	1988.0	
63.100	63.200	BT	50	4.20	3.48	3.84	2843.1		50	3.19	3.02	3.11	2241.0	
63.200	63.300	BT	50	5.40	4.78	5.09	3898.2		49	4.59	4.82	4.71	3569.5	
63.300	63.400	BT	52	2.73	2.17	2.45	1718.7		47	2.34	2.11	2.23	1542.9	
63.400	63.500	BT	53	6.17	3.61	4.89	3727.1		49	5.30	4.51	4.91	3739.9	
63.500	63.600	BT	51	3.54	3.96	3.75	2768.6		48	3.74	3.83	3.79	2797.5	
63.600	63.700	BT	52	3.76	2.93	3.35	2435.9		48	2.00	2.01	2.01	1373.1	
63.700	63.780	BT	52	3.07	3.24	3.16	2281.5	2662	47	3.08	3.61	3.35	2435.9	2461
78.200	78.300	BT	43	2.86	2.43	2.65	1872.7		38	2.48	2.50	2.49	1750.2	
78.300	78.400	BT	46	3.91	4.53	4.22	3160.0		39	2.61	2.66	2.64	1864.7	
78.400	78.500	BT	46	3.33	3.15	3.24	2350.4		47	2.61	2.65	2.63	1860.8	
78.500	78.600	BT	47	3.00	3.28	3.14	2269.4		49	1.84	1.90	1.87	1270.0	
78.600	78.700	BT	48	2.84	3.06	2.95	2116.1		50	1.75	1.63	1.69	1133.9	
78.700	78.800	BT	47	3.63	4.96	4.30	3223.0		50	2.16	2.73	2.45	1714.8	
78.800	78.900	BT	36	3.83	3.94	3.89	2880.4		43	3.88	3.60	3.74	2760.3	
78.900	79.050	BT	24	2.99	3.05	3.02	2172.4	2506	25	3.03	3.39	3.21	2326.1	1835
83.340	83.400	BT	24	2.97	3.07	3.02	2172.4		24	2.69	3.31	3.00	2156.3	
83.400	83.500	BT	32	2.50	3.41	2.96	2120.1		28	2.46	3.49	2.98	2136.2	
83.500	83.600	BT	41	3.10	3.27	3.19	2305.8		37	1.91	2.15	2.03	1392.3	
83.600	83.700	BT	47	2.44	1.86	2.15	1484.8		42	1.97	2.16	2.07	1419.2	
83.700	83.800	BT	50	2.89	2.48	2.69	1904.4		45	2.05	1.88	1.97	1342.5	
83.800	83.900	BT	52	2.59	1.80	2.20	1519.7		49	1.83	1.96	1.90	1289.0	
83.900	84.000	BT	52	3.32	3.48	3.40	2480.8	1998	49	2.18	2.29	2.24	1550.7	1612
84.000	84.100	BT	51	3.57	3.16	3.37	2452.2		49	1.96	2.08	2.02	1384.6	
84.100	84.200	BT	51	2.83	2.76	2.80	1992.0		49	3.03	3.22	3.13	2257.2	
84.200	84.300	BT	28	3.09	3.53	3.31	2407.4		48	2.60	2.44	2.52	1773.8	
84.300	84.400	BT	40	3.18	2.91	3.05	2192.6		49	2.42	2.42	2.42	1695.2	
84.400	84.500	BT	50	2.70	2.83	2.77	1968.1		50	1.96	1.99	1.98	1350.1	
84.500	84.600	BT	53	2.76	2.63	2.70	1912.3		47	2.05	2.38	2.22	1535.2	
84.600	84.700	BT	54	2.98	2.65	2.82	2008.0		45	1.86	2.46	2.16	1492.5	
84.700	84.800	BT	53	2.51	2.67	2.59	1829.1		43	2.59	2.70	2.65	1872.7	
84.800	84.900	BT	55	3.17	2.97	3.07	2212.8		46	1.34	1.74	1.54	1021.8	
84.900	85.000	BT	55	1.80	1.97	1.89	1281.4	2026	47	1.45	1.91	1.68	1126.4	1551
85.000	85.100	BT	54	1.69	2.15	1.92	1308.1		49	1.68	1.67	1.68	1122.6	
85.100	85.200	BT	55	2.11	1.98	2.05	1403.8		48	2.04	2.12	2.08	1430.8	
85.200	85.300	BT	54	2.91	2.27	2.59	1829.1		48	1.54	1.71	1.63	1085.2	
85.300	85.400	BT	54	3.30	2.54	2.92	2092.0		49	1.17	1.48	1.33	863.4	
85.400	85.500	BT	54	1.82	1.65	1.74	1167.8		49	1.41	1.70	1.56	1032.9	
85.500	85.600	BT	53	2.10	1.73	1.92	1304.3		47	2.08	1.92	2.00	1369.3	
85.600	85.700	BT	47	3.32	3.07	3.20	2313.9		49	2.00	1.74	1.87	1270.0	
85.700	85.800	BT	38	2.84	3.72	3.28	2383.0		50	1.73	1.83	1.78	1201.7	
85.800	85.900	BT	30	2.68	3.29	2.99	2144.3		48	3.23	3.00	3.12	2249.1	

Roughness Analysis of Flexible Pavement on LHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)														
Chainage (km)			Inner Lane						Outer Lane					
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km
85.900	85.980	BT	17	2.71	3.51	3.11	2245.1	1819	48	2.38	2.28	2.33	1624.7	1325
89.750	89.900	BT	43	2.87	4.38	3.63	2665.4		52	4.41	4.20	4.31	3231.4	
89.900	90.000	BT	42	3.91	4.15	4.03	3001.1	2833	51	2.62	2.91	2.77	1968.1	2600
90.000	90.100	BT	43	3.20	3.43	3.32	2411.5		51	2.11	2.38	2.25	1558.5	
90.100	90.200	BT	44	2.13	2.74	2.44	1706.9		48	2.61	2.53	2.57	1813.3	
90.200	90.300	BT	43	2.37	3.13	2.75	1956.1		49	2.11	1.91	2.01	1377.0	
90.300	90.400	BT	42	3.02	2.27	2.65	1872.7		51	2.17	2.18	2.18	1504.2	
90.400	90.500	BT	40	2.07	2.55	2.31	1609.1		50	1.91	1.81	1.86	1262.4	
90.500	90.600	BT	40	2.57	3.20	2.89	2064.0		47	2.57	2.29	2.43	1703.0	
90.600	90.700	BT	41	2.72	3.34	3.03	2180.5		48	1.74	1.80	1.77	1194.2	
90.700	90.800	BT	41	3.09	3.03	3.06	2204.7		44	1.80	2.09	1.95	1327.2	
90.800	90.900	BT	41	2.80	2.19	2.50	1754.1		48	2.97	2.90	2.94	2104.1	
90.900	91.000	BT	42	3.85	2.51	3.18	2301.8	2006	50	2.49	2.59	2.54	1789.6	1563
91.000	91.100	BT	40	2.86	1.88	2.37	1656.0		47	2.41	2.22	2.32	1613.0	
91.100	91.200	BT	38	2.43	2.03	2.23	1546.8		50	1.39	1.67	1.53	1014.4	
91.200	91.300	BT	39	3.01	2.71	2.86	2044.0		52	1.96	1.82	1.89	1285.2	
91.300	91.400	BT	41	3.09	3.20	3.15	2273.4		52	2.45	2.24	2.35	1636.4	
91.400	91.500	BT	39	2.31	2.46	2.39	1667.7		51	2.51	2.54	2.53	1777.8	
91.500	91.600	BT	40	3.01	2.16	2.59	1825.1		50	1.76	1.71	1.74	1167.8	
91.600	91.700	BT	44	3.74	2.34	3.04	2188.6		51	2.03	2.24	2.14	1473.2	
91.700	91.800	BT	44	3.02	3.10	3.06	2204.7		52	1.74	1.96	1.85	1254.8	
91.800	91.900	BT	41	3.93	2.35	3.14	2269.4		51	2.84	2.78	2.81	2004.0	
91.900	92.000	BT	40	2.61	1.98	2.30	1597.4	1927	51	1.78	1.86	1.82	1232.0	1446
92.000	92.100	BT	41	2.61	2.26	2.44	1706.9		48	2.05	2.19	2.12	1461.6	
92.100	92.200	BT	41	3.12	2.47	2.80	1992.0		48	2.70	2.53	2.62	1848.9	
92.200	92.300	BT	42	2.23	1.76	2.00	1365.5		39	2.42	2.22	2.32	1616.9	
92.300	92.450	BT	21	4.26	4.10	4.18	3126.5	2048	36	1.78	1.94	1.86	1262.4	1547

Roughness Analysis of Flexible Pavement on RHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)														
Chainage (km)			Inner Lane						Outer Lane					
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km
83.200	83.100	BT	23	3.98	3.81	3.90	2888.7		19	4.60	5.01	4.81	3654.6	
83.100	83.000	BT	39	3.07	3.26	3.17	2289.6	2589	36	2.52	3.33	2.93	2096.0	2875
83.000	82.900	BT	48	3.43	3.03	3.23	2342.3		43	1.60	1.90	1.75	1179.1	
82.900	82.800	BT	54	3.13	3.09	3.11	2245.1		48	1.48	1.51	1.50	988.4	
82.800	82.700	BT	54	2.81	2.61	2.71	1924.3		51	2.05	1.98	2.02	1380.8	
82.700	82.600	BT	55	3.02	2.90	2.96	2124.2		51	2.03	2.07	2.05	1407.7	
82.600	82.500	BT	58	2.14	2.16	2.15	1484.8		51	1.56	1.67	1.62	1077.7	
82.500	82.400	BT	58	1.24	1.38	1.31	852.5		48	1.45	1.48	1.47	966.2	
82.400	82.300	BT	55	1.38	1.35	1.37	892.7		43	1.59	1.53	1.56	1036.7	
82.300	82.200	BT	37	2.72	3.78	3.25	2358.6		29	2.67	2.55	2.61	1844.9	
82.200	82.100	BT	42	1.65	1.56	1.61	1070.2		23	1.99	2.28	2.14	1473.2	
82.100	82.000	BT	51	1.63	1.54	1.59	1055.3	1635	29	1.45	1.59	1.52	1006.9	1236
82.000	81.900	BT	56	1.75	1.60	1.68	1122.6		34	2.35	2.35	2.35	1640.4	
81.900	81.800	BT	58	2.84	3.42	3.13	2261.3		40	1.55	1.75	1.65	1103.9	
81.800	81.700	BT	58	3.00	2.79	2.90	2072.0		48	1.77	1.74	1.76	1182.9	
81.700	81.600	BT	58	2.48	2.35	2.42	1691.2		50	1.96	1.94	1.95	1331.0	
81.600	81.500	BT	58	1.75	1.71	1.73	1164.0		52	2.00	1.87	1.94	1319.5	
81.500	81.400	BT	59	1.57	1.42	1.50	988.4		52	1.83	1.67	1.75	1179.1	
81.400	81.300	BT	50	1.49	1.60	1.55	1025.5		52	1.68	1.63	1.66	1107.6	
81.300	81.200	BT	44	1.57	1.85	1.71	1148.9		52	1.86	1.85	1.86	1258.6	
81.200	81.100	BT	43	1.38	1.53	1.46	958.8		52	1.29	1.37	1.33	867.1	
81.100	80.950	BT	41	3.51	3.83	3.67	2702.5	1514	48	3.39	3.43	3.41	2489.0	1348
78.100	78.000	BT	33	2.15	2.03	2.09	1438.5		47	2.32	2.26	2.29	1593.5	
78.000	77.900	BT	38	1.67	1.87	1.77	1194.2		50	1.80	2.26	2.03	1392.3	
77.900	77.800	BT	42	2.30	2.63	2.47	1730.5		51	2.06	2.12	2.09	1438.5	
77.800	77.700	BT	41	2.38	2.78	2.58	1821.2		51	2.48	2.39	2.44	1706.9	
77.700	77.600	BT	36	3.57	3.16	3.37	2452.2		46	3.00	3.32	3.16	2285.5	
77.600	77.500	BT	43	3.96	5.58	4.77	3624.8		50	3.73	3.45	3.59	2636.6	
77.500	77.400	BT	47	2.51	2.73	2.62	1852.8		52	2.38	2.51	2.45	1714.8	
77.400	77.300	BT	42	1.80	1.96	1.88	1277.6		50	1.86	1.83	1.85	1251.0	
77.300	77.200	BT	42	1.83	2.16	2.00	1365.5		51	1.65	1.73	1.69	1133.9	
77.200	77.100	BT	44	1.96	2.53	2.25	1558.5		52	1.78	2.05	1.92	1304.3	
77.100	77.000	BT	46	2.33	2.68	2.51	1762.0		53	1.69	1.88	1.79	1205.5	
77.000	76.850	BT	43	3.01	3.27	3.14	2269.4	1862	52	3.18	2.91	3.05	2192.6	1655
76.090	76.000	BT	46	4.25	3.86	4.06	3022.0		44	4.67	3.92	4.30	3223.0	
76.000	75.900	BT	46	3.46	3.45	3.46	2525.8		48	2.17	3.14	2.66	1880.6	
75.900	75.800	BT	43	3.46	3.92	3.69	2719.0		48	3.93	4.00	3.97	2947.0	
75.800	75.700	BT	53	1.60	1.71	1.66	1107.6		52	1.61	1.54	1.58	1047.8	
75.700	75.600	BT	56	1.89	2.00	1.95	1327.2		52	1.51	1.60	1.56	1032.9	
75.600	75.500	BT	57	2.03	1.91	1.97	1346.3		51	1.74	1.83	1.79	1205.5	
75.500	75.400	BT	58	2.05	1.79	1.92	1308.1		52	1.65	1.52	1.59	1055.3	
75.400	75.300	BT	59	1.64	1.59	1.62	1077.7		47	1.87	1.71	1.79	1209.3	
75.300	75.200	BT	47	2.53	2.68	2.61	1841.0		39	1.81	1.89	1.85	1254.8	
75.200	75.100	BT	28	3.65	3.81	3.73	2752.0		32	3.74	3.91	3.83	2830.7	
75.100	75.000	BT	47	2.36	2.04	2.20	1523.5	1868	41	2.18	2.09	2.14	1473.2	1742
75.000	74.900	BT	45	2.74	2.92	2.83	2020.0		49	2.83	2.59	2.71	1924.3	
74.900	74.800	BT	43	6.19	5.95	6.07	4748.0		43	3.95	4.23	4.09	3051.2	
74.800	74.700	BT	50	5.64	5.66	5.65	4381.6		39	5.65	5.51	5.58	4320.9	
74.700	74.600	BT	49	2.50	2.43	2.47	1730.5		39	2.33	2.43	2.38	1663.8	
74.600	74.500	BT	44	1.56	1.64	1.60	1066.5		40	1.45	1.62	1.54	1018.1	
74.500	74.400	BT	41	3.14	3.08	3.11	2245.1		38	2.10	2.16	2.13	1469.4	
74.400	74.300	BT	44	3.02	3.39	3.21	2322.0		32	3.48	3.61	3.55	2599.6	
74.300	74.200	BT	52	3.20	2.80	3.00	2156.3		38	3.15	3.30	3.23	2338.3	
74.200	74.100	BT	56	2.59	2.30	2.45	1714.8		43	1.86	1.69	1.78	1198.0	
74.100	74.000	BT	58	2.72	2.55	2.64	1864.7	2425	51	1.93	1.74	1.84	1243.4	2083
74.000	73.900	BT	56	2.08	1.85	1.97	1342.5		54	2.09	2.17	2.13	1469.4	
73.900	73.800	BT	47	3.40	3.44	3.42	2497.2		46	4.06	3.93	4.00	2971.9	
73.800	73.700	BT	51	2.71	2.24	2.48	1738.4		47	1.94	2.00	1.97	1346.3	
73.700	73.600	BT	56	2.40	2.19	2.30	1597.4		52	1.86	1.85	1.86	1258.6	
73.600	73.500	BT	56	3.22	2.10	2.66	1884.6		52	1.97	1.91	1.94	1323.4	
73.500	73.400	BT	56	2.75	1.95	2.35	1640.4		53	2.21	2.26	2.24	1550.7	
73.400	73.300	BT	55	3.03	3.53	3.28	2383.0		54	2.50	2.49	2.50	1754.1	
73.300	73.200	BT	57	2.54	2.71	2.63	1856.8		54	2.85	2.72	2.79	1984.0	
73.200	73.100	BT	59	2.60	2.54	2.57	1813.3		53	2.02	2.00	2.01	1377.0	
73.100	73.000	BT	58	2.66	2.58	2.62	1852.8	1861	52	3.17	2.85	3.01	2164.4	1720
73.000	72.900	BT	59	2.27	2.57	2.42	1695.2		53	2.92	2.48	2.70	1916.3	
72.900	72.800	BT	59	2.17	1.96	2.07	1419.2		48	3.18	2.58	2.88	2060.0	
72.800	72.700	BT	60	2.95	2.31	2.63	1860.8		34	2.99	3.21	3.10	2237.0	
72.700	72.600	BT	56	2.91	2.92	2.92	2088.0		40	2.38	2.37	2.38	1659.9	
72.600	72.500	BT	34	4.09	4.45	4.27	3202.0		32	4.29	4.24	4.27	3197.8	
72.500	72.400	BT	33	3.02	3.03	3.03	2176.5		24	4.02	3.49	3.76	2772.7	
72.400	72.300	BT	43	3.24	2.93	3.09	2224.9		38	1.81	2.34	2.08	1426.9	
72.300	72.200	BT	29	4.43	4.35	4.39	3302.9		37	3.73	3.80	3.77	2781.0	
72.200	72.100	BT	36	3.60	3.94	3.77	2785.1		39	4.49	5.47	4.98	3804.0	
72.100	72.000	BT	51	2.37	2.30	2.34	1628.6	2238	47	1.92	2.00	1.96	1338.7	2319
72.000	71.900	BT	55	1.60	1.69	1.65	1100.1		53	1.56	1.68	1.62	1081.4	
71.900	71.800	BT	56	2.05	1.86	1.96	1334.8		55	1.36	1.69	1.53	1010.7	
71.800	71.700	BT	56	2.38	2.26	2.32	1616.9		53	1.74	1.75	1.75	1175.3	

Roughness Analysis of Flexible Pavement on RHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)														
Chainage (km)			Inner Lane						Outer Lane					
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km
71.700	71.600	BT	56	2.44	2.63	2.54	1785.6		52	2.55	2.46	2.51	1762.0	
71.600	71.500	BT	57	1.60	1.56	1.58	1051.6		53	1.67	1.55	1.61	1074.0	
71.500	71.400	BT	58	2.11	2.25	2.18	1508.0		53	2.04	1.90	1.97	1346.3	
71.400	71.300	BT	36	4.17	3.75	3.96	2942.8		46	3.30	3.40	3.35	2440.0	
71.300	71.200	BT	39	2.20	2.14	2.17	1500.3		46	2.32	2.06	2.19	1515.8	
71.200	71.100	BT	50	1.78	1.98	1.88	1277.6		50	1.49	1.48	1.49	981.0	
71.100	71.000	BT	52	2.46	2.73	2.60	1833.1	1595	51	1.93	1.98	1.96	1334.8	1372
71.000	70.900	BT	45	2.46	2.42	2.44	1710.9		52	1.65	1.64	1.65	1100.1	
70.900	70.800	BT	43	2.33	2.53	2.43	1703.0		52	2.07	2.03	2.05	1407.7	
70.800	70.700	BT	50	2.07	1.99	2.03	1392.3		46	1.74	1.92	1.83	1239.6	
70.700	70.600	BT	52	1.67	1.63	1.65	1103.9		45	1.59	1.88	1.74	1167.8	
70.600	70.500	BT	52	2.02	2.02	2.02	1384.6		49	1.82	1.98	1.90	1292.8	
70.500	70.400	BT	44	3.65	3.81	3.73	2752.0		46	2.05	2.07	2.06	1415.4	
70.400	70.300	BT	27	4.07	3.78	3.93	2913.7		29	3.91	3.89	3.90	2892.9	
70.300	70.200	BT	39	2.35	3.00	2.68	1896.5		35	2.92	3.46	3.19	2309.9	
70.200	70.100	BT	42	3.83	3.58	3.71	2731.4		40	3.32	3.57	3.45	2517.6	
70.100	70.000	BT	49	1.89	1.90	1.90	1289.0	1888	46	2.53	2.55	2.54	1789.6	1713
70.000	69.900	BT	52	1.73	1.85	1.79	1209.3		53	1.71	1.82	1.77	1190.4	
69.900	69.800	BT	52	1.50	1.42	1.46	962.5		53	1.48	1.56	1.52	1006.9	
69.800	69.700	BT	47	3.15	3.31	3.23	2342.3		50	1.52	1.54	1.53	1014.4	
69.700	69.600	BT	50	2.47	3.01	2.74	1948.1		49	3.05	3.29	3.17	2293.6	
69.600	69.500	BT	55	2.03	2.07	2.05	1407.7		52	1.65	1.46	1.56	1032.9	
69.500	69.400	BT	44	3.15	3.32	3.24	2346.4		41	3.02	3.12	3.07	2212.8	
69.400	69.300	BT	46	3.01	2.85	2.93	2100.1		42	2.85	2.72	2.79	1984.0	
69.300	69.200	BT	55	1.79	1.79	1.79	1209.3		51	1.87	1.87	1.87	1270.0	
69.200	69.100	BT	57	1.57	1.28	1.43	936.7		51	1.61	1.63	1.62	1081.4	
69.100	69.000	BT	58	2.06	1.97	2.02	1380.8	1584	52	2.14	1.95	2.05	1403.8	1449
69.000	68.900	BT	59	2.08	1.94	2.01	1377.0		51	2.15	2.22	2.19	1511.9	
68.900	68.800	BT	58	1.93	1.85	1.89	1285.2		52	1.81	2.00	1.91	1296.7	
68.800	68.700	BT	56	3.41	2.78	3.10	2233.0		52	2.36	2.47	2.42	1691.2	
68.700	68.600	BT	57	4.00	3.65	3.83	2830.7		44	3.70	3.49	3.60	2640.7	
68.600	68.500	BT	59	3.18	3.64	3.41	2489.0		49	3.06	3.31	3.19	2305.8	
68.500	68.400	BT	59	3.08	2.72	2.90	2076.0		53	3.15	3.05	3.10	2237.0	
68.400	68.300	BT	54	3.41	3.07	3.24	2350.4		50	3.52	3.26	3.39	2472.7	
68.300	68.200	BT	55	3.22	2.91	3.07	2208.7		49	2.64	2.47	2.56	1801.4	
68.200	68.100	BT	60	2.72	2.36	2.54	1789.6		52	2.56	2.49	2.53	1777.8	
68.100	68.000	BT	58	1.64	1.75	1.70	1137.7	1978	52	2.36	2.52	2.44	1710.9	1945
68.000	67.900	BT	57	3.16	3.31	3.24	2346.4		52	2.13	1.91	2.02	1384.6	
67.900	67.800	BT	56	3.33	3.36	3.35	2435.9		43	3.32	3.31	3.32	2411.5	
67.800	67.700	BT	58	1.58	1.96	1.77	1194.2		49	1.99	1.80	1.90	1289.0	
67.700	67.600	BT	60	1.61	1.62	1.62	1077.7		52	1.75	1.51	1.63	1088.9	
67.600	67.500	BT	60	2.43	2.73	2.58	1821.2		45	2.82	2.89	2.86	2039.9	
67.500	67.400	BT	58	1.77	1.98	1.88	1273.8		32	1.94	1.86	1.90	1292.8	
67.400	67.300	BT	60	1.93	2.09	2.01	1377.0		42	1.94	1.92	1.93	1315.7	
67.300	67.200	BT	57	1.98	2.35	2.17	1496.4		49	2.13	2.18	2.16	1488.7	
67.200	67.100	BT	50	1.86	1.94	1.90	1292.8		54	1.88	1.71	1.80	1213.1	
67.100	67.000	BT	46	2.57	3.00	2.79	1984.0	1630	54	1.87	1.75	1.81	1224.4	1475
67.000	66.900	BT	44	2.51	2.84	2.68	1896.5		55	2.17	2.06	2.12	1457.8	
66.900	66.800	BT	45	1.73	2.26	2.00	1365.5		54	1.34	1.24	1.29	837.9	
66.800	66.700	BT	45	1.89	2.55	2.22	1539.1		53	1.44	1.47	1.46	958.8	
66.700	66.600	BT	44	3.06	3.34	3.20	2318.0		51	2.01	1.83	1.92	1308.1	
66.600	66.500	BT	43	3.47	3.35	3.41	2489.0		46	2.75	2.66	2.71	1920.3	
66.500	66.400	BT	46	3.61	3.48	3.55	2599.6		43	3.54	3.24	3.39	2472.7	
66.400	66.300	BT	44	2.10	2.59	2.35	1636.4		48	1.81	1.81	1.81	1224.4	
66.300	66.200	BT	42	1.72	1.85	1.79	1205.5		49	1.81	1.77	1.79	1209.3	
66.200	66.100	BT	41	1.99	2.23	2.11	1453.9		50	1.74	1.70	1.72	1156.5	
66.100	66.000	BT	38	2.40	2.57	2.49	1746.2	1825	49	2.23	1.93	2.08	1430.8	1398
66.000	65.900	BT	41	2.03	2.20	2.12	1457.8		50	2.36	2.21	2.29	1589.6	
65.900	65.800	BT	43	2.13	2.36	2.25	1558.5		50	2.43	2.25	2.34	1632.5	
65.800	65.700	BT	43	1.62	1.82	1.72	1156.5		51	1.76	1.62	1.69	1133.9	
65.700	65.600	BT	43	2.72	2.71	2.72	1928.2		50	2.14	2.16	2.15	1484.8	
65.600	65.500	BT	42	1.83	2.41	2.12	1461.6		50	2.23	2.24	2.24	1550.7	
65.500	65.400	BT	43	2.03	2.50	2.27	1574.0		51	1.78	1.74	1.76	1186.6	
65.400	65.300	BT	40	2.46	2.68	2.57	1813.3		51	1.42	1.50	1.46	962.5	
65.300	65.200	BT	40	2.33	2.54	2.44	1706.9		52	2.70	2.58	2.64	1868.7	
65.200	65.100	BT	41	1.86	2.40	2.13	1469.4		52	1.91	1.94	1.93	1311.9	
65.100	65.000	BT	43	2.23	2.25	2.24	1554.6	1568	52	2.09	2.23	2.16	1492.5	1421
65.000	64.900	BT	48	1.75	2.13	1.94	1323.4		52	1.80	1.99	1.90	1289.0	
64.900	64.800	BT	45	1.44	2.04	1.74	1171.5		52	1.56	1.54	1.55	1029.2	
64.800	64.700	BT	42	2.14	2.57	2.36	1644.3		50	2.39	2.62	2.51	1762.0	
64.700	64.600	BT	40	2.42	2.81	2.62	1848.9		51	2.52	2.36	2.44	1710.9	
64.600	64.500	BT	41	2.39	2.65	2.52	1773.8		54	1.96	1.74	1.85	1254.8	
64.500	64.400	BT	45	1.80	1.95	1.88	1273.8		50	1.85	2.24	2.05	1403.8	
64.400	64.300	BT	55	1.94	1.94	1.94	1323.4		37	1.99	1.93	1.96	1338.7	
64.300	64.200	BT	59	2.26	2.14	2.20	1523.5		41	2.55	2.25	2.40	1679.5	
64.200	64.100	BT	56	2.57	1.77	2.17	1500.3		43	1.69	1.52	1.61	1070.2	
64.100	64.000	BT	52	3.01	3.10	3.06	2200.7	1558	29	2.68	2.36	2.52	1773.8	1431
64.000	63.900	BT	51	3.03	2.21	2.62	1852.8		20	3.27	3.14	3.21	2322.0	

Roughness Analysis of Flexible Pavement on RHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)														
Chainage (km)			Inner Lane						Outer Lane					
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km
63.900	63.750	BT	54	3.12	2.64	2.88	2060.0	1956	38	2.08	1.93	2.01	1373.1	1848
62.730	62.600	BT	43	4.57	4.53	4.55	3438.1		46	4.31	4.71	4.51	3404.2	
62.600	62.550	BT	43	3.60	3.24	3.42	2497.2	2968	46	3.51	3.85	3.68	2710.8	3057
61.970	61.900	BT	47	2.55	2.32	2.44	1706.9		52	1.73	1.74	1.74	1167.8	
61.900	61.800	BT	47	1.88	1.96	1.92	1308.1		52	1.64	1.70	1.67	1118.9	
61.800	61.700	BT	46	1.45	1.63	1.54	1021.8		51	1.99	1.81	1.90	1292.8	
61.700	61.600	BT	43	2.72	2.15	2.44	1706.9		50	1.64	1.50	1.57	1044.1	
61.600	61.500	BT	40	1.83	1.88	1.86	1258.6		50	1.76	1.57	1.67	1115.1	
61.500	61.400	BT	34	2.18	2.27	2.23	1542.9		50	1.38	1.29	1.34	870.7	
61.400	61.300	BT	36	2.05	2.41	2.23	1546.8		50	2.08	2.04	2.06	1415.4	
61.300	61.200	BT	45	1.96	2.05	2.01	1373.1		45	2.53	2.60	2.57	1809.3	
61.200	61.100	BT	52	2.45	1.96	2.21	1527.4		43	2.09	2.14	2.12	1457.8	
61.100	61.000	BT	51	1.98	2.83	2.41	1683.4	1468	46	1.64	1.74	1.69	1133.9	1243
61.000	60.900	BT	46	1.87	3.13	2.50	1758.1		46	1.88	1.78	1.83	1239.6	
60.900	60.800	BT	45	1.86	2.54	2.20	1523.5		48	1.72	1.72	1.72	1156.5	
60.800	60.700	BT	44	2.32	2.61	2.47	1730.5		51	1.72	1.50	1.61	1074.0	
60.700	60.600	BT	43	2.41	3.24	2.83	2016.0		52	2.00	1.92	1.96	1338.7	
60.600	60.500	BT	43	2.50	2.37	2.44	1706.9		50	1.90	1.95	1.93	1311.9	
60.500	60.400	BT	41	3.35	3.14	3.25	2354.5		43	3.76	3.38	3.57	2620.2	
60.400	60.300	BT	40	2.89	2.89	2.89	2068.0		40	2.33	2.27	2.30	1601.3	
60.300	60.200	BT	41	3.30	4.66	3.98	2959.4		36	3.29	3.84	3.57	2616.1	
60.200	60.100	BT	46	3.35	3.47	3.41	2489.0		34	3.41	3.07	3.24	2350.4	
60.100	60.000	BT	46	2.11	2.31	2.21	1531.3	2014	46	1.64	1.59	1.62	1077.7	1639
60.000	59.900	BT	46	1.49	1.73	1.61	1074.0		51	2.09	2.08	2.09	1434.6	
59.900	59.800	BT	44	2.36	2.20	2.28	1585.7		52	1.78	1.76	1.77	1194.2	
59.800	59.700	BT	43	1.71	2.07	1.89	1285.2		52	1.93	1.84	1.89	1281.4	
59.700	59.600	BT	44	3.76	3.34	3.55	2603.7		51	2.47	2.23	2.35	1640.4	
59.600	59.500	BT	44	2.44	2.01	2.23	1542.9		51	2.09	2.08	2.09	1434.6	
59.500	59.400	BT	47	2.26	1.99	2.13	1465.5		52	1.85	1.88	1.87	1266.2	
59.400	59.300	BT	55	2.03	1.99	2.01	1377.0		53	1.96	2.14	2.05	1407.7	
59.300	59.200	BT	52	2.07	2.06	2.07	1419.2		53	1.76	1.72	1.74	1171.5	
59.200	59.100	BT	55	2.10	1.83	1.97	1342.5		52	1.64	1.61	1.63	1085.2	
59.100	59.000	BT	58	2.02	1.96	1.99	1361.6	1506	50	2.25	2.25	2.25	1562.4	1348
59.000	58.900	BT	57	2.48	2.61	2.55	1793.5		48	2.33	2.36	2.35	1636.4	
58.900	58.800	BT	55	3.04	3.57	3.31	2403.3		42	3.19	3.29	3.24	2350.4	
58.800	58.700	BT	56	3.26	3.68	3.47	2538.1		48	2.07	2.20	2.14	1473.2	
58.700	58.600	BT	59	3.14	2.68	2.91	2084.0		50	1.94	2.01	1.98	1350.1	
58.600	58.500	BT	61	2.97	2.75	2.86	2044.0		52	2.40	2.38	2.39	1671.7	
58.500	58.400	BT	62	3.57	3.47	3.52	2579.1		53	2.20	2.24	2.22	1539.1	
58.400	58.300	BT	60	2.74	2.64	2.69	1908.4		51	2.84	2.34	2.59	1829.1	
58.300	58.200	BT	61	3.24	2.86	3.05	2196.6		50	2.22	2.04	2.13	1469.4	
58.200	58.100	BT	60	3.17	2.77	2.97	2132.2		52	2.31	2.19	2.25	1562.4	
58.100	58.000	BT	61	2.43	2.45	2.44	1710.9	2139	52	1.58	1.55	1.57	1040.4	1592
58.000	57.900	BT	61	1.82	1.88	1.85	1254.8		51	2.25	2.16	2.21	1527.4	
57.900	57.800	BT	61	2.65	2.39	2.52	1773.8		53	2.06	1.90	1.98	1354.0	
57.800	57.700	BT	61	2.09	2.09	2.09	1438.5		52	2.19	2.26	2.23	1542.9	
57.700	57.600	BT	57	3.18	2.87	3.03	2176.5		49	1.99	2.01	2.00	1369.3	
57.600	57.500	BT	50	2.28	2.13	2.21	1527.4		49	1.95	1.86	1.91	1296.7	
57.500	57.400	BT	55	2.29	2.17	2.23	1546.8		52	2.03	1.86	1.95	1327.2	
57.400	57.300	BT	56	2.23	2.44	2.34	1628.6		53	1.89	1.93	1.91	1300.5	
57.300	57.200	BT	55	2.46	2.25	2.36	1644.3		51	2.47	2.45	2.46	1726.6	
57.200	57.100	BT	55	3.42	3.73	3.58	2624.3		46	3.44	3.19	3.32	2411.5	
57.100	57.000	BT	57	3.07	2.95	3.01	2164.4	1778	52	2.56	2.40	2.48	1742.3	1560
57.000	56.900	BT	58	2.57	2.69	2.63	1860.8		53	2.59	2.29	2.44	1710.9	
56.900	56.800	BT	58	2.34	2.37	2.36	1644.3		53	2.49	2.29	2.39	1671.7	
56.800	56.700	BT	57	2.81	2.51	2.66	1884.6		52	2.77	2.51	2.64	1868.7	
56.700	56.600	BT	58	2.50	2.41	2.46	1722.7		52	2.33	2.38	2.36	1644.3	
56.600	56.500	BT	60	3.18	2.76	2.97	2132.2		52	2.96	2.63	2.80	1992.0	
56.500	56.400	BT	61	2.28	2.13	2.21	1527.4		52	2.03	2.11	2.07	1423.1	
56.400	56.300	BT	61	2.00	1.86	1.93	1315.7		52	2.73	2.79	2.76	1964.1	
56.300	56.200	BT	60	3.15	2.92	3.04	2184.5		52	2.29	2.28	2.29	1589.6	
56.200	56.100	BT	58	2.74	2.60	2.67	1892.5		52	2.59	2.53	2.56	1805.4	
56.100	56.000	BT	58	2.71	2.84	2.78	1976.0	1814	52	3.19	2.90	3.05	2192.6	1786
56.000	55.900	BT	59	3.62	3.30	3.46	2529.9		51	2.96	3.01	2.99	2144.3	
55.900	55.800	BT	60	3.21	2.92	3.07	2208.7		52	3.66	3.39	3.53	2583.2	
55.800	55.700	BT	60	3.24	3.15	3.20	2313.9		52	3.20	2.97	3.09	2224.9	
55.700	55.600	BT	54	3.20	3.19	3.20	2313.9		53	3.08	2.84	2.96	2124.2	
55.600	55.500	BT	48	2.50	2.70	2.60	1837.0		54	2.94	2.68	2.81	2004.0	
55.500	55.400	BT	47	2.37	2.56	2.47	1730.5		52	3.01	3.06	3.04	2184.5	
55.400	55.300	BT	42	2.90	4.16	3.53	2587.3		48	3.56	3.69	3.63	2665.4	
55.300	55.200	BT	37	4.18	3.63	3.91	2897.1		49	3.70	3.79	3.75	2764.4	
55.200	55.100	BT	35	3.86	4.02	3.94	2926.1	2372	31	3.56	4.08	3.82	2826.5	2391
53.250	53.100	BT	28	4.31	3.96	4.14	3088.8		52	2.35	2.36	2.36	1644.3	
53.100	53.000	BT	17	3.20	3.79	3.50	2558.6	2824	52	2.64	2.42	2.53	1781.7	1713
53.000	52.900	BT	21	4.30	5.05	4.68	3544.0		52	2.72	2.35	2.54	1785.6	
52.900	52.800	BT	36	2.37	2.30	2.34	1628.6		52	2.90	2.62	2.76	1964.1	
52.800	52.700	BT	41	3.68	3.37	3.53	2583.2		52	2.31	2.06	2.19	1511.9	
52.700	52.600	BT	47	1.95	1.72	1.84	1243.4		52	2.08	1.92	2.00	1369.3	

Roughness Analysis of Flexible Pavement on RHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)														
Chainage (km)			Inner Lane						Outer Lane					
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km
52.600	52.500	BT	52	2.12	2.06	2.09	1438.5		52	1.96	1.95	1.96	1334.8	
52.500	52.400	BT	52	1.57	1.39	1.48	977.3		54	1.91	1.79	1.85	1254.8	
52.400	52.300	BT	50	2.70	3.29	3.00	2152.3		52	2.02	1.91	1.97	1342.5	
52.300	52.200	BT	45	4.92	4.02	4.47	3370.4		43	4.64	4.05	4.35	3265.0	
52.200	52.120	BT	48	4.06	4.29	4.18	3122.3	2229	45	2.61	2.17	2.39	1671.7	1722
47.510	47.400	BT	51	2.35	2.99	2.67	1892.5		49	1.97	2.36	2.17	1496.4	
47.400	47.300	BT	56	2.08	2.43	2.26	1566.3		48	1.84	1.86	1.85	1254.8	
47.300	47.200	BT	55	1.73	1.88	1.81	1220.7		49	1.76	1.63	1.70	1137.7	
47.200	47.100	BT	54	2.34	2.35	2.35	1636.4		50	1.92	1.79	1.86	1258.6	
47.100	47.000	BT	50	5.22	4.49	4.86	3697.2	2003	45	4.92	5.17	5.05	3859.6	1801
47.000	46.900	BT	52	4.79	4.58	4.69	3552.5		46	4.90	5.38	5.14	3941.1	
46.900	46.800	BT	53	3.07	3.31	3.19	2309.9		47	3.57	3.19	3.38	2464.5	
46.800	46.700	BT	56	1.85	1.85	1.85	1254.8		51	1.65	1.69	1.67	1118.9	
46.700	46.600	BT	57	1.77	1.81	1.79	1209.3		52	1.96	2.16	2.06	1415.4	
46.600	46.500	BT	58	1.53	1.37	1.45	955.2		52	1.92	1.86	1.89	1285.2	
46.500	46.420	BT	57	3.04	3.11	3.08	2216.8	1916	52	1.95	1.84	1.90	1289.0	1919
46.010	45.900	BT	58	1.91	1.86	1.89	1281.4		52	2.22	2.20	2.21	1531.3	
45.900	45.800	BT	59	2.08	1.99	2.04	1396.2		53	2.37	2.33	2.35	1640.4	
45.800	45.700	BT	58	1.62	1.60	1.61	1074.0		52	1.69	1.67	1.68	1126.4	
45.700	45.600	BT	54	3.40	3.53	3.47	2534.0		51	2.10	1.93	2.02	1380.8	
45.600	45.500	BT	52	4.28	4.72	4.50	3395.8		44	4.01	4.61	4.31	3235.6	
45.500	45.400	BT	55	3.99	3.25	3.62	2661.3		45	4.04	4.01	4.03	2996.9	
45.400	45.300	BT	58	4.01	3.42	3.72	2739.6		50	2.00	2.04	2.02	1384.6	
45.300	45.200	BT	55	4.87	4.14	4.51	3400.0		47	4.66	4.75	4.71	3569.5	
45.200	45.100	BT	55	4.19	4.02	4.11	3063.7		35	4.52	4.30	4.41	3319.8	
45.100	45.000	BT	57	1.95	1.98	1.97	1342.5	2289	44	1.94	1.92	1.93	1315.7	2150
45.000	44.900	BT	58	1.72	1.71	1.72	1152.7		50	1.71	1.70	1.71	1145.2	
44.900	44.800	BT	58	1.91	1.87	1.89	1285.2		52	1.85	1.68	1.77	1190.4	
44.800	44.700	BT	57	2.04	2.03	2.04	1396.2		53	1.93	1.85	1.89	1285.2	
44.700	44.600	BT	57	2.83	2.64	2.74	1944.2		53	2.40	2.05	2.23	1542.9	
44.600	44.500	BT	57	2.15	2.16	2.16	1488.7		54	2.76	2.79	2.78	1976.0	
44.500	44.400	BT	59	2.76	2.73	2.75	1952.1		53	2.26	2.08	2.17	1500.3	
44.400	44.300	BT	58	2.33	2.62	2.48	1738.4		52	2.21	2.03	2.12	1461.6	
44.300	44.200	BT	57	3.92	3.92	3.92	2909.5		51	4.17	4.27	4.22	3160.0	
44.200	44.100	BT	58	2.33	2.26	2.30	1597.4		53	3.75	3.20	3.48	2542.2	
44.100	44.000	BT	60	1.91	1.81	1.86	1262.4	1673	54	1.51	1.58	1.55	1025.5	1683
44.000	43.900	BT	60	3.20	3.58	3.39	2472.7		53	2.02	2.09	2.06	1411.5	
43.900	43.800	BT	61	4.04	4.02	4.03	3001.1		53	2.24	2.20	2.22	1539.1	
43.800	43.700	BT	59	2.49	2.35	2.42	1695.2		53	2.00	2.09	2.05	1403.8	
43.700	43.600	BT	58	3.00	4.54	3.77	2785.1		52	2.33	2.18	2.26	1566.3	
43.600	43.500	BT	57	3.20	3.58	3.39	2472.7		52	2.03	1.86	1.95	1327.2	
43.500	43.400	BT	57	1.85	2.16	2.01	1373.1		52	1.70	1.92	1.81	1224.4	
43.400	43.300	BT	58	1.76	1.47	1.62	1077.7		52	1.87	1.54	1.71	1145.2	
43.300	43.200	BT	59	2.03	2.64	2.34	1628.6		53	2.33	2.02	2.18	1504.2	
43.200	43.130	BT	59	3.69	3.31	3.50	2562.7	2119	52	2.35	2.37	2.36	1648.2	1419
30.470	30.400	BT	47	4.24	4.48	4.36	3277.7		37	3.26	3.11	3.19	2305.8	
30.400	30.300	BT	37	4.88	4.54	4.71	3573.7		20	4.28	4.95	4.62	3493.1	
30.300	30.200	BT	19	2.98	2.97	2.98	2136.2	2996	19	2.89	2.96	2.93	2096.0	2632
30.200	30.100	BT												
30.100	30.000	BT						-						-

Roughness Analysis of Rigid Pavement on LHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)														
Chainage (km)			Inner Lane						Outer Lane					
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km
30.000	30.100	CC	20	3.50	3.22	3.36	2448.2		19	3.72	3.12	3.42	2497.2	
30.100	30.200	CC	32	3.67	3.51	3.59	2636.6		28	3.81	3.58	3.70	2723.1	
30.200	30.300	CC	19	3.32	3.68	3.50	2562.7		32	3.71	3.46	3.59	2632.5	
30.300	30.400	CC	25	3.45	3.41	3.43	2505.4		28	3.79	3.42	3.61	2649.0	
30.400	30.520	CC	41	3.52	3.30	3.41	2489.0	2528	39	3.53	3.19	3.36	2448.2	2590
32.000	32.100	CC	51	2.42	2.70	2.56	1805.4		50	2.75	2.55	2.65	1876.6	
32.100	32.200	CC	54	2.78	2.95	2.87	2048.0		51	2.64	2.78	2.71	1924.3	
32.200	32.300	CC	53	3.35	3.26	3.31	2403.3		46	2.24	2.35	2.30	1597.4	
32.300	32.400	CC	48	3.52	4.04	3.78	2793.4		44	3.49	3.56	3.53	2583.2	
32.400	32.500	CC	50	3.57	3.45	3.51	2570.9		51	3.75	3.60	3.68	2706.6	
32.500	32.600	CC	54	3.63	3.66	3.65	2681.9		53	3.58	3.40	3.49	2554.5	
32.600	32.700	CC	55	3.77	3.49	3.63	2669.5		52	3.50	3.60	3.55	2603.7	
32.700	32.800	CC	52	3.45	3.35	3.40	2480.8		51	3.57	3.35	3.46	2529.9	
32.800	32.900	CC	50	3.23	3.64	3.44	2509.4		47	3.61	3.36	3.49	2550.4	
32.900	33.000	CC	52	3.20	3.36	3.28	2383.0	2435	49	3.52	4.04	3.78	2793.4	2372
33.000	33.100	CC	56	3.50	3.73	3.62	2657.2		48	3.53	3.60	3.57	2616.1	
33.100	33.200	CC	56	3.76	3.66	3.71	2735.5		48	3.61	3.16	3.39	2468.6	
33.200	33.300	CC	56	3.45	3.37	3.41	2489.0		49	4.10	3.47	3.79	2797.5	
33.300	33.400	CC	55	3.50	3.78	3.64	2677.8		49	3.40	3.50	3.45	2521.7	
33.400	33.500	CC	55	3.48	3.47	3.48	2542.2		48	3.51	3.14	3.33	2419.6	
33.500	33.600	CC	55	3.34	3.21	3.28	2378.9		49	3.39	3.25	3.32	2415.5	
33.600	33.700	CC	55	3.50	3.33	3.42	2493.1		49	3.38	3.73	3.56	2607.8	
33.700	33.800	CC	56	3.75	3.79	3.77	2785.1		49	3.54	3.86	3.70	2727.3	
33.800	33.900	CC	54	3.59	3.72	3.66	2690.1		49	3.28	3.29	3.29	2387.0	
33.900	34.000	CC	49	4.04	3.75	3.90	2888.7	2634	43	3.58	3.33	3.46	2525.8	2549
34.000	34.100	CC	44	3.99	4.03	4.01	2984.4		31	3.61	3.96	3.79	2797.5	
34.100	34.200	CC	37	3.76	3.79	3.78	2789.3		26	3.57	3.74	3.66	2690.1	
34.200	34.300	CC	37	3.40	3.66	3.53	2587.3		9	3.23	3.68	3.46	2525.8	
34.300	34.400	CC	41	3.75	3.51	3.63	2669.5		11	3.39	3.30	3.35	2435.9	
34.400	34.500	CC	43	3.22	3.55	3.39	2468.6		21	3.71	3.47	3.59	2636.6	
34.500	34.600	CC	45	3.73	3.98	3.86	2855.5		31	3.60	3.50	3.55	2603.7	
34.600	34.700	CC	52	3.46	3.58	3.52	2579.1		32	3.83	3.90	3.87	2863.8	
34.700	34.800	CC	54	3.74	3.34	3.54	2595.5		34	3.70	3.65	3.68	2706.6	
34.800	34.900	CC	45	3.34	3.44	3.39	2472.7		31	3.71	3.56	3.64	2673.7	
34.900	35.000	CC	38	3.42	3.31	3.37	2452.2	2645	26	3.42	3.15	3.29	2387.0	2632
35.000	35.100	CC	39	3.61	3.85	3.73	2752.0		32	3.45	3.75	3.60	2644.8	
35.100	35.200	CC	41	3.48	3.39	3.44	2509.4		35	3.88	3.68	3.78	2793.4	
35.200	35.300	CC	49	3.73	3.45	3.59	2636.6		37	3.97	3.54	3.76	2772.7	
35.300	35.400	CC	47	3.58	3.12	3.35	2440.0		33	3.20	3.47	3.34	2427.8	
35.400	35.500	CC	47	3.91	3.37	3.64	2677.8		36	3.74	3.44	3.59	2636.6	
35.500	35.600	CC	53	3.94	3.75	3.85	2847.2		41	3.94	3.82	3.88	2876.3	
35.600	35.700	CC	51	3.74	3.29	3.52	2575.0		44	3.73	3.91	3.82	2826.5	
35.700	35.800	CC	42	3.66	3.67	3.67	2698.4		46	3.62	3.90	3.76	2776.8	
35.800	35.900	CC	35	3.30	3.65	3.48	2542.2		47	3.48	3.35	3.42	2493.1	
35.900	36.000	CC	34	3.59	3.39	3.49	2554.5	2623	47	3.65	3.45	3.55	2603.7	2685
36.000	36.100	CC	35	3.30	3.27	3.29	2387.0		47	3.37	3.24	3.31	2403.3	
36.100	36.200	CC	34	4.07	4.46	4.27	3197.8		45	4.46	4.18	4.32	3244.0	
36.200	36.300	CC	33	3.55	3.76	3.66	2690.1		42	3.66	3.74	3.70	2727.3	
36.300	36.400	CC	33	3.85	3.25	3.55	2603.7		46	3.72	3.27	3.50	2558.6	
36.400	36.500	CC	33	3.19	3.46	3.33	2419.6		47	3.74	3.56	3.65	2686.0	
36.500	36.600	CC	34	3.22	3.40	3.31	2407.4		48	3.48	3.32	3.40	2480.8	
36.600	36.700	CC	33	3.46	3.77	3.62	2657.2		46	3.92	3.71	3.82	2822.4	
36.700	36.800	CC	32	3.85	3.96	3.91	2897.1		46	3.68	3.48	3.58	2628.4	
36.800	36.900	CC	33	3.79	3.28	3.54	2591.4		48	3.47	3.24	3.36	2444.1	
36.900	37.000	CC	34	3.71	3.77	3.74	2760.3	2661	49	3.52	4.03	3.78	2789.3	2678
37.000	37.100	CC	33	3.25	3.33	3.29	2391.1		48	3.38	3.39	3.39	2468.6	
37.100	37.200	CC	31	3.61	3.19	3.40	2480.8		46	3.69	3.37	3.53	2587.3	
37.200	37.300	CC	31	3.82	3.23	3.53	2583.2		45	3.55	3.72	3.64	2673.7	
37.300	37.400	CC	33	3.80	3.74	3.77	2785.1		40	3.59	3.30	3.45	2517.6	
37.400	37.500	CC	30	3.41	3.68	3.55	2599.6		41	3.38	3.29	3.34	2427.8	
37.500	37.600	CC	37	3.55	3.29	3.42	2497.2		42	3.90	3.86	3.88	2876.3	
37.600	37.700	CC	34	3.53	3.77	3.65	2686.0		40	3.60	3.78	3.69	2719.0	
37.700	37.800	CC	41	3.51	3.51	3.51	2570.9		34	3.46	3.43	3.45	2517.6	
37.800	37.900	CC	48	3.50	3.75	3.63	2665.4		32	3.65	3.14	3.40	2476.7	
37.900	38.000	CC	53	3.61	3.20	3.41	2484.9	2574	32	3.15	3.50	3.33	2419.6	2568
39.540	39.600	CC	53	4.24	3.89	4.07	3030.3		32	3.31	4.34	3.83	2830.7	
39.600	39.700	CC	54	3.13	3.41	3.27	2374.8		30	3.52	3.99	3.76	2772.7	
39.700	39.800	CC	52	4.46	3.31	3.89	2880.4		29	3.74	4.28	4.01	2984.4	
39.800	39.900	CC	50	3.30	3.05	3.18	2297.7		32	3.08	3.26	3.17	2293.6	
39.900	40.000	CC	45	2.99	3.29	3.14	2269.4	2571	24	3.83	3.17	3.50	2562.7	2689
40.000	40.100	CC	40	4.17	3.63	3.90	2892.9		18	3.27	2.88	3.08	2216.8	
40.100	40.200	CC	31	3.96	3.84	3.90	2892.9		33	3.24	2.91	3.08	2216.8	
40.200	40.300	CC	32	3.36	2.91	3.14	2265.3		38	3.51	3.62	3.57	2616.1	
40.300	40.400	CC	39	3.29	3.47	3.38	2464.5		42	3.27	3.57	3.42	2497.2	
40.400	40.500	CC	37	3.55	3.30	3.43	2501.3		46	3.33	3.32	3.33	2419.6	
40.500	40.600	CC	38	3.72	3.38	3.55	2603.7		47	3.23	3.71	3.47	2538.1	

Roughness Analysis of Rigid Pavement on LHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)														
Chainage (km)			Inner Lane						Outer Lane					
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km
40.600	40.740	CC	41	3.77	3.67	3.72	2743.8	2623	44	3.62	3.72	3.67	2702.5	2458
43.140	43.200	CC	53	4.21	4.10	4.16	3105.6		48	4.17	3.97	4.07	3034.5	
43.200	43.300	CC	54	3.96	4.16	4.06	3026.1		48	4.46	4.16	4.31	3235.6	
43.300	43.400	CC	54	4.67	4.49	4.58	3463.5		49	4.50	4.30	4.40	3311.4	
43.400	43.500	CC	52	4.34	4.65	4.50	3391.5		46	4.35	4.04	4.20	3139.1	
43.500	43.600	CC	52	3.80	4.28	4.04	3009.5		39	3.84	4.37	4.11	3063.7	
43.600	43.700	CC	53	4.41	4.02	4.22	3155.8		45	4.65	4.09	4.37	3286.1	
43.700	43.800	CC	51	4.27	4.03	4.15	3101.4		41	4.57	4.21	4.39	3302.9	
43.800	43.900	CC	54	4.59	4.35	4.47	3370.4		47	4.34	3.81	4.08	3038.7	
43.900	44.000	CC	54	3.85	3.82	3.84	2839.0	3163	48	3.28	3.12	3.20	2318.0	3081
44.000	44.100	CC	55	3.60	4.06	3.83	2834.8		49	3.47	3.32	3.40	2476.7	
44.100	44.200	CC	53	4.10	4.64	4.37	3286.1		48	3.48	3.67	3.58	2624.3	
44.200	44.300	CC	48	3.85	3.97	3.91	2901.2		42	3.82	4.18	4.00	2976.1	
44.300	44.400	CC	52	3.78	4.19	3.99	2963.6		49	4.29	4.12	4.21	3147.4	
44.400	44.500	CC	54	3.74	3.79	3.77	2781.0		51	3.41	3.46	3.44	2509.4	
44.500	44.600	CC	55	4.07	4.13	4.10	3059.6		49	3.81	3.42	3.62	2657.2	
44.600	44.700	CC	55	4.18	4.29	4.24	3172.6		51	3.12	3.52	3.32	2415.5	
44.700	44.800	CC	53	4.31	4.14	4.23	3164.2		50	3.74	3.98	3.86	2859.7	
44.800	44.900	CC	52	4.12	4.13	4.13	3080.5		50	3.66	3.73	3.70	2723.1	
44.900	45.000	CC	46	4.08	4.61	4.35	3265.0	3051	49	3.71	4.07	3.89	2884.6	2727
45.000	45.100	CC	38	3.87	3.66	3.77	2781.0		50	3.43	3.08	3.26	2362.6	
45.100	45.200	CC	34	4.35	3.86	4.11	3063.7		46	3.16	3.65	3.41	2484.9	
45.200	45.300	CC	33	4.24	4.49	4.37	3281.9		44	3.54	3.27	3.41	2484.9	
45.300	45.400	CC	34	4.35	4.05	4.20	3143.3		48	3.85	3.40	3.63	2665.4	
45.400	45.500	CC	35	4.39	3.85	4.12	3076.3		49	3.60	3.84	3.72	2743.8	
45.500	45.600	CC	33	4.52	4.19	4.36	3273.5		47	3.53	3.05	3.29	2391.1	
45.600	45.700	CC	33	3.62	3.84	3.73	2752.0		45	3.26	3.59	3.43	2501.3	
45.700	45.800	CC	35	3.86	4.22	4.04	3009.5		49	3.52	3.93	3.73	2747.9	
45.800	45.900	CC	36	4.44	4.20	4.32	3244.0		50	3.87	4.00	3.94	2922.0	
45.900	46.000	CC	35	4.03	4.47	4.25	3185.2	3081	49	3.58	3.99	3.79	2797.5	2610
46.000	46.100	CC	36	3.72	3.41	3.57	2616.1		49	3.72	4.01	3.87	2863.8	
46.100	46.200	CC	37	3.44	3.22	3.33	2423.7		48	4.08	3.65	3.87	2863.8	
46.200	46.300	CC	35	3.24	3.81	3.53	2583.2		46	3.72	3.25	3.49	2550.4	
46.300	46.400	CC	35	3.55	3.97	3.76	2776.8		48	3.25	3.33	3.29	2391.1	
46.400	46.500	CC	33	3.53	3.38	3.46	2525.8		48	3.72	3.41	3.57	2616.1	
46.500	46.600	CC	34	3.57	3.29	3.43	2505.4		48	3.82	3.60	3.71	2735.5	
46.600	46.700	CC	36	3.37	3.03	3.20	2318.0		50	3.59	4.11	3.85	2851.4	
46.700	46.800	CC	36	3.66	3.63	3.65	2681.9		49	3.23	3.64	3.44	2509.4	
46.800	46.900	CC	33	3.99	4.06	4.03	2996.9		46	4.45	3.80	4.13	3080.5	
46.900	47.000	CC	32	4.15	4.61	4.38	3294.5	2672	44	4.02	4.59	4.31	3231.4	2769
47.000	47.100	CC	31	3.58	3.56	3.57	2620.2		46	3.43	3.71	3.57	2620.2	
47.100	47.200	CC	30	3.93	4.61	4.27	3202.0		44	4.56	4.09	4.33	3248.2	
47.200	47.300	CC	31	3.87	3.95	3.91	2901.2		46	4.09	4.18	4.14	3088.8	
47.300	47.400	CC	33	3.62	3.94	3.78	2793.4		47	4.28	4.04	4.16	3109.7	
47.400	47.500	CC	35	3.61	3.42	3.52	2575.0		48	4.13	4.35	4.24	3176.8	
47.500	47.570	CC	31	3.27	3.53	3.40	2480.8	2762	46	3.24	3.60	3.42	2497.2	2957
52.230	52.300	CC	53	4.22	3.18	3.70	2727.3		45	3.83	3.40	3.62	2657.2	
52.300	52.400	CC	45	3.14	3.54	3.34	2431.8		47	3.29	3.27	3.28	2383.0	
52.400	52.500	CC	43	3.67	3.94	3.81	2814.1		49	3.53	3.41	3.47	2538.1	
52.500	52.600	CC	47	3.50	3.82	3.66	2694.3		48	3.83	3.65	3.74	2760.3	
52.600	52.700	CC	50	3.32	3.47	3.40	2476.7		49	4.17	3.64	3.91	2897.1	
52.700	52.800	CC	53	3.77	3.66	3.72	2739.6		49	3.35	3.57	3.46	2529.9	
52.800	52.900	CC	52	4.04	3.33	3.69	2714.9		39	3.64	3.81	3.73	2747.9	
52.900	53.000	CC	52	3.53	2.72	3.13	2257.2	2607	46	4.00	3.61	3.81	2814.1	2666
53.000	53.100	CC	49	3.56	3.00	3.28	2383.0		46	3.44	3.66	3.55	2603.7	
53.100	53.200	CC	41	3.00	3.05	3.03	2176.5		34	3.23	3.28	3.26	2362.6	
53.200	53.300	CC	45	3.27	3.31	3.29	2391.1		44	3.23	3.81	3.52	2579.1	
53.300	53.400	CC	52	3.46	3.53	3.50	2558.6		44	3.82	3.53	3.68	2706.6	
53.400	53.500	CC	53	3.37	3.81	3.59	2636.6		44	3.59	4.05	3.82	2826.5	
53.500	53.600	CC	53	3.58	3.23	3.41	2484.9		46	3.29	3.61	3.45	2521.7	
53.600	53.700	CC	49	3.58	3.46	3.52	2579.1		37	3.62	3.91	3.77	2781.0	
53.700	53.800	CC	47	2.97	3.16	3.07	2208.7		43	2.82	3.27	3.05	2192.6	
53.800	53.900	CC	51	3.16	3.40	3.28	2383.0		49	2.90	3.29	3.10	2233.0	
53.900	54.000	CC	53	3.25	3.76	3.51	2566.8	2437	51	4.06	3.58	3.82	2826.5	2563
54.000	54.100	CC	52	3.36	3.85	3.61	2649.0		51	3.76	3.77	3.77	2781.0	
54.100	54.200	CC	53	3.54	3.29	3.42	2493.1		51	3.05	2.84	2.95	2112.1	
54.200	54.300	CC	53	3.55	3.78	3.67	2698.4		50	3.23	2.96	3.10	2233.0	
54.300	54.400	CC	53	2.76	3.22	2.99	2148.3		42	3.21	2.93	3.07	2212.8	
54.400	54.500	CC	53	2.94	3.29	3.12	2249.1		32	3.49	3.43	3.46	2529.9	
54.500	54.600	CC	54	3.21	3.41	3.31	2407.4		33	3.16	3.42	3.29	2391.1	
54.600	54.700	CC	55	3.30	3.51	3.41	2484.9		33	3.63	3.15	3.39	2472.7	
54.700	54.800	CC	55	3.78	3.23	3.51	2566.8		35	3.10	3.24	3.17	2293.6	
54.800	54.900	CC	54	3.36	3.48	3.42	2497.2		26	3.67	3.23	3.45	2521.7	
54.900	55.000	CC	54	3.04	3.31	3.18	2297.7	2449	25	3.18	3.34	3.26	2366.7	2391
55.000	55.100	CC	53	6.31	6.82	6.57	5183.7		17	6.76	6.40	6.58	5197.0	
55.100	55.200	CC	48	3.40	3.40	3.40	2480.8		22	3.04	3.38	3.21	2326.1	

Roughness Analysis of Rigid Pavement on LHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)														
Chainage (km)			Inner Lane						Outer Lane					
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km
55.200	55.300	CC	42	3.22	3.84	3.53	2587.3		30	3.23	3.56	3.40	2476.7	
55.300	55.400	CC	42	3.47	3.49	3.48	2546.3		27	3.00	3.16	3.08	2220.8	
55.400	55.500	CC	35	3.12	2.91	3.02	2168.4		41	3.48	3.30	3.39	2472.7	
55.500	55.600	CC	46	3.28	2.99	3.14	2265.3		47	3.43	3.34	3.39	2468.6	
55.600	55.700	CC	52	3.01	3.35	3.18	2301.8		49	2.90	3.22	3.06	2204.7	
55.700	55.800	CC	56	3.41	3.45	3.43	2505.4		50	3.20	3.17	3.19	2305.8	
55.800	55.900	CC	55	3.30	3.53	3.42	2493.1		50	3.36	3.39	3.38	2460.4	
55.900	56.000	CC	54	3.24	3.62	3.43	2505.4	2704	51	2.89	3.23	3.06	2204.7	2634
56.000	56.100	CC	53	3.54	3.37	3.46	2525.8		50	3.70	3.38	3.54	2595.5	
56.100	56.200	CC	53	3.12	2.79	2.96	2120.1		50	3.44	3.32	3.38	2464.5	
56.200	56.300	CC	52	2.98	3.11	3.05	2192.6		50	3.33	2.91	3.12	2253.2	
56.300	56.400	CC	53	3.10	3.41	3.26	2362.6		49	3.06	2.96	3.01	2164.4	
56.400	56.500	CC	55	3.25	3.45	3.35	2440.0		49	3.57	3.17	3.37	2456.3	
56.500	56.600	CC	53	3.38	3.37	3.38	2460.4		50	3.42	2.91	3.17	2289.6	
56.600	56.700	CC	53	3.56	3.24	3.40	2480.8		50	3.53	3.29	3.41	2489.0	
56.700	56.800	CC	54	3.35	3.71	3.53	2587.3		47	3.18	3.48	3.33	2423.7	
56.800	56.900	CC	53	3.06	2.85	2.96	2120.1		42	3.11	3.06	3.09	2224.9	
56.900	57.000	CC	55	3.17	2.96	3.07	2208.7	2350	40	3.71	3.14	3.43	2501.3	2386
57.000	57.100	CC	55	2.95	2.80	2.88	2056.0		39	2.78	2.86	2.82	2012.0	
57.100	57.200	CC	51	2.66	2.92	2.79	1988.0		33	3.01	3.26	3.14	2265.3	
57.200	57.300	CC	35	3.07	2.86	2.97	2128.2		36	3.63	3.21	3.42	2497.2	
57.300	57.400	CC	38	2.83	2.91	2.87	2052.0		46	3.37	3.14	3.26	2362.6	
57.400	57.500	CC	48	2.99	2.83	2.91	2084.0		45	3.04	3.03	3.04	2184.5	
57.500	57.600	CC	52	3.03	3.11	3.07	2212.8		41	2.86	2.74	2.80	1996.0	
57.600	57.700	CC	53	2.85	2.89	2.87	2052.0		39	2.92	3.23	3.08	2216.8	
57.700	57.800	CC	53	3.15	2.70	2.93	2096.0		39	3.53	3.27	3.40	2480.8	
57.800	57.900	CC	53	2.72	3.07	2.90	2072.0		39	3.19	3.13	3.16	2285.5	
57.900	58.000	CC	53	3.28	2.96	3.12	2253.2	2099	39	3.08	2.81	2.95	2112.1	2241
58.000	58.100	CC	53	3.13	2.97	3.05	2196.6		45	3.36	3.10	3.23	2342.3	
58.100	58.200	CC	52	2.87	3.21	3.04	2188.6		48	2.95	2.97	2.96	2124.2	
58.200	58.300	CC	53	2.99	3.29	3.14	2269.4		50	2.92	2.86	2.89	2068.0	
58.300	58.400	CC	53	3.02	2.91	2.97	2128.2		51	3.38	2.88	3.13	2261.3	
58.400	58.500	CC	54	3.10	2.79	2.95	2112.1		51	3.44	3.39	3.42	2493.1	
58.500	58.600	CC	54	2.95	2.86	2.91	2080.0		49	3.13	3.35	3.24	2350.4	
58.600	58.700	CC	54	3.31	3.31	3.31	2407.4		43	3.22	3.45	3.34	2427.8	
58.700	58.800	CC	54	2.77	3.30	3.04	2184.5		46	3.49	3.08	3.29	2387.0	
58.800	58.900	CC	51	3.21	3.07	3.14	2269.4		31	3.06	2.83	2.95	2112.1	
58.900	59.000	CC	29	2.84	3.15	3.00	2152.3	2199	33	3.29	3.06	3.18	2297.7	2286
59.000	59.100	CC	35	3.11	3.01	3.06	2204.7		42	3.05	2.95	3.00	2156.3	
59.100	59.200	CC	46	2.78	3.08	2.93	2100.1		47	2.70	3.05	2.88	2056.0	
59.200	59.300	CC	52	3.07	2.93	3.00	2156.3		48	3.24	3.36	3.30	2399.3	
59.300	59.400	CC	53	3.11	3.12	3.12	2249.1		49	3.12	3.22	3.17	2293.6	
59.400	59.500	CC	53	2.76	3.33	3.05	2192.6		48	3.06	2.99	3.03	2176.5	
59.500	59.600	CC	53	2.96	2.90	2.93	2100.1		48	3.17	3.27	3.22	2334.2	
59.600	59.700	CC	54	3.02	3.34	3.18	2301.8		49	2.83	3.06	2.95	2112.1	
59.700	59.800	CC	54	2.91	2.80	2.86	2039.9		50	2.87	2.94	2.91	2080.0	
59.800	59.900	CC	52	2.86	2.97	2.92	2088.0		50	3.01	3.00	3.01	2160.4	
59.900	60.000	CC	53	3.27	2.94	3.11	2241.0	2167	50	3.16	2.93	3.05	2192.6	2196
60.000	60.100	CC	51	3.15	3.17	3.16	2285.5		49	3.28	3.43	3.36	2444.1	
60.100	60.200	CC	50	3.22	3.68	3.45	2521.7		42	3.74	3.29	3.52	2575.0	
60.200	60.300	CC	42	5.59	4.93	5.26	4044.3		24	5.07	5.11	5.09	3898.2	
60.300	60.400	CC	28	3.72	3.35	3.54	2591.4		35	3.42	3.45	3.44	2509.4	
60.400	60.500	CC	42	3.71	4.12	3.92	2905.4		39	3.53	3.66	3.60	2640.7	
60.500	60.600	CC	44	4.38	3.89	4.14	3088.8		43	3.80	3.84	3.82	2826.5	
60.600	60.700	CC	49	3.59	3.02	3.31	2403.3		50	3.39	3.00	3.20	2313.9	
60.700	60.800	CC	53	3.69	3.25	3.47	2538.1		51	3.08	2.90	2.99	2148.3	
60.800	60.900	CC	53	3.07	3.36	3.22	2330.1		50	2.98	3.11	3.05	2192.6	
60.900	61.000	CC	50	3.42	3.22	3.32	2415.5	2712	50	2.98	2.92	2.95	2116.1	2566
61.000	61.100	CC	25	4.05	3.31	3.68	2710.8		48	3.08	3.50	3.29	2391.1	
61.100	61.200	CC	41	2.53	2.64	2.59	1825.1		49	2.82	3.05	2.94	2104.1	
61.200	61.300	CC	48	4.57	4.41	4.49	3387.3		50	3.32	2.98	3.15	2277.4	
61.300	61.400	CC	51	3.29	3.43	3.36	2448.2		43	2.73	2.70	2.72	1928.2	
61.400	61.500	CC	52	3.27	3.15	3.21	2326.1		46	2.06	2.40	2.23	1546.8	
61.500	61.600	CC	52	3.35	3.28	3.32	2411.5		49	2.68	2.48	2.58	1821.2	
61.600	61.700	CC	52	2.69	2.72	2.71	1920.3		49	2.41	2.12	2.27	1574.0	
61.700	61.800	CC	50	3.75	3.55	3.65	2686.0		48	2.69	2.72	2.71	1920.3	
61.800	61.900	CC	51	2.28	2.55	2.42	1691.2		49	1.99	1.85	1.92	1308.1	
61.900	62.050	CC	50	2.77	2.95	2.86	2044.0	2345	49	3.70	3.60	3.65	2686.0	1956
63.780	63.900	CC	52	3.34	3.97	3.66	2690.1		47	3.69	3.39	3.54	2595.5	
63.900	64.000	CC	53	2.88	2.93	2.91	2080.0	2385	50	3.00	2.74	2.87	2052.0	2324
64.000	64.100	CC	55	2.92	2.81	2.87	2048.0		51	2.70	2.98	2.84	2027.9	
64.100	64.200	CC	54	3.00	3.08	3.04	2188.6		50	2.79	2.94	2.87	2048.0	
64.200	64.300	CC	54	3.01	3.19	3.10	2237.0		52	2.73	3.06	2.90	2072.0	
64.300	64.400	CC	55	3.26	3.40	3.33	2423.7		50	3.24	2.93	3.09	2224.9	
64.400	64.500	CC	54	3.12	3.29	3.21	2322.0		51	2.93	2.94	2.94	2104.1	
64.500	64.600	CC	53	2.91	3.36	3.14	2265.3		46	3.08	2.99	3.04	2184.5	

Roughness Analysis of Rigid Pavement on LHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)														
Chainage (km)			Inner Lane						Outer Lane					
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km
64.600	64.700	CC	54	3.33	3.23	3.28	2383.0		45	3.02	3.38	3.20	2318.0	
64.700	64.800	CC	53	5.07	5.13	5.10	3906.8		46	5.23	4.90	5.07	3876.8	
64.800	64.900	CC	51	3.14	3.71	3.43	2501.3		35	3.44	3.20	3.32	2415.5	
64.900	65.000	CC	53	3.27	3.16	3.22	2330.1	2461	41	3.33	3.33	3.33	2423.7	2370
65.000	65.100	CC	54	3.19	3.14	3.17	2289.6		48	3.38	3.41	3.40	2476.7	
65.100	65.200	CC	54	3.01	3.08	3.05	2192.6		51	3.39	3.27	3.33	2423.7	
65.200	65.300	CC	55	2.98	3.09	3.04	2184.5		51	3.43	3.25	3.34	2431.8	
65.300	65.400	CC	50	4.23	4.77	4.50	3395.8		45	4.28	4.62	4.45	3353.5	
65.400	65.500	CC	46	2.76	3.27	3.02	2168.4		40	3.19	2.80	3.00	2152.3	
65.500	65.600	CC	51	3.36	3.30	3.33	2423.7		48	2.95	3.25	3.10	2237.0	
65.600	65.700	CC	53	3.33	3.73	3.53	2587.3		51	3.36	3.78	3.57	2620.2	
65.700	65.800	CC	49	3.04	3.28	3.16	2285.5		49	3.68	3.39	3.54	2591.4	
65.800	65.900	CC	49	3.73	3.45	3.59	2636.6		46	3.16	3.50	3.33	2423.7	
65.900	66.000	CC	34	3.31	3.24	3.28	2378.9	2454	28	3.04	3.51	3.28	2378.9	2509
66.000	66.100	CC	27	3.28	2.92	3.10	2237.0		25	2.90	3.21	3.06	2200.7	
66.100	66.200	CC	41	3.29	3.55	3.42	2497.2		38	3.14	2.94	3.04	2188.6	
66.200	66.300	CC	49	3.52	3.20	3.36	2448.2		46	3.58	3.51	3.55	2599.6	
66.300	66.400	CC	53	3.26	3.55	3.41	2484.9		49	3.25	3.64	3.45	2517.6	
66.400	66.500	CC	52	2.91	2.93	2.92	2092.0		49	3.13	3.57	3.35	2440.0	
66.500	66.600	CC	44	3.41	3.19	3.30	2399.3		44	3.18	3.21	3.20	2313.9	
66.600	66.700	CC	48	3.15	3.06	3.11	2241.0		42	2.83	3.25	3.04	2188.6	
66.700	66.800	CC	50	3.21	2.96	3.09	2224.9		49	2.95	3.39	3.17	2293.6	
66.800	66.900	CC	52	3.67	3.36	3.52	2575.0		51	3.43	3.76	3.60	2640.7	
66.900	67.000	CC	50	3.18	2.86	3.02	2172.4	2337	51	3.32	3.76	3.54	2595.5	2398
67.000	67.100	CC	42	3.30	3.07	3.19	2305.8		48	3.41	3.27	3.34	2431.8	
67.100	67.200	CC	32	3.27	3.54	3.41	2484.9		48	3.06	3.32	3.19	2309.9	
67.200	67.300	CC	31	3.58	3.60	3.59	2636.6		51	2.96	2.90	2.93	2100.1	
67.300	67.400	CC	34	3.10	3.33	3.22	2330.1		51	3.20	3.00	3.10	2237.0	
67.400	67.500	CC	34	3.03	3.30	3.17	2289.6		51	3.92	3.39	3.66	2690.1	
67.500	67.600	CC	34	3.29	3.78	3.54	2591.4		51	3.28	3.63	3.46	2525.8	
67.600	67.700	CC	32	3.20	2.76	2.98	2140.2		41	3.57	3.21	3.39	2472.7	
67.700	67.800	CC	33	3.09	3.03	3.06	2204.7		38	3.14	3.40	3.27	2374.8	
67.800	67.900	CC	31	3.34	3.34	3.34	2431.8		45	3.15	3.23	3.19	2309.9	
67.900	68.000	CC	29	2.67	2.99	2.83	2020.0	2344	33	2.94	3.14	3.04	2188.6	2364
68.000	68.100	CC	32	3.02	3.01	3.02	2168.4		37	2.98	2.69	2.84	2024.0	
68.100	68.200	CC	37	3.37	3.46	3.42	2493.1		47	3.42	3.07	3.25	2354.5	
68.200	68.300	CC	36	3.43	3.64	3.54	2591.4		49	2.76	2.85	2.81	2000.0	
68.300	68.400	CC	36	3.35	3.21	3.28	2383.0		50	3.48	3.25	3.37	2452.2	
68.400	68.500	CC	27	3.02	3.47	3.25	2354.5		40	3.10	3.08	3.09	2228.9	
68.500	68.600	CC	35	2.92	3.18	3.05	2196.6		45	3.39	3.73	3.56	2611.9	
68.600	68.700	CC	32	4.39	5.07	4.73	3590.7		47	4.40	4.81	4.61	3484.6	
68.700	68.800	CC	26	5.12	5.99	5.56	4299.2		43	5.46	5.28	5.37	4139.2	
68.800	68.900	CC	32	2.69	2.99	2.84	2027.9		42	2.70	2.88	2.79	1988.0	
68.900	69.000	CC	33	3.15	3.15	3.15	2277.4	2638	47	3.06	3.26	3.16	2285.5	2557
69.000	69.100	CC	35	3.49	3.55	3.52	2579.1		45	3.57	3.47	3.52	2579.1	
69.100	69.200	CC	38	3.93	3.36	3.65	2681.9		44	3.38	3.87	3.63	2665.4	
69.200	69.300	CC	39	2.81	3.14	2.98	2136.2		38	2.93	2.91	2.92	2092.0	
69.300	69.400	CC	37	3.08	3.41	3.25	2354.5		37	3.12	3.28	3.20	2318.0	
69.400	69.500	CC	34	3.23	2.88	3.06	2200.7		32	2.96	2.87	2.92	2088.0	
69.500	69.600	CC	26	3.42	3.50	3.46	2529.9		29	3.17	3.01	3.09	2228.9	
69.600	69.700	CC	30	3.44	3.64	3.54	2595.5		34	3.48	3.43	3.46	2525.8	
69.700	69.800	CC	30	2.90	3.10	3.00	2156.3		35	3.36	3.80	3.58	2628.4	
69.800	69.900	CC	28	3.00	3.39	3.20	2313.9		36	3.13	2.92	3.03	2176.5	
69.900	70.000	CC	41	3.30	3.29	3.30	2395.2	2394	41	3.19	3.23	3.21	2326.1	2363
70.000	70.100	CC	45	3.86	4.27	4.07	3030.3		39	4.24	3.80	4.02	2992.8	
70.100	70.200	CC	41	4.68	4.07	4.38	3290.3		28	4.07	4.52	4.30	3223.0	
70.200	70.300	CC	32	4.36	3.90	4.13	3084.6		33	4.25	4.61	4.43	3336.7	
70.300	70.400	CC	28	4.19	4.67	4.43	3336.7		30	4.39	3.94	4.17	3113.9	
70.400	70.500	CC	28	3.80	4.34	4.07	3034.5		32	4.01	4.15	4.08	3042.8	
70.500	70.600	CC	22	4.20	3.99	4.10	3055.4		41	4.08	3.93	4.01	2980.3	
70.600	70.700	CC	40	2.88	2.98	2.93	2100.1		45	3.15	3.44	3.30	2395.2	
70.700	70.800	CC	47	3.22	3.31	3.27	2370.8		49	3.09	3.51	3.30	2399.3	
70.800	70.900	CC	51	3.06	3.08	3.07	2212.8		49	2.87	3.10	2.99	2144.3	
70.900	71.000	CC	50	3.53	3.22	3.38	2460.4	2798	49	3.24	3.09	3.17	2289.6	2792
71.000	71.100	CC	47	3.07	2.83	2.95	2116.1		51	3.15	2.69	2.92	2092.0	
71.100	71.200	CC	43	3.04	3.38	3.21	2326.1		51	2.90	3.42	3.16	2285.5	
71.200	71.300	CC	38	3.17	3.05	3.11	2245.1		50	3.41	3.32	3.37	2452.2	
71.300	71.400	CC	35	3.35	3.44	3.40	2476.7		48	3.01	2.84	2.93	2096.0	
71.400	71.500	CC	33	3.17	2.95	3.06	2204.7		38	3.25	3.25	3.25	2358.6	
71.500	71.600	CC	36	3.53	3.27	3.40	2480.8		44	2.78	2.81	2.80	1992.0	
71.600	71.700	CC	34	2.77	3.13	2.95	2116.1		49	3.24	2.95	3.10	2233.0	
71.700	71.800	CC	32	3.10	3.26	3.18	2301.8		47	3.31	3.45	3.38	2464.5	
71.800	71.900	CC	37	3.10	3.01	3.06	2200.7		50	3.05	2.91	2.98	2140.2	
71.900	72.000	CC	49	3.46	3.07	3.27	2370.8	2284	51	3.21	3.26	3.24	2346.4	2246
72.000	72.100	CC	54	2.91	3.36	3.14	2265.3		51	2.84	2.90	2.87	2052.0	
72.100	72.200	CC	54	3.14	3.64	3.39	2472.7		51	3.15	2.95	3.05	2196.6	

Roughness Analysis of Rigid Pavement on LHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)														
Chainage (km)			Inner Lane						Outer Lane					
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km
72.200	72.300	CC	49	3.08	3.24	3.16	2285.5		48	3.58	3.18	3.38	2464.5	
72.300	72.400	CC	37	2.83	3.11	2.97	2132.2		39	2.92	2.99	2.96	2120.1	
72.400	72.500	CC	47	4.80	5.32	5.06	3872.5		42	4.55	4.55	4.55	3438.1	
72.500	72.600	CC	29	3.37	2.97	3.17	2293.6		24	2.71	3.04	2.88	2056.0	
72.600	72.700	CC	33	3.26	3.27	3.27	2370.8		32	3.09	3.09	3.09	2228.9	
72.700	72.800	CC	43	3.16	2.95	3.06	2200.7		42	3.16	3.52	3.34	2431.8	
72.800	72.900	CC	48	3.01	3.04	3.03	2176.5		37	3.09	3.14	3.12	2249.1	
72.900	73.000	CC	50	3.25	3.10	3.18	2297.7	2437	36	3.52	3.24	3.38	2464.5	2370
73.000	73.100	CC	53	2.93	3.14	3.04	2184.5		43	2.98	3.24	3.11	2245.1	
73.100	73.200	CC	54	3.25	3.23	3.24	2350.4		46	3.37	3.38	3.38	2460.4	
73.200	73.300	CC	53	2.88	3.42	3.15	2277.4		47	3.29	3.46	3.38	2460.4	
73.300	73.400	CC	43	3.11	3.05	3.08	2220.8		43	2.99	2.71	2.85	2035.9	
73.400	73.500	CC	35	3.32	3.07	3.20	2313.9		38	3.11	3.23	3.17	2293.6	
73.500	73.600	CC	44	3.16	3.16	3.16	2285.5		47	3.30	3.50	3.40	2480.8	
73.600	73.700	CC	48	2.93	2.95	2.94	2108.1		51	2.93	3.20	3.07	2208.7	
73.700	73.800	CC	49	3.35	3.70	3.53	2583.2		51	3.43	3.20	3.32	2411.5	
73.800	73.900	CC	47	3.21	2.92	3.07	2208.7		50	3.08	3.11	3.10	2233.0	
73.900	74.000	CC	36	3.30	3.11	3.21	2322.0	2285	46	3.41	3.47	3.44	2513.5	2334
74.000	74.100	CC	43	2.91	3.25	3.08	2220.8		50	3.50	3.20	3.35	2440.0	
74.100	74.200	CC	46	3.25	2.97	3.11	2245.1		51	2.96	3.17	3.07	2208.7	
74.200	74.300	CC	42	3.06	3.40	3.23	2342.3		39	3.58	3.35	3.47	2534.0	
74.300	74.400	CC	33	2.99	3.34	3.17	2289.6		29	3.15	3.48	3.32	2411.5	
74.400	74.500	CC	39	5.24	5.29	5.27	4048.6		38	5.05	5.16	5.11	3911.1	
74.500	74.600	CC	45	3.26	2.89	3.08	2216.8		40	3.05	3.01	3.03	2180.5	
74.600	74.700	CC	50	3.37	3.10	3.24	2346.4		46	3.71	3.29	3.50	2562.7	
74.700	74.800	CC	49	3.23	2.97	3.10	2237.0		41	3.13	3.45	3.29	2391.1	
74.800	74.900	CC	46	4.94	4.70	4.82	3667.4		27	4.64	4.53	4.59	3467.7	
74.900	75.000	CC	45	3.03	3.03	3.03	2180.5	2579	22	3.44	2.90	3.17	2293.6	2640
75.000	75.100	CC	51	3.15	3.28	3.22	2330.1		26	3.13	3.43	3.28	2383.0	
75.100	75.200	CC	54	2.97	3.24	3.11	2241.0		21	2.93	3.23	3.08	2220.8	
75.200	75.300	CC	45	4.44	5.05	4.75	3603.5		18	4.94	4.88	4.91	3744.1	
75.300	75.400	CC	44	2.93	3.01	2.97	2132.2		27	2.98	2.86	2.92	2092.0	
75.400	75.500	CC	52	3.06	3.26	3.16	2285.5		42	3.36	2.99	3.18	2297.7	
75.500	75.600	CC	53	3.17	2.98	3.08	2216.8		49	3.70	3.13	3.42	2493.1	
75.600	75.700	CC	52	3.48	3.60	3.54	2595.5		52	2.89	3.46	3.18	2297.7	
75.700	75.800	CC	53	3.59	3.01	3.30	2399.3		52	3.70	3.26	3.48	2546.3	
75.800	75.900	CC	53	3.34	2.94	3.14	2269.4		50	2.76	3.12	2.94	2108.1	
75.900	76.000	CC	49	2.85	3.14	3.00	2152.3	2423	47	3.27	3.05	3.16	2285.5	2447
76.000	76.100	CC	46	3.32	2.88	3.10	2237.0		46	3.35	3.50	3.43	2501.3	
76.100	76.200	CC	39	3.37	3.79	3.58	2628.4		42	3.48	3.44	3.46	2529.9	
76.200	76.300	CC	40	3.62	3.31	3.47	2534.0		46	2.95	3.37	3.16	2285.5	
76.300	76.400	CC	47	4.19	3.63	3.91	2901.2		48	3.44	3.16	3.30	2399.3	
76.400	76.500	CC	50	3.63	3.68	3.66	2690.1		47	3.51	3.05	3.28	2383.0	
76.500	76.600	CC	49	3.84	3.76	3.80	2809.9		49	3.45	3.61	3.53	2587.3	
76.600	76.700	CC	44	3.38	3.22	3.30	2399.3		48	3.65	3.28	3.47	2534.0	
76.700	76.800	CC	37	3.30	3.30	3.30	2399.3		45	3.39	3.26	3.33	2419.6	
76.800	76.900	CC	45	2.91	3.10	3.01	2160.4		49	3.91	3.50	3.71	2731.4	
76.900	77.000	CC	48	3.03	3.06	3.05	2192.6	2495	48	3.59	3.68	3.64	2673.7	2504
77.000	77.100	CC	47	3.77	3.41	3.59	2636.6		49	3.24	3.41	3.33	2419.6	
77.100	77.200	CC	44	3.24	3.83	3.54	2591.4		44	3.56	3.20	3.38	2464.5	
77.200	77.300	CC	47	3.79	4.01	3.90	2892.9		46	3.72	3.41	3.57	2616.1	
77.300	77.400	CC	45	4.01	3.52	3.77	2781.0		44	3.72	3.81	3.77	2781.0	
77.400	77.500	CC	47	3.97	3.63	3.80	2809.9		43	3.29	3.56	3.43	2501.3	
77.500	77.600	CC	49	3.17	3.15	3.16	2285.5		46	3.68	3.76	3.72	2743.8	
77.600	77.700	CC	45	3.20	3.36	3.28	2383.0		41	3.69	3.49	3.59	2636.6	
77.700	77.800	CC	43	3.89	3.51	3.70	2727.3		42	3.88	3.69	3.79	2797.5	
77.800	77.900	CC	46	3.66	4.06	3.86	2859.7		48	3.53	3.23	3.38	2464.5	
77.900	78.000	CC	47	3.44	3.05	3.25	2354.5	2632	48	3.71	3.44	3.58	2624.3	2605
78.000	78.100	CC	47	3.20	3.42	3.31	2407.4		45	3.35	3.46	3.41	2484.9	
78.100	78.200	CC	45	3.64	3.21	3.43	2501.3	2454	46	3.91	3.71	3.81	2818.2	2652
79.050	79.200	CC	28	3.24	3.12	3.18	2301.8		41	3.48	3.19	3.34	2427.8	
79.200	79.300	CC	24	3.45	3.31	3.38	2464.5		47	3.25	2.89	3.07	2212.8	
79.300	79.400	CC	23	3.17	2.91	3.04	2188.6		48	3.62	3.13	3.38	2460.4	
79.400	79.500	CC	37	3.31	3.49	3.40	2480.8		48	3.43	3.20	3.32	2411.5	
79.500	79.600	CC	41	3.41	3.77	3.59	2636.6	2414	50	2.82	3.13	2.98	2136.2	2330
79.600	79.700	CC	40	3.46	3.41	3.44	2509.4		46	2.95	3.10	3.03	2176.5	
79.700	79.800	CC	41	3.20	3.39	3.30	2395.2		42	2.80	3.08	2.94	2108.1	
79.800	79.900	CC	51	3.39	3.27	3.33	2423.7		45	3.32	3.37	3.35	2435.9	
79.900	80.000	CC	56	3.42	3.62	3.52	2579.1	2477	41	3.34	3.26	3.30	2399.3	2280
80.000	80.100	CC	55	3.30	3.63	3.47	2534.0		38	3.38	3.40	3.39	2472.7	
80.100	80.200	CC	55	3.33	3.06	3.20	2313.9		38	2.93	2.91	2.92	2092.0	
80.200	80.300	CC	55	3.59	3.41	3.50	2562.7		35	3.10	2.97	3.04	2184.5	
80.300	80.400	CC	55	3.28	3.19	3.24	2346.4		33	3.16	3.55	3.36	2444.1	
80.400	80.500	CC	53	3.41	3.23	3.32	2415.5		31	3.13	2.76	2.95	2112.1	
80.500	80.600	CC	50	3.81	3.49	3.65	2686.0		38	2.89	3.27	3.08	2220.8	
80.600	80.700	CC	51	3.42	3.56	3.49	2554.5		43	3.53	3.13	3.33	2423.7	

Roughness Analysis of Rigid Pavement on LHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)														
Chainage (km)			Inner Lane						Outer Lane					
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km
80.700	80.800	CC	41	3.62	3.63	3.63	2665.4		35	3.21	3.24	3.23	2338.3	
80.800	80.900	CC	39	3.68	3.38	3.53	2587.3		35	3.07	3.01	3.04	2188.6	
80.900	81.000	CC	47	3.09	3.36	3.23	2338.3	2500	40	2.93	3.35	3.14	2269.4	2275
81.000	81.100	CC	51	3.63	3.37	3.50	2562.7		45	3.55	3.13	3.34	2431.8	
81.100	81.200	CC	53	3.36	3.09	3.23	2338.3		50	3.12	3.52	3.32	2415.5	
81.200	81.300	CC	54	3.49	3.33	3.41	2489.0		49	2.88	3.01	2.95	2112.1	
81.300	81.400	CC	54	3.26	3.77	3.52	2575.0		43	3.04	3.03	3.04	2184.5	
81.400	81.500	CC	53	3.34	3.95	3.65	2681.9		40	3.36	3.22	3.29	2391.1	
81.500	81.600	CC	54	2.44	2.17	2.31	1605.2		44	1.92	1.95	1.94	1319.5	
81.600	81.700	CC	54	3.52	3.56	3.54	2595.5		48	2.68	2.59	2.64	1864.7	
81.700	81.800	CC	55	3.68	3.73	3.71	2731.4		46	2.84	2.64	2.74	1948.1	
81.800	81.900	CC	55	3.18	3.17	3.18	2297.7		47	2.88	3.04	2.96	2124.2	
81.900	82.000	CC	55	4.09	3.89	3.99	2967.8	2484	49	2.69	3.00	2.85	2031.9	2082
82.000	82.100	CC	54	5.74	5.44	5.59	4329.5		51	3.95	3.69	3.82	2826.5	
82.100	82.200	CC	49	3.51	3.06	3.29	2387.0		47	3.30	3.23	3.27	2370.8	
82.200	82.300	CC	33	3.30	3.09	3.20	2313.9		36	3.23	3.76	3.50	2558.6	
82.300	82.400	CC	39	2.30	2.23	2.27	1574.0		39	2.59	2.65	2.62	1852.8	
82.400	82.500	CC	39	3.25	2.55	2.90	2076.0		47	3.07	3.53	3.30	2399.3	
82.500	82.600	CC	38	2.19	1.75	1.97	1346.3		49	2.45	2.44	2.45	1714.8	
82.600	82.700	CC	40	3.38	3.27	3.33	2419.6		48	2.83	3.09	2.96	2124.2	
82.700	82.800	CC	42	2.75	3.04	2.90	2072.0		48	2.95	3.29	3.12	2253.2	
82.800	82.900	CC	43	2.45	2.20	2.33	1620.8		49	2.33	2.32	2.33	1620.8	
82.900	83.000	CC	43	2.88	2.49	2.69	1904.4	2204	49	2.18	2.51	2.35	1636.4	2136
83.000	83.100	CC	37	2.58	2.52	2.55	1797.5		45	2.56	2.28	2.42	1695.2	
83.100	83.200	CC	26	3.96	3.67	3.82	2822.4		24	4.54	4.56	4.55	3438.1	
83.200	83.340	CC	13	4.12	4.11	4.12	3072.1	2564	18	4.42	4.28	4.35	3269.3	2801
85.980	86.100	CC	20	4.31	4.30	4.31	3231.4		49	3.21	3.12	3.17	2289.6	
86.100	86.200	CC	38	3.66	3.93	3.80	2805.8		51	3.19	3.02	3.11	2241.0	
86.200	86.300	CC	46	2.47	2.45	2.46	1726.6		50	4.16	3.70	3.93	2917.8	
86.300	86.400	CC	45	3.71	4.11	3.91	2901.2		50	2.80	2.65	2.73	1936.2	
86.400	86.500	CC	37	4.03	3.82	3.93	2913.7		39	3.70	3.63	3.67	2698.4	
86.500	86.600	CC	42	3.03	3.38	3.21	2322.0		35	3.81	3.63	3.72	2743.8	
86.600	86.700	CC	46	2.56	2.63	2.60	1833.1		43	2.28	2.13	2.21	1527.4	
86.700	86.800	CC	46	2.65	2.39	2.52	1773.8		48	3.29	2.97	3.13	2261.3	
86.800	86.900	CC	49	2.37	2.50	2.44	1706.9		50	2.40	2.03	2.22	1535.2	
86.900	87.000	CC	50	3.21	3.11	3.16	2285.5	2350	51	2.30	2.35	2.33	1620.8	2177
87.000	87.100	CC	50	2.88	2.87	2.88	2056.0		49	3.03	2.84	2.94	2104.1	
87.100	87.200	CC	50	3.10	3.46	3.28	2383.0		47	3.03	3.46	3.25	2354.5	
87.200	87.300	CC	53	2.91	3.28	3.10	2233.0		47	3.29	3.06	3.18	2297.7	
87.300	87.400	CC	54	3.30	2.97	3.14	2265.3		51	3.16	3.03	3.10	2233.0	
87.400	87.500	CC	53	3.36	3.44	3.40	2480.8		51	3.20	3.27	3.24	2346.4	
87.500	87.600	CC	54	3.38	3.71	3.55	2599.6		51	3.28	3.41	3.35	2435.9	
87.600	87.700	CC	54	3.38	3.17	3.28	2378.9		50	3.61	2.84	3.23	2338.3	
87.700	87.800	CC	53	3.07	3.22	3.15	2273.4		51	3.27	2.79	3.03	2180.5	
87.800	87.900	CC	49	3.10	3.18	3.14	2269.4		50	3.02	3.10	3.06	2204.7	
87.900	88.000	CC	50	3.45	3.34	3.40	2476.7	2342	45	3.14	3.16	3.15	2277.4	2277
88.000	88.100	CC	52	3.99	3.35	3.67	2702.5		50	3.28	3.06	3.17	2293.6	
88.100	88.200	CC	53	3.46	3.86	3.66	2694.3		52	3.04	3.28	3.16	2285.5	
88.200	88.300	CC	52	3.46	3.00	3.23	2342.3		52	3.43	3.77	3.60	2644.8	
88.300	88.400	CC	53	2.95	3.13	3.04	2188.6		53	3.16	3.31	3.24	2346.4	
88.400	88.500	CC	51	2.97	3.25	3.11	2245.1		52	3.57	3.62	3.60	2640.7	
88.500	88.600	CC	52	2.43	2.76	2.60	1833.1		50	3.31	3.09	3.20	2318.0	
88.600	88.700	CC	53	2.71	2.51	2.61	1844.9		51	2.21	2.37	2.29	1593.5	
88.700	88.800	CC	53	2.10	2.23	2.17	1496.4		52	2.26	2.47	2.37	1652.1	
88.800	88.900	CC	52	2.40	2.68	2.54	1789.6		52	1.94	1.94	1.94	1323.4	
88.900	89.000	CC	40	4.44	4.42	4.43	3336.7	2247	48	4.09	4.17	4.13	3084.6	2218
89.000	89.100	CC	45	3.08	3.31	3.20	2313.9		33	3.87	3.38	3.63	2665.4	
89.100	89.200	CC	49	2.33	2.63	2.48	1742.3		38	3.21	3.31	3.26	2366.7	
89.200	89.300	CC	47	2.85	2.90	2.88	2056.0		44	1.96	1.98	1.97	1346.3	
89.300	89.400	CC	42	2.94	2.87	2.91	2080.0		50	2.87	2.48	2.68	1896.5	
89.400	89.500	CC	42	3.65	3.88	3.77	2781.0		52	3.19	3.11	3.15	2277.4	
89.500	89.600	CC	37	2.63	3.06	2.85	2031.9		50	3.23	3.12	3.18	2297.7	
89.600	89.750	CC	40	3.20	3.45	3.33	2419.6	2204	46	2.53	2.51	2.52	1773.8	2089

Roughness Analysis of Rigid Pavement on RHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)														
Chainage (km)			Inner Lane						Outer Lane					
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km
92.450	92.300	CC	25	3.96	4.30	4.13	3084.6		20	4.05	4.75	4.40	3311.4	
92.300	92.200	CC	41	3.88	3.68	3.78	2793.4		34	3.34	3.81	3.58	2624.3	
92.200	92.100	CC	39	4.08	3.68	3.88	2876.3		30	4.28	4.08	4.18	3126.5	
92.100	92.000	CC	45	2.46	2.44	2.45	1718.7	2618	40	2.40	2.50	2.45	1718.7	2695
92.000	91.900	CC	48	2.55	2.35	2.45	1718.7		40	2.87	2.73	2.80	1996.0	
91.900	91.800	CC	48	2.41	2.39	2.40	1679.5		39	2.54	2.89	2.72	1928.2	
91.800	91.700	CC	53	2.22	2.47	2.35	1636.4		45	2.73	2.88	2.81	2000.0	
91.700	91.600	CC	55	2.48	2.43	2.46	1722.7		49	2.50	2.35	2.43	1699.1	
91.600	91.500	CC	55	2.34	2.43	2.39	1667.7		52	2.06	2.01	2.04	1396.2	
91.500	91.400	CC	55	2.52	2.49	2.51	1762.0		51	2.64	2.50	2.57	1813.3	
91.400	91.300	CC	56	2.82	3.11	2.97	2128.2		50	2.35	2.13	2.24	1554.6	
91.300	91.200	CC	55	3.13	3.26	3.20	2313.9		48	2.71	2.53	2.62	1852.8	
91.200	91.100	CC	55	2.91	2.57	2.74	1948.1		50	2.99	2.65	2.82	2012.0	
91.100	91.000	CC	55	2.35	2.53	2.44	1710.9	1829	51	2.47	2.30	2.39	1667.7	1792
91.000	90.900	CC	55	2.58	2.39	2.49	1746.2		49	2.37	2.49	2.43	1703.0	
90.900	90.800	CC	56	2.30	3.12	2.71	1924.3		48	2.36	2.42	2.39	1671.7	
90.800	90.700	CC	55	2.80	2.90	2.85	2035.9		48	2.39	2.06	2.23	1542.9	
90.700	90.600	CC	56	2.85	2.71	2.78	1980.0		51	2.24	2.17	2.21	1527.4	
90.600	90.500	CC	56	2.76	2.36	2.56	1805.4		52	3.39	3.03	3.21	2326.1	
90.500	90.400	CC	56	2.94	3.14	3.04	2188.6		52	2.17	2.20	2.19	1511.9	
90.400	90.300	CC	55	2.38	2.41	2.40	1675.6		52	2.71	2.23	2.47	1734.4	
90.300	90.200	CC	55	2.72	2.92	2.82	2012.0		51	2.42	2.19	2.31	1605.2	
90.200	90.100	CC	56	3.23	3.23	3.23	2342.3		45	3.21	2.90	3.06	2200.7	
90.100	90.000	CC	56	2.97	3.10	3.04	2184.5	1989	51	2.41	2.93	2.67	1892.5	1772
90.000	89.900	CC	56	2.57	2.57	2.57	1813.3		53	2.22	2.27	2.25	1558.5	
89.900	89.800	CC	55	3.08	3.29	3.19	2305.8		52	3.07	3.17	3.12	2253.2	
89.800	89.700	CC	55	3.43	3.89	3.66	2694.3		53	2.81	2.64	2.73	1936.2	
89.700	89.600	CC	55	4.09	4.21	4.15	3101.4		52	2.63	2.93	2.78	1980.0	
89.600	89.500	CC	54	3.74	3.56	3.65	2686.0		53	3.30	3.68	3.49	2554.5	
89.500	89.400	CC	55	2.44	2.53	2.49	1746.2		54	2.65	2.80	2.73	1936.2	
89.400	89.300	CC	56	1.82	1.87	1.85	1251.0		53	2.18	1.92	2.05	1407.7	
89.300	89.200	CC	57	2.74	2.74	2.74	1948.1		54	2.98	3.04	3.01	2164.4	
89.200	89.100	CC	57	2.97	2.87	2.92	2092.0		55	2.91	2.89	2.90	2076.0	
89.100	89.000	CC	57	2.84	2.71	2.78	1976.0	2161	55	2.58	2.48	2.53	1781.7	1965
89.000	88.900	CC	56	3.27	3.51	3.39	2472.7		53	3.26	3.09	3.18	2297.7	
88.900	88.800	CC	56	2.86	2.92	2.89	2068.0		55	3.35	3.15	3.25	2358.6	
88.800	88.700	CC	57	2.78	2.80	2.79	1988.0		53	2.61	2.55	2.58	1821.2	
88.700	88.600	CC	55	2.52	2.52	2.52	1773.8		53	2.05	2.04	2.05	1403.8	
88.600	88.500	CC	54	3.88	3.64	3.76	2776.8		54	3.82	3.35	3.59	2632.5	
88.500	88.400	CC	55	3.55	3.54	3.55	2599.6		54	3.27	2.65	2.96	2124.2	
88.400	88.300	CC	54	3.63	3.81	3.72	2743.8		54	3.34	3.22	3.28	2383.0	
88.300	88.200	CC	55	3.30	3.32	3.31	2407.4		52	3.48	3.17	3.33	2419.6	
88.200	88.100	CC	52	3.31	3.50	3.41	2484.9		49	3.39	3.73	3.56	2611.9	
88.100	88.000	CC	52	2.58	2.94	2.76	1964.1	2328	50	2.62	2.64	2.63	1860.8	2191
88.000	87.900	CC	51	3.27	3.63	3.45	2521.7		47	4.01	4.27	4.14	3093.0	
87.900	87.800	CC	51	3.65	3.76	3.71	2731.4		45	4.65	4.18	4.42	3324.0	
87.800	87.700	CC	53	3.21	2.79	3.00	2156.3		50	2.74	2.82	2.78	1980.0	
87.700	87.600	CC	54	3.06	3.12	3.09	2228.9		52	3.43	3.04	3.24	2346.4	
87.600	87.500	CC	52	3.01	3.34	3.18	2297.7		52	3.09	3.50	3.30	2395.2	
87.500	87.400	CC	49	3.29	3.04	3.17	2289.6		52	3.05	3.27	3.16	2285.5	
87.400	87.300	CC	50	2.79	2.89	2.84	2027.9		53	2.85	3.19	3.02	2172.4	
87.300	87.200	CC	35	3.14	3.51	3.33	2419.6		51	3.64	3.51	3.58	2624.3	
87.200	87.100	CC	44	2.48	2.49	2.49	1746.2		52	1.84	1.88	1.86	1262.4	
87.100	87.000	CC	51	2.81	2.78	2.80	1992.0	2241	53	2.29	2.70	2.50	1754.1	2324
87.000	86.900	CC	44	4.40	4.88	4.64	3514.3		52	3.94	4.19	4.07	3030.3	
86.900	86.800	CC	46	4.06	3.69	3.88	2872.1		51	3.62	3.56	3.59	2636.6	
86.800	86.700	CC	46	3.12	3.52	3.32	2415.5		51	3.19	3.75	3.47	2538.1	
86.700	86.600	CC	43	3.08	3.48	3.28	2383.0		50	3.49	3.88	3.69	2714.9	
86.600	86.500	CC	34	4.00	3.91	3.96	2938.6		48	3.68	3.89	3.79	2797.5	
86.500	86.400	CC	30	4.40	4.54	4.47	3370.4		38	4.35	4.39	4.37	3286.1	
86.400	86.300	CC	43	4.27	4.07	4.17	3118.1		38	3.76	4.01	3.89	2880.4	
86.300	86.200	CC	51	3.17	3.14	3.16	2281.5		45	2.50	2.14	2.32	1616.9	
86.200	86.100	CC	54	3.36	3.24	3.30	2399.3		50	2.24	2.15	2.20	1519.7	
86.100	86.000	CC	56	2.45	2.02	2.24	1550.7	2684	51	2.45	2.10	2.28	1581.8	2460
86.000	85.900	CC	55	2.68	2.18	2.43	1703.0		51	2.43	2.41	2.42	1695.2	
85.900	85.800	CC	55	2.84	2.74	2.79	1988.0		52	3.08	2.94	3.01	2164.4	
85.800	85.700	CC	56	3.23	3.34	3.29	2387.0		51	2.83	3.35	3.09	2228.9	
85.700	85.600	CC	51	3.63	3.67	3.65	2686.0		51	3.99	3.43	3.71	2735.5	
85.600	85.500	CC	50	3.54	2.91	3.23	2338.3		52	3.49	3.02	3.26	2362.6	
85.500	85.400	CC	55	3.14	2.94	3.04	2188.6		52	3.21	3.45	3.33	2423.7	
85.400	85.300	CC	55	3.53	3.01	3.27	2374.8		52	3.30	3.87	3.59	2632.5	
85.300	85.200	CC	55	3.11	3.63	3.37	2456.3		51	3.41	3.28	3.35	2435.9	
85.200	85.100	CC	55	3.11	3.35	3.23	2342.3		50	3.45	3.12	3.29	2387.0	
85.100	85.000	CC	55	3.59	3.39	3.49	2554.5	2302	50	2.91	2.60	2.76	1960.1	2303
85.000	84.900	CC	55	3.16	3.18	3.17	2293.6		48	3.20	3.33	3.27	2370.8	
84.900	84.800	CC	55	2.44	2.85	2.65	1872.7		49	2.63	2.85	2.74	1948.1	
84.800	84.700	CC	55	3.15	3.16	3.16	2281.5		50	3.09	3.13	3.11	2245.1	
84.700	84.600	CC	56	2.76	2.80	2.78	1980.0		47	2.49	2.55	2.52	1773.8	
84.600	84.500	CC	56	3.36	3.20	3.28	2383.0		45	2.85	3.12	2.99	2144.3	
84.500	84.400	CC	55	3.73	4.51	4.12	3076.3		49	3.73	3.74	3.74	2756.2	

Roughness Analysis of Rigid Pavement on RHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)														
Chainage (km)			Inner Lane						Outer Lane					
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km
84.400	84.300	CC	53	4.32	4.74	4.53	3421.1		47	4.58	4.69	4.64	3510.1	
84.300	84.200	CC	55	2.73	3.48	3.11	2241.0		51	3.16	3.05	3.11	2241.0	
84.200	84.100	CC	56	4.60	4.19	4.40	3307.2		51	3.10	3.15	3.13	2257.2	
84.100	84.000	CC	54	3.40	3.39	3.40	2476.7	2533	52	3.30	3.06	3.18	2301.8	2355
84.000	83.900	CC	50	4.01	4.00	4.01	2980.3		52	2.67	3.04	2.86	2039.9	
83.900	83.800	CC	46	3.93	4.31	4.12	3076.3		44	4.12	4.16	4.14	3093.0	
83.800	83.700	CC	48	4.10	4.22	4.16	3109.7		48	4.72	4.67	4.70	3561.0	
83.700	83.600	CC	47	4.30	3.83	4.07	3030.3		45	3.58	3.79	3.69	2714.9	
83.600	83.500	CC	46	4.34	4.91	4.63	3501.6		34	4.50	4.73	4.62	3493.1	
83.500	83.400	CC	49	3.75	3.56	3.66	2690.1		40	3.60	3.51	3.56	2607.8	
83.400	83.300	CC	43	3.49	3.87	3.68	2710.8		40	3.92	3.43	3.68	2706.6	
83.300	83.200	CC	24	4.66	5.29	4.98	3799.7	3112	25	4.97	4.97	4.97	3795.4	3001
80.950	80.800	CC	41	3.89	4.15	4.02	2992.8		36	3.74	3.85	3.80	2805.8	
80.800	80.700	CC	27	6.36	6.49	6.43	5060.1		24	5.75	6.20	5.98	4664.9	
80.700	80.600	CC	38	2.21	2.23	2.22	1539.1		31	3.05	2.92	2.99	2144.3	
80.600	80.500	CC	47	3.88	3.67	3.78	2789.3		42	3.79	3.75	3.77	2785.1	
80.500	80.400	CC	49	3.66	3.77	3.72	2739.6		46	3.29	3.50	3.40	2476.7	
80.400	80.300	CC	52	3.73	3.55	3.64	2677.8		37	3.40	3.16	3.28	2383.0	
80.300	80.200	CC	54	2.78	2.55	2.67	1888.5		40	2.45	2.61	2.53	1781.7	
80.200	80.100	CC	54	2.93	3.16	3.05	2192.6		48	3.34	3.38	3.36	2448.2	
80.100	80.000	CC	54	2.33	2.34	2.34	1628.6	2612	52	2.70	2.45	2.58	1817.2	2590
80.000	79.900	CC	55	3.52	3.37	3.45	2517.6		52	3.40	3.83	3.62	2657.2	
79.900	79.800	CC	55	4.06	3.63	3.85	2847.2		53	3.77	3.82	3.80	2805.8	
79.800	79.700	CC	50	4.23	4.10	4.17	3113.9		52	3.82	3.70	3.76	2776.8	
79.700	79.600	CC	43	3.22	3.56	3.39	2472.7		49	3.28	3.33	3.31	2403.3	
79.600	79.500	CC	35	5.44	5.81	5.63	4359.9		36	5.64	6.15	5.90	4595.0	
79.500	79.400	CC	45	3.46	3.52	3.49	2554.5		44	3.42	3.32	3.37	2456.3	
79.400	79.300	CC	53	3.35	3.26	3.31	2403.3		49	3.24	3.37	3.31	2403.3	
79.300	79.200	CC	53	3.13	3.54	3.34	2427.8		50	3.48	3.08	3.28	2383.0	
79.200	79.100	CC	55	3.40	3.89	3.65	2681.9		52	3.58	3.32	3.45	2521.7	
79.100	79.000	CC	43	4.42	4.26	4.34	3260.8	2864	51	4.09	3.64	3.87	2863.8	2787
79.000	78.900	CC	18	3.73	4.05	3.89	2884.6		35	3.44	3.34	3.39	2472.7	
78.900	78.800	CC	37	4.39	4.97	4.68	3548.3		33	4.48	4.69	4.59	3467.7	
78.800	78.700	CC	42	4.53	4.14	4.34	3256.6		35	4.42	4.52	4.47	3370.4	
78.700	78.600	CC	48	3.69	3.91	3.80	2809.9		36	3.46	3.99	3.73	2747.9	
78.600	78.500	CC	54	3.35	3.41	3.38	2464.5		29	3.63	4.17	3.90	2892.9	
78.500	78.400	CC	56	3.45	3.09	3.27	2374.8		38	3.50	3.14	3.32	2415.5	
78.400	78.300	CC	55	3.11	3.17	3.14	2269.4		44	3.67	3.49	3.58	2628.4	
78.300	78.200	CC	55	3.42	3.16	3.29	2391.1		39	3.69	3.89	3.79	2801.7	
78.200	78.100	CC	38	3.82	3.38	3.60	2644.8	2738	40	3.74	3.76	3.75	2768.6	2841
76.850	76.700	CC	39	3.54	4.02	3.78	2793.4		49	3.50	3.91	3.71	2731.4	
76.700	76.600	CC	42	4.27	4.16	4.22	3155.8		48	3.74	4.19	3.97	2947.0	
76.600	76.500	CC	47	3.49	3.07	3.28	2383.0		45	3.66	3.23	3.45	2517.6	
76.500	76.400	CC	54	3.12	3.35	3.24	2346.4		50	3.93	3.64	3.79	2797.5	
76.400	76.300	CC	55	3.49	3.39	3.44	2513.5		51	3.85	3.93	3.89	2884.6	
76.300	76.200	CC	55	2.25	2.68	2.47	1730.5		52	2.04	2.10	2.07	1423.1	
76.200	76.090	CC	50	3.17	3.31	3.24	2350.4	2468	51	2.16	2.26	2.21	1531.3	2405
63.750	63.600	CC	45	3.22	3.60	3.41	2489.0		45	3.12	3.39	3.26	2362.6	
63.600	63.500	CC	45	3.24	3.19	3.22	2330.1		48	3.45	3.24	3.35	2435.9	
63.500	63.400	CC	44	3.35	3.57	3.46	2529.9		50	3.16	3.19	3.18	2297.7	
63.400	63.300	CC	46	3.60	3.49	3.55	2599.6		49	3.56	3.03	3.30	2395.2	
63.300	63.200	CC	43	3.21	3.45	3.33	2423.7		48	3.32	3.57	3.45	2517.6	
63.200	63.100	CC	41	3.69	3.38	3.54	2591.4		49	3.22	3.13	3.18	2297.7	
63.100	63.000	CC	44	3.15	3.17	3.16	2285.5	2464	50	3.14	3.45	3.30	2395.2	2386
63.000	62.900	CC	47	3.30	3.21	3.26	2362.6		51	3.09	3.24	3.17	2289.6	
62.900	62.800	CC	48	3.31	3.63	3.47	2538.1		50	3.12	3.46	3.29	2391.1	
62.800	62.730	CC	41	3.14	3.45	3.30	2395.2	2432	44	3.28	3.56	3.42	2497.2	2393
62.550	62.400	CC	46	2.90	2.98	2.94	2108.1		48	3.52	3.86	3.69	2719.0	
62.400	62.300	CC	49	3.00	3.39	3.20	2313.9		51	3.08	2.85	2.97	2128.2	
62.300	62.200	CC	50	3.19	3.53	3.36	2448.2		52	2.23	2.16	2.20	1519.7	
62.200	62.100	CC	49	2.56	3.14	2.85	2035.9		51	3.09	3.19	3.14	2269.4	
62.100	61.970	CC	48	3.41	3.55	3.48	2546.3	2290	50	3.41	3.35	3.38	2464.5	2220
55.100	55.000	CC	39	3.95	3.66	3.81	2814.1		44	3.82	3.39	3.61	2649.0	
55.000	54.900	CC	43	3.67	3.91	3.79	2801.7		46	3.62	3.47	3.55	2599.6	
54.900	54.800	CC	49	3.85	3.43	3.64	2677.8		49	3.34	3.57	3.46	2525.8	
54.800	54.700	CC	53	3.15	3.59	3.37	2456.3		52	3.50	3.82	3.66	2694.3	
54.700	54.600	CC	55	3.83	3.63	3.73	2752.0		52	3.61	4.28	3.95	2930.3	
54.600	54.500	CC	56	4.14	3.66	3.90	2892.9		53	4.02	3.34	3.68	2710.8	
54.500	54.400	CC	56	3.50	3.28	3.39	2472.7		53	3.21	3.51	3.36	2448.2	
54.400	54.300	CC	55	3.99	3.47	3.73	2752.0		52	3.62	3.83	3.73	2747.9	
54.300	54.200	CC	54	3.79	3.54	3.67	2698.4		53	4.06	3.78	3.92	2909.5	
54.200	54.100	CC	53	4.12	3.74	3.93	2917.8		54	3.21	3.47	3.34	2431.8	
54.100	54.000	CC	55	3.48	3.58	3.53	2587.3	2711	53	3.78	3.81	3.80	2805.8	2678
54.000	53.900	CC	53	3.21	3.33	3.27	2374.8		52	3.96	3.66	3.81	2818.2	
53.900	53.800	CC	54	3.34	3.63	3.49	2550.4		52	3.58	3.82	3.70	2727.3	
53.800	53.700	CC	55	4.13	3.60	3.87	2863.8		53	3.70	3.28	3.49	2554.5	
53.700	53.600	CC	51	3.78	3.80	3.79	2801.7		51	3.68	3.72	3.70	2727.3	
53.600	53.500	CC	44	3.92	3.93	3.93	2913.7		50	3.97	3.59	3.78	2793.4	
53.500	53.400	CC	38	3.54	3.84	3.69	2719.0		53	3.37	3.19	3.28	2383.0	
53.400	53.250	CC	36	3.40	3.15	3.28	2378.9	2657	51	3.35	3.72	3.54	2591.4	2656

Roughness Analysis of Rigid Pavement on RHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)														
Chainage (km)			Inner Lane						Outer Lane					
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km
52.120	52.000	CC	50	3.43	3.87	3.65	2686.0		51	3.64	3.32	3.48	2546.3	
52.000	51.900	CC	51	3.45	3.39	3.42	2497.2		53	3.11	3.17	3.14	2269.4	
51.900	51.800	CC	52	3.45	3.82	3.64	2673.7		53	3.36	3.66	3.51	2570.9	
51.800	51.700	CC	52	3.51	3.66	3.59	2632.5		52	3.80	3.53	3.67	2698.4	
51.700	51.600	CC	53	3.12	3.63	3.38	2460.4		53	3.31	3.35	3.33	2423.7	
51.600	51.500	CC	53	3.23	3.59	3.41	2489.0		54	3.38	3.28	3.33	2423.7	
51.500	51.400	CC	52	3.37	3.45	3.41	2489.0		54	3.64	3.28	3.46	2529.9	
51.400	51.300	CC	53	3.55	3.49	3.52	2579.1		53	3.96	3.39	3.68	2706.6	
51.300	51.200	CC	54	3.83	3.42	3.63	2665.4		53	3.21	3.20	3.21	2322.0	
51.200	51.100	CC	53	3.52	3.61	3.57	2616.1		52	3.36	3.43	3.40	2476.7	
51.100	51.000	CC	54	3.44	3.32	3.38	2464.5	2568	53	3.06	3.23	3.15	2273.4	2476
51.000	50.900	CC	48	3.10	3.08	3.09	2228.9		52	3.14	3.50	3.32	2415.5	
50.900	50.800	CC	47	3.26	3.79	3.53	2583.2		47	3.84	3.23	3.54	2591.4	
50.800	50.700	CC	50	3.94	3.34	3.64	2677.8		52	3.78	3.95	3.87	2863.8	
50.700	50.600	CC	51	3.50	3.12	3.31	2407.4		50	3.68	3.79	3.74	2756.2	
50.600	50.500	CC	52	4.74	4.43	4.59	3467.7		51	4.43	5.12	4.78	3629.0	
50.500	50.400	CC	53	3.33	3.58	3.46	2525.8		53	4.04	3.58	3.81	2818.2	
50.400	50.300	CC	52	3.41	3.13	3.27	2374.8		52	3.53	3.60	3.57	2616.1	
50.300	50.200	CC	52	3.38	3.03	3.21	2322.0		51	3.46	3.71	3.59	2632.5	
50.200	50.100	CC	52	3.48	3.12	3.30	2399.3		49	3.72	3.82	3.77	2785.1	
50.100	50.000	CC	52	3.82	3.79	3.81	2814.1	2580	45	3.56	4.09	3.83	2830.7	2794
50.000	49.900	CC	49	3.65	3.69	3.67	2702.5		11	3.78	3.96	3.87	2868.0	
49.900	49.800	CC	37	3.31	3.48	3.40	2476.7		27	3.61	3.57	3.59	2636.6	
49.800	49.700	CC	26	3.00	3.32	3.16	2285.5		17	3.21	3.44	3.33	2419.6	
49.700	49.600	CC	25	3.29	3.23	3.26	2366.7		17	3.64	3.59	3.62	2657.2	
49.600	49.500	CC	43	3.31	3.35	3.33	2423.7		21	3.68	3.76	3.72	2743.8	
49.500	49.400	CC	51	3.80	3.39	3.60	2640.7		26	3.30	3.34	3.32	2415.5	
49.400	49.300	CC	56	3.79	3.96	3.88	2872.1		28	3.14	3.18	3.16	2285.5	
49.300	49.200	CC	54	3.72	3.61	3.67	2698.4		30	3.56	3.52	3.54	2595.5	
49.200	49.100	CC	44	3.27	3.10	3.19	2305.8		31	3.90	3.65	3.78	2789.3	
49.100	49.000	CC	44	3.49	3.41	3.45	2521.7	2529	28	3.95	3.38	3.67	2698.4	2611
49.000	48.900	CC	52	3.69	4.10	3.90	2888.7		24	3.16	3.51	3.34	2427.8	
48.900	48.800	CC	54	3.35	3.08	3.22	2330.1		38	3.32	3.27	3.30	2395.2	
48.800	48.700	CC	50	3.42	3.65	3.54	2591.4		39	3.33	3.65	3.49	2554.5	
48.700	48.600	CC	52	3.67	4.09	3.88	2876.3		43	3.46	3.83	3.65	2681.9	
48.600	48.500	CC	53	4.02	3.62	3.82	2826.5		48	4.06	3.65	3.86	2855.5	
48.500	48.400	CC	52	4.31	3.93	4.12	3076.3		49	3.50	3.48	3.49	2554.5	
48.400	48.300	CC	54	3.78	3.58	3.68	2710.8		49	3.29	3.11	3.20	2318.0	
48.300	48.200	CC	49	3.96	3.76	3.86	2859.7		42	3.20	3.45	3.33	2419.6	
48.200	48.100	CC	46	3.75	3.58	3.67	2698.4		46	3.54	3.52	3.53	2587.3	
48.100	48.000	CC	42	3.81	3.39	3.60	2644.8	2750	48	4.10	3.59	3.85	2847.2	2564
48.000	47.900	CC	38	3.36	3.35	3.36	2444.1		49	3.31	3.73	3.52	2579.1	
47.900	47.800	CC	37	3.22	3.70	3.46	2529.9		50	3.23	3.45	3.34	2431.8	
47.800	47.700	CC	39	3.96	3.59	3.78	2789.3		50	3.96	3.45	3.71	2731.4	
47.700	47.600	CC	38	3.51	3.55	3.53	2587.3		49	3.60	3.99	3.80	2805.8	
47.600	47.510	CC	42	3.01	3.40	3.21	2322.0	2535	48	3.34	3.53	3.44	2509.4	2612
46.420	46.300	CC	57	3.47	3.06	3.27	2370.8		51	3.26	3.18	3.22	2334.2	
46.300	46.200	CC	56	3.35	3.70	3.53	2583.2		52	3.53	3.16	3.35	2435.9	
46.200	46.100	CC	55	3.82	3.85	3.84	2839.0		51	3.79	3.71	3.75	2768.6	
46.100	46.010	CC	57	3.77	3.46	3.62	2657.2	2613	52	3.35	3.73	3.54	2595.5	2534
43.130	43.000	CC	59	4.38	4.34	4.36	3277.7		51	4.48	4.26	4.37	3286.1	
43.000	42.900	CC	60	4.20	3.76	3.98	2959.4		54	4.11	4.22	4.17	3113.9	
42.900	42.800	CC	58	4.28	3.90	4.09	3051.2		54	4.36	4.56	4.46	3362.0	
42.800	42.700	CC	57	4.42	4.00	4.21	3151.6		53	3.42	3.42	3.42	2497.2	
42.700	42.600	CC	59	3.23	3.09	3.16	2285.5		55	3.03	3.29	3.16	2285.5	
42.600	42.500	CC	58	3.73	3.32	3.53	2583.2		53	3.18	3.70	3.44	2513.5	
42.500	42.400	CC	59	3.25	3.56	3.41	2484.9		52	3.36	3.95	3.66	2690.1	
42.400	42.300	CC	58	3.62	3.93	3.78	2789.3		53	4.09	4.03	4.06	3026.1	
42.300	42.200	CC	59	3.92	3.66	3.79	2801.7		53	4.01	4.11	4.06	3026.1	
42.200	42.100	CC	56	3.31	3.15	3.23	2342.3		51	4.63	4.11	4.37	3286.1	
42.100	42.000	CC	50	3.32	3.77	3.55	2599.6	2757	45	4.33	3.71	4.02	2992.8	2916
42.000	41.900	CC	54	3.08	3.34	3.21	2326.1		51	3.73	3.67	3.70	2727.3	
41.900	41.800	CC	57	3.19	3.53	3.36	2448.2		54	3.25	3.72	3.49	2550.4	
41.800	41.700	CC	57	4.09	3.48	3.79	2797.5		54	3.84	4.17	4.01	2980.3	
41.700	41.600	CC	58	3.41	3.46	3.44	2509.4		54	4.66	3.92	4.29	3218.8	
41.600	41.500	CC	59	3.38	3.84	3.61	2653.1		56	4.27	4.26	4.27	3197.8	
41.500	41.400	CC	52	3.59	3.96	3.78	2789.3		54	4.25	3.58	3.92	2905.4	
41.400	41.300	CC	42	4.20	4.14	4.17	3118.1		48	3.82	3.40	3.61	2653.1	
41.300	41.200	CC	39	4.97	4.41	4.69	3556.8		49	3.34	3.69	3.52	2575.0	
41.200	41.100	CC	47	3.52	3.98	3.75	2768.6		53	3.48	3.91	3.70	2723.1	
41.100	41.000	CC	47	3.33	3.45	3.39	2472.7	2744	53	3.70	4.26	3.98	2959.4	2849
41.000	40.900	CC	43	3.07	3.38	3.23	2338.3		54	4.34	4.20	4.27	3202.0	
40.900	40.800	CC	44	3.35	3.72	3.54	2591.4		51	4.18	3.82	4.00	2976.1	
40.800	40.700	CC	45	3.55	3.70	3.63	2665.4		48	3.97	3.60	3.79	2797.5	
40.700	40.600	CC	47	3.51	3.30	3.41	2484.9		51	3.91	3.37	3.64	2677.8	
40.600	40.500	CC	46	3.50	3.53	3.52	2575.0		52	3.97	3.75	3.86	2859.7	
40.500	40.400	CC	43	4.06	3.74	3.90	2892.9		53	3.29	3.45	3.37	2456.3	
40.400	40.300	CC	46	4.37	4.03	4.20	3143.3		52	3.33	3.51	3.42	2497.2	
40.300	40.200	CC	41	4.30	3.81	4.06	3022.0		53	3.88	3.92	3.90	2892.9	
40.200	40.100	CC	40	3.84	3.71	3.78	2789.3		51	4.31	4.07	4.19	3134.9	

Roughness Analysis of Rigid Pavement on RHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)														
Chainage (km)			Inner Lane						Outer Lane					
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km
40.100	40.000	CC	45	4.21	3.78	4.00	2971.9	2747	53	3.67	3.95	3.81	2818.2	2831
40.000	39.900	CC	46	3.89	3.60	3.75	2764.4		54	3.49	3.80	3.65	2681.9	
39.900	39.800	CC	44	3.81	3.44	3.63	2665.4		53	3.10	3.35	3.23	2338.3	
39.800	39.700	CC	37	3.86	3.60	3.73	2752.0		49	3.57	3.35	3.46	2529.9	
39.700	39.600	CC	36	3.48	3.47	3.48	2542.2		48	3.56	3.04	3.30	2399.3	
39.600	39.500	CC	40	3.11	3.22	3.17	2289.6		43	3.01	3.36	3.19	2305.8	
39.500	39.400	CC	42	3.08	3.51	3.30	2395.2		45	3.28	3.28	3.28	2383.0	
39.400	39.300	CC	35	3.86	3.38	3.62	2661.3		47	3.65	3.53	3.59	2636.6	
39.300	39.200	CC	27	3.18	3.66	3.42	2497.2		45	3.65	3.52	3.59	2632.5	
39.200	39.100	CC	28	3.46	3.53	3.50	2558.6		31	3.06	3.25	3.16	2281.5	
39.100	39.000	CC	39	3.67	3.63	3.65	2686.0	2581	43	3.45	3.20	3.33	2419.6	2461
39.000	38.900	CC	47	3.47	3.75	3.61	2653.1		52	3.58	3.80	3.69	2719.0	
38.900	38.800	CC	48	3.23	3.21	3.22	2334.2		54	3.62	3.36	3.49	2554.5	
38.800	38.700	CC	45	3.47	3.61	3.54	2595.5		53	3.19	3.31	3.25	2358.6	
38.700	38.600	CC	40	3.19	3.42	3.31	2403.3		53	3.59	3.27	3.43	2505.4	
38.600	38.500	CC	27	3.41	3.69	3.55	2603.7		54	3.59	3.68	3.64	2673.7	
38.500	38.400	CC	42	3.44	3.62	3.53	2587.3		52	3.41	3.67	3.54	2595.5	
38.400	38.300	CC	40	3.24	3.37	3.31	2403.3		35	3.01	3.38	3.20	2313.9	
38.300	38.200	CC	43	3.39	3.17	3.28	2383.0		45	3.79	3.34	3.57	2616.1	
38.200	38.100	CC	43	3.39	3.87	3.63	2669.5		52	3.58	3.47	3.53	2583.2	
38.100	38.000	CC	43	3.52	3.53	3.53	2583.2	2522	54	3.49	3.43	3.46	2529.9	2545
38.000	37.900	CC	41	3.19	3.13	3.16	2285.5		55	3.51	3.23	3.37	2456.3	
37.900	37.800	CC	41	3.51	3.31	3.41	2489.0		54	3.40	3.81	3.61	2649.0	
37.800	37.700	CC	42	3.92	3.36	3.64	2677.8		55	3.02	3.48	3.25	2358.6	
37.700	37.600	CC	42	3.55	3.01	3.28	2383.0		56	3.23	3.63	3.43	2505.4	
37.600	37.500	CC	41	3.37	3.17	3.27	2374.8		55	3.88	3.52	3.70	2727.3	
37.500	37.400	CC	43	3.33	3.44	3.39	2468.6		55	3.48	3.07	3.28	2378.9	
37.400	37.300	CC	47	3.72	3.37	3.55	2599.6		55	3.19	3.50	3.35	2435.9	
37.300	37.200	CC	55	3.23	3.11	3.17	2293.6		55	3.05	2.82	2.94	2104.1	
37.200	37.100	CC	50	3.02	3.39	3.21	2322.0		55	3.14	3.16	3.15	2277.4	
37.100	37.000	CC	51	3.61	3.35	3.48	2546.3	2444	55	3.10	2.73	2.92	2088.0	2398
37.000	36.900	CC	53	3.21	3.11	3.16	2285.5		55	3.04	2.93	2.99	2144.3	
36.900	36.800	CC	53	3.90	3.39	3.65	2681.9		55	3.36	3.45	3.41	2484.9	
36.800	36.700	CC	54	3.17	3.29	3.23	2342.3		55	3.26	3.09	3.18	2297.7	
36.700	36.600	CC	54	3.53	3.15	3.34	2431.8		55	3.62	3.86	3.74	2760.3	
36.600	36.500	CC	55	3.07	3.46	3.27	2370.8		56	3.15	2.93	3.04	2188.6	
36.500	36.400	CC	55	3.16	3.61	3.39	2468.6		55	3.42	3.69	3.56	2607.8	
36.400	36.300	CC	53	3.58	3.75	3.67	2698.4		55	3.78	3.91	3.85	2847.2	
36.300	36.200	CC	52	3.02	3.42	3.22	2334.2		55	3.46	3.51	3.49	2550.4	
36.200	36.100	CC	52	3.21	3.50	3.36	2444.1		55	3.04	3.51	3.28	2378.9	
36.100	36.000	CC	52	3.22	3.58	3.40	2480.8	2454	54	3.14	3.50	3.32	2415.5	2468
36.000	35.900	CC	50	3.19	3.43	3.31	2407.4		53	3.09	3.38	3.24	2346.4	
35.900	35.800	CC	55	3.24	3.25	3.25	2354.5		55	3.02	3.26	3.14	2269.4	
35.800	35.700	CC	58	3.19	3.29	3.24	2350.4		54	3.10	3.28	3.19	2309.9	
35.700	35.600	CC	59	3.38	3.56	3.47	2538.1		54	3.53	3.31	3.42	2497.2	
35.600	35.500	CC	58	3.65	3.90	3.78	2789.3		54	3.47	3.12	3.30	2395.2	
35.500	35.400	CC	59	3.22	3.80	3.51	2570.9		55	3.52	3.76	3.64	2677.8	
35.400	35.300	CC	56	3.46	3.22	3.34	2431.8		55	3.79	3.38	3.59	2632.5	
35.300	35.200	CC	57	3.01	3.36	3.19	2305.8		55	3.11	3.46	3.29	2387.0	
35.200	35.100	CC	57	3.50	3.19	3.35	2435.9		55	3.55	3.77	3.66	2694.3	
35.100	35.000	CC	56	3.24	3.07	3.16	2281.5	2447	55	4.31	4.04	4.18	3122.3	2533
35.000	34.900	CC	54	3.33	3.77	3.55	2603.7		53	3.74	4.25	4.00	2971.9	
34.900	34.800	CC	56	3.87	3.68	3.78	2789.3		54	3.37	3.76	3.57	2616.1	
34.800	34.700	CC	56	3.79	3.27	3.53	2587.3		53	3.93	3.69	3.81	2818.2	
34.700	34.600	CC	56	3.29	3.31	3.30	2399.3		53	3.45	3.35	3.40	2480.8	
34.600	34.500	CC	56	3.20	3.11	3.16	2281.5		54	3.54	3.26	3.40	2480.8	
34.500	34.400	CC	56	3.76	3.53	3.65	2681.9		55	3.53	3.00	3.27	2370.8	
34.400	34.300	CC	54	4.14	4.16	4.15	3101.4		53	3.84	4.00	3.92	2909.5	
34.300	34.200	CC	48	3.81	3.86	3.84	2839.0		50	4.29	3.86	4.08	3038.7	
34.200	34.100	CC	41	3.76	3.26	3.51	2570.9		46	3.69	3.42	3.56	2607.8	
34.100	34.000	CC	47	3.14	3.41	3.28	2378.9	2623	47	3.75	3.61	3.68	2710.8	2701
34.000	33.900	CC	51	3.28	3.08	3.18	2301.8		48	3.52	3.34	3.43	2505.4	
33.900	33.800	CC	48	3.37	3.73	3.55	2603.7		53	3.22	3.32	3.27	2374.8	
33.800	33.700	CC	49	3.06	3.21	3.14	2265.3		53	3.34	3.00	3.17	2293.6	
33.700	33.600	CC	50	3.04	3.00	3.02	2172.4		52	3.68	3.33	3.51	2566.8	
33.600	33.500	CC	44	3.36	3.49	3.43	2501.3		53	3.87	3.52	3.70	2723.1	
33.500	33.400	CC	45	3.49	3.11	3.30	2399.3		54	3.70	4.36	4.03	3001.1	
33.400	33.300	CC	46	3.55	3.16	3.36	2444.1		54	3.50	3.06	3.28	2383.0	
33.300	33.200	CC	45	3.31	3.30	3.31	2403.3		53	3.28	3.70	3.49	2554.5	
33.200	33.100	CC	45	3.20	3.41	3.31	2403.3		52	3.72	3.65	3.69	2714.9	
33.100	33.000	CC	47	3.28	3.52	3.40	2480.8	2398	54	4.11	3.69	3.90	2892.9	2601
33.000	32.900	CC	47	3.63	3.69	3.66	2694.3		54	3.95	3.88	3.92	2905.4	
32.900	32.800	CC	45	3.81	3.51	3.66	2694.3		54	3.34	3.66	3.50	2562.7	
32.800	32.700	CC	45	3.71	3.83	3.77	2785.1		55	3.23	3.10	3.17	2289.6	
32.700	32.600	CC	45	3.89	3.98	3.94	2922.0		55	3.16	3.57	3.37	2452.2	
32.600	32.500	CC	45	4.59	3.96	4.28	3206.2		53	3.90	3.51	3.71	2731.4	
32.500	32.400	CC	44	3.56	3.20	3.38	2464.5		52	3.64	3.99	3.82	2822.4	
32.400	32.300	CC	42	3.40	3.15	3.28	2378.9		41	4.21	3.93	4.07	3034.5	
32.300	32.200	CC	43	3.61	3.24	3.43	2501.3		41	3.91	3.66	3.79	2797.5	
32.200	32.100	CC	46	3.39	3.75	3.57	2620.2		50	3.44	3.72	3.58	2628.4	
32.100	32.000	CC	50	4.02	3.49	3.76	2772.7	2704	52	3.40	3.51	3.46	2525.8	2675

Roughness Analysis of Rigid Pavement on RHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)														
Chainage (km)			Inner Lane						Outer Lane					
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km
32.000	31.900	CC	50	4.06	3.69	3.88	2872.1		53	3.70	3.60	3.65	2686.0	
31.900	31.800	CC	47	4.10	3.76	3.93	2917.8		53	3.99	3.89	3.94	2926.1	
31.800	31.700	CC	46	4.35	4.22	4.29	3214.6		52	3.69	4.36	4.03	2996.9	
31.700	31.600	CC	45	3.37	3.26	3.32	2411.5		52	3.31	3.60	3.46	2525.8	
31.600	31.500	CC	48	3.07	3.29	3.18	2301.8		53	3.42	3.00	3.21	2326.1	
31.500	31.400	CC	57	3.46	3.82	3.64	2677.8		54	3.46	3.13	3.30	2395.2	
31.400	31.300	CC	54	3.30	3.69	3.50	2558.6		53	3.83	3.58	3.71	2731.4	
31.300	31.200	CC	49	3.55	4.01	3.78	2793.4		53	3.60	4.19	3.90	2888.7	
31.200	31.100	CC	50	3.97	3.51	3.74	2760.3		52	3.91	3.51	3.71	2735.5	
31.100	31.000	CC	48	4.17	3.77	3.97	2951.1	2746	53	3.69	4.10	3.90	2888.7	2710
31.000	30.900	CC	47	4.58	4.35	4.47	3366.2		51	3.71	4.05	3.88	2876.3	
30.900	30.800	CC	44	4.43	5.00	4.72	3578.0		46	4.06	4.00	4.03	3001.1	
30.800	30.700	CC	46	4.47	3.95	4.21	3151.6		47	3.87	3.79	3.83	2834.8	
30.700	30.600	CC	48	4.16	3.88	4.02	2992.8		47	4.11	3.46	3.79	2797.5	
30.600	30.470	CC	47	3.69	4.38	4.04	3005.3	3219	43	3.47	3.53	3.50	2562.7	2814

Roughness Analysis of Flexible Pavement on LHS Direction: NH-27: Rakhaldubi to Kalijhar(Pkg-II)															
Chainage (km)			Inner Lane						Outer Lane						Remarks
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	
961.500	961.600	BT	19	4.69	4.11	4.40	3311.4		19	3.99	4.03	4.01	2984.4		
961.600	961.700	BT	28	2.26	2.47	2.37	1652.1		28	3.12	3.21	3.17	2289.6		
961.700	961.800	BT	31	2.79	2.82	2.81	2000.0		31	3.71	3.52	3.62	2657.2		
961.800	961.900	BT	29	2.75	2.93	2.84	2027.9		29	4.01	3.96	3.99	2963.6		
961.900	962.000	BT	24	5.48	4.94	5.21	4001.3	2598.5	24	6.30	6.21	6.26	4910.4	3161.0	
962.000	962.100	BT													Under Construction
962.100	962.200	BT													Under Construction
962.200	962.250	BT						-						-	Under Construction
962.250	962.300	BT	14	4.30	4.67	4.49	3383.1		14	4.19	3.61	3.90	2892.9		
962.300	962.400	BT	30	4.32	3.62	3.97	2951.1		30	3.49	3.83	3.66	2694.3		
962.400	962.500	BT	39	4.03	3.52	3.78	2789.3		39	3.36	4.00	3.68	2710.8		
962.500	962.600	BT	43	3.94	3.77	3.86	2855.5		43	3.53	4.23	3.88	2876.3		
962.600	962.700	BT	44	3.00	3.67	3.34	2427.8		44	3.88	3.56	3.72	2743.8		
962.700	962.800	BT	44	4.19	3.61	3.90	2892.9		44	4.11	3.67	3.89	2884.6		
962.800	962.900	BT	43	5.27	5.04	5.16	3954.0		43	3.30	3.36	3.33	2423.7		
962.900	963.000	BT	39	5.41	5.03	5.22	4009.9	3157.9	39	5.59	5.24	5.42	4178.0	2925.5	
963.000	963.100	BT	42	3.55	3.40	3.48	2542.2		42	3.38	3.36	3.37	2456.3		
963.100	963.200	BT	45	3.58	3.92	3.75	2768.6		45	3.63	3.60	3.62	2657.2		
963.200	963.300	BT	47	3.91	3.80	3.86	2855.5		47	3.80	3.85	3.83	2830.7		
963.300	963.400	BT	49	3.75	3.48	3.62	2657.2		49	3.77	3.71	3.74	2760.3		
963.400	963.500	BT	49	3.34	3.58	3.46	2529.9		49	3.53	3.70	3.62	2657.2		
963.500	963.600	BT	50	3.30	3.36	3.33	2423.7		50	3.79	4.01	3.90	2892.9		
963.600	963.700	BT	47	3.87	3.45	3.66	2694.3		47	3.52	3.86	3.69	2719.0		
963.700	963.800	BT	47	3.88	3.56	3.72	2743.8		47	3.63	3.46	3.55	2599.6		
963.800	963.900	BT	46	3.13	3.67	3.40	2480.8		46	4.19	3.61	3.90	2892.9		
963.900	964.000	BT	43	3.71	3.37	3.54	2595.5	2629.1	43	3.66	3.89	3.78	2789.3	2725.5	
964.000	964.100	BT	42	4.04	3.64	3.84	2843.1		42	3.62	3.31	3.47	2534.0		
964.100	964.200	BT	42	3.74	3.48	3.61	2653.1		42	3.47	3.84	3.66	2690.1		
964.200	964.300	BT	47	3.58	3.24	3.41	2489.0		47	4.11	3.67	3.89	2884.6		
964.300	964.400	BT	51	3.38	3.91	3.65	2681.9		51	3.52	3.79	3.66	2690.1		
964.400	964.500	BT	52	3.28	3.77	3.53	2583.2		52	3.60	3.97	3.79	2797.5		
964.500	964.600	BT	52	2.64	2.77	2.71	1920.3		52	3.34	3.60	3.47	2538.1		
964.600	964.700	BT	52	2.64	2.55	2.60	1833.1		52	2.96	3.17	3.07	2208.7		
964.700	964.800	BT	52	2.93	3.40	3.17	2289.6		52	3.78	4.61	4.20	3139.1		
964.800	964.900	BT	53	3.36	3.29	3.33	2419.6		53	2.97	4.35	3.66	2694.3		
964.900	965.000	BT	52	3.06	3.18	3.12	2253.2	2396.6	52	3.23	3.74	3.49	2550.4	2672.7	
965.000	965.100	BT	53	2.61	2.90	2.76	1960.1		53	3.67	4.27	3.97	2951.1		
965.100	965.200	BT	52	2.93	3.02	2.98	2136.2		52	3.63	3.42	3.53	2583.2		
965.200	965.300	BT	52	4.42	4.32	4.37	3286.1		52	3.60	4.13	3.87	2863.8		
965.300	965.360	BT	52	6.07	5.62	5.85	4551.3	2983.4	52	5.87	5.82	5.85	4551.3	3237.4	
970.050	970.200	BT	50	3.95	3.61	3.78	2793.4		50	3.56	4.00	3.78	2793.4		
970.200	970.300	BT	51	3.73	3.96	3.85	2847.2		51	4.01	3.72	3.87	2863.8		
970.300	970.400	BT	51	3.70	4.00	3.85	2851.4		51	3.90	3.65	3.78	2789.3		
970.400	970.500	BT	52	3.86	3.63	3.75	2764.4		52	3.68	3.91	3.80	2805.8		
970.500	970.600	BT	52	3.64	3.89	3.77	2781.0		52	4.08	3.66	3.87	2868.0		
970.600	970.700	BT	50	3.89	3.63	3.76	2776.8		50	5.98	5.26	5.62	4355.6		
970.700	970.800	BT	54	3.96	3.55	3.76	2772.7		54	3.86	3.49	3.68	2706.6		
970.800	970.950	BT	52	3.80	3.96	3.88	2876.3	2807.9	52	2.97	3.37	3.17	2293.6	2934.5	
971.670	971.800	BT	40	3.88	3.37	3.63	2665.4		40	3.28	3.21	3.25	2354.5		
971.800	971.900	BT	44	4.02	3.76	3.89	2884.6		44	2.88	3.26	3.07	2212.8		
971.900	972.000	BT	41	3.73	3.59	3.66	2694.3	2748.1	41	3.18	2.80	2.99	2148.3	2238.5	
972.000	972.100	BT	47	3.53	3.76	3.65	2681.9		47	2.96	3.44	3.20	2318.0		
972.100	972.200	BT	37	3.79	3.90	3.85	2847.2		37	3.02	3.52	3.27	2374.8		
972.200	972.300	BT	41	3.71	3.40	3.56	2607.8		41	3.53	3.29	3.41	2489.0		
972.300	972.400	BT	46	3.54	3.64	3.59	2636.6		46	3.39	3.87	3.63	2669.5		
972.400	972.500	BT	52	3.64	4.05	3.85	2847.2		52	3.27	3.49	3.38	2464.5		
972.500	972.600	BT	54	3.29	3.30	3.30	2395.2		54	3.39	3.13	3.26	2366.7		
972.600	972.700	BT	54	3.12	3.20	3.16	2285.5		54	2.71	2.73	2.72	1932.2		
972.700	972.800	BT	57	3.25	3.11	3.18	2301.8		57	2.60	2.56	2.58	1821.2		
972.800	972.900	BT	57	3.41	3.75	3.58	2628.4		57	3.08	3.50	3.29	2391.1		
972.900	973.000	BT	56	3.15	3.30	3.23	2338.3	2557.0	56	2.80	2.89	2.85	2031.9	2285.9	
973.000	973.100	BT	57	3.47	3.48	3.48	2542.2		57	2.73	3.03	2.88	2060.0		
973.100	973.200	BT	55	2.86	2.92	2.89	2068.0		55	3.00	3.55	3.28	2378.9		
973.200	973.300	BT	54	4.18	3.92	4.05	3017.8		54	3.51	3.07	3.29	2391.1		
973.300	973.400	BT	54	4.91	4.28	4.60	3476.2		54	3.48	3.84	3.66	2694.3		
973.400	973.500	BT	55	3.72	3.85	3.79	2797.5		55	3.70	4.05	3.88	2872.1		
973.500	973.600	BT	53	4.51	4.97	4.74	3599.3		53	3.80	4.10	3.95	2934.5		
973.600	973.700	BT	56	3.97	3.51	3.74	2760.3		56	3.05	3.34	3.20	2313.9		
973.700	973.800	BT	58	2.66	3.31	2.99	2144.3		58	2.25	2.40	2.33	1620.8		
973.800	973.900	BT	56	4.25	4.09	4.17	3118.1		56	3.47	3.79	3.63	2669.5		
973.900	974.000	BT	54	3.80	3.87	3.84	2839.0	2836.3	54	3.93	3.92	3.93	2913.7	2484.9	
974.000	974.100	BT	53	3.63	4.01	3.82	2826.5		53	3.82	3.49	3.66	2690.1		
974.100	974.200	BT	50	3.96	3.79	3.88	2872.1		50	3.31	3.32	3.32	2411.5		
974.200	974.300	BT	44	3.01	3.41	3.21	2326.1		44	3.93	3.35	3.64	2677.8		
974.300	974.400	BT	44	3.27	3.34	3.31	2403.3		44	3.25	3.58	3.42	2493.1		
974.400	974.500	BT	42	3.57	3.69	3.63	2669.5		42	3.72	3.83	3.78	2789.3		
974.500	974.600	BT	40	3.23	3.58	3.41	2484.9		40	3.72	3.84	3.78	2793.4		
974.600	974.700	BT	31	3.64	3.78	3.71	2735.5		31	3.27	3.49	3.38	2464.5		
974.700	974.800	BT	31	3.97	3.71	3.84	2843.1		31	3.68	3.59	3.64	2673.7		
974.800	974.900	BT	31	3.56	3.58	3.57	2620.2		31	3.06	3.33	3.20	2313.9		
974.900	975.000	BT	29	3.61	3.85	3.73	2752.0	2653.3	29	3.61	3.92	3.77	2781.0	2608.8	
975.000	975.100	BT	21	4.34	3.89	4.12	3072.1		21	8.21	8.05	8.13	6586.3		
975.100	975.200	BT	29	4.60	4.36	4.48	3378.9		29	4.28	4.20	4.24	3176.8		
975.200	975.300	BT	36	4.50	4.14	4.32	3244.0		36	4.52	4.20	4.36	3277.7		
975.300	975.400	BT	35	4.51	4.60	4.56	3442.3		35	4.51	4.97	4.74	3599.3		
975.400	975.500	BT	43	5.13	4.53	4.83	3675.9		43	2.96	3.44	3.20	2318.0		
975.500	975.600	BT	47	3.61	3.73	3.67	2702.5		47	3.77	3.46	3.62	2657.2		

Roughness Analysis of Flexible Pavement on LHS Direction: NH-27: Rakhaldubi to Kalijhar(Pkg-II)															
Chainage (km)			Inner Lane						Outer Lane						Remarks
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	
975.600	975.700	BT	49	3.77	4.01	3.89	2884.6		49	3.14	3.13	3.14	2265.3		
975.700	975.800	BT	50	3.88	4.36	4.12	3076.3		50	3.38	3.64	3.51	2570.9		
975.800	975.900	BT	50	3.55	3.01	3.28	2383.0		50	3.52	3.69	3.61	2649.0		
975.900	976.000	BT	51	4.14	3.84	3.99	2967.8	3082.7	51	3.62	3.69	3.66	2690.1	3179.0	
976.000	976.100	BT	51	4.25	4.95	4.60	3480.4		51	3.48	3.45	3.47	2534.0		
976.100	976.200	BT	51	4.52	4.64	4.58	3463.5		51	4.63	3.66	4.15	3097.2		
976.200	976.300	BT	51	3.97	4.50	4.24	3172.6		51	3.88	3.69	3.79	2797.5		
976.300	976.400	BT	51	2.98	4.17	3.58	2624.3		51	3.57	4.28	3.93	2913.7		
976.400	976.500	BT	50	3.68	3.50	3.59	2636.6		50	4.56	4.90	4.73	3590.7		
976.500	976.600	BT	51	4.24	4.52	4.38	3294.5		51	4.08	3.91	4.00	2971.9		
976.600	976.700	BT	53	3.43	3.94	3.69	2714.9		53	3.45	3.44	3.45	2517.6		
976.700	976.800	BT	52	2.24	3.07	2.66	1880.6		52	2.72	2.93	2.83	2016.0		
976.800	976.900	BT	52	2.08	2.92	2.50	1758.1		52	3.35	2.88	3.12	2249.1		
976.900	977.000	BT	52	2.36	2.79	2.58	1817.2	2684.3	52	2.58	2.28	2.43	1703.0	2639.1	
977.000	977.100	BT	53	2.80	3.40	3.10	2237.0		53	3.18	3.15	3.17	2289.6		
977.100	977.200	BT	53	2.81	3.51	3.16	2285.5		53	3.35	3.51	3.43	2505.4		
977.200	977.300	BT	53	2.20	2.64	2.42	1695.2		53	3.25	2.83	3.04	2188.6		
977.300	977.400	BT	52	2.44	3.00	2.72	1932.2		52	3.30	2.83	3.07	2208.7		
977.400	977.500	BT	51	2.91	4.09	3.50	2562.7		51	3.50	3.30	3.40	2480.8		
977.500	977.600	BT	52	3.19	3.65	3.42	2497.2		52	3.21	2.89	3.05	2196.6		
977.600	977.700	BT	52	3.08	3.51	3.30	2395.2		52	3.02	3.10	3.06	2204.7		
977.700	977.800	BT	53	3.17	3.39	3.28	2383.0		53	3.50	3.10	3.30	2399.3		
977.800	977.900	BT	53	3.60	3.60	3.60	2644.8		53	3.32	3.35	3.34	2427.8		
977.900	978.000	BT	53	3.29	3.08	3.19	2305.8	2293.9	53	3.45	2.76	3.11	2241.0	2314.2	
978.000	978.100	BT	53	3.66	3.01	3.34	2427.8		53	3.66	3.30	3.48	2546.3		
978.100	978.200	BT	52	2.96	2.98	2.97	2132.2		52	2.93	2.92	2.93	2096.0		
978.200	978.300	BT	53	3.81	4.05	3.93	2917.8		53	3.48	3.33	3.41	2484.9		
978.300	978.400	BT	53	3.63	3.77	3.70	2727.3		53	3.31	3.23	3.27	2374.8		
978.400	978.500	BT	53	2.81	3.18	3.00	2152.3		53	3.25	3.08	3.17	2289.6		
978.500	978.600	BT	53	3.46	3.24	3.35	2440.0		53	3.47	3.54	3.51	2566.8		
978.600	978.700	BT	52	3.19	2.97	3.08	2220.8		52	2.71	3.15	2.93	2100.1		
978.700	978.800	BT	51	5.33	4.09	4.71	3573.7		51	3.48	3.84	3.66	2694.3		
978.800	978.900	BT	49	4.14	4.12	4.13	3084.6		49	3.63	3.62	3.63	2665.4		
978.900	979.000	BT	52	3.67	3.33	3.50	2562.7	2623.9	52	2.48	2.30	2.39	1671.7	2349.0	
979.000	979.100	BT	52	3.35	2.33	2.84	2027.9		52	3.12	3.79	3.46	2525.8		
979.100	979.200	BT	49	4.48	3.98	4.23	3168.4		49	3.81	3.58	3.70	2723.1		
979.200	979.300	BT	50	4.55	4.17	4.36	3277.7		50	3.75	4.07	3.91	2901.2		
979.300	979.400	BT	52	3.63	3.25	3.44	2513.5		52	3.25	3.33	3.29	2391.1		
979.400	979.500	BT	51	3.58	2.85	3.22	2330.1		51	3.07	3.21	3.14	2269.4		
979.500	979.600	BT	45	4.68	3.76	4.22	3160.0		45	2.83	2.76	2.80	1992.0		
979.600	979.700	BT	41	3.80	4.39	4.10	3055.4		41	3.27	2.90	3.09	2224.9		
979.700	979.800	BT	47	3.60	3.21	3.41	2484.9		47	3.41	3.54	3.48	2542.2		
979.800	979.900	BT	51	3.27	3.76	3.52	2575.0		51	2.67	2.82	2.75	1952.1		
979.900	980.000	BT	51	3.41	2.97	3.19	2309.9	2690.3	51	3.03	3.22	3.13	2257.2	2377.9	
980.000	980.100	BT	48	4.46	3.92	4.19	3134.9		48	5.65	5.17	5.41	4173.7		
980.100	980.200	BT	52	4.43	4.26	4.35	3265.0		52	2.70	2.41	2.56	1801.4		
980.200	980.300	BT	52	3.54	2.84	3.19	2309.9		52	2.64	2.08	2.36	1648.2		
980.300	980.400	BT	52	3.57	3.34	3.46	2525.8		52	3.42	2.82	3.12	2253.2		
980.400	980.500	BT	52	3.39	3.67	3.53	2587.3		52	3.32	3.31	3.32	2411.5		
980.500	980.600	BT	52	3.11	3.22	3.17	2289.6		52	2.59	2.59	2.59	1829.1		
980.600	980.700	BT	53	2.75	2.57	2.66	1884.6		53	2.09	1.98	2.04	1396.2		
980.700	980.800	BT	50	2.39	2.84	2.62	1848.9		50	3.51	3.76	3.64	2673.7		
980.800	980.900	BT	43	3.47	3.23	3.35	2440.0		43	4.56	3.95	4.26	3189.4		
980.900	981.000	BT	47	3.41	3.14	3.28	2378.9	2466.5	47	3.06	3.61	3.34	2427.8	2380.4	
981.000	981.100	BT	50	3.67	3.33	3.50	2562.7		50	3.37	3.03	3.20	2318.0		
981.100	981.200	BT	51	3.81	3.59	3.70	2727.3		51	3.19	2.88	3.04	2184.5		
981.200	981.300	BT	51	3.91	3.85	3.88	2876.3		51	2.93	3.29	3.11	2245.1		Toll Plaza
981.300	981.400	BT	50	3.99	3.50	3.75	2764.4		50	3.50	3.38	3.44	2513.5		
981.400	981.500	BT	52	3.66	3.58	3.62	2661.3		52	3.44	3.02	3.23	2342.3		
981.500	981.600	BT	52	3.23	3.22	3.23	2338.3		52	4.33	3.81	4.07	3034.5		
981.600	981.700	BT	52	3.59	3.49	3.54	2595.5		52	4.02	4.07	4.05	3013.6		
981.700	981.800	BT	51	3.71	4.08	3.90	2888.7		51	5.04	4.84	4.94	3769.8		
981.800	981.900	BT	52	3.89	4.03	3.96	2942.8		52	3.27	2.92	3.10	2233.0		
981.900	982.000	BT	50	4.84	3.80	4.32	3244.0	2760.1	50	3.33	3.25	3.29	2391.1	2604.5	
982.000	982.100	BT	51	3.47	3.77	3.62	2661.3		51	3.63	3.66	3.65	2681.9		
982.100	982.200	BT	51	3.77	3.92	3.85	2847.2		51	4.20	4.39	4.30	3223.0		
982.200	982.300	BT	51	3.85	3.58	3.72	2739.6		51	3.54	3.07	3.31	2403.3		
982.300	982.400	BT	51	3.52	3.21	3.37	2452.2		51	3.52	3.21	3.37	2452.2		
982.400	982.500	BT	52	3.76	3.23	3.50	2558.6		52	3.76	3.23	3.50	2558.6		
982.500	982.600	BT	51	4.22	4.55	4.39	3298.7		51	3.26	3.07	3.17	2289.6		
982.600	982.700	BT	50	4.58	4.36	4.47	3370.4		50	3.94	4.40	4.17	3118.1		
982.700	982.800	BT	50	4.84	4.40	4.62	3497.4		50	4.36	4.37	4.37	3281.9		
982.800	982.900	BT	51	4.01	3.67	3.84	2843.1		51	3.63	4.08	3.86	2855.5		
982.900	983.000	BT	52	4.19	4.00	4.10	3055.4	2932.4	52	3.97	3.74	3.86	2855.5	2772.0	
983.000	983.100	BT	50	4.31	4.02	4.17	3113.9		50	3.55	3.60	3.58	2624.3		
983.100	983.200	BT	44	2.99	3.00	3.00	2152.3		44	2.74	3.01	2.88	2056.0		
983.200	983.300	BT	51	3.86	3.62	3.74	2760.3		51	3.75	3.83	3.79	2801.7		
983.300	983.400	BT	52	3.22	3.62	3.42	2497.2		52	2.90	3.06	2.98	2140.2		
983.400	983.500	BT	52	2.38	2.45	2.42	1691.2		52	3.13	2.85	2.99	2148.3		
983.500	983.600	BT	52	2.75	2.67	2.71	1924.3		52	2.84	2.51	2.68	1896.5		
983.600	983.700	BT	51	4.84	4.58	4.71	3573.7		51	4.25	4.41	4.33	3252.4		
983.700	983.800	BT	52	2.51	2.77	2.64	1868.7		52	2.59	2.26	2.43	1699.1		
983.800	983.900	BT	52	2.65	3.08	2.87	2048.0		52	2.07	1.89	1.98	1354.0		
983.900	984.000	BT	52	2.97	3.34	3.16	2281.5	2391.1	52	2.42	2.32	2.37	1656.0	2162.8	
984.000	984.100	BT	53	3.48	3.42	3.45	2521.7		53	1.95	1.86	1.91	1296.7		
984.100	984.200	BT	53	2.74	2.52	2.63	1860.8		53	2.59	2.41	2.50	1758.1		
984.200	984.300	BT	53	2.53	2.32	2.43	1699.1		53	1.78	1.71	1.75	1175.3		

Roughness Analysis of Flexible Pavement on LHS Direction: NH-27: Rakhaldubi to Kalijhar(Pkg-II)															
Chainage (km)			Inner Lane						Outer Lane						Remarks
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	
984.300	984.400	BT	50	4.61	4.16	4.39	3298.7		50	4.03	4.28	4.16	3105.6		
984.400	984.500	BT	50	3.57	2.27	2.92	2092.0		50	2.80	2.53	2.67	1888.5		
984.500	984.600	BT	53	2.49	2.44	2.47	1730.5		53	1.85	1.80	1.83	1235.8		
984.600	984.700	BT	52	2.41	2.24	2.33	1620.8		52	1.81	1.87	1.84	1247.2		
984.700	984.800	BT	52	2.21	2.13	2.17	1500.3		52	2.02	2.05	2.04	1396.2		
984.800	984.900	BT	52	3.04	2.82	2.93	2100.1		52	2.68	2.93	2.81	2000.0		
984.900	985.000	BT	53	3.28	3.20	3.24	2350.4	2077.4	53	2.58	2.48	2.53	1781.7	1688.5	
985.000	985.100	BT	53	2.89	2.87	2.88	2060.0		53	3.09	2.88	2.99	2144.3		
985.100	985.200	BT	53	2.87	2.60	2.74	1944.2		53	3.82	3.53	3.68	2706.6		
985.200	985.300	BT	51	4.54	4.57	4.56	3442.3		51	4.55	4.23	4.39	3302.9		
985.300	985.400	BT	51	3.12	3.24	3.18	2301.8		51	3.78	3.74	3.76	2776.8		
985.400	985.500	BT	53	3.32	3.68	3.50	2562.7		53	2.09	2.28	2.19	1511.9		
985.500	985.600	BT	53	2.73	3.21	2.97	2132.2		53	2.48	2.31	2.40	1675.6		
985.600	985.700	BT	52	3.60	3.43	3.52	2575.0		52	2.87	2.68	2.78	1976.0		
985.700	985.800	BT	51	2.96	3.15	3.06	2200.7		51	2.44	2.19	2.32	1613.0		
985.800	985.900	BT	52	3.41	3.16	3.29	2387.0		52	2.51	2.53	2.52	1773.8		
985.900	986.000	BT	51	3.07	2.78	2.93	2096.0	2370.2	51	2.15	2.23	2.19	1515.8	2099.7	
986.000	986.100	BT	52	2.72	2.61	2.67	1888.5		52	1.76	1.79	1.78	1198.0		
986.100	986.200	BT	51	3.85	2.68	3.27	2370.8		51	3.05	2.73	2.89	2068.0		
986.200	986.300	BT	50	4.31	3.40	3.86	2855.5		50	4.60	4.57	4.59	3467.7		
986.300	986.400	BT	51	2.23	2.32	2.28	1581.8		51	2.84	2.68	2.76	1964.1		
986.400	986.500	BT	49	4.74	4.74	4.74	3599.3		49	4.21	4.47	4.34	3260.8		
986.500	986.600	BT	52	4.31	3.90	4.11	3063.7		52	2.83	2.77	2.80	1996.0		
986.600	986.700	BT	51	3.61	3.52	3.57	2616.1		51	2.19	2.26	2.23	1542.9		
986.700	986.800	BT	52	2.90	3.05	2.98	2136.2		52	2.83	2.74	2.79	1984.0		
986.800	986.900	BT	51	3.80	4.72	4.26	3193.6		51	2.22	2.40	2.31	1609.1		
986.900	987.000	BT	51	3.05	2.95	3.00	2156.3	2546.2	51	3.39	3.38	3.39	2468.6	2155.9	
987.000	987.100	BT	51	1.93	2.15	2.04	1400.0		51	2.45	2.25	2.35	1640.4		
987.100	987.200	BT	52	3.15	2.58	2.87	2048.0		52	3.19	2.99	3.09	2228.9		
987.200	987.300	BT	52	2.48	2.55	2.52	1769.9		52	2.08	2.26	2.17	1500.3		
987.300	987.400	BT	51	1.86	1.80	1.83	1239.6		51	1.99	1.76	1.88	1273.8		
987.400	987.500	BT	52	2.44	2.42	2.43	1703.0		52	1.53	1.71	1.62	1081.4		
987.500	987.600	BT	52	2.54	2.28	2.41	1687.3		52	2.72	3.16	2.94	2108.1		
987.600	987.700	BT	52	3.14	3.14	3.14	2269.4		52	2.53	2.60	2.57	1809.3		
987.700	987.800	BT	52	2.48	2.51	2.50	1754.1		52	1.88	1.82	1.85	1254.8		
987.800	987.900	BT	52	2.79	2.79	2.79	1988.0		52	2.50	2.71	2.61	1841.0		
987.900	988.000	BT	52	2.74	2.63	2.69	1904.4	1776.4	52	2.27	2.41	2.34	1632.5	1637.1	
988.000	988.100	BT	52	2.18	2.32	2.25	1562.4		52	2.65	2.46	2.56	1801.4		
988.100	988.200	BT	53	3.01	3.79	3.40	2480.8		53	2.43	3.75	3.09	2228.9		
988.200	988.300	BT	53	2.48	2.38	2.43	1703.0		53	3.02	2.59	2.81	2000.0		
988.300	988.400	BT	53	3.17	2.78	2.98	2136.2		53	2.99	2.93	2.96	2124.2		
988.400	988.500	BT	53	2.55	2.17	2.36	1648.2		53	2.73	2.37	2.55	1797.5		
988.500	988.600	BT	52	2.39	2.40	2.40	1675.6		52	2.53	2.33	2.43	1703.0		
988.600	988.700	BT	53	2.13	2.22	2.18	1504.2		53	2.71	2.55	2.63	1860.8		
988.700	988.800	BT	51	4.23	4.59	4.41	3319.8		51	4.10	4.48	4.29	3218.8		
988.800	988.900	BT	52	2.15	2.03	2.09	1438.5		52	2.36	2.26	2.31	1609.1		
988.900	989.000	BT	54	2.13	1.95	2.04	1400.0	1886.9	54	1.97	1.96	1.97	1342.5	1968.6	
989.000	989.100	BT	53	2.10	2.22	2.16	1492.5		53	1.80	1.59	1.70	1137.7		
989.100	989.200	BT	53	1.91	1.97	1.94	1323.4		53	2.05	2.00	2.03	1388.5		
989.200	989.300	BT	53	2.39	2.06	2.23	1542.9		53	2.04	1.98	2.01	1377.0		
989.300	989.400	BT	53	3.09	3.19	3.14	2269.4		53	2.53	2.71	2.62	1852.8		
989.400	989.500	BT	52	2.53	2.49	2.51	1765.9		52	2.48	2.53	2.51	1762.0		
989.500	989.600	BT	53	2.67	2.66	2.67	1888.5		53	2.71	2.77	2.74	1948.1		
989.600	989.700	BT	54	2.42	2.25	2.34	1628.6		54	1.91	2.08	2.00	1365.5		
989.700	989.800	BT	54	3.52	3.45	3.49	2550.4		54	2.53	2.52	2.53	1777.8		
989.800	989.900	BT	55	2.44	2.43	2.44	1706.9		55	2.55	2.33	2.44	1710.9		
989.900	990.000	BT	55	2.16	2.32	2.24	1554.6	1772.3	55	1.59	1.83	1.71	1148.9	1546.9	
990.000	990.100	BT	53	2.23	2.25	2.24	1554.6		53	1.80	1.81	1.81	1220.7		
990.100	990.200	BT	53	4.06	4.30	4.18	3126.5		53	3.54	3.07	3.31	2403.3		
990.200	990.300	BT	53	3.05	3.24	3.15	2273.4		53	2.64	2.57	2.61	1841.0		
990.300	990.400	BT	53	2.61	2.39	2.50	1758.1		53	2.44	2.30	2.37	1656.0		
990.400	990.500	BT	53	2.75	2.27	2.51	1765.9		53	2.17	2.16	2.17	1496.4		
990.500	990.600	BT	53	2.50	2.62	2.56	1805.4		53	2.22	2.03	2.13	1465.5		
990.600	990.700	BT	52	3.64	3.15	3.40	2476.7		52	3.26	3.06	3.16	2285.5		
990.700	990.800	BT	52	3.01	3.14	3.08	2216.8		52	2.19	2.27	2.23	1546.8		
990.800	990.900	BT	52	2.35	2.50	2.43	1699.1		52	2.11	2.13	2.12	1461.6		
990.900	991.000	BT	53	2.57	2.44	2.51	1762.0	2043.9	53	2.35	2.66	2.51	1762.0	1713.9	
991.000	991.100	BT	53	2.84	3.18	3.01	2164.4		53	2.19	2.20	2.20	1519.7		
991.100	991.200	BT	51	2.12	2.25	2.19	1511.9		51	2.08	2.00	2.04	1400.0		
991.200	991.300	BT	51	3.76	3.28	3.52	2579.1		51	3.13	3.72	3.43	2501.3		
991.300	991.400	BT	53	2.37	2.42	2.40	1675.6		53	2.14	2.14	2.14	1477.1		
991.400	991.500	BT	53	2.25	2.27	2.26	1570.2		53	2.06	2.17	2.12	1457.8		
991.500	991.600	BT	52	1.78	2.36	2.07	1423.1		52	1.84	1.84	1.84	1247.2		
991.600	991.700	BT	51	3.00	3.44	3.22	2334.2		51	2.10	2.21	2.16	1488.7		
991.700	991.800	BT	52	3.16	3.28	3.22	2334.2		52	3.27	2.92	3.10	2233.0		
991.800	991.900	BT	52	3.12	3.46	3.29	2391.1		52	2.98	2.80	2.89	2068.0		
991.900	992.000	BT	50	2.90	2.70	2.80	1996.0	1998.0	50	2.92	2.72	2.82	2012.0	1740.5	
992.000	992.100	BT	49	3.35	3.17	3.26	2366.7		49	2.47	2.65	2.56	1805.4		
992.100	992.200	BT	49	3.85	3.23	3.54	2595.5		49	3.65	3.38	3.52	2575.0		
992.200	992.300	BT	52	3.60	3.78	3.69	2719.0		52	3.90	3.76	3.83	2834.8		
992.300	992.400	BT	52	3.91	3.76	3.84	2839.0		52	2.88	2.90	2.89	2068.0		
992.400	992.500	BT	51	4.02	3.74	3.88	2876.3		51	3.17	3.77	3.47	2538.1		
992.500	992.600	BT	50	3.90	3.54	3.72	2743.8		50	2.74	3.02	2.88	2060.0		
992.600	992.700	BT	51	4.04	3.53	3.79	2797.5		51	3.87	3.44	3.66	2690.1		
992.700	992.800	BT	51	4.18	3.86	4.02	2992.8		51	3.73	3.63	3.68	2710.8		
992.800	992.900	BT	50	3.90	3.36	3.63	2669.5		50	3.74	3.86	3.80	2809.9		
992.900	993.000	BT	52	2.76	2.28	2.52	1773.8	2637.4	52	2.15	1.99	2.07	1423.1	2351.5	

Roughness Analysis of Flexible Pavement on LHS Direction: NH-27: Rakhaldubi to Kalijhar(Pkg-II)															
Chainage (km)			Inner Lane						Outer Lane						Remarks
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	
993.000	993.100	BT	53	2.97	2.63	2.80	1996.0		53	2.34	2.17	2.26	1566.3		
993.100	993.200	BT	52	2.67	1.84	2.26	1566.3		52	2.09	1.53	1.81	1224.4		
993.200	993.300	BT	53	2.32	2.43	2.38	1659.9		53	1.95	1.85	1.90	1292.8		
993.300	993.400	BT	53	2.52	2.36	2.44	1710.9		53	2.26	2.01	2.14	1473.2		
993.400	993.500	BT	52	2.46	2.69	2.58	1817.2		52	2.63	2.68	2.66	1880.6		
993.500	993.600	BT	52	3.05	3.47	3.26	2366.7		52	3.05	2.77	2.91	2084.0		
993.600	993.700	BT	52	2.31	2.51	2.41	1687.3		52	2.99	2.94	2.97	2128.2		
993.700	993.800	BT	51	2.95	3.07	3.01	2164.4		51	2.38	2.16	2.27	1577.9		
993.800	993.900	BT	50	3.29	2.96	3.13	2257.2		50	2.99	2.77	2.88	2060.0		
993.900	994.000	BT	52	4.38	3.78	4.08	3042.8	2026.9	52	2.19	2.18	2.19	1511.9	1679.9	
994.000	994.100	BT	49	2.27	2.37	2.32	1616.9		49	3.14	3.19	3.17	2289.6		
994.100	994.200	BT	50	2.88	3.34	3.11	2245.1		50	2.55	2.69	2.62	1852.8		
994.200	994.300	BT	53	2.71	2.79	2.75	1956.1		53	2.55	2.57	2.56	1805.4		
994.300	994.400	BT	52	2.43	2.75	2.59	1829.1		52	2.58	2.27	2.43	1699.1		
994.400	994.500	BT	52	3.58	3.42	3.50	2562.7		52	2.54	2.39	2.47	1730.5		
994.500	994.600	BT	52	2.49	2.59	2.54	1789.6		52	2.32	2.22	2.27	1577.9		
994.600	994.700	BT	52	2.96	3.17	3.07	2208.7		52	2.58	2.51	2.55	1793.5		
994.700	994.800	BT	52	2.99	2.94	2.97	2128.2		52	2.74	2.66	2.70	1916.3		
994.800	994.900	BT	52	2.68	2.66	2.67	1892.5		52	2.46	2.43	2.45	1714.8		
994.900	995.000	BT	52	3.26	3.49	3.38	2460.4	2068.9	52	2.67	2.59	2.63	1860.8	1824.1	
995.000	995.100	BT	52	2.77	2.49	2.63	1860.8		52	2.33	2.28	2.31	1605.2		
995.100	995.200	BT	50	2.66	2.60	2.63	1860.8		50	2.49	2.45	2.47	1734.4		
995.200	995.300	BT	50	4.00	3.78	3.89	2884.6		50	3.11	3.17	3.14	2269.4		
995.300	995.400	BT	49	3.70	4.00	3.85	2851.4		49	2.50	3.04	2.77	1972.0		
995.400	995.500	BT	51	2.49	3.33	2.91	2084.0		51	2.66	3.03	2.85	2031.9		
995.500	995.600	BT	52	3.17	3.59	3.38	2464.5		52	3.00	3.01	3.01	2160.4		
995.600	995.700	BT	51	2.93	3.53	3.23	2342.3		51	2.87	2.67	2.77	1972.0		
995.700	995.800	BT	51	3.36	2.77	3.07	2208.7		51	2.79	2.31	2.55	1797.5		
995.800	995.900	BT	51	4.07	3.71	3.89	2884.6		51	4.82	4.18	4.50	3395.8		
995.900	996.000	BT	46	4.89	5.49	5.19	3984.1	2542.6	46	4.88	5.35	5.12	3919.7	2285.8	
996.000	996.100	BT	37	4.94	4.55	4.75	3603.5		37	4.22	3.77	4.00	2971.9		
996.100	996.200	BT	30	5.17	4.54	4.86	3697.2		30	3.59	3.36	3.48	2542.2		
996.200	996.300	BT	30	3.03	2.85	2.94	2106.1		30	3.14	3.19	3.17	2289.6		
996.300	996.400	BT	23	3.01	3.01	3.01	2162.4		23	4.14	3.81	3.98	2955.3		
996.400	996.500	BT	22	2.67	2.77	2.72	1932.2		22	3.67	4.06	3.87	2863.8		
996.500	996.600	BT	34	2.31	2.55	2.43	1703.0		34	4.09	4.09	4.09	3051.2		
996.600	996.700	BT	39	4.18	4.50	4.34	3260.8		39	4.10	4.58	4.34	3260.8		
996.700	996.800	BT	44	4.11	4.51	4.31	3235.6		44	4.41	4.75	4.58	3463.5		
996.800	996.900	BT	46	4.39	4.71	4.55	3438.1		46	4.69	4.28	4.49	3383.1		
996.900	997.000	BT	47	4.86	4.47	4.67	3535.5	2867.4	47	4.57	4.05	4.31	3235.6	3001.7	
997.000	997.100	BT	45	4.20	4.60	4.40	3311.4		45	4.08	4.07	4.08	3038.7		
997.100	997.200	BT	38	2.33	2.39	2.36	1648.2		38	3.34	3.26	3.30	2399.3		
997.200	997.300	BT	36	2.16	2.07	2.12	1457.8		36	2.37	2.37	2.37	1656.0		
997.300	997.400	BT	39	2.60	2.27	2.44	1706.9		39	2.35	2.52	2.44	1706.9		
997.400	997.500	BT	41	2.68	2.68	2.68	1900.4		41	2.81	2.72	2.77	1968.1		
997.500	997.600	BT	46	2.93	3.25	3.09	2228.9		46	2.80	2.93	2.87	2048.0		
997.600	997.700	BT	50	2.65	2.33	2.49	1750.2		50	2.21	2.09	2.15	1484.8		
997.700	997.800	BT	51	2.02	2.24	2.13	1469.4		51	2.14	1.98	2.06	1415.4		
997.800	997.900	BT	52	2.19	2.03	2.11	1453.9		52	2.29	2.14	2.22	1535.2		
997.900	998.000	BT	51	3.37	3.02	3.20	2313.9	1924.1	51	2.86	2.57	2.72	1928.2	1918.0	
998.000	998.100	BT	47	2.86	2.93	2.90	2072.0		47	2.26	2.25	2.26	1566.3		
998.100	998.200	BT	45	2.89	2.71	2.80	1996.0		45	2.47	2.30	2.39	1667.7		
998.200	998.300	BT	51	3.25	2.71	2.98	2140.2		51	3.59	3.36	3.48	2542.2		
998.300	998.400	BT	51	2.16	2.05	2.11	1450.0		51	2.91	2.69	2.80	1996.0		
998.400	998.500	BT	52	2.30	2.57	2.44	1706.9		52	2.58	2.70	2.64	1868.7		
998.500	998.600	BT	52	2.83	3.12	2.98	2136.2		52	2.37	2.06	2.22	1535.2		
998.600	998.700	BT	51	2.52	2.45	2.49	1746.2		51	2.24	2.71	2.48	1738.4		
998.700	998.800	BT	51	3.17	3.39	3.28	2383.0		51	2.78	2.59	2.69	1904.4		
998.800	998.900	BT	50	3.84	4.21	4.03	2996.9		50	4.14	3.81	3.98	2955.3		
998.900	999.000	BT	52	3.71	3.16	3.44	2509.4	2113.7	52	2.59	2.52	2.56	1801.4	1957.6	
999.000	999.100	BT	51	3.69	2.71	3.20	2318.0		51	3.07	2.70	2.89	2064.0		
999.100	999.200	BT	51	2.66	2.65	2.66	1880.6		51	3.34	2.77	3.06	2200.7		
999.200	999.300	BT	49	3.61	3.94	3.78	2789.3		49	3.07	3.09	3.08	2220.8		
999.300	999.400	BT	45	3.07	3.11	3.09	2228.9		45	2.68	2.82	2.75	1956.1		
999.400	999.500	BT	42	3.32	3.59	3.46	2525.8		42	3.20	3.27	3.24	2346.4		
999.500	999.600	BT	49	2.89	3.24	3.07	2208.7		49	2.50	2.37	2.44	1706.9		
999.600	999.700	BT	49	3.77	3.64	3.71	2731.4		49	2.86	3.73	3.30	2395.2		
999.700	999.800	BT	50	3.54	3.24	3.39	2472.7		50	2.28	2.35	2.32	1613.0		
999.800	999.900	BT	52	2.83	2.60	2.72	1928.2		52	1.82	1.81	1.82	1228.2		
999.900	1000.000	BT	52	2.75	2.66	2.71	1920.3	2300.4	52	2.10	2.27	2.19	1511.9	1924.3	
1000.000	1000.100	BT	53	3.05	2.75	2.90	2076.0		53	1.95	1.82	1.89	1281.4		
1000.100	1000.200	BT	51	2.54	2.55	2.55	1793.5		51	2.78	2.64	2.71	1924.3		
1000.200	1000.300	BT	47	3.41	2.66	3.04	2184.5		47	2.31	2.34	2.33	1620.8		
1000.300	1000.400	BT	47	4.07	3.77	3.92	2909.5		47	2.56	2.46	2.51	1765.9		
1000.400	1000.500	BT	49	3.78	3.26	3.52	2579.1		49	3.26	3.21	3.24	2346.4		
1000.500	1000.600	BT	48	4.24	3.04	3.64	2677.8		48	3.12	3.12	3.12	2253.2		
1000.600	1000.700	BT	42	4.20	4.08	4.14	3093.0		42	4.22	3.77	4.00	2971.9		
1000.700	1000.800	BT	49	3.40	2.52	2.96	2124.2		49	3.00	2.89	2.95	2112.1		
1000.800	1000.900	BT	52	3.86	4.67	4.27	3197.8		52	2.57	2.41	2.49	1750.2		
1000.900	1001.000	BT	48	4.04	3.99	4.02	2988.6	2562.4	48	4.14	3.64	3.89	2884.6	2091.1	
1001.000	1001.100	BT	34	4.56	4.18	4.37	3286.1		34	4.36	3.89	4.13	3080.5		
1001.100	1001.200	BT	34	4.65	4.33	4.49	3387.3		34	4.56	4.18	4.37	3286.1		
1001.200	1001.300	BT	33	3.46	4.07	3.77	2781.0		33	3.78	3.42	3.60	2644.8		
1001.300	1001.400	BT	24	3.92	4.59	4.26	3189.4		24	4.96	4.38	4.67	3539.8		
1001.400	1001.500	BT	32	4.87	5.06	4.97	3791.1		32	3.92	4.59	4.26	3189.4		
1001.500	1001.600	BT	38	3.18	3.29	3.24	2346.4		38	3.92	4.05	3.99	2963.6		
1001.600	1001.700	BT	39	3.42	3.50	3.46	2529.9		39	3.46	4.07	3.77	2781.0		

Roughness Analysis of Flexible Pavement on LHS Direction: NH-27: Rakhaldubi to Kalijhar(Pkg-II)															
Chainage (km)			Inner Lane						Outer Lane						Remarks
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	
1001.700	1001.800	BT	32	4.08	4.39	4.24	3172.6		32	4.80	4.32	4.56	3446.5		
1001.800	1001.900	BT	21	4.46	4.41	4.44	3340.9		21	4.41	4.11	4.26	3193.6		
1001.900	1002.000	BT	21	4.20	4.44	4.32	3244.0	3106.9	21	4.29	4.69	4.49	3387.3	3151.3	
1002.000	1002.100	BT	22	4.15	4.82	4.49	3383.1		22	4.69	4.67	4.68	3548.3		
1002.100	1002.200	BT	35	4.72	4.67	4.70	3561.0		35	4.29	4.67	4.48	3378.9		
1002.200	1002.300	BT	35	4.78	5.02	4.90	3735.6		35	4.69	4.06	4.38	3290.3		
1002.300	1002.400	BT	43	4.84	4.59	4.72	3578.0		43	4.99	4.27	4.63	3505.8		
1002.400	1002.500	BT	48	4.50	4.72	4.61	3488.9		48	4.34	4.39	4.37	3281.9		
1002.500	1002.600	BT	48	4.80	4.77	4.79	3637.5		48	2.43	2.52	2.48	1738.4		
1002.600	1002.700	BT	43	5.16	4.89	5.03	3842.5		43	3.18	3.29	3.24	2346.4		
1002.700	1002.800	BT	43	3.21	3.36	3.29	2387.0		43	1.94	1.91	1.93	1311.9		
1002.800	1002.900	BT	48	2.82	2.29	2.56	1801.4		48	2.37	2.14	2.26	1566.3		
1002.900	1003.000	BT	49	2.48	2.67	2.58	1817.2	3123.2	49	2.57	2.45	2.51	1765.9	2573.4	
1003.000	1003.100	BT	49	3.09	2.66	2.88	2056.0		49	3.20	2.84	3.02	2172.4		
1003.100	1003.200	BT	48	3.90	3.76	3.83	2834.8		48	4.52	3.28	3.90	2892.9		
1003.200	1003.300	BT	51	3.43	4.76	4.10	3055.4		51	2.58	2.45	2.52	1769.9		
1003.300	1003.400	BT	51	3.34	3.43	3.39	2468.6		51	2.30	2.37	2.34	1628.6		
1003.400	1003.500	BT	51	2.43	2.39	2.41	1687.3		51	3.42	3.50	3.46	2529.9		
1003.500	1003.600	BT	51	2.84	3.02	2.93	2100.1		51	2.45	2.30	2.38	1659.9		
1003.600	1003.700	BT	52	2.59	2.24	2.42	1691.2		52	2.20	2.27	2.24	1550.7		
1003.700	1003.800	BT	52	3.19	4.14	3.67	2698.4		52	4.05	2.57	3.31	2407.4		
1003.800	1003.900	BT	52	3.58	3.40	3.49	2554.5		52	3.78	3.42	3.60	2644.8		
1003.900	1004.000	BT	53	6.36	6.06	6.21	4870.8	2601.7	53	2.38	2.33	2.36	1644.3	2090.1	
1004.000	1004.100	BT	53	3.39	2.59	2.99	2148.3		53	2.64	2.81	2.73	1936.2		
1004.100	1004.200	BT	53	4.39	4.13	4.26	3193.6		53	2.06	2.34	2.20	1523.5		
1004.200	1004.300	BT	52	4.16	3.05	3.61	2649.0		52	2.63	2.90	2.77	1968.1		
1004.300	1004.400	BT	53	3.47	2.99	3.23	2342.3		53	2.23	2.18	2.21	1527.4		
1004.400	1004.500	BT	53	3.99	3.55	3.77	2785.1		53	2.75	2.45	2.60	1837.0		
1004.500	1004.600	BT	53	3.44	3.49	3.47	2534.0		53	2.17	2.20	2.19	1511.9		
1004.600	1004.700	BT	52	3.85	4.06	3.96	2938.6		52	2.67	2.57	2.62	1852.8		
1004.700	1004.800	BT	53	4.04	3.96	4.00	2976.1		53	3.54	3.76	3.65	2686.0		
1004.800	1004.900	BT	53	4.25	3.72	3.99	2963.6		53	3.76	3.76	3.76	2776.8		
1004.900	1005.000	BT	53	3.71	3.98	3.85	2847.2	2737.8	53	3.34	3.53	3.44	2509.4	2012.9	
1005.000	1005.100	BT	52	4.08	3.95	4.02	2988.6		52	3.53	4.05	3.79	2801.7		
1005.100	1005.200	BT	53	4.31	4.22	4.27	3197.8		53	3.22	3.81	3.52	2575.0		
1005.200	1005.300	BT	52	3.08	3.14	3.11	2245.1		52	4.04	3.77	3.91	2897.1		
1005.300	1005.400	BT	50	4.06	4.56	4.31	3235.6		50	3.30	3.32	3.31	2407.4		
1005.400	1005.500	BT	52	3.46	3.28	3.37	2456.3		52	3.58	3.14	3.36	2448.2		
1005.500	1005.600	BT	53	4.12	4.36	4.24	3176.8		53	2.02	2.12	2.07	1423.1		
1005.600	1005.700	BT	54	4.16	3.86	4.01	2984.4		54	2.84	2.60	2.72	1932.2		
1005.700	1005.800	BT	53	4.04	4.28	4.16	3109.7		53	3.08	3.14	3.11	2245.1		
1005.800	1005.900	BT	54	4.39	4.13	4.26	3193.6		54	4.07	5.35	4.71	3573.7		
1005.900	1006.000	BT	54	4.78	4.46	4.62	3497.4	3008.5	54	2.97	3.57	3.27	2374.8	2467.8	
1006.000	1006.100	BT	54	3.52	3.36	3.44	2513.5		54	2.68	2.56	2.62	1852.8		
1006.100	1006.200	BT	54	3.71	3.59	3.65	2686.0		54	3.46	3.28	3.37	2456.3		
1006.200	1006.300	BT	54	3.35	3.48	3.42	2493.1		54	2.73	2.53	2.63	1860.8		
1006.300	1006.400	BT	54	2.94	3.37	3.16	2281.5		54	2.46	2.34	2.40	1679.5		
1006.400	1006.500	BT	53	2.94	2.51	2.73	1936.2		53	1.96	1.99	1.98	1350.1		
1006.500	1006.600	BT	53	2.90	3.53	3.22	2330.1		53	2.62	2.61	2.62	1848.9		
1006.600	1006.700	BT	53	3.18	3.32	3.25	2358.6		53	2.76	2.64	2.70	1916.3		
1006.700	1006.800	BT	53	2.54	3.05	2.80	1992.0		53	2.09	2.03	2.06	1415.4		
1006.800	1006.900	BT	52	2.58	2.57	2.58	1817.2		52	1.89	2.08	1.99	1357.8		
1006.900	1007.000	BT	50	3.54	3.68	3.61	2653.1	2306.1	50	2.60	2.75	2.68	1896.5	1763.4	
1007.000	1007.100	BT	49	3.87	3.76	3.82	2822.4		49	2.94	3.05	3.00	2152.3		
1007.100	1007.200	BT	47	4.38	3.86	4.12	3076.3		47	2.67	3.13	2.90	2076.0		
1007.200	1007.300	BT	42	3.83	3.91	3.87	2868.0		42	3.80	3.79	3.80	2805.8		
1007.300	1007.400	BT	41	3.93	4.34	4.14	3088.8		41	3.66	3.72	3.69	2719.0		
1007.400	1007.500	BT	42	4.16	3.83	4.00	2971.9		42	3.76	4.04	3.90	2892.9		
1007.500	1007.600	BT	45	3.31	2.72	3.02	2168.4		45	3.68	2.97	3.33	2419.6		
1007.600	1007.700	BT	43	3.40	3.45	3.43	2501.3		43	3.74	3.33	3.54	2591.4		
1007.700	1007.800	BT	41	3.76	3.57	3.67	2698.4		41	2.93	3.07	3.00	2156.3		
1007.800	1007.900	BT	48	3.59	4.17	3.88	2876.3		48	3.70	3.17	3.44	2509.4		
1007.900	1008.000	BT	53	3.52	3.63	3.58	2624.3	2769.6	53	3.03	3.12	3.08	2216.8	2454.0	
1008.000	1008.100	BT	52	2.69	3.14	2.92	2088.0		52	2.46	2.49	2.48	1738.4		
1008.100	1008.200	BT	53	2.96	3.43	3.20	2313.9		53	3.73	3.13	3.43	2505.4		
1008.200	1008.300	BT	51	3.33	3.31	3.32	2415.5		51	2.97	3.05	3.01	2164.4		
1008.300	1008.400	BT	49	3.57	3.68	3.63	2665.4		49	3.71	3.32	3.52	2575.0		
1008.400	1008.500	BT	48	3.60	3.90	3.75	2768.6		48	3.67	3.62	3.65	2681.9		
1008.500	1008.600	BT	51	2.86	2.34	2.60	1837.0		51	2.18	2.12	2.15	1484.8		
1008.600	1008.700	BT	51	3.73	3.46	3.60	2640.7		51	2.76	2.80	2.78	1980.0		
1008.700	1008.800	BT	49	4.01	3.70	3.86	2855.5		49	4.36	4.53	4.45	3349.3		
1008.800	1008.900	BT	49	3.49	3.79	3.64	2677.8		49	3.18	3.75	3.47	2534.0		
1008.900	1009.000	BT	48	3.81	3.66	3.74	2756.2	2501.9	48	4.11	3.69	3.90	2892.9	2390.6	
1009.000	1009.100	BT	49	3.70	3.55	3.63	2665.4		49	3.03	2.85	2.94	2108.1		
1009.100	1009.200	BT	52	3.86	3.93	3.90	2888.7		52	3.17	2.58	2.88	2056.0		
1009.200	1009.300	BT	53	3.68	3.61	3.65	2681.9		53	4.02	3.99	4.01	2980.3		
1009.300	1009.400	BT	51	3.53	3.80	3.67	2698.4		51	2.25	2.06	2.16	1488.7		
1009.400	1009.500	BT	50	3.82	3.69	3.76	2772.7		50	2.62	3.67	3.15	2273.4		
1009.500	1009.600	BT	52	3.87	3.89	3.88	2876.3		52	2.68	2.31	2.50	1754.1		
1009.600	1009.700	BT	52	3.79	3.43	3.61	2653.1		52	2.66	2.57	2.62	1848.9		
1009.700	1009.800	BT	52	3.07	3.64	3.36	2444.1		52	2.53	2.43	2.48	1742.3		
1009.800	1009.900	BT	51	4.01	3.77	3.89	2884.6		51	3.07	3.61	3.34	2431.8		
1009.900	1010.000	BT	52	3.29	3.02	3.16	2281.5	2684.7	52	3.67	3.88	3.78	2789.3	2147.3	
1010.000	1010.100	BT	52	3.57	3.27	3.42	2497.2		52	2.55	2.62	2.59	1825.1		
1010.100	1010.200	BT	53	3.47	4.09	3.78	2793.4		53	3.01	2.99	3.00	2156.3		
1010.200	1010.300	BT	51	4.14	3.61	3.88	2872.1		51	2.93	3.51	3.22	2334.2		
1010.300	1010.400	BT	47	3.75	3.45	3.60	2644.8		47	3.53	3.53	3.53	2587.3		

Roughness Analysis of Flexible Pavement on LHS Direction: NH-27: Rakhaldubi to Kalijhar(Pkg-II)															
Chainage (km)			Inner Lane						Outer Lane						Remarks
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	
1010.400	1010.500	BT	49	3.51	3.44	3.48	2542.2		49	3.61	3.41	3.51	2570.9		
1010.500	1010.600	BT	49	3.25	3.40	3.33	2419.6		49	3.43	3.38	3.41	2484.9		
1010.600	1010.700	BT	52	3.45	3.03	3.24	2350.4		52	2.87	2.74	2.81	2000.0		
1010.700	1010.800	BT	52	3.52	3.43	3.48	2542.2		52	2.99	2.39	2.69	1908.4		
1010.800	1010.900	BT	52	3.54	3.25	3.40	2476.7		52	3.61	3.13	3.37	2456.3		
1010.900	1011.000	BT	52	3.26	2.58	2.92	2092.0	2523.1	52	2.78	2.56	2.67	1892.5	2221.6	
1011.000	1011.100	BT	53	3.65	2.35	3.00	2156.3		53	1.91	2.29	2.10	1446.2		
1011.100	1011.200	BT	52	3.43	3.19	3.31	2407.4		52	3.13	2.77	2.95	2116.1		
1011.200	1011.300	BT	52	3.43	2.82	3.13	2257.2		52	2.46	2.20	2.33	1624.7		
1011.300	1011.400	BT	51	4.22	2.79	3.51	2566.8		51	2.24	2.26	2.25	1562.4		
1011.400	1011.500	BT	48	3.62	3.35	3.49	2550.4		48	2.60	2.79	2.70	1912.3		
1011.500	1011.600	BT	50	2.69	2.56	2.63	1856.8		50	2.67	2.55	2.61	1844.9		
1011.600	1011.700	BT	50	2.87	2.97	2.92	2092.0		50	2.55	2.61	2.58	1821.2		
1011.700	1011.800	BT	51	2.41	2.58	2.50	1754.1		51	3.26	2.90	3.08	2220.8		
1011.800	1011.900	BT	50	3.54	2.92	3.23	2342.3		50	3.28	2.83	3.06	2200.7		
1011.900	1012.000	BT	49	3.12	3.02	3.07	2212.8	2219.6	49	3.12	2.79	2.96	2120.1	1887.0	
1012.000	1012.100	BT	48	2.30	2.52	2.41	1687.3		48	2.15	2.10	2.13	1465.5		
1012.100	1012.200	BT	50	4.03	3.84	3.94	2922.0		50	2.74	2.46	2.60	1837.0		
1012.200	1012.300	BT	52	3.23	3.53	3.38	2464.5		52	3.50	3.73	3.62	2657.2		
1012.300	1012.400	BT	45	3.25	3.57	3.41	2489.0		45	3.66	3.28	3.47	2538.1		
1012.400	1012.500	BT	29	2.70	3.50	3.10	2237.0		29	2.84	3.19	3.02	2168.4		
1012.500	1012.600	BT	36	5.93	4.51	5.22	4009.9		36	2.80	2.96	2.88	2060.0		
1012.600	1012.700	BT	30	4.44	4.74	4.59	3471.9		30	4.83	4.18	4.51	3400.0		
1012.700	1012.800	BT	31	3.73	3.50	3.62	2657.2		31	3.34	3.70	3.52	2579.1		
1012.800	1012.900	BT	16	2.64	2.44	2.54	1789.6		16	3.60	3.95	3.78	2789.3		
1012.900	1013.000	BT	20	3.54	3.02	3.28	2383.0	2611.1	20	2.84	2.91	2.88	2056.0	2355.0	

Roughness Analysis of Flexible Pavement on RHS Direction: NH-27: Rakhaldubi to Kalijhar (Pkg-II)															
Chainage (km)			Inner Lane						Outer Lane						
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Remarks
1001.620	1001.500	BT	46	4.55	4.15	4.35	3269.3		46	4.02	3.67	3.85	2847.2		
1001.500	1001.400	BT	45	3.69	4.27	3.98	2959.4		45	4.42	4.07	4.25	3181.0		
1001.400	1001.300	BT	32	5.10	4.93	5.02	3833.9		32	4.08	4.33	4.21	3147.4		
1001.300	1001.200	BT	24	3.84	3.95	3.90	2888.7		24	4.78	4.80	4.79	3641.8		
1001.200	1001.100	BT	33	3.74	3.62	3.68	2710.8		33	4.84	4.71	4.78	3629.0		
1001.100	1001.000	BT	31	4.06	3.96	4.01	2984.4		31	4.78	4.80	4.79	3641.8		
1001.000	1000.920	BT	30	5.78	5.83	5.81	4516.5	3309.0	30	3.45	3.59	3.52	2579.1	3238.2	
969.890	969.800	BT	34	2.80	2.97	2.89	2064.0		34	3.50	3.30	3.40	2480.8		
969.800	969.700	BT	34	3.14	3.27	3.21	2322.0		34	3.14	2.97	3.06	2200.7		
969.700	969.600	BT	32	3.20	3.21	3.21	2322.0		32	2.99	3.29	3.14	2269.4		
969.600	969.500	BT	27	3.50	3.52	3.51	2570.9		27	3.09	3.04	3.07	2208.7		
969.500	969.400	BT	19	3.52	3.27	3.40	2476.7		19	3.24	3.41	3.33	2419.6		
969.400	969.300	BT	26	2.88	3.33	3.11	2241.0		26	2.99	2.93	2.96	2124.2		
969.300	969.200	BT	29	3.25	3.15	3.20	2318.0		29	3.08	3.10	3.09	2228.9		
969.200	969.100	BT	26	3.33	4.38	3.86	2855.5		26	3.21	3.21	3.21	2326.1		
969.100	969.000	BT	24	2.82	3.68	3.25	2358.6	2392.1	24	2.86	2.90	2.88	2060.0	2257.6	
969.000	968.900	BT	24	2.70	3.07	2.89	2064.0		24	3.84	4.14	3.99	2967.8		
968.900	968.800	BT	38	3.59	4.46	4.03	2996.9		38	2.84	3.08	2.96	2124.2		
968.800	968.700	BT	44	3.63	3.60	3.62	2657.2		44	3.17	2.91	3.04	2188.6		
968.700	968.600	BT	45	3.43	3.34	3.39	2468.6		45	2.19	3.05	2.62	1852.8		
968.600	968.500	BT	38	4.41	4.22	4.32	3239.8		38	3.31	3.02	3.17	2289.6		
968.500	968.400	BT	43	3.27	3.44	3.36	2444.1		43	3.40	2.91	3.16	2281.5		
968.400	968.300	BT	46	3.44	3.14	3.29	2391.1		46	3.24	2.52	2.88	2060.0		
968.300	968.200	BT	46	3.41	3.38	3.40	2476.7		46	3.37	3.71	3.54	2595.5		
968.200	968.100	BT	48	3.78	3.71	3.75	2764.4		48	3.16	3.26	3.21	2326.1		
968.100	968.000	BT	48	3.16	2.80	2.98	2140.2	2564.3	48	3.05	3.09	3.07	2212.8	2289.9	
968.000	967.900	BT	48	3.28	3.35	3.32	2411.5		48	3.19	3.25	3.22	2334.2		
967.900	967.800	BT	49	3.58	3.02	3.30	2399.3		49	3.41	3.17	3.29	2391.1		
967.800	967.700	BT	49	3.60	3.23	3.42	2493.1		49	2.72	3.09	2.91	2080.0		
967.700	967.600	BT	47	2.68	2.76	2.72	1932.2		47	3.09	2.90	3.00	2152.3		
967.600	967.500	BT	48	3.21	3.41	3.31	2407.4		48	2.99	3.19	3.09	2228.9		
967.500	967.400	BT	48	2.87	2.87	2.87	2052.0		48	2.57	2.96	2.77	1968.1		
967.400	967.300	BT	49	2.59	2.59	2.59	1829.1		49	2.61	2.64	2.63	1856.8		
967.300	967.200	BT	51	2.28	2.42	2.35	1640.4		51	2.40	2.82	2.61	1844.9		
967.200	967.100	BT	52	3.10	2.82	2.96	2124.2		52	2.25	2.04	2.15	1480.9		
967.100	967.000	BT	51	2.97	2.81	2.89	2068.0	2135.7	51	3.06	3.38	3.22	2334.2	2067.1	
967.000	966.900	BT	48	2.80	3.26	3.03	2180.5		48	3.16	3.29	3.23	2338.3		
966.900	966.800	BT	37	3.22	3.65	3.44	2509.4		37	3.19	3.61	3.40	2480.8		
966.800	966.700	BT	44	3.35	3.68	3.52	2575.0		44	3.22	3.63	3.43	2501.3		
966.700	966.600	BT	48	3.70	3.50	3.60	2644.8		48	2.82	2.71	2.77	1968.1		
966.600	966.500	BT	45	3.72	3.46	3.59	2636.6		45	3.27	3.30	3.29	2387.0		
966.500	966.400	BT	47	3.53	3.36	3.45	2517.6		47	2.84	2.84	2.84	2027.9		
966.400	966.300	BT	45	3.36	3.70	3.53	2587.3		45	3.41	3.01	3.21	2326.1		
966.300	966.200	BT	43	3.45	3.47	3.46	2529.9		43	3.28	3.53	3.41	2484.9		
966.200	966.100	BT	49	3.55	3.48	3.52	2575.0		49	3.15	3.28	3.22	2330.1		
966.100	966.000	BT	49	3.31	3.26	3.29	2387.0	2514.3	49	3.25	3.51	3.38	2464.5	2330.9	
966.000	965.900	BT	51	3.31	2.99	3.15	2277.4		51	3.17	2.86	3.02	2168.4		
965.900	965.800	BT	51	3.07	2.95	3.01	2164.4		51	2.98	2.91	2.95	2112.1		
965.800	965.700	BT	51	3.56	3.25	3.41	2484.9		51	4.52	4.14	4.33	3252.4		
965.700	965.600	BT	50	4.36	4.27	4.32	3239.8		50	3.04	3.09	3.07	2208.7		
965.600	965.500	BT	51	3.14	3.36	3.25	2358.6		51	3.41	3.72	3.57	2616.1		
965.500	965.400	BT	51	3.31	3.19	3.25	2358.6		51	3.06	3.27	3.17	2289.6		
965.400	965.300	BT	51	3.80	3.75	3.78	2789.3		51	3.47	3.27	3.37	2456.3		
965.300	965.200	BT	52	3.08	3.32	3.20	2318.0		52	3.14	3.27	3.21	2322.0		
965.200	965.080	BT	43	3.58	3.03	3.31	2403.3	2488.3	43	3.32	3.27	3.30	2395.2	2424.5	

Roughness Analysis of Rigid Pavement on LHS Direction: NH-27: Rakhaldubi to Kalijhar(Pkg-II)															
Chainage (km)			Inner Lane						Outer Lane						Remarks
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	
965.360	965.500	CC	50	5.02	6.12	5.57	4312.2		50	6.14	6.34	6.24	4897.2		
965.500	965.600	CC	50	3.55	3.21	3.38	2464.5		50	3.90	4.10	4.00	2976.1		
965.600	965.700	CC	50	2.67	2.77	2.72	1932.2		50	3.65	3.18	3.42	2493.1		
965.700	965.800	CC	51	4.33	3.97	4.15	3101.4		51	3.70	3.56	3.63	2669.5		
965.800	965.900	CC	51	3.67	3.26	3.47	2534.0		51	3.68	3.57	3.63	2665.4		
965.900	966.000	CC	52	2.52	2.66	2.59	1829.1	2695.6	52	2.78	2.68	2.73	1940.2	2940.3	
966.000	966.100	CC	49	4.06	4.61	4.34	3256.6		49	4.54	3.91	4.23	3164.2		
966.100	966.200	CC	47	4.52	4.15	4.34	3256.6		47	4.04	4.19	4.12	3072.1		
966.200	966.300	CC	49	2.07	1.96	2.02	1380.8		49	2.60	2.54	2.57	1813.3		
966.300	966.400	CC	51	2.98	2.51	2.75	1952.1		51	2.75	2.60	2.68	1896.5		
966.400	966.500	CC	51	2.77	2.39	2.58	1821.2		51	2.63	2.30	2.47	1730.5		
966.500	966.600	CC	48	3.00	2.64	2.82	2012.0		48	2.54	2.59	2.57	1809.3		
966.600	966.700	CC	44	2.24	2.02	2.13	1469.4		44	2.63	2.50	2.57	1809.3		
966.700	966.800	CC	47	2.51	1.82	2.17	1496.4		47	2.41	2.39	2.40	1679.5		
966.800	966.900	CC	48	2.86	2.86	2.86	2044.0		48	3.13	3.09	3.11	2245.1		
966.900	967.000	CC	50	2.97	2.76	2.87	2048.0	2073.7	50	3.00	2.85	2.93	2096.0	2131.6	
967.000	967.100	CC	51	2.87	2.87	2.87	2052.0		51	2.40	2.65	2.53	1777.8		
967.100	967.200	CC	51	3.26	2.78	3.02	2172.4		51	2.93	2.84	2.89	2064.0		
967.200	967.300	CC	52	2.71	2.38	2.55	1793.5		52	2.97	2.95	2.96	2124.2		
967.300	967.400	CC	51	2.48	2.26	2.37	1656.0		51	2.60	2.66	2.63	1860.8		
967.400	967.500	CC	51	2.53	2.02	2.28	1581.8		51	2.30	2.25	2.28	1581.8		
967.500	967.600	CC	51	1.85	1.89	1.87	1270.0		51	2.14	2.34	2.24	1554.6		
967.600	967.700	CC	51	2.08	2.06	2.07	1423.1		51	2.40	2.27	2.34	1628.6		
967.700	967.800	CC	52	2.23	2.39	2.31	1609.1		52	3.34	2.84	3.09	2228.9		
967.800	967.900	CC	52	3.06	2.53	2.80	1992.0		52	3.04	2.40	2.72	1932.2		
967.900	968.000	CC	53	2.92	2.95	2.94	2104.1	1765.4	53	3.25	3.64	3.45	2517.6	1927.0	
968.000	968.100	CC	52	3.34	3.07	3.21	2322.0		52	3.84	3.25	3.55	2599.6		
968.100	968.200	CC	53	2.91	3.28	3.10	2233.0		53	3.31	3.09	3.20	2318.0		
968.200	968.300	CC	52	1.73	2.20	1.97	1342.5		52	2.11	2.25	2.18	1508.0		
968.300	968.400	CC	52	3.00	3.61	3.31	2403.3		52	3.08	3.15	3.12	2249.1		
968.400	968.500	CC	52	3.01	2.88	2.95	2112.1		52	3.48	3.10	3.29	2391.1		
968.500	968.600	CC	52	2.30	2.59	2.45	1714.8		52	2.48	2.12	2.30	1601.3		
968.600	968.700	CC	53	1.80	2.17	1.99	1357.8		53	1.89	1.95	1.92	1308.1		
968.700	968.800	CC	52	3.00	2.73	2.87	2048.0		52	3.06	2.96	3.01	2164.4		
968.800	968.900	CC	52	2.56	2.96	2.76	1964.1		52	2.41	2.24	2.33	1620.8		
968.900	969.000	CC	53	2.83	2.89	2.86	2044.0	1954.1	53	2.80	2.87	2.84	2024.0	1978.4	
969.000	969.100	CC	52	3.24	3.24	3.24	2350.4		52	2.91	3.38	3.15	2273.4		
969.100	969.200	CC	51	3.07	3.38	3.23	2338.3		51	3.23	3.19	3.21	2326.1		
969.200	969.300	CC	50	3.26	2.93	3.10	2233.0		50	3.40	2.96	3.18	2301.8		
969.300	969.400	CC	52	2.92	2.78	2.85	2035.9		52	3.03	2.77	2.90	2076.0		
969.400	969.500	CC	52	3.02	2.94	2.98	2140.2		52	3.86	3.20	3.53	2587.3		
969.500	969.600	CC	49	4.90	4.63	4.77	3620.5		49	4.11	3.70	3.91	2897.1		
969.600	969.700	CC	42	4.08	3.54	3.81	2818.2		42	4.10	3.84	3.97	2951.1		
969.700	969.800	CC	47	3.39	3.19	3.29	2391.1		47	3.37	3.08	3.23	2338.3		
969.800	969.900	CC	52	3.60	3.14	3.37	2456.3		52	3.25	3.33	3.29	2391.1		
969.900	970.050	CC	52	5.76	5.77	5.77	4481.6	2686.6	52	4.62	4.55	4.59	3467.7	2561.0	
970.950	971.100	CC	38	2.89	3.35	3.12	2253.2		38	3.01	3.26	3.14	2265.3		
971.100	971.200	CC	36	3.29	3.35	3.32	2415.5		36	3.33	3.47	3.40	2480.8		
971.200	971.300	CC	15	3.01	3.31	3.16	2285.5		15	3.12	3.38	3.25	2358.6		
971.300	971.400	CC	24	3.46	3.16	3.31	2407.4		24	3.48	3.30	3.39	2472.7		
971.400	971.500	CC	38	3.21	3.16	3.19	2305.8		38	3.29	3.23	3.26	2366.7		
971.500	971.600	CC	36	3.30	2.94	3.12	2253.2		36	3.43	3.29	3.36	2448.2		
971.600	971.670	CC	37	3.44	3.15	3.30	2395.2	2330.8	37	3.64	3.66	3.65	2686.0	2439.8	

Roughness Analysis of Rigid Pavement on RHS Direction: NH-27: Rakhaldubi to Kalijhar (Pkg-II)															
Chainage (km)			Inner Lane						Outer Lane						
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Remarks
1013.000	1012.900	CC	21	3.34	3.71	3.53	2583.2		21	3.24	3.30	3.27	2374.8		
1012.900	1012.800	CC	35	3.46	3.44	3.45	2521.7		35	3.22	3.34	3.28	2383.0		
1012.800	1012.700	CC	38	3.94	4.00	3.97	2951.1		38	3.19	3.51	3.35	2440.0		
1012.700	1012.600	CC	32	4.65	4.24	4.45	3349.3		32	4.62	4.03	4.33	3248.2		
1012.600	1012.500	CC	28	4.41	4.62	4.52	3408.5		28	4.38	4.73	4.56	3442.3		
1012.500	1012.400	CC	39	4.10	4.34	4.22	3160.0		39	2.93	3.35	3.14	2269.4		
1012.400	1012.300	CC	45	3.83	3.86	3.85	2847.2		45	3.36	3.31	3.34	2427.8		
1012.300	1012.200	CC	44	3.65	3.25	3.45	2521.7		44	4.05	3.87	3.96	2942.8		
1012.200	1012.100	CC	39	3.43	3.47	3.45	2521.7		39	3.38	3.49	3.44	2509.4		
1012.100	1012.000	CC	40	4.04	4.32	4.18	3126.5	2899.1	40	3.78	3.39	3.59	2632.5	2667.0	
1012.000	1011.900	CC	46	3.95	3.59	3.77	2785.1		46	3.57	3.72	3.65	2681.9		
1011.900	1011.800	CC	46	4.38	3.86	4.12	3076.3		46	4.08	3.78	3.93	2917.8		
1011.800	1011.700	CC	46	4.48	3.92	4.20	3143.3		46	3.27	2.86	3.07	2208.7		
1011.700	1011.600	CC	47	3.34	3.86	3.60	2644.8		47	3.78	3.33	3.56	2607.8		
1011.600	1011.500	CC	47	3.34	4.21	3.78	2789.3		47	3.57	3.48	3.53	2583.2		
1011.500	1011.400	CC	47	4.03	3.83	3.93	2917.8		47	3.08	3.10	3.09	2228.9		
1011.400	1011.300	CC	48	4.34	4.10	4.22	3160.0		48	3.86	3.81	3.84	2839.0		
1011.300	1011.200	CC	49	3.36	3.43	3.40	2476.7		49	2.41	2.85	2.63	1860.8		
1011.200	1011.100	CC	50	3.18	3.48	3.33	2423.7		50	3.63	3.42	3.53	2583.2		
1011.100	1011.000	CC	49	3.56	3.24	3.40	2480.8	2789.8	49	2.83	3.02	2.93	2096.0	2460.7	
1011.000	1010.900	CC	50	3.89	3.86	3.88	2872.1		50	2.97	3.24	3.11	2241.0		
1010.900	1010.800	CC	50	3.55	3.62	3.59	2632.5		50	4.04	3.25	3.65	2681.9		
1010.800	1010.700	CC	50	3.83	3.67	3.75	2768.6		50	4.16	4.29	4.23	3164.2		
1010.700	1010.600	CC	45	5.15	5.07	5.11	3915.4		45	4.53	4.67	4.60	3480.4		
1010.600	1010.500	CC	42	4.09	4.14	4.12	3072.1		42	5.61	5.36	5.49	4238.6		
1010.500	1010.400	CC	23	4.98	4.38	4.68	3548.3		23	5.15	4.75	4.95	3778.3		
1010.400	1010.300	CC	39	3.59	4.00	3.80	2805.8		39	3.11	3.32	3.22	2330.1		
1010.300	1010.200	CC	46	4.06	4.18	4.12	3076.3		46	3.76	3.41	3.59	2632.5		
1010.200	1010.100	CC	47	3.89	3.24	3.57	2616.1		47	4.47	4.00	4.24	3172.6		
1010.100	1010.000	CC	47	3.19	3.11	3.15	2277.4	2958.5	47	3.51	3.24	3.38	2460.4	3018.0	
1010.000	1009.900	CC	47	4.77	4.20	4.49	3383.1		47	3.57	3.58	3.58	2624.3		
1009.900	1009.800	CC	48	4.30	4.14	4.22	3160.0		48	3.78	3.42	3.60	2644.8		
1009.800	1009.700	CC	47	4.30	4.23	4.27	3197.8		47	3.93	3.82	3.88	2872.1		
1009.700	1009.600	CC	42	4.58	3.74	4.16	3109.7		42	3.64	3.65	3.65	2681.9		
1009.600	1009.500	CC	48	3.57	2.92	3.25	2354.5		48	2.63	3.29	2.96	2124.2		
1009.500	1009.400	CC	46	3.02	2.83	2.93	2096.0		46	2.79	2.95	2.87	2052.0		
1009.400	1009.300	CC	36	3.57	3.57	3.57	2620.2		36	3.42	4.23	3.83	2830.7		
1009.300	1009.200	CC	33	3.52	4.01	3.77	2781.0		33	3.83	4.11	3.97	2951.1		
1009.200	1009.100	CC	36	5.33	5.06	5.20	3988.4		36	4.80	4.99	4.90	3731.3		
1009.100	1009.000	CC	39	3.38	3.63	3.51	2566.8	2925.8	39	3.99	3.50	3.75	2764.4	2727.7	
1009.000	1008.900	CC	39	4.17	3.69	3.93	2917.8		39	5.27	4.91	5.09	3898.2		
1008.900	1008.800	CC	44	3.30	3.34	3.32	2415.5		44	3.77	3.48	3.63	2665.4		
1008.800	1008.700	CC	49	3.25	3.39	3.32	2415.5		49	3.79	3.87	3.83	2834.8		
1008.700	1008.600	CC	49	4.14	4.79	4.47	3366.2		49	4.29	4.58	4.44	3340.9		
1008.600	1008.500	CC	50	3.84	4.27	4.06	3022.0		50	4.28	4.36	4.32	3244.0		
1008.500	1008.400	CC	50	4.79	4.26	4.53	3416.9		50	4.73	4.02	4.38	3290.3		
1008.400	1008.300	CC	47	4.42	4.59	4.51	3400.0		47	4.43	4.60	4.52	3408.5		
1008.300	1008.200	CC	47	4.68	4.58	4.63	3505.8		47	4.59	4.21	4.40	3311.4		
1008.200	1008.100	CC	48	3.74	4.00	3.87	2868.0		48	4.69	4.59	4.64	3514.3		
1008.100	1008.000	CC	51	5.06	4.64	4.85	3692.9	3102.1	51	4.48	4.10	4.29	3218.8	3272.7	
1008.000	1007.900	CC	51	3.46	2.66	3.06	2204.7		51	3.14	2.66	2.90	2076.0		
1007.900	1007.800	CC	50	6.48	5.85	6.17	4831.3		50	4.81	4.60	4.71	3569.5		
1007.800	1007.700	CC	50	4.74	4.19	4.47	3366.2		50	4.41	4.84	4.63	3501.6		
1007.700	1007.600	CC	51	3.23	3.03	3.13	2261.3		51	3.77	3.16	3.47	2534.0		
1007.600	1007.500	CC	44	2.82	2.46	2.64	1868.7		44	3.28	3.10	3.19	2309.9		
1007.500	1007.400	CC	26	5.32	4.87	5.10	3902.5		26	5.09	4.66	4.88	3714.3		
1007.400	1007.300	CC	36	4.04	4.20	4.12	3076.3		36	4.71	4.08	4.40	3307.2		
1007.300	1007.200	CC	36	3.82	3.51	3.67	2698.4		36	3.36	3.73	3.55	2599.6		
1007.200	1007.100	CC	39	5.11	4.64	4.88	3714.3		39	4.11	4.19	4.15	3101.4		
1007.100	1007.000	CC	48	4.07	3.78	3.93	2913.7	3083.7	48	2.95	2.95	2.95	2116.1	2882.9	
1007.000	1006.900	CC	42	2.62	2.53	2.58	1817.2		42	2.57	2.50	2.54	1785.6		
1006.900	1006.800	CC	44	3.52	3.37	3.45	2517.6		44	3.28	3.26	3.27	2374.8		
1006.800	1006.700	CC	48	3.34	3.63	3.49	2550.4		48	2.94	2.98	2.96	2124.2		
1006.700	1006.600	CC	47	3.46	3.29	3.38	2460.4		47	3.23	2.86	3.05	2192.6		
1006.600	1006.500	CC	43	4.69	4.52	4.61	3484.6		43	3.75	3.67	3.71	2735.5		
1006.500	1006.400	CC	43	3.16	3.14	3.15	2277.4		43	3.07	2.83	2.95	2116.1		
1006.400	1006.300	CC	49	3.23	3.37	3.30	2399.3		49	3.66	3.72	3.69	2719.0		
1006.300	1006.200	CC	50	3.56	3.57	3.57	2616.1		50	3.32	3.00	3.16	2285.5		
1006.200	1006.100	CC	43	5.00	4.59	4.80	3646.1		43	4.86	4.49	4.68	3544.0		
1006.100	1006.000	CC	42	3.77	4.13	3.95	2934.5	2670.4	42	4.54	4.88	4.71	3573.7	2545.1	
1006.000	1005.900	CC	48	2.80	2.51	2.66	1880.6		48	2.65	2.57	2.61	1844.9		
1005.900	1005.800	CC	50	4.16	3.47	3.82	2822.4		50	2.96	2.68	2.82	2012.0		
1005.800	1005.700	CC	51	3.79	3.56	3.68	2706.6		51	2.93	2.65	2.79	1988.0		
1005.700	1005.600	CC	52	3.09	3.24	3.17	2289.6		52	2.93	2.81	2.87	2052.0		
1005.600	1005.500	CC	51	3.16	3.22	3.19	2309.9		51	3.35	3.04	3.20	2313.9		
1005.500	1005.400	CC	48	2.90	2.74	2.82	2012.0		48	3.04	2.82	2.93	2100.1		
1005.400	1005.300	CC	42	3.25	3.16	3.21	2322.0		42	3.40	3.11	3.26	2362.6		
1005.300	1005.200	CC	30	3.97	4.54	4.26	3189.4		30	4.42	4.41	4.42	3324.0		
1005.200	1005.100	CC	37	3.57	3.64	3.61	2649.0		37	4.23	4.09	4.16	3109.7		
1005.100	1005.000	CC	34	3.68	3.67	3.68	2706.6	2488.8	34	4.51	4.46	4.49	3383.1	2449.0	
1005.000	1004.900	CC	41	3.55	3.71	3.63	2669.5		41	3.86	3.69	3.78	2789.3		
1004.900	1004.800	CC	47	3.60	3.81	3.71	2731.4		47	2.55	2.81	2.68	1900.4		
1004.800	1004.700	CC	50	3.31	2.78	3.05	2192.6		50	2.72	2.33	2.53	1777.8		
1004.700	1004.600	CC	43	2.84	2.58	2.71	1924.3		43	2.74	2.69	2.72	1928.2		

Roughness Analysis of Rigid Pavement on RHS Direction: NH-27: Rakhaldubi to Kalijhar (Pkg-II)															
Chainage (km)			Inner Lane						Outer Lane						
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Remarks
1004.600	1004.500	CC	43	3.14	2.84	2.99	2148.3		43	3.44	3.20	3.32	2415.5		
1004.500	1004.400	CC	41	2.84	2.49	2.67	1888.5		41	3.65	3.24	3.45	2517.6		
1004.400	1004.300	CC	36	3.18	3.07	3.13	2257.2		36	4.43	3.85	4.14	3093.0		
1004.300	1004.200	CC	32	2.50	2.92	2.71	1924.3		32	4.33	4.12	4.23	3164.2		
1004.200	1004.100	CC	31	3.83	3.81	3.82	2826.5		31	3.63	3.78	3.71	2731.4		
1004.100	1004.000	CC	26	3.20	3.32	3.26	2366.7	2292.9	26	3.30	3.38	3.34	2431.8	2474.9	
1004.000	1003.900	CC	19	3.36	3.73	3.55	2599.6		19	5.94	5.96	5.95	4643.0		
1003.900	1003.800	CC	34	3.84	3.58	3.71	2735.5		34	6.13	5.92	6.03	4708.6		
1003.800	1003.700	CC	40	4.13	4.64	4.39	3298.7		40	4.28	3.51	3.90	2888.7		
1003.700	1003.600	CC	44	3.46	3.19	3.33	2419.6		44	3.23	2.58	2.91	2080.0		
1003.600	1003.500	CC	47	3.88	3.59	3.74	2756.2		47	2.92	2.83	2.88	2056.0		
1003.500	1003.400	CC	48	2.70	3.03	2.87	2048.0		48	2.30	2.05	2.18	1504.2		
1003.400	1003.300	CC	50	2.90	3.21	3.06	2200.7		50	3.11	2.93	3.02	2172.4		
1003.300	1003.200	CC	52	2.89	2.91	2.90	2076.0		52	2.11	1.88	2.00	1365.5		
1003.200	1003.100	CC	52	2.75	2.56	2.66	1880.6		52	3.65	3.48	3.57	2616.1		
1003.100	1003.000	CC	47	4.59	4.99	4.79	3641.8	2565.7	47	3.49	3.63	3.56	2611.9	2664.6	
1003.000	1002.900	CC	48	2.87	3.07	2.97	2132.2		48	2.26	2.26	2.26	1570.2		
1002.900	1002.800	CC	50	1.99	2.14	2.07	1419.2		50	2.10	2.05	2.08	1426.9		
1002.800	1002.700	CC	50	2.66	3.00	2.83	2020.0		50	3.32	2.64	2.98	2140.2		
1002.700	1002.600	CC	51	3.74	3.51	3.63	2665.4		51	3.37	3.08	3.23	2338.3		
1002.600	1002.500	CC	47	3.25	3.14	3.20	2313.9		47	3.29	2.57	2.93	2100.1		
1002.500	1002.400	CC	30	3.07	2.87	2.97	2132.2		30	3.74	3.62	3.68	2710.8		
1002.400	1002.300	CC	31	4.08	3.66	3.87	2868.0		31	3.04	2.92	2.98	2140.2		
1002.300	1002.200	CC	41	2.47	2.15	2.31	1609.1		41	3.19	3.72	3.46	2525.8		
1002.200	1002.100	CC	45	3.57	3.33	3.45	2521.7		45	2.64	2.74	2.69	1908.4		
1002.100	1002.000	CC	45	3.49	3.33	3.41	2489.0	2217.1	45	3.32	3.00	3.16	2285.5	2114.6	
1002.000	1001.900	CC	48	3.85	3.56	3.71	2731.4		48	3.19	3.19	3.19	2309.9		
1001.900	1001.800	CC	47	4.17	3.63	3.90	2892.9		47	3.52	3.32	3.42	2497.2		
1001.800	1001.700	CC	47	4.12	3.92	4.02	2992.8		47	3.73	3.76	3.75	2764.4		
1001.700	1001.620	CC	46	4.02	3.67	3.85	2847.2	2866.1	46	4.19	4.43	4.31	3235.6	2701.8	
1000.920	1000.800	CC	34	6.19	6.28	6.24	4892.8		34	6.06	5.97	6.02	4699.9		
1000.800	1000.700	CC	39	4.47	4.73	4.60	3480.4		39	3.84	3.95	3.90	2888.7		
1000.700	1000.600	CC	42	4.15	3.83	3.99	2967.8		42	4.63	4.52	4.58	3459.2		
1000.600	1000.500	CC	44	5.17	4.64	4.91	3739.9		44	4.78	4.80	4.79	3641.8		
1000.500	1000.400	CC	45	3.95	3.43	3.69	2719.0		45	3.44	3.15	3.30	2395.2		
1000.400	1000.300	CC	44	2.88	3.49	3.19	2305.8		44	4.03	4.16	4.10	3055.4		
1000.300	1000.200	CC	45	3.84	3.38	3.61	2653.1		45	4.41	4.21	4.31	3235.6		
1000.200	1000.100	CC	45	3.72	3.75	3.74	2756.2		45	2.79	2.61	2.70	1916.3		
1000.100	1000.000	CC	43	3.28	3.21	3.25	2354.5	3096.6	43	2.56	2.79	2.68	1896.5	3021.0	
1000.000	999.900	CC	37	2.93	3.22	3.08	2216.8		37	3.01	3.26	3.14	2265.3		
999.900	999.800	CC	29	3.87	3.94	3.91	2897.1		29	3.64	3.52	3.58	2628.4		
999.800	999.700	CC	34	3.71	3.99	3.85	2851.4		34	2.77	2.87	2.82	2012.0		
999.700	999.600	CC	34	3.08	3.59	3.34	2427.8		34	2.69	2.97	2.83	2020.0		
999.600	999.500	CC	39	3.85	3.49	3.67	2702.5		39	3.82	3.40	3.61	2653.1		
999.500	999.400	CC	41	3.27	3.47	3.37	2456.3		41	4.06	3.96	4.01	2984.4		
999.400	999.300	CC	37	3.94	3.61	3.78	2789.3		37	3.45	3.59	3.52	2579.1		
999.300	999.200	CC	43	3.67	3.61	3.64	2677.8		43	3.20	3.30	3.25	2358.6		
999.200	999.100	CC	44	5.07	4.46	4.77	3620.5		44	4.80	4.27	4.54	3425.4		
999.100	999.000	CC	46	5.64	5.61	5.63	4359.9	2899.9	46	3.82	3.51	3.67	2698.4	2562.5	
999.000	998.900	CC	48	5.16	5.49	5.33	4100.3		48	2.67	2.45	2.56	1805.4		
998.900	998.800	CC	49	3.14	3.50	3.32	2415.5		49	2.20	2.15	2.18	1504.2		
998.800	998.700	CC	49	5.25	4.73	4.99	3812.5		49	5.14	5.10	5.12	3923.9		
998.700	998.600	CC	51	3.43	3.54	3.49	2550.4		51	2.80	2.61	2.71	1920.3		
998.600	998.500	CC	53	3.04	3.56	3.30	2399.3		53	2.33	2.20	2.27	1574.0		
998.500	998.400	CC	53	4.09	4.20	4.15	3097.2		53	3.32	3.22	3.27	2374.8		
998.400	998.300	CC	52	2.98	3.00	2.99	2148.3		52	3.58	3.25	3.42	2493.1		
998.300	998.200	CC	53	2.23	2.31	2.27	1577.9		53	2.38	2.34	2.36	1648.2		
998.200	998.100	CC	49	3.17	3.14	3.16	2281.5		49	2.89	2.94	2.92	2088.0		
998.100	998.000	CC	50	3.29	3.58	3.44	2509.4	2689.2	50	3.61	3.40	3.51	2566.8	2189.9	
998.000	997.900	CC	53	2.46	2.30	2.38	1663.8		53	2.04	2.08	2.06	1415.4		
997.900	997.800	CC	53	3.73	3.57	3.65	2686.0		53	2.87	2.69	2.78	1980.0		
997.800	997.700	CC	53	3.42	3.33	3.38	2460.4		53	3.74	3.01	3.38	2460.4		
997.700	997.600	CC	52	3.69	3.52	3.61	2649.0		52	3.80	3.17	3.49	2550.4		
997.600	997.500	CC	54	2.55	2.66	2.61	1841.0		54	2.45	2.22	2.34	1628.6		
997.500	997.400	CC	53	3.27	2.99	3.13	2261.3		53	2.70	2.61	2.66	1880.6		
997.400	997.300	CC	53	4.02	3.75	3.89	2880.4		53	4.16	3.73	3.95	2930.3		
997.300	997.200	CC	55	3.32	2.91	3.12	2249.1		55	3.05	2.33	2.69	1908.4		
997.200	997.100	CC	55	3.47	3.04	3.26	2362.6		55	2.55	2.40	2.48	1738.4		
997.100	997.000	CC	51	3.76	3.59	3.68	2706.6	2376.0	51	3.38	3.80	3.59	2636.6	2112.9	
997.000	996.900	CC	50	4.06	4.09	4.08	3038.7		50	4.42	3.76	4.09	3051.2		
996.900	996.800	CC	54	3.11	3.06	3.09	2224.9		54	2.57	2.30	2.44	1706.9		
996.800	996.700	CC	48	3.77	3.91	3.84	2843.1		48	3.24	3.39	3.32	2411.5		
996.700	996.600	CC	34	2.48	2.70	2.59	1829.1		34	2.69	3.20	2.95	2112.1		
996.600	996.500	CC	37	3.18	2.87	3.03	2176.5		37	2.94	3.09	3.02	2168.4		
996.500	996.400	CC	40	5.06	3.97	4.52	3408.5		40	3.15	3.33	3.24	2350.4		
996.400	996.300	CC	35	4.05	3.73	3.89	2884.6		35	4.95	4.55	4.75	3607.8		
996.300	996.200	CC	35	3.80	4.24	4.02	2992.8		35	4.08	4.33	4.21	3147.4		
996.200	996.100	CC	37	3.86	3.58	3.72	2743.8		37	5.06	4.99	5.03	3842.5		
996.100	996.000	CC	38	3.84	3.82	3.83	2834.8	2697.7	38	4.48	4.24	4.36	3277.7	2767.6	
996.000	995.900	CC	37	4.04	3.85	3.95	2930.3		37	3.91	3.84	3.88	2872.1		
995.900	995.800	CC	35	5.81	5.57	5.69	4416.4		35	5.25	4.73	4.99	3812.5		
995.800	995.700	CC	43	3.33	2.97	3.15	2277.4		43	2.73	2.79	2.76	1964.1		
995.700	995.600	CC	50	2.93	2.79	2.86	2044.0		50	2.33	3.10	2.72	1928.2		
995.600	995.500	CC	52	3.23	2.96	3.10	2233.0		52	2.20	2.42	2.31	1609.1		

Roughness Analysis of Rigid Pavement on RHS Direction: NH-27: Rakhaldubi to Kalijhar (Pkg-II)															
Chainage (km)			Inner Lane						Outer Lane						
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Remarks
995.500	995.400	CC	51	3.16	3.26	3.21	2326.1		51	2.71	2.71	2.71	1924.3		
995.400	995.300	CC	50	4.07	3.61	3.84	2843.1		50	3.93	3.57	3.75	2768.6		
995.300	995.200	CC	47	3.20	3.65	3.43	2501.3		47	3.22	3.59	3.41	2484.9		
995.200	995.100	CC	40	3.19	3.16	3.18	2297.7		40	3.52	3.09	3.31	2403.3		
995.100	995.000	CC	27	2.13	2.12	2.13	1465.5	2533.5	27	2.75	2.72	2.74	1944.2	2371.1	
995.000	994.900	CC	30	3.31	3.22	3.27	2370.8		30	3.82	3.71	3.77	2781.0		
994.900	994.800	CC	43	2.72	3.20	2.96	2124.2		43	2.44	2.40	2.42	1695.2		
994.800	994.700	CC	47	3.45	3.02	3.24	2346.4		47	3.45	3.16	3.31	2403.3		
994.700	994.600	CC	47	3.16	3.38	3.27	2374.8		47	3.41	3.19	3.30	2399.3		
994.600	994.500	CC	48	2.94	3.01	2.98	2136.2		48	2.53	2.82	2.68	1896.5		
994.500	994.400	CC	48	3.23	3.66	3.45	2517.6		48	2.81	2.86	2.84	2024.0		
994.400	994.300	CC	51	3.11	3.28	3.20	2313.9		51	2.77	2.90	2.84	2024.0		
994.300	994.200	CC	51	3.52	3.90	3.71	2735.5		51	2.95	2.95	2.95	2116.1		
994.200	994.100	CC	51	3.30	3.11	3.21	2322.0		51	2.67	2.60	2.64	1864.7		
994.100	994.000	CC	50	3.70	3.50	3.60	2644.8	2388.6	50	3.68	3.35	3.52	2575.0	2177.9	
994.000	993.900	CC	49	3.98	3.05	3.52	2575.0		49	3.29	2.61	2.95	2116.1		
993.900	993.800	CC	50	3.14	3.18	3.16	2285.5		50	3.44	3.30	3.37	2456.3		
993.800	993.700	CC	52	3.58	3.29	3.44	2509.4		52	3.59	3.06	3.33	2419.6		
993.700	993.600	CC	51	4.02	3.79	3.91	2897.1		51	2.97	3.23	3.10	2237.0		
993.600	993.500	CC	46	3.57	3.56	3.57	2616.1		46	3.38	3.49	3.44	2509.4		
993.500	993.400	CC	44	3.42	3.73	3.58	2624.3		44	4.49	4.29	4.39	3302.9		
993.400	993.300	CC	48	3.31	3.67	3.49	2554.5		48	3.55	3.12	3.34	2427.8		
993.300	993.200	CC	48	4.12	3.71	3.92	2905.4		48	4.11	4.14	4.13	3080.5		
993.200	993.100	CC	50	2.42	2.95	2.69	1904.4		50	2.41	2.00	2.21	1527.4		
993.100	993.000	CC	54	3.90	3.23	3.57	2616.1	2548.8	54	2.56	2.57	2.57	1809.3	2388.6	
993.000	992.900	CC	56	2.94	3.64	3.29	2391.1		56	2.35	2.47	2.41	1687.3		
992.900	992.800	CC	54	3.62	3.53	3.58	2624.3		54	3.01	3.30	3.16	2281.5		
992.800	992.700	CC	52	4.13	3.62	3.88	2872.1		52	4.10	3.68	3.89	2884.6		
992.700	992.600	CC	56	3.49	3.32	3.41	2484.9		56	2.15	2.05	2.10	1446.2		
992.600	992.500	CC	56	2.65	2.98	2.82	2008.0		56	2.68	2.53	2.61	1841.0		
992.500	992.400	CC	55	3.55	3.59	3.57	2620.2		55	2.92	2.81	2.87	2048.0		
992.400	992.300	CC	54	3.12	3.62	3.37	2456.3		54	2.87	2.55	2.71	1924.3		
992.300	992.200	CC	53	3.37	4.06	3.72	2739.6		53	4.61	4.24	4.43	3332.4		
992.200	992.100	CC	51	3.84	3.68	3.76	2776.8		51	4.23	3.75	3.99	2967.8		
992.100	992.000	CC	55	4.12	3.66	3.89	2884.6	2585.8	55	2.94	3.05	3.00	2152.3	2256.5	
992.000	991.900	CC	55	3.74	3.37	3.56	2607.8		55	2.08	2.10	2.09	1438.5		
991.900	991.800	CC	55	3.56	3.84	3.70	2727.3		55	2.90	3.13	3.02	2168.4		
991.800	991.700	CC	54	3.50	3.77	3.64	2673.7		54	3.52	3.34	3.43	2505.4		
991.700	991.600	CC	53	4.45	3.85	4.15	3101.4		53	3.33	2.83	3.08	2220.8		
991.600	991.500	CC	46	2.85	3.13	2.99	2148.3		46	2.70	2.56	2.63	1860.8		
991.500	991.400	CC	47	2.86	2.64	2.75	1956.1		47	2.43	2.48	2.46	1722.7		
991.400	991.300	CC	49	4.66	4.05	4.36	3273.5		49	3.85	3.57	3.71	2735.5		
991.300	991.200	CC	40	4.63	4.61	4.62	3497.4		40	4.28	4.43	4.36	3273.5		
991.200	991.100	CC	40	3.85	3.92	3.89	2880.4		40	2.78	2.73	2.76	1960.1		
991.100	991.000	CC	45	2.47	2.30	2.39	1667.7	2653.4	45	1.96	1.93	1.95	1327.2	2121.3	
991.000	990.900	CC	44	2.97	2.76	2.87	2048.0		44	2.98	3.10	3.04	2188.6		
990.900	990.800	CC	43	3.05	2.63	2.84	2027.9		43	3.05	2.80	2.93	2096.0		
990.800	990.700	CC	42	4.10	4.15	4.13	3080.5		42	4.25	4.05	4.15	3101.4		
990.700	990.600	CC	37	3.53	3.27	3.40	2480.8		37	3.34	3.10	3.22	2334.2		
990.600	990.500	CC	40	3.66	3.31	3.49	2550.4		40	3.59	3.15	3.37	2456.3		
990.500	990.400	CC	38	2.34	2.43	2.39	1667.7		38	2.59	2.48	2.54	1785.6		
990.400	990.300	CC	25	2.30	2.71	2.51	1762.0		25	3.16	3.66	3.41	2489.0		
990.300	990.200	CC	41	3.26	2.89	3.08	2216.8		41	2.99	3.22	3.11	2241.0		
990.200	990.100	CC	50	2.01	2.30	2.16	1488.7		50	2.95	2.92	2.94	2104.1		
990.100	990.000	CC	52	2.66	2.76	2.71	1924.3	2124.7	52	3.24	2.83	3.04	2184.5	2298.1	
990.000	989.900	CC	52	3.48	3.01	3.25	2354.5		52	2.93	2.83	2.88	2060.0		
989.900	989.800	CC	52	2.98	2.88	2.93	2100.1		52	2.70	2.40	2.55	1797.5		
989.800	989.700	CC	52	3.41	3.19	3.30	2399.3		52	2.89	2.59	2.74	1948.1		
989.700	989.600	CC	54	2.15	2.32	2.24	1550.7		54	2.22	2.02	2.12	1461.6		
989.600	989.500	CC	53	2.22	2.29	2.26	1566.3		53	2.30	2.51	2.41	1683.4		
989.500	989.400	CC	38	2.65	2.72	2.69	1904.4		38	3.24	3.09	3.17	2289.6		
989.400	989.300	CC	42	2.70	2.90	2.80	1996.0		42	3.27	3.01	3.14	2269.4		
989.300	989.200	CC	50	2.55	2.38	2.47	1730.5		50	2.21	2.06	2.14	1473.2		
989.200	989.100	CC	53	2.52	2.79	2.66	1880.6		53	2.09	1.90	2.00	1365.5		
989.100	989.000	CC	53	2.92	2.82	2.87	2052.0	1953.4	53	2.04	2.25	2.15	1480.9	1782.9	
989.000	988.900	CC	52	3.02	3.29	3.16	2281.5		52	2.76	2.55	2.66	1880.6		
988.900	988.800	CC	55	2.91	2.57	2.74	1948.1		55	2.79	2.42	2.61	1841.0		
988.800	988.700	CC	53	3.05	3.27	3.16	2285.5		53	3.91	4.06	3.99	2963.6		
988.700	988.600	CC	50	3.05	2.92	2.99	2144.3		50	4.68	4.47	4.58	3459.2		
988.600	988.500	CC	53	2.63	2.51	2.57	1813.3		53	1.98	2.03	2.01	1373.1		
988.500	988.400	CC	54	2.79	2.85	2.82	2012.0		54	1.96	2.35	2.16	1488.7		
988.400	988.300	CC	54	3.42	3.15	3.29	2387.0		54	2.56	2.99	2.78	1976.0		
988.300	988.200	CC	55	3.02	3.45	3.24	2346.4		55	2.23	2.65	2.44	1710.9		
988.200	988.100	CC	55	2.90	3.08	2.99	2148.3		55	2.79	3.04	2.92	2088.0		
988.100	988.000	CC	55	2.58	2.59	2.59	1825.1	2119.2	55	1.88	1.97	1.93	1311.9	2009.3	
988.000	987.900	CC	53	3.11	2.67	2.89	2068.0		53	2.13	2.10	2.12	1457.8		
987.900	987.800	CC	54	3.30	2.84	3.07	2212.8		54	2.86	2.38	2.62	1852.8		
987.800	987.700	CC	54	2.35	2.38	2.37	1652.1		54	2.94	2.54	2.74	1948.1		
987.700	987.600	CC	51	7.03	5.66	6.35	4989.6		51	5.64	5.61	5.63	4359.9		
987.600	987.500	CC	52	2.51	2.58	2.55	1793.5		52	2.28	2.16	2.22	1539.1		
987.500	987.400	CC	48	2.69	2.67	2.68	1900.4		48	2.90	2.90	2.90	2076.0		
987.400	987.300	CC	41	2.57	2.42	2.50	1754.1		41	2.84	2.54	2.69	1908.4		
987.300	987.200	CC	44	2.98	2.64	2.81	2004.0		44	2.42	2.53	2.48	1738.4		
987.200	987.100	CC	41	3.28	3.24	3.26	2366.7		41	4.31	4.56	4.44	3340.9		

Roughness Analysis of Rigid Pavement on RHS Direction: NH-27: Rakhaldubi to Kalijhar (Pkg-II)															
Chainage (km)			Inner Lane						Outer Lane						
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Remarks
987.100	987.000	CC	41	3.07	3.43	3.25	2358.6	2310.0	41	2.95	2.77	2.86	2044.0	2226.5	
987.000	986.900	CC	34	3.50	3.67	3.59	2632.5		34	3.88	3.73	3.81	2814.1		
986.900	986.800	CC	27	3.83	4.19	4.01	2984.4		27	3.87	3.73	3.80	2809.9		
986.800	986.700	CC	42	3.37	3.18	3.28	2378.9		42	2.54	2.96	2.75	1956.1		
986.700	986.600	CC	47	3.36	3.43	3.40	2476.7		47	4.16	3.59	3.88	2872.1		
986.600	986.500	CC	49	3.34	3.93	3.64	2673.7		49	3.94	3.70	3.82	2826.5		
986.500	986.400	CC	47	4.08	3.62	3.85	2851.4		47	3.84	4.05	3.95	2930.3		
986.400	986.300	CC	37	4.89	3.63	4.26	3193.6		37	5.25	4.73	4.99	3812.5		
986.300	986.200	CC	42	5.80	4.55	5.18	3971.2		42	4.23	4.18	4.21	3147.4		
986.200	986.100	CC	44	4.28	4.13	4.21	3147.4		44	4.33	3.81	4.07	3034.5		
986.100	986.000	CC	46	5.29	4.88	5.09	3893.9	3020.4	46	5.30	4.84	5.07	3881.1	3008.5	
986.000	985.900	CC	50	3.73	4.11	3.92	2909.5		50	3.35	2.93	3.14	2269.4		
985.900	985.800	CC	54	3.32	2.44	2.88	2060.0		54	2.73	2.48	2.61	1841.0		
985.800	985.700	CC	54	3.26	3.41	3.34	2427.8		54	3.03	3.39	3.21	2326.1		
985.700	985.600	CC	53	5.46	5.86	5.66	4390.3		53	4.89	3.63	4.26	3193.6		
985.600	985.500	CC	47	3.21	3.38	3.30	2395.2		47	3.68	3.16	3.42	2497.2		
985.500	985.400	CC	52	2.56	2.44	2.50	1758.1		52	2.98	2.82	2.90	2076.0		
985.400	985.300	CC	53	3.77	3.39	3.58	2628.4		53	4.02	4.20	4.11	3067.9		
985.300	985.200	CC	51	3.77	4.22	4.00	2971.9		51	3.52	3.81	3.67	2698.4		
985.200	985.100	CC	51	3.17	3.42	3.30	2395.2		51	5.03	4.34	4.69	3552.5		
985.100	985.000	CC	53	2.82	3.06	2.94	2108.1	2604.4	53	2.30	2.36	2.33	1624.7	2514.7	
985.000	984.900	CC	53	2.80	2.99	2.90	2072.0		53	2.71	2.82	2.77	1968.1		
984.900	984.800	CC	53	3.01	3.05	3.03	2180.5		53	2.56	2.58	2.57	1813.3		
984.800	984.700	CC	53	3.14	3.46	3.30	2399.3		53	2.57	2.47	2.52	1773.8		
984.700	984.600	CC	52	3.06	3.13	3.10	2233.0		52	2.63	2.94	2.79	1984.0		
984.600	984.500	CC	52	3.35	3.00	3.18	2297.7		52	2.62	2.45	2.54	1785.6		
984.500	984.400	CC	53	3.00	3.30	3.15	2277.4		53	3.17	2.85	3.01	2164.4		
984.400	984.300	CC	52	3.80	3.79	3.80	2805.8		52	3.76	3.38	3.57	2620.2		
984.300	984.200	CC	51	3.31	3.44	3.38	2460.4		51	3.39	3.38	3.39	2468.6		
984.200	984.100	CC	53	2.91	2.90	2.91	2080.0		53	2.65	2.47	2.56	1805.4		
984.100	984.000	CC	53	3.59	3.14	3.37	2452.2	2325.8	53	2.42	2.50	2.46	1726.6	2011.0	
984.000	983.900	CC	53	3.67	3.16	3.42	2493.1		53	2.39	1.99	2.19	1515.8		
983.900	983.800	CC	53	3.14	3.02	3.08	2220.8		53	2.26	2.14	2.20	1523.5		
983.800	983.700	CC	53	3.45	3.27	3.36	2448.2		53	2.91	2.96	2.94	2104.1		
983.700	983.600	CC	51	3.86	3.44	3.65	2686.0		51	3.38	2.64	3.01	2164.4		
983.600	983.500	CC	42	5.08	4.82	4.95	3778.3		42	4.09	4.14	4.12	3072.1		
983.500	983.400	CC	48	2.88	3.12	3.00	2156.3		48	3.01	2.90	2.96	2120.1		
983.400	983.300	CC	52	2.96	3.06	3.01	2164.4		52	1.93	2.04	1.99	1357.8		
983.300	983.200	CC	53	3.28	3.73	3.51	2566.8		53	2.66	2.79	2.73	1936.2		
983.200	983.100	CC	51	3.55	3.43	3.49	2554.5		51	3.38	3.50	3.44	2513.5		
983.100	983.000	CC	52	3.86	3.77	3.82	2822.4	2589.1	52	2.22	2.36	2.29	1593.5	1990.1	
983.000	982.900	CC	52	3.88	4.43	4.16	3105.6		52	4.41	4.48	4.45	3349.3		
982.900	982.800	CC	52	2.98	3.05	3.02	2168.4		52	2.59	2.64	2.62	1848.9		
982.800	982.700	CC	51	3.66	3.36	3.51	2570.9		51	4.52	4.36	4.44	3345.1		
982.700	982.600	CC	45	3.66	3.63	3.65	2681.9		45	3.41	3.14	3.28	2378.9		
982.600	982.500	CC	49	3.53	3.17	3.35	2440.0		49	3.33	3.18	3.26	2362.6		
982.500	982.400	CC	49	3.17	3.25	3.21	2326.1		49	2.76	3.38	3.07	2212.8		
982.400	982.300	CC	45	2.72	2.35	2.54	1785.6		45	3.41	3.41	3.41	2489.0		
982.300	982.200	CC	50	2.82	2.52	2.67	1892.5		50	2.05	1.81	1.93	1315.7		
982.200	982.100	CC	51	2.34	2.14	2.24	1554.6		51	2.67	2.57	2.62	1852.8		
982.100	982.000	CC	53	2.79	2.40	2.60	1833.1	2235.9	53	2.50	2.30	2.40	1679.5	2283.5	
982.000	981.900	CC	49	4.89	3.63	4.26	3193.6		49	3.57	3.18	3.38	2460.4		
981.900	981.800	CC	45	3.77	3.74	3.76	2772.7		45	4.01	3.56	3.79	2797.5		
981.800	981.700	CC	51	2.12	2.16	2.14	1477.1		51	3.69	3.23	3.46	2529.9		
981.700	981.600	CC	52	2.41	2.72	2.57	1809.3		52	2.61	2.51	2.56	1805.4		
981.600	981.500	CC	51	2.16	2.25	2.21	1527.4		51	2.64	2.84	2.74	1948.1		
981.500	981.400	CC	51	3.14	3.01	3.08	2216.8		51	2.93	2.95	2.94	2108.1		
981.400	981.300	CC	51	2.27	2.17	2.22	1539.1		51	2.48	2.67	2.58	1817.2		
981.300	981.200	CC	51	2.62	2.48	2.55	1797.5		51	2.04	2.21	2.13	1465.5		
981.200	981.100	CC	51	2.87	2.73	2.80	1996.0		51	3.07	2.62	2.85	2031.9		
981.100	981.000	CC	51	2.69	2.72	2.71	1920.3	2025.0	51	2.84	2.49	2.67	1888.5	2085.3	
981.000	980.900	CC	52	3.59	3.27	3.43	2505.4		52	3.21	3.18	3.20	2313.9		
980.900	980.800	CC	49	4.43	4.27	4.35	3269.3		49	3.06	2.82	2.94	2108.1		
980.800	980.700	CC	49	3.10	2.77	2.94	2104.1		49	3.01	3.31	3.16	2285.5		
980.700	980.600	CC	51	2.86	2.39	2.63	1856.8		51	2.38	2.09	2.24	1550.7		
980.600	980.500	CC	52	2.74	2.83	2.79	1984.0		52	2.15	1.99	2.07	1423.1		
980.500	980.400	CC	51	3.23	2.95	3.09	2228.9		51	3.11	3.46	3.29	2387.0		
980.400	980.300	CC	41	2.41	2.35	2.38	1663.8		41	3.56	3.01	3.29	2387.0		
980.300	980.200	CC	41	2.05	2.21	2.13	1469.4		41	2.65	2.53	2.59	1829.1		
980.200	980.100	CC	50	2.01	2.13	2.07	1423.1		50	2.48	2.37	2.43	1699.1		
980.100	980.000	CC	51	3.07	3.37	3.22	2334.2	2083.9	51	2.79	2.58	2.69	1904.4	1988.8	
980.000	979.900	CC	49	3.00	3.15	3.08	2216.8		49	3.09	3.02	3.06	2200.7		
979.900	979.800	CC	53	2.85	2.61	2.73	1940.2		53	3.56	3.24	3.40	2480.8		
979.800	979.700	CC	53	3.06	3.05	3.06	2200.7		53	2.31	2.19	2.25	1562.4		
979.700	979.600	CC	53	2.84	2.67	2.76	1960.1		53	2.79	2.49	2.64	1868.7		
979.600	979.500	CC	53	1.94	2.00	1.97	1346.3		53	2.47	2.30	2.39	1667.7		
979.500	979.400	CC	53	3.06	3.04	3.05	2196.6		53	2.08	2.06	2.07	1423.1		
979.400	979.300	CC	52	2.49	2.78	2.64	1864.7		52	3.52	3.02	3.27	2374.8		
979.300	979.200	CC	50	2.49	2.67	2.58	1821.2		50	3.28	2.97	3.13	2257.2		
979.200	979.100	CC	43	3.56	3.63	3.60	2640.7		43	3.81	3.59	3.70	2727.3		
979.100	979.000	CC	39	3.68	4.09	3.89	2880.4	2106.8	39	4.01	3.77	3.89	2884.6	2144.7	
979.000	978.900	CC	49	2.80	2.63	2.72	1928.2		49	2.68	2.65	2.67	1888.5		
978.900	978.800	CC	52	2.87	2.87	2.87	2052.0		52	2.32	2.52	2.42	1695.2		
978.800	978.700	CC	52	2.90	2.89	2.90	2072.0		52	2.92	2.52	2.72	1932.2		

Roughness Analysis of Rigid Pavement on RHS Direction: NH-27: Rakhaldubi to Kalijhar (Pkg-II)															
Chainage (km)			Inner Lane						Outer Lane						
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Remarks
978.700	978.600	CC	53	2.75	2.80	2.78	1976.0		53	2.67	2.62	2.65	1872.7		
978.600	978.500	CC	52	3.01	2.97	2.99	2148.3		52	3.05	2.63	2.84	2027.9		
978.500	978.400	CC	53	3.38	3.14	3.26	2366.7		53	2.66	2.99	2.83	2016.0		
978.400	978.300	CC	54	4.17	3.18	3.68	2706.6		54	2.44	2.77	2.61	1841.0		
978.300	978.200	CC	53	2.91	2.45	2.68	1900.4		53	3.37	3.01	3.19	2309.9		
978.200	978.100	CC	51	2.67	3.00	2.84	2024.0		51	3.22	2.96	3.09	2228.9		
978.100	978.000	CC	52	2.94	3.07	3.01	2160.4	2133.5	52	3.27	2.88	3.08	2216.8	2002.9	
978.000	977.900	CC	52	2.71	2.98	2.85	2031.9		52	2.94	2.84	2.89	2068.0		
977.900	977.800	CC	51	2.99	3.06	3.03	2176.5		51	2.96	3.24	3.10	2237.0		
977.800	977.700	CC	52	3.49	3.05	3.27	2374.8		52	3.15	3.12	3.14	2265.3		
977.700	977.600	CC	51	2.82	2.79	2.81	2000.0		51	2.47	2.39	2.43	1703.0		
977.600	977.500	CC	44	3.03	2.65	2.84	2027.9		44	3.42	2.97	3.20	2313.9		
977.500	977.400	CC	39	3.31	2.82	3.07	2208.7		39	3.21	3.27	3.24	2350.4		
977.400	977.300	CC	40	2.73	2.44	2.59	1825.1		40	3.66	2.97	3.32	2411.5		
977.300	977.200	CC	38	3.03	2.76	2.90	2072.0		38	3.69	3.38	3.54	2591.4		
977.200	977.100	CC	35	3.06	3.27	3.17	2289.6		35	3.30	3.31	3.31	2403.3		
977.100	977.000	CC	17	2.65	2.38	2.52	1769.9	2077.7	17	3.61	3.15	3.38	2464.5	2280.8	
977.000	976.900	CC	31	2.97	2.87	2.92	2092.0		31	3.78	3.53	3.66	2690.1		
976.900	976.800	CC	41	2.34	2.24	2.29	1593.5		41	2.85	2.75	2.80	1996.0		
976.800	976.700	CC	47	2.37	2.37	2.37	1656.0		47	2.71	2.71	2.71	1924.3		
976.700	976.600	CC	48	2.93	2.42	2.68	1896.5		48	2.35	2.48	2.42	1691.2		
976.600	976.500	CC	50	3.29	3.01	3.15	2277.4		50	3.03	2.95	2.99	2148.3		
976.500	976.400	CC	48	3.18	3.41	3.30	2395.2		48	3.10	3.30	3.20	2318.0		
976.400	976.300	CC	49	3.22	2.45	2.84	2024.0		49	2.63	2.77	2.70	1916.3		
976.300	976.200	CC	51	2.46	2.60	2.53	1781.7		51	2.81	2.94	2.88	2056.0		
976.200	976.100	CC	52	2.21	2.01	2.11	1453.9		52	1.87	2.24	2.06	1411.5		
976.100	976.000	CC	52	2.97	2.85	2.91	2084.0	1925.4	52	3.14	2.84	2.99	2148.3	2030.0	
976.000	975.900	CC	50	2.62	2.38	2.50	1758.1		50	2.79	2.69	2.74	1948.1		
975.900	975.800	CC	51	3.42	3.01	3.22	2330.1		51	3.27	3.35	3.31	2407.4		
975.800	975.700	CC	51	3.29	3.32	3.31	2403.3		51	2.42	2.17	2.30	1597.4		
975.700	975.600	CC	49	1.95	2.02	1.99	1357.8		49	3.16	2.85	3.01	2160.4		
975.600	975.500	CC	50	2.62	2.52	2.57	1813.3		50	2.79	2.67	2.73	1940.2		
975.500	975.400	CC	48	3.14	3.50	3.32	2415.5		48	2.86	2.59	2.73	1936.2		
975.400	975.300	CC	48	2.97	3.08	3.03	2176.5		48	2.76	2.80	2.78	1980.0		
975.300	975.200	CC	37	4.36	4.62	4.49	3387.3		37	4.52	4.97	4.75	3603.5		
975.200	975.100	CC	30	4.94	4.40	4.67	3539.8		30	5.00	4.61	4.81	3654.6		
975.100	975.000	CC	24	4.21	4.73	4.47	3370.4	2455.2	24	3.64	4.04	3.84	2843.1	2407.1	
975.000	974.900	CC	34	3.14	3.16	3.15	2277.4		34	4.09	3.34	3.72	2739.6		
974.900	974.800	CC	44	2.44	2.82	2.63	1860.8		44	3.22	3.46	3.34	2431.8		
974.800	974.700	CC	45	3.20	3.71	3.46	2525.8		45	2.70	2.86	2.78	1980.0		
974.700	974.600	CC	49	2.98	3.38	3.18	2301.8		49	2.29	2.21	2.25	1562.4		
974.600	974.500	CC	52	2.83	2.74	2.79	1984.0		52	2.98	2.67	2.83	2016.0		
974.500	974.400	CC	50	3.33	3.33	3.33	2423.7		50	2.92	2.58	2.75	1956.1		
974.400	974.300	CC	45	3.06	3.16	3.11	2245.1		45	3.40	3.11	3.26	2362.6		
974.300	974.200	CC	38	2.55	2.44	2.50	1754.1		38	3.13	3.54	3.34	2427.8		
974.200	974.100	CC	40	2.17	2.26	2.22	1535.2		40	2.53	2.39	2.46	1726.6		
974.100	974.000	CC	44	2.14	2.29	2.22	1535.2	2044.3	44	2.25	2.25	2.25	1562.4	2076.5	
974.000	973.900	CC	44	3.21	3.20	3.21	2322.0		44	3.34	3.33	3.34	2427.8		
973.900	973.800	CC	43	2.57	2.46	2.52	1769.9		43	3.64	3.40	3.52	2579.1		
973.800	973.700	CC	44	2.27	2.35	2.31	1609.1		44	2.17	2.16	2.17	1496.4		
973.700	973.600	CC	46	2.61	2.11	2.36	1648.2		46	2.35	2.14	2.25	1558.5		
973.600	973.500	CC	49	2.66	2.50	2.58	1821.2		49	2.03	2.14	2.09	1434.6		
973.500	973.400	CC	48	2.53	2.38	2.46	1722.7		48	3.00	2.50	2.75	1956.1		
973.400	973.300	CC	35	3.67	3.58	3.63	2665.4		35	3.69	3.42	3.56	2607.8		
973.300	973.200	CC	33	3.18	3.52	3.35	2440.0		33	3.38	3.41	3.40	2476.7		
973.200	973.100	CC	45	2.53	2.57	2.55	1797.5		45	3.34	3.24	3.29	2391.1		
973.100	973.000	CC	52	3.17	2.89	3.03	2180.5	1997.6	52	2.51	2.57	2.54	1789.6	2071.8	
973.000	972.900	CC	52	3.66	3.57	3.62	2657.2		52	2.68	2.72	2.70	1916.3		
972.900	972.800	CC	54	3.69	3.02	3.36	2444.1		54	3.85	3.34	3.60	2640.7		
972.800	972.700	CC	53	3.58	3.22	3.40	2480.8		53	3.30	3.61	3.46	2525.8		
972.700	972.600	CC	55	3.31	3.16	3.24	2346.4		55	3.40	3.43	3.42	2493.1		
972.600	972.500	CC	56	2.66	2.46	2.56	1805.4		56	2.59	2.68	2.64	1864.7		
972.500	972.400	CC	55	2.91	2.42	2.67	1888.5		55	2.51	2.29	2.40	1679.5		
972.400	972.300	CC	55	3.20	3.31	3.26	2362.6		55	3.01	2.75	2.88	2060.0		
972.300	972.200	CC	55	2.65	2.19	2.42	1695.2		55	3.42	3.02	3.22	2334.2		
972.200	972.100	CC	54	2.43	2.44	2.44	1706.9		54	2.42	2.07	2.25	1558.5		
972.100	972.000	CC	51	3.52	3.17	3.35	2435.9	2182.3	51	2.85	2.70	2.78	1976.0	2104.9	
972.000	971.900	CC	51	2.34	2.40	2.37	1656.0		51	2.54	2.59	2.57	1809.3		
971.900	971.800	CC	50	2.31	2.35	2.33	1624.7		50	2.10	1.99	2.05	1403.8		
971.800	971.700	CC	50	3.08	3.44	3.26	2366.7		50	2.67	2.68	2.68	1896.5		
971.700	971.600	CC	52	2.78	3.07	2.93	2096.0		52	3.53	2.98	3.26	2362.6		
971.600	971.500	CC	53	2.14	2.20	2.17	1500.3		53	2.47	2.47	2.47	1734.4		
971.500	971.400	CC	51	2.06	2.24	2.15	1484.8		51	2.05	2.08	2.07	1419.2		
971.400	971.300	CC	48	2.93	3.30	3.12	2249.1		48	2.14	1.94	2.04	1400.0		
971.300	971.200	CC	46	3.41	3.03	3.22	2334.2		46	3.55	3.07	3.31	2407.4		
971.200	971.100	CC	40	3.15	3.58	3.37	2452.2		40	3.24	3.23	3.24	2346.4		
971.100	971.000	CC	16	3.35	3.08	3.22	2330.1	2009.4	16	3.04	3.20	3.12	2253.2	1903.3	
971.000	970.900	CC	31	2.41	2.49	2.45	1718.7		31	3.03	3.08	3.06	2200.7		
970.900	970.800	CC	37	2.73	2.79	2.76	1964.1		37	2.42	2.47	2.45	1714.8		
970.800	970.700	CC	38	3.05	3.23	3.14	2269.4		38	3.23	3.05	3.14	2269.4		
970.700	970.600	CC	40	3.34	3.13	3.24	2346.4		40	3.02	3.30	3.16	2285.5		Toll Plaza
970.600	970.500	CC	44	2.74	2.77	2.76	1960.1		44	2.26	2.10	2.18	1508.0		
970.500	970.400	CC	44	3.57	3.04	3.31	2403.3		44	3.34	3.05	3.20	2313.9		
970.400	970.300	CC	44	2.95	2.67	2.81	2004.0		44	2.77	3.08	2.93	2096.0		

Roughness Analysis of Rigid Pavement on RHS Direction: NH-27: Rakhaldubi to Kalijhar (Pkg-II)															
Chainage (km)			Inner Lane						Outer Lane						
From	To	Pav Type	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Speed (Kmph)	Left Wheel Path IRI	Right Wheel Path IRI	Average Lane IRI	BI (mm/km)	Avg. BI per km	Remarks
970.300	970.200	CC	44	3.01	3.02	3.02	2168.4		44	3.02	2.64	2.83	2020.0		
970.200	970.100	CC	44	3.23	3.06	3.15	2273.4		44	2.43	2.71	2.57	1813.3		
970.100	970.000	CC	44	3.17	3.13	3.15	2277.4		44	2.79	2.98	2.89	2064.0		
970.000	969.890	CC	44	4.96	4.69	4.83	3671.6	2277.9	44	3.81	3.92	3.87	2863.8	2104.5	
965.080	965.000	CC	31	9.36	7.93	8.65	7055.3		31	5.16	4.60	4.88	3718.5		
965.000	964.900	CC	42	3.55	3.47	3.51	2570.9		42	3.65	3.11	3.38	2464.5		
964.900	964.800	CC	47	3.29	3.07	3.18	2301.8		47	3.33	3.48	3.41	2484.9		
964.800	964.700	CC	51	3.43	3.56	3.50	2558.6		51	3.71	3.64	3.68	2706.6		
964.700	964.600	CC	51	3.62	3.43	3.53	2583.2		51	3.26	3.41	3.34	2427.8		
964.600	964.500	CC	54	3.37	3.68	3.53	2583.2		54	3.24	2.97	3.11	2241.0		
964.500	964.400	CC	54	3.20	3.38	3.29	2391.1		54	3.29	3.36	3.33	2419.6		
964.400	964.300	CC	53	3.40	4.29	3.85	2847.2		53	2.74	2.29	2.52	1769.9		
964.300	964.200	CC	52	2.97	2.98	2.98	2136.2		52	2.36	2.65	2.51	1762.0		
964.200	964.100	CC	52	3.29	3.36	3.33	2419.6		52	3.58	3.16	3.37	2456.3		
964.100	964.000	CC	48	2.78	2.80	2.79	1988.0	2857.7	48	4.58	4.14	4.36	3277.7	2520.8	
964.000	963.900	CC	48	3.03	3.32	3.18	2297.7		48	3.13	3.23	3.18	2301.8		
963.900	963.800	CC	51	3.45	3.46	3.46	2525.8		51	3.03	3.50	3.27	2370.8		
963.800	963.700	CC	50	3.12	3.43	3.28	2378.9		50	2.91	2.98	2.95	2112.1		
963.700	963.600	CC	50	3.19	3.54	3.37	2452.2		50	3.03	3.52	3.28	2378.9		
963.600	963.500	CC	48	3.36	3.19	3.28	2378.9		48	3.85	3.71	3.78	2793.4		
963.500	963.400	CC	50	3.18	3.66	3.42	2497.2		50	3.02	3.36	3.19	2309.9		
963.400	963.300	CC	51	3.16	3.59	3.38	2460.4		51	2.90	2.89	2.90	2072.0		
963.300	963.200	CC	51	3.34	3.64	3.49	2554.5		51	2.98	3.23	3.11	2241.0		
963.200	963.100	CC	50	3.28	3.64	3.46	2529.9		50	3.38	3.36	3.37	2456.3		
963.100	963.000	CC	50	4.35	4.39	4.37	3286.1	2536.2	50	2.73	2.61	2.67	1892.5	2292.9	
963.000	962.900	CC	47	3.00	3.19	3.10	2233.0		47	3.72	3.34	3.53	2587.3		
962.900	962.800	CC	41	3.28	3.52	3.40	2480.8		41	3.42	3.20	3.31	2407.4		
962.800	962.700	CC	43	3.23	3.36	3.30	2395.2		43	3.11	3.41	3.26	2366.7		
962.700	962.600	CC	47	3.45	3.48	3.47	2534.0		47	2.79	2.83	2.81	2004.0		
962.600	962.500	CC	52	3.29	3.03	3.16	2285.5		52	3.38	3.23	3.31	2403.3		
962.500	962.400	CC	50	2.91	3.19	3.05	2196.6		50	2.97	2.46	2.72	1928.2		
962.400	962.300	CC	46	2.96	2.92	2.94	2108.1		46	3.00	3.57	3.29	2387.0		
962.300	962.200	CC	28	3.24	3.37	3.31	2403.3		28	3.87	3.66	3.77	2781.0		
962.200	962.100	CC	33	3.41	3.79	3.60	2644.8		33	2.86	3.01	2.94	2104.1		
962.100	962.000	CC	37	2.43	2.48	2.46	1722.7	2300.4	37	3.48	3.16	3.32	2415.5	2338.5	
962.000	961.900	CC	36	3.12	3.03	3.08	2216.8		36	3.17	2.86	3.02	2168.4		
961.900	961.800	CC	39	2.53	2.24	2.39	1667.7		39	2.41	2.11	2.26	1570.2		
961.800	961.700	CC	37	3.08	3.44	3.26	2366.7		37	3.26	3.30	3.28	2383.0		
961.700	961.600	CC	32	3.38	3.22	3.30	2399.3		32	3.68	3.22	3.45	2521.7		
961.600	961.500	CC	12	3.36	3.62	3.49	2554.5	2241.0	12	3.38	3.66	3.52	2579.1	2244.5	

Annexure – 4.4

Rutting Data

Rutting Analysis of Flexible Pavement on LHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)											
Chainage (km)			Inner Lane				Outer Lane				Remarks
From	To	Pav Type	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	
30.520	30.600	BT	48	8.57	6.94	7.76	42	4.94	3.72	4.33	
30.600	30.700	BT	52	6.31	5.56	5.94	46	3.33	3.81	3.57	
30.700	30.800	BT	53	8.16	10.87	9.52	35	6.69	6.05	6.37	
30.800	30.900	BT	52	6.43	8.41	7.42	39	3.43	2.96	3.20	
30.900	31.000	BT	48	7.34	6.62	6.98	43	3.91	3.00	3.46	
31.000	31.100	BT	41	5.73	4.92	5.33	47	1.99	2.86	2.43	
31.100	31.200	BT	40	3.98	3.28	3.63	42	3.18	2.79	2.99	
31.200	31.300	BT	46	4.06	4.47	4.27	42	2.21	1.95	2.08	
31.300	31.400	BT	51	3.86	5.34	4.60	46	2.19	1.94	2.07	
31.400	31.500	BT	52	6.82	6.05	6.44	49	3.72	3.06	3.39	
31.500	31.600	BT	52	6.00	4.64	5.32	50	3.22	3.21	3.22	
31.600	31.700	BT	52	8.80	7.39	8.10	48	2.34	2.61	2.48	
31.700	31.800	BT	54	9.78	9.11	9.45	51	3.15	4.11	3.63	
31.800	31.900	BT	53	7.03	6.30	6.67	52	2.32	2.10	2.21	
31.900	32.000	BT	52	6.56	5.63	6.10	50	2.10	2.88	2.49	
38.000	38.100	BT	53	4.48	4.38	4.43	20	4.56	5.46	5.01	
38.100	38.200	BT	54	5.44	6.03	5.74	39	4.57	5.71	5.14	
38.200	38.300	BT	53	6.23	6.54	6.39	44	5.37	5.62	5.50	
38.300	38.400	BT	54	5.68	4.17	4.93	47	3.89	5.10	4.50	
38.400	38.500	BT	55	3.88	4.38	4.13	49	6.40	4.91	5.66	
38.500	38.600	BT	55	6.05	6.27	6.16	49	6.12	6.00	6.06	
38.600	38.700	BT	55	4.30	5.28	4.79	49	5.35	4.70	5.03	
38.700	38.800	BT	55	4.41	4.66	4.54	48	3.64	4.70	4.17	
38.800	38.900	BT	54	11.18	8.06	9.62	48	6.11	4.52	5.32	
38.900	39.000	BT	55	10.15	7.34	8.75	45	5.13	4.94	5.04	
39.000	39.100	BT	55	11.73	9.56	10.65	41	4.48	3.79	4.14	
39.100	39.200	BT	56	10.86	8.30	9.58	43	4.17	5.73	4.95	
39.200	39.300	BT	54	11.22	8.32	9.77	43	5.36	7.25	6.31	
39.300	39.400	BT	54	10.45	7.66	9.06	43	4.30	4.45	4.38	
39.400	39.540	BT	54	10.55	8.17	9.36	40	5.42	4.57	5.00	
40.740	40.800	BT	46	10.02	7.30	8.66	42	4.62	3.58	4.10	
40.800	40.900	BT	49	7.06	5.35	6.21	44	3.90	2.51	3.21	
40.900	41.000	BT	52	10.29	8.05	9.17	43	5.50	2.88	4.19	
41.000	41.100	BT	53	9.66	7.23	8.45	46	4.42	1.99	3.21	
41.100	41.200	BT	55	8.51	5.70	7.11	51	4.40	2.30	3.35	
41.200	41.300	BT	52	7.93	10.19	9.06	46	6.59	3.60	5.10	
41.300	41.400	BT	47	13.96	11.68	12.82	27	10.12	8.39	9.26	
41.400	41.500	BT	52	9.65	6.70	8.18	31	6.85	5.46	6.16	
41.500	41.600	BT	54	7.52	4.55	6.04	43	4.49	2.54	3.52	
41.600	41.700	BT	55	9.54	6.71	8.13	48	4.77	3.08	3.93	
41.700	41.800	BT	54	10.25	8.51	9.38	48	5.44	3.01	4.23	
41.800	41.900	BT	54	10.26	8.74	9.50	43	6.14	4.26	5.20	
41.900	42.000	BT	54	10.20	7.40	8.80	40	4.87	2.17	3.52	
42.000	42.100	BT	52	13.41	11.05	12.23	22	5.69	4.86	5.28	
42.100	42.200	BT	52	12.17	9.32	10.75	19	6.51	4.03	5.27	
42.200	42.300	BT	55	7.95	5.90	6.93	22	4.38	2.35	3.37	
42.300	42.400	BT	56	7.41	5.22	6.32	26	4.08	2.12	3.10	
42.400	42.500	BT	55	5.62	3.36	4.49	25	3.42	1.81	2.62	
42.500	42.600	BT	55	6.28	3.88	5.08	29	5.31	2.36	3.84	
42.600	42.700	BT	55	8.75	5.89	7.32	38	4.15	2.19	3.17	
42.700	42.800	BT	55	8.73	6.46	7.60	39	5.67	2.76	4.22	
42.800	42.900	BT	54	9.08	6.96	8.02	45	4.24	2.42	3.33	
42.900	43.000	BT	54	7.50	4.77	6.14	49	4.18	2.13	3.16	
43.000	43.140	BT	53	7.48	4.84	6.16	50	4.12	2.26	3.19	
47.570	47.700	BT	30	10.09	8.81	9.45	46	7.07	4.91	5.99	
47.700	47.800	BT	37	5.19	4.78	4.99	48	4.41	2.43	3.42	
47.800	47.900	BT	45	6.49	7.28	6.89	48	3.47	2.70	3.09	
47.900	48.000	BT	51	7.91	7.91	7.91	45	4.18	2.71	3.45	
48.000	48.100	BT	52	4.83	7.83	6.33	16	4.25	2.51	3.38	
48.100	48.200	BT	52	6.59	4.96	5.78	27	4.51	1.92	3.22	
48.200	48.300	BT	50	11.01	9.67	10.34	30	8.73	6.05	7.39	
48.300	48.400	BT	48	5.70	4.83	5.27	38	3.79	1.95	2.87	

Rutting Analysis of Flexible Pavement on LHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)											
Chainage (km)			Inner Lane				Outer Lane				Remarks
From	To	Pav Type	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	
48.400	48.500	BT	55	6.36	3.98	5.17	36	5.64	4.20	4.92	
48.500	48.600	BT	54	6.55	5.22	5.89	34	3.56	2.26	2.91	
48.600	48.700	BT	54	4.89	5.47	5.18	39	4.41	2.03	3.22	
48.700	48.800	BT	53	9.33	8.01	8.67	38	5.90	4.85	5.38	
48.800	48.900	BT	54	10.47	9.04	9.76	43	5.05	2.88	3.97	
48.900	49.000	BT	57	8.52	7.18	7.85	47	5.00	2.37	3.69	
49.000	49.100	BT	55	7.27	7.45	7.36	48	5.54	2.90	4.22	
49.100	49.200	BT	52	11.72	14.26	12.99	46	7.35	4.37	5.86	
49.200	49.300	BT	55	10.95	11.62	11.29	49	4.25	2.96	3.61	
49.300	49.400	BT	55	7.17	6.50	6.84	48	4.03	2.06	3.05	
49.400	49.500	BT	53	5.95	3.88	4.92	46	4.48	2.17	3.33	
49.500	49.600	BT	44	4.58	4.53	4.56	32	6.79	4.51	5.65	
49.600	49.700	BT	23	5.98	4.58	5.28	15	6.99	4.43	5.71	
49.700	49.800	BT	9	6.72	4.99	5.86	21	7.24	4.27	5.76	
49.800	49.900	BT	18	8.67	5.72	7.20	38	4.32	2.85	3.59	
49.900	50.000	BT	23	7.52	10.61	9.07	46	4.37	2.92	3.65	
50.000	50.100	BT	28	7.22	9.98	8.60	48	3.76	2.89	3.33	
50.100	50.200	BT	33	9.16	10.73	9.95	49	4.23	2.03	3.13	
50.200	50.300	BT	36	5.68	7.84	6.76	49	4.64	2.60	3.62	
50.300	50.400	BT	37	7.11	9.15	8.13	49	4.39	3.17	3.78	
50.400	50.500	BT	40	8.35	10.77	9.56	48	4.02	2.77	3.40	
50.500	50.600	BT	42	7.45	7.94	7.70	49	3.19	1.99	2.59	
50.600	50.700	BT	42	8.03	8.62	8.33	43	5.41	4.03	4.72	
50.700	50.800	BT	37	11.65	9.34	10.50	30	5.78	4.71	5.25	
50.800	50.900	BT	33	7.23	9.37	8.30	35	5.36	3.45	4.41	
50.900	51.000	BT	31	9.83	9.77	9.80	35	5.75	4.77	5.26	
51.000	51.100	BT	44	7.62	6.48	7.05	44	4.39	1.97	3.18	
51.100	51.200	BT	50	6.84	8.87	7.86	47	4.58	2.03	3.31	
51.200	51.300	BT	54	8.38	5.99	7.19	49	4.35	2.49	3.42	
51.300	51.400	BT	54	12.62	10.53	11.58	49	4.34	2.90	3.62	
51.400	51.500	BT	54	7.99	8.55	8.27	49	4.60	1.84	3.22	
51.500	51.600	BT	53	8.54	6.58	7.56	50	4.12	1.53	2.83	
51.600	51.700	BT	54	9.25	6.28	7.77	44	7.76	5.37	6.57	
51.700	51.800	BT	53	9.63	9.90	9.77	41	4.90	3.04	3.97	
51.800	51.900	BT	55	10.35	7.49	8.92	46	4.88	3.00	3.94	
51.900	52.000	BT	55	9.51	7.86	8.69	50	4.26	3.12	3.69	
52.000	52.100	BT	55	7.89	7.71	7.80	51	4.57	2.38	3.48	
52.100	52.230	BT	55	3.78	3.53	3.66	50	2.69	4.20	3.45	
62.050	62.100	BT	40	3.30	3.05	3.18	50	4.27	4.92	4.60	
62.100	62.200	BT	42	4.64	5.07	4.86	49	3.01	4.37	3.69	
62.200	62.300	BT	45	9.65	7.67	8.66	49	2.99	3.10	3.05	
62.300	62.400	BT	47	4.42	5.88	5.15	48	3.62	2.87	3.25	
62.400	62.500	BT	45	4.93	4.90	4.92	47	3.90	4.26	4.08	
62.500	62.600	BT	44	4.39	4.74	4.57	43	5.06	3.77	4.42	
62.600	62.700	BT	32	9.99	7.32	8.66	28	13.55	11.03	12.29	
62.700	62.800	BT	29	10.01	7.99	9.00	26	10.97	8.31	9.64	
62.800	62.900	BT	33	7.93	5.65	6.79	32	6.59	3.98	5.29	
62.900	63.000	BT	43	3.75	5.09	4.42	42	4.06	2.88	3.47	
63.000	63.100	BT	48	3.63	3.47	3.55	48	5.17	3.16	4.17	
63.100	63.200	BT	50	5.69	5.21	5.45	50	6.07	4.24	5.16	
63.200	63.300	BT	50	8.77	6.15	7.46	49	9.65	7.68	8.67	
63.300	63.400	BT	52	6.85	6.28	6.57	47	4.81	2.01	3.41	
63.400	63.500	BT	53	9.70	7.06	8.38	49	7.26	5.99	6.63	
63.500	63.600	BT	51	8.79	6.50	7.65	48	7.03	6.18	6.61	
63.600	63.700	BT	52	8.50	5.87	7.19	48	4.31	2.49	3.40	
63.700	63.780	BT	52	6.14	5.06	5.60	47	5.94	3.73	4.84	
78.200	78.300	BT	43	5.27	4.16	4.72	38	4.28	5.63	4.96	
78.300	78.400	BT	46	11.10	13.45	12.28	39	5.63	4.37	5.00	
78.400	78.500	BT	46	10.38	10.79	10.59	47	6.01	3.82	4.92	
78.500	78.600	BT	47	8.55	9.66	9.11	49	5.85	3.20	4.53	
78.600	78.700	BT	48	6.95	9.87	8.41	50	4.79	3.15	3.97	
78.700	78.800	BT	47	8.87	11.50	10.19	50	6.24	3.48	4.86	

Rutting Analysis of Flexible Pavement on LHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)											
Chainage (km)			Inner Lane				Outer Lane				Remarks
From	To	Pav Type	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	
78.800	78.900	BT	36	2.64	1.84	2.24	43	10.32	8.03	9.18	
78.900	79.050	BT	24	3.52	3.04	3.28	25	3.06	4.33	3.70	
83.340	83.400	BT	24	7.28	8.14	7.71	24	4.33	2.97	3.65	
83.400	83.500	BT	32	7.63	8.77	8.20	28	4.98	3.47	4.23	
83.500	83.600	BT	41	11.23	8.45	9.84	37	3.74	1.94	2.84	
83.600	83.700	BT	47	8.24	5.24	6.74	42	4.57	1.73	3.15	
83.700	83.800	BT	50	7.16	5.47	6.32	45	4.33	3.29	3.81	
83.800	83.900	BT	52	6.43	5.73	6.08	49	5.28	2.37	3.83	
83.900	84.000	BT	52	7.39	7.33	7.36	49	5.57	2.72	4.15	
84.000	84.100	BT	51	5.09	3.79	4.44	49	4.35	3.74	4.05	
84.100	84.200	BT	51	5.92	6.32	6.12	49	6.39	4.83	5.61	
84.200	84.300	BT	28	13.48	16.51	15.00	48	6.46	4.82	5.64	
84.300	84.400	BT	40	7.24	4.61	5.93	49	6.17	4.04	5.11	
84.400	84.500	BT	50	5.20	7.13	6.17	50	4.89	3.99	4.44	
84.500	84.600	BT	53	7.91	5.04	6.48	47	6.23	3.26	4.75	
84.600	84.700	BT	54	6.33	4.43	5.38	45	5.42	2.96	4.19	
84.700	84.800	BT	53	5.91	7.89	6.90	43	5.93	3.99	4.96	
84.800	84.900	BT	55	7.66	6.93	7.30	46	3.72	2.86	3.29	
84.900	85.000	BT	55	7.39	8.68	8.04	47	4.24	2.47	3.36	
85.000	85.100	BT	54	5.92	8.16	7.04	49	5.01	2.31	3.66	
85.100	85.200	BT	55	8.22	6.09	7.16	48	5.72	2.77	4.25	
85.200	85.300	BT	54	9.87	7.84	8.86	48	4.54	2.75	3.65	
85.300	85.400	BT	54	8.10	8.92	8.51	49	3.25	2.55	2.90	
85.400	85.500	BT	54	6.65	8.01	7.33	49	3.08	2.85	2.97	
85.500	85.600	BT	53	7.37	4.82	6.10	47	5.35	2.66	4.01	
85.600	85.700	BT	47	8.54	6.08	7.31	49	4.76	2.73	3.75	
85.700	85.800	BT	38	10.93	13.16	12.05	50	5.06	3.99	4.53	
85.800	85.900	BT	30	6.88	9.62	8.25	48	7.47	5.11	6.29	
85.900	85.980	BT	17	6.56	8.79	7.68	48	5.49	3.81	4.65	
89.750	89.900	BT	43	7.93	10.96	9.45	52	9.01	6.20	7.61	
89.900	90.000	BT	42	7.36	9.95	8.66	51	6.74	4.41	5.58	
90.000	90.100	BT	43	7.09	9.71	8.40	51	5.39	3.32	4.36	
90.100	90.200	BT	44	5.06	7.86	6.46	48	7.01	4.08	5.55	
90.200	90.300	BT	43	7.51	9.94	8.73	49	5.82	4.06	4.94	
90.300	90.400	BT	42	6.73	5.95	6.34	51	6.11	4.28	5.20	
90.400	90.500	BT	40	10.67	13.44	12.06	50	4.47	3.32	3.90	
90.500	90.600	BT	40	7.58	9.75	8.67	47	6.09	3.45	4.77	
90.600	90.700	BT	41	8.24	10.62	9.43	48	4.98	2.98	3.98	
90.700	90.800	BT	41	7.18	6.02	6.60	44	4.83	2.09	3.46	
90.800	90.900	BT	41	5.04	3.30	4.17	48	8.35	5.51	6.93	
90.900	91.000	BT	42	5.92	3.60	4.76	50	6.24	4.62	5.43	
91.000	91.100	BT	40	5.82	3.63	4.73	47	5.73	3.88	4.81	
91.100	91.200	BT	38	6.44	4.19	5.32	50	4.04	2.41	3.23	
91.200	91.300	BT	39	7.84	5.97	6.91	52	4.67	3.40	4.04	
91.300	91.400	BT	41	6.63	7.99	7.31	52	6.82	4.80	5.81	
91.400	91.500	BT	39	6.84	8.03	7.44	51	6.68	5.26	5.97	
91.500	91.600	BT	40	9.34	6.98	8.16	50	4.49	2.50	3.50	
91.600	91.700	BT	44	7.86	5.11	6.49	51	5.51	3.88	4.70	
91.700	91.800	BT	44	9.28	6.49	7.89	52	4.90	2.80	3.85	
91.800	91.900	BT	41	9.58	7.32	8.45	51	6.99	4.74	5.87	
91.900	92.000	BT	40	7.16	4.24	5.70	51	4.40	2.96	3.68	
92.000	92.100	BT	41	7.27	4.59	5.93	48	5.36	3.39	4.38	
92.100	92.200	BT	41	5.62	3.56	4.59	48	5.41	4.28	4.85	
92.200	92.300	BT	42	6.25	3.52	4.89	39	4.78	2.62	3.70	
92.300	92.450	BT	21	7.72	6.13	6.93	36	3.47	1.62	2.55	

Rutting Analysis of Flexible Pavement on RHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)											
Chainage (km)			Inner Lane				Outer Lane				Remarks
From	To	Pav Type	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	
83.200	83.100	BT	23	3.82	4.13	3.98	19	6.17	5.59	5.88	
83.100	83.000	BT	39	11.62	9.73	10.68	36	3.82	5.44	4.63	
83.000	82.900	BT	48	10.74	9.09	9.92	43	2.69	4.21	3.45	
82.900	82.800	BT	54	10.21	11.10	10.66	48	2.86	2.94	2.90	
82.800	82.700	BT	54	8.60	7.84	8.22	51	2.55	2.60	2.58	
82.700	82.600	BT	55	7.74	8.26	8.00	51	2.72	2.63	2.68	
82.600	82.500	BT	58	8.08	8.00	8.04	51	3.28	2.41	2.85	
82.500	82.400	BT	58	6.04	4.91	5.48	48	2.86	3.52	3.19	
82.400	82.300	BT	55	5.15	5.59	5.37	43	2.00	3.30	2.65	
82.300	82.200	BT	37	7.37	7.63	7.50	29	3.72	3.06	3.39	
82.200	82.100	BT	42	5.03	6.47	5.75	23	2.06	3.85	2.96	
82.100	82.000	BT	51	5.33	6.04	5.69	29	1.91	2.43	2.17	
82.000	81.900	BT	56	8.19	6.88	7.54	34	2.63	4.17	3.40	
81.900	81.800	BT	58	10.79	7.82	9.31	40	2.76	4.33	3.55	
81.800	81.700	BT	58	9.54	11.98	10.76	48	2.56	2.17	2.37	
81.700	81.600	BT	58	9.34	11.73	10.54	50	2.63	4.03	3.33	
81.600	81.500	BT	58	8.28	9.63	8.96	52	2.63	3.39	3.01	
81.500	81.400	BT	59	4.46	3.05	3.76	52	2.03	3.32	2.68	
81.400	81.300	BT	50	5.13	5.23	5.18	52	2.14	2.59	2.37	
81.300	81.200	BT	44	6.42	5.98	6.20	52	2.38	4.02	3.20	
81.200	81.100	BT	43	4.00	6.15	5.08	52	2.82	2.86	2.84	
81.100	80.950	BT	41	7.81	8.63	8.22	48	4.10	6.36	5.23	
78.100	78.000	BT	33	4.29	5.23	4.76	47	2.93	2.60	2.77	
78.000	77.900	BT	38	5.52	3.83	4.68	50	2.30	3.59	2.95	
77.900	77.800	BT	42	5.11	5.63	5.37	51	2.61	4.09	3.35	
77.800	77.700	BT	41	6.89	8.01	7.45	51	2.75	2.85	2.80	
77.700	77.600	BT	36	7.08	7.54	7.31	46	3.63	5.16	4.40	
77.600	77.500	BT	43	10.71	12.17	11.44	50	4.77	5.17	4.97	
77.500	77.400	BT	47	6.86	7.65	7.26	52	3.75	4.55	4.15	
77.400	77.300	BT	42	7.90	6.92	7.41	50	3.20	2.58	2.89	
77.300	77.200	BT	42	6.96	5.84	6.40	51	2.69	3.07	2.88	
77.200	77.100	BT	44	5.37	7.05	6.21	52	3.05	3.53	3.29	
77.100	77.000	BT	46	5.25	6.73	5.99	53	2.97	3.78	3.38	
77.000	76.850	BT	43	8.06	7.26	7.66	52	4.37	3.26	3.82	
76.090	76.000	BT	46	8.27	7.92	8.10	44	8.29	9.75	9.02	
76.000	75.900	BT	46	7.64	8.47	8.06	48	4.16	5.39	4.78	
75.900	75.800	BT	43	9.80	8.77	9.29	48	8.97	8.39	8.68	
75.800	75.700	BT	53	4.00	5.68	4.84	52	2.25	3.31	2.78	
75.700	75.600	BT	56	4.69	4.65	4.67	52	2.45	3.41	2.93	
75.600	75.500	BT	57	4.44	4.31	4.38	51	2.41	3.84	3.13	
75.500	75.400	BT	58	6.54	6.30	6.42	52	2.13	2.37	2.25	
75.400	75.300	BT	59	4.36	2.92	3.64	47	2.64	2.50	2.57	
75.300	75.200	BT	47	10.45	9.43	9.94	39	1.73	2.63	2.18	
75.200	75.100	BT	28	6.76	7.68	7.22	32	5.90	6.02	5.96	
75.100	75.000	BT	47	4.86	4.88	4.87	41	2.77	3.94	3.36	
75.000	74.900	BT	45	5.39	5.70	5.55	49	3.29	5.12	4.21	
74.900	74.800	BT	43	13.84	16.65	15.25	43	6.55	5.97	6.26	
74.800	74.700	BT	50	10.08	7.52	8.80	39	6.81	8.02	7.42	
74.700	74.600	BT	49	5.19	4.14	4.67	39	2.99	4.14	3.57	
74.600	74.500	BT	44	3.24	4.04	3.64	40	1.84	3.21	2.53	
74.500	74.400	BT	41	12.93	10.64	11.79	38	3.06	2.23	2.65	
74.400	74.300	BT	44	5.69	6.40	6.05	32	4.47	4.94	4.71	

Rutting Analysis of Flexible Pavement on RHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)											
Chainage (km)			Inner Lane				Outer Lane				Remarks
From	To	Pav Type	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	
74.300	74.200	BT	52	5.81	4.29	5.05	38	4.05	3.45	3.75	
74.200	74.100	BT	56	8.29	7.41	7.85	43	2.50	4.18	3.34	
74.100	74.000	BT	58	6.13	5.83	5.98	51	2.98	3.74	3.36	
74.000	73.900	BT	56	5.53	3.96	4.75	54	3.26	5.09	4.18	
73.900	73.800	BT	47	5.43	4.99	5.21	46	4.76	6.83	5.80	
73.800	73.700	BT	51	6.51	5.98	6.25	47	3.96	3.51	3.74	
73.700	73.600	BT	56	6.35	4.90	5.63	52	3.10	3.98	3.54	
73.600	73.500	BT	56	6.22	5.24	5.73	52	2.32	4.23	3.28	
73.500	73.400	BT	56	4.55	6.54	5.55	53	3.23	2.56	2.90	
73.400	73.300	BT	55	8.88	6.85	7.87	54	2.76	3.26	3.01	
73.300	73.200	BT	57	5.23	5.15	5.19	54	3.02	3.27	3.15	
73.200	73.100	BT	59	6.73	5.81	6.27	53	2.52	2.51	2.52	
73.100	73.000	BT	58	5.27	5.38	5.33	52	3.93	3.54	3.74	
73.000	72.900	BT	59	4.75	5.45	5.10	53	3.39	4.93	4.16	
72.900	72.800	BT	59	4.50	3.05	3.78	48	3.34	4.30	3.82	
72.800	72.700	BT	60	7.49	8.77	8.13	34	3.66	3.36	3.51	
72.700	72.600	BT	56	8.30	9.48	8.89	40	3.11	2.88	3.00	
72.600	72.500	BT	34	5.68	6.43	6.06	32	8.41	5.62	7.02	
72.500	72.400	BT	33	9.09	6.26	7.68	24	4.27	4.36	4.32	
72.400	72.300	BT	43	6.69	7.90	7.30	38	2.98	4.69	3.84	
72.300	72.200	BT	29	8.16	8.33	8.25	37	5.56	4.48	5.02	
72.200	72.100	BT	36	6.74	4.66	5.70	39	6.31	6.22	6.27	
72.100	72.000	BT	51	4.36	4.56	4.46	47	2.20	4.07	3.14	
72.000	71.900	BT	55	3.28	4.41	3.85	53	2.41	3.81	3.11	
71.900	71.800	BT	56	4.55	5.00	4.78	55	2.34	3.75	3.05	
71.800	71.700	BT	56	3.84	5.67	4.76	53	1.98	2.79	2.39	
71.700	71.600	BT	56	4.55	4.50	4.53	52	3.60	2.87	3.24	
71.600	71.500	BT	57	3.21	4.61	3.91	53	2.24	1.73	1.99	
71.500	71.400	BT	58	3.22	3.90	3.56	53	3.57	2.77	3.17	
71.400	71.300	BT	36	8.98	11.07	10.03	46	5.72	6.62	6.17	
71.300	71.200	BT	39	3.99	5.68	4.84	46	2.88	2.07	2.48	
71.200	71.100	BT	50	4.03	4.25	4.14	50	2.12	3.35	2.74	
71.100	71.000	BT	52	6.11	6.06	6.09	51	2.58	4.43	3.51	
71.000	70.900	BT	45	9.37	7.17	8.27	52	2.84	3.68	3.26	
70.900	70.800	BT	43	5.04	5.07	5.06	52	3.47	3.19	3.33	
70.800	70.700	BT	50	3.51	5.29	4.40	46	3.32	2.69	3.01	
70.700	70.600	BT	52	3.29	2.86	3.08	45	2.35	3.23	2.79	
70.600	70.500	BT	52	4.66	3.36	4.01	49	2.40	3.82	3.11	
70.500	70.400	BT	44	5.65	6.98	6.32	46	2.31	2.41	2.36	
70.400	70.300	BT	27	8.79	8.06	8.43	29	8.57	7.33	7.95	
70.300	70.200	BT	39	5.87	4.88	5.38	35	4.37	4.99	4.68	
70.200	70.100	BT	42	7.57	8.65	8.11	40	6.62	5.70	6.16	
70.100	70.000	BT	49	4.43	3.25	3.84	46	3.36	2.89	3.13	
70.000	69.900	BT	52	4.60	4.20	4.40	53	2.11	3.37	2.74	
69.900	69.800	BT	52	3.77	4.37	4.07	53	1.96	3.96	2.96	
69.800	69.700	BT	47	7.77	6.30	7.04	50	2.64	2.12	2.38	
69.700	69.600	BT	50	5.31	7.26	6.29	49	2.96	3.95	3.46	
69.600	69.500	BT	55	5.41	5.14	5.28	52	2.56	2.08	2.32	
69.500	69.400	BT	44	9.10	9.87	9.49	41	5.78	4.48	5.13	
69.400	69.300	BT	46	7.17	7.47	7.32	42	3.54	2.80	3.17	
69.300	69.200	BT	55	4.42	5.43	4.93	51	2.31	3.55	2.93	
69.200	69.100	BT	57	4.65	6.57	5.61	51	1.94	3.59	2.77	

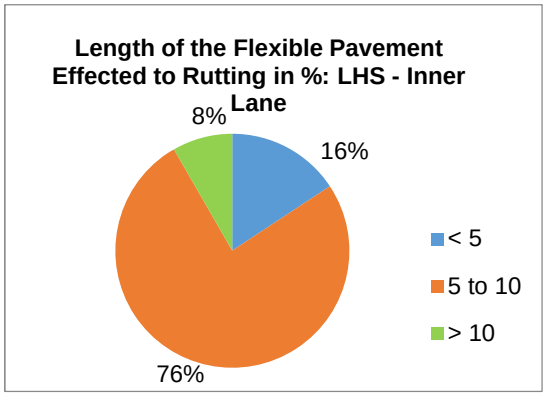
Rutting Analysis of Flexible Pavement on RHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)											
Chainage (km)			Inner Lane				Outer Lane				Remarks
From	To	Pav Type	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	
69.100	69.000	BT	58	5.15	5.87	5.51	52	2.74	2.24	2.49	
69.000	68.900	BT	59	4.74	4.78	4.76	51	2.77	3.05	2.91	
68.900	68.800	BT	58	3.84	5.04	4.44	52	2.26	4.23	3.25	
68.800	68.700	BT	56	6.54	5.61	6.08	52	3.39	2.80	3.10	
68.700	68.600	BT	57	7.65	9.08	8.37	44	5.13	4.73	4.93	
68.600	68.500	BT	59	7.44	7.19	7.32	49	4.12	3.13	3.63	
68.500	68.400	BT	59	6.56	4.95	5.76	53	4.10	3.32	3.71	
68.400	68.300	BT	54	7.67	8.74	8.21	50	4.93	4.72	4.83	
68.300	68.200	BT	55	7.83	7.49	7.66	49	2.60	4.08	3.34	
68.200	68.100	BT	60	5.76	4.28	5.02	52	3.82	3.20	3.51	
68.100	68.000	BT	58	4.05	5.94	5.00	52	2.49	3.35	2.92	
68.000	67.900	BT	57	8.50	8.04	8.27	52	1.96	2.83	2.40	
67.900	67.800	BT	56	12.16	14.21	13.19	43	4.28	5.38	4.83	
67.800	67.700	BT	58	3.70	4.54	4.12	49	1.74	1.95	1.85	
67.700	67.600	BT	60	5.81	6.87	6.34	52	2.72	2.11	2.42	
67.600	67.500	BT	60	6.65	7.09	6.87	45	3.50	4.51	4.01	
67.500	67.400	BT	58	4.65	5.35	5.00	32	4.09	3.79	3.94	
67.400	67.300	BT	60	5.69	5.24	5.47	42	3.99	3.11	3.55	
67.300	67.200	BT	57	5.33	7.16	6.25	49	3.14	4.02	3.58	
67.200	67.100	BT	50	5.63	6.10	5.87	54	2.59	2.01	2.30	
67.100	67.000	BT	46	6.12	5.96	6.04	54	2.62	2.18	2.40	
67.000	66.900	BT	44	8.19	8.94	8.57	55	2.83	1.92	2.38	
66.900	66.800	BT	45	6.45	6.32	6.39	54	2.31	1.51	1.91	
66.800	66.700	BT	45	4.62	5.16	4.89	53	1.82	3.33	2.58	
66.700	66.600	BT	44	10.29	9.99	10.14	51	2.78	2.83	2.81	
66.600	66.500	BT	43	13.56	15.37	14.47	46	4.11	5.08	4.60	
66.500	66.400	BT	46	9.54	9.02	9.28	43	6.33	4.39	5.36	
66.400	66.300	BT	44	4.20	5.84	5.02	48	2.39	2.84	2.62	
66.300	66.200	BT	42	4.40	4.50	4.45	49	1.92	2.44	2.18	
66.200	66.100	BT	41	6.04	4.24	5.14	50	1.98	2.66	2.32	
66.100	66.000	BT	38	4.79	3.60	4.20	49	3.69	2.84	3.27	
66.000	65.900	BT	41	5.26	3.73	4.50	50	2.72	3.72	3.22	
65.900	65.800	BT	43	4.92	5.53	5.23	50	3.11	2.27	2.69	
65.800	65.700	BT	43	4.05	5.16	4.61	51	3.09	2.95	3.02	
65.700	65.600	BT	43	6.96	5.40	6.18	50	2.93	2.73	2.83	
65.600	65.500	BT	42	6.41	5.93	6.17	50	3.49	2.16	2.83	
65.500	65.400	BT	43	6.41	5.66	6.04	51	2.41	4.12	3.27	
65.400	65.300	BT	40	5.36	4.28	4.82	51	2.78	3.42	3.10	
65.300	65.200	BT	40	5.55	5.26	5.41	52	4.37	4.08	4.23	
65.200	65.100	BT	41	3.66	4.51	4.09	52	2.81	4.29	3.55	
65.100	65.000	BT	43	5.74	7.06	6.40	52	3.26	3.01	3.14	
65.000	64.900	BT	48	4.33	4.00	4.17	52	2.57	3.94	3.26	
64.900	64.800	BT	45	5.34	3.94	4.64	52	2.34	3.74	3.04	
64.800	64.700	BT	42	8.71	6.93	7.82	50	3.75	4.15	3.95	
64.700	64.600	BT	40	8.87	6.79	7.83	51	3.94	3.66	3.80	
64.600	64.500	BT	41	7.18	7.20	7.19	54	3.09	2.74	2.92	
64.500	64.400	BT	45	4.96	4.57	4.77	50	2.99	4.19	3.59	
64.400	64.300	BT	55	7.02	7.92	7.47	37	2.67	3.40	3.04	
64.300	64.200	BT	59	6.01	6.09	6.05	41	3.15	3.34	3.25	
64.200	64.100	BT	56	4.81	3.05	3.93	43	2.71	3.95	3.33	
64.100	64.000	BT	52	7.11	8.97	8.04	29	2.84	2.71	2.78	
64.000	63.900	BT	51	6.65	8.19	7.42	20	2.95	2.67	2.81	

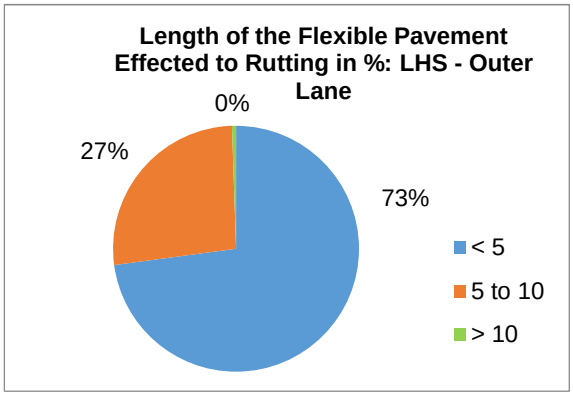
Rutting Analysis of Flexible Pavement on RHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)											
Chainage (km)			Inner Lane				Outer Lane				Remarks
From	To	Pav Type	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	
63.900	63.750	BT	54	8.62	6.52	7.57	38	1.79	3.14	2.47	
62.730	62.600	BT	43	9.61	7.64	8.63	46	3.76	5.18	4.47	
62.600	62.550	BT	43	4.17	4.09	4.13	46	1.56	3.54	2.55	
61.970	61.900	BT	47	6.13	8.34	7.24	52	1.53	2.73	2.13	
61.900	61.800	BT	47	4.62	4.52	4.57	52	1.39	3.15	2.27	
61.800	61.700	BT	46	3.75	3.68	3.72	51	1.37	2.88	2.13	
61.700	61.600	BT	43	5.39	5.07	5.23	50	1.59	2.61	2.10	
61.600	61.500	BT	40	3.52	5.27	4.40	50	1.83	2.98	2.41	
61.500	61.400	BT	34	4.05	5.50	4.78	50	2.21	2.45	2.33	
61.400	61.300	BT	36	4.25	4.69	4.47	50	2.19	3.08	2.64	
61.300	61.200	BT	45	6.11	4.80	5.46	45	2.27	3.63	2.95	
61.200	61.100	BT	52	6.40	5.47	5.94	43	1.82	3.79	2.81	
61.100	61.000	BT	51	5.72	6.10	5.91	46	2.77	2.82	2.80	
61.000	60.900	BT	46	4.53	5.71	5.12	46	2.34	3.95	3.15	
60.900	60.800	BT	45	6.12	7.71	6.92	48	2.32	3.09	2.71	
60.800	60.700	BT	44	5.68	7.41	6.55	51	2.40	2.80	2.60	
60.700	60.600	BT	43	5.81	5.00	5.41	52	2.04	2.82	2.43	
60.600	60.500	BT	43	5.33	3.66	4.50	50	1.99	3.10	2.55	
60.500	60.400	BT	41	14.63	17.28	15.96	43	4.42	3.54	3.98	
60.400	60.300	BT	40	7.13	7.05	7.09	40	2.52	3.21	2.87	
60.300	60.200	BT	41	7.74	7.02	7.38	36	3.25	3.32	3.29	
60.200	60.100	BT	46	9.63	10.93	10.28	34	2.82	2.52	2.67	
60.100	60.000	BT	46	4.70	5.83	5.27	46	2.37	2.22	2.30	
60.000	59.900	BT	46	4.26	6.15	5.21	51	2.48	2.78	2.63	
59.900	59.800	BT	44	5.65	5.62	5.64	52	2.56	2.48	2.52	
59.800	59.700	BT	43	4.34	6.31	5.33	52	2.50	2.62	2.56	
59.700	59.600	BT	44	6.07	5.82	5.95	51	2.39	3.77	3.08	
59.600	59.500	BT	44	5.16	4.42	4.79	51	1.90	3.18	2.54	
59.500	59.400	BT	47	8.15	7.06	7.61	52	1.78	3.01	2.40	
59.400	59.300	BT	55	7.66	6.33	7.00	53	2.33	2.93	2.63	
59.300	59.200	BT	52	4.34	3.99	4.17	53	1.97	2.83	2.40	
59.200	59.100	BT	55	4.29	4.14	4.22	52	1.72	2.66	2.19	
59.100	59.000	BT	58	4.94	3.79	4.37	50	1.51	2.94	2.23	
59.000	58.900	BT	57	9.01	8.54	8.78	48	1.96	2.17	2.07	
58.900	58.800	BT	55	11.74	9.95	10.85	42	6.77	6.64	6.71	
58.800	58.700	BT	56	8.61	8.04	8.33	48	2.47	4.30	3.39	
58.700	58.600	BT	59	6.39	5.41	5.90	50	2.24	3.45	2.85	
58.600	58.500	BT	61	7.75	6.26	7.01	52	3.53	4.93	4.23	
58.500	58.400	BT	62	9.31	9.89	9.60	53	2.80	2.40	2.60	
58.400	58.300	BT	60	8.65	9.17	8.91	51	3.01	2.10	2.56	
58.300	58.200	BT	61	9.96	11.00	10.48	50	2.53	4.33	3.43	
58.200	58.100	BT	60	7.98	6.84	7.41	52	2.70	4.31	3.51	
58.100	58.000	BT	61	6.14	5.49	5.82	52	2.54	2.86	2.70	
58.000	57.900	BT	61	4.53	5.81	5.17	51	2.91	4.12	3.52	
57.900	57.800	BT	61	7.88	7.72	7.80	53	2.41	3.98	3.20	
57.800	57.700	BT	61	5.36	5.57	5.47	52	3.25	4.22	3.74	
57.700	57.600	BT	57	8.49	8.19	8.34	49	2.45	3.52	2.99	
57.600	57.500	BT	50	6.15	6.28	6.22	49	2.98	3.76	3.37	
57.500	57.400	BT	55	6.26	5.31	5.79	52	2.59	3.38	2.99	
57.400	57.300	BT	56	6.08	5.77	5.93	53	2.44	3.48	2.96	
57.300	57.200	BT	55	5.85	4.02	4.94	51	2.78	3.83	3.31	
57.200	57.100	BT	55	7.68	6.21	6.95	46	4.47	3.10	3.79	

Rutting Analysis of Flexible Pavement on RHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)											
Chainage (km)			Inner Lane				Outer Lane				Remarks
From	To	Pav Type	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	
57.100	57.000	BT	57	10.79	10.76	10.78	52	2.40	2.36	2.38	
57.000	56.900	BT	58	6.88	6.32	6.60	53	1.77	2.22	2.00	
56.900	56.800	BT	58	9.54	10.58	10.06	53	1.74	2.11	1.93	
56.800	56.700	BT	57	9.39	11.18	10.29	52	2.03	2.60	2.32	
56.700	56.600	BT	58	7.14	5.58	6.36	52	2.52	2.61	2.57	
56.600	56.500	BT	60	11.38	9.92	10.65	52	3.19	2.40	2.80	
56.500	56.400	BT	61	9.99	8.59	9.29	52	2.31	2.91	2.61	
56.400	56.300	BT	61	9.33	7.91	8.62	52	2.62	2.66	2.64	
56.300	56.200	BT	60	8.20	7.53	7.87	52	2.12	3.12	2.62	
56.200	56.100	BT	58	7.66	5.98	6.82	52	2.28	2.52	2.40	
56.100	56.000	BT	58	7.64	6.28	6.96	52	2.29	2.26	2.28	
56.000	55.900	BT	59	12.86	11.93	12.40	51	2.28	2.09	2.19	
55.900	55.800	BT	60	11.91	9.17	10.54	52	1.74	2.07	1.91	
55.800	55.700	BT	60	7.43	9.86	8.65	52	2.59	2.43	2.51	
55.700	55.600	BT	54	8.13	6.92	7.53	53	2.40	1.86	2.13	
55.600	55.500	BT	48	6.41	4.53	5.47	54	2.05	2.23	2.14	
55.500	55.400	BT	47	8.15	6.94	7.55	52	1.62	1.98	1.80	
55.400	55.300	BT	42	6.21	4.80	5.51	48	3.54	4.77	4.16	
55.300	55.200	BT	37	5.05	4.87	4.96	49	2.24	3.19	2.72	
55.200	55.100	BT	35	9.45	9.53	9.49	31	1.51	1.82	1.67	
53.250	53.100	BT	28	5.23	4.51	4.87	52	2.72	2.29	2.51	
53.100	53.000	BT	17	5.71	6.05	5.88	52	1.94	1.87	1.91	
53.000	52.900	BT	21	3.01	4.66	3.84	52	1.88	1.73	1.81	
52.900	52.800	BT	36	3.10	4.51	3.81	52	1.43	1.38	1.41	
52.800	52.700	BT	41	4.56	4.09	4.33	52	1.57	2.00	1.79	
52.700	52.600	BT	47	3.32	2.72	3.02	52	2.06	2.31	2.19	
52.600	52.500	BT	52	2.82	2.57	2.70	52	2.01	1.84	1.93	
52.500	52.400	BT	52	3.27	1.51	2.39	54	2.54	2.03	2.29	
52.400	52.300	BT	50	3.34	4.05	3.70	52	2.75	1.96	2.36	
52.300	52.200	BT	45	8.44	6.68	7.56	43	2.68	3.10	2.89	
52.200	52.120	BT	48	5.19	7.13	6.16	45	2.95	2.26	2.61	
47.510	47.400	BT	51	5.90	6.55	6.23	49	1.97	2.38	2.18	
47.400	47.300	BT	56	6.76	6.60	6.68	48	1.82	2.05	1.94	
47.300	47.200	BT	55	6.24	5.44	5.84	49	1.87	2.10	1.99	
47.200	47.100	BT	54	6.64	8.96	7.80	50	1.72	2.38	2.05	
47.100	47.000	BT	50	15.82	15.74	15.78	45	3.39	2.90	3.15	
47.000	46.900	BT	52	8.65	7.66	8.16	46	3.74	4.50	4.12	
46.900	46.800	BT	53	7.57	10.11	8.84	47	2.73	3.54	3.14	
46.800	46.700	BT	56	6.63	5.54	6.09	51	1.62	2.19	1.91	
46.700	46.600	BT	57	4.96	3.48	4.22	52	2.04	2.16	2.10	
46.600	46.500	BT	58	3.81	5.05	4.43	52	1.82	1.94	1.88	
46.500	46.420	BT	57	7.52	7.04	7.28	52	1.69	1.88	1.79	
46.010	45.900	BT	58	4.85	3.26	4.06	52	1.66	2.84	2.25	
45.900	45.800	BT	59	5.60	4.95	5.28	53	1.77	2.78	2.28	
45.800	45.700	BT	58	4.81	3.03	3.92	52	1.99	2.52	2.26	
45.700	45.600	BT	54	5.23	4.86	5.05	51	2.00	2.85	2.43	
45.600	45.500	BT	52	5.73	6.69	6.21	44	3.69	3.82	3.76	
45.500	45.400	BT	55	7.17	6.88	7.03	45	4.23	2.95	3.59	
45.400	45.300	BT	58	7.72	9.03	8.38	50	2.29	3.20	2.75	
45.300	45.200	BT	55	5.51	4.84	5.18	47	4.42	5.33	4.88	
45.200	45.100	BT	55	6.32	6.16	6.24	35	3.72	4.89	4.31	
45.100	45.000	BT	57	5.65	4.64	5.15	44	1.88	2.78	2.33	

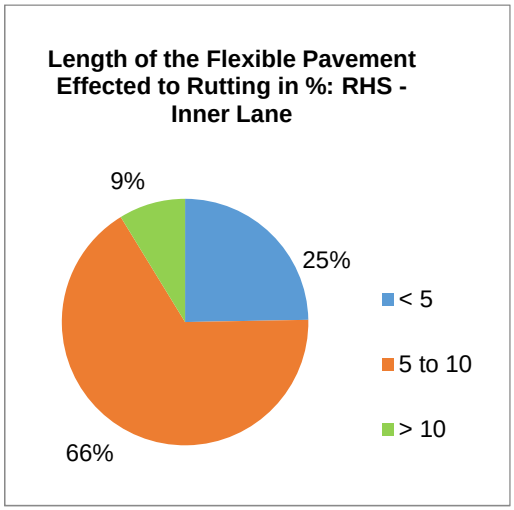
Rutting Analysis of Flexible Pavement on RHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)											
Chainage (km)			Inner Lane				Outer Lane				Remarks
From	To	Pav Type	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	
45.000	44.900	BT	58	5.24	4.94	5.09	50	1.67	2.12	1.90	
44.900	44.800	BT	58	5.90	4.58	5.24	52	1.87	2.35	2.11	
44.800	44.700	BT	57	8.69	8.29	8.49	53	1.72	2.46	2.09	
44.700	44.600	BT	57	9.44	10.38	9.91	53	2.29	2.93	2.61	
44.600	44.500	BT	57	6.84	7.21	7.03	54	1.96	3.54	2.75	
44.500	44.400	BT	59	8.15	10.75	9.45	53	2.13	2.74	2.44	
44.400	44.300	BT	58	6.84	4.88	5.86	52	1.55	3.00	2.28	
44.300	44.200	BT	57	5.19	4.83	5.01	51	3.42	4.85	4.14	
44.200	44.100	BT	58	8.37	10.02	9.20	53	2.99	2.96	2.98	
44.100	44.000	BT	60	8.13	8.03	8.08	54	1.82	2.14	1.98	
44.000	43.900	BT	60	9.11	8.72	8.92	53	2.05	3.20	2.63	
43.900	43.800	BT	61	14.92	12.45	13.69	53	3.15	3.43	3.29	
43.800	43.700	BT	59	8.40	10.41	9.41	53	2.57	3.47	3.02	
43.700	43.600	BT	58	9.39	8.86	9.13	52	1.72	3.45	2.59	
43.600	43.500	BT	57	10.77	11.18	10.98	52	1.49	3.44	2.47	
43.500	43.400	BT	57	6.04	4.12	5.08	52	1.72	2.73	2.23	
43.400	43.300	BT	58	5.69	5.97	5.83	52	2.15	2.72	2.44	
43.300	43.200	BT	59	8.22	7.42	7.82	53	2.07	3.58	2.83	
43.200	43.130	BT	59	14.87	14.91	14.89	52	1.99	3.70	2.85	
30.470	30.400	BT	47	4.14	3.82	3.98	37	2.41	2.26	2.34	
30.400	30.300	BT	37	5.94	6.11	6.03	20	3.29	2.42	2.86	
30.300	30.200	BT	19	6.18	5.33	5.76	19	3.87	5.32	4.60	
30.200	30.100	BT									Under Construction
30.100	30.000	BT									Under Construction

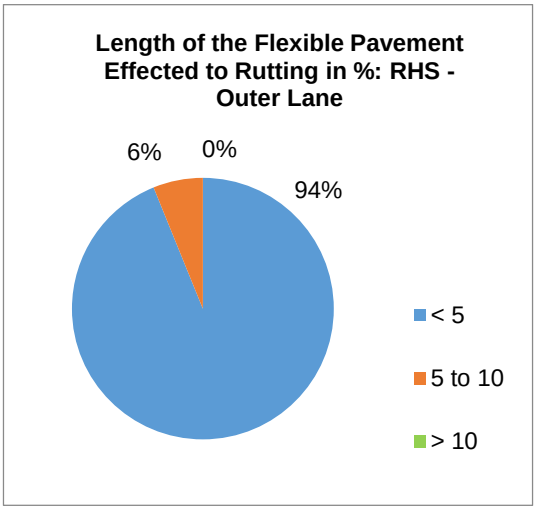
Summary of Rutting of Flexible Pavement on LHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)					
Distress	(Depth, mm)	Length of the Road Effected with Rutting			
		LHS (Length in Km)		LHS (Length in %)	
		Inner Lane	Outer Lane	Inner Lane	Outer Lane
Rutting	< 5	2.830	13.120	15.7	72.9
	5 to 10	13.670	4.780	75.9	26.6
	> 10	1.500	0.100	8.3	0.6





Summary of Rutting of Flexible Pavement on RHS Direction: NH-27: Kochugaon to Rakhaldubi (Pkg-I)					
Distress	(Depth, mm)	Length of the Road Effected with Rutting			
		RHS (Length in Km)		RHS (Length in %)	
		Inner Lane	Outer Lane	Inner Lane	Outer Lane
Rutting	< 5	6.980	26.520	24.7	93.8
	5 to 10	18.810	1.740	66.6	6.2
	> 10	2.470	0.000	8.7	0.0





Rutting Analysis of Flexible Pavement on LHS Direction: NH-27:Rakhaldubi to Kalijhar (Pkg-II)											
Chainage (km)			Inner Lane				Outer Lane				Remarks
From	To	Pav Type	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	
961.500	961.600	BT	19	5.27	4.29	4.78	19	4.92	2.62	3.77	
961.600	961.700	BT	28	5.12	3.67	4.40	28	5.25	2.49	3.87	
961.700	961.800	BT	31	7.80	7.23	7.52	31	5.83	2.91	4.37	
961.800	961.900	BT	29	6.13	7.13	6.63	29	6.48	3.86	5.17	
961.900	962.000	BT	24	4.48	5.59	5.04	24	6.66	5.77	6.22	
962.000	962.100	BT									Under Construction
962.100	962.200	BT									Under Construction
962.200	962.250	BT									Under Construction
962.250	962.300	BT	14	4.55	5.10	4.83	14	2.65	2.40	2.53	
962.300	962.400	BT	30	7.10	8.36	7.73	30	4.89	2.95	3.92	
962.400	962.500	BT	39	9.20	8.25	8.73	39	5.09	5.08	5.09	
962.500	962.600	BT	43	8.30	9.45	8.88	43	4.36	4.15	4.26	
962.600	962.700	BT	44	7.34	8.47	7.91	44	5.67	3.22	4.45	
962.700	962.800	BT	44	5.54	6.34	5.94	44	6.37	3.48	4.93	
962.800	962.900	BT	43	5.09	7.32	6.21	43	4.44	4.07	4.26	
962.900	963.000	BT	39	6.44	5.32	5.88	39	8.27	5.96	7.12	
963.000	963.100	BT	42	4.11	5.54	4.83	42	6.42	4.27	5.35	
963.100	963.200	BT	45	5.47	4.61	5.04	45	6.44	4.14	5.29	
963.200	963.300	BT	47	6.22	6.69	6.46	47	7.75	7.11	7.43	
963.300	963.400	BT	49	5.08	4.65	4.87	49	7.84	4.89	6.37	
963.400	963.500	BT	49	7.58	6.07	6.83	49	6.99	7.31	7.15	
963.500	963.600	BT	50	9.21	9.36	9.29	50	7.39	5.01	6.20	
963.600	963.700	BT	47	4.49	5.20	4.85	47	5.23	4.87	5.05	
963.700	963.800	BT	47	8.26	9.44	8.85	47	7.59	5.36	6.48	
963.800	963.900	BT	46	6.42	7.14	6.78	46	7.73	6.01	6.87	
963.900	964.000	BT	43	5.08	4.03	4.56	43	7.98	5.51	6.75	
964.000	964.100	BT	42	5.38	4.76	5.07	42	8.56	5.65	7.11	
964.100	964.200	BT	42	8.05	7.45	7.75	42	6.91	4.81	5.86	
964.200	964.300	BT	47	7.91	6.75	7.33	47	5.59	4.32	4.96	
964.300	964.400	BT	51	7.49	7.63	7.56	51	7.52	4.63	6.08	
964.400	964.500	BT	52	4.67	3.27	3.97	52	6.69	4.47	5.58	
964.500	964.600	BT	52	4.27	5.05	4.66	52	6.36	3.81	5.09	
964.600	964.700	BT	52	5.24	6.51	5.88	52	4.42	2.26	3.34	
964.700	964.800	BT	52	3.70	4.70	4.20	52	5.64	3.53	4.59	
964.800	964.900	BT	53	6.58	7.87	7.23	53	4.47	3.47	3.97	
964.900	965.000	BT	52	6.08	7.41	6.75	52	4.36	3.19	3.78	
965.000	965.100	BT	53	5.29	4.72	5.01	53	5.80	3.47	4.64	
965.100	965.200	BT	52	5.34	5.97	5.66	52	5.15	2.94	4.05	
965.200	965.300	BT	52	2.08	2.34	2.21	52	1.87	2.74	2.31	
965.300	965.360	BT	52	2.55	2.91	2.73	52	2.73	2.08	2.41	
970.050	970.200	BT	50	12.75	13.78	13.27	50	3.60	1.92	2.76	
970.200	970.300	BT	51	8.84	7.60	8.22	51	3.49	2.31	2.90	
970.300	970.400	BT	51	7.54	6.01	6.78	51	7.83	7.28	7.56	
970.400	970.500	BT	52	7.73	6.66	7.20	52	7.37	4.73	6.05	
970.500	970.600	BT	52	10.18	9.29	9.74	52	8.42	7.37	7.90	
970.600	970.700	BT	50	14.27	13.26	13.77	50	10.60	7.94	9.27	
970.700	970.800	BT	54	12.58	14.06	13.32	54	6.90	6.14	6.52	
970.800	970.950	BT	52	9.51	10.15	9.83	52	6.59	3.98	5.29	
971.670	971.800	BT	40	8.38	8.94	8.66	40	10.22	7.78	9.00	
971.800	971.900	BT	44	7.41	8.45	7.93	44	11.29	8.84	10.07	
971.900	972.000	BT	41	13.60	13.90	13.75	41	8.65	6.26	7.46	
972.000	972.100	BT	47	8.10	8.82	8.46	47	6.87	6.64	6.76	
972.100	972.200	BT	37	9.53	9.36	9.45	37	7.99	5.97	6.98	
972.200	972.300	BT	41	11.49	10.69	11.09	41	8.63	6.25	7.44	
972.300	972.400	BT	46	12.48	12.08	12.28	46	8.55	5.84	7.20	
972.400	972.500	BT	52	14.86	15.62	15.24	52	10.59	7.95	9.27	
972.500	972.600	BT	54	10.42	10.97	10.70	54	10.90	8.45	9.68	
972.600	972.700	BT	54	10.19	10.71	10.45	54	8.58	5.60	7.09	
972.700	972.800	BT	57	12.26	11.31	11.79	57	8.65	5.85	7.25	
972.800	972.900	BT	57	12.06	11.72	11.89	57	10.77	8.22	9.50	
972.900	973.000	BT	56	13.49	12.57	13.03	56	9.65	6.75	8.20	
973.000	973.100	BT	57	9.78	9.15	9.47	57	12.99	11.40	12.20	
973.100	973.200	BT	55	12.08	11.46	11.77	55	10.35	8.32	9.34	
973.200	973.300	BT	54	12.58	12.17	12.38	54	8.89	6.18	7.54	
973.300	973.400	BT	54	9.15	8.20	8.68	54	10.12	7.55	8.84	
973.400	973.500	BT	55	9.21	8.30	8.76	55	11.40	10.78	11.09	
973.500	973.600	BT	53	15.48	14.23	14.86	53	10.95	8.24	9.60	

Rutting Analysis of Flexible Pavement on LHS Direction: NH-27:Rakhaldubi to Kalijhar (Pkg-II)											
Chainage (km)			Inner Lane				Outer Lane				Remarks
From	To	Pav Type	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	
973.600	973.700	BT	56	10.47	11.82	11.15	56	9.77	8.32	9.05	
973.700	973.800	BT	58	11.36	12.46	11.91	58	6.12	4.05	5.09	
973.800	973.900	BT	56	16.14	15.18	15.66	56	11.01	8.37	9.69	
973.900	974.000	BT	54	17.76	17.60	17.68	54	8.68	8.25	8.47	
974.000	974.100	BT	53	12.17	11.12	11.65	53	8.87	8.59	8.73	
974.100	974.200	BT	50	14.10	13.05	13.58	50	11.07	9.36	10.22	
974.200	974.300	BT	44	19.65	19.38	19.52	44	8.63	8.04	8.34	
974.300	974.400	BT	44	12.17	12.61	12.39	44	9.96	8.41	9.19	
974.400	974.500	BT	42	12.08	12.44	12.26	42	9.92	8.24	9.08	
974.500	974.600	BT	40	16.65	15.02	15.84	40	9.87	8.03	8.95	
974.600	974.700	BT	31	13.54	13.89	13.72	31	6.61	4.71	5.66	
974.700	974.800	BT	31	13.17	12.17	12.67	31	8.94	6.59	7.77	
974.800	974.900	BT	31	15.70	15.35	15.53	31	7.42	6.85	7.14	
974.900	975.000	BT	29	8.06	9.79	8.93	29	10.23	8.26	9.25	
975.000	975.100	BT	21	13.91	13.71	13.81	21	5.84	8.83	7.34	
975.100	975.200	BT	29	9.73	10.41	10.07	29	8.13	6.07	7.10	
975.200	975.300	BT	36	6.43	5.70	6.07	36	7.55	8.58	8.07	
975.300	975.400	BT	35	10.03	8.53	9.28	35	10.07	8.90	9.49	
975.400	975.500	BT	43	15.88	14.71	15.30	43	7.73	5.77	6.75	
975.500	975.600	BT	47	8.30	9.74	9.02	47	9.02	6.60	7.81	
975.600	975.700	BT	49	13.27	15.89	14.58	49	7.31	7.63	7.47	
975.700	975.800	BT	50	12.23	14.53	13.38	50	8.33	8.32	8.33	
975.800	975.900	BT	50	17.01	18.73	17.87	50	10.37	7.50	8.94	
975.900	976.000	BT	51	14.76	16.37	15.57	51	8.67	6.83	7.75	
976.000	976.100	BT	51	11.75	13.86	12.81	51	8.26	5.86	7.06	
976.100	976.200	BT	51	15.23	13.57	14.40	51	9.11	8.95	9.03	
976.200	976.300	BT	51	11.52	9.74	10.63	51	8.43	6.05	7.24	
976.300	976.400	BT	51	8.90	10.03	9.47	51	8.27	6.10	7.19	
976.400	976.500	BT	50	9.36	12.32	10.84	50	7.96	5.80	6.88	
976.500	976.600	BT	51	18.25	15.33	16.79	51	7.88	5.86	6.87	
976.600	976.700	BT	53	8.87	11.86	10.37	53	7.87	5.11	6.49	
976.700	976.800	BT	52	14.48	14.71	14.60	52	7.12	4.32	5.72	
976.800	976.900	BT	52	10.36	10.96	10.66	52	7.13	4.86	6.00	
976.900	977.000	BT	52	7.24	4.59	5.92	52	6.65	4.26	5.46	
977.000	977.100	BT	53	8.33	11.16	9.75	53	7.70	4.95	6.33	
977.100	977.200	BT	53	8.01	10.34	9.18	53	7.13	6.67	6.90	
977.200	977.300	BT	53	7.50	8.98	8.24	53	7.17	4.24	5.71	
977.300	977.400	BT	52	6.95	9.51	8.23	52	8.19	5.20	6.70	
977.400	977.500	BT	51	8.47	10.97	9.72	51	7.95	5.27	6.61	
977.500	977.600	BT	52	10.06	11.41	10.74	52	6.79	4.25	5.52	
977.600	977.700	BT	52	8.10	10.68	9.39	52	6.70	4.42	5.56	
977.700	977.800	BT	53	10.23	10.79	10.51	53	7.18	5.07	6.13	
977.800	977.900	BT	53	11.33	8.50	9.92	53	7.07	4.88	5.98	
977.900	978.000	BT	53	11.57	9.04	10.31	53	7.69	5.24	6.47	
978.000	978.100	BT	53	12.64	10.02	11.33	53	7.70	4.78	6.24	
978.100	978.200	BT	52	10.49	8.40	9.45	52	6.98	4.67	5.83	
978.200	978.300	BT	53	12.69	9.95	11.32	53	8.19	6.13	7.16	
978.300	978.400	BT	53	11.49	10.14	10.82	53	7.10	4.50	5.80	
978.400	978.500	BT	53	7.71	9.74	8.73	53	7.64	4.88	6.26	
978.500	978.600	BT	53	11.92	9.32	10.62	53	7.42	4.95	6.19	
978.600	978.700	BT	52	10.72	8.79	9.76	52	7.94	5.35	6.65	
978.700	978.800	BT	51	16.93	15.69	16.31	51	9.95	7.41	8.68	
978.800	978.900	BT	49	17.24	16.02	16.63	49	9.64	7.36	8.50	
978.900	979.000	BT	52	15.06	13.23	14.15	52	7.58	4.59	6.09	
979.000	979.100	BT	52	13.43	11.55	12.49	52	7.94	6.82	7.38	
979.100	979.200	BT	49	17.39	14.80	16.10	49	10.49	9.62	10.06	
979.200	979.300	BT	50	14.96	12.93	13.95	50	9.16	8.35	8.76	
979.300	979.400	BT	52	11.15	12.71	11.93	52	7.24	4.99	6.12	
979.400	979.500	BT	51	13.36	12.47	12.92	51	8.03	5.09	6.56	
979.500	979.600	BT	45	14.40	15.35	14.88	45	8.47	6.27	7.37	
979.600	979.700	BT	41	14.60	11.78	13.19	41	7.56	4.85	6.21	
979.700	979.800	BT	47	15.22	16.95	16.09	47	7.81	5.24	6.53	
979.800	979.900	BT	51	12.90	14.54	13.72	51	7.21	6.76	6.99	
979.900	980.000	BT	51	14.38	15.20	14.79	51	8.70	6.32	7.51	
980.000	980.100	BT	48	15.24	16.90	16.07	48	8.74	7.19	7.97	
980.100	980.200	BT	52	13.52	10.58	12.05	52	7.10	6.71	6.91	
980.200	980.300	BT	52	13.56	12.37	12.97	52	8.46	6.04	7.25	

Rutting Analysis of Flexible Pavement on LHS Direction: NH-27:Rakhaldubi to Kalijhar (Pkg-II)											
Chainage (km)			Inner Lane				Outer Lane				Remarks
From	To	Pav Type	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	
980.300	980.400	BT	52	15.91	13.29	14.60	52	7.98	7.61	7.80	
980.400	980.500	BT	52	9.98	12.75	11.37	52	6.86	4.08	5.47	
980.500	980.600	BT	52	11.44	9.50	10.47	52	6.06	3.73	4.90	
980.600	980.700	BT	53	10.04	10.38	10.21	53	5.10	2.97	4.04	
980.700	980.800	BT	50	9.94	11.59	10.77	50	6.05	3.16	4.61	
980.800	980.900	BT	43	12.84	10.39	11.62	43	8.44	5.57	7.01	
980.900	981.000	BT	47	16.17	17.93	17.05	47	7.61	4.84	6.23	
981.000	981.100	BT	50	15.46	16.34	15.90	50	7.84	6.29	7.07	
981.100	981.200	BT	51	19.86	17.33	18.60	51	8.74	6.11	7.43	
981.200	981.300	BT	51	9.78	12.27	11.03	51	7.24	4.83	6.04	
981.300	981.400	BT	50	12.70	11.52	12.11	50	6.70	6.10	6.40	
981.400	981.500	BT	52	12.29	10.44	11.37	52	6.38	6.20	6.29	
981.500	981.600	BT	52	8.38	7.76	8.07	52	8.38	5.84	7.11	
981.600	981.700	BT	52	12.07	14.74	13.41	52	9.02	8.36	8.69	
981.700	981.800	BT	51	15.05	14.17	14.61	51	11.41	11.32	11.37	
981.800	981.900	BT	52	14.97	14.28	14.63	52	8.61	6.35	7.48	
981.900	982.000	BT	50	12.80	10.78	11.79	50	9.63	7.04	8.34	
982.000	982.100	BT	51	12.89	12.86	12.88	51	10.23	7.78	9.01	
982.100	982.200	BT	51	18.40	16.93	17.67	51	8.92	7.29	8.11	
982.200	982.300	BT	51	14.46	12.58	13.52	51	9.27	6.86	8.07	
982.300	982.400	BT	51	8.36	9.51	8.94	51	7.68	4.69	6.19	
982.400	982.500	BT	52	9.99	9.57	9.78	52	5.98	3.85	4.92	
982.500	982.600	BT	51	7.46	8.03	7.75	51	6.08	3.66	4.87	
982.600	982.700	BT	50	8.06	7.14	7.60	50	6.29	5.86	6.08	
982.700	982.800	BT	50	10.52	9.51	10.02	50	14.75	11.88	13.32	
982.800	982.900	BT	51	12.98	14.74	13.86	51	14.93	12.77	13.85	
982.900	983.000	BT	52	12.39	14.42	13.41	52	7.75	5.94	6.85	
983.000	983.100	BT	50	8.62	6.47	7.55	50	6.11	5.63	5.87	
983.100	983.200	BT	44	6.05	5.40	5.73	44	5.37	2.77	4.07	
983.200	983.300	BT	51	8.76	6.04	7.40	51	5.94	4.72	5.33	
983.300	983.400	BT	52	8.82	7.59	8.21	52	6.50	4.18	5.34	
983.400	983.500	BT	52	7.48	8.94	8.21	52	6.31	3.76	5.04	
983.500	983.600	BT	52	6.95	8.56	7.76	52	6.03	3.84	4.94	
983.600	983.700	BT	51	9.73	7.57	8.65	51	6.82	6.62	6.72	
983.700	983.800	BT	52	6.49	7.26	6.88	52	5.25	3.03	4.14	
983.800	983.900	BT	52	5.59	6.39	5.99	52	4.67	1.93	3.30	
983.900	984.000	BT	52	6.09	6.31	6.20	52	5.34	2.52	3.93	
984.000	984.100	BT	53	7.15	8.61	7.88	53	5.19	2.95	4.07	
984.100	984.200	BT	53	6.62	6.72	6.67	53	6.57	3.65	5.11	
984.200	984.300	BT	53	6.59	5.93	6.26	53	4.92	2.54	3.73	
984.300	984.400	BT	50	6.45	7.43	6.94	50	7.29	4.48	5.89	
984.400	984.500	BT	50	4.48	5.03	4.76	50	5.50	2.57	4.04	
984.500	984.600	BT	53	4.30	4.22	4.26	53	4.58	2.43	3.51	
984.600	984.700	BT	52	6.06	5.66	5.86	52	4.46	2.56	3.51	
984.700	984.800	BT	52	6.91	6.24	6.58	52	5.27	2.42	3.85	
984.800	984.900	BT	52	7.60	6.62	7.11	52	6.40	4.31	5.36	
984.900	985.000	BT	53	6.56	5.32	5.94	53	6.36	3.37	4.87	
985.000	985.100	BT	53	6.90	4.70	5.80	53	5.68	5.54	5.61	
985.100	985.200	BT	53	5.20	5.05	5.13	53	6.94	5.39	6.17	
985.200	985.300	BT	51	9.08	7.58	8.33	51	10.67	8.92	9.80	
985.300	985.400	BT	51	4.62	6.88	5.75	51	6.48	3.61	5.05	
985.400	985.500	BT	53	5.11	8.06	6.59	53	5.07	3.05	4.06	
985.500	985.600	BT	53	6.16	8.69	7.43	53	6.00	3.65	4.83	
985.600	985.700	BT	52	10.98	9.76	10.37	52	6.12	3.25	4.69	
985.700	985.800	BT	51	8.02	10.68	9.35	51	6.01	3.06	4.54	
985.800	985.900	BT	52	6.25	6.55	6.40	52	5.93	3.41	4.67	
985.900	986.000	BT	51	7.53	6.84	7.19	51	6.71	3.83	5.27	
986.000	986.100	BT	52	5.22	4.58	4.90	52	4.44	2.44	3.44	
986.100	986.200	BT	51	9.90	12.79	11.35	51	7.22	4.74	5.98	
986.200	986.300	BT	50	5.35	6.26	5.81	50	8.43	7.02	7.73	
986.300	986.400	BT	51	3.45	5.94	4.70	51	6.27	3.44	4.86	
986.400	986.500	BT	49	9.84	8.45	9.15	49	10.75	8.79	9.77	
986.500	986.600	BT	52	7.00	5.86	6.43	52	6.17	5.92	6.05	
986.600	986.700	BT	51	5.15	6.49	5.82	51	5.95	2.96	4.46	
986.700	986.800	BT	52	5.31	7.23	6.27	52	7.07	4.09	5.58	
986.800	986.900	BT	51	6.32	8.73	7.53	51	4.87	3.08	3.98	
986.900	987.000	BT	51	4.74	5.27	5.01	51	5.50	5.30	5.40	

Rutting Analysis of Flexible Pavement on LHS Direction: NH-27:Rakhaldubi to Kalijhar (Pkg-II)											
Chainage (km)			Inner Lane				Outer Lane				Remarks
From	To	Pav Type	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	
987.000	987.100	BT	51	4.44	4.81	4.63	51	5.06	2.69	3.88	
987.100	987.200	BT	52	5.55	3.22	4.39	52	5.04	4.86	4.95	
987.200	987.300	BT	52	4.00	3.69	3.85	52	5.13	2.37	3.75	
987.300	987.400	BT	51	4.18	5.57	4.88	51	4.47	2.09	3.28	
987.400	987.500	BT	52	4.59	5.94	5.27	52	4.37	2.49	3.43	
987.500	987.600	BT	52	5.07	4.21	4.64	52	6.18	3.74	4.96	
987.600	987.700	BT	52	6.74	6.51	6.63	52	5.88	3.44	4.66	
987.700	987.800	BT	52	6.45	7.70	7.08	52	5.32	2.32	3.82	
987.800	987.900	BT	52	6.13	6.38	6.26	52	5.63	3.21	4.42	
987.900	988.000	BT	52	5.50	5.74	5.62	52	6.21	3.38	4.80	
988.000	988.100	BT	52	5.21	5.21	5.21	52	6.54	4.04	5.29	
988.100	988.200	BT	53	7.43	6.30	6.87	53	5.31	2.76	4.04	
988.200	988.300	BT	53	5.54	4.30	4.92	53	6.48	4.06	5.27	
988.300	988.400	BT	53	5.42	5.10	5.26	53	6.46	3.65	5.06	
988.400	988.500	BT	53	5.45	6.14	5.80	53	6.56	4.34	5.45	
988.500	988.600	BT	52	7.49	9.67	8.58	52	7.03	4.41	5.72	
988.600	988.700	BT	53	4.60	7.47	6.04	53	7.29	4.43	5.86	
988.700	988.800	BT	51	7.98	10.23	9.11	51	11.69	11.22	11.46	
988.800	988.900	BT	52	4.83	5.48	5.16	52	6.46	3.71	5.09	
988.900	989.000	BT	54	4.10	5.29	4.70	54	5.41	2.77	4.09	
989.000	989.100	BT	53	4.06	5.97	5.02	53	4.62	2.27	3.45	
989.100	989.200	BT	53	4.53	5.92	5.23	53	4.89	2.78	3.84	
989.200	989.300	BT	53	5.33	6.31	5.82	53	4.95	2.17	3.56	
989.300	989.400	BT	53	8.51	8.32	8.42	53	6.25	4.04	5.15	
989.400	989.500	BT	52	5.79	6.25	6.02	52	5.87	2.99	4.43	
989.500	989.600	BT	53	6.45	6.09	6.27	53	5.91	5.74	5.83	
989.600	989.700	BT	54	5.70	6.48	6.09	54	5.43	3.35	4.39	
989.700	989.800	BT	54	8.23	7.07	7.65	54	5.93	3.30	4.62	
989.800	989.900	BT	55	6.69	6.42	6.56	55	6.83	4.47	5.65	
989.900	990.000	BT	55	5.03	4.23	4.63	55	4.38	2.90	3.64	
990.000	990.100	BT	53	4.70	3.89	4.30	53	4.94	2.82	3.88	
990.100	990.200	BT	53	8.57	6.14	7.36	53	7.80	5.07	6.44	
990.200	990.300	BT	53	7.74	9.71	8.73	53	6.64	3.81	5.23	
990.300	990.400	BT	53	5.18	7.08	6.13	53	5.35	2.68	4.02	
990.400	990.500	BT	53	5.05	4.31	4.68	53	5.13	2.43	3.78	
990.500	990.600	BT	53	5.28	6.41	5.85	53	5.50	2.88	4.19	
990.600	990.700	BT	52	9.08	6.35	7.72	52	7.69	7.32	7.51	
990.700	990.800	BT	52	6.81	4.64	5.73	52	5.26	2.82	4.04	
990.800	990.900	BT	52	6.37	4.11	5.24	52	5.72	3.40	4.56	
990.900	991.000	BT	53	5.28	4.14	4.71	53	5.96	3.03	4.50	
991.000	991.100	BT	53	6.83	7.48	7.16	53	6.19	3.93	5.06	
991.100	991.200	BT	51	5.18	5.59	5.39	51	4.20	2.00	3.10	
991.200	991.300	BT	51	8.86	7.17	8.02	51	9.58	6.87	8.23	
991.300	991.400	BT	53	5.52	5.14	5.33	53	4.59	2.27	3.43	
991.400	991.500	BT	53	5.58	4.35	4.97	53	5.66	2.83	4.25	
991.500	991.600	BT	52	3.88	4.55	4.22	52	4.68	1.83	3.26	
991.600	991.700	BT	51	6.93	4.68	5.81	51	4.99	2.24	3.62	
991.700	991.800	BT	52	7.89	10.53	9.21	52	5.75	4.91	5.33	
991.800	991.900	BT	52	8.15	5.24	6.70	52	5.63	5.19	5.41	
991.900	992.000	BT	50	5.43	3.25	4.34	50	5.31	3.01	4.16	
992.000	992.100	BT	49	7.72	5.39	6.56	49	6.05	3.81	4.93	
992.100	992.200	BT	49	9.47	7.47	8.47	49	7.30	6.90	7.10	
992.200	992.300	BT	52	12.12	9.35	10.74	52	8.64	7.38	8.01	
992.300	992.400	BT	52	6.35	6.96	6.66	52	5.96	2.96	4.46	
992.400	992.500	BT	51	6.08	7.28	6.68	51	6.51	5.41	5.96	
992.500	992.600	BT	50	9.12	7.52	8.32	50	5.84	3.49	4.67	
992.600	992.700	BT	51	10.73	8.01	9.37	51	10.22	9.11	9.67	
992.700	992.800	BT	51	11.78	10.57	11.18	51	8.87	5.99	7.43	
992.800	992.900	BT	50	12.28	10.04	11.16	50	10.79	8.46	9.63	
992.900	993.000	BT	52	10.79	10.22	10.51	52	5.83	3.32	4.58	
993.000	993.100	BT	53	12.39	14.28	13.34	53	6.43	3.71	5.07	
993.100	993.200	BT	52	4.98	2.84	3.91	52	4.92	2.59	3.76	
993.200	993.300	BT	53	6.30	5.98	6.14	53	5.89	3.60	4.75	
993.300	993.400	BT	53	6.99	6.48	6.74	53	5.10	3.19	4.15	
993.400	993.500	BT	52	7.24	8.01	7.63	52	5.90	3.06	4.48	
993.500	993.600	BT	52	8.44	8.65	8.55	52	5.89	3.56	4.73	
993.600	993.700	BT	52	5.14	5.60	5.37	52	5.22	3.00	4.11	

Rutting Analysis of Flexible Pavement on LHS Direction: NH-27:Rakhaldubi to Kalijhar (Pkg-II)											
Chainage (km)			Inner Lane				Outer Lane				Remarks
From	To	Pav Type	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	
993.700	993.800	BT	51	7.50	5.70	6.60	51	4.64	2.57	3.61	
993.800	993.900	BT	50	7.51	4.91	6.21	50	5.92	5.26	5.59	
993.900	994.000	BT	52	7.40	9.41	8.41	52	5.82	3.57	4.70	
994.000	994.100	BT	49	6.14	4.84	5.49	49	7.06	4.17	5.62	
994.100	994.200	BT	50	8.32	8.68	8.50	50	6.00	3.77	4.89	
994.200	994.300	BT	53	7.36	6.56	6.96	53	5.04	2.37	3.71	
994.300	994.400	BT	52	6.43	4.03	5.23	52	5.42	2.78	4.10	
994.400	994.500	BT	52	9.96	8.21	9.09	52	4.92	4.75	4.84	
994.500	994.600	BT	52	5.98	3.39	4.69	52	4.54	2.18	3.36	
994.600	994.700	BT	52	6.39	4.54	5.47	52	5.61	3.23	4.42	
994.700	994.800	BT	52	6.81	4.07	5.44	52	4.86	4.44	4.65	
994.800	994.900	BT	52	6.06	3.06	4.56	52	4.58	2.43	3.51	
994.900	995.000	BT	52	8.04	5.68	6.86	52	4.87	4.77	4.82	
995.000	995.100	BT	52	6.07	4.52	5.30	52	5.53	3.37	4.45	
995.100	995.200	BT	50	5.79	3.98	4.89	50	5.09	2.94	4.02	
995.200	995.300	BT	50	10.52	9.33	9.93	50	5.74	2.77	4.26	
995.300	995.400	BT	49	10.86	9.40	10.13	49	5.87	3.06	4.47	
995.400	995.500	BT	51	6.93	8.81	7.87	51	5.90	3.53	4.72	
995.500	995.600	BT	52	10.29	10.27	10.28	52	6.06	4.88	5.47	
995.600	995.700	BT	51	10.55	8.20	9.38	51	6.18	4.17	5.18	
995.700	995.800	BT	51	8.34	6.79	7.57	51	6.45	3.95	5.20	
995.800	995.900	BT	51	9.50	8.27	8.89	51	8.78	6.69	7.74	
995.900	996.000	BT	46	13.43	16.30	14.87	46	12.83	12.72	12.78	
996.000	996.100	BT	37	18.70	17.17	17.94	37	16.19	15.72	15.96	
996.100	996.200	BT	30	11.02	13.70	12.36	30	18.51	15.67	17.09	
996.200	996.300	BT	30	12.30	15.24	13.77	30	16.62	17.19	16.91	
996.300	996.400	BT	23	16.08	13.90	14.99	23	14.11	11.50	12.81	
996.400	996.500	BT	22	13.47	13.31	13.39	22	8.33	6.03	7.18	
996.500	996.600	BT	34	10.87	10.97	10.92	34	8.59	6.07	7.33	
996.600	996.700	BT	39	15.70	13.13	14.42	39	8.66	6.32	7.49	
996.700	996.800	BT	44	11.49	9.62	10.56	44	9.28	7.12	8.20	
996.800	996.900	BT	46	12.12	9.84	10.98	46	8.15	5.35	6.75	
996.900	997.000	BT	47	11.28	13.48	12.38	47	9.51	6.55	8.03	
997.000	997.100	BT	45	8.70	11.53	10.12	45	9.33	6.57	7.95	
997.100	997.200	BT	38	6.42	4.01	5.22	38	5.71	3.40	4.56	
997.200	997.300	BT	36	5.71	3.91	4.81	36	5.32	2.33	3.83	
997.300	997.400	BT	39	6.01	3.83	4.92	39	4.28	1.80	3.04	
997.400	997.500	BT	41	7.96	5.69	6.83	41	5.38	3.06	4.22	
997.500	997.600	BT	46	9.27	7.71	8.49	46	4.64	2.08	3.36	
997.600	997.700	BT	50	5.86	4.91	5.39	50	3.84	2.08	2.96	
997.700	997.800	BT	51	9.12	11.02	10.07	51	3.50	2.16	2.83	
997.800	997.900	BT	52	12.17	9.99	11.08	52	3.89	1.90	2.90	
997.900	998.000	BT	51	9.62	12.18	10.90	51	4.56	1.88	3.22	
998.000	998.100	BT	47	11.57	13.25	12.41	47	4.87	1.93	3.40	
998.100	998.200	BT	45	5.45	4.93	5.19	45	4.77	1.88	3.33	
998.200	998.300	BT	51	7.68	6.01	6.85	51	5.43	2.78	4.11	
998.300	998.400	BT	51	5.78	5.92	5.85	51	5.67	3.23	4.45	
998.400	998.500	BT	52	6.20	4.23	5.22	52	5.03	2.35	3.69	
998.500	998.600	BT	52	9.96	7.79	8.88	52	5.06	2.93	4.00	
998.600	998.700	BT	51	7.41	4.81	6.11	51	4.75	2.49	3.62	
998.700	998.800	BT	51	8.72	6.15	7.44	51	4.72	2.54	3.63	
998.800	998.900	BT	50	9.84	7.74	8.79	50	6.95	4.19	5.57	
998.900	999.000	BT	52	10.95	7.99	9.47	52	5.42	2.97	4.20	
999.000	999.100	BT	51	8.94	8.42	8.68	51	5.17	3.15	4.16	
999.100	999.200	BT	51	8.43	8.36	8.40	51	4.72	2.20	3.46	
999.200	999.300	BT	49	9.95	8.72	9.34	49	5.60	3.16	4.38	
999.300	999.400	BT	45	7.95	6.86	7.41	45	4.83	2.18	3.51	
999.400	999.500	BT	42	11.04	9.00	10.02	42	5.32	2.99	4.16	
999.500	999.600	BT	49	8.76	7.97	8.37	49	4.70	2.61	3.66	
999.600	999.700	BT	49	11.55	10.65	11.10	49	6.02	3.39	4.71	
999.700	999.800	BT	50	8.82	8.69	8.76	50	4.99	2.13	3.56	
999.800	999.900	BT	52	7.17	6.94	7.06	52	4.04	1.80	2.92	
999.900	1000.000	BT	52	5.66	5.14	5.40	52	4.49	1.84	3.17	
1000.000	1000.100	BT	53	8.40	5.99	7.20	53	4.36	1.63	3.00	
1000.100	1000.200	BT	51	6.45	6.17	6.31	51	4.90	2.57	3.74	
1000.200	1000.300	BT	47	6.36	4.59	5.48	47	4.34	1.69	3.02	
1000.300	1000.400	BT	47	8.76	7.03	7.90	47	4.58	1.66	3.12	

Rutting Analysis of Flexible Pavement on LHS Direction: NH-27:Rakhaldubi to Kalijhar (Pkg-II)											
Chainage (km)			Inner Lane				Outer Lane				Remarks
From	To	Pav Type	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	
1000.400	1000.500	BT	49	8.67	6.07	7.37	49	4.49	2.31	3.40	
1000.500	1000.600	BT	48	9.24	7.44	8.34	48	6.42	6.29	6.36	
1000.600	1000.700	BT	42	9.88	10.36	10.12	42	7.37	5.59	6.48	
1000.700	1000.800	BT	49	7.81	6.87	7.34	49	4.62	2.49	3.56	
1000.800	1000.900	BT	52	11.60	9.47	10.54	52	5.47	2.50	3.99	
1000.900	1001.000	BT	48	12.68	9.75	11.22	48	6.36	3.43	4.90	
1001.000	1001.100	BT	34	10.87	13.05	11.96	34	7.23	4.63	5.93	
1001.100	1001.200	BT	34	11.28	14.16	12.72	34	10.30	7.56	8.93	
1001.200	1001.300	BT	33	10.69	13.40	12.05	33	11.60	11.23	11.42	
1001.300	1001.400	BT	24	8.89	6.93	7.91	24	10.02	7.73	8.88	
1001.400	1001.500	BT	32	12.87	11.23	12.05	32	8.75	5.80	7.28	
1001.500	1001.600	BT	38	15.80	16.22	16.01	38	8.10	5.26	6.68	
1001.600	1001.700	BT	39	10.16	11.67	10.92	39	5.86	4.20	5.03	
1001.700	1001.800	BT	32	10.79	10.33	10.56	32	5.79	3.32	4.56	
1001.800	1001.900	BT	21	10.71	10.03	10.37	21	3.60	2.54	3.07	
1001.900	1002.000	BT	21	11.19	8.81	10.00	21	4.59	2.52	3.56	
1002.000	1002.100	BT	22	11.14	8.32	9.73	22	3.42	2.85	3.14	
1002.100	1002.200	BT	35	10.12	8.62	9.37	35	4.89	2.89	3.89	
1002.200	1002.300	BT	35	6.95	5.16	6.06	35	4.22	3.11	3.67	
1002.300	1002.400	BT	43	12.41	9.74	11.08	43	4.62	3.16	3.89	
1002.400	1002.500	BT	48	14.26	16.39	15.33	48	7.39	4.57	5.98	
1002.500	1002.600	BT	48	7.49	7.99	7.74	48	3.39	3.52	3.46	
1002.600	1002.700	BT	43	7.32	8.08	7.70	43	4.09	2.52	3.31	
1002.700	1002.800	BT	43	6.05	8.09	7.07	43	3.22	2.19	2.71	
1002.800	1002.900	BT	48	7.31	6.38	6.85	48	3.29	2.07	2.68	
1002.900	1003.000	BT	49	5.52	7.60	6.56	49	3.21	2.00	2.61	
1003.000	1003.100	BT	49	6.39	7.67	7.03	49	3.62	2.42	3.02	
1003.100	1003.200	BT	48	9.76	12.37	11.07	48	5.48	3.30	4.39	
1003.200	1003.300	BT	51	8.62	10.37	9.50	51	3.53	2.32	2.93	
1003.300	1003.400	BT	51	7.29	8.40	7.85	51	3.63	2.52	3.08	
1003.400	1003.500	BT	51	4.72	7.52	6.12	51	4.81	2.63	3.72	
1003.500	1003.600	BT	51	5.39	6.39	5.89	51	3.53	2.30	2.92	
1003.600	1003.700	BT	52	5.29	7.95	6.62	52	3.01	2.55	2.78	
1003.700	1003.800	BT	52	9.66	10.01	9.84	52	6.11	3.11	4.61	
1003.800	1003.900	BT	52	10.28	13.07	11.68	52	7.55	4.92	6.24	
1003.900	1004.000	BT	53	9.73	9.95	9.84	53	4.06	2.18	3.12	
1004.000	1004.100	BT	53	9.00	7.84	8.42	53	4.21	3.04	3.63	
1004.100	1004.200	BT	53	15.38	13.69	14.54	53	3.04	2.43	2.74	
1004.200	1004.300	BT	52	14.97	13.32	14.15	52	3.87	2.96	3.42	
1004.300	1004.400	BT	53	8.09	8.18	8.14	53	3.04	2.28	2.66	
1004.400	1004.500	BT	53	9.36	11.12	10.24	53	3.85	1.82	2.84	
1004.500	1004.600	BT	53	6.59	9.22	7.91	53	3.35	1.67	2.51	
1004.600	1004.700	BT	52	8.31	11.28	9.80	52	4.16	1.93	3.05	
1004.700	1004.800	BT	53	10.50	8.67	9.59	53	4.94	2.87	3.91	
1004.800	1004.900	BT	53	9.79	7.61	8.70	53	5.25	3.03	4.14	
1004.900	1005.000	BT	53	7.08	9.77	8.43	53	5.33	2.62	3.98	
1005.000	1005.100	BT	52	7.78	6.56	7.17	52	4.48	2.61	3.55	
1005.100	1005.200	BT	53	9.38	8.31	8.85	53	4.98	2.95	3.97	
1005.200	1005.300	BT	52	9.04	10.70	9.87	52	5.87	3.71	4.79	
1005.300	1005.400	BT	50	14.44	13.27	13.86	50	7.77	5.03	6.40	
1005.400	1005.500	BT	52	11.53	12.30	11.92	52	5.54	2.76	4.15	
1005.500	1005.600	BT	53	12.88	13.49	13.19	53	3.36	2.09	2.73	
1005.600	1005.700	BT	54	8.49	8.80	8.65	54	4.55	2.48	3.52	
1005.700	1005.800	BT	53	5.94	8.68	7.31	53	4.77	2.71	3.74	
1005.800	1005.900	BT	54	7.42	9.74	8.58	54	5.65	5.54	5.60	
1005.900	1006.000	BT	54	9.19	11.19	10.19	54	5.69	3.21	4.45	
1006.000	1006.100	BT	54	10.50	10.70	10.60	54	5.00	3.25	4.13	
1006.100	1006.200	BT	54	6.89	9.60	8.25	54	5.84	3.80	4.82	
1006.200	1006.300	BT	54	8.91	8.45	8.68	54	4.84	1.98	3.41	
1006.300	1006.400	BT	54	6.83	9.64	8.24	54	4.61	2.58	3.60	
1006.400	1006.500	BT	53	6.01	6.99	6.50	53	4.26	1.91	3.09	
1006.500	1006.600	BT	53	7.45	9.52	8.49	53	4.89	2.66	3.78	
1006.600	1006.700	BT	53	8.28	9.98	9.13	53	5.05	2.89	3.97	
1006.700	1006.800	BT	53	6.41	8.10	7.26	53	4.74	1.96	3.35	
1006.800	1006.900	BT	52	7.05	8.34	7.70	52	3.95	1.97	2.96	
1006.900	1007.000	BT	50	7.00	8.50	7.75	50	4.85	2.09	3.47	
1007.000	1007.100	BT	49	9.25	9.24	9.25	49	5.13	2.26	3.70	

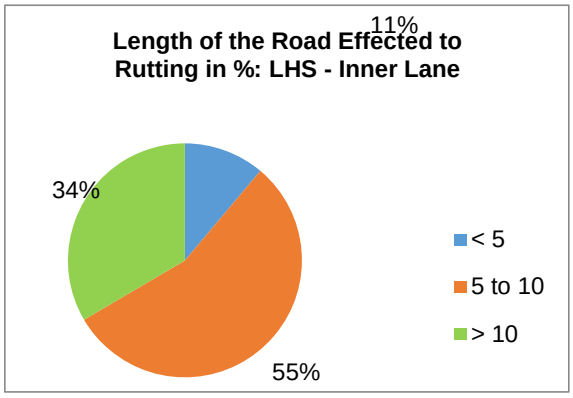
Rutting Analysis of Flexible Pavement on LHS Direction: NH-27:Rakhaldubi to Kalijhar (Pkg-II)											
Chainage (km)			Inner Lane				Outer Lane				Remarks
From	To	Pav Type	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	
1007.100	1007.200	BT	47	5.09	7.23	6.16	47	4.99	2.14	3.57	
1007.200	1007.300	BT	42	5.88	4.88	5.38	42	7.23	4.88	6.06	
1007.300	1007.400	BT	41	4.06	6.01	5.04	41	6.29	4.15	5.22	
1007.400	1007.500	BT	42	7.48	7.69	7.59	42	10.19	7.65	8.92	
1007.500	1007.600	BT	45	3.41	3.62	3.52	45	5.59	3.39	4.49	
1007.600	1007.700	BT	43	5.85	8.32	7.09	43	7.11	5.39	6.25	
1007.700	1007.800	BT	41	5.86	7.45	6.66	41	5.70	2.97	4.34	
1007.800	1007.900	BT	48	4.97	7.46	6.22	48	6.55	4.36	5.46	
1007.900	1008.000	BT	53	4.86	7.55	6.21	53	6.01	3.57	4.79	
1008.000	1008.100	BT	52	2.96	5.33	4.15	52	5.48	2.58	4.03	
1008.100	1008.200	BT	53	3.16	4.85	4.01	53	5.51	3.16	4.34	
1008.200	1008.300	BT	51	4.64	4.31	4.48	51	5.94	3.22	4.58	
1008.300	1008.400	BT	49	4.93	2.99	3.96	49	8.20	5.68	6.94	
1008.400	1008.500	BT	48	4.54	3.61	4.08	48	7.02	5.17	6.10	
1008.500	1008.600	BT	51	3.00	5.50	4.25	51	5.06	2.32	3.69	
1008.600	1008.700	BT	51	4.80	5.88	5.34	51	5.61	2.74	4.18	
1008.700	1008.800	BT	49	5.56	6.43	6.00	49	6.13	6.01	6.07	
1008.800	1008.900	BT	49	7.02	6.83	6.93	49	6.67	4.43	5.55	
1008.900	1009.000	BT	48	4.32	4.10	4.21	48	5.50	3.27	4.39	
1009.000	1009.100	BT	49	4.30	6.45	5.38	49	6.21	3.85	5.03	
1009.100	1009.200	BT	52	6.61	8.13	7.37	52	5.92	3.43	4.68	
1009.200	1009.300	BT	53	11.71	12.79	12.25	53	6.50	5.46	5.98	
1009.300	1009.400	BT	51	15.36	16.77	16.07	51	4.82	2.55	3.69	
1009.400	1009.500	BT	50	15.07	14.04	14.56	50	5.44	5.40	5.42	
1009.500	1009.600	BT	52	12.61	12.20	12.41	52	5.70	3.25	4.48	
1009.600	1009.700	BT	52	13.15	13.40	13.28	52	5.07	2.86	3.97	
1009.700	1009.800	BT	52	5.59	7.50	6.55	52	5.05	2.86	3.96	
1009.800	1009.900	BT	51	6.43	4.91	5.67	51	6.69	3.85	5.27	
1009.900	1010.000	BT	52	11.24	13.12	12.18	52	6.57	3.88	5.23	
1010.000	1010.100	BT	52	11.70	9.93	10.82	52	5.05	2.35	3.70	
1010.100	1010.200	BT	53	13.65	13.63	13.64	53	5.79	3.36	4.58	
1010.200	1010.300	BT	51	13.14	10.85	12.00	51	5.94	3.04	4.49	
1010.300	1010.400	BT	47	11.37	14.35	12.86	47	6.53	4.15	5.34	
1010.400	1010.500	BT	49	12.24	11.79	12.02	49	6.44	6.40	6.42	
1010.500	1010.600	BT	49	10.82	11.79	11.31	49	7.00	4.76	5.88	
1010.600	1010.700	BT	52	14.55	12.96	13.76	52	6.56	4.22	5.39	
1010.700	1010.800	BT	52	9.98	11.74	10.86	52	6.39	3.61	5.00	
1010.800	1010.900	BT	52	6.42	5.50	5.96	52	6.44	5.64	6.04	
1010.900	1011.000	BT	52	4.93	4.86	4.90	52	6.26	3.69	4.98	
1011.000	1011.100	BT	53	10.24	12.53	11.39	53	4.26	2.43	3.35	
1011.100	1011.200	BT	52	5.80	6.30	6.05	52	5.28	4.89	5.09	
1011.200	1011.300	BT	52	5.82	7.19	6.51	52	4.70	2.58	3.64	
1011.300	1011.400	BT	51	5.58	5.35	5.47	51	5.26	2.75	4.01	
1011.400	1011.500	BT	48	6.20	5.51	5.86	48	5.69	3.20	4.45	
1011.500	1011.600	BT	50	3.30	2.51	2.91	50	5.44	3.10	4.27	
1011.600	1011.700	BT	50	4.01	5.92	4.97	50	5.36	3.03	4.20	
1011.700	1011.800	BT	51	3.84	3.09	3.47	51	6.29	3.73	5.01	
1011.800	1011.900	BT	50	7.25	6.12	6.69	50	6.49	3.89	5.19	
1011.900	1012.000	BT	49	4.80	5.89	5.35	49	6.01	3.46	4.74	
1012.000	1012.100	BT	48	3.62	5.19	4.41	48	4.47	2.39	3.43	
1012.100	1012.200	BT	50	4.18	3.91	4.05	50	4.92	2.79	3.86	
1012.200	1012.300	BT	52	7.13	8.01	7.57	52	8.91	7.64	8.28	
1012.300	1012.400	BT	45	4.24	6.67	5.46	45	6.13	5.70	5.92	
1012.400	1012.500	BT	29	3.73	5.71	4.72	29	6.11	4.08	5.10	
1012.500	1012.600	BT	36	8.48	6.16	7.32	36	5.58	3.55	4.57	
1012.600	1012.700	BT	30	9.95	7.08	8.52	30	9.55	7.32	8.44	
1012.700	1012.800	BT	31	5.26	4.84	5.05	31	6.94	6.15	6.55	
1012.800	1012.900	BT	16	4.08	5.79	4.94	16	5.72	3.55	4.64	
1012.900	1013.000	BT	20	6.55	9.31	7.93	20	4.94	2.27	3.61	

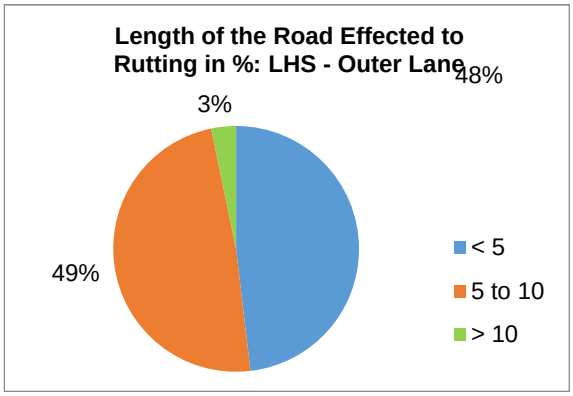
Rutting Analysis of Flexible Pavement on RHS Direction: NH-27: Rakhaldubi to Kalijhar (Pkg-II)											
Chainage (km)			Inner Lane				Outer Lane				Remarks
From	To	Pav Type	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	
1001.620	1001.500	BT	46	2.90	1.26	2.08	46	1.88	2.59	2.24	
1001.500	1001.400	BT	45	1.72	1.80	1.76	45	1.45	2.99	2.22	
1001.400	1001.300	BT	32	10.83	8.08	9.46	32	8.00	5.73	6.87	
1001.300	1001.200	BT	24	8.64	6.15	7.40	24	10.64	8.38	9.51	
1001.200	1001.100	BT	33	12.84	12.36	12.60	33	3.29	2.45	2.87	
1001.100	1001.000	BT	31	13.90	11.92	12.91	31	8.03	5.47	6.75	
1001.000	1000.920	BT	30	12.52	14.77	13.65	30	15.31	16.53	15.92	
969.890	969.800	BT	34	5.11	6.44	5.78	34	5.77	4.13	4.95	
969.800	969.700	BT	34	6.39	5.89	6.14	34	5.38	4.41	4.90	
969.700	969.600	BT	32	4.66	7.14	5.90	32	3.72	4.34	4.03	
969.600	969.500	BT	27	7.56	7.61	7.59	27	5.07	2.41	3.74	
969.500	969.400	BT	19	6.13	5.24	5.69	19	4.29	5.04	4.67	
969.400	969.300	BT	26	7.91	10.87	9.39	26	5.70	2.78	4.24	
969.300	969.200	BT	29	8.22	9.81	9.02	29	4.31	4.81	4.56	
969.200	969.100	BT	26	6.37	8.77	7.57	26	4.64	2.56	3.60	
969.100	969.000	BT	24	5.70	7.98	6.84	24	5.64	2.81	4.23	
969.000	968.900	BT	24	5.62	6.86	6.24	24	3.02	2.98	3.00	
968.900	968.800	BT	38	8.68	9.33	9.01	38	3.66	2.47	3.07	
968.800	968.700	BT	44	6.14	8.86	7.50	44	3.00	2.89	2.95	
968.700	968.600	BT	45	8.02	10.84	9.43	45	3.08	2.85	2.97	
968.600	968.500	BT	38	5.40	5.70	5.55	38	4.87	3.41	4.14	
968.500	968.400	BT	43	9.28	7.52	8.40	43	4.16	2.45	3.31	
968.400	968.300	BT	46	10.45	8.15	9.30	46	2.98	2.75	2.87	
968.300	968.200	BT	46	8.78	8.26	8.52	46	3.85	3.48	3.67	
968.200	968.100	BT	48	7.00	6.72	6.86	48	4.19	2.63	3.41	
968.100	968.000	BT	48	6.62	8.06	7.34	48	4.22	2.47	3.35	
968.000	967.900	BT	48	5.73	8.59	7.16	48	3.73	1.98	2.86	
967.900	967.800	BT	49	5.95	7.59	6.77	49	3.91	2.51	3.21	
967.800	967.700	BT	49	7.46	7.48	7.47	49	3.42	2.47	2.95	
967.700	967.600	BT	47	5.29	6.21	5.75	47	3.45	2.24	2.85	
967.600	967.500	BT	48	6.67	5.29	5.98	48	3.44	2.65	3.05	
967.500	967.400	BT	48	3.61	5.82	4.72	48	3.12	2.24	2.68	
967.400	967.300	BT	49	3.33	5.30	4.32	49	3.18	2.31	2.75	
967.300	967.200	BT	51	3.81	5.38	4.60	51	3.68	2.92	3.30	
967.200	967.100	BT	52	4.83	5.67	5.25	52	3.63	2.47	3.05	
967.100	967.000	BT	51	5.41	7.56	6.49	51	4.37	2.98	3.68	
967.000	966.900	BT	48	5.77	8.46	7.12	48	3.66	2.64	3.15	
966.900	966.800	BT	37	6.16	8.96	7.56	37	3.98	2.95	3.47	
966.800	966.700	BT	44	6.93	9.66	8.30	44	4.64	3.02	3.83	
966.700	966.600	BT	48	7.95	8.66	8.31	48	3.32	2.46	2.89	
966.600	966.500	BT	45	7.32	6.28	6.80	45	3.76	2.14	2.95	
966.500	966.400	BT	47	7.22	6.43	6.83	47	3.64	1.74	2.69	
966.400	966.300	BT	45	7.65	5.00	6.33	45	4.89	2.49	3.69	
966.300	966.200	BT	43	6.87	8.79	7.83	43	4.57	2.56	3.57	
966.200	966.100	BT	49	8.69	8.88	8.79	49	5.06	2.50	3.78	
966.100	966.000	BT	49	8.03	6.12	7.08	49	4.03	4.88	4.46	
966.000	965.900	BT	51	10.90	10.46	10.68	51	4.07	3.26	3.67	

Rutting Analysis of Flexible Pavement on RHS Direction: NH-27: Rakhaldubi to Kalijhar (Pkg-II)											
Chainage (km)			Inner Lane				Outer Lane				Remarks
From	To	Pav Type	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	Speed (kmph)	LWP-RUT (mm)	RWP-RUT (mm)	Avg Rutting (mm)	
965.900	965.800	BT	51	8.46	9.54	9.00	51	4.39	2.88	3.64	
965.800	965.700	BT	51	9.08	8.99	9.04	51	3.76	3.98	3.87	
965.700	965.600	BT	50	8.86	11.14	10.00	50	2.87	3.93	3.40	
965.600	965.500	BT	51	7.00	6.19	6.60	51	3.98	1.98	2.98	
965.500	965.400	BT	51	9.17	9.32	9.25	51	4.80	1.93	3.37	
965.400	965.300	BT	51	6.54	8.63	7.59	51	4.33	2.10	3.22	
965.300	965.200	BT	52	6.80	9.13	7.97	52	4.23	2.67	3.45	
965.200	965.080	BT	43	8.24	10.80	9.52	43	7.74	5.75	6.75	

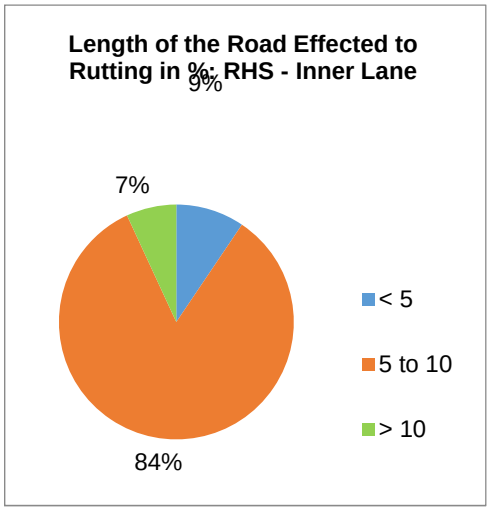
Summary of Rutting Analysis of Flexible Pavement on RHS Direction: NH-27: Rakhaldubi to Kalijhar (Pkg-II)

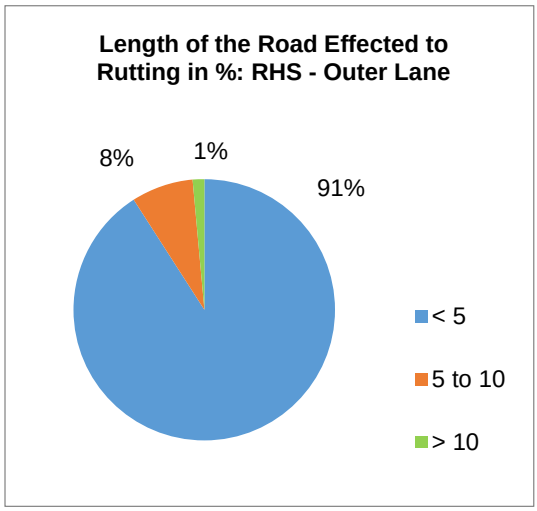
Distress	(Depth, mm)	Length of the Road Effected with Rutting			
		LHS (Length in Km)		LHS (Length in %)	
		Inner Lane	Outer Lane	Inner Lane	Outer Lane
Rutting	< 5	5.110	22.060	11.1	48.1
	5 to 10	25.380	22.280	55.4	48.6
	> 10	15.350	1.500	33.5	3.3





Summary of Rutting Analysis of Flexible Pavement on RHS Direction: NH-27: Rakhaldubi to Kalijhar (Pkg-II)					
Distress	(Depth, mm)	Length of the Road Effected with Rutting			
		RHS (Length in Km)		RHS (Length in %)	
		Inner Lane	Outer Lane	Inner Lane	Outer Lane
Rutting	< 5	0.520	5.010	9.4	90.9
	5 to 10	4.610	0.420	83.7	7.6
	> 10	0.380	0.080	6.9	1.5





Annexure – 4.5

Axle Load Data Analysis

AXLE LOAD SURVEY DATA & VDF ANALYSIS

Road Name:	NH-27_Package-1_Patgaon Toll Plaza_Km.49+600	**Location:**	49+600
Direction:	Both The Directions	**Date:**	24 November 2022

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
18	Guwahati-Kochugaon	BP2A0091	Guwahati	Kolkata	Bus	1.2	Passengers	Yes	1940	3260					0.586	0.800			0.118	0.409			0.526	
84	Guwahati-Kochugaon	AS01LC5411	Bongaigaon	Alipur	Bus	1.2	Passengers	Yes	1985	2980					0.599	0.731			0.129	0.285			0.414	
98	Guwahati-Kochugaon	AS19AC4167	Guwahati	Siliguri	Bus	1.2	Passengers	Yes	1985	2875					0.599	0.705			0.129	0.247			0.376	
121	Guwahati-Kochugaon	AS25EC3256	Barpeta	Gossaigaon	Bus	1.2	Passengers	Yes	2315	3475					0.699	0.852			0.238	0.528			0.766	
140	Guwahati-Kochugaon	BP2A0084	Bongaigaon	Hasimara	Bus	1.2	Passengers	Yes	2510	3665					0.758	0.899			0.329	0.653			0.982	
216	Guwahati-Kochugaon	AS01PC0102	Guwahati	Bengal	Bus	1.2	Passengers	Yes	2035	2615					0.614	0.641			0.142	0.169			0.312	0.600
257	Guwahati-Kochugaon	AS16C2683	Guwahati	Siliguri	Bus	1.2	Passengers	Yes	1960	2980					0.592	0.731			0.123	0.285			0.408	
263	Guwahati-Kochugaon	AS17B2797	Bhutan	Kuchagaon	Bus	1.2	Passengers	Yes	2490	3580					0.752	0.878			0.319	0.594			0.913	
303	Guwahati-Kochugaon	WB73D1635	Gorgaon	Kolkata	Bus	1.2	Passengers	Yes	1960	3205					0.592	0.786			0.123	0.382			0.504	
345	Guwahati-Kochugaon	AS01MC7587	Guwahati	Gossaigaon	Bus	1.2	Passengers	Yes	2105	3645					0.635	0.894			0.163	0.639			0.802	
1	Guwahati-Kochugaon	WB37D1378	Guwahati	Bengal	LCV	1.2	Empty	Yes	1465	2145					0.442	0.526			0.038	0.077			0.115	
4	Guwahati-Kochugaon	MH04FD5984	Guwahati	Bihar	LCV	1.2	Biscuits	Yes	1680	2895					0.507	0.710			0.066	0.254			0.320	
5	Guwahati-Kochugaon	WB15D8375	Shillong	Kolkata	LCV	1.2	Ginger	Yes	3065	6235					0.925	1.529			0.733	5.467			6.200	
8	Guwahati-Kochugaon	WB19L1750	Guwahati	Kolkata	LCV	1.2	Seeds	Yes	1850	2955					0.558	0.725			0.097	0.276			0.373	
9	Guwahati-Kochugaon	KA01AD0706	Guwahati	Delhi	LCV	1.2	Empty	Yes	1760	2085					0.531	0.511			0.080	0.068			0.148	
12	Guwahati-Kochugaon	WB27E2440	Bijni	Siliguri	LCV	1.2	Empty	Yes	1820	1630					0.549	0.400			0.091	0.026			0.117	
15	Guwahati-Kochugaon	RJ14GG4614	Guwahati	Kolkata	LCV	1.2	Bamboo	Yes	2590	4795					0.782	1.176			0.374	1.912			2.286	
29	Guwahati-Kochugaon	JH10Y5398	Guwahati	Kolkata	LCV	1.2	Empty	Yes	1965	1740					0.593	0.427			0.124	0.033			0.157	
35	Guwahati-Kochugaon	HR38Y7409	Jorhat	Siliguri	LCV	1.2	Empty	Yes	1670	1345					0.504	0.330			0.065	0.012			0.076	
42	Guwahati-Kochugaon	BP3A0826	Bhutan	Siliguri	LCV	1.2	Empty	Yes	2500	2015					0.755	0.494			0.324	0.060			0.384	
49	Guwahati-Kochugaon	WB73D6296	Guwahati	Siliguri	LCV	1.2	Empty	Yes	2640	1980					0.797	0.486			0.403	0.056			0.459	
65	Guwahati-Kochugaon	WB11F0886	Guwahati	Siliguri	LCV	1.2	Seeds	Yes	1985	2965					0.599	0.727			0.129	0.280			0.408	
76	Guwahati-Kochugaon	BP02A1025	Meghalaya	Nagpur	LCV	1.2	Empty	Yes	1945	1740					0.587	0.427			0.119	0.033			0.152	
77	Guwahati-Kochugaon	BP02B1365	Meghalaya	Nagpur	LCV	1.2	Empty	Yes	1905	1845					0.575	0.452			0.109	0.042			0.151	
87	Guwahati-Kochugaon	BP02A4741	Meghalaya	Nagpur	LCV	1.2	Empty	Yes	1970	1650					0.595	0.405			0.125	0.027			0.152	
93	Guwahati-Kochugaon	UP78HN1479	Guwahati	Ispur	LCV	1.2	Pipes	Yes	1985	3650					0.599	0.895			0.129	0.642			0.771	
104	Guwahati-Kochugaon	TN545534	Guwahati	Siliguri	LCV	1.2	Parcel	Yes	1980	3415					0.598	0.838			0.128	0.492			0.620	
105	Guwahati-Kochugaon	WB176093	Guwahati	Siliguri	LCV	1.2	Parcel	Yes	1850	3625					0.558	0.889			0.097	0.625			0.722	
118	Guwahati-Kochugaon	WB51C5398	Guwahati	Siliguri	LCV	1.2	Coal	Yes	1980	3460					0.598	0.849			0.128	0.518			0.646	
128	Guwahati-Kochugaon	UP17AT9805	Guwahati	Bengal	LCV	1.2	Parcel	Yes	2760	4075					0.833	0.999			0.482	0.998			1.479	
132	Guwahati-Kochugaon	WB11E5919	Guwahati	Siliguri	LCV	1.2	Machine	Yes	2465	4075					0.744	0.999			0.306	0.998			1.304	
133	Guwahati-Kochugaon	WB38Y3528	Guwahati	Siliguri	LCV	1.2	Machine	Yes	2570	4395					0.776	1.078			0.362	1.350			1.712	
143	Guwahati-Kochugaon	UP84T3924	Guwahati	Uttar Pradesh	LCV	1.2	Army Material	Yes	2265	3640					0.684	0.893			0.218	0.635			0.854	
144	Guwahati-Kochugaon	UP50DT0057	Shillong	Delhi	LCV	1.2	Metals	Yes	3680	6385					1.111	1.566			1.522	6.013			7.535	
148	Guwahati-Kochugaon	PB69A5717	Bongaigaon	Hasimara	LCV	1.2	Empty	Yes	1360	970					0.411	0.238			0.028	0.003			0.032	
150	Guwahati-Kochugaon	MH19C2889	Bongaigaon	Gossaigaon	LCV	1.2	Empty	Yes	1970	1630					0.595	0.400			0.125	0.026			0.151	
160	Guwahati-Kochugaon	BP4A0552	Bhutan	Phuentsholing	LCV	1.2	Cement	Yes	2975	4465					0.898	1.095			0.650	1.438			2.088	
161	Guwahati-Kochugaon	BP4A0553	Bhutan	Phuentsholing	LCV	1.2	Cement	Yes	3075	5290					0.928	1.297			0.742	2.833			3.575	
167	Guwahati-Kochugaon	WB23F7250	Guwahati	Kolkata	LCV	1.2	Tyres	Yes	2890	4390					0.872	1.077			0.579	1.344			1.923	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
171	Guwahati-Kochugaon	HR55AJ3594	Guwahati	Sirampur	LCV	1.2	Empty	Yes	2105	1645					0.635	0.403			0.163	0.026			0.189	
174	Guwahati-Kochugaon	WB73F8793	Bongaigaon	Patna	LCV	1.2	Parcel	Yes	1960	3120					0.592	0.765			0.123	0.343			0.465	
176	Guwahati-Kochugaon	AS26AC0402	Bongaigaon	Sirampur	LCV	1.2	Fuel	Yes	1960	3650					0.592	0.895			0.123	0.642			0.765	**1.137**
193	Guwahati-Kochugaon	AS01NL4541	Guwahati	Gossaigaon	LCV	1.2	Empty	Yes	1980	1740					0.598	0.427			0.128	0.033			0.161	
194	Guwahati-Kochugaon	WB058826	Guwahati	Patna	LCV	1.2	Parcel	Yes	1945	3625					0.587	0.889			0.119	0.625			0.743	
201	Guwahati-Kochugaon	NL01AL4862	Guwahati	Siliguri	LCV	1.2	Empty	Yes	2105	1845					0.635	0.452			0.163	0.042			0.205	
204	Guwahati-Kochugaon	BP2A8246	Bhutan	Sirapur	LCV	1.2	Fuel	Yes	2105	1960					0.635	0.481			0.163	0.053			0.216	
221	Guwahati-Kochugaon	BP2B1444	Namlang	Siliguri	LCV	1.2	Cement	Yes	3580	6860					1.081	1.682			1.363	8.012			9.375	
222	Guwahati-Kochugaon	BP4A0558	Namlang	Siliguri	LCV	1.2	Cement	Yes	3015	5730					0.910	1.405			0.686	3.900			4.586	
226	Guwahati-Kochugaon	AS16AC4130	Guwahati	Kusaiya	LCV	1.2	Fuel	Yes	2160	4980					0.652	1.221			0.181	2.225			2.406	
227	Guwahati-Kochugaon	WB73G2284	Guwahati	Bengal	LCV	1.2	Empty	Yes	1960	1740					0.592	0.427			0.123	0.033			0.156	
228	Guwahati-Kochugaon	BP1A0170	Bhutan	Sirapur	LCV	1.2	Empty	Yes	1805	1620					0.545	0.397			0.088	0.025			0.113	
233	Guwahati-Kochugaon	UP78GT0705	Guwahati	Uttar Pradesh	LCV	1.2	Empty	Yes	1955	1720					0.590	0.422			0.121	0.032			0.153	
235	Guwahati-Kochugaon	MH46AM6179	Guwahati	Siliguri	LCV	1.2	Parcel	Yes	2105	3955					0.635	0.970			0.163	0.885			1.048	
245	Guwahati-Kochugaon	BP2A3024	Guwahati	Kolkata	LCV	1.2	Empty	Yes	1965	1850					0.593	0.454			0.124	0.042			0.166	
246	Guwahati-Kochugaon	BP2A8147	Guwahati	Kolkata	LCV	1.2	Empty	Yes	2010	1890					0.607	0.464			0.135	0.046			0.182	
253	Guwahati-Kochugaon	BP2A2395	Bhutan	Sirapur	LCV	1.2	Empty	Yes	1905	1745					0.575	0.428			0.109	0.034			0.143	
254	Guwahati-Kochugaon	BP2A3870	Bhutan	Sirapur	LCV	1.2	Empty	Yes	2005	1855					0.605	0.455			0.134	0.043			0.177	
260	Guwahati-Kochugaon	WB23C8123	Guwahati	Kolkata	LCV	1.2	Empty	Yes	1190	785					0.359	0.193			0.017	0.001			0.018	
261	Guwahati-Kochugaon	WB73E5625	Guwahati	Srirampur	LCV	1.2	Stones	Yes	3505	6535					1.058	1.603			1.253	6.598			7.851	
265	Guwahati-Kochugaon	BP2B0420	Bhutan	Sirapur	LCV	1.2	Empty	Yes	2015	1860					0.608	0.456			0.137	0.043			0.180	
266	Guwahati-Kochugaon	BP4A0607	Bhutan	Sirapur	LCV	1.2	Empty	Yes	1995	1745					0.602	0.428			0.131	0.034			0.165	
269	Guwahati-Kochugaon	NL01Q6626	Guwahati	Kolkata	LCV	1.2	Biscuits	Yes	1955	3265					0.590	0.801			0.121	0.411			0.532	
273	Guwahati-Kochugaon	AS01PC4054	Guwahati	Srirampur	LCV	1.2	Vegetables	Yes	2205	4255					0.666	1.044			0.196	1.186			1.382	
274	Guwahati-Kochugaon	AS25FC0901	Bongaigaon	Kolkata	LCV	1.2	Parcel	Yes	2305	3985					0.696	0.977			0.234	0.912			1.147	
288	Guwahati-Kochugaon	WB41D1335	Bongaigaon	Patna	LCV	1.2	Empty	Yes	2020	1875					0.610	0.460			0.138	0.045			0.183	
308	Guwahati-Kochugaon	AS25EC4479	Guwahati	Uttar Pradesh	LCV	1.2	Tea leaves	Yes	2210	4250					0.667	1.042			0.198	1.180			1.378	
329	Guwahati-Kochugaon	WB73F2215	Bijni	Siliguri	LCV	1.2	Empty	Yes	1960	1745					0.592	0.428			0.123	0.034			0.156	
331	Guwahati-Kochugaon	UP35BT2132	Guwahati	Kolkata	LCV	1.2	Empty	Yes	2105	1875					0.635	0.460			0.163	0.045			0.208	
337	Guwahati-Kochugaon	WB59B8312	Guwahati	Delhi	LCV	1.2	Parcel	Yes	2105	3965					0.635	0.972			0.163	0.894			1.057	
338	Guwahati-Kochugaon	AS01JC6891	Guwahati	Uttar Pradesh	LCV	1.2	Empty	Yes	2245	1850					0.678	0.454			0.211	0.042			0.253	
347	Guwahati-Kochugaon	NL01AD2192	Guwahati	Siliguri	LCV	1.2	Tea leaves	Yes	1965	3455					0.593	0.847			0.124	0.515			0.639	
355	Guwahati-Kochugaon	UP45AT5528	Bongaigaon	Kolkata	LCV	1.2	Empty	Yes	2010	1875					0.607	0.460			0.135	0.045			0.180	
395	Guwahati-Kochugaon	BP2A5737	Bhutan	Jhagarpur	LCV	1.2	Empty	Yes	1945	1765					0.587	0.433			0.119	0.035			0.154	
2	Guwahati-Kochugaon	AS26L6481	Guwahati	Bengal	2Axle	1.2	Cylinder	Yes	3425	5240					1.034	1.285			1.142	2.727			3.870	
6	Guwahati-Kochugaon	WB57E6801	Sivasagar	Kolkata	2Axle	1.2	Plastic	Yes	3215	5140					0.970	1.261			0.887	2.525			3.412	
7	Guwahati-Kochugaon	AS16C0350	Guwahati	Bengal	2Axle	1.2	Cylinder	Yes	3250	5460					0.981	1.339			0.926	3.215			4.141	
17	Guwahati-Kochugaon	HR38V6854	Guwahati	Kolkata	2Axle	1.2	Cotton	Yes	2740	5505					0.827	1.350			0.468	3.322			3.790	
20	Guwahati-Kochugaon	NL01 26238	Guwahati	Kolkata	2Axle	1.2	Parcel	Yes	2695	4565					0.813	1.120			0.438	1.571			2.009	
24	Guwahati-Kochugaon	WB73FG501	Meghalaya	Siliguri	2Axle	1.2	Empty	Yes	2055	1925					0.620	0.472			0.148	0.050			0.198	
34	Guwahati-Kochugaon	NL01AS3477	Guwahati	Siliguri	2Axle	1.2	Parcel	Yes	2790	4785					0.842	1.174			0.503	1.896			2.399	
40	Guwahati-Kochugaon	MH04JU5390	Guwahati	Siliguri	2Axle	1.2	Empty	Yes	2035	1845					0.614	0.452			0.142	0.042			0.184	
45	Guwahati-Kochugaon	AS01NC5685	Guwahati	Siliguri	2Axle	1.2	Biscuits	Yes	3215	6120					0.970	1.501			0.887	5.075			5.962	

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			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
48	Guwahati-Kochugaon	WB73G1531	Guwahati	Siliguri	2Axle	1.2	Tea leaves	Yes	2740	5840					0.827	1.432			0.468	4.208			4.676	
52	Guwahati-Kochugaon	BP2A0950	Bhutan	Siliguri	2Axle	1.2	Tea leaves	Yes	2250	2195					0.679	0.538			0.213	0.084			0.297	
58	Guwahati-Kochugaon	HR38W5480	Guwahati	Siliguri	2Axle	1.2	Empty	Yes	2145	2850					0.647	0.699			0.176	0.239			0.414	
59	Guwahati-Kochugaon	HR74B8319	Guwahati	Sirampur	2Axle	1.2	Empty	Yes	2830	1950					0.854	0.478			0.532	0.052			0.585	
85	Guwahati-Kochugaon	WB296847	Guwahati	Kolkata	2Axle	1.2	Parcel	Yes	2415	5240					0.729	1.285			0.282	2.727			3.010	
92	Guwahati-Kochugaon	NL01AE3947	Guwahati	Mumbai	2Axle	1.2	Empty	Yes	2210	1840					0.667	0.451			0.198	0.041			0.239	
110	Guwahati-Kochugaon	WB175009	Tinsukia	Kolkata	2Axle	1.2	Parcel	Yes	2415	5260					0.729	1.290			0.282	2.769			3.052	
115	Guwahati-Kochugaon	HR38AD7255	Guwahati	Siliguri	2Axle	1.2	Empty	Yes	2960	2645					0.893	0.649			0.637	0.177			0.814	
124	Guwahati-Kochugaon	AS19C8245	Bongaigaon	Kolkata	2Axle	1.2	Fuel	Yes	3465	6890					1.046	1.690			1.197	8.153			9.349	
126	Guwahati-Kochugaon	NL01N8781	Guwahati	Siliguri	2Axle	1.2	Parcel	Yes	2790	5850					0.842	1.435			0.503	4.237			4.740	
127	Guwahati-Kochugaon	HR61C8685	Tinsukia	Hyderabad	2Axle	1.2	Courier	Yes	3075	5490					0.928	1.346			0.742	3.286			4.029	
129	Guwahati-Kochugaon	NL01AA1802	Meghalaya	Uttar Pradesh	2Axle	1.2	Parcel	Yes	2650	5985					0.800	1.468			0.409	4.642			5.051	
130	Guwahati-Kochugaon	RJ14GH5819	Guwahati	Rajasthan	2Axle	1.2	Parcel	Yes	2515	6410					0.759	1.572			0.332	6.107			6.439	
134	Guwahati-Kochugaon	HR38Y6968	Guwahati	Kolkata	2Axle	1.2	JCB	Yes	3490	6075					1.053	1.490			1.231	4.927			6.159	
142	Guwahati-Kochugaon	WB73A5614	Meghalaya	Bengal	2Axle	1.2	Parcel	Yes	2895	5630					0.874	1.381			0.583	3.635			4.218	
145	Guwahati-Kochugaon	UP21BN2815	Guwahati	Kolkata	2Axle	1.2	Parcel	Yes	2895	5735					0.874	1.406			0.583	3.913			4.496	
147	Guwahati-Kochugaon	JH25EC9485	Guwahati	Kerala	2Axle	1.2	Parcel	Yes	2470	4855					0.746	1.191			0.309	2.010			2.319	
168	Guwahati-Kochugaon	NL01Q7072	Guwahati	Kolkata	2Axle	1.2	Parcel	Yes	3035	5970					0.916	1.464			0.704	4.595			5.300	
175	Guwahati-Kochugaon	AS19C9666	Bongaigaon	Kolkata	2Axle	1.2	Fuel	Yes	2420	4650					0.730	1.140			0.285	1.691			1.976	
180	Guwahati-Kochugaon	WB19J8087	Bongaigaon	Siliguri	2Axle	1.2	Empty	Yes	1965	1755					0.593	0.430			0.124	0.034			0.158	**2.565**
183	Guwahati-Kochugaon	BP2A0150	Bhutan	Sirapur	2Axle	1.2	Empty	Yes	3455	2965					1.043	0.727			1.183	0.280			1.462	
198	Guwahati-Kochugaon	RJ32G7270	Guwahati	Rajasthan	2Axle	1.2	Machine	Yes	3420	2860					1.032	0.701			1.136	0.242			1.378	
208	Guwahati-Kochugaon	HR74B3529	Bongaigaon	Siliguri	2Axle	1.2	Empty	Yes	2035	1920					0.614	0.471			0.142	0.049			0.192	
215	Guwahati-Kochugaon	HR47E4193	Guwahati	Srirampur	2Axle	1.2	Parcel	Yes	2745	5390					0.829	1.322			0.471	3.053			3.525	
218	Guwahati-Kochugaon	HR55AH9414	Guwahati	Rasti	2Axle	1.2	Parcel	Yes	2535	4780					0.765	1.172			0.343	1.889			2.231	
219	Guwahati-Kochugaon	RJ27GD0552	Shillong	Odisha	2Axle	1.2	JCB	Yes	2680	5445					0.809	1.335			0.428	3.180			3.608	
220	Guwahati-Kochugaon	WB37D4457	Guwahati	Kolkata	2Axle	1.2	Empty	Yes	2480	2880					0.749	0.706			0.314	0.249			0.563	
232	Guwahati-Kochugaon	RJ09GD1517	Guwahati	Haryana	2Axle	1.2	Medicine	Yes	2515	4625					0.759	1.134			0.332	1.655			1.987	
252	Guwahati-Kochugaon	WB29B2755	Tinsukia	Kolkata	2Axle	1.2	Parcel	Yes	2855	5405					0.862	1.326			0.551	3.087			3.639	
259	Guwahati-Kochugaon	RJ32GC7958	Guwahati	siliguri	2Axle	1.2	Parcel	Yes	2850	3325					0.860	0.815			0.548	0.442			0.990	
268	Guwahati-Kochugaon	AS176101	Meghalaya	Ispur	2Axle	1.2	Coal	Yes	2615	4210					0.789	1.032			0.388	1.136			1.525	
272	Guwahati-Kochugaon	NL01Q7437	Bongaigaon	Siliguri	2Axle	1.2	Empty	Yes	2645	2215					0.798	0.543			0.406	0.087			0.493	
276	Guwahati-Kochugaon	AS23AC3507	Guwahati	Uttar Pradesh	2Axle	1.2	Fuel	Yes	2415	5875					0.729	1.441			0.282	4.310			4.592	
281	Guwahati-Kochugaon	AS26CB7542	Guwahati	Srirampur	2Axle	1.2	Fuel	Yes	2640	5120					0.797	1.256			0.403	2.486			2.889	
282	Guwahati-Kochugaon	AS19CB2415	Guwahati	Kolkata	2Axle	1.2	Fuel	Yes	2590	4985					0.782	1.223			0.374	2.234			2.608	
292	Guwahati-Kochugaon	HR38AA8760	Bijni	Bihar	2Axle	1.2	Empty	Yes	2590	1960					0.782	0.481			0.374	0.053			0.427	
293	Guwahati-Kochugaon	NL01AS3529	Silampur	Delhi	2Axle	1.2	Agarabati	Yes	2450	4960					0.740	1.216			0.299	2.190			2.489	
299	Guwahati-Kochugaon	UP31BN8232	Guwahati	Kolkata	2Axle	1.2	Parcel	Yes	2840	4250					0.857	1.042			0.540	1.180			1.720	
309	Guwahati-Kochugaon	MH14KA6423	Guwahati	Nagpur	2Axle	1.2	Parcel	Yes	2875	4155					0.868	1.019			0.567	1.078			1.645	
319	Guwahati-Kochugaon	MH14HG9625	Bijni	Siliguri	2Axle	1.2	Empty	Yes	2965	2340					0.895	0.574			0.642	0.108			0.750	
321	Guwahati-Kochugaon	NL01AF5422	Guwahati	Srirampur	2Axle	1.2	Empty	Yes	2645	2215					0.798	0.543			0.406	0.087			0.493	
323	Guwahati-Kochugaon	HR47E9403	Guwahati	Kolkata	2Axle	1.2	Tea leaves	Yes	2965	5125					0.895	1.257			0.642	2.496			3.137	
377	Guwahati-Kochugaon	UP21CT8017	Guwahati	Uttar Pradesh	2Axle	1.2	Parcel	Yes	2750	5230					0.830	1.283			0.475	2.707			3.181	

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			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
378	Guwahati-Kochugaon	JK05F5232	Bijni	Patna	2Axle	1.2	Empty	Yes	2875	2215					0.868	0.543			0.567	0.087			0.654	
382	Guwahati-Kochugaon	NL01AE3570	Guwahati	Bihar	2Axle	1.2	Empty	Yes	2875	2250					0.868	0.552			0.567	0.093			0.660	
385	Guwahati-Kochugaon	MP09HJ1005	Bongaigaon	Siliguri	2Axle	1.2	Empty	Yes	2750	2215					0.830	0.543			0.475	0.087			0.562	
386	Guwahati-Kochugaon	NL01AD4335	Bijni	Bihar	2Axle	1.2	Parcel	Yes	2515	4875					0.759	1.196			0.332	2.043			2.375	
387	Guwahati-Kochugaon	NL01AD8776	Guwahati	Nagpur	2Axle	1.2	Courier	Yes	2715	5215					0.819	1.279			0.451	2.676			3.127	
3	Guwahati-Kochugaon	NL01AG0160	Guwahati	Indore	3Axle	1.22	Parcel	Yes	4290	6370	5710				1.295		1.601		2.812		6.578		9.389	
16	Guwahati-Kochugaon	NL01A6900	Guwahati	Kolkata	3Axle	1.22	Tea leaves	No	3455	5105	4985				1.043		1.338		1.183		3.202		4.385	
19	Guwahati-Kochugaon	UP21CT7056	Guwahati	Kolkata	3Axle	1.22	Parcel	Yes	2455	4105	3685				0.741		1.033		0.302		1.138		1.439	
28	Guwahati-Kochugaon	UP21CN1886	Bongaigaon	Uttar Pradesh	3Axle	1.22	Parcel	Yes	2645	5960	4565				0.798		1.395		0.406		3.791		4.197	
32	Guwahati-Kochugaon	RJ31GA7374	Guwahati	Rajasthan	3Axle	1.22	Tea leaves	No	3075	5790	5240				0.928		1.462		0.742		4.572		5.314	
37	Guwahati-Kochugaon	UP14HT8952	Tinsukia	Delhi	3Axle	1.22	Seeds	No	3275	6570	6135				0.989		1.684		0.955		8.049		9.004	
38	Guwahati-Kochugaon	NL01AC3692	Guwahati	Siliguri	3Axle	1.22	Fuel	No	2895	5790	5155				0.874		1.451		0.583		4.433		5.016	
43	Guwahati-Kochugaon	NL01AC0155	Guwahati	Kolkata	3Axle	1.22	Parcel	No	2495	6255	5960				0.753		1.619		0.322		6.877		7.199	
44	Guwahati-Kochugaon	RJ09GB5536	Guwahati	Patna	3Axle	1.22	Shampoo	No	2850	6455	6105				0.860		1.665		0.548		7.687		8.235	
46	Guwahati-Kochugaon	AS01NC9465	Guwahati	Siliguri	3Axle	1.22	Biscuits	No	3920	6850	6240				1.183		1.735		1.960		9.069		11.029	
47	Guwahati-Kochugaon	NL01AD8190	Guwahati	Siliguri	3Axle	1.22	Flour	Yes	3415	7315	6740				1.031		1.863		1.129		12.054		13.183	
54	Guwahati-Kochugaon	BP2A6469	Guwahati	Siliguri	3Axle	1.22	Empty	No	2215	2160	1095				0.669		0.432		0.200		0.035		0.234	
56	Guwahati-Kochugaon	TN12V7142	Goalpara	Hyderabad	3Axle	1.22	Shampoo	No	3015	6035	5980				0.910		1.593		0.686		6.438		7.123	
63	Guwahati-Kochugaon	HR73Y1618	Guwahati	Siliguri	3Axle	1.22	Tea leaves	No	3680	5420	4980				1.111		1.379		1.522		3.614		5.136	
71	Guwahati-Kochugaon	NL01G2727	Guwahati	Siliguri	3Axle	1.22	Rice	Yes	2745	8545	7940				0.829		2.185		0.471		22.813		23.284	
75	Guwahati-Kochugaon	HR55AG1043	Guwahati	Siliguri	3Axle	1.22	Empty	Yes	2415	2015	1960				0.729		0.527		0.282		0.077		0.359	
78	Guwahati-Kochugaon	UP21BN6149	Meghalaya	Nagpur	3Axle	1.22	Bamboo Sticks	Yes	2985	5985	5540				0.901		1.528		0.659		5.450		6.109	
81	Guwahati-Kochugaon	NL01AD3357	Guwahati	Siliguri	3Axle	1.22	Cotton	Yes	2450	5875	5245				0.740		1.474		0.299		4.723		5.022	
86	Guwahati-Kochugaon	RJ07GD9135	Tezpur	Rajasthan	3Axle	1.22	Empty	Yes	2745	1960	1750				0.829		0.492		0.471		0.059		0.530	
89	Guwahati-Kochugaon	PB23T1195	Guwahati	Lucknow	3Axle	1.22	Bamboo Sticks	Yes	2450	6985	6455				0.740		1.782		0.299		10.079		10.378	
96	Guwahati-Kochugaon	WB23D6694	Guwahati	Kolkata	3Axle	1.22	Tea leaves	Yes	2450	5120	4850				0.740		1.322		0.299		3.052		3.351	
97	Guwahati-Kochugaon	NL01AB4242	Guwahati	Ispur	3Axle	1.22	Tea leaves	Yes	2505	5465	4985				0.756		1.385		0.327		3.684		4.011	
102	Guwahati-Kochugaon	RJ49GA2314	Tinsukia	Delhi	3Axle	1.22	Shampoo	Yes	4245	5425	4985				1.281		1.380		2.695		3.628		6.323	
103	Guwahati-Kochugaon	WB57C5246	Tinsukia	Kolkata	3Axle	1.22	Tea leaves	No	2515	4685	4210				0.759		1.179		0.332		1.934		2.266	
108	Guwahati-Kochugaon	WB23E6909	Guwahati	Kolkata	3Axle	1.22	Tea leaves	Yes	2415	6125	5980				0.729		1.605		0.282		6.633		6.915	
112	Guwahati-Kochugaon	AS16AC0848	Bijni	Gossaigaon	3Axle	1.22	Biscuits	No	3745	5260	4980				1.130		1.358		1.633		3.396		5.029	
113	Guwahati-Kochugaon	WB2JE2311	Guwahati	Siliguri	3Axle	1.22	Ujala	Yes	3680	7980	7250				1.111		2.019		1.522		16.620		18.142	
117	Guwahati-Kochugaon	AS16AC2915	Bijni	Gossaigaon	3Axle	1.22	Concrete	No	4055	9250	8975				1.224		2.416		2.244		34.080		36.324	
119	Guwahati-Kochugaon	AS01NL0295	Bijni	Kolkata	3Axle	1.22	Parcel	Yes	2845	5960	5245				0.859		1.485		0.544		4.869		5.413	
120	Guwahati-Kochugaon	MH12HD3203	Guwahati	Nagpur	3Axle	1.22	Parcel	Yes	2515	6245	5980				0.759		1.621		0.332		6.900		7.232	
122	Guwahati-Kochugaon	WB23F5954	Guwahati	Kolkata	3Axle	1.22	Tea leaves	Yes	3075	6570	5835				0.928		1.645		0.742		7.315		8.057	
137	Guwahati-Kochugaon	WB11D1628	Guwahati	Kolkata	3Axle	1.22	Tea Powder	Yes	3275	6790	6005				0.989		1.696		0.955		8.279		9.234	
141	Guwahati-Kochugaon	MP07HB3360	Guwahati	Uttar Pradesh	3Axle	1.22	Courier	Yes	2910	6495	5890				0.878		1.642		0.595		7.268		7.863	
153	Guwahati-Kochugaon	WB25K1955	Jorhat	Kolkata	3Axle	1.22	Tea leaves	Yes	3685	6790	6395				1.112		1.748		1.531		9.336		10.866	
154	Guwahati-Kochugaon	NL01AF2881	Guwahati	Delhi	3Axle	1.22	Plastic	Yes	3835	6990	6340				1.158		1.767		1.795		9.753		11.549	
157	Guwahati-Kochugaon	NL07A7213	Kolaghat	Barpeta	3Axle	1.22	Fuel	No	3430	6870	6195				1.035		1.732		1.149		9.000		10.149	
158	Guwahati-Kochugaon	WB11D0942	Guwahati	Kolkata	3Axle	1.22	Tea Powder	Yes	3795	6690	6210				1.145		1.710		1.722		8.554		10.276	
169	Guwahati-Kochugaon	AP05TB4949	Guwahati	Hyderabad	3Axle	1.22	Coal	Yes	2985	6125	5875				0.901		1.591		0.659		6.405		7.064	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
172	Guwahati-Kochugaon	WB76B2463	Bijni	Kolkata	3Axle	1.22	Tea leaves	No	2485	5940	5260				0.750		1.485		0.317		4.861		5.177	
185	Guwahati-Kochugaon	NL01K8636	Guwahati	Kolkata	3Axle	1.22	Tea leaves	No	3205	5465	4980				0.967		1.385		0.876		3.677		4.553	
190	Guwahati-Kochugaon	NL01L5810	Bongaigaon	Siliguri	3Axle	1.22	Fuel	Yes	2965	5505	5125				0.895		1.409		0.642		3.944		4.586	
200	Guwahati-Kochugaon	AP37TD2829	Meghalaya	Hyderabad	3Axle	1.22	Empty	No	2245	2965	2540				0.678		0.730		0.211		0.284		0.495	
211	Guwahati-Kochugaon	WB65B1054	Guwahati	Bengal	3Axle	1.22	Tea leaves	Yes	2420	4330	3985				0.730		1.102		0.285		1.477		1.761	
212	Guwahati-Kochugaon	UK08CB1366	Guwahati	Jharkhand	3Axle	1.22	Tea Powder	Yes	3870	6935	6150				1.168		1.735		1.862		9.056		10.918	
217	Guwahati-Kochugaon	HR55X6005	Guwahati	Srirampur	3Axle	1.22	Empty	Yes	2500	2075	1920				0.755		0.530		0.324		0.079		0.403	
224	Guwahati-Kochugaon	WB15A4873	Guwahati	Gossaigaon	3Axle	1.22	Empty	No	2645	2290	1965				0.798		0.564		0.406		0.101		0.508	
229	Guwahati-Kochugaon	NL01AB9842	Guwahati	Uttar Pradesh	3Axle	1.22	Tea Powder	No	2565	5865	5245				0.774		1.473		0.359		4.706		5.066	
231	Guwahati-Kochugaon	WB73D5061	Guwahati	Kolkata	3Axle	1.22	Furniture	No	2645	5215	4875				0.798		1.338		0.406		3.202		3.608	
236	Guwahati-Kochugaon	MH03CP6491	Bongaigaon	Sirapur	3Axle	1.22	Bamboo Sticks	No	2245	5105	4875				0.678		1.323		0.211		3.064		3.275	
237	Guwahati-Kochugaon	WB23E5713	Guwahati	Kolkata	3Axle	1.22	Empty	Yes	2450	2210	1965				0.740		0.553		0.299		0.094		0.393	**5.361**
241	Guwahati-Kochugaon	WB23B8519	Bongaigaon	Kolkata	3Axle	1.22	Empty	No	2415	2210	1965				0.729		0.553		0.282		0.094		0.376	
244	Guwahati-Kochugaon	NL01AD7408	Bongaigaon	Sirapur	3Axle	1.22	Parcel	No	3105	5985	5260				0.937		1.491		0.772		4.939		5.711	
248	Guwahati-Kochugaon	UP21CT4557	Guwahati	Uttar Pradesh	3Axle	1.22	Agarabati	No	2215	4695	4210				0.669		1.181		0.200		1.942		2.142	
250	Guwahati-Kochugaon	NL01L4269	Bongaigaon	Kolkata	3Axle	1.22	Empty	No	3010	2545	2100				0.909		0.616		0.681		0.144		0.825	
251	Guwahati-Kochugaon	NL01N6528	Guwahati	Siliguri	3Axle	1.22	Tea Powder	No	3265	4985	4120				0.986		1.207		0.943		2.123		3.066	
256	Guwahati-Kochugaon	UP21CT6039	Guwahati	Kolkata	3Axle	1.22	Parcel	No	2160	5985	5265				0.652		1.491		0.181		4.948		5.129	
270	Guwahati-Kochugaon	NL01L5662	Bongaigaon	Kuchagaon	3Axle	1.22	Fuel	Yes	2455	5960	5245				0.741		1.485		0.302		4.869		5.171	
275	Guwahati-Kochugaon	MH46BU2574	Bongaigaon	Nagpur	3Axle	1.22	Parcel	Yes	2875	5680	5220				0.868		1.445		0.567		4.360		4.928	
277	Guwahati-Kochugaon	WB23D6919	Guwahati	Kolkata	3Axle	1.22	Empty	Yes	3245	2965	2155				0.979		0.679		0.920		0.212		1.133	
280	Guwahati-Kochugaon	AS16AC1256	Guwahati	Srirampur	3Axle	1.22	Fuel	No	2455	5720	5255				0.741		1.455		0.302		4.482		4.783	
283	Guwahati-Kochugaon	TS08UB1475	Meghalaya	Hyderabad	3Axle	1.22	Parcel	Yes	2645	5420	5205				0.798		1.409		0.406		3.937		4.343	
284	Guwahati-Kochugaon	NL01AF8877	Guwahati	Patna	3Axle	1.22	Parcel	Yes	2505	5745	5105				0.756		1.438		0.327		4.281		4.608	
285	Guwahati-Kochugaon	WB51A2144	Tinsukia	Kolkata	3Axle	1.22	Tea leaves	Yes	2405	5565	5245				0.726		1.433		0.278		4.218		4.496	
289	Guwahati-Kochugaon	WB11D7786	Guwahati	Kolkata	3Axle	1.22	Parcel	No	2455	5460	4980				0.741		1.384		0.302		3.670		3.971	
290	Guwahati-Kochugaon	HR55AB6812	Guwahati	Kolkata	3Axle	1.22	Parcel	No	2360	5985	5260				0.712		1.491		0.257		4.939		5.197	
291	Guwahati-Kochugaon	UP78FT9765	Guwahati	Patna	3Axle	1.22	Empty	Yes	2415	2160	1850				0.729		0.532		0.282		0.080		0.362	
304	Guwahati-Kochugaon	UP21BN6925	Guwahati	Nagpur	3Axle	1.22	Tea leaves	No	3455	5405	4980				1.043		1.377		1.183		3.593		4.776	
305	Guwahati-Kochugaon	AS01GC8521	Guwahati	Kolkata	3Axle	1.22	Empty	Yes	3260	2545	2205				0.984		0.630		0.938		0.157		1.095	
306	Guwahati-Kochugaon	AP05TN1626	Meghalaya	Hyderabad	3Axle	1.22	Empty	Yes	2965	2480	1905				0.895		0.581		0.642		0.114		0.756	
307	Guwahati-Kochugaon	HP30A4046	Bijni	Siliguri	3Axle	1.22	Empty	No	3750	2960	2455				1.132		0.718		1.641		0.266		1.907	
311	Guwahati-Kochugaon	UP21CN8881	Guwahati	Patna	3Axle	1.22	Tea leaves	Yes	2875	4960	4255				0.868		1.222		0.567		2.227		2.795	
312	Guwahati-Kochugaon	UP25ET5047	Bijni	Siliguri	3Axle	1.22	Parcel	Yes	3125	5465	4960				0.943		1.382		0.792		3.649		4.440	
315	Guwahati-Kochugaon	UP21BN7760	Guwahati	Patna	3Axle	1.22	Logistics	Yes	3455	5260	4985				1.043		1.358		1.183		3.403		4.586	
316	Guwahati-Kochugaon	UP27AT9277	Bongaigaon	Uttar Pradesh	3Axle	1.22	Bamboo Sticks	Yes	3215	6745	6215				0.970		1.718		0.887		8.715		9.601	
322	Guwahati-Kochugaon	UP21CT6090	Bongaigaon	Madhya Pradesh	3Axle	1.22	Bamboo Sticks	Yes	3455	6985	6455				1.043		1.782		1.183		10.079		11.262	
326	Guwahati-Kochugaon	WB25E9966	Guwahati	Uttar Pradesh	3Axle	1.22	Metals	No	2765	5875	5455				0.835		1.502		0.485		5.090		5.575	
327	Guwahati-Kochugaon	UP21BN6297	Guwahati	Kolkata	3Axle	1.22	Empty	Yes	3120	2875	2120				0.942		0.662		0.787		0.192		0.979	
330	Guwahati-Kochugaon	NL01AF7195	Meghalaya	Siliguri	3Axle	1.22	Parcel	Yes	2870	4875	4545				0.866		1.249		0.563		2.432		2.996	
335	Guwahati-Kochugaon	NL01A6685	Meghalaya	Rajasthan	3Axle	1.22	Parcel	No	2815	5265	4985				0.850		1.359		0.521		3.410		3.931	
336	Guwahati-Kochugaon	WB11C4014	Guwahati	Kolkata	3Axle	1.22	Parcel	No	2745	4865	4590				0.829		1.253		0.471		2.469		2.940	
341	Guwahati-Kochugaon	AS01DC7787	Bongaigaon	Madhya Pradesh	3Axle	1.22	Empty	No	3480	2960	2545				1.050		0.730		1.217		0.284		1.501	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
343	Guwahati-Kochugaon	BR01G9316	Guwahati	Bihar	3Axle	1.22	Logistics	Yes	3245	5125	4875				0.979		1.326		0.920		3.089		4.009	
344	Guwahati-Kochugaon	WB57D5310	Guwahati	Kolkata	3Axle	1.22	Tea leaves	Yes	2985	5455	4965				0.901		1.381		0.659		3.642		4.301	
346	Guwahati-Kochugaon	AS01PC3678	Goalpara	Siliguri	3Axle	1.22	Bamboo Sticks	No	2455	5745	5215				0.741		1.453		0.302		4.457		4.759	
351	Guwahati-Kochugaon	WB258911	Tinsukia	Sirapur	3Axle	1.22	Tea leaves	No	3425	5245	4960				1.034		1.353		1.142		3.350		4.492	
352	Guwahati-Kochugaon	HR55AG4752	Guwahati	Binnaguri	3Axle	1.22	Parcel	Yes	2845	4965	4405				0.859		1.242		0.544		2.381		2.925	
353	Guwahati-Kochugaon	UP21CN5247	Guwahati	Sirapur	3Axle	1.22	Parcel	Yes	2745	5125	4780				0.829		1.313		0.471		2.973		3.445	
354	Guwahati-Kochugaon	WB69C5957	Bijni	Siliguri	3Axle	1.22	Empty	No	2875	2495	1965				0.868		0.591		0.567		0.122		0.689	
356	Guwahati-Kochugaon	HR55AF2249	Guwahati	Kolkata	3Axle	1.22	Empty	Yes	2245	2445	2105				0.678		0.603		0.211		0.132		0.343	
362	Guwahati-Kochugaon	UP21CN5506	Bongaigaon	Siliguri	3Axle	1.22	Tea leaves	No	3210	5215	4995				0.969		1.354		0.881		3.357		4.238	
366	Guwahati-Kochugaon	NL01L4266	Bijni	Siliguri	3Axle	1.22	Empty	Yes	2860	2210	1960				0.863		0.553		0.555		0.093		0.649	
369	Guwahati-Kochugaon	NL01AB9058	Guwahati	Kolkata	3Axle	1.22	Parcel	Yes	3210	4985	4210				0.969		1.219		0.881		2.208		3.089	
371	Guwahati-Kochugaon	WB23D2008	Guwahati	Kolkata	3Axle	1.22	Tea leaves	Yes	2910	5205	4980				0.878		1.350		0.595		3.324		3.919	
372	Guwahati-Kochugaon	NL01L4923	Tinsukia	Bihar	3Axle	1.22	Parcel	Yes	3105	5780	5430				0.937		1.486		0.772		4.878		5.650	
384	Guwahati-Kochugaon	UK06CB8463	Guwahati	Kolkata	3Axle	1.22	Tea leaves	Yes	2645	5215	4980				0.798		1.352		0.406		3.337		3.743	
388	Guwahati-Kochugaon	HR01C9777	Guwahati	Solapur	3Axle	1.22	Tea leaves	No	2875	5495	4875				0.868		1.375		0.567		3.572		4.139	
389	Guwahati-Kochugaon	AP16TH8877	Guwahati	Kurnool	3Axle	1.22	Bamboo Sticks	No	2715	6545	6125				0.819		1.680		0.451		7.960		8.411	
391	Guwahati-Kochugaon	RJ52GA3533	Bongaigaon	Srirampur	3Axle	1.22	Logistics	Yes	2875	4260	3985				0.868		1.093		0.567		1.428		1.995	
392	Guwahati-Kochugaon	AP05TF1339	Guwahati	Kadapa	3Axle	1.22	Bamboo Sticks	No	3125	6105	5875				0.943		1.588		0.792		6.363		7.154	
10	Guwahati-Kochugaon	WB15D9750	Meghalaya	Siliguri	MAV	1.1.22	Clinker	No	3175	4275	6570	6035			0.958	1.290	1.671		0.844	2.772	7.798		11.414	
11	Guwahati-Kochugaon	WB25J3224	Meghalaya	Siliguri	MAV	1.1.22	Clinker	No	3035	3690	5875	5140			0.916	1.114	1.460		0.704	1.539	4.547		6.791	
21	Guwahati-Kochugaon	NL01AF2095	Tinsukia	Bihar	MAV	1.1.22	Shampoo	No	2740	3565	5245	4960			0.827	1.076	1.353		0.468	1.341	3.350		5.159	
22	Guwahati-Kochugaon	WB59CB8072	Guwahati	Bengal	MAV	1.1.22	Parcel	No	2520	3025	4235	4140			0.761	0.913	1.110		0.335	0.695	1.520		2.550	
31	Guwahati-Kochugaon	TN52F7349	Guwahati	Hyderabad	MAV	1.1.22	Solar plates	No	2870	4075	5970	5260			0.866	1.230	1.489		0.563	2.289	4.913		7.765	
33	Guwahati-Kochugaon	WB29B6947	Guwahati	Kolkata	MAV	1.1.22	Carbon	No	3495	4390	6975	6210			1.055	1.325	1.748		1.239	3.083	9.336		13.657	
51	Guwahati-Kochugaon	NB25E7737	Guwahati	Kolkata	MAV	1.1.22	Tea leaves	No	3250	4255	5640	5240			0.981	1.284	1.442		0.926	2.721	4.329		7.975	
53	Guwahati-Kochugaon	BP2B1664	Bhutan	Siliguri	MAV	1.1.22	Empty	No	2550	2235	1925	1755			0.770	0.675	0.488		0.351	0.207	0.057		0.615	
55	Guwahati-Kochugaon	NL01L6770	Guwahati	Bihar	MAV	1.1.22	Cotton	No	3550	4295	5785	5240			1.072	1.296	1.462		1.318	2.825	4.564		8.707	
62	Guwahati-Kochugaon	RJ14GK4905	Guwahati	Rajasthan	MAV	1.1.22	Empty	No	2150	2545	2635	2345			0.649	0.768	0.660		0.177	0.348	0.190		0.716	
67	Guwahati-Kochugaon	WB23C6267	Dibrugarh	Kolkata	MAV	1.1.22	Plastic	No	3850	5455	7330	6955			1.162	1.647	1.894		1.824	7.350	12.863		22.037	
68	Guwahati-Kochugaon	AS25CC5300	Guwahati	Kolkata	MAV	1.1.22	Fuel	No	2240	2985	4120	3965			0.676	0.901	1.072		0.209	0.659	1.320		2.188	
70	Guwahati-Kochugaon	WB29B5034	Guwahati	Durgapur	MAV	1.1.22	Coal	No	3415	5665	8245	7850			1.031	1.710	2.134		1.129	8.549	20.729		30.407	
88	Guwahati-Kochugaon	RJ06GB5374	Guwahati	Siliguri	MAV	1.1.22	Tea leaves	No	2150	3620	6155	5875			0.649	1.093	1.595		0.177	1.425	6.470		8.073	
91	Guwahati-Kochugaon	AS25EC9261	Guwahati	Kolkata	MAV	1.1.22	Fuel	No	2560	4290	6855	6125			0.773	1.295	1.721		0.357	2.812	8.768		11.936	
106	Guwahati-Kochugaon	WB41G0896	Bijni	Durgapur	MAV	1.1.22	Empty	No	2515	2365	2065	1785			0.759	0.714	0.510		0.332	0.260	0.068		0.660	
107	Guwahati-Kochugaon	OD07B6455	Guwahati	Odisha	MAV	1.1.22	Tea leaves	No	2045	3985	6680	6285			0.617	1.203	1.719		0.145	2.093	8.728		10.966	
111	Guwahati-Kochugaon	OD01H0792	Guwahati	Odisha	MAV	1.1.22	Tea leaves	No	3685	4980	6875	6205			1.112	1.503	1.734		1.531	5.105	9.042		15.678	
125	Guwahati-Kochugaon	AP05TA4599	Guwahati	Kolkata	MAV	1.1.22	Bamboo Sticks	No	3275	3890	7075	6270			0.989	1.174	1.769		0.955	1.901	9.797		12.653	
131	Guwahati-Kochugaon	AP29W2699	Meghalaya	Madhya Pradesh	MAV	1.1.22	Iron	No	3760	4170	7170	6530			1.135	1.259	1.816		1.659	2.510	10.882		15.051	
135	Guwahati-Kochugaon	AP21TX2854	Guwahati	Jharkhand	MAV	1.1.22	Plywood	No	3605	5605	7020	6275			1.088	1.692	1.763		1.402	8.193	9.651		19.246	
136	Guwahati-Kochugaon	BP2B1317	Guwahati	Kolkata	MAV	1.1.22	Cement	No	3875	5055	8675	8190			1.170	1.526	2.236		1.872	5.420	24.990		32.282	
138	Guwahati-Kochugaon	UP37T8270	Guwahati	Rajasthan	MAV	1.1.22	Tea Powder	No	3580	5170	7075	6710			1.081	1.561	1.828		1.363	5.930	11.155		18.448	
139	Guwahati-Kochugaon	UP38T3555	Guwahati	Rajasthan	MAV	1.1.22	Tea Powder	No	4075	4485	6995	6235			1.230	1.354	1.754		2.289	3.359	9.464		15.111	
146	Guwahati-Kochugaon	JH02AV3649	Guwahati	Kolkata	MAV	1.1.22	Rice	No	3490	3885	6930	6515			1.053	1.173	1.782		1.231	1.891	10.094		13.216	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
149	Guwahati-Kochugaon	NL01AD4346	Guwahati	Bengal	MAV	1.1.22	Carbon	No	3845	4395	7295	6470			1.161	1.327	1.825		1.814	3.097	11.090		16.001	
164	Guwahati-Kochugaon	HR65A8145	Dibrugarh	Delhi	MAV	1.1.22	Plastic	No	3475	4870	7190	6835			1.049	1.470	1.859		1.210	4.669	11.952		17.831	
170	Guwahati-Kochugaon	NL02Q3726	Guwahati	Delhi	MAV	1.1.22	Empty	No	2455	2105	1985	1645			0.741	0.635	0.481		0.302	0.163	0.054		0.518	
178	Guwahati-Kochugaon	TS04UD1149	Guwahati	Kolkata	MAV	1.1.22	Carbon	No	2920	4150	7420	7125			0.881	1.253	1.928		0.603	2.462	13.825		16.891	
179	Guwahati-Kochugaon	AS16C2132	Bongaigaon	Gossaigaon	MAV	1.1.22	Empty	No	2655	2325	1960	1790			0.801	0.702	0.497		0.412	0.243	0.061		0.716	
181	Guwahati-Kochugaon	WB76B2585	Bongaigaon	Siliguri	MAV	1.1.22	Coal	No	2985	3745	6125	5845			0.901	1.130	1.587		0.659	1.633	6.342		8.633	
182	Guwahati-Kochugaon	AP055TF0456	Guwahati	Kolkata	MAV	1.1.22	Tea leaves	No	3125	4565	6875	6245			0.943	1.378	1.739		0.792	3.605	9.153		13.549	
188	Guwahati-Kochugaon	NL01G9026	Guwahati	Bihar	MAV	1.1.22	Tea leaves	No	2645	3885	5720	5240			0.798	1.173	1.453		0.406	1.891	4.457		6.754	
189	Guwahati-Kochugaon	AP16TH7979	Meghalaya	Ispur	MAV	1.1.22	Tea leaves	No	3105	4465	6145	5870			0.937	1.348	1.593		0.772	3.299	6.438		10.508	
195	Guwahati-Kochugaon	NL01G9559	Bongaigaon	Kolkata	MAV	1.1.22	Tea leaves	No	2455	3415	5240	4740			0.741	1.031	1.323		0.302	1.129	3.064		4.495	
202	Guwahati-Kochugaon	PB10BB1599	Bongaigaon	Bihar	MAV	1.1.22	Fuel	No	2545	2105	1980	1645			0.768	0.635	0.481		0.348	0.163	0.053		0.565	
213	Guwahati-Kochugaon	AP16TS1377	Dimapur	Purnia	MAV	1.1.22	Bamboo Sticks	No	3640	4415	7390	6495			1.099	1.333	1.841		1.457	3.154	11.482		16.093	
214	Guwahati-Kochugaon	AS01GC4411	Guwahati	Bengal	MAV	1.1.22	Carbon	No	3550	5195	7075	6390			1.072	1.568	1.785		1.318	6.046	10.154		17.518	
238	Guwahati-Kochugaon	WB71B2924	Guwahati	Sirapur	MAV	1.1.22	Empty	No	2210	1965	1850	1640			0.667	0.593	0.463		0.198	0.124	0.046		0.368	
239	Guwahati-Kochugaon	AP37TJ2689	Lanka	Kadapa	MAV	1.1.22	Turmeric	No	2515	3985	6125	5965			0.759	1.203	1.603		0.332	2.093	6.600		9.025	
240	Guwahati-Kochugaon	NL02L5774	Guwahati	Sirapur	MAV	1.1.22	Empty	No	2415	2210	1960	1750			0.729	0.667	0.492		0.282	0.198	0.059		0.539	
262	Guwahati-Kochugaon	WB11D8494	Dibrugarh	Kolkata	MAV	1.1.22	Fuel	No	3660	5290	7395	6830			1.105	1.597	1.886		1.489	6.500	12.648		20.638	
267	Guwahati-Kochugaon	UP78CT0665	Guwahati	Srirampur	MAV	1.1.22	Parcel	No	2450	3850	6420	5985			0.740	1.162	1.645		0.299	1.824	7.315		9.438	
271	Guwahati-Kochugaon	NL01A9388	Guwahati	Uttar Pradesh	MAV	1.1.22	Empty	No	2860	2545	2155	1865			0.863	0.768	0.533		0.555	0.348	0.081		0.984	
287	Guwahati-Kochugaon	JH02A4470	Bongaigaon	Kolkata	MAV	1.1.22	Empty	No	2455	2055	1745	1540			0.741	0.620	0.436		0.302	0.148	0.036		0.486	
297	Guwahati-Kochugaon	UP17AT5165	Dibrugarh	Delhi	MAV	1.1.22	Plastic	No	2865	4190	7465	6980			0.865	1.265	1.915		0.559	2.558	13.449		16.567	
301	Guwahati-Kochugaon	RJ13GC4595	Guwahati	Rajasthan	MAV	1.1.22	Parcel	No	3465	4895	6460	5980			1.046	1.478	1.649		1.197	4.766	7.398		13.360	
302	Guwahati-Kochugaon	UP21BN3836	Bijni	Patna	MAV	1.1.22	Parcel	No	3250	4780	6255	5870			0.981	1.443	1.607		0.926	4.333	6.677		11.936	
313	Guwahati-Kochugaon	BR01G2464	Guwahati	Jharkhand	MAV	1.1.22	Biscuits	No	3250	5120	6985	6435			0.981	1.545	1.779		0.926	5.704	10.019		16.649	
314	Guwahati-Kochugaon	WB23E5454	Guwahati	Kolkata	MAV	1.1.22	Empty	No	3455	2985	2415	2120			1.043	0.901	0.601		1.183	0.659	0.131		1.972	
317	Guwahati-Kochugaon	AP27TX9869	Guwahati	Siliguri	MAV	1.1.22	Empty	No	2985	2535	1980	1760			0.901	0.765	0.496		0.659	0.343	0.060		1.062	
318	Guwahati-Kochugaon	CG04CR6700	Bongaigaon	Kolkata	MAV	1.1.22	Fuel	No	3125	4985	7145	6875			0.943	1.505	1.859		0.792	5.126	11.935		17.852	
320	Guwahati-Kochugaon	WB57BG9587	Guwahati	Srirampur	MAV	1.1.22	Empty	No	2425	2015	1905	1760			0.732	0.608	0.486		0.287	0.137	0.056		0.480	
324	Guwahati-Kochugaon	AS01NL3065	Meghalaya	Siliguri	MAV	1.1.22	Gas	No	2745	4915	6455	6215			0.829	1.484	1.680		0.471	4.844	7.960		13.276	
328	Guwahati-Kochugaon	RJ02GB6492	Guwahati	Patna	MAV	1.1.22	Tea leaves	No	2895	4465	6155	5980			0.874	1.348	1.609		0.583	3.299	6.699		10.581	
332	Guwahati-Kochugaon	UP32LN1472	Bijni	Kolkata	MAV	1.1.22	Empty	No	2460	2040	1860	1570			0.743	0.616	0.455		0.304	0.144	0.043		0.491	
334	Guwahati-Kochugaon	PB059655	Bongaigaon	Bihar	MAV	1.1.22	Empty	No	2380	2060	1860	1610			0.718	0.622	0.460		0.266	0.149	0.045		0.461	
340	Guwahati-Kochugaon	MH22AN2223	Guwahati	Nagpur	MAV	1.1.22	Plastic	No	3245	4960	6980	6425			0.979	1.497	1.777		0.920	5.024	9.974		15.919	
348	Guwahati-Kochugaon	UP15CT4829	Guwahati	Sirapur	MAV	1.1.22	Fuel	No	2545	3690	6450	5980			0.768	1.114	1.648		0.348	1.539	7.374		9.261	
349	Guwahati-Kochugaon	NL01AB2822	Guwahati	Madhya Pradesh	MAV	1.1.22	Carbon	No	2745	3615	6155	5850			0.829	1.091	1.592		0.471	1.418	6.416		8.305	
367	Guwahati-Kochugaon	WB57B7786	Bijni	Kolkata	MAV	1.1.22	Tea leaves	No	3155	4265	5940	5340			0.952	1.287	1.495		0.822	2.747	5.001		8.570	
368	Guwahati-Kochugaon	NL02Q7743	Guwahati	Siliguri	MAV	1.1.22	Empty	No	2875	2540	1965	1750			0.868	0.767	0.493		0.567	0.346	0.059		0.971	
370	Guwahati-Kochugaon	PB29R6220	Bijni	Uttar Pradesh	MAV	1.1.22	Empty	No	2745	2215	1965	1805			0.829	0.669	0.500		0.471	0.200	0.062		0.733	
380	Guwahati-Kochugaon	PB11BY3661	Guwahati	Siliguri	MAV	1.1.22	Bamboo Sticks	No	2540	4210	6975	6415			0.767	1.271	1.775		0.346	2.608	9.930		12.883	
381	Guwahati-Kochugaon	AS01JC4674	Guwahati	Patna	MAV	1.1.22	Gas	No	3105	4965	6515	5980			0.937	1.499	1.657		0.772	5.044	7.530		13.345	
383	Guwahati-Kochugaon	AP37TF2488	Guwahati	Vizag	MAV	1.1.22	Plastic	No	2750	4105	6125	5875			0.830	1.239	1.591		0.475	2.357	6.405		9.237	
393	Guwahati-Kochugaon	AP16TF4219	Bongaigaon	Vizag	MAV	1.1.22	Plastic	No	3265	6415	7215	6855			0.986	1.936	1.865		0.943	14.057	12.106		27.107	
359	Guwahati-Kochugaon	NL01AG1566	Bongaigaon	Sirapur	MAV	1.2.11	Vehicle	No	3125	6495	7490	6875			0.943	1.593	1.904		0.792	6.438	13.154		20.383	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
23	Guwahati-Kochugaon	AS25EC8705	Guwahati	Bengal	MAV	1.2.22	Tea leaves	No	3215	4235	5625	5215			0.970	1.039	1.437		0.887	1.164	4.265		6.316	
39	Guwahati-Kochugaon	AS11CC8096	Guwahati	Siliguri	MAV	1.2.22	Fuel	No	3430	4395	6760	6110			1.035	1.078	1.706		1.149	1.350	8.475		10.974	
66	Guwahati-Kochugaon	AS01CC6945	Guwahati	Kolkata	MAV	1.2.22	Fuel	No	2705	3450	6140	5980			0.816	0.846	1.607		0.444	0.513	6.666		7.622	
90	Guwahati-Kochugaon	AS25EC9241	Guwahati	Kolkata	MAV	1.2.22	Fuel	No	2245	4245	6955	6425			0.678	1.041	1.774		0.211	1.175	9.900		11.286	
109	Guwahati-Kochugaon	NL01AE2930	Guwahati	Tamil Nadu	MAV	1.2.22	Empty	No	2685	2415	1980	1760			0.810	0.592	0.496		0.431	0.123	0.060		0.615	
123	Guwahati-Kochugaon	AS01JC5708	Guwahati	Bengal	MAV	1.2.22	Gas	No	3775	5655	6560	6035			1.139	1.387	1.670		1.686	3.700	7.773		13.159	
151	Guwahati-Kochugaon	NL01K7720	Guwahati	Siliguri	MAV	1.2.22	Empty	No	2390	2075	2195	1960			0.721	0.509	0.551		0.271	0.067	0.092		0.430	
152	Guwahati-Kochugaon	WB73F9020	Morigaon	Siliguri	MAV	1.2.22	Container	No	2670	2385	2085	1975			0.806	0.585	0.538		0.422	0.117	0.084		0.623	
156	Guwahati-Kochugaon	NL01L1844	Guwahati	Kolkata	MAV	1.2.22	Empty	No	2175	2015	1970	1740			0.657	0.494	0.492		0.186	0.060	0.059		0.304	
159	Guwahati-Kochugaon	NL01Q7234	Kolaghat	Barpeta	MAV	1.2.22	Gas	No	3470	4895	6490	5790			1.047	1.200	1.628		1.203	2.077	7.025		10.305	
162	Guwahati-Kochugaon	AS11C8099	Kolaghat	Barpeta	MAV	1.2.22	Gas	No	3695	4890	6795	5890			1.115	1.199	1.682		1.547	2.069	7.998		11.614	
166	Guwahati-Kochugaon	NL01AC5817	Guwahati	Siliguri	MAV	1.2.22	Empty	No	2395	2075	2130	1860			0.723	0.509	0.529		0.273	0.067	0.078		0.418	
173	Guwahati-Kochugaon	HR38AB9874	Guwahati	Sirampur	MAV	1.2.22	Empty	No	2560	2120	1945	1750			0.773	0.520	0.490		0.357	0.073	0.058		0.487	
177	Guwahati-Kochugaon	NL01K8691	Bongaigaon	Sirampur	MAV	1.2.22	Empty	No	2420	2120	1965	1745			0.730	0.520	0.492		0.285	0.073	0.059		0.416	
184	Guwahati-Kochugaon	NL02K3756	Guwahati	Sirapur	MAV	1.2.22	Fuel	No	2965	4055	7125	6985			0.895	0.994	1.871		0.642	0.978	12.244		13.864	
187	Guwahati-Kochugaon	HR38U3706	Bongaigaon	Kolkata	MAV	1.2.22	Empty	No	2560	2100	1965	1705			0.773	0.515	0.487		0.357	0.070	0.056		0.483	8.375
191	Guwahati-Kochugaon	AS25EC9441	Guwahati	Kolkata	MAV	1.2.22	Fuel	No	3645	5120	7145	6985			1.100	1.256	1.873		1.465	2.486	12.314		16.265	
196	Guwahati-Kochugaon	AS07AC5387	Meghalaya	Bihar	MAV	1.2.22	Fuel	No	2450	3690	6120	5840			0.740	0.905	1.586		0.299	0.671	6.320		7.290	
197	Guwahati-Kochugaon	AS01JC5710	Bongaigaon	Uttar Pradesh	MAV	1.2.22	Parcel	No	2560	3840	6540	5960			0.773	0.942	1.657		0.357	0.787	7.542		8.685	
203	Guwahati-Kochugaon	AS01C7344	Guwahati	Siripuram	MAV	1.2.22	Parcel	No	2645	4995	6420	6145			0.798	1.225	1.666		0.406	2.252	7.700		10.358	
205	Guwahati-Kochugaon	AS25EC8666	Guwahati	Patna	MAV	1.2.22	Coal	No	2750	4405	7120	6850			0.830	1.080	1.852		0.475	1.362	11.765		13.602	
206	Guwahati-Kochugaon	WB23B4395	Bijni	Kolkata	MAV	1.2.22	Parcel	No	2555	4105	7105	6550			0.771	1.007	1.810		0.354	1.027	10.740		12.121	
207	Guwahati-Kochugaon	BR06GA1311	Guwahati	Siliguri	MAV	1.2.22	Empty	No	2270	2035	2115	1930			0.685	0.499	0.536		0.220	0.062	0.083		0.365	
210	Guwahati-Kochugaon	AS25EC9517	Dibrugarh	Delhi	MAV	1.2.22	Gas	No	2890	4210	5970	5235			0.872	1.032	1.485		0.579	1.136	4.869		6.585	
242	Guwahati-Kochugaon	NL01AE1309	Nagaland	Uttar Pradesh	MAV	1.2.22	Empty	No	2685	2410	2525	1980			0.810	0.591	0.597		0.431	0.122	0.127		0.681	
255	Guwahati-Kochugaon	NL01K0961	Guwahati	Bihar	MAV	1.2.22	Fuel	No	2415	3695	6975	6455			0.729	0.906	1.780		0.282	0.674	10.049		11.006	
264	Guwahati-Kochugaon	NL01A6136	Bongaigaon	Kuchagaon	MAV	1.2.22	Empty	No	2390	2035	2075	1930			0.721	0.499	0.531		0.271	0.062	0.079		0.412	
300	Guwahati-Kochugaon	RJ47GA2587	Guwahati	Rajasthan	MAV	1.2.22	Empty	No	2985	2495	1965	1740			0.901	0.612	0.491		0.659	0.140	0.058		0.857	
325	Guwahati-Kochugaon	BR01GF0979	Bongaigaon	Uttar Pradesh	MAV	1.2.22	Biscuits	No	2635	3985	5745	5215			0.795	0.977	1.453		0.400	0.912	4.457		5.770	
342	Guwahati-Kochugaon	PB03BC9555	Guwahati	Kolkata	MAV	1.2.22	Empty	No	2960	2545	2105	1850			0.893	0.624	0.524		0.637	0.152	0.076		0.865	
365	Guwahati-Kochugaon	AS25CC9935	Bongaigaon	Siliguri	MAV	1.2.22	Fuel	No	3210	1850	6750	6240			0.969	0.454	1.722		0.881	0.042	8.795		9.719	
373	Guwahati-Kochugaon	AS25CC9003	Bongaigaon	Srirampur	MAV	1.2.22	Gas	No	3245	4985	7415	6985			0.979	1.223	1.909		0.920	2.234	13.282		16.437	
390	Guwahati-Kochugaon	AS11CC8119	Guwahati	Bihar	MAV	1.2.22	Gas	No	2785	3965	6240	5875			0.841	0.972	1.606		0.499	0.894	6.655		8.048	
13	Guwahati-Kochugaon	PB11CQ6702	Kumari	Uttar Pradesh	MAV	1.1.122	Empty	No	2035	1975	1730	2135	1870		0.614	0.596		0.5023211	0.142	0.126		0.063668656	0.332	
25	Guwahati-Kochugaon	UP83CT5547	Guwahati	Kolkata	MAV	1.1.122	Empty	No	1965	2430	3145	3745	3335		0.593	0.733		0.895594289	0.124	0.289		0.643346974	1.057	
27	Guwahati-Kochugaon	NL01AE1888	Guwahati	Kolkata	MAV	1.1.122	Parcel	No	2450	3525	3820	3255	3195		0.740	1.064		0.89953578	0.299	1.282		0.654747381	2.235	
36	Guwahati-Kochugaon	WB39B8136	Guwahati	Kolkata	MAV	1.1.122	Tea leaves	No	2870	3470	2775	6365	5655		0.866	1.047		1.295874573	0.563	1.203		2.820017957	4.587	
41	Guwahati-Kochugaon	NL01AC9586	Guwahati	Kolkata	MAV	1.1.122	Carbon	No	3510	4375	3660	7175	6430		1.059	1.321		1.512218621	1.260	3.041		5.229477834	9.530	
50	Guwahati-Kochugaon	PB11CC9155	Guwahati	Siliguri	MAV	1.1.122	Tea leaves	No	3750	4155	3980	8975	7980		1.132	1.254		1.83366909	1.641	2.474		11.30534595	15.421	
61	Guwahati-Kochugaon	NL01AB8625	Guwahati	Bengal	MAV	1.1.122	Empty	No	1950	2415	3325	3490	3210		0.589	0.729		0.878076553	0.120	0.282		0.594469423	0.997	
74	Guwahati-Kochugaon	PB13BA9397	Guwahati	Purnia	MAV	1.1.122	Empty	No	2745	2345	1985	2015	1640		0.829	0.708		0.494000175	0.471	0.251		0.059553654	0.782	
100	Guwahati-Kochugaon	RJ09GB8322	Guwahati	Bengal	MAV	1.1.122	Empty	No	2660	1980	2420	2105	2140		0.803	0.598		0.583778576	0.416	0.128		0.116142885	0.659	
101	Guwahati-Kochugaon	RJ01GB5426	Guwahati	Siliguri	MAV	1.1.122	Empty	No	2515	2315	2055	1705	1650		0.759	0.699		0.473854778	0.332	0.238		0.050417471	0.621	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
114	Guwahati-Kochugaon	UP53GT3456	Guwahati	Punjab	MAV	1.1.122	Fuel	No	3875	4265	3125	9875	9515		1.170	1.287		1.97205921	1.872	2.747		15.12445733	19.743	
116	Guwahati-Kochugaon	WB39B3941	Guwahati	Kolkata	MAV	1.1.122	Empty	No	2450	2125	1960	1750	1555		0.740	0.641		0.461154419	0.299	0.169		0.045225721	0.514	
165	Guwahati-Kochugaon	NL01AF8899	Dibrugarh	Siliguri	MAV	1.1.122	Fuel	No	3610	4590	3270	6935	6330		1.090	1.385		1.448278882	1.410	3.684		4.39955542	9.494	
192	Guwahati-Kochugaon	NL01AC0613	Bijni	Siliguri	MAV	1.1.122	Empty	No	2985	2415	1965	1745	1540		0.901	0.729		0.459840589	0.659	0.282		0.044712526	0.986	
243	Guwahati-Kochugaon	RJ14GP1260	Guwahati	Patna	MAV	1.1.122	Empty	No	2750	2210	1985	2235	1745		0.830	0.667		0.522466497	0.475	0.198		0.074513298	0.747	
249	Guwahati-Kochugaon	UP15CT9093	Guwahati	Siliguri	MAV	1.1.122	Empty	No	3245	2965	2115	2515	1845		0.979	0.895		0.567136726	0.920	0.642		0.103454905	1.665	
294	Guwahati-Kochugaon	WB59C9565	Guwahati	Kolkata	MAV	1.1.122	Empty	No	2560	2210	2435	1960	1750		0.773	0.667		0.53823246	0.357	0.198		0.083922719	0.638	
295	Guwahati-Kochugaon	NL01AD0526	Guwahati	Kolkata	MAV	1.1.122	Fuel	No	2365	4125	7265	8150	7960		0.714	1.245		2.047385478	0.260	2.403		17.57108072	20.234	
296	Guwahati-Kochugaon	BR01GG6860	Bongaigaon	Bihar	MAV	1.1.122	Carbon	No	2565	5225	6180	8465	7980		0.774	1.577		1.981693965	0.359	6.187		15.42220058	21.968	
333	Guwahati-Kochugaon	UP917734	Guwahati	Uttar Pradesh	MAV	1.1.122	Empty	No	2450	2130	1960	1840	1530		0.740	0.643		0.466847683	0.299	0.171		0.04750079	0.517	
339	Guwahati-Kochugaon	WB831590	Bijni	Madhya Pradesh	MAV	1.1.122	Empty	No	3105	2965	2545	1965	1740		0.937	0.895		0.547429272	0.772	0.642		0.089807388	1.503	
357	Guwahati-Kochugaon	AP39U9929	Guwahati	Vizag	MAV	1.1.122	Carbon	No	4215	4875	5265	7425	6805		1.272	1.471		1.707541386	2.620	4.688		8.5012924	15.810	
360	Guwahati-Kochugaon	UP51BT2944	Guwahati	Sirapur	MAV	1.1.122	Tea leaves	No	2745	3695	4460	5985	5215		0.829	1.115		1.371638784	0.471	1.547		3.539639449	5.558	
361	Guwahati-Kochugaon	TS07UE2979	Guwahati	Vizag	MAV	1.1.122	Carbon	No	2840	3815	4740	6575	6215		0.857	1.152		1.535429622	0.540	1.758		5.558014304	7.856	
375	Guwahati-Kochugaon	UP25CT1040	Guwahati	Bihar	MAV	1.1.122	Bamboo Sticks	No	2875	4215	6985	7515	6990		0.868	1.272		1.882280809	0.567	2.620		12.55271469	15.740	
376	Guwahati-Kochugaon	UP25DT0405	Guwahati	Bihar	MAV	1.1.122	Bamboo Sticks	No	2890	4430	6885	7620	7250		0.872	1.337		1.90549181	0.579	3.197		13.18342784	16.959	
379	Guwahati-Kochugaon	UK18CA3488	Guwahati	Siliguri	MAV	1.1.122	Tea leaves	No	2750	3965	4970	5840	5210		0.830	1.197		1.40317071	0.475	2.052		3.876520123	6.403	
69	Guwahati-Kochugaon	UP14GT6521	Guwahati	Delhi	MAV	1.1.222	Rice	No	3685	5315	7325	9875	9245		1.112	1.604		2.316282736	1.531	6.624		28.78500314	36.940	
82	Guwahati-Kochugaon	NL01AF5815	Guwahati	Siliguri	MAV	1.1.222	Carbon	No	3250	4120	7350	8460	7950		0.981	1.244		2.081107121	0.926	2.392		18.75762033	22.075	
83	Guwahati-Kochugaon	MH14JL6666	Guwahati	Bhopal	MAV	1.1.222	Bamboo Sticks	No	2745	4480	6585	7680	7155		0.829	1.352		1.876149601	0.471	3.344		12.38995879	16.205	
99	Guwahati-Kochugaon	GJ10TV8288	Guwahati	Gujarat	MAV	1.1.222	Empty	No	2875	2240	1985	1760	1485		0.868	0.676		0.458088815	0.567	0.209		0.044035076	0.820	
155	Guwahati-Kochugaon	UP35AT4216	Guwahati	Kolkata	MAV	1.1.222	Plastic	No	3690	4395	6970	7685	7070		1.114	1.327		1.90286415	1.539	3.097		13.11085868	17.747	
223	Guwahati-Kochugaon	MH18BG8022	Guwahati	Gossaigaon	MAV	1.1.222	Empty	No	2580	2320	1980	1760	1545		0.779	0.700		0.462906193	0.368	0.240		0.045916837	0.654	
234	Guwahati-Kochugaon	BP2B1667	Guwahati	Uttar Pradesh	MAV	1.1.222	Cement	No	2455	3690	7420	8860	8240		0.741	1.114		2.14767452	0.302	1.539		21.27521018	23.116	
286	Guwahati-Kochugaon	OD09T3040	Meghalaya	Kolkata	MAV	1.1.222	Empty	No	2875	2125	2525	1945	1720		0.868	0.641		0.542173951	0.567	0.169		0.086408127	0.823	
310	Guwahati-Kochugaon	UP82T4881	Guwahati	Nagpur	MAV	1.1.222	Tea leaves	No	2470	3465	6940	7240	6845		0.746	1.046		1.841552071	0.309	1.197		11.50101086	13.007	
350	Guwahati-Kochugaon	MP14HC0241	Bongaigaon	Siliguri	MAV	1.1.222	Empty	No	2615	2240	2545	1980	1745		0.789	0.676		0.549181046	0.388	0.209		0.090962452	0.688	
374	Guwahati-Kochugaon	TS02UD1377	Meghalaya	Kurnool	MAV	1.1.222	Plastic	No	3105	4755	7205	8565	8215		0.937	1.435		2.100814575	0.772	4.243		19.47829267	24.493	
26	Guwahati-Kochugaon	HR63C6969	Guwahati	Sirapur	MAV	1.2.122	Empty	No	2390	2125	2615	2825	2320		0.721	0.521		0.679688184	0.271	0.074		0.21342185	0.558	
14	Guwahati-Kochugaon	NL01G7991	Guwahati	Kolkata	MAV	1.2.222	Empty	No	2195	1995	2035	2370	2145		0.663	0.489		0.573705877	0.193	0.057		0.108332108	0.358	
30	Guwahati-Kochugaon	RJ01GC2283	Jorhat	Siliguri	MAV	1.2.222	Empty	No	2120	1960	1745	1540	1495		0.640	0.481		0.418673907	0.168	0.053		0.030725827	0.252	
57	Guwahati-Kochugaon	NL03KA2546	Guwahati	Bihar	MAV	1.2.222	Empty	No	1920	1845	1785	1145	1020		0.580	0.452		0.3459753	0.113	0.042		0.014327829	0.169	
60	Guwahati-Kochugaon	UP57AT1613	Guwahati	Bihar	MAV	1.2.222	Seeds	No	2975	2745	8345	7915	7230		0.898	0.673		2.057458176	0.650	0.205		17.91942471	18.775	
79	Guwahati-Kochugaon	WB11D5189	Tezpur	Kolkata	MAV	1.2.222	Empty	No	2545	2120	1980	1510	1205		0.768	0.520		0.411228869	0.348	0.073		0.028597916	0.450	
80	Guwahati-Kochugaon	WB11D5191	Tezpur	Kolkata	MAV	1.2.222	Empty	No	2120	1840	2050	1950	1785		0.640	0.451		0.506700534	0.168	0.041		0.065918217	0.275	
94	Guwahati-Kochugaon	JH10BQ6638	Guwahati	Siliguri	MAV	1.2.222	Empty	No	2845	2640	1985	1760	1495		0.859	0.647		0.458964702	0.544	0.176		0.044372832	0.764	
95	Guwahati-Kochugaon	WB39B5965	Guwahati	Siliguri	MAV	1.2.222	Empty	No	3125	2850	2540	1980	1765		0.943	0.699		0.550494876	0.792	0.239		0.091836035	1.122	
163	Guwahati-Kochugaon	UP53HT1370	Dibrugarh	Delhi	MAV	1.2.222	Plastic	No	3275	4975	5970	7675	6890		0.989	1.220		1.798633617	0.955	2.216		10.46576128	13.637	
186	Guwahati-Kochugaon	RJ14GG4788	Guwahati	Sirapur	MAV	1.2.222	Tea leaves	No	3245	4745	4205	7205	6980		0.979	1.164		1.61075589	0.920	1.834		6.73160947	9.486	
199	Guwahati-Kochugaon	RJ46GA3547	Bijni	Rajasthan	MAV	1.2.222	Tea leaves	No	2455	4105	8425	9460	8970		0.741	1.007		2.352194097	0.302	1.027		30.6120647	31.941	
209	Guwahati-Kochugaon	WB39C2153	Guwahati	Kolkata	MAV	1.2.222	Empty	No	2210	2035	1860	2035	1760		0.667	0.499		0.495314005	0.198	0.062		0.060189735	0.320	
225	Guwahati-Kochugaon	NL01Q2747	Guwahati	Siliguri	MAV	1.2.222	Empty	No	3245	2965	2545	2100	1965		0.979	0.727		0.578961198	0.920	0.280		0.112356405	1.312	
258	Guwahati-Kochugaon	NL01AB4947	Guwahati	Kolkata	MAV	1.2.222	Empty	No	2890	2560	2720	1960	1805		0.872	0.628		0.568012613	0.579	0.155		0.104095491	0.839	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
278	Guwahati-Kochugaon	NL01AD2170	Bongaigaon	Patna	MAV	1.2.222	Empty	No	3125	2860	2240	1865	1540		0.943	0.701		0.494438119	0.792	0.242		0.059765118	1.093	
279	Guwahati-Kochugaon	NL01AD2134	Bongaigaon	Patna	MAV	1.2.222	Empty	No	2965	2555	2100	1760	1640		0.895	0.627		0.481737759	0.642	0.154		0.053857074	0.850	
358	Guwahati-Kochugaon	MH46H3244	Guwahati	Sirapur	MAV	1.2.222	Empty	No	2345	2095	1905	2195	1945		0.708	0.514		0.529473592	0.251	0.070		0.078591797	0.399	
363	Guwahati-Kochugaon	JH02AP2412	Guwahati	Srirampur	MAV	1.2.222	Empty	No	2720	2510	2842	2430	1960		0.821	0.616		0.633441359	0.454	0.144		0.160999922	0.759	
364	Guwahati-Kochugaon	NL02N0131	Nagaland	Kolkata	MAV	1.2.222	Empty	No	2650	2210	2430	1970	1750		0.800	0.542		0.538670404	0.409	0.086		0.084196194	0.580	
394	Guwahati-Kochugaon	NL01Q5339	Guwahati	Durgapur	MAV	1.2.222	Empty	No	2415	3125	2825	2915	2210		0.729	0.766		0.696330034	0.282	0.345		0.235104266	0.862	
64	Guwahati-Kochugaon	RJ01GB7736	Guwahati	Siliguri	MAV	1.22.222	Empty	No	2980	3410	3680	3450	3250	2985	0.899		0.940	0.848	0.655		0.781	0.518	1.953	
72	Guwahati-Kochugaon	UP12BT7786	Meghalaya	Durgapur	MAV	1.22.222	Agarabati	No	2845	5460	4250	8120	7960	7325	0.859		1.287	2.050	0.544		2.746	17.661	20.951	
73	Guwahati-Kochugaon	PB13BC0397	Guwahati	Siliguri	MAV	1.22.222	Empty	No	2340	3260	3480	2980	1995	1745	0.706		0.894	0.589	0.249		0.637	0.120	1.006	
230	Guwahati-Kochugaon	RJ09GD0326	Gorgaon	Gossaigaon	MAV	1.22.222	Bamboo Sticks	No	2985	4265	6105	7525	8995	8205	0.901		1.375	2.166	0.659		3.572	21.996	26.227	
247	Guwahati-Kochugaon	RJ06GC0332	Guwahati	Kolkata	MAV	1.22.222	Empty	No	2415	2210	1965	1845	1505	1230	0.729		0.553	0.401	0.282		0.094	0.026	0.402	
298	Guwahati-Kochugaon	UP51AT6955	Guwahati	Varanasi	MAV	1.22.222	Empty	No	3425	2965	2640	2255	1935	1740	1.034		0.743	0.519	1.142		0.305	0.073	1.520	
193	Kochugaon-Guwahati	AS12E6275	Siliguri	Guwahati	Bus	1.2	Passengers	Yes	2845	3745					0.859	0.918			0.544	0.712			1.255	
271	Kochugaon-Guwahati	AS01GC1580	Siliguri	Bongaigaon	Bus	1.2	Passengers	Yes	2840	3810					0.857	0.934			0.540	0.762			1.302	
279	Kochugaon-Guwahati	AS01PC2294	Serfanguri	Guwahati	Bus	1.2	Passengers	Yes	2840	3650					0.857	0.895			0.540	0.642			1.182	**1.370**
313	Kochugaon-Guwahati	AR11A0045	Erode	Shillong	Bus	1.2	Passengers	Yes	3215	4010					0.970	0.983			0.887	0.935			1.822	
353	Kochugaon-Guwahati	AS02E9737	Siliguri	Bongaigaon	Bus	1.2	Passengers	Yes	2975	3645					0.898	0.894			0.650	0.639			1.289	
8	Kochugaon-Guwahati	HR46F9920	Siliguri	Guwahati	LCV	1.2	Parcel	Yes	2460	3860					0.743	0.947			0.304	0.803			1.107	
10	Kochugaon-Guwahati	MH46AF6179	Siliguri	Bongaigaon	LCV	1.2	Parcel	Yes	1740	3650					0.525	0.895			0.076	0.642			0.718	
11	Kochugaon-Guwahati	NL01AG2315	Siliguri	Tezpur	LCV	1.2	Parcel	Yes	2045	4240					0.617	1.040			0.145	1.169			1.314	
13	Kochugaon-Guwahati	WB726345	Siliguri	Guwahati	LCV	1.2	Parcel	Yes	2340	3860					0.706	0.947			0.249	0.803			1.052	
14	Kochugaon-Guwahati	MH15HW6669	Maharashtra	Bongaigaon	LCV	1.2	Tiles	Yes	2890	5610					0.872	1.376			0.579	3.583			4.162	
22	Kochugaon-Guwahati	WB354658	Gurhanwa	Guwahati	LCV	1.2	Medicine	Yes	1840	3620					0.555	0.888			0.095	0.621			0.716	
27	Kochugaon-Guwahati	NL01AE8246	Kolkata	Nagaland	LCV	1.2	Parcel	Yes	2040	4240					0.616	1.040			0.144	1.169			1.313	
29	Kochugaon-Guwahati	WB25K8975	Kolkata	Tripura	LCV	1.2	Fish	Yes	2430	4750					0.733	1.165			0.289	1.842			2.131	
41	Kochugaon-Guwahati	WB11F1834	Kolkata	Tripura	LCV	1.2	Fish	Yes	2810	5960					0.848	1.462			0.518	4.565			5.082	
42	Kochugaon-Guwahati	WB37E2531	Kolkata	Tripura	LCV	1.2	Eggs	Yes	1750	2860					0.528	0.701			0.078	0.242			0.320	
64	Kochugaon-Guwahati	BP02A9149	Uttar Pradesh	Bhutan	LCV	1.2	Water Tanks	Yes	2240	5740					0.676	1.408			0.209	3.927			4.136	
70	Kochugaon-Guwahati	BP421460	Uttar Pradesh	Bhutan	LCV	1.2	Water Bottle	Yes	2460	4230					0.743	1.037			0.304	1.158			1.462	
76	Kochugaon-Guwahati	WB11B2894	Kolkata	Guwahati	LCV	1.2	Parcel	Yes	1840	3720					0.555	0.912			0.095	0.693			0.788	
77	Kochugaon-Guwahati	BP05A0078	Kolkata	Guwahati	LCV	1.2	Hardware	Yes	2040	4210					0.616	1.032			0.144	1.136			1.280	
83	Kochugaon-Guwahati	NL01AD3497	Nagpur	Guwahati	LCV	1.2	Parcel	Yes	2440	4860					0.736	1.192			0.294	2.018			2.312	
96	Kochugaon-Guwahati	KA52B5273	Delhi	Guwahati	LCV	1.2	Parcel	Yes	2230	4210					0.673	1.032			0.205	1.136			1.342	
110	Kochugaon-Guwahati	HR55AD0274	Chandigarh	Shillong	LCV	1.2	Parcel	Yes	1930	3045					0.583	0.747			0.115	0.311			0.426	
115	Kochugaon-Guwahati	AS19C8682	Patgaon	Bongaigaon	LCV	1.2	Empty	Yes	1340	1075					0.404	0.264			0.027	0.005			0.032	
123	Kochugaon-Guwahati	BP05A0145	Kolkata	Nagaon	LCV	1.2	Hardware	Yes	2130	4135					0.643	1.014			0.171	1.058			1.228	
160	Kochugaon-Guwahati	AP31UG7179	Patgaon	Bijni	LCV	1.2	Empty	Yes	1810	1420					0.546	0.348			0.089	0.015			0.104	
197	Kochugaon-Guwahati	WB41E3506	Patgaon	Karigaon	LCV	1.2	Empty	Yes	1495	1215					0.451	0.298			0.041	0.008			0.049	
211	Kochugaon-Guwahati	WB37D9608	West Bengal	Guwahati	LCV	1.2	Machinery	Yes	1965	4050					0.593	0.993			0.124	0.973			1.097	**1.398**
221	Kochugaon-Guwahati	UP25CT0634	Udgir	Guwahati	LCV	1.2	Fan	Yes	1945	4135					0.587	1.014			0.119	1.058			1.176	
223	Kochugaon-Guwahati	WB15B7822	Kolkata	Guwahati	LCV	1.2	Medicine	Yes	2135	5340					0.644	1.310			0.172	2.942			3.114	
233	Kochugaon-Guwahati	MH04BR8134	Siliguri	Guwahati	LCV	1.2	Empty	Yes	1450	1150					0.438	0.282			0.037	0.006			0.043	
235	Kochugaon-Guwahati	WB23F6557	Patgaon	Karigaon	LCV	1.2	Empty	Yes	1560	1145					0.471	0.281			0.049	0.006			0.055	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
240	Kochugaon-Guwahati	MH48AY3850	Pune	Guwahati	LCV	1.2	Machinery	Yes	2910	4325					0.878	1.061			0.595	1.266			1.861	
254	Kochugaon-Guwahati	HR47E8242	Gurugram	Mizoram	LCV	1.2	Parcel	Yes	2135	3945					0.644	0.968			0.172	0.876			1.049	
262	Kochugaon-Guwahati	HR45C3888	Delhi	Guwahati	LCV	1.2	Medicine	Yes	2810	3840					0.848	0.942			0.518	0.787			1.304	
272	Kochugaon-Guwahati	UP84AT2207	Delhi	Mizoram	LCV	1.2	Machinery	Yes	3160	4530					0.954	1.111			0.828	1.523			2.351	
273	Kochugaon-Guwahati	WB19K4572	Kolkata	Guwahati	LCV	1.2	Ice Cream	Yes	2870	3360					0.866	0.824			0.563	0.461			1.024	
274	Kochugaon-Guwahati	UP63BT1084	Delhi	Mizoram	LCV	1.2	Tower Parts	Yes	2460	3810					0.743	0.934			0.304	0.762			1.066	
303	Kochugaon-Guwahati	WB11D9970	Kolkata	Guwahati	LCV	1.2	Parcel	Yes	2720	4155					0.821	1.019			0.454	1.078			1.533	
311	Kochugaon-Guwahati	UP11AT6108	Bihar	Guwahati	LCV	1.2	Plastic Chairs	Yes	2680	3450					0.809	0.846			0.428	0.513			0.941	
328	Kochugaon-Guwahati	UP82AT2249	Lucknow	Nagaland	LCV	1.2	Parcel	Yes	2640	4210					0.797	1.032			0.403	1.136			1.540	
332	Kochugaon-Guwahati	BP01A4122	Kolkata	Guwahati	LCV	1.2	Empty	Yes	1460	1035					0.441	0.254			0.038	0.004			0.042	
333	Kochugaon-Guwahati	WB19L2164	West Bengal	Guwahati	LCV	1.2	Fan	Yes	2530	4150					0.764	1.018			0.340	1.073			1.413	
339	Kochugaon-Guwahati	WB51B3751	Kolkata	Guwahati	LCV	1.2	Electric wire	Yes	2740	5160					0.827	1.265			0.468	2.565			3.032	
350	Kochugaon-Guwahati	UP02BT7022	Kanpur	Guwahati	LCV	1.2	Machinery	Yes	2740	4275					0.827	1.048			0.468	1.208			1.676	
356	Kochugaon-Guwahati	BR31GA4134	Bihar	Guwahati	LCV	1.2	Electrical	Yes	2435	4750					0.735	1.165			0.292	1.842			2.133	
360	Kochugaon-Guwahati	BP02B0146	Lucknow	Mizoram	LCV	1.2	Empty	Yes	1540	1075					0.465	0.264			0.047	0.005			0.052	
387	Kochugaon-Guwahati	WB13Y3126	Patgaon	Bongaigaon	LCV	1.2	Vegetables	Yes	2730	3720					0.824	0.912			0.461	0.693			1.154	
17	Kochugaon-Guwahati	MH12RN8984	Raipur	Guwahati	2Axle	1.2	Parcel	Yes	2630	5410					0.794	1.327			0.397	3.099			3.496	
21	Kochugaon-Guwahati	UP78FN5815	Haryana	Guwahati	2Axle	1.2	Parcel	Yes	2640	4820					0.797	1.182			0.403	1.953			2.356	
23	Kochugaon-Guwahati	NL01Q2380	Gurhanwa	Tezpur	2Axle	1.2	Parcel	Yes	2510	5220					0.758	1.280			0.329	2.686			3.015	
26	Kochugaon-Guwahati	HR55AD4566	Delhi	Nagaland	2Axle	1.2	Parcel	Yes	2650	5230					0.800	1.283			0.409	2.707			3.116	
39	Kochugaon-Guwahati	NL01Q3477	Kolkata	Nagaland	2Axle	1.2	Parcel	Yes	2650	5430					0.800	1.332			0.409	3.145			3.554	
40	Kochugaon-Guwahati	AS01UC6953	Kolkata	Guwahati	2Axle	1.2	Parcel	Yes	2840	5450					0.857	1.337			0.540	3.192			3.732	
54	Kochugaon-Guwahati	UP78G6374	Kolkata	Nagaland	2Axle	1.2	Parcel	Yes	2840	5260					0.857	1.290			0.540	2.769			3.309	
55	Kochugaon-Guwahati	HR55W1236	Haryana	Bongaigaon	2Axle	1.2	Parcel	Yes	2640	5410					0.797	1.327			0.403	3.099			3.502	
56	Kochugaon-Guwahati	UP78DT1715	Kolkata	Bijni	2Axle	1.2	Parcel	Yes	2620	4840					0.791	1.187			0.391	1.985			2.376	
57	Kochugaon-Guwahati	UT78FT9418	Behanga	Guwahati	2Axle	1.2	Parcel	Yes	2890	5210					0.872	1.278			0.579	2.665			3.245	
58	Kochugaon-Guwahati	HR55U0388	Haryana	Mizoram	2Axle	1.2	Parcel	Yes	2780	5310					0.839	1.302			0.496	2.876			3.372	
66	Kochugaon-Guwahati	JH12L3234	Jharkhand	Mizoram	2Axle	1.2	Parcel	Yes	2840	5620					0.857	1.378			0.540	3.609			4.149	
69	Kochugaon-Guwahati	RJ14GN2509	Delhi	Guwahati	2Axle	1.2	Parcel	Yes	2840	5260					0.857	1.290			0.540	2.769			3.309	
72	Kochugaon-Guwahati	UP78HN2744	Nagpur	Mizoram	2Axle	1.2	Parcel	Yes	2860	5260					0.863	1.290			0.555	2.769			3.325	
93	Kochugaon-Guwahati	UP21C3552	Kolkata	Guwahati	2Axle	1.2	Parcel	Yes	2710	5470					0.818	1.342			0.448	3.239			3.686	
94	Kochugaon-Guwahati	UP21CN5516	Kolkata	Guwahati	2Axle	1.2	Parcel	Yes	2870	5620					0.866	1.378			0.563	3.609			4.172	
95	Kochugaon-Guwahati	WB78T5334	Kolkata	Nagaland	2Axle	1.2	Parcel	Yes	2490	4870					0.752	1.194			0.319	2.035			2.354	
97	Kochugaon-Guwahati	HR55U0357	Nagpur	Guwahati	2Axle	1.2	Parcel	Yes	2760	4430					0.833	1.086			0.482	1.393			1.875	
98	Kochugaon-Guwahati	NL01L6374	Delhi	Guwahati	2Axle	1.2	Parcel	Yes	2475	4730					0.747	1.160			0.311	1.811			2.122	
99	Kochugaon-Guwahati	KA01AP0341	Kolkata	Bongaigaon	2Axle	1.2	Parcel	Yes	2530	4840					0.764	1.187			0.340	1.985			2.325	
107	Kochugaon-Guwahati	NL01Q0941	Delhi	Guwahati	2Axle	1.2	Furniture	Yes	2440	4650					0.736	1.140			0.294	1.691			1.986	
109	Kochugaon-Guwahati	HR55AM9215	Gurugram	Nalbari	2Axle	1.2	Parcel	Yes	2560	4130					0.773	1.013			0.357	1.053			1.409	
117	Kochugaon-Guwahati	NL01AS5482	Delhi	Mizoram	2Axle	1.2	Parcel	Yes	3015	4570					0.910	1.121			0.686	1.578			2.264	
120	Kochugaon-Guwahati	UP21CN0497	Uttar Pradesh	Bongaigaon	2Axle	1.2	Parcel	Yes	2815	4370					0.850	1.072			0.521	1.319			1.841	
142	Kochugaon-Guwahati	NL01D6146	Delhi	Guwahati	2Axle	1.2	Furniture	Yes	2450	3650					0.740	0.895			0.299	0.642			0.941	
155	Kochugaon-Guwahati	HR38T9733	Haryana	Nalbari	2Axle	1.2	Machinery	Yes	3540	5630					1.069	1.381			1.304	3.635			4.938	
156	Kochugaon-Guwahati	HR38X8226	Haryana	Mizoram	2Axle	1.2	Parcel	Yes	2350	3940					0.709	0.966			0.253	0.872			1.125	

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			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
162	Kochugaon-Guwahati	NL01SP6168	Karnataka	Guwahati	2Axle	1.2	Biscuits	Yes	2510	4230					0.758	1.037			0.329	1.158			1.488	3.076
165	Kochugaon-Guwahati	RJ32GC6564	Delhi	Guwahati	2Axle	1.2	Parcel	Yes	2880	4185					0.869	1.026			0.571	1.110			1.681	
174	Kochugaon-Guwahati	CG64MB2691	Kolkata	Guwahati	2Axle	1.2	Chips	Yes	2215	4935					0.669	1.210			0.200	2.146			2.346	
181	Kochugaon-Guwahati	HR55AJ4738	Delhi	Guwahati	2Axle	1.2	Parcel	Yes	2835	6385					0.856	1.566			0.536	6.013			6.549	
186	Kochugaon-Guwahati	NL01AA3329	Delhi	Guwahati	2Axle	1.2	Bikes	Yes	2675	5015					0.807	1.230			0.425	2.288			2.713	
189	Kochugaon-Guwahati	WB176285	Kolkata	Guwahati	2Axle	1.2	Parcel	Yes	1945	5730					0.587	1.405			0.119	3.900			4.019	
196	Kochugaon-Guwahati	HR38T8463	Srirampur	Guwahati	2Axle	1.2	Helmets	Yes	2740	4825					0.827	1.183			0.468	1.961			2.429	
207	Kochugaon-Guwahati	RJ32GC8746	Delhi	Guwahati	2Axle	1.2	Parcel	Yes	2965	5525					0.895	1.355			0.642	3.371			4.012	
217	Kochugaon-Guwahati	AS01N2071	Siliguri	Guwahati	2Axle	1.2	Medicine	Yes	2750	4715					0.830	1.156			0.475	1.788			2.263	
224	Kochugaon-Guwahati	OD01T2522	Kolkata	Shillong	2Axle	1.2	Tyres	Yes	3450	6160					1.041	1.511			1.176	5.209			6.385	
239	Kochugaon-Guwahati	NL01AE8235	Kolkata	Shillong	2Axle	1.2	Parcel	Yes	2835	3875					0.856	0.950			0.536	0.816			1.352	
241	Kochugaon-Guwahati	JH02BG5286	Ranchi	Guwahati	2Axle	1.2	Furniture	Yes	3520	5275					1.062	1.294			1.274	2.801			4.075	
243	Kochugaon-Guwahati	NL01N2127	Kolkata	Nagaon	2Axle	1.2	Parcel	Yes	2840	4850					0.857	1.189			0.540	2.002			2.542	
245	Kochugaon-Guwahati	NL02N2578	Delhi	Guwahati	2Axle	1.2	Parcel	Yes	3175	4915					0.958	1.205			0.844	2.111			2.955	
247	Kochugaon-Guwahati	HR38W8958	Pondicherry	Guwahati	2Axle	1.2	Plastic Chairs	Yes	2890	4870					0.872	1.194			0.579	2.035			2.614	
249	Kochugaon-Guwahati	CH01BB9061	Mumbai	Guwahati	2Axle	1.2	Electronics	Yes	3450	6740					1.041	1.653			1.176	7.466			8.642	
251	Kochugaon-Guwahati	NL01AF0274	Kolkata	Guwahati	2Axle	1.2	Parcel	Yes	2840	3740					0.857	0.917			0.540	0.708			1.248	
252	Kochugaon-Guwahati	HR38AD2432	Chandigarh	Mizoram	2Axle	1.2	Parcel	Yes	2730	4130					0.824	1.013			0.461	1.053			1.514	
256	Kochugaon-Guwahati	AS01GC7928	Sultanpur	Bongaigaon	2Axle	1.2	Fuel	Yes	3140	5925					0.948	1.453			0.807	4.458			5.265	
258	Kochugaon-Guwahati	NL01AU0460	Kolkata	Kohima	2Axle	1.2	Parcel	Yes	2870	4345					0.866	1.066			0.563	1.289			1.853	
259	Kochugaon-Guwahati	NL01AB0118	Delhi	Guwahati	2Axle	1.2	Machinery	Yes	3610	5435					1.090	1.333			1.410	3.157			4.566	
263	Kochugaon-Guwahati	AS26C8691	Kolkata	Guwahati	2Axle	1.2	Fuel	Yes	3345	5685					1.010	1.394			1.039	3.779			4.818	
283	Kochugaon-Guwahati	RJ32GC6827	Delhi	Guwahati	2Axle	1.2	Parcel	Yes	2680	3810					0.809	0.934			0.428	0.762			1.191	
294	Kochugaon-Guwahati	UP17AT7730	Gorakhpur	Aizawl	2Axle	1.2	Wheat	Yes	3475	6525					1.049	1.600			1.210	6.558			7.768	
298	Kochugaon-Guwahati	WB295751	Kolkata	Guwahati	2Axle	1.2	Parcel	Yes	3240	4415					0.978	1.083			0.915	1.375			2.289	
304	Kochugaon-Guwahati	HR38AB6047	Goa	Guwahati	2Axle	1.2	Spare parts	Yes	3125	4825					0.943	1.183			0.792	1.961			2.752	
307	Kochugaon-Guwahati	NL01Q4945	Kolkata	Guwahati	2Axle	1.2	Parcel	Yes	2540	4230					0.767	1.037			0.346	1.158			1.504	
320	Kochugaon-Guwahati	NL01AF8161	Kolkata	Guwahati	2Axle	1.2	Parcel	Yes	2710	4430					0.818	1.086			0.448	1.393			1.841	
346	Kochugaon-Guwahati	WB73J6285	Kolkata	Guwahati	2Axle	1.2	Parcel	Yes	2895	4520					0.874	1.109			0.583	1.510			2.093	
354	Kochugaon-Guwahati	UP21CT4054	Uttar Pradesh	Guwahati	2Axle	1.2	Fruits	Yes	3865	5260					1.167	1.290			1.852	2.769			4.622	
355	Kochugaon-Guwahati	HR38Z0457	Delhi	Nagaon	2Axle	1.2	Parcel	Yes	3260	4535					0.984	1.112			0.938	1.530			2.468	
357	Kochugaon-Guwahati	PB04A0433	Mumbai	Guwahati	2Axle	1.2	Furniture	Yes	3425	4725					1.034	1.159			1.142	1.803			2.945	
358	Kochugaon-Guwahati	MH04K8999	Pune	Guwahati	2Axle	1.2	Ice Cream	Yes	3175	4920					0.958	1.207			0.844	2.120			2.963	
359	Kochugaon-Guwahati	UP07T6627	Lucknow	Mizoram	2Axle	1.2	Dal	Yes	3560	6735					1.075	1.652			1.333	7.443			8.777	
362	Kochugaon-Guwahati	MH40BL1497	Bengaluru	Guwahati	2Axle	1.2	Parcel	Yes	2945	4715					0.889	1.156			0.624	1.788			2.412	
372	Kochugaon-Guwahati	RJ14YD5119	Patna	Guwahati	2Axle	1.2	Pipes	Yes	2730	4530					0.824	1.111			0.461	1.523			1.984	
373	Kochugaon-Guwahati	NL01AF1399	Delhi	Nagaland	2Axle	1.2	Shampoo	Yes	2510	4340					0.758	1.064			0.329	1.283			1.613	
374	Kochugaon-Guwahati	NL01R1063	Nagpur	Manipur	2Axle	1.2	Parcel	Yes	2870	4315					0.866	1.058			0.563	1.254			1.817	
383	Kochugaon-Guwahati	NL01AC9349	Delhi	Guwahati	2Axle	1.2	Parcel	Yes	2740	4730					0.827	1.160			0.468	1.811			2.279	
385	Kochugaon-Guwahati	WB71B8313	Kolkata	Guwahati	2Axle	1.2	Parcel	Yes	3150	4735					0.951	1.161			0.817	1.818			2.636	
386	Kochugaon-Guwahati	HR74B1067	Haryana	Nagaland	2Axle	1.2	Parcel	Yes	3140	4950					0.948	1.214			0.807	2.172			2.979	
4	Kochugaon-Guwahati	NL02Q0377	Siliguri	Bongaigaon	3Axle	1.22	Empty	No	2800	2160	1960				0.845		0.546		0.510		0.089		0.599	
5	Kochugaon-Guwahati	WB11D3921	Delhi	Tezpur	3Axle	1.22	Biscuits	No	3860	4640	5260				1.165		1.312		1.843		2.967		4.810	

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			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
9	Kochugaon-Guwahati	MH04HY6155	Gujarat	Guwahati	3Axle	1.22	Parcel	Yes	3660	6240	5870				1.105		1.605		1.489		6.644		8.133	
16	Kochugaon-Guwahati	WB57B1787	Kolkata	Guwahati	3Axle	1.22	Dal	No	2840	5820	5430				0.857		1.491		0.540		4.948		5.488	
30	Kochugaon-Guwahati	WB41E1649	Kolkata	Guwahati	3Axle	1.22	Parcel	No	2850	5240	4890				0.860		1.343		0.548		3.253		3.800	
34	Kochugaon-Guwahati	HR61D7805	Bihar	Nagaland	3Axle	1.22	Vegetables	No	2840	5860	5370				0.857		1.489		0.540		4.913		5.453	
36	Kochugaon-Guwahati	NL01N8000	Kolkata	Nagaland	3Axle	1.22	Parcel	Yes	2870	5320	4930				0.866		1.359		0.563		3.410		3.973	
38	Kochugaon-Guwahati	UP21BN3214	Haridwar	Guwahati	3Axle	1.22	Parcel	Yes	3240	5620	5410				0.978		1.462		0.915		4.572		5.487	
46	Kochugaon-Guwahati	PB06V8257	Gujarat	Guwahati	3Axle	1.22	Gas	No	3420	5380	4620				1.032		1.326		1.136		3.089		4.225	
51	Kochugaon-Guwahati	NL01N2095	Nagpur	Guwahati	3Axle	1.22	Parcel	No	2850	5240	4910				0.860		1.346		0.548		3.279		3.826	
52	Kochugaon-Guwahati	UP21CN0135	Nagpur	Bongaigaon	3Axle	1.22	Railway Materia	Yes	2810	4840	4620				0.848		1.254		0.518		2.474		2.991	
59	Kochugaon-Guwahati	UP21CT3207	Haridwar	Guwahati	3Axle	1.22	Parcel	No	2840	4460	5230				0.857		1.285		0.540		2.723		3.263	
60	Kochugaon-Guwahati	NL02L9088	Kolkata	Bongaigaon	3Axle	1.22	Parcel	Yes	2790	4860	5620				0.842		1.389		0.503		3.726		4.229	
61	Kochugaon-Guwahati	PB65BC0315	Kolkata	Guwahati	3Axle	1.22	Biscuits	Yes	2990	4520	5230				0.903		1.293		0.663		2.792		3.455	
78	Kochugaon-Guwahati	WB172230	Kolkata	Guwahati	3Axle	1.22	Dal	No	2850	4420	5270				0.860		1.285		0.548		2.723		3.271	
79	Kochugaon-Guwahati	HR55AG3132	Haryana	Bongaigaon	3Axle	1.22	Parcel	Yes	2760	5640	5230				0.833		1.441		0.482		4.313		4.794	
81	Kochugaon-Guwahati	UP21BN9113	Nagpur	Guwahati	3Axle	1.22	Vegetables	Yes	2810	5430	5080				0.848		1.393		0.518		3.769		4.287	
84	Kochugaon-Guwahati	HR47E3064	Haryana	Guwahati	3Axle	1.22	Parcel	No	3240	4420	5670				0.978		1.338		0.915		3.202		4.116	
85	Kochugaon-Guwahati	HR55X6554	Haryana	Guwahati	3Axle	1.22	Parcel	No	3190	4370	5620				0.963		1.324		0.860		3.077		3.936	
86	Kochugaon-Guwahati	UP21BN7648	Nagpur	Bongaigaon	3Axle	1.22	Parcel	No	3240	5260	4830				0.978		1.338		0.915		3.202		4.116	
92	Kochugaon-Guwahati	UP21CN0396	Kolkata	Nagaland	3Axle	1.22	Parcel	Yes	2840	5260	5430				0.857		1.417		0.540		4.034		4.574	
113	Kochugaon-Guwahati	NL01AS8514	Delhi	Guwahati	3Axle	1.22	Parcel	No	2870	3945	4120				0.866		1.069		0.563		1.307		1.870	
124	Kochugaon-Guwahati	WB11E1574	Kolkata	Nagaon	3Axle	1.22	Fish	Yes	3415	5135	5340				1.031		1.389		1.129		3.719		4.848	
125	Kochugaon-Guwahati	NL61AF3808	Kolkata	Guwahati	3Axle	1.22	Machinery	No	2975	5740	5515				0.898		1.492		0.650		4.957		5.607	
126	Kochugaon-Guwahati	AP31TE6246	Tadepalle	Guwahati	3Axle	1.22	Fish	Yes	3340	5260	5435				1.008		1.418		1.033		4.042		5.075	
127	Kochugaon-Guwahati	AP39N9199	Tadepalle	Guwahati	3Axle	1.22	Fish	Yes	3415	5475	5310				1.031		1.430		1.129		4.179		5.308	
128	Kochugaon-Guwahati	RJ14GF7803	Gujarat	Guwahati	3Axle	1.22	Food Mixture	No	3120	4530	4135				0.942		1.149		0.787		1.741		2.528	
137	Kochugaon-Guwahati	HR55AX6764	Haryana	Bongaigaon	3Axle	1.22	Furniture	No	2940	4560	4350				0.887		1.181		0.620		1.947		2.567	
140	Kochugaon-Guwahati	NL02AD3536	Kolkata	Guwahati	3Axle	1.22	Fuel	Yes	3450	6750	6340				1.041		1.735		1.176		9.069		10.245	
146	Kochugaon-Guwahati	RJ11GB6911	Madhya Pradesh	Guwahati	3Axle	1.22	Parcel	Yes	4340	5680	5430				1.310		1.473		2.945		4.706		7.651	
147	Kochugaon-Guwahati	HR61C5633	Delhi	Guwahati	3Axle	1.22	Furniture	Yes	4230	6560	6750				1.277		1.765		2.658		9.695		12.352	
148	Kochugaon-Guwahati	HR55U5368	Haryana	Guwahati	3Axle	1.22	Furniture	No	3830	4730	4450				1.156		1.217		1.786		2.194		3.980	
152	Kochugaon-Guwahati	BP02B1583	Kolkata	Assam	3Axle	1.22	Empty	No	2415	2020	1710				0.729		0.494		0.282		0.060		0.342	
153	Kochugaon-Guwahati	BP02B1780	Kolkata	Sivasagar	3Axle	1.22	Empty	No	2435	2140	1850				0.735		0.529		0.292		0.078		0.370	
154	Kochugaon-Guwahati	WB03C7806	Kolkata	Sivasagar	3Axle	1.22	Parcel	Yes	2870	4670	4315				0.866		1.191		0.563		2.013		2.576	
158	Kochugaon-Guwahati	GJ27TP166	Ahmedabad	Guwahati	3Axle	1.22	Clothes	No	3450	5130	5440				1.041		1.401		1.176		3.856		5.032	
163	Kochugaon-Guwahati	AP05TF3717	Kakinada	Guwahati	3Axle	1.22	Fish	No	3035	6215	5765				0.916		1.588		0.704		6.363		7.067	
166	Kochugaon-Guwahati	PB32J8207	Punjab	Guwahati	3Axle	1.22	Battery	No	3375	5510	5915				1.019		1.515		1.077		5.263		6.340	
170	Kochugaon-Guwahati	HR38AB5775	Delhi	Guwahati	3Axle	1.22	Furniture	Yes	3470	6210	6325				1.047		1.662		1.203		7.626		8.830	
171	Kochugaon-Guwahati	NL01AP6094	Pune	Guwahati	3Axle	1.22	Parcel	No	3760	6250	6025				1.135		1.627		1.659		7.013		8.672	
175	Kochugaon-Guwahati	UP78CN5372	Raipur	Guwahati	3Axle	1.22	Bottles	No	4305	5045	5530				1.299		1.402		2.851		3.863		6.714	
176	Kochugaon-Guwahati	UP21BN9331	Raipur	Guwahati	3Axle	1.22	Bottles	Yes	4215	5135	5415				1.272		1.399		2.620		3.827		6.447	
179	Kochugaon-Guwahati	NL01AD3877	Kolkata	Guwahati	3Axle	1.22	Oil	No	3845	4415	4055				1.161		1.123		1.814		1.590		3.404	
183	Kochugaon-Guwahati	WB23C1028	Kolkata	Guwahati	3Axle	1.22	Tea	No	3145	5725	5475				0.949		1.485		0.812		4.861		5.673	
202	Kochugaon-Guwahati	AS03BC0393	Gujarat	Guwahati	3Axle	1.22	Oil	Yes	3320	6580	6130				1.002		1.685		1.008		8.061		9.070	**5.721**

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
210	Kochugaon-Guwahati	RJ14GH8039	Delhi	Guwahati	3Axle	1.22	Parcel	No	3145	4280	3815				0.949		1.073		0.812		1.326		2.139	
214	Kochugaon-Guwahati	PB11CL4410	Punjab	Guwahati	3Axle	1.22	Parcel	No	3135	5340	5155				0.946		1.391		0.802		3.748		4.549	
216	Kochugaon-Guwahati	HR55AL2650	Delhi	Guwahati	3Axle	1.22	Medicine	Yes	4340	7560	6950				1.310		1.924		2.945		13.693		16.638	
220	Kochugaon-Guwahati	HR38C5838	Delhi	Guwahati	3Axle	1.22	Cycle	Yes	3485	6835	6415				1.052		1.757		1.224		9.521		10.746	
222	Kochugaon-Guwahati	AP16TH9377	Kolkata	Shillong	3Axle	1.22	Parcel	No	3915	5160	4740				1.182		1.312		1.950		2.967		4.917	
234	Kochugaon-Guwahati	BP01A4199	Cooch Behar	Bhutan	3Axle	1.22	Empty	No	2970	1970	1740				0.896		0.492		0.646		0.059		0.704	
237	Kochugaon-Guwahati	UP25FT0634	Kolkata	Bijni	3Axle	1.22	Parcel	No	2840	4280	4110				0.857		1.112		0.540		1.531		2.071	
266	Kochugaon-Guwahati	TR01AQ1557	Delhi	Tripura	3Axle	1.22	Parcel	Yes	3150	4370	4150				0.951		1.130		0.817		1.628		2.445	
267	Kochugaon-Guwahati	UP78FN7497	Kanpur	Guwahati	3Axle	1.22	Powder	No	4230	6795	6410				1.277		1.751		2.658		9.392		12.050	
277	Kochugaon-Guwahati	WB11B0979	Kolkata	Bijni	3Axle	1.22	Parcel	No	3140	4350	4125				0.948		1.124		0.807		1.594		2.401	
282	Kochugaon-Guwahati	WB73E3264	Delhi	Guwahati	3Axle	1.22	Empty	No	2235	2020	1975				0.675		0.530		0.207		0.079		0.286	
284	Kochugaon-Guwahati	NL01AA7469	Kolkata	Guwahati	3Axle	1.22	Parcel	Yes	2870	4130	4470				0.866		1.140		0.563		1.690		2.253	
285	Kochugaon-Guwahati	NL01AF8549	Pune	Nagaon	3Axle	1.22	Parcel	No	2710	4530	4315				0.818		1.173		0.448		1.891		2.338	
286	Kochugaon-Guwahati	AS02LC9911	Kolkata	Shillong	3Axle	1.22	Fuel	Yes	3560	6755	6530				1.075		1.761		1.333		9.622		10.955	
288	Kochugaon-Guwahati	HR55Y5555	Haryana	Kohima	3Axle	1.22	Parcel	No	2895	5430	5160				0.874		1.404		0.583		3.885		4.468	
290	Kochugaon-Guwahati	UP17T8477	Gorakhpur	Guwahati	3Axle	1.22	Wheat	Yes	4195	6835	6540				1.266		1.773		2.571		9.886		12.456	
292	Kochugaon-Guwahati	NL01AF5786	Mumbai	Guwahati	3Axle	1.22	Furniture	Yes	3120	5620	5415				0.942		1.463		0.787		4.581		5.367	
295	Kochugaon-Guwahati	WB11E5930	Kolkata	Guwahati	3Axle	1.22	Chairs	No	3140	5490	5215				0.948		1.419		0.807		4.057		4.864	
296	Kochugaon-Guwahati	NL01AD6832	Nagpur	Guwahati	3Axle	1.22	Parcel	No	3275	4675	4480				0.989		1.214		0.955		2.170		3.125	
301	Kochugaon-Guwahati	PB65BA1981	Jalpaiguri	Nalbari	3Axle	1.22	Pig	No	2750	4530	4310				0.830		1.172		0.475		1.886		2.361	
302	Kochugaon-Guwahati	MH04JK9642	Goa	Guwahati	3Axle	1.22	Chocolate	Yes	2985	4230	4095				0.901		1.104		0.659		1.484		2.143	
305	Kochugaon-Guwahati	TN52K4356	Erode	Guwahati	3Axle	1.22	Parcel	No	3575	4270	4180				1.079		1.120		1.356		1.575		2.931	
306	Kochugaon-Guwahati	HP72D0103	West Bengal	Meghalaya	3Axle	1.22	Parcel	Yes	2940	4350	3950				0.887		1.100		0.620		1.466		2.086	
312	Kochugaon-Guwahati	BP02B0253	Phuentsholing	Guwahati	3Axle	1.22	Paper	Yes	2905	3810	3645				0.877		0.988		0.591		0.954		1.545	
315	Kochugaon-Guwahati	WB39A6721	Kolkata	Nagaland	3Axle	1.22	Parcel	No	3075	4670	4475				0.928		1.212		0.742		2.161		2.903	
321	Kochugaon-Guwahati	RJ47GA1280	Rajasthan	Nagaland	3Axle	1.22	Marble	No	3870	8675	8345				1.168		2.256		1.862		25.922		27.784	
322	Kochugaon-Guwahati	NL01AB5888	Bihar	Nagaon	3Axle	1.22	Pulses	No	4123	6875	6570				1.244		1.782		2.399		10.094		12.493	
331	Kochugaon-Guwahati	NL01AG2131	Kolkata	Guwahati	3Axle	1.22	Medicine	Yes	3340	4975	4730				1.008		1.287		1.033		2.740		3.773	
334	Kochugaon-Guwahati	NL01AA6206	Haryana	Guwahati	3Axle	1.22	Thread	No	3215	5420	5135				0.970		1.399		0.887		3.834		4.721	
337	Kochugaon-Guwahati	JK03J5213	Jharkhand	Guwahati	3Axle	1.22	Iron	Yes	3570	7235	6890				1.078		1.873		1.348		12.296		13.645	
338	Kochugaon-Guwahati	NL01AF4089	Delhi	Tripura	3Axle	1.22	Fruits	Yes	3230	6720	6530				0.975		1.757		0.903		9.521		10.425	
340	Kochugaon-Guwahati	RJ09GC0403	Delhi	Nagaland	3Axle	1.22	Furniture	Yes	3840	5675	5520				1.159		1.484		1.805		4.852		6.657	
344	Kochugaon-Guwahati	UP59GT5815	Tadepalligudem	Guwahati	3Axle	1.22	Parcel	No	3125	4570	4320				0.943		1.179		0.792		1.929		2.721	
347	Kochugaon-Guwahati	WB41E7921	Kolkata	Guwahati	3Axle	1.22	Marble	No	3750	8765	8435				1.132		2.280		1.641		27.036		28.677	
348	Kochugaon-Guwahati	NL01AF0725	Delhi	Dimapur	3Axle	1.22	Oil	No	4125	7235	5925				1.245		1.745		2.403		9.265		11.668	
351	Kochugaon-Guwahati	WB57B8886	Kolkata	Guwahati	3Axle	1.22	Chemical	Yes	3120	4925	4730				0.942		1.280		0.787		2.684		3.471	
352	Kochugaon-Guwahati	UP21B0747	Noida	Shillong	3Axle	1.22	Parcel	No	3435	4735	4530				1.037		1.228		1.156		2.276		3.432	
361	Kochugaon-Guwahati	HR55Y8476	Haryana	Guwahati	3Axle	1.22	Fan	No	2870	4675	4895				0.866		1.269		0.563		2.591		3.154	
367	Kochugaon-Guwahati	UK07CD0590	Kolkata	Guwahati	3Axle	1.22	Parcel	No	3240	5715	5520				0.978		1.489		0.915		4.922		5.836	
371	Kochugaon-Guwahati	AS16AC2915	Kolkata	Guwahati	3Axle	1.22	Bitumen	Yes	3735	7535	7415				1.127		1.982		1.615		15.431		17.046	
377	Kochugaon-Guwahati	AS16A2914	Patgaon	Bongaigaon	3Axle	1.22	Empty	No	2740	1915	1720				0.827		0.482		0.468		0.054		0.522	
379	Kochugaon-Guwahati	NL01A9481	Kolkata	Guwahati	3Axle	1.22	Fuel	No	2730	5625	5335				0.824		1.453		0.461		4.457		4.918	
381	Kochugaon-Guwahati	WB11C7663	West Bengal	Nagaland	3Axle	1.22	Parcel	Yes	3240	4975	4710				0.978		1.284		0.915		2.718		3.633	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
384	Kochugaon-Guwahati	MH04GR4389	Gujarat	Mizoram	3Axle	1.22	Perfume	No	2935	5430	5145				0.886		1.402		0.616		3.863		4.479	
6	Kochugaon-Guwahati	UP14GT7093	Siliguri	Tezpur	MAV	1.1.22	Fertilizer	No	2460	3260	5890	5610			0.743	0.984	1.525		0.304	0.938	5.403		6.644	
20	Kochugaon-Guwahati	WB57C1011	Kolkata	Nagaland	MAV	1.1.22	Dal	No	3220	3640	5620	5420			0.972	1.099	1.464		0.892	1.457	4.589		6.938	
28	Kochugaon-Guwahati	AP02TB9077	Vizag	Guwahati	MAV	1.1.22	Paints	No	2850	4620	6190	5780			0.860	1.395	1.587		0.548	3.782	6.342		10.671	
31	Kochugaon-Guwahati	AS01GC7586	Siliguri	Barpara	MAV	1.1.22	Parcel	No	3540	4520	5470	5160			1.069	1.364	1.409		1.304	3.465	3.944		8.712	
33	Kochugaon-Guwahati	BR37F4026	Bihar	Guwahati	MAV	1.1.22	Parcel	No	2840	4020	6420	6170			0.857	1.213	1.669		0.540	2.168	7.761		10.469	
44	Kochugaon-Guwahati	RJ09GA8822	Gujarat	Guwahati	MAV	1.1.22	Tiles	No	3310	4820	6985	6535			0.999	1.455	1.792		0.996	4.480	10.321		15.798	
48	Kochugaon-Guwahati	WB41E4690	Kolkata	Bijni	MAV	1.1.22	Vegetables	No	3290	4420	5920	5630			0.993	1.334	1.531		0.973	3.168	5.497		9.638	
49	Kochugaon-Guwahati	AS25FC0402	Bihar	Guwahati	MAV	1.1.22	Fuel	No	2840	4565	6540	6210			0.857	1.378	1.690		0.540	3.605	8.163		12.308	
53	Kochugaon-Guwahati	NL018993	Kolkata	Guwahati	MAV	1.1.22	Parcel	No	2640	3585	5820	5430			0.797	1.082	1.491		0.403	1.371	4.948		6.722	
62	Kochugaon-Guwahati	AP39TB3339	Tadepalle	Adalguri	MAV	1.1.22	Fish	No	3270	3680	6820	6240			0.987	1.111	1.731		0.949	1.522	8.987		11.458	
63	Kochugaon-Guwahati	AP37TE5788	Tadepalle	Adalguri	MAV	1.1.22	Fish	No	3250	3710	6790	6220			0.981	1.120	1.725		0.926	1.573	8.850		11.348	
65	Kochugaon-Guwahati	UP78CN2577	Uttar Pradesh	Guwahati	MAV	1.1.22	Powder	No	5445	4820	6520	6320			1.644	1.455	1.702		7.296	4.480	8.396		20.173	
68	Kochugaon-Guwahati	KA51AH2201	Delhi	Guwahati	MAV	1.1.22	Parcel	No	3160	4530	4060	3680			0.954	1.367	1.026		0.828	3.495	1.109		5.432	
87	Kochugaon-Guwahati	AS17B2415	Bihar	Guwahati	MAV	1.1.22	Vegetables	No	2840	3620	5620	5240			0.857	1.093	1.440		0.540	1.425	4.297		6.262	
88	Kochugaon-Guwahati	AP07H7386	Tadepalle	Tripura	MAV	1.1.22	Fish	No	3240	4420	6320	5920			0.978	1.334	1.623		0.915	3.168	6.933		11.016	
91	Kochugaon-Guwahati	WB41H0747	Bihar	Guwahati	MAV	1.1.22	Vegetables	No	3260	4370	5860	5430			0.984	1.319	1.497		0.938	3.027	5.019		8.984	
102	Kochugaon-Guwahati	AP16TG1897	Kakinada	Adalguri	MAV	1.1.22	Fish	No	3450	3135	5730	5545			1.041	0.946	1.495		1.176	0.802	4.992		6.970	
103	Kochugaon-Guwahati	AP16TW9559	Kakinada	Adalguri	MAV	1.1.22	Fish	No	3255	3240	5895	5630			0.982	0.978	1.528		0.932	0.915	5.450		7.296	
105	Kochugaon-Guwahati	WB59D6238	Kolkata	Guwahati	MAV	1.1.22	Dal	No	2830	2745	5840	5345			0.854	0.829	1.483		0.532	0.471	4.835		5.838	
106	Kochugaon-Guwahati	WB57C9558	Kolkata	Guwahati	MAV	1.1.22	Dal	No	3040	2850	6540	5350			0.918	0.860	1.576		0.709	0.548	6.174		7.430	
108	Kochugaon-Guwahati	WB65P8993	Kharagpur	Barpeta	MAV	1.1.22	Rice	No	3240	3015	6230	5945			0.978	0.910	1.614		0.915	0.686	6.787		8.388	
112	Kochugaon-Guwahati	AS01AS8514	Kolkata	Guwahati	MAV	1.1.22	Fuel	No	3445	3190	6940	6450			1.040	0.963	1.775		1.169	0.860	9.930		11.959	
118	Kochugaon-Guwahati	AP16TC8477	Vijayawada	Guwahati	MAV	1.1.22	Powder	No	3650	3375	6340	5835			1.102	1.019	1.614		1.473	1.077	6.787		9.338	
119	Kochugaon-Guwahati	AP39TB3669	Guntur	Guwahati	MAV	1.1.22	Chilli	No	3985	3640	6875	6650			1.203	1.099	1.793		2.093	1.457	10.336		13.887	
122	Kochugaon-Guwahati	HR69C2802	Alipurduar	Bongaigaon	MAV	1.1.22	Empty	No	2735	2340	1975	1740			0.826	0.706	0.493		0.464	0.249	0.059		0.772	
133	Kochugaon-Guwahati	AP05TG3447	Gujarat	Guwahati	MAV	1.1.22	Ceiling materia	No	4390	4130	6975	6520			1.325	1.247	1.789		3.083	2.415	10.245		15.743	
135	Kochugaon-Guwahati	WB59B9326	Bihar	Guwahati	MAV	1.1.22	Vegetables	No	4130	4740	7595	7250			1.247	1.431	1.968		2.415	4.190	15.002		21.607	
138	Kochugaon-Guwahati	UP25CT4268	Lucknow	Guwahati	MAV	1.1.22	Vegetables	No	3840	7375	7140	6785			1.159	2.226	1.846		1.805	24.556	11.615		37.976	
139	Kochugaon-Guwahati	NL02L7412	Bihar	Nagaon	MAV	1.1.22	Vegetables	No	3750	3430	7560	7340			1.132	1.035	1.975		1.641	1.149	15.225		18.016	
141	Kochugaon-Guwahati	WB72D7456	Kolkata	Guwahati	MAV	1.1.22	Machinery	No	3640	3150	7340	7125			1.099	0.951	1.918		1.457	0.817	13.524		15.798	
143	Kochugaon-Guwahati	NL01A5904	Kolkata	Shillong	MAV	1.1.22	Fuel	No	3350	3140	5879	5635			1.011	0.948	1.526		1.045	0.807	5.429		7.281	
144	Kochugaon-Guwahati	WB41S8742	Jalpaiguri	Guwahati	MAV	1.1.22	Vegetables	No	3740	4625	6735	6425			1.129	1.396	1.745		1.624	3.798	9.265		14.687	
150	Kochugaon-Guwahati	HR47C8728	Delhi	Guwahati	MAV	1.1.22	Parcel	No	3840	3650	5875	5640			1.159	1.102	1.527		1.805	1.473	5.431		8.709	
151	Kochugaon-Guwahati	WB77C5762	Kolkata	Assam	MAV	1.1.22	Ceiling materia	No	3560	3430	6875	6430			1.075	1.035	1.764		1.333	1.149	9.680		12.162	
157	Kochugaon-Guwahati	JH04Y8694	Ranchi	Guwahati	MAV	1.1.22	Powder	No	3970	3430	7430	7150			1.198	1.035	1.933		2.062	1.149	13.959		17.170	
169	Kochugaon-Guwahati	NL01N8822	Agra	Guwahati	MAV	1.1.22	Vegetables	No	4280	3840	6850	6415			1.292	1.159	1.759		2.785	1.805	9.564		14.155	
190	Kochugaon-Guwahati	WB23E4805	Kolkata	Guwahati	MAV	1.1.22	Maida	No	5360	2360	7430	6950			1.618	0.712	1.906		6.851	0.257	13.209		20.317	
191	Kochugaon-Guwahati	HP17C8555	West Bengal	Silchar	MAV	1.1.22	Iron	No	3640	5235	7340	6750			1.099	1.580	1.868		1.457	6.234	12.175		19.866	
198	Kochugaon-Guwahati	NL01AC6179	Kolkata	Guwahati	MAV	1.1.22	Iron	No	3540	4650	6875	6430			1.069	1.404	1.764		1.304	3.881	9.680		14.865	
199	Kochugaon-Guwahati	PB13AB0713	Punjab	Guwahati	MAV	1.1.22	Steel	No	3310	4565	6435	6140			0.999	1.378	1.667		0.996	3.605	7.724		12.325	
200	Kochugaon-Guwahati	UP83AT7239	Agra	Guwahati	MAV	1.1.22	Vegetables	No	4310	5235	8420	8120			1.301	1.580	2.193		2.864	6.234	23.119		32.217	
201	Kochugaon-Guwahati	WB59A4481	Kolkata	Guwahati	MAV	1.1.22	Drums	No	4430	4155	7650	6840			1.337	1.254	1.921		3.197	2.474	13.617		19.288	
203	Kochugaon-Guwahati	WB59C5430	Kolkata	Guwahati	MAV	1.1.22	Vegetables	No	4345	5120	8750	8315			1.312	1.545	2.262		2.959	5.704	26.197		34.860	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
204	Kochugaon-Guwahati	WB41S8866	Kolkata	Guwahati	MAV	1.1.22	Chemical	No	4220	2540	7565	6935			1.274	0.767	1.922		2.632	0.346	13.655		16.633	
205	Kochugaon-Guwahati	AP37TB8969	Srirampur	Guwahati	MAV	1.1.22	Eggs	No	2810	2805	6610	6595			0.848	0.847	1.751		0.518	0.514	9.392		10.424	
206	Kochugaon-Guwahati	UP83BT3813	Srirampur	Guwahati	MAV	1.1.22	Garlic	No	4235	5565	7380	7120			1.278	1.680	1.922		2.670	7.961	13.655		24.286	
208	Kochugaon-Guwahati	RJ52GA8498	Gujarat	Guwahati	MAV	1.1.22	Maize	No	4480	2290	7080	6980			1.352	0.691	1.864		3.344	0.228	12.072		15.644	
213	Kochugaon-Guwahati	HR55AG1586	Chandigarh	Guwahati	MAV	1.1.22	Perfume	No	3765	4985	6780	6440			1.136	1.505	1.753		1.668	5.126	9.435		16.229	
215	Kochugaon-Guwahati	NL01N7988	Agra	Guwahati	MAV	1.1.22	Vegetables	No	3340	2740	6015	5875			1.008	0.827	1.576		1.033	0.468	6.174		7.675	
219	Kochugaon-Guwahati	WB37D0656	Raniganj	Bijni	MAV	1.1.22	Steel	No	3595	5215	7630	7235			1.085	1.574	1.971		1.386	6.139	15.083		22.609	
227	Kochugaon-Guwahati	NL01AA1960	Kolkata	Shillong	MAV	1.1.22	Iron	No	3545	3415	4965	4550			1.070	1.031	1.261		1.311	1.129	2.532		4.972	
231	Kochugaon-Guwahati	RJ18B5321	Rajasthan	Kohima	MAV	1.1.22	Marble	No	3240	3650	7450	7035			0.978	1.102	1.920		0.915	1.473	13.599		15.987	
238	Kochugaon-Guwahati	NL01AF7464	Kathmandu	Guwahati	MAV	1.1.22	Dal	No	4530	4175	6810	6660			1.367	1.260	1.786		3.495	2.522	10.169		16.187	
244	Kochugaon-Guwahati	UP32JN9833	Agra	Guwahati	MAV	1.1.22	Vegetables	No	4390	4040	6930	6540			1.325	1.219	1.786		3.083	2.211	10.169		15.464	
253	Kochugaon-Guwahati	NL01Q1116	Alipur	Tajpur	MAV	1.1.22	Vegetables	No	4240	4110	7130	6840			1.280	1.241	1.852		2.683	2.369	11.765		16.817	
255	Kochugaon-Guwahati	UP17T9440	Delhi	Barpeta	MAV	1.1.22	Furniture	No	3245	4930	4630	4325			0.979	1.488	1.187		0.920	4.903	1.986		7.810	
261	Kochugaon-Guwahati	UP70FT1598	Lucknow	Nagaland	MAV	1.1.22	Wheat	No	4565	4140	7650	7420			1.378	1.250	1.998		3.605	2.438	15.932		21.975	
265	Kochugaon-Guwahati	AP37TJ3688	Tadepalle	Guwahati	MAV	1.1.22	Fish	No	3340	5260	5570	5350			1.008	1.588	1.448		1.033	6.354	4.393		11.780	
278	Kochugaon-Guwahati	NL01AF1580	Gujarat	Guwahati	MAV	1.1.22	Medicine	No	3450	3850	4860	4670			1.041	1.162	1.263		1.176	1.824	2.548		5.548	
289	Kochugaon-Guwahati	RJ14GG8563	Makrana	Imphal	MAV	1.1.22	Marble	No	4960	4740	8735	8415			1.497	1.431	2.274		5.024	4.190	26.723		35.937	
293	Kochugaon-Guwahati	AP39TY5430	Tadepalle	Silchar	MAV	1.1.22	Fish	No	3675	3315	5780	5510			1.109	1.001	1.497		1.514	1.002	5.019		7.535	
297	Kochugaon-Guwahati	WB23D8166	Kolkata	Shillong	MAV	1.1.22	Rice	No	4895	4515	8490	8145			1.478	1.363	2.205		4.766	3.449	23.655		31.870	
300	Kochugaon-Guwahati	AP16TH8485	Vijayawada	Guwahati	MAV	1.1.22	Fish	No	3410	4895	6450	6170			1.029	1.478	1.673		1.122	4.766	7.835		13.723	
308	Kochugaon-Guwahati	NL01AC5994	Delhi	Guwahati	MAV	1.1.22	Wheat	No	4610	4210	6130	5750			1.391	1.271	1.575		3.749	2.608	6.153		12.510	
314	Kochugaon-Guwahati	NL01G0795	Kolkata	Guwahati	MAV	1.1.22	Chemical	No	3450	3275	5970	5680			1.041	0.989	1.544		1.176	0.955	5.690		7.821	
317	Kochugaon-Guwahati	WB57B3851	Kolkata	Guwahati	MAV	1.1.22	Dal	No	4560	4235	9870	6650			1.376	1.278	2.190		3.589	2.670	23.007		29.266	
323	Kochugaon-Guwahati	BR01AT1251	Bihar	Guwahati	MAV	1.1.22	Pulses	No	4540	6740	6870	6640			1.370	2.034	1.791		3.526	17.130	10.291		30.947	
325	Kochugaon-Guwahati	NL01FN8314	Shimla	Guwahati	MAV	1.1.22	Medicine	No	2875	2640	3875	3740			0.868	0.797	1.010		0.567	0.403	1.039		2.009	
336	Kochugaon-Guwahati	WB33C4657	Kolkata	Guwahati	MAV	1.1.22	Rice	No	4995	3925	7290	6930			1.508	1.185	1.885		5.167	1.970	12.631		19.768	
341	Kochugaon-Guwahati	WB73C2338	Patgaon	Bhutan	MAV	1.1.22	Food Grains	No	4560	4135	6825	6530			1.376	1.248	1.771		3.589	2.427	9.827		15.842	
342	Kochugaon-Guwahati	NL01G9357	Kolkata	Guwahati	MAV	1.1.22	Steel	No	4875	4680	8670	8410			1.471	1.413	2.264		4.688	3.982	26.289		34.959	
345	Kochugaon-Guwahati	AP07TE6499	Tadepalligudem	Guwahati	MAV	1.1.22	Dal	No	4230	4115	6530	6245			1.277	1.242	1.694		2.658	2.380	8.227		13.265	
363	Kochugaon-Guwahati	UP17BT0294	Delhi	Nagaland	MAV	1.1.22	Liquor	No	4120	4375	6530	5750			1.244	1.321	1.628		2.392	3.041	7.025		12.457	
388	Kochugaon-Guwahati	AP26TD4879	Tadepalle	Guwahati	MAV	1.1.22	Fish	No	3450	3725	6120	5750			1.041	1.124	1.574		1.176	1.598	6.132		8.906	
242	Kochugaon-Guwahati	NL01EI1549	Delhi	Guwahati	MAV	1.2.11	Cars	No	2430	5430	4320	3950			0.733	1.332	1.096		0.289	3.145	1.445		4.879	
250	Kochugaon-Guwahati	NL01AB8637	Pune	Guwahati	MAV	1.2.11	Cars	No	3410	4610	3425	3140			1.029	1.131	0.870		1.122	1.634	0.574		3.330	
257	Kochugaon-Guwahati	NL01K4803	Delhi	Guwahati	MAV	1.2.11	Cars	No	3540	4750	3230	3110			1.069	1.165	0.841		1.304	1.842	0.499		3.644	
1	Kochugaon-Guwahati	AS01NC0724	Kolkata	Tinsukia	MAV	1.2.22	Fuel	No	2840	4420	6940	6350			0.857	1.084	1.762		0.540	1.381	9.637		11.557	
2	Kochugaon-Guwahati	AS01WC7505	Kolkata	Tinsukia	MAV	1.2.22	Fuel	No	2940	4520	6820	6270			0.887	1.109	1.735		0.620	1.510	9.069		11.200	
3	Kochugaon-Guwahati	HR55AA6677	Gujarat	Tezpur	MAV	1.2.22	Cars	No	2150	3260	4840	4420			0.649	0.800	1.228		0.177	0.409	2.271		2.857	
25	Kochugaon-Guwahati	NL01L1106	Kolkata	Tezpur	MAV	1.2.22	Oil	No	3240	3820	5620	5240			0.978	0.937	1.440		0.915	0.770	4.297		5.982	
32	Kochugaon-Guwahati	AS26C5291	Kolkata	Guwahati	MAV	1.2.22	Gas	No	3140	3860	6420	6125			0.948	0.947	1.663		0.807	0.803	7.651		9.261	
35	Kochugaon-Guwahati	AS25EC9310	Kolkata	Guwahati	MAV	1.2.22	Gas	No	3240	3810	6520	6230			0.978	0.934	1.690		0.915	0.762	8.163		9.840	
43	Kochugaon-Guwahati	AS01JC6073	Bihar	Guwahati	MAV	1.2.22	Gas	No	2930	4520	6990	6570			0.884	1.109	1.798		0.612	1.510	10.444		12.566	
45	Kochugaon-Guwahati	AS01JC4529	Kolkata	Guwahati	MAV	1.2.22	Gas	No	2665	5240	7620	7430			0.804	1.285	1.995		0.419	2.727	15.848		18.994	
47	Kochugaon-Guwahati	UP30FT5368	Nagpur	Guwahati	MAV	1.2.22	Onion	No	3390	4420	6370	5870			1.023	1.084	1.623		1.096	1.381	6.933		9.410	
71	Kochugaon-Guwahati	AS26C5195	Kolkata	Guwahati	MAV	1.2.22	Gas	No	3240	3860	5670	5310			0.978	0.947	1.456		0.915	0.803	4.490		6.208	
73	Kochugaon-Guwahati	PB65AD7033	Kolkata	Guwahati	MAV	1.2.22	Parcel	No	3240	4520	4230	3820			0.978	1.109	1.067		0.915	1.510	1.297		3.722	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
74	Kochugaon-Guwahati	BP13AW9605	Delhi	Guwahati	MAV	1.2.22	Parcel	No	3280	4060	5680	5230			0.990	0.996	1.446		0.961	0.983	4.376		6.320	
75	Kochugaon-Guwahati	NL01AE9922	Kolkata	Nagaland	MAV	1.2.22	Parcel	No	3540	4440	4260	3890			1.069	1.089	1.080		1.304	1.406	1.363		4.072	
80	Kochugaon-Guwahati	RJ18CG1875	Gujarat	Guwahati	MAV	1.2.22	Tiles	No	2250	4460	5840	5370			0.679	1.094	1.486		0.213	1.431	4.878		6.522	
82	Kochugaon-Guwahati	KA51AG5336	Delhi	Guwahati	MAV	1.2.22	Parcel	No	3240	4530	4220	3920			0.978	1.111	1.079		0.915	1.523	1.356		3.794	**13.841**
89	Kochugaon-Guwahati	AS04BC6605	Kolkata	Guwahati	MAV	1.2.22	Gas	No	3190	3870	5640	5320			0.963	0.949	1.453		0.860	0.811	4.457		6.128	
90	Kochugaon-Guwahati	AS01NC0207	Kolkata	Guwahati	MAV	1.2.22	Gas	No	3210	3920	5820	5470			0.969	0.961	1.497		0.881	0.854	5.019		6.754	
121	Kochugaon-Guwahati	AS01D9889	Kolkata	Guwahati	MAV	1.2.22	Fuel	No	3530	3125	6730	6520			1.065	0.766	1.757		1.289	0.345	9.521		11.155	
134	Kochugaon-Guwahati	AS25EC8641	Kolkata	Guwahati	MAV	1.2.22	Fuel	No	2940	5845	7145	6785			0.887	1.433	1.847		0.620	4.222	11.631		16.474	
136	Kochugaon-Guwahati	RJ09GB1434	Delhi	Guwahati	MAV	1.2.22	Machinery	No	3845	5430	7530	7325			1.161	1.332	1.969		1.814	3.145	15.042		20.002	
161	Kochugaon-Guwahati	HR55N8730	Chandigarh	Guwahati	MAV	1.2.22	Chemical	No	3140	3450	7530	7145			0.948	0.846	1.946		0.807	0.513	14.326		15.646	
184	Kochugaon-Guwahati	AS01NC0414	Haldia	Guwahati	MAV	1.2.22	Fuel	No	3015	5875	6915	6425			0.910	1.441	1.769		0.686	4.310	9.782		14.778	
194	Kochugaon-Guwahati	AS23CC6478	Haldia	Tinsukia	MAV	1.2.22	Oil	No	2970	5695	6685	6125			0.896	1.397	1.698		0.646	3.805	8.318		12.769	
195	Kochugaon-Guwahati	AS23CC6498	Haldia	Tinsukia	MAV	1.2.22	Oil	No	2835	5785	6595	6220			0.856	1.419	1.699		0.536	4.052	8.331		12.919	
212	Kochugaon-Guwahati	NL01AB1565	Deccan	Goalpara	MAV	1.2.22	Wires	No	2560	6720	5430	4265			0.773	1.648	1.285		0.357	7.377	2.729		10.463	
268	Kochugaon-Guwahati	CG04JD0383	Bilai	Guwahati	MAV	1.2.22	Iron	No	3870	6870	7250	6870			1.168	1.685	1.872		1.862	8.058	12.279		22.199	
269	Kochugaon-Guwahati	NL01AD2527	Jamshedpur	Nagaon	MAV	1.2.22	Steel	No	3710	6450	7150	6980			1.120	1.582	1.873		1.573	6.261	12.314		20.148	
270	Kochugaon-Guwahati	CG04JL7972	Jamshedpur	Nagaon	MAV	1.2.22	Steel	No	3840	6310	6900	6740			1.159	1.548	1.808		1.805	5.735	10.693		18.232	
316	Kochugaon-Guwahati	NL01G1166	Nagpur	Shillong	MAV	1.2.22	Fruits	No	3470	5675	5490	5175			1.047	1.392	1.414		1.203	3.752	3.996		8.952	
349	Kochugaon-Guwahati	AS04AC8991	Haldharpur	Dimapur	MAV	1.2.22	Gas	No	2925	7520	7285	6725			0.883	1.844	1.857		0.608	11.569	11.901		24.077	
364	Kochugaon-Guwahati	KA51AG9610	Delhi	Guwahati	MAV	1.2.22	Cars	No	3940	6730	6970	6545			1.189	1.651	1.792		2.000	7.421	10.306		19.728	
365	Kochugaon-Guwahati	NL01AS2327	Kolkata	Guwahati	MAV	1.2.22	Cars	No	3815	6845	6915	6620			1.152	1.679	1.794		1.758	7.942	10.367		20.067	
366	Kochugaon-Guwahati	AS25EC8608	Kolkata	Nagaland	MAV	1.2.22	Fuel	No	2935	4415	6875	6215			0.886	1.083	1.735		0.616	1.375	9.069		11.060	
368	Kochugaon-Guwahati	AS27C7541	Kolkata	Guwahati	MAV	1.2.22	Fuel	No	2875	4375	6735	3675			0.868	1.073	1.380		0.567	1.325	3.628		5.520	
370	Kochugaon-Guwahati	AS04BC1495	Kolkata	Guwahati	MAV	1.2.22	Fuel	No	3130	6915	7435	7210			0.945	1.696	1.942		0.797	8.272	14.210		23.278	
375	Kochugaon-Guwahati	NL01G7577	Uttar Pradesh	Guwahati	MAV	1.2.22	Tower Frame	No	2975	3565	5670	5425			0.898	0.874	1.471		0.650	0.584	4.681		5.915	
380	Kochugaon-Guwahati	WB39C1094	Alipurduar	Guwahati	MAV	1.2.22	Empty	No	2730	2250	1970	1710			0.824	0.552	0.488		0.461	0.093	0.057		0.610	
382	Kochugaon-Guwahati	AS01JC6022	Kolkata	Guwahati	MAV	1.2.22	Fuel	No	2875	4685	7430	7150			0.868	1.149	1.933		0.567	1.743	13.959		16.269	
7	Kochugaon-Guwahati	NL01Q1206	Kolkata	Tezpur	MAV	1.1.122	Fuel	No	3275	4455	2480	5985	5450		0.989	1.345		1.218796531	0.955	3.270		2.206606222	6.431	
18	Kochugaon-Guwahati	BR11GC5925	Bihar	Nagaland	MAV	1.1.122	Vegetables	No	3240	4460	4020	5820	5410		0.978	1.346		1.335727424	0.915	3.284		3.183254565	7.382	
104	Kochugaon-Guwahati	WB29B2928	Kolkata	Guwahati	MAV	1.1.122	Dal	No	2945	2850	5935	6535	6130		0.889	0.860		1.629149514	0.624	0.548		7.044396176	8.216	
116	Kochugaon-Guwahati	NL01AS0956	Kolkata	Guwahati	MAV	1.1.122	Fuel	No	3530	3410	4565	6875	6640		1.065	1.029		1.583603398	1.289	1.122		6.289059453	8.700	
130	Kochugaon-Guwahati	WB11S3375	Tharad	Guwahati	MAV	1.1.122	Vegetables	No	2505	2770	3105	8545	8320		0.756	0.836		1.74914601	0.327	0.489		9.360612243	10.176	
131	Kochugaon-Guwahati	BR21GD7540	Bihar	Guwahati	MAV	1.1.122	Dal	No	3850	4325	3245	8235	7630		1.162	1.305		1.673819742	1.824	2.904		7.849368967	12.578	
132	Kochugaon-Guwahati	BR21GD2186	Bihar	Guwahati	MAV	1.1.122	Dal	No	3625	4580	5235	7225	6825		1.094	1.382		1.689147762	1.433	3.652		8.140865294	13.227	
145	Kochugaon-Guwahati	BR06GD0886	Nagpur	Guwahati	MAV	1.1.122	Powder	No	4410	4136	4850	5765	5630		1.331	1.248		1.422878164	3.140	2.429		4.098933368	9.668	
149	Kochugaon-Guwahati	UP25CT7372	Agra	Guwahati	MAV	1.1.122	Vegetables	No	3775	3430	4635	7570	7430		1.139	1.035		1.719803801	1.686	1.149		8.748137857	11.583	
159	Kochugaon-Guwahati	WB59G8290	Kolkata	Guwahati	MAV	1.1.122	Fuel	No	3560	3230	5235	7015	6850		1.075	0.975		1.672943856	1.333	0.903		7.832951992	10.070	
164	Kochugaon-Guwahati	NL01A8476	Kolkata	Guwahati	MAV	1.1.122	Rice	No	3760	4415	5645	8270	7570		1.135	1.333		1.881842866	1.659	3.154		12.54103639	17.354	
168	Kochugaon-Guwahati	AP16TJ6983	Karnataka	Guwahati	MAV	1.1.122	Army Milk	No	3845	3540	5965	8430	7940		1.161	1.069		1.956293247	1.814	1.304		14.64656634	17.764	
177	Kochugaon-Guwahati	JH16BL0520	Jharkhand	Arunachal Pradesh	MAV	1.1.122	Powder	No	3820	4715	5330	7405	7140		1.153	1.423		1.740825085	1.768	4.102		9.183760409	15.054	
178	Kochugaon-Guwahati	WB19H7905	Kolkata	Guwahati	MAV	1.1.122	Oil	No	3955	4335	2460	8335	7945		1.194	1.308		1.64141193	2.031	2.931		7.258892119	12.221	
209	Kochugaon-Guwahati	UP30AT4914	Lucknow	Guwahati	MAV	1.1.122	Vegetables	No	4705	4515	5630	8450	7840		1.420	1.363		1.919943943	4.068	3.449		13.58795798	21.105	
218	Kochugaon-Guwahati	MP20HB6019	Pune	Assam	MAV	1.1.122	Vegetables	No	3960	4550	5235	7530	7140		1.195	1.373		1.743452746	2.041	3.558		9.2393352	14.838	
228	Kochugaon-Guwahati	RJ16GE3287	Agra	Assam	MAV	1.1.122	Vegetables	No	4535	4140	6535	6840	6535		1.369	1.250		1.743890689	3.511	2.438		9.24862213	15.198	
229	Kochugaon-Guwahati	RJ19CG3287	Agra	Guwahati	MAV	1.1.122	Vegetables	No	4235	4815	5245	7560	7235		1.278	1.453		1.755277218	2.670	4.462		9.49254937	16.624	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
230	Kochugaon-Guwahati	WB37S3122	Kolkata	Guwahati	MAV	1.1.122	Wires	No	3450	3140	5635	6540	6250		1.041	0.948		1.613821494	1.176	0.807		6.783002575	8.766	
232	Kochugaon-Guwahati	WB57B7549	Kharagpur	Nagaland	MAV	1.1.122	Vegetables	No	4650	4010	6950	6705	6050		1.404	1.210		1.725935009	3.881	2.146		8.873557188	14.901	
236	Kochugaon-Guwahati	WB57A9565	Kolkata	Guwahati	MAV	1.1.122	Vegetables	No	3410	3990	4125	6940	6610		1.029	1.204		1.548129982	1.122	2.104		5.744201759	8.970	
260	Kochugaon-Guwahati	PB06BC9899	Punjab	Guwahati	MAV	1.1.122	Rice	No	4530	4325	5960	8630	8245		1.367	1.305		2.000087589	3.495	2.904		16.00280302	22.403	
276	Kochugaon-Guwahati	BR02GB2332	Patna	Guwahati	MAV	1.1.122	Sprouts	No	3540	3280	4325	5675	5430		1.069	0.990		1.351493387	1.304	0.961		3.336227824	5.601	
287	Kochugaon-Guwahati	UP25ET4728	Gorakhpur	Guwahati	MAV	1.1.122	Wheat	No	3930	4325	3825	6915	6720		1.186	1.305		1.529298415	1.980	2.904		5.469768593	10.354	
309	Kochugaon-Guwahati	HR31AB7242	Bihar	Guwahati	MAV	1.1.122	Rice	No	3710	5350	6515	7430	7165		1.120	1.615		1.84899711	1.573	6.800		11.68812719	20.061	
310	Kochugaon-Guwahati	WB90J1540	Kolkata	Guwahati	MAV	1.1.122	Coconut Oil	No	3240	4645	5235	5650	5445		0.978	1.402		1.430323202	0.915	3.864		4.185397733	8.964	
326	Kochugaon-Guwahati	NL01AE3886	Delhi	Guwahati	MAV	1.1.122	Machinery	No	3865	4250	3965	7960	7785		1.167	1.283		1.726372953	1.852	2.708		8.882567018	13.443	
327	Kochugaon-Guwahati	NL01A4036	Nagpur	Guwahati	MAV	1.1.122	Machinery	No	4840	4530	4890	7635	7295		1.461	1.367		1.736007708	4.555	3.495		9.082524884	17.133	
329	Kochugaon-Guwahati	WB37D3186	Kolkata	Guwahati	MAV	1.1.122	Vegetables	No	4865	4620	5235	7620	7435		1.468	1.395		1.777174389	4.650	3.782		9.9751672	18.407	
330	Kochugaon-Guwahati	CG10AU4803	Raipur	Bongaigaon	MAV	1.1.122	Rice	No	3930	4715	5980	8215	7820		1.186	1.423		1.928264868	1.980	4.102		13.82505141	19.908	
343	Kochugaon-Guwahati	RJ01AC1541	Kolkata	Guwahati	MAV	1.1.122	Marble	No	4715	4535	5120	7435	7215		1.423	1.369		1.731628274	4.102	3.511		8.99122101	16.605	
376	Kochugaon-Guwahati	BR01GC9587	Bihar	Guwahati	MAV	1.1.122	Steel Pipes	No	3730	3525	5745	6930	6715		1.126	1.064		1.698344574	1.607	1.282		8.319615054	11.208	
19	Kochugaon-Guwahati	NL01AA9285	Nagpur	Bongaigaon	MAV	1.1.222	Vegetables	No	3610	4220	5840	5290	4885		1.090	1.274		1.402732767	1.410	2.632		3.871682788	7.914	
24	Kochugaon-Guwahati	HR37D8132	Bihar	Nagaland	MAV	1.1.222	Vegetables	No	3440	4420	5840	6220	5920		1.038	1.334		1.57484453	1.162	3.168		6.151071076	10.482	
100	Kochugaon-Guwahati	UP32GN8466	Agra	Guwahati	MAV	1.1.222	Vegetables	No	3135	4560	4985	6170	5945		0.946	1.376		1.497766489	0.802	3.589		5.032414875	9.423	
101	Kochugaon-Guwahati	NL01AD0511	Delhi	Kohima	MAV	1.1.222	Machinery	No	2635	2895	3950	5430	5165		0.795	0.874		1.273977402	0.400	0.583		2.634188795	3.617	
173	Kochugaon-Guwahati	JH10CL0817	West Bengal	Bhutan	MAV	1.1.222	Steel	No	3730	3445	6185	7015	6895		1.126	1.040		1.760094596	1.607	1.169		9.597188786	12.373	
180	Kochugaon-Guwahati	WB57E6502	Kolkata	Guwahati	MAV	1.1.222	Plastic	No	3945	3765	5435	8240	7825		1.191	1.136		1.883156696	2.010	1.668		12.57609575	16.255	
185	Kochugaon-Guwahati	WB53C5839	Haldia	Guwahati	MAV	1.1.222	Iron Rods	No	2965	3240	3790	8260	7740		0.895	0.978		1.733380047	0.642	0.915		9.027659549	10.584	
187	Kochugaon-Guwahati	JH16BX6969	West Bengal	Guwahati	MAV	1.1.222	Iron	No	3455	4175	3535	9550	7920		1.043	1.260		1.839800298	1.183	2.522		11.45731199	15.162	
192	Kochugaon-Guwahati	WB39C1696	West Bengal	Silchar	MAV	1.1.222	Iron	No	3530	4350	5140	7585	7280		1.065	1.313		1.752211614	1.289	2.972		9.426407683	13.687	
378	Kochugaon-Guwahati	WB61B6339	Kolkata	Guwahati	MAV	1.1.222	Fish	No	3345	3920	4125	5670	5430		1.010	1.183		1.333537707	1.039	1.960		3.162432037	6.162	
324	Kochugaon-Guwahati	NL01AE5896	Kolkata	Guwahati	MAV	1.2.122	Steel	No	3710	5750	4840	7210	6950		1.120	1.410		1.664184987	1.573	3.955		7.670194901	13.197	
15	Kochugaon-Guwahati	NL02L2215	Siliguri	Bongaigaon	MAV	1.2.222	Aggregate	No	3240	5130	4640	6370	5890		0.978	1.258		1.480248752	0.915	2.505		4.80107858	8.221	
37	Kochugaon-Guwahati	PB03U4366	Kolkata	Guwahati	MAV	1.2.222	Steel	No	3340	5420	5110	6870	6250		1.008	1.329		1.596741701	1.033	3.122		6.500378877	10.655	
50	Kochugaon-Guwahati	UP20T9147	Siliguri	Tezpur	MAV	1.2.222	Fertilizer	No	3350	4340	4960	6350	6020		1.011	1.064		1.517911886	1.045	1.283		5.308676323	7.638	
67	Kochugaon-Guwahati	GJ12RT8341	Kolkata	Guwahati	MAV	1.2.222	Oil	No	3620	5460	5260	7620	7240		1.093	1.339		1.762284313	1.425	3.215		9.645037073	14.286	
114	Kochugaon-Guwahati	UP15CD5748	Lucknow	Nagaon	MAV	1.2.222	Wheat	No	3840	4250	4380	7750	7475		1.159	1.042		1.717176141	1.805	1.180		8.694795708	11.680	
129	Kochugaon-Guwahati	UP25ET1659	Odisha	Assam	MAV	1.2.222	Tiles	No	3835	5760	6325	7015	6350		1.158	1.413		1.724621179	1.795	3.982		8.846568819	14.624	
167	Kochugaon-Guwahati	NL01AC8367	Kolkata	Guwahati	MAV	1.2.222	Jawar	No	4125	5345	6850	6475	5430		1.245	1.311		1.64272576	2.403	2.953		7.282160887	12.638	
172	Kochugaon-Guwahati	PB29X2817	Kolkata	Arunachal Pradesh	MAV	1.2.222	Steel	No	3150	4425	5850	8675	8430		0.951	1.085		2.010598231	0.817	1.387		16.34184866	18.546	
248	Kochugaon-Guwahati	RJ18GB8202	Kolkata	Guwahati	MAV	1.2.222	Metal	No	4075	5635	7195	9170	8630		1.230	1.382		2.189279145	2.289	3.648		22.97230428	28.909	
264	Kochugaon-Guwahati	HR38AC5783	Bilai	Guwahati	MAV	1.2.222	Pedigree	No	3120	4265	5665	6325	5825		0.942	1.046		1.560392397	0.787	1.197		5.928370022	7.912	
275	Kochugaon-Guwahati	BR03GA8322	Gujarat	Guwahati	MAV	1.2.222	Wood	No	3640	3120	4985	6530	6340		1.099	0.765		1.563895945	1.457	0.343		5.981793464	7.782	
280	Kochugaon-Guwahati	MH46BM9297	Serfanguri	Guwahati	MAV	1.2.222	Wires	No	3630	4340	6525	7320	6940		1.096	1.064		1.820530787	1.441	1.283		10.98479891	13.710	
318	Kochugaon-Guwahati	NL01K0664	Kolkata	Guwahati	MAV	1.2.222	Steel	No	3770	6450	4330	7310	6940		1.138	1.582		1.62739774	1.677	6.261		7.014146531	14.952	
319	Kochugaon-Guwahati	NL01N9191	Kolkata	Guwahati	MAV	1.2.222	Steel	No	3810	6540	4510	7250	7010		1.150	1.604		1.64403959	1.749	6.618		7.305485553	15.673	
369	Kochugaon-Guwahati	NL01AD2836	Jharkhand	Guwahati	MAV	1.2.222	Steel	No	3415	5835	6235	7540	7435		1.031	1.431		1.857755978	1.129	4.194		11.91117677	17.234	
291	Kochugaon-Guwahati	RJ51GA1063	Makrana	Guwahati	MAV	1.22.122	Marble	No	4315	7345	7490	4650	8615	8425	1.302		1.967	1.900	2.878		14.961	13.027	30.866	
12	Kochugaon-Guwahati	NL01AE9346	Kolkata	Tinsukia	MAV	1.22.222	Fuel	No	3525	4125	5320	5620	6540	6220	1.064		1.252	1.610	1.282		2.458	6.717	10.457	
111	Kochugaon-Guwahati	RJ02GB5736	Rajasthan	Guwahati	MAV	1.22.222	Marble	No	3125	4730	4675	8254	8830	8540	0.943		1.247	2.244	0.792		2.417	25.373	28.582	
182	Kochugaon-Guwahati	JH05CQ2295	Jharkhand	Guwahati	MAV	1.22.222	Hardware	No	3475	7925	7565	7235	9465	8945	1.049		2.054	2.246	1.210		17.784	25.457	44.451	
188	Kochugaon-Guwahati	RJ05GB6445	West Bengal	Guwahati	MAV	1.22.222	Iron	No	3340	7105	7535	5035	8640	8250	1.008		1.941	1.920	1.033		14.190	13.600	28.824	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)							ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle		Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
225	Kochugaon-Guwahati	HR35AD6538	Haryana	Guwahati	MAV	1.22.222	Pipes	No	2930	5460	5270	2340	6850	6415		0.884		1.423	1.367	0.612		4.095	3.490	8.197	
226	Kochugaon-Guwahati	RJ16AK4339	Jharkhand	Guwahati	MAV	1.22.222	Steel	No	4215	7145	7415	5075	8415	7960		1.272		1.930	1.879	2.620		13.883	12.460	28.962	
246	Kochugaon-Guwahati	CG07AZ9398	Kolkata	Guwahati	MAV	1.22.222	JCB	No	3275	4960	4790	5670	5725	`		0.989		1.293	1.461	0.955		2.792	4.550	8.297	
281	Kochugaon-Guwahati	RJ02GB9786	Markapur	Guwahati	MAV	1.22.222	Marble	No	3400	8615	6650	6985	8960	6420		1.026		2.024	1.959	1.109		16.773	14.725	32.608	
299	Kochugaon-Guwahati	PB08EA5092	Gujarat	Guwahati	MAV	1.22.222	Tiles	No	4800	8680	8420	3450	8695	8390		1.449		2.267	1.799	4.406		26.412	10.466	41.285	
335	Kochugaon-Guwahati	BP2A8890	Phuentsholing	Guwahati	MAV	1.22.222	Empty	No	2430	1840	1745	1975	1730	1535		0.733		0.475	0.459	0.289		0.051	0.044	0.385	

AXLE LOAD SURVEY DATA & VDF ANALYSIS

Road Name:	**NH-27 Package-2_Dahalapara Toll Plaza_Km.971+200**	**Location:**	**971+200**
Direction:	**Both The Directions**	**Date:**	**25 November 2022**

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
8	Guwahati-Kochugaon	AS13C2657	Guwahati	Bongaigaon	Bus	1.2	Passengers	Yes	2195	3785					0.663	0.928			0.193	0.742			0.935	
13	Guwahati-Kochugaon	AS17B8509	Guwahati	Nagpur	Bus	1.2	Passengers	Yes	2350	3650					0.709	0.895			0.253	0.642			0.895	
30	Guwahati-Kochugaon	AS15C8229	Guwahati	Bongaigaon	Bus	1.2	Passengers	Yes	2195	3960					0.663	0.971			0.193	0.890			1.082	
38	Guwahati-Kochugaon	AS12F9737	Tinsukia	Bongaigaon	Bus	1.2	Passengers	Yes	2210	3545					0.667	0.869			0.198	0.571			0.769	
41	Guwahati-Kochugaon	AS15C5777	Nagaon	Gossaigaon	Bus	1.2	Passengers	Yes	2125	3645					0.641	0.894			0.169	0.639			0.808	
57	Guwahati-Kochugaon	AS01MC9823	Guwahati	Dhupguri	Bus	1.2	Passengers	Yes	2210	3745					0.667	0.918			0.198	0.712			0.910	
77	Guwahati-Kochugaon	AS28C5284	Guwahati	Dhupguri	Bus	1.2	Passengers	Yes	2315	3585					0.699	0.879			0.238	0.598			0.836	
103	Guwahati-Kochugaon	AS01GC4719	Guwahati	Dhupguri	Bus	1.2	Passengers	Yes	2345	3545					0.708	0.869			0.251	0.571			0.822	**0.911**
105	Guwahati-Kochugaon	AS01MC8167	Borbila	Kolkata	Bus	1.2	Passengers	Yes	2245	3250					0.678	0.797			0.211	0.404			0.614	
156	Guwahati-Kochugaon	AS19AC3687	Guwahati	Bongaigaon	Bus	1.2	Passengers	Yes	2215	3620					0.669	0.888			0.200	0.621			0.821	
208	Guwahati-Kochugaon	AS17C0787	Guwahati	Duggri	Bus	1.2	Passengers	Yes	2310	3810					0.697	0.934			0.236	0.762			0.999	
241	Guwahati-Kochugaon	AS19AC3477	Nagaon	Siliguri	Bus	1.2	Passengers	Yes	2415	3965					0.729	0.972			0.282	0.894			1.176	
309	Guwahati-Kochugaon	AS01GC5511	Guwahati	Dhupguri	Bus	1.2	Passengers	Yes	2560	3920					0.773	0.961			0.357	0.854			1.211	
326	Guwahati-Kochugaon	AS15C8321	Udalguri	Bongaigaon	Bus	1.2	Passengers	Yes	2345	3645					0.708	0.894			0.251	0.639			0.890	
369	Guwahati-Kochugaon	BP02A0084	Guwahati	Bongaigaon	Bus	1.2	Passengers	Yes	2215	3725					0.669	0.914			0.200	0.697			0.896	
3	Guwahati-Kochugaon	AS01JC5771	Guwahati	Bongaigaon	LCV	1.2	Parcel	No	2680	4985					0.809	1.223			0.428	2.234			2.662	
7	Guwahati-Kochugaon	AS01BC6878	Guwahati	Bongaigaon	LCV	1.2	Empty	No	2210	1855					0.667	0.455			0.198	0.043			0.241	
10	Guwahati-Kochugaon	AS19C2875	Guwahati	Bongaigaon	LCV	1.2	Cement	No	2645	4965					0.798	1.218			0.406	2.198			2.605	
16	Guwahati-Kochugaon	AS01MC9277	Guwahati	Bongaigaon	LCV	1.2	Parcel	Yes	1575	2875					0.475	0.705			0.051	0.247			0.298	
17	Guwahati-Kochugaon	AS01HC2919	Guwahati	Bongaigaon	LCV	1.2	Parcel	No	1985	2765					0.599	0.678			0.129	0.211			0.340	
19	Guwahati-Kochugaon	AS17C2938	Guwahati	Siliguri	LCV	1.2	Empty	No	1985	1765					0.599	0.433			0.129	0.035			0.164	
28	Guwahati-Kochugaon	UP27AT4851	Guwahati	Bongaigaon	LCV	1.2	Transport Material	Yes	1965	2875					0.593	0.705			0.124	0.247			0.371	
32	Guwahati-Kochugaon	AS26C4702	Shillong	Bongaigaon	LCV	1.2	Parcel	No	1945	2075					0.587	0.509			0.119	0.067			0.186	
42	Guwahati-Kochugaon	BP02AD0048	Nagaon	Gossaigaon	LCV	1.2	Furniture	No	1965	3855					0.593	0.945			0.124	0.799			0.923	
43	Guwahati-Kochugaon	BP02A4797	Nagaon	Gossaigaon	LCV	1.2	Furniture	No	2105	3705					0.635	0.909			0.163	0.682			0.845	
45	Guwahati-Kochugaon	AS17C5080	Guwahati	Siliguri	LCV	1.2	Empty	Yes	2210	1875					0.667	0.460			0.198	0.045			0.243	
58	Guwahati-Kochugaon	AS01CC4087	Guwahati	Gossaigaon	LCV	1.2	Parcel	Yes	2105	4206					0.635	1.032			0.163	1.132			1.295	
60	Guwahati-Kochugaon	MH15GV0723	Guwahati	Kanpur	LCV	1.2	Pipes	No	2120	4620					0.640	1.133			0.168	1.648			1.816	
65	Guwahati-Kochugaon	WB19K2521	Guwahati	Siliguri	LCV	1.2	Parcel	Yes	2420	3960					0.730	0.971			0.285	0.890			1.174	
72	Guwahati-Kochugaon	AS19AC1393	Guwahati	Siliguri	LCV	1.2	Empty	No	1640	1230					0.495	0.302			0.060	0.008			0.068	
75	Guwahati-Kochugaon	AS28C9790	Guwahati	Dhupguri	LCV	1.2	Empty	No	1960	1545					0.592	0.379			0.123	0.021			0.143	
78	Guwahati-Kochugaon	BP01A2988	Bhutan	Bongaigaon	LCV	1.2	Empty	Yes	2105	1765					0.635	0.433			0.163	0.035			0.198	
84	Guwahati-Kochugaon	WB72B0080	Guwahati	Bongaigaon	LCV	1.2	Empty	No	2210	1960					0.667	0.481			0.198	0.053			0.251	
91	Guwahati-Kochugaon	WB39C0556	Guwahati	Bhaktiarpur	LCV	1.2	Empty	Yes	2210	1960					0.667	0.481			0.198	0.053			0.251	
93	Guwahati-Kochugaon	BP03A0091	Guwahati	Bongaigaon	LCV	1.2	Empty	Yes	2105	1950					0.635	0.478			0.163	0.052			0.215	
96	Guwahati-Kochugaon	AS01LC4598	Pathsala	Dhupguri	LCV	1.2	Empty	No	2210	1855					0.667	0.455			0.198	0.043			0.241	
108	Guwahati-Kochugaon	AS26C9859	Guwahati	Bongaigaon	LCV	1.2	Empty	Yes	2215	1965					0.669	0.482			0.200	0.054			0.254	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
111	Guwahati-Kochugaon	AS18AC3621	Guwahati	Kolkata	LCV	1.2	Rice	Yes	2410	3965					0.727	0.972			0.280	0.894			1.174	
120	Guwahati-Kochugaon	MP939040	Itanagar	Kolkata	LCV	1.2	Empty	Yes	2120	1740					0.640	0.427			0.168	0.033			0.201	
138	Guwahati-Kochugaon	AS27C6879	Tezpur	Bihar	LCV	1.2	Parcel	Yes	2415	3960					0.729	0.971			0.282	0.890			1.172	
139	Guwahati-Kochugaon	TS09UC4017	Guwahati	Hyderabad	LCV	1.2	Empty	No	2315	1960					0.699	0.481			0.238	0.053			0.292	
155	Guwahati-Kochugaon	AS25FC0901	Itanagar	Kolkata	LCV	1.2	Parcel	No	2210	3920					0.667	0.961			0.198	0.854			1.052	
167	Guwahati-Kochugaon	PB10GX6205	Guwahati	Kolkata	LCV	1.2	Empty	No	2210	1870					0.667	0.459			0.198	0.044			0.242	
172	Guwahati-Kochugaon	AS28AC0320	Tezpur	Gossaigaon	LCV	1.2	Empty	Yes	2105	1875					0.635	0.460			0.163	0.045			0.208	
173	Guwahati-Kochugaon	WB25L3732	Tezpur	Gossaigaon	LCV	1.2	Parcel	Yes	2345	3985					0.708	0.977			0.251	0.912			1.163	
181	Guwahati-Kochugaon	AS17C1791	Itanagar	Siliguri	LCV	1.2	Empty	No	2315	1960					0.699	0.481			0.238	0.053			0.292	
183	Guwahati-Kochugaon	WB25K7531	Assam	Kolkata	LCV	1.2	Tins	Yes	2510	4820					0.758	1.182			0.329	1.953			2.282	
188	Guwahati-Kochugaon	PB03BF1300	Itanagar	Bihar	LCV	1.2	Parcel	Yes	2340	4960					0.706	1.216			0.249	2.190			2.438	
190	Guwahati-Kochugaon	UP65KT6875	Guwahati	Lucknow	LCV	1.2	Empty	Yes	2310	1980					0.697	0.486			0.236	0.056			0.292	
195	Guwahati-Kochugaon	WB23E4899	Guwahati	Kolkata	LCV	1.2	Empty	No	2210	1875					0.667	0.460			0.198	0.045			0.243	
198	Guwahati-Kochugaon	HR45D1277	Guwahati	Siliguri	LCV	1.2	Empty	Yes	1640	1430					0.495	0.351			0.060	0.015			0.075	
200	Guwahati-Kochugaon	AS17B6348	Guwahati	Patna	LCV	1.2	Parcel	No	2430	4820					0.733	1.182			0.289	1.953			2.242	**0.813**
202	Guwahati-Kochugaon	UP63BT0615	Guwahati	Siliguri	LCV	1.2	Parcel	No	2430	4840					0.733	1.187			0.289	1.985			2.275	
204	Guwahati-Kochugaon	HR38AA9332	Guwahati	Siliguri	LCV	1.2	Empty	Yes	1625	1440					0.490	0.353			0.058	0.016			0.073	
207	Guwahati-Kochugaon	AS19C2259	Borbila	Bongaigaon	LCV	1.2	Empty	Yes	1590	1340					0.480	0.329			0.053	0.012			0.065	
212	Guwahati-Kochugaon	AS26C9541	Nalbari	Bongaigaon	LCV	1.2	Empty	Yes	2105	1855					0.635	0.455			0.163	0.043			0.206	
213	Guwahati-Kochugaon	HR47F0988	Guwahati	Delhi	LCV	1.2	Parcel	Yes	2245	3895					0.678	0.955			0.211	0.833			1.043	
216	Guwahati-Kochugaon	TN12AV3834	Guwahati	Bongaigaon	LCV	1.2	Empty	Yes	2215	1740					0.669	0.427			0.200	0.033			0.233	
217	Guwahati-Kochugaon	AS19AC4562	Guwahati	Siliguri	LCV	1.2	GAS	Yes	2125	4995					0.641	1.225			0.169	2.252			2.421	
222	Guwahati-Kochugaon	MH04GR9306	Guwahati	Siliguri	LCV	1.2	Parcel	No	2235	5225					0.675	1.281			0.207	2.696			2.903	
223	Guwahati-Kochugaon	UP25BT8494	Tezpur	Siliguri	LCV	1.2	Empty	Yes	2125	1875					0.641	0.460			0.169	0.045			0.214	
232	Guwahati-Kochugaon	AS26C8881	Guwahati	Bongaigaon	LCV	1.2	Empty	No	2120	1845					0.640	0.452			0.168	0.042			0.210	
234	Guwahati-Kochugaon	AS28AC0577	Borbila	Siliguri	LCV	1.2	Vegetables	Yes	2245	3965					0.678	0.972			0.211	0.894			1.105	
235	Guwahati-Kochugaon	MH04KF2452	Borbila	Bongaigaon	LCV	1.2	Empty	Yes	2340	1960					0.706	0.481			0.249	0.053			0.302	
239	Guwahati-Kochugaon	UP14FT1517	Guwahati	Bihar	LCV	1.2	Empty	Yes	2455	1990					0.741	0.488			0.302	0.057			0.358	
240	Guwahati-Kochugaon	AS28AC0254	Guwahati	Kolkata	LCV	1.2	Empty	No	1280	980					0.386	0.240			0.022	0.003			0.026	
242	Guwahati-Kochugaon	AS28AC0124	Guwahati	Siliguri	LCV	1.2	Empty	Yes	2215	1965					0.669	0.482			0.200	0.054			0.254	
244	Guwahati-Kochugaon	HR38Z7020	Jorhat	Haryana	LCV	1.2	Empty	Yes	1245	950					0.376	0.233			0.020	0.003			0.023	
252	Guwahati-Kochugaon	AS01JC5833	Borbila	Srirampur	LCV	1.2	Parcel	No	2456	3945					0.741	0.968			0.302	0.876			1.178	
257	Guwahati-Kochugaon	MP13GA1551	Shillong	Pune	LCV	1.2	Tea leaves	Yes	2415	4965					0.729	1.218			0.282	2.198			2.481	
263	Guwahati-Kochugaon	WB14F0480	Borbila	Kolkata	LCV	1.2	Threads	Yes	2415	4120					0.729	1.010			0.282	1.042			1.325	
270	Guwahati-Kochugaon	HP122119	Guwahati	Kolkata	LCV	1.2	Empty	No	2345	1965					0.708	0.482			0.251	0.054			0.305	
276	Guwahati-Kochugaon	AS25EC8332	Guwahati	Siliguri	LCV	1.2	Empty	Yes	1460	1230					0.441	0.302			0.038	0.008			0.046	
278	Guwahati-Kochugaon	AS25FC3763	Guwahati	Bongaigaon	LCV	1.2	GAS	No	2535	4975					0.765	1.220			0.343	2.216			2.559	
281	Guwahati-Kochugaon	GJ27TD1853	Guwahati	Maharashtra	LCV	1.2	Bags	Yes	2435	4950					0.735	1.214			0.292	2.172			2.464	
287	Guwahati-Kochugaon	AS01EC9892	Guwahati	Bongaigaon	LCV	1.2	Parcel	Yes	2415	4210					0.729	1.032			0.282	1.136			1.419	
288	Guwahati-Kochugaon	AS01LC9301	Guwahati	Gossaigaon	LCV	1.2	Empty	Yes	1870	1450					0.564	0.356			0.102	0.016			0.117	
296	Guwahati-Kochugaon	UP15ET3053	Tezpur	Varanasi	LCV	1.2	Parcel	Yes	2210	3425					0.667	0.840			0.198	0.498			0.696	
300	Guwahati-Kochugaon	AS23AC3505	Guwahati	Siliguri	LCV	1.2	Empty	No	2350	1960					0.709	0.481			0.253	0.053			0.307	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
308	Guwahati-Kochugaon	HR58C4827	Tezpur	Gossaigaon	LCV	1.2	Empty	Yes	2450	1960					0.740	0.481			0.299	0.053			0.352	
318	Guwahati-Kochugaon	NL01AF0807	Nagaland	Jharkhand	LCV	1.2	Logistics	No	2345	3925					0.708	0.963			0.251	0.859			1.110	
321	Guwahati-Kochugaon	MH04LE0847	Guwahati	Nagpur	LCV	1.2	Tea leaves	Yes	2345	4565					0.708	1.120			0.251	1.571			1.822	
334	Guwahati-Kochugaon	AS01MC8387	Tezpur	Bongaigaon	LCV	1.2	Empty	Yes	2210	1875					0.667	0.460			0.198	0.045			0.243	
344	Guwahati-Kochugaon	MH48CB4011	Itanagar	Pune	LCV	1.2	Pipes	Yes	2545	4215					0.768	1.034			0.348	1.142			1.490	
345	Guwahati-Kochugaon	WB11E9552	Tezpur	Siliguri	LCV	1.2	Empty	No	2210	1855					0.667	0.455			0.198	0.043			0.241	
354	Guwahati-Kochugaon	NL01AD9817	Guwahati	Patna	LCV	1.2	Empty	Yes	2340	1960					0.706	0.481			0.249	0.053			0.302	
363	Guwahati-Kochugaon	MH20EG7149	Guwahati	Bongaigaon	LCV	1.2	Empty	Yes	2210	1840					0.667	0.451			0.198	0.041			0.239	
6	Guwahati-Kochugaon	HR38U5442	Meghalaya	Bihar	2Axle	1.2	Parcel	Yes	2670	4485					0.806	1.100			0.422	1.464			1.886	
29	Guwahati-Kochugaon	NL01AA6693	Guwahati	Bongaigaon	2Axle	1.2	Rice	Yes	2610	4555					0.788	1.117			0.385	1.557			1.943	
31	Guwahati-Kochugaon	HR38AD8853	Shillong	Bongaigaon	2Axle	1.2	Perfume	Yes	2595	4985					0.783	1.223			0.376	2.234			2.610	
33	Guwahati-Kochugaon	WB61B5966	Guwahati	Siliguri	2Axle	1.2	Tea leaves	No	3405	4965					1.028	1.218			1.116	2.198			3.314	
49	Guwahati-Kochugaon	AS19C3275	Borbila	Bongaigaon	2Axle	1.2	Cement	Yes	3475	4125					1.049	1.012			1.210	1.047			2.258	
61	Guwahati-Kochugaon	AS26C9519	Borbila	Taligaon	2Axle	1.2	GAS	Yes	3415	5980					1.031	1.467			1.129	4.626			5.755	
62	Guwahati-Kochugaon	AP16TK0909	Guwahati	Kurnool	2Axle	1.2	Empty	Yes	2455	2100					0.741	0.515			0.302	0.070			0.372	
85	Guwahati-Kochugaon	BP04A0346	Guwahati	Dhupguri	2Axle	1.2	Empty	Yes	2345	2100					0.708	0.515			0.251	0.070			0.321	
87	Guwahati-Kochugaon	BP02Axle8781	Bhutan	Siliguri	2Axle	1.2	Paint	Yes	3415	4965					1.031	1.218			1.129	2.198			3.327	
95	Guwahati-Kochugaon	AS19AC0866	Guwahati	Bhaktiarpur	2Axle	1.2	Empty	Yes	2415	2965					0.729	0.727			0.282	0.280			0.562	
100	Guwahati-Kochugaon	AS17B0317	Borbila	Gulbi	2Axle	1.2	Empty	Yes	1940	2305					0.586	0.565			0.118	0.102			0.220	
101	Guwahati-Kochugaon	WB23D1978	Shillong	Kolkata	2Axle	1.2	Flour	Yes	3400	5185					1.026	1.272			1.109	2.615			3.724	
104	Guwahati-Kochugaon	AS25A5305	Guwahati	Bongaigaon	2Axle	1.2	Empty	Yes	2040	2360					0.616	0.579			0.144	0.112			0.256	
115	Guwahati-Kochugaon	UP78DT3821	Guwahati	Bihar	2Axle	1.2	Parcel	Yes	2985	5125					0.901	1.257			0.659	2.496			3.155	
117	Guwahati-Kochugaon	AS26C2203	Itanagar	Siliguri	2Axle	1.2	GAS	Yes	2685	5495					0.810	1.348			0.431	3.298			3.730	
128	Guwahati-Kochugaon	WB29B2937	Guwahati	Kolkata	2Axle	1.2	Parcel	Yes	3460	4950					1.044	1.214			1.190	2.172			3.362	
143	Guwahati-Kochugaon	MH14HG9419	Guwahati	Bongaigaon	2Axle	1.2	Empty	Yes	2735	2265					0.826	0.555			0.464	0.095			0.560	
144	Guwahati-Kochugaon	BR03GB2116	Nalbari	Dhupguri	2Axle	1.2	Parcel	Yes	2875	5230					0.868	1.283			0.567	2.707			3.274	
178	Guwahati-Kochugaon	WB23E9605	Itanagar	Kolkata	2Axle	1.2	Parcel	Yes	2905	5455					0.877	1.338			0.591	3.203			3.794	
186	Guwahati-Kochugaon	AS09AC5973	Guwahati	Kolkata	2Axle	1.2	Empty	Yes	2350	1960					0.709	0.481			0.253	0.053			0.307	
196	Guwahati-Kochugaon	HR55AD7559	Guwahati	Siliguri	2Axle	1.2	Empty	Yes	2210	1875					0.667	0.460			0.198	0.045			0.243	
197	Guwahati-Kochugaon	AS26C2205	Borbila	Bongaigaon	2Axle	1.2	GAS	Yes	2855	5625					0.862	1.380			0.551	3.622			4.173	
201	Guwahati-Kochugaon	UP21BN8543	Guwahati	Bihar	2Axle	1.2	Chairs	Yes	2840	5230					0.857	1.283			0.540	2.707			3.247	
203	Guwahati-Kochugaon	HR38T0085	Guwahati	Bongaigaon	2Axle	1.2	Empty	Yes	2830	2210					0.854	0.542			0.532	0.086			0.619	
205	Guwahati-Kochugaon	AS26C3911	Pathsala	Kokrajhar	2Axle	1.2	Empty	Yes	2895	2345					0.874	0.575			0.583	0.109			0.692	
210	Guwahati-Kochugaon	BP02Axle6808	Namlang	Gailpur	2Axle	1.2	Coal	Yes	3240	5620					0.978	1.378			0.915	3.609			4.524	**2.195**
219	Guwahati-Kochugaon	AS01BC9521	Guwahati	Siliguri	2Axle	1.2	Empty	Yes	2875	2210					0.868	0.542			0.567	0.086			0.653	
246	Guwahati-Kochugaon	NL01AC2311	Guwahati	Siliguri	2Axle	1.2	Parcel	Yes	2875	4960					0.868	1.216			0.567	2.190			2.757	
250	Guwahati-Kochugaon	NL01AD8362	Guwahati	Delhi	2Axle	1.2	Parcel	Yes	3145	4965					0.949	1.218			0.812	2.198			3.010	
253	Guwahati-Kochugaon	HR38AC1308	Guwahati	Delhi	2Axle	1.2	Parcel	Yes	3685	4585					1.112	1.124			1.531	1.599			3.129	
254	Guwahati-Kochugaon	HR55A4533	Guwahati	Delhi	2Axle	1.2	Furniture	Yes	3290	5725					0.993	1.404			0.973	3.886			4.859	
255	Guwahati-Kochugaon	CG03YJ7301	Shillong	Kolkata	2Axle	1.2	Parcel	Yes	3125	5240					0.943	1.285			0.792	2.727			3.519	
259	Guwahati-Kochugaon	NL01AA9291	Shillong	Kolkata	2Axle	1.2	Spare parts	Yes	2875	5235					0.868	1.284			0.567	2.717			3.284	
260	Guwahati-Kochugaon	NL01AA0621	Borbila	Siliguri	2Axle	1.2	Parcel	Yes	2845	4875					0.859	1.196			0.544	2.043			2.587	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
262	Guwahati-Kochugaon	PB13AW1923	Guwahati	Delhi	2Axle	1.2	Parcel	Yes	3245	5265					0.979	1.291			0.920	2.780			3.700	
275	Guwahati-Kochugaon	HR55AJ9768	Shillong	Delhi	2Axle	1.2	Parcel	Yes	3340	4960					1.008	1.216			1.033	2.190			3.223	
277	Guwahati-Kochugaon	NL01G7026	Guwahati	Siliguri	2Axle	1.2	Kurkure	Yes	2690	5420					0.812	1.329			0.435	3.122			3.557	
297	Guwahati-Kochugaon	NL01P4945	Shillong	Kolkata	2Axle	1.2	Empty	Yes	2315	1875					0.699	0.460			0.238	0.045			0.283	
301	Guwahati-Kochugaon	NL01Q5780	Udalguri	Bongaigaon	2Axle	1.2	Empty	Yes	2415	2105					0.729	0.516			0.282	0.071			0.353	
314	Guwahati-Kochugaon	NL01AB4117	Tezpur	Siliguri	2Axle	1.2	Parcel	Yes	3555	4120					1.073	1.010			1.326	1.042			2.368	
322	Guwahati-Kochugaon	MH04JK7784	Udalguri	Kolkata	2Axle	1.2	Empty	Yes	2545	1960					0.768	0.481			0.348	0.053			0.402	
324	Guwahati-Kochugaon	NL01AF0774	Guwahati	Siliguri	2Axle	1.2	Empty	Yes	2545	1960					0.768	0.481			0.348	0.053			0.402	
332	Guwahati-Kochugaon	HR74B6308	Guwahati	Jabalpur	2Axle	1.2	Empty	Yes	2415	1960					0.729	0.481			0.282	0.053			0.336	
343	Guwahati-Kochugaon	NL01AD9671	Itanagar	Bihar	2Axle	1.2	Transport Material	Yes	2640	4415					0.797	1.083			0.403	1.375			1.778	
348	Guwahati-Kochugaon	NL01Q2141	Nalbari	Bongaigaon	2Axle	1.2	Empty	Yes	2415	1965					0.729	0.482			0.282	0.054			0.336	
351	Guwahati-Kochugaon	AS11BC0649	Guwahati	Gossaigaon	2Axle	1.2	Empty(Fuel)	Yes	2610	2960					0.788	0.726			0.385	0.278			0.663	
356	Guwahati-Kochugaon	HR55AA1565	Tezpur	Delhi	2Axle	1.2	Transport Material	Yes	2845	5210					0.859	1.278			0.544	2.665			3.209	
357	Guwahati-Kochugaon	UP75AT9315	Tezpur	Kolkata	2Axle	1.2	Transport Material	Yes	3045	5360					0.919	1.315			0.714	2.986			3.700	
367	Guwahati-Kochugaon	WB116271	Guwahati	Kolkata	2Axle	1.2	Parcel	Yes	2915	4945					0.880	1.213			0.599	2.163			2.762	
371	Guwahati-Kochugaon	CG04MZ7297	Guwahati	Solapur	2Axle	1.2	Empty	Yes	2315	2275					0.699	0.558			0.238	0.097			0.335	
372	Guwahati-Kochugaon	AS16C0582	Shillong	Siliguri	2Axle	1.2	Empty	Yes	2615	2215					0.789	0.543			0.388	0.087			0.475	
376	Guwahati-Kochugaon	HR55AG6680	Guwahati	Delhi	2Axle	1.2	Parcel	Yes	3250	5490					0.981	1.346			0.926	3.286			4.212	
5	Guwahati-Kochugaon	AS17C0379	Guwahati	Bongaigaon	3Axle	1.22	Marble	No	3750	6210	5965				1.132		1.614		1.641		6.787		8.429	
12	Guwahati-Kochugaon	HR55AL8766	Guwahati	Nagpur	3Axle	1.22	Parcel	Yes	3245	6875	6240				0.979		1.739		0.920		9.139		10.059	
20	Guwahati-Kochugaon	NL01AF5717	Itanagar	Dhupguri	3Axle	1.22	Parcel	Yes	3575	4565	3985				1.079		1.134		1.356		1.651		3.007	
22	Guwahati-Kochugaon	NL01L5579	Guwahati	Bihar	3Axle	1.22	Steel	Yes	3850	5260	4980				1.162		1.358		1.824		3.396		5.220	
23	Guwahati-Kochugaon	HR55AK6755	Guwahati	Kolkata	3Axle	1.22	Tea leaves	Yes	2875	6455	5965				0.868		1.647		0.567		7.350		7.917	
24	Guwahati-Kochugaon	HR55W2325	Nagaon	Uttarakhand	3Axle	1.22	Tyre	Yes	2960	6255	5870				0.893		1.607		0.637		6.677		7.314	
26	Guwahati-Kochugaon	HR74A4129	Guwahati	Siliguri	3Axle	1.22	Cement	Yes	3875	6545	6120				1.170		1.679		1.872		7.948		9.819	
34	Guwahati-Kochugaon	AS01F3137	Guwahati	Siliguri	3Axle	1.22	Tea leaves	No	3215	4165	3985				0.970		1.080		0.887		1.363		2.250	
39	Guwahati-Kochugaon	BP02B1435	Tinsukia	Bongaigaon	3Axle	1.22	Cement	No	3985	6125	5535				1.203		1.546		2.093		5.710		7.803	
40	Guwahati-Kochugaon	BP02B0528	Tinsukia	Bongaigaon	3Axle	1.22	Parcel	No	4030	3985	3525				1.216		0.996		2.189		0.983		3.172	
47	Guwahati-Kochugaon	PB65BB5877	Guwahati	Bongaigaon	3Axle	1.22	Steel	No	3745	5575	5120				1.130		1.418		1.633		4.042		5.674	
48	Guwahati-Kochugaon	PB65BB5477	Guwahati	Bongaigaon	3Axle	1.22	Steel	No	3960	5465	4965				1.195		1.383		2.041		3.656		5.697	
52	Guwahati-Kochugaon	HR55T8869	Guwahati	Delhi	3Axle	1.22	Plastic	Yes	3740	5420	5210				1.129		1.409		1.624		3.944		5.568	
53	Guwahati-Kochugaon	AS19AC4660	Borbila	Jogighopa	3Axle	1.22	Cotton	Yes	3165	5680	5315				0.955		1.458		0.833		4.514		5.347	
54	Guwahati-Kochugaon	AS26AC0407	Borbila	Bongaigaon	3Axle	1.22	Marble	Yes	3415	6210	5965				1.031		1.614		1.129		6.787		7.916	
55	Guwahati-Kochugaon	AP39UJ2777	Guwahati	Vizag	3Axle	1.22	Plastic	No	3255	5860	5210				0.982		1.468		0.932		4.639		5.571	
68	Guwahati-Kochugaon	AS19AC3834	Guwahati	Siliguri	3Axle	1.22	Steel	Yes	3980	5210	4980				1.201		1.351		2.083		3.331		5.413	
69	Guwahati-Kochugaon	NL01T4580	Tezpur	Dhupguri	3Axle	1.22	Parcel	Yes	3545	5425	4985				1.070		1.380		1.311		3.628		4.939	
71	Guwahati-Kochugaon	AS19AZ3821	Guwahati	Bongaigaon	3Axle	1.22	Steel	No	3815	6310	5930				1.152		1.623		1.758		6.933		8.692	
79	Guwahati-Kochugaon	AS26C9511	Itanagar	Bongaigaon	3Axle	1.22	Marble	Yes	3655	6210	5965				1.103		1.614		1.481		6.787		8.269	
80	Guwahati-Kochugaon	AS17B2359	Itanagar	Bongaigaon	3Axle	1.22	Parcel	Yes	3345	3645	3245				1.010		0.913		1.039		0.696		1.735	
88	Guwahati-Kochugaon	AS19AC3770	Guwahati	Siliguri	3Axle	1.22	Cement	Yes	4010	5565	5005				1.210		1.401		2.146		3.856		6.002	
92	Guwahati-Kochugaon	NL03A3294	Guwahati	Bongaigaon	3Axle	1.22	Empty	No	2675	2305	1850				0.807		0.551		0.425		0.092		0.517	
97	Guwahati-Kochugaon	AS19AC3351	Borbila	Bongaigaon	3Axle	1.22	Aggregate	No	3515	6910	6245				1.061		1.744		1.267		9.251		10.518	

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			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
99	Guwahati-Kochugaon	AS18AC6611	Borbila	Kolkata	3Axle	1.22	Aggregate	No	3340	8410	8215				1.008		2.204		1.033		23.598		24.631	
112	Guwahati-Kochugaon	AP21TA1624	Arunachal Pradesh	Kolkata	3Axle	1.22	Powder	No	3855	6870	6155				1.164		1.727		1.833		8.891		10.724	
140	Guwahati-Kochugaon	RJ23GB9572	Guwahati	Patna	3Axle	1.22	Empty	Yes	2495	2105	1875				0.753		0.528		0.322		0.078		0.399	
147	Guwahati-Kochugaon	AS17C0199	Guwahati	Jharkhand	3Axle	1.22	Empty	Yes	2455	2120	1960				0.741		0.541		0.302		0.086		0.387	
148	Guwahati-Kochugaon	HR55AG7564	Meghalaya	Uttar Pradesh	3Axle	1.22	Parcel	Yes	3325	5965	5425				1.004		1.510		1.015		5.199		6.214	
149	Guwahati-Kochugaon	AS01MC5201	Itanagar	Siliguri	3Axle	1.22	Empty	Yes	2415	2210	1980				0.729		0.555		0.282		0.095		0.378	
150	Guwahati-Kochugaon	WB11D3086	Guwahati	Siliguri	3Axle	1.22	Empty	Yes	2565	2120	1760				0.774		0.514		0.359		0.070		0.429	
151	Guwahati-Kochugaon	WB23F5457	Guwahati	Bongaigaon	3Axle	1.22	Parcel	Yes	4125	5945	4965				1.245		1.446		2.403		4.376		6.780	
152	Guwahati-Kochugaon	UP21CT5945	Tezpur	Bongaigaon	3Axle	1.22	Empty	Yes	2450	2100	1965				0.740		0.539		0.299		0.084		0.383	
157	Guwahati-Kochugaon	UP21BN2518	Guwahati	Uttar Pradesh	3Axle	1.22	Biscuits	Yes	3455	5420	4980				1.043		1.379		1.183		3.614		4.797	
161	Guwahati-Kochugaon	AP39UF9899	Guwahati	Vizag	3Axle	1.22	Bamboo Sticks	No	2960	5980	5490				0.893		1.521		0.637		5.347		5.984	
162	Guwahati-Kochugaon	AP37TF1689	Guwahati	Vizag	3Axle	1.22	Bamboo Sticks	No	2855	5875	5240				0.862		1.474		0.551		4.715		5.266	
171	Guwahati-Kochugaon	NL01AC4690	Guwahati	Bongaigaon	3Axle	1.22	Parcel	Yes	3745	4965	4250				1.130		1.222		1.633		2.227		3.860	
174	Guwahati-Kochugaon	AS01MC3021	Guwahati	Gossaigaon	3Axle	1.22	Empty	Yes	2415	2210	1965				0.729		0.553		0.282		0.094		0.376	
175	Guwahati-Kochugaon	BR06GA3420	Udalguri	Bihar	3Axle	1.22	Empty	Yes	2545	2105	1745				0.768		0.510		0.348		0.068		0.416	
177	Guwahati-Kochugaon	WB39B3724	Guwahati	Kolkata	3Axle	1.22	GAS	No	2945	5960	5125				0.889		1.470		0.624		4.664		5.288	
180	Guwahati-Kochugaon	AS26C5570	Guwahati	Uttar Pradesh	3Axle	1.22	Tea leaves	No	3315	4855	4245				1.001		1.206		1.002		2.118		3.121	
206	Guwahati-Kochugaon	HR55AH1783	Guwahati	Haryana	3Axle	1.22	Parcel	No	3940	5820	5210				1.189		1.462		2.000		4.572		6.573	**4.892**
209	Guwahati-Kochugaon	AS17C0378	Borbila	Bongaigaon	3Axle	1.22	Aggregate	No	3310	6820	6640				0.999		1.784		0.996		10.139		11.136	
229	Guwahati-Kochugaon	WB11C1311	Guwahati	Kolkata	3Axle	1.22	Empty	No	2435	2105	1895				0.735		0.530		0.292		0.079		0.371	
231	Guwahati-Kochugaon	AS17C4187	Guwahati	Bongaigaon	3Axle	1.22	Bamboo Sticks	Yes	2760	5250	4985				0.833		1.357		0.482		3.390		3.871	
248	Guwahati-Kochugaon	AP23T8474	Guwahati	Siliguri	3Axle	1.22	Parcel	Yes	3695	4585	3960				1.115		1.133		1.547		1.647		3.194	
251	Guwahati-Kochugaon	NL02G5437	Guwahati	Kolkata	3Axle	1.22	Empty	No	2565	2215	1875				0.774		0.542		0.359		0.086		0.446	
264	Guwahati-Kochugaon	UP21AM6270	Shillong	Varanasi	3Axle	1.22	Tea leaves	Yes	3565	5215	4685				1.076		1.312		1.341		2.967		4.308	
266	Guwahati-Kochugaon	AS26C8767	Borbila	Patna	3Axle	1.22	Aggregate	No	3545	8645	8240				1.070		2.238		1.311		25.109		26.420	
269	Guwahati-Kochugaon	HR45F0367	Itanagar	Siliguri	3Axle	1.22	Threads	Yes	3650	4955	4205				1.102		1.214		1.473		2.175		3.648	
274	Guwahati-Kochugaon	AP16TG2867	Guwahati	Vizag	3Axle	1.22	Bamboo Sticks	No	2875	6415	5875				0.868		1.629		0.567		7.047		7.615	
279	Guwahati-Kochugaon	AP07TF8789	Tinsukia	Pune	3Axle	1.22	Army Bags	No	3630	4755	3965				1.096		1.156		1.441		1.786		3.227	
283	Guwahati-Kochugaon	WL01AF3808	Guwahati	Delhi	3Axle	1.22	Logistics	Yes	3640	5420	4750				1.099		1.348		1.457		3.305		4.762	
285	Guwahati-Kochugaon	HR55AC1597	Guwahati	Delhi	3Axle	1.22	Kurkure	No	3465	4810	4215				1.046		1.196		1.197		2.049		3.246	
289	Guwahati-Kochugaon	WB23B6553	Guwahati	Bihar	3Axle	1.22	Parcel	Yes	3540	5260	4870				1.069		1.343		1.304		3.253		4.556	
290	Guwahati-Kochugaon	AP05TD6729	Shillong	Vijayawada	3Axle	1.22	Plastic	No	3430	5450	5240				1.035		1.417		1.149		4.034		5.183	
292	Guwahati-Kochugaon	AP37TA3345	Guwahati	Kurnool	3Axle	1.22	Ginger	Yes	3040	5740	5250				0.918		1.457		0.709		4.506		5.215	
293	Guwahati-Kochugaon	AS19AC3821	Itanagar	Srirampur	3Axle	1.22	Empty	No	3240	2870	2210				0.978		0.673		0.915		0.206		1.120	
295	Guwahati-Kochugaon	NL01L0920	Guwahati	Pune	3Axle	1.22	Parcel	No	3740	5340	4970				1.129		1.367		1.624		3.490		5.114	
298	Guwahati-Kochugaon	NL01AE4486	Guwahati	Siliguri	3Axle	1.22	Parcel	Yes	4045	5860	4985				1.221		1.438		2.222		4.273		6.495	
302	Guwahati-Kochugaon	UP22T5187	Guwahati	Siliguri	3Axle	1.22	Empty	Yes	2845	2210	1965				0.859		0.553		0.544		0.094		0.638	
304	Guwahati-Kochugaon	NL01AE4473	Guwahati	Gossaigaon	3Axle	1.22	Empty	Yes	2745	2215	1760				0.829		0.527		0.471		0.077		0.548	
316	Guwahati-Kochugaon	NL01AC6822	Guwahati	Patna	3Axle	1.22	Empty	Yes	2560	2210	1870				0.773		0.541		0.357		0.086		0.442	
319	Guwahati-Kochugaon	MP09HJ2705	Tezpur	Mirzapur	3Axle	1.22	Parcel	Yes	3450	4255	3680				1.041		1.052		1.176		1.225		2.401	
320	Guwahati-Kochugaon	UP21BN5517	Guwahati	Bongaigaon	3Axle	1.22	Furniture	Yes	3565	5460	4980				1.076		1.384		1.341		3.670		5.010	
325	Guwahati-Kochugaon	HR69C6434	Guwahati	Delhi	3Axle	1.22	Parcel	Yes	3645	4875	4210				1.100		1.204		1.465		2.104		3.570	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
328	Guwahati-Kochugaon	AS19AC3809	Guwahati	Varanasi	3Axle	1.22	Empty	No	2875	2290	1745				0.868		0.535		0.567		0.082		0.649	
329	Guwahati-Kochugaon	NL01AF5475	Tezpur	Siliguri	3Axle	1.22	Parcel	Yes	3875	5465	4950				1.170		1.381		1.872		3.635		5.506	
338	Guwahati-Kochugaon	NL01AG1534	Shillong	Gossaigaon	3Axle	1.22	Transport Material	Yes	2875	5210	4875				0.868		1.337		0.567		3.195		3.763	
340	Guwahati-Kochugaon	NL01AF8161	Nagaland	Mirzapur	3Axle	1.22	Transport Material	Yes	3315	4255	3945				1.001		1.087		1.002		1.397		2.399	
341	Guwahati-Kochugaon	NL01AC8504	Nagaland	Mirzapur	3Axle	1.22	Parcel	Yes	3465	4815	4250				1.046		1.202		1.197		2.086		3.282	
350	Guwahati-Kochugaon	NL01AA9591	Guwahati	Siliguri	3Axle	1.22	Empty(Fuel)	Yes	2810	2215	1870				0.848		0.542		0.518		0.086		0.604	
352	Guwahati-Kochugaon	NL01L3960	Tezpur	Patna	3Axle	1.22	Parcel	Yes	3875	4995	4510				1.170		1.260		1.872		2.521		4.393	
353	Guwahati-Kochugaon	HR55V5760	Nalbari	Mirzapur	3Axle	1.22	Bikes	Yes	2910	6245	5445				0.878		1.550		0.595		5.769		6.364	
359	Guwahati-Kochugaon	HR38Y2413	Nalbari	Delhi	3Axle	1.22	Parcel	Yes	3565	3985	3125				1.076		0.943		1.341		0.789		2.130	
362	Guwahati-Kochugaon	AS18AC2166	Tezpur	Siliguri	3Axle	1.22	Aggregate	No	2745	6415	5840				0.829		1.625		0.471		6.967		7.439	
364	Guwahati-Kochugaon	UP17AT4877	Udalguri	Gossaigaon	3Axle	1.22	Empty	Yes	2875	2215	1945				0.868		0.552		0.567		0.093		0.660	
365	Guwahati-Kochugaon	UK08CB0586	Tezpur	Delhi	3Axle	1.22	Transport Material	Yes	3575	4125	3565				1.079		1.019		1.356		1.080		2.436	
366	Guwahati-Kochugaon	HR55AE7685	Guwahati	Delhi	3Axle	1.22	Parcel	Yes	3345	4985	4765				1.010		1.293		1.039		2.792		3.831	
370	Guwahati-Kochugaon	BP02B0433	Udalguri	Bongaigaon	3Axle	1.22	Cement	No	3315	6920	6415				1.001		1.768		1.002		9.768		10.770	
375	Guwahati-Kochugaon	HR55U5368	Guwahati	Kolkata	3Axle	1.22	Empty	No	2755	2345	1955				0.832		0.570		0.478		0.106		0.584	
379	Guwahati-Kochugaon	RJ32GB6143	Arunachal Pradesh	Kolkata	3Axle	1.22	Empty	Yes	3125	2605	2120				0.943		0.626		0.792		0.154		0.946	
4	Guwahati-Kochugaon	NL01AD0694	Guwahati	Kokrajhar	MAV	1.1.22	Marble	No	3640	4615	6960	6325			1.099	1.393	1.761		1.457	3.765	9.622		14.845	
9	Guwahati-Kochugaon	HR737724	Guwahati	Siliguri	MAV	1.1.22	Tea leaves	No	3360	4060	5860	5045			1.014	1.225	1.446		1.058	2.255	4.368		7.682	
11	Guwahati-Kochugaon	NL01Q1084	Guwahati	Delhi	MAV	1.1.22	Cement	No	3845	4965	7125	6745			1.161	1.499	1.839		1.814	5.044	11.432		18.291	
14	Guwahati-Kochugaon	UP15DT2799	Guwahati	Kolkata	MAV	1.1.22	Cement	No	3250	4635	6790	6550			0.981	1.399	1.769		0.926	3.831	9.782		14.540	
15	Guwahati-Kochugaon	AP37TJ3589	Guwahati	Vizag	MAV	1.1.22	Bamboo Sticks	No	3050	4420	6980	6255			0.921	1.334	1.755		0.718	3.168	9.478		13.365	
18	Guwahati-Kochugaon	AS01MC4532	Jorhat	Kolkata	MAV	1.1.22	Coal	No	3575	4755	6840	6240			1.079	1.435	1.734		1.356	4.243	9.042		14.641	
21	Guwahati-Kochugaon	BP02B1023	Guwahati	Kolkata	MAV	1.1.22	Cement	No	3855	5365	7125	6545			1.164	1.619	1.812		1.833	6.877	10.787		19.497	
25	Guwahati-Kochugaon	AS19C9132	Nagaon	Uttarakhand	MAV	1.1.22	Rice	No	3320	5980	6955	6435			1.002	1.805	1.775		1.008	10.615	9.930		21.553	
44	Guwahati-Kochugaon	UP37T1235	Guwahati	Bihar	MAV	1.1.22	Tins	No	3065	3985	5220	4985			0.925	1.203	1.353		0.733	2.093	3.350		6.176	
46	Guwahati-Kochugaon	AS01PC1219	Borbila	Tura	MAV	1.1.22	Rice	No	3445	4985	6120	5875			1.040	1.505	1.590		1.169	5.126	6.395		12.690	
59	Guwahati-Kochugaon	AS01GC2039	Borbila	Dhupguri	MAV	1.1.22	Rice	No	3745	4920	6280	5990			1.130	1.485	1.627		1.633	4.864	7.002		13.498	
66	Guwahati-Kochugaon	WB23C9776	Itanagar	Siliguri	MAV	1.1.22	Aggregate	No	4060	4120	6960	6445			1.225	1.244	1.777		2.255	2.392	9.974		14.622	
70	Guwahati-Kochugaon	AS01PC1218	Guwahati	Siliguri	MAV	1.1.22	Bamboo Sticks	No	3815	4980	6125	5985			1.152	1.503	1.605		1.758	5.105	6.644		13.507	
73	Guwahati-Kochugaon	BR27G1303	Itanagar	Salakati	MAV	1.1.22	Parcel	No	2915	4425	5230	4980			0.880	1.336	1.354		0.599	3.182	3.357		7.139	
74	Guwahati-Kochugaon	AS16C2021	Guwahati	Dhupguri	MAV	1.1.22	Aggregate	No	3855	4215	5965	5545			1.164	1.272	1.526		1.833	2.620	5.422		9.875	
82	Guwahati-Kochugaon	WB37C1742	Guwahati	Kolkata	MAV	1.1.22	Tumeric	No	3685	5285	6485	5875			1.112	1.595	1.639		1.531	6.476	7.209		15.216	
83	Guwahati-Kochugaon	UP84AT2365	Guwahati	Kolkata	MAV	1.1.22	Ginger	No	3855	4245	6640	6245			1.164	1.281	1.708		1.833	2.695	8.515		13.043	
86	Guwahati-Kochugaon	AS27C6364	Guwahati	Kolkata	MAV	1.1.22	Coal	No	3450	4920	6545	6240			1.041	1.485	1.695		1.176	4.864	8.253		14.293	
94	Guwahati-Kochugaon	RJ14GD3663	Itanagar	Rajasthan	MAV	1.1.22	Mats	No	3805	4465	5425	5120			1.149	1.348	1.398		1.740	3.299	3.820		8.859	
98	Guwahati-Kochugaon	WB59B3952	Tinsukia	Kolkata	MAV	1.1.22	Tea leaves	No	3745	6415	7215	6875			1.130	1.936	1.868		1.633	14.057	12.175		27.865	
113	Guwahati-Kochugaon	WB51A9663	Guwahati	Kolkata	MAV	1.1.22	Empty	No	2470	2680	2420	1980			0.746	0.809	0.583		0.309	0.428	0.116		0.853	
114	Guwahati-Kochugaon	JH04Q8521	Borbila	Kolkata	MAV	1.1.22	Rice	No	3875	4985	7465	7005			1.170	1.505	1.918		1.872	5.126	13.542		20.540	
116	Guwahati-Kochugaon	AS19C3856	Guwahati	Uttar Pradesh	MAV	1.1.22	Bamboo Sticks	No	3815	4065	6985	6455			1.152	1.227	1.782		1.758	2.267	10.079		14.104	
118	Guwahati-Kochugaon	NL02L8069	Guwahati	Bongaigaon	MAV	1.1.22	Parcel	No	3855	4225	6145	5895			1.164	1.275	1.596		1.833	2.645	6.491		10.969	
123	Guwahati-Kochugaon	AP16TJ7147	Dimapur	Bihar	MAV	1.1.22	Coal	No	3615	4965	7490	7210			1.091	1.499	1.949		1.418	5.044	14.424		20.886	
129	Guwahati-Kochugaon	UP14HT8535	Guwahati	Kolkata	MAV	1.1.22	Coal	No	3910	5320	6480	6210			1.180	1.606	1.682		1.940	6.649	8.011		16.600	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
130	Guwahati-Kochugaon	MH40CD8702	Itanagar	Odisha	MAV	1.1.22	Bamboo Sticks	No	3865	4980	6195	5875			1.167	1.503	1.600		1.852	5.105	6.556		13.514	
134	Guwahati-Kochugaon	AS16AC3781	Guwahati	Kokrajhar	MAV	1.1.22	Empty	No	2495	2865	3020	2745			0.753	0.865	0.764		0.322	0.559	0.341		1.222	
135	Guwahati-Kochugaon	NL01C2891	Guwahati	Bihar	MAV	1.1.22	Empty	No	2565	2950	2745	2215			0.774	0.890	0.658		0.359	0.629	0.187		1.175	
137	Guwahati-Kochugaon	JK02CA4257	Guwahati	Uttar Pradesh	MAV	1.1.22	Empty	No	2315	2750	2565	1960			0.699	0.830	0.600		0.238	0.475	0.130		0.843	
145	Guwahati-Kochugaon	AS01JC6230	Guwahati	Kolkata	MAV	1.1.22	Empty	No	2575	3120	2680	2455			0.777	0.942	0.681		0.365	0.787	0.215		1.366	
166	Guwahati-Kochugaon	AP39Y9889	Guwahati	Vizag	MAV	1.1.22	Plastic	No	4155	4960	6720	5860			1.254	1.497	1.668		2.474	5.024	7.737		15.234	
176	Guwahati-Kochugaon	AS02E5939	Tezpur	Gossaigaon	MAV	1.1.22	Empty	No	2465	2135	1985	1740			0.744	0.644	0.494		0.306	0.172	0.059		0.538	
179	Guwahati-Kochugaon	AP07TG3366	Guwahati	Vizag	MAV	1.1.22	Bamboo Sticks	No	3855	4985	6125	5870			1.164	1.505	1.590		1.833	5.126	6.395		13.354	
191	Guwahati-Kochugaon	AS01TC6072	Guwahati	Kolkata	MAV	1.1.22	Empty	No	2450	2205	1965	1650			0.740	0.666	0.479		0.299	0.196	0.053		0.548	
194	Guwahati-Kochugaon	PB06L8745	Guwahati	Punjab	MAV	1.1.22	Empty	No	2585	2345	2035	1875			0.780	0.708	0.518		0.371	0.251	0.072		0.694	
199	Guwahati-Kochugaon	BR28C1457	Itanagar	Patna	MAV	1.1.22	Empty	No	2490	2025	1760	1540			0.752	0.611	0.437		0.319	0.140	0.037		0.495	
215	Guwahati-Kochugaon	NL01AF5476	Guwahati	Uttar Pradesh	MAV	1.1.22	Empty	No	2480	2755	2320	1960			0.749	0.832	0.567		0.314	0.478	0.104		0.896	
218	Guwahati-Kochugaon	RJ14GD2708	Guwahati	Srirampur	MAV	1.1.22	Empty	No	2410	2285	2120	1850			0.727	0.690	0.526		0.280	0.226	0.077		0.583	
221	Guwahati-Kochugaon	MH40CD8706	Guwahati	Nagpur	MAV	1.1.22	Bamboo Sticks	No	3815	4225	6945	6225			1.152	1.275	1.746		1.758	2.645	9.293		13.696	
230	Guwahati-Kochugaon	WB176597	Guwahati	Kolkata	MAV	1.1.22	Bamboo Sticks	No	2875	4135	6425	5985			0.868	1.248	1.645		0.567	2.427	7.327		10.321	
233	Guwahati-Kochugaon	MH12BG3821	Guwahati	Kolkata	MAV	1.1.22	Bamboo Sticks	No	3125	4260	6980	6455			0.943	1.286	1.781		0.792	2.734	10.064		13.589	
236	Guwahati-Kochugaon	AS01KC1090	Guwahati	Bihar	MAV	1.1.22	Coal	No	4010	5260	6850	6240			1.210	1.588	1.735		2.146	6.354	9.069		17.570	
238	Guwahati-Kochugaon	TN31P4126	Guwahati	Kolkata	MAV	1.1.22	Tea leaves	No	3125	4125	5960	5420			0.943	1.245	1.509		0.792	2.403	5.181		8.376	
247	Guwahati-Kochugaon	WB37E2747	Guwahati	Kolkata	MAV	1.1.22	Tea leaves	No	3345	4625	5875	5465			1.010	1.396	1.503		1.039	3.798	5.108		9.946	
249	Guwahati-Kochugaon	AS17C5303	Guwahati	Kokrajhar	MAV	1.1.22	Empty	No	2475	2035	1985	1760			0.747	0.614	0.496		0.311	0.142	0.061		0.515	
256	Guwahati-Kochugaon	MP09HH8271	Itanagar	Patna	MAV	1.1.22	Empty	No	2875	3245	2745	2215			0.868	0.979	0.658		0.567	0.920	0.187		1.674	
265	Guwahati-Kochugaon	AS19C3887	Guwahati	Kolkata	MAV	1.1.22	Tea leaves	No	3855	4215	5865	5215			1.164	1.272	1.469		1.833	2.620	4.656		9.109	
268	Guwahati-Kochugaon	WB15C2114	Guwahati	Patna	MAV	1.1.22	Tea leaves	No	3450	4560	5640	4980			1.041	1.376	1.408		1.176	3.589	3.929		8.694	
271	Guwahati-Kochugaon	AP39Y4455	Meghalaya	Vijayawada	MAV	1.1.22	Paddy	No	3340	4210	6450	5870			1.008	1.271	1.633		1.033	2.608	7.116		10.757	
273	Guwahati-Kochugaon	NL01K1093	Guwahati	Delhi	MAV	1.1.22	Empty	No	2465	2215	1965	1675			0.744	0.669	0.483		0.306	0.200	0.054		0.561	
280	Guwahati-Kochugaon	JK01AK9909	Guwahati	Jammu and Kashmir	MAV	1.1.22	Batteries	No	4125	6145	7985	6565			1.245	1.855	1.929		2.403	11.836	13.844		28.084	
282	Guwahati-Kochugaon	WB67A7312	Guwahati	Kolkata	MAV	1.1.22	Empty	No	2870	2745	2450	1960			0.866	0.829	0.585		0.563	0.471	0.117		1.151	
284	Guwahati-Kochugaon	MP09HH3137	Guwahati	Pune	MAV	1.1.22	Bamboo Sticks	No	3345	4415	6575	6120			1.010	1.333	1.683		1.039	3.154	8.023		12.216	
294	Guwahati-Kochugaon	WB29E6603	Guwahati	Kolkata	MAV	1.1.22	Bamboo Sticks	No	2850	4955	6255	5740			0.860	1.496	1.590		0.548	5.004	6.395		11.946	
299	Guwahati-Kochugaon	AP31TG1486	Guwahati	Bongaigaon	MAV	1.1.22	Empty	No	2465	2860	2540	2140			0.744	0.863	0.620		0.306	0.555	0.148		1.010	
303	Guwahati-Kochugaon	AS01NC0644	Tezpur	Gossaigaon	MAV	1.1.22	Tea leaves	No	3215	4105	6215	5825			0.970	1.239	1.596		0.887	2.357	6.491		9.735	
305	Guwahati-Kochugaon	AP03TH2348	Guwahati	Vijayawada	MAV	1.1.22	Plastic	No	3875	4530	6425	5805			1.170	1.367	1.621		1.872	3.495	6.911		12.278	
306	Guwahati-Kochugaon	AP05TB8899	Guwahati	Siliguri	MAV	1.1.22	Empty	No	2450	2930	2360	1950			0.740	0.884	0.571		0.299	0.612	0.107		1.017	
310	Guwahati-Kochugaon	HR58C9713	Guwahati	Bongaigaon	MAV	1.1.22	Empty	No	2760	3520	2750	2345			0.833	1.062	0.675		0.482	1.274	0.208		1.964	
313	Guwahati-Kochugaon	AS16AC4051	Guwahati	Bongaigaon	MAV	1.1.22	Empty	No	2650	3250	2875	2475			0.800	0.981	0.709		0.409	0.926	0.253		1.588	
317	Guwahati-Kochugaon	AS19AC1371	Guwahati	Nagpur	MAV	1.1.22	Empty	No	2412	3125	2865	2415			0.728	0.943	0.700		0.281	0.792	0.240		1.313	
323	Guwahati-Kochugaon	RJ19GF2489	Guwahati	Gossaigaon	MAV	1.1.22	Empty	No	2345	2875	2480	2120			0.708	0.868	0.610		0.251	0.567	0.138		0.956	
327	Guwahati-Kochugaon	UP369282	Guwahati	Varanasi	MAV	1.1.22	Tea leaves	No	3880	4620	6145	5875			1.171	1.395	1.594		1.881	3.782	6.448		12.111	
331	Guwahati-Kochugaon	KA25C9924	Guwahati	Bongaigaon	MAV	1.1.22	Plastic	No	3565	5220	7210	6545			1.076	1.576	1.824		1.341	6.163	11.058		18.562	
337	Guwahati-Kochugaon	AS16C1503	Tezpur	Nagpur	MAV	1.1.22	Empty	No	2565	2310	1965	1540			0.774	0.697	0.465		0.359	0.236	0.047		0.642	
346	Guwahati-Kochugaon	WB29B5029	Guwahati	Bengal	MAV	1.1.22	Fish Food	No	3855	4960	6455	5875			1.164	1.497	1.635		1.833	5.024	7.140		13.997	
347	Guwahati-Kochugaon	KA25D1243	Tezpur	Patna	MAV	1.1.22	Bamboo Sticks	No	3440	4525	6775	6015			1.038	1.366	1.696		1.162	3.480	8.266		12.909	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
349	Guwahati-Kochugaon	WB29A3948	Nalbari	Kolkata	MAV	1.1.22	Tea leaves	No	3505	4325	6245	5875			1.058	1.305	1.607		1.253	2.904	6.666		10.823	
358	Guwahati-Kochugaon	AS16AC4048	Guwahati	Bongaigaon	MAV	1.1.22	Empty	No	2875	2425	2965	2410			0.868	0.732	0.713		0.567	0.287	0.258		1.112	
374	Guwahati-Kochugaon	NL01K1595	Borbila	Bongaigaon	MAV	1.1.22	Pesticides	No	3825	4050	7245	6745			1.155	1.222	1.855		1.777	2.233	11.833		15.843	
377	Guwahati-Kochugaon	NL01L0024	Arunachal Pradesh	Kolkata	MAV	1.1.22	Empty	No	2550	2035	1855	1650			0.770	0.614	0.465		0.351	0.142	0.047		0.540	
378	Guwahati-Kochugaon	NL01L0022	Arunachal Pradesh	Kolkata	MAV	1.1.22	Empty	No	2520	2215	2320	1980			0.761	0.669	0.570		0.335	0.200	0.106		0.640	
226	Guwahati-Kochugaon	NL01AE1562	Tezpur	Bongaigaon	MAV	1.2.11	Parcel	No	3855	5965	6850	6240			1.164	1.463	1.735		1.833	4.580	9.069		15.483	
258	Guwahati-Kochugaon	NL01AD1962	Guwahati	Nagpur	MAV	1.2.11	Bikes	No	3125	6255	8465	7960			0.943	1.534	2.178		0.792	5.538	22.483		28.812	
261	Guwahati-Kochugaon	NL01D1086	Tezpur	Bongaigaon	MAV	1.2.11	Spare parts	No	3545	4125	5875	5215			1.070	1.012	1.470		1.311	1.047	4.673		7.031	
360	Guwahati-Kochugaon	NL01Q0018	Meghalaya	Nagpur	MAV	1.2.11	Bikes	No	3015	5880	7020	6380			0.910	1.442	1.776		0.686	4.324	9.960		14.970	
1	Guwahati-Kochugaon	AS01FC4744	Guwahati	Bongaigaon	MAV	1.2.22	GAS	No	3740	4225	6955	6315			1.129	1.036	1.759		1.624	1.153	9.579		12.356	
35	Guwahati-Kochugaon	AS15AC4726	Itanagar	Bongaigaon	MAV	1.2.22	Steel	No	3640	5545	7210	6955			1.099	1.360	1.878		1.457	3.420	12.436		17.313	
36	Guwahati-Kochugaon	AS04BC1417	Itanagar	Bongaigaon	MAV	1.2.22	Steel	No	3855	5710	7285	6765			1.164	1.400	1.863		1.833	3.846	12.037		17.716	**8.112**
50	Guwahati-Kochugaon	AS25CC9338	Tinsukia	Kolkata	MAV	1.2.22	Steel	No	3615	5870	6415	6025			1.091	1.440	1.649		1.418	4.295	7.398		13.111	
76	Guwahati-Kochugaon	AS25CC9863	Udalguri	Bongaigaon	MAV	1.2.22	Aggregate	No	4255	5875	5645	5365			1.284	1.441	1.460		2.721	4.310	4.539		11.570	
81	Guwahati-Kochugaon	AS01NC1227	Nalbari	Chaprakata	MAV	1.2.22	Empty	No	2215	2410	2345	1965			0.669	0.591	0.571		0.200	0.122	0.107		0.428	
89	Guwahati-Kochugaon	AS01JC6274	Guwahati	Dhupguri	MAV	1.2.22	Empty	No	2345	2565	2410	1965			0.708	0.629	0.580		0.251	0.157	0.113		0.521	
90	Guwahati-Kochugaon	AS23BC9461	Guwahati	Dhupguri	MAV	1.2.22	Empty	No	2465	2790	2545	2120			0.744	0.684	0.618		0.306	0.219	0.146		0.672	
121	Guwahati-Kochugaon	AS01MC8878	Guwahati	Bongaigaon	MAV	1.2.22	Empty	No	2555	3250	2980	2455			0.771	0.797	0.721		0.354	0.404	0.270		1.027	
122	Guwahati-Kochugaon	AS01DC8444	Guwahati	Bongaigaon	MAV	1.2.22	Empty	No	2435	3320	2510	2210			0.735	0.814	0.626		0.292	0.440	0.153		0.885	
124	Guwahati-Kochugaon	NL01K8800	Guwahati	Kolkata	MAV	1.2.22	Empty	No	2685	2875	2475	2120			0.810	0.705	0.609		0.431	0.247	0.138		0.816	
131	Guwahati-Kochugaon	NL01AC8432	Guwahati	Jharkhand	MAV	1.2.22	Empty	No	2595	2775	2110	1985			0.783	0.681	0.543		0.376	0.215	0.087		0.678	
132	Guwahati-Kochugaon	AS25CC9677	Guwahati	Bihar	MAV	1.2.22	Empty	No	2230	2460	2210	1875			0.673	0.603	0.542		0.205	0.132	0.086		0.424	
133	Guwahati-Kochugaon	AS01MC8886	Guwahati	Kolkata	MAV	1.2.22	Empty	No	2560	2455	2345	1965			0.773	0.602	0.571		0.357	0.131	0.107		0.595	
136	Guwahati-Kochugaon	AS25EC9153	Guwahati	Kolkata	MAV	1.2.22	GAS(Empty)	No	3815	3875	2740	2240			1.152	0.950	0.660		1.758	0.816	0.190		2.764	
142	Guwahati-Kochugaon	AS25EC9377	Itanagar	Kolkata	MAV	1.2.22	Empty	No	2565	2735	2215	1965			0.774	0.671	0.554		0.359	0.202	0.094		0.656	
146	Guwahati-Kochugaon	AS26GC9477	Guwahati	Kolkata	MAV	1.2.22	Empty	No	2435	2985	2745	2120			0.735	0.732	0.645		0.292	0.287	0.173		0.752	
158	Guwahati-Kochugaon	NL01AC5984	Tezpur	Gossaigaon	MAV	1.2.22	Bamboo Sticks	No	3445	5015	6345	5895			1.040	1.230	1.623		1.169	2.288	6.933		10.391	
168	Guwahati-Kochugaon	AS23CC7984	Guwahati	Patna	MAV	1.2.22	Biscuits	No	3445	4960	5870	5425			1.040	1.216	1.497		1.169	2.190	5.028		8.386	
169	Guwahati-Kochugaon	HR45C8986	Itanagar	Nagpur	MAV	1.2.22	Empty	No	2455	2985	2215	1960			0.741	0.732	0.553		0.302	0.287	0.094		0.683	
170	Guwahati-Kochugaon	HR45C8424	Guwahati	Odisha	MAV	1.2.22	Empty	No	2365	2895	2340	1745			0.714	0.710	0.542		0.260	0.254	0.086		0.600	
192	Guwahati-Kochugaon	AS04BC4579	Guwahati	Kolkata	MAV	1.2.22	Empty	No	2355	2195	1870	1540			0.711	0.538	0.452		0.255	0.084	0.042		0.381	
193	Guwahati-Kochugaon	RJ05GB3510	Guwahati	Kolkata	MAV	1.2.22	Empty	No	2410	2875	2545	2105			0.727	0.705	0.616		0.280	0.247	0.144		0.672	
227	Guwahati-Kochugaon	GJ10AT9185	Jorhat	Kolkata	MAV	1.2.22	Empty	No	2645	3215	2875	2215			0.798	0.788	0.675		0.406	0.386	0.207		1.000	
228	Guwahati-Kochugaon	NL01K4097	Jorhat	Kolkata	MAV	1.2.22	Empty	No	2545	2875	2695	2050			0.768	0.705	0.629		0.348	0.247	0.157		0.752	
245	Guwahati-Kochugaon	AS04BC1411	Guwahati	Kolkata	MAV	1.2.22	Empty	No	2560	2980	2475	1960			0.773	0.731	0.588		0.357	0.285	0.120		0.761	
267	Guwahati-Kochugaon	NL01AE5397	Guwahati	Prayagraj	MAV	1.2.22	Empty	No	2460	2850	2240	1970			0.743	0.699	0.558		0.304	0.239	0.097		0.640	
272	Guwahati-Kochugaon	PB23T7173	Udalguri	Patna	MAV	1.2.22	Empty	No	2350	3210	2870	2215			0.709	0.787	0.674		0.253	0.384	0.207		0.844	
286	Guwahati-Kochugaon	AS27C7609	Guwahati	Bongaigaon	MAV	1.2.22	Bamboo Sticks	No	3765	5875	6860	6250			1.136	1.441	1.738		1.668	4.310	9.125		15.103	
315	Guwahati-Kochugaon	AS01JC6236	Udalguri	Kolkata	MAV	1.2.22	Empty	No	2875	3620	2485	2120			0.868	0.888	0.610		0.567	0.621	0.139		1.327	
333	Guwahati-Kochugaon	AS01FC1955	Guwahati	Bongaigaon	MAV	1.2.22	Empty	No	2875	3245	2640	2210			0.868	0.796	0.643		0.567	0.401	0.171		1.139	
361	Guwahati-Kochugaon	NL01L2062	Guwahati	Bongaigaon	MAV	1.2.22	Fuel(Empty)	No	3645	3525	3120	2760			1.100	0.865	0.780		1.465	0.559	0.369		2.393	
37	Guwahati-Kochugaon	WB61B6429	Tinsukia	Bongaigaon	MAV	1.1.122	Steel	No	3755	4350	5355	7415	7000		1.133	1.313		1.731628274	1.650	2.972		8.99122101	13.614	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
63	Guwahati-Kochugaon	TN52J7179	Borbila	Salakati	MAV	1.1.122	Soil	No	3655	4245	5545	6240	5965		1.103	1.281		1.554699133	1.481	2.695		5.842321137	10.019	
64	Guwahati-Kochugaon	NL01AE8776	Guwahati	Kolkata	MAV	1.1.122	Marble	No	3740	4430	6150	7345	6920		1.129	1.337		1.788122975	1.624	3.197		10.22326299	15.044	
141	Guwahati-Kochugaon	WB37D3186	Itanagar	Kolkata	MAV	1.1.122	Empty	No	2450	2985	2555	2120	1965		0.740	0.901		0.581588859	0.299	0.659		0.114410086	1.072	
159	Guwahati-Kochugaon	TS34Z3979	Guwahati	Hyderabad	MAV	1.1.122	Parcel	No	3055	3685	5920	7125	6855		0.922	1.112		1.743014802	0.723	1.531		9.230055266	11.484	
160	Guwahati-Kochugaon	KA53D0943	Guwahati	Kolkata	MAV	1.1.122	Empty	No	2870	3240	2875	2695	2555		0.866	0.978		0.711658054	0.563	0.915		0.256498881	1.734	
163	Guwahati-Kochugaon	BP2B0273	Bhutan	Bongaigaon	MAV	1.1.122	Cement	No	3955	4980	6495	8340	7960		1.194	1.503		1.996584041	2.031	5.105		15.89096905	23.027	
164	Guwahati-Kochugaon	NL01AF0067	Guwahati	Uttar Pradesh	MAV	1.1.122	Cement	No	3850	4560	6575	7965	7125		1.162	1.376		1.897608829	1.824	3.589		12.96661957	18.379	
165	Guwahati-Kochugaon	UP41BT2642	Guwahati	Uttar Pradesh	MAV	1.1.122	Coal	No	4155	5365	6145	7925	7455		1.254	1.619		1.885346413	2.474	6.877		12.63469133	21.986	
182	Guwahati-Kochugaon	WB23E5486	Guwahati	Bhopal	MAV	1.1.122	Bamboo Sticks	No	3155	3860	5520	6955	6385		0.952	1.165		1.651922572	0.822	1.843		7.446612404	10.112	
211	Guwahati-Kochugaon	NL01AG1292	Tezpur	Bhopal	MAV	1.1.122	Bamboo Sticks	No	3015	3985	5245	6875	6125		0.910	1.203		1.598055531	0.686	2.093		6.521799852	9.301	
307	Guwahati-Kochugaon	HR74A9822	Guwahati	Bongaigaon	MAV	1.1.122	Empty	No	2565	3250	2870	2210	1965		0.774	0.981		0.617062276	0.359	0.926		0.144982634	1.430	
311	Guwahati-Kochugaon	MH24AU2748	Guwahati	Nagpur	MAV	1.1.122	Mats	No	3650	4210	3870	5210	4870		1.102	1.271		1.221862135	1.473	2.608		2.228890978	6.310	
368	Guwahati-Kochugaon	AP39TE0945	Tezpur	Vijayawada	MAV	1.1.122	Threads	No	3415	4215	2715	5980	5410		1.031	1.272		1.235438381	1.129	2.620		2.329616093	6.079	
107	Guwahati-Kochugaon	BP02B1182	Namlang	Phuentsholing	MAV	1.1.222	Cement	No	4635	5740	7040	7320	6905		1.399	1.733		1.862573356	3.831	9.011		12.03520644	24.877	
335	Guwahati-Kochugaon	AS16AC4050	Itanagar	Bongaigaon	MAV	1.1.222	Empty	No	2840	3465	3250	3125	2960		0.857	1.046		0.817640361	0.540	1.197		0.446940062	2.183	
342	Guwahati-Kochugaon	AP04TW8092	Guwahati	Kadapa	MAV	1.1.222	Fish Food	No	2545	4215	5875	7125	6805		0.768	1.272		1.734693878	0.348	2.620		9.055061051	12.023	
373	Guwahati-Kochugaon	UP15ET4777	Shillong	Siliguri	MAV	1.1.222	Coal	No	4390	5850	6980	7550	7280		1.325	1.766		1.910309188	3.083	9.722		13.31725323	26.122	
109	Guwahati-Kochugaon	UP30AT8539	Dibrugarh	Kanpur	MAV	1.2.122	Plastic	No	4245	5365	4285	6455	6235		1.281	1.316		1.486817903	2.695	2.997		4.886873842	10.579	
110	Guwahati-Kochugaon	UP72AT4788	Dibrugarh	Kanpur	MAV	1.2.122	Plastic	No	4055	5215	4305	6985	6435		1.224	1.279		1.552509416	2.244	2.676		5.809476124	10.729	
291	Guwahati-Kochugaon	MP20HB8129	Guwahati	Siliguri	MAV	1.2.122	Threads	No	3745	4875	3970	5140	4780		1.130	1.196		1.216606814	1.633	2.043		2.190791154	5.867	
27	Guwahati-Kochugaon	RJ06GA9054	Itanagar	Siliguri	MAV	1.2.222	Cement	No	4340	5720	6455	7340	6965		1.310	1.403		1.81834107	2.945	3.873		10.93204454	17.750	
56	Guwahati-Kochugaon	PB04N9647	Guwahati	Bengal	MAV	1.2.222	Carbon	No	2955	5965	8420	9230	8555		0.892	1.463		2.295261452	0.633	4.580		27.75419606	32.967	
119	Guwahati-Kochugaon	PB46M8065	Guwahati	Uttar Pradesh	MAV	1.2.222	Empty	No	2565	2845	2435	2125	1965		0.774	0.698		0.57151616	0.359	0.237		0.106687628	0.703	
125	Guwahati-Kochugaon	OD14F2786	Dimapur	Odisha	MAV	1.2.222	Empty	No	2555	2980	2740	2655	2220		0.771	0.731		0.666987825	0.354	0.285		0.197911772	0.837	
126	Guwahati-Kochugaon	OD14F2198	Dimapur	Odisha	MAV	1.2.222	Empty	No	2430	2870	2435	2480	2160		0.733	0.704		0.619689936	0.289	0.245		0.147467994	0.682	
127	Guwahati-Kochugaon	OD14E5077	Guwahati	Odisha	MAV	1.2.222	Empty	No	2560	2790	2335	2540	2125		0.773	0.684		0.613120785	0.357	0.219		0.141313664	0.717	
154	Guwahati-Kochugaon	PB13BD9866	Guwahati	Punjab	MAV	1.2.222	Empty	No	2415	2810	2745	2210	1965		0.729	0.689		0.60611369	0.282	0.226		0.134963513	0.643	
184	Guwahati-Kochugaon	WB11F1452	Guwahati	Siliguri	MAV	1.2.222	Empty	No	2345	2745	2565	2210	1895		0.708	0.673		0.584216519	0.251	0.205		0.116491793	0.573	
185	Guwahati-Kochugaon	WB11F2552	Itanagar	Siliguri	MAV	1.2.222	Empty	No	2430	2670	2345	1985	1765		0.733	0.655		0.533853026	0.289	0.184		0.081224461	0.555	
187	Guwahati-Kochugaon	PB07AF8792	Guwahati	Kolkata	MAV	1.2.222	Empty	No	2410	2872	2645	2215	1960		0.727	0.704		0.597354822	0.280	0.246		0.127329635	0.653	
214	Guwahati-Kochugaon	WB11D8452	Guwahati	Kolkata	MAV	1.2.222	Empty	No	2365	2875	2535	2415	2210		0.714	0.705		0.627134974	0.260	0.247		0.154683534	0.662	
220	Guwahati-Kochugaon	WB11F2752	Guwahati	Kolkata	MAV	1.2.222	Empty	No	2345	2875	2425	2020	1875		0.708	0.705		0.55356048	0.251	0.247		0.093898858	0.592	
225	Guwahati-Kochugaon	WB57D8682	Guwahati	Bongaigaon	MAV	1.2.222	Empty	No	2575	2845	2405	2245	1965		0.777	0.698		0.579399142	0.365	0.237		0.112696749	0.715	
312	Guwahati-Kochugaon	PB02DM5795	Guwahati	Gossaigaon	MAV	1.2.222	Empty	No	2455	2875	2740	2315	1980		0.741	0.705		0.616186389	0.302	0.247		0.144161205	0.693	
336	Guwahati-Kochugaon	NL01AD3352	Itanagar	Patna	MAV	1.2.222	Empty	No	2865	3215	2875	2650	2210		0.865	0.788		0.677498467	0.559	0.386		0.210684831	1.156	
339	Guwahati-Kochugaon	UP63AT4447	Guwahati	Rajasthan	MAV	1.2.222	Tea leaves	No	2515	4965	5420	6455	6215		0.759	1.218		1.584479285	0.332	2.198		6.30298485	8.833	
355	Guwahati-Kochugaon	OD16B6197	Guwahati	Gossaigaon	MAV	1.2.222	Empty	No	2515	2970	2410	2215	1820		0.759	0.728		0.564509065	0.332	0.281		0.101550878	0.715	
2	Guwahati-Kochugaon	RJ06GC4878	Tezpur	Bongaigaon	MAV	1.22.222	Empty	No	3120	2785	2340	2025	1960	1750	0.942		0.679	0.502	0.787		0.213	0.064	1.063	
51	Guwahati-Kochugaon	NL01AD6432	Guwahati	Jaipur	MAV	1.22.222	Soil	No	4575	5225	6965	7415	8145	7845	1.381		1.616	2.050	3.636		6.821	17.661	28.119	
67	Guwahati-Kochugaon	PB13BD9633	Itanagar	Siliguri	MAV	1.22.222	Marble	No	4280	5790	6540	7240	8660	8245	1.292		1.635	2.115	2.785		7.140	20.003	29.928	
102	Guwahati-Kochugaon	UP25BT5862	Shillong	Kolkata	MAV	1.22.222	Empty	No	2415	2665	2455	2340	1985	1635	0.729		0.679	0.522	0.282		0.212	0.074	0.569	
106	Guwahati-Kochugaon	BP02B0274	Namlang	Phuentsholing	MAV	1.22.222	Cement	No	4385	5965	6125	6945	7490	6855	1.324		1.603	1.865	3.069		6.600	12.092	21.761	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
153	Guwahati-Kochugaon	NL01AE1033	Guwahati	Gossaigaon	MAV	1.22.222	Empty	No	2565	2875	2745	2360	2210	1965	0.774		0.745	0.572	0.359		0.308	0.107	0.775	
189	Guwahati-Kochugaon	HR68C0639	Guwahati	Patna	MAV	1.22.222	Empty	No	2455	2895	2435	2235	2105	1965	0.741		0.707	0.552	0.302		0.249	0.093	0.644	
224	Guwahati-Kochugaon	RJ09GD1116	Guwahati	Bhopal	MAV	1.22.222	Empty	No	2475	2985	2875	2540	2465	1945	0.747		0.777	0.609	0.311		0.364	0.137	0.813	
237	Guwahati-Kochugaon	NL01RC0584	Borbila	Kolkata	MAV	1.22.222	Empty	No	2455	3215	2875	2285	2655	2120	0.741		0.807	0.618	0.302		0.425	0.146	0.873	
243	Guwahati-Kochugaon	UP53CT9976	Guwahati	Siliguri	MAV	1.22.222	Empty	No	2545	2965	2420	2295	1960	1745	0.768		0.714	0.526	0.348		0.260	0.076	0.684	
330	Guwahati-Kochugaon	UP21AT7118	Guwahati	Gossaigaon	MAV	1.22.222	Empty	No	2415	2875	2540	2210	1960	1745	0.729		0.718	0.518	0.282		0.266	0.072	0.620	
75	Kochugaon-Guwahati	BR06PD0623	Patna	Guwahati	Bus	1.2	Passengers	Yes	3250	4180					0.981	1.025			0.926	1.104			2.030	
80	Kochugaon-Guwahati	AS15C8041	Bunagaon	Guwahati	Bus	1.2	Passengers	Yes	2580	3715					0.779	0.911			0.368	0.689			1.057	
156	Kochugaon-Guwahati	AS25EC9227	Cooch Behar	Tezpur	Bus	1.2	Passengers	Yes	2740	3525					0.827	0.865			0.468	0.559			1.026	
174	Kochugaon-Guwahati	AS162329	Alipurduar	Guwahati	Bus	1.2	Passengers	Yes	2810	3645					0.848	0.894			0.518	0.639			1.156	
205	Kochugaon-Guwahati	AS15AC1839	Bongaigaon	Manikpur	Bus	1.2	Passengers	Yes	2475	3120					0.747	0.765			0.311	0.343			0.654	
207	Kochugaon-Guwahati	AS13C5349	Hapachara	Nowagaon	Bus	1.2	Passengers	Yes	2875	3430					0.868	0.841			0.567	0.501			1.068	
210	Kochugaon-Guwahati	AS15C7338	Atapur	Nowagaon	Bus	1.2	Passengers	Yes	2730	3375					0.824	0.828			0.461	0.469			0.930	
264	Kochugaon-Guwahati	AS25BC3644	Cooch Behar	Tezpur	Bus	1.2	Passengers	Yes	2970	3620					0.896	0.888			0.646	0.621			1.267	**1.437**
269	Kochugaon-Guwahati	AS17C5223	Cooch Behar	Guwahati	Bus	1.2	Passengers	Yes	3250	4150					0.981	1.018			0.926	1.073			1.999	
328	Kochugaon-Guwahati	AS15A7059	Cooch Behar	Barpeta	Bus	1.2	Passengers	Yes	2930	3560					0.884	0.873			0.612	0.581			1.193	
341	Kochugaon-Guwahati	AS07AC9787	Cooch Behar	Howly	Bus	1.2	Passengers	Yes	2840	3975					0.857	0.975			0.540	0.903			1.443	
342	Kochugaon-Guwahati	AS12E9737	Cooch Behar	Guwahati	Bus	1.2	Passengers	Yes	2730	3540					0.824	0.868			0.461	0.568			1.029	
344	Kochugaon-Guwahati	AR01Q3015	Darbhanga	Tinsukia	Bus	1.2	Passengers	Yes	3350	4285					1.011	1.051			1.045	1.220			2.265	
367	Kochugaon-Guwahati	BR30PA4406	Patna	Guwahati	Bus	1.2	Passengers	Yes	3210	3715					0.969	0.911			0.881	0.689			1.570	
369	Kochugaon-Guwahati	AS01NC3924	Patgaon	Manipur	Bus	1.2	Passengers	Yes	3710	4350					1.120	1.067			1.573	1.295			2.868	
18	Kochugaon-Guwahati	AS25DC1968	Bijni	Guwahati	LCV	1.2	Empty	Yes	1530	1135					0.462	0.278			0.045	0.006			0.051	
20	Kochugaon-Guwahati	UP14ST6350	Uttar Pradesh	Mizoram	LCV	1.2	Chains	No	2230	4530					0.673	1.111			0.205	1.523			1.729	
23	Kochugaon-Guwahati	AS17B6348	Kakinada	Guwahati	LCV	1.2	Cow food	No	3045	5165					0.919	1.267			0.714	2.575			3.288	
33	Kochugaon-Guwahati	AS19AC1351	Bilasipara	Guwahati	LCV	1.2	House material	Yes	1940	2460					0.586	0.603			0.118	0.132			0.250	
38	Kochugaon-Guwahati	AS25DC2413	Bongaigaon	Guwahati	LCV	1.2	Empty	No	1620	1890					0.489	0.464			0.057	0.046			0.103	
40	Kochugaon-Guwahati	AS01AC3756	Kolkata	Tinsukia	LCV	1.2	Empty	No	1540	1235					0.465	0.303			0.047	0.008			0.055	
50	Kochugaon-Guwahati	AS01HC9641	Sil Koti	Shillong	LCV	1.2	Tea leaves	No	2345	5045					0.708	1.237			0.251	2.344			2.595	
64	Kochugaon-Guwahati	AS18AC2834	Patgaon	Guwahati	LCV	1.2	Empty	Yes	1850	1670					0.558	0.410			0.097	0.028			0.125	
76	Kochugaon-Guwahati	AS19C2879	Patgaon	Guwahati	LCV	1.2	Empty	No	1890	1710					0.570	0.419			0.106	0.031			0.137	
83	Kochugaon-Guwahati	AS01GC4397	Bunagaon	Guwahati	LCV	1.2	Empty	No	1845	1680					0.557	0.412			0.096	0.029			0.125	
87	Kochugaon-Guwahati	UP20AT7554	Uttarakhand	Guwahati	LCV	1.2	Wires	Yes	2460	4335					0.743	1.063			0.304	1.278			1.582	
97	Kochugaon-Guwahati	AP39TC1278	Vijayawada	Guwahati	LCV	1.2	Army material	No	2340	3140					0.706	0.770			0.249	0.352			0.601	
99	Kochugaon-Guwahati	AS25C5344	Patgaon	Guwahati	LCV	1.2	Empty	No	1920	1625					0.580	0.399			0.113	0.025			0.138	
113	Kochugaon-Guwahati	AS01SC3034	Bongaigaon	Guwahati	LCV	1.2	Liquor	No	1240	2560					0.374	0.628			0.020	0.155			0.175	
138	Kochugaon-Guwahati	AS12AC8261	Cooch Behar	Barpeta	LCV	1.2	Empty	Yes	1315	1120					0.397	0.275			0.025	0.006			0.031	
150	Kochugaon-Guwahati	AS17C5024	Patgaon	Tejpur	LCV	1.2	Empty	Yes	1840	1750					0.555	0.429			0.095	0.034			0.129	
155	Kochugaon-Guwahati	AS01CC6152	Bongaigaon	Barpeta	LCV	1.2	Empty	Yes	1635	1230					0.494	0.302			0.059	0.008			0.068	
159	Kochugaon-Guwahati	DL12AD5739	Delhi	Guwahati	LCV	1.2	Electrical	No	2375	4350					0.717	1.067			0.264	1.295			1.559	
169	Kochugaon-Guwahati	CG04NS9047	Delhi	Mizoram	LCV	1.2	Plastic	No	2120	3140					0.640	0.770			0.168	0.352			0.519	
188	Kochugaon-Guwahati	AS01FC7667	Bijni	Guwahati	LCV	1.2	Empty	No	1935	1740					0.584	0.427			0.116	0.033			0.150	
196	Kochugaon-Guwahati	AS01EC2997	Bongaigaon	Guwahati	LCV	1.2	Empty	No	1430	1015					0.432	0.249			0.035	0.004			0.039	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
204	Kochugaon-Guwahati	AS01JC5831	Bijni	Guwahati	LCV	1.2	Empty	No	1460	1130					0.441	0.277			0.038	0.006			0.044	1.163
219	Kochugaon-Guwahati	HR38X2070	Gurugram	Guwahati	LCV	1.2	Parcel	No	3120	5820					0.942	1.427			0.787	4.151			4.937	
220	Kochugaon-Guwahati	HR38Y1907	Haryana	Arunachal Pradesh	LCV	1.2	Solar Panels	No	1835	3220					0.554	0.790			0.094	0.389			0.483	
247	Kochugaon-Guwahati	WB25K7128	Kolkata	Guwahati	LCV	1.2	Chemical	No	2320	4530					0.700	1.111			0.240	1.523			1.764	
251	Kochugaon-Guwahati	WB25K3323	Kolkata	Tripura	LCV	1.2	Medicine	Yes	2430	5240					0.733	1.285			0.289	2.727			3.017	
265	Kochugaon-Guwahati	UP80FT89866	Kheri	Guwahati	LCV	1.2	Generators	No	2550	4535					0.770	1.112			0.351	1.530			1.881	
274	Kochugaon-Guwahati	HR38A9237	Delhi	Nagaland	LCV	1.2	Road Material	Yes	2845	5245					0.859	1.286			0.544	2.738			3.282	
286	Kochugaon-Guwahati	KA52B1603	Patna	Guwahati	LCV	1.2	Oil	Yes	2965	4920					0.895	1.207			0.642	2.120			2.761	
289	Kochugaon-Guwahati	WB39C0751	Asansol	Guwahati	LCV	1.2	Pipes	No	2410	5430					0.727	1.332			0.280	3.145			3.425	
312	Kochugaon-Guwahati	AS01CC5995	Patgaon	Tinsukia	LCV	1.2	Empty	Yes	1535	1230					0.463	0.302			0.046	0.008			0.054	
318	Kochugaon-Guwahati	UP81C2464	Bongaigaon	Tezpur	LCV	1.2	Empty	No	1475	1230					0.445	0.302			0.039	0.008			0.048	
320	Kochugaon-Guwahati	AS183398	Bongaigaon	Sorbhog	LCV	1.2	Bricks	No	2945	5340					0.889	1.310			0.624	2.942			3.566	
323	Kochugaon-Guwahati	HR38AT5177	Haryana	Shillong	LCV	1.2	Electrical	Yes	2560	3720					0.773	0.912			0.357	0.693			1.049	
333	Kochugaon-Guwahati	AS01C7857	Alipurduar	Guwahati	LCV	1.2	Empty	No	1530	1175					0.462	0.288			0.045	0.007			0.052	
335	Kochugaon-Guwahati	WB69B6314	Cooch Behar	Manipur	LCV	1.2	Potatoes	Yes	3150	4675					0.951	1.147			0.817	1.728			2.545	
338	Kochugaon-Guwahati	WB03C7075	West Bengal	Guwahati	LCV	1.2	Ice Cream	No	2850	4530					0.860	1.111			0.548	1.523			2.071	
343	Kochugaon-Guwahati	HR55AJ9347	Delhi	Guwahati	LCV	1.2	Parcel	Yes	3025	5225					0.913	1.281			0.695	2.696			3.391	
355	Kochugaon-Guwahati	AS25C5348	Alipurduar	Nalbari	LCV	1.2	Empty	Yes	1435	1130					0.433	0.277			0.035	0.006			0.041	
358	Kochugaon-Guwahati	AS19AC2636	Kolkata	Guwahati	LCV	1.2	Empty	Yes	1435	1020					0.433	0.250			0.035	0.004			0.039	
359	Kochugaon-Guwahati	PB10GK2077	Kolkata	Guwahati	LCV	1.2	Empty	No	1440	1130					0.435	0.277			0.036	0.006			0.042	
389	Kochugaon-Guwahati	WB73Y3126	Patgaon	Guwahati	LCV	1.2	Vegetables	No	2730	3720					0.824	0.912			0.461	0.693			1.154	
392	Kochugaon-Guwahati	HP46E3979	Patgaon	Tezpur	LCV	1.2	Empty	Yes	1430	1025					0.432	0.251			0.035	0.004			0.039	
394	Kochugaon-Guwahati	TH05CM2792	Jharkhand	Guwahati	LCV	1.2	Steel Material	No	2835	4530					0.856	1.111			0.536	1.523			2.060	
1	Kochugaon-Guwahati	HR55AK0860	Delhi	Guwahati	2Axle	1.2	Bikes	Yes	2875	5095					0.868	1.250			0.567	2.438			3.005	
2	Kochugaon-Guwahati	NL01AD2287	Delhi	Guwahati	2Axle	1.2	Bikes	Yes	2890	5275					0.872	1.294			0.579	2.801			3.380	
5	Kochugaon-Guwahati	HR55AM0791	Haryana	Tinsukia	2Axle	1.2	Electrical	Yes	2935	5045					0.886	1.237			0.616	2.344			2.959	
6	Kochugaon-Guwahati	HR55M0530	Delhi	Guwahati	2Axle	1.2	Parcel	No	2720	6370					0.821	1.562			0.454	5.956			6.411	
7	Kochugaon-Guwahati	AS18C9725	Bilasipara	Guwahati	2Axle	1.2	Empty	No	1530	1875					0.462	0.460			0.045	0.045			0.090	
8	Kochugaon-Guwahati	BP02A8847	Bilasipara	Guwahati	2Axle	1.2	Empty	No	1540	1835					0.465	0.450			0.047	0.041			0.088	
17	Kochugaon-Guwahati	AS05C3725	Siliguri	Guwahati	2Axle	1.2	Fuel	No	3560	5735					1.075	1.406			1.333	3.913			5.247	
21	Kochugaon-Guwahati	BP02A9074	Uttar Pradesh	Mizoram	2Axle	1.2	House material	No	2250	5350					0.679	1.312			0.213	2.964			3.176	
27	Kochugaon-Guwahati	AS08D5092	Salmara	Guwahati	2Axle	1.2	Empty	No	2625	1965					0.792	0.482			0.394	0.054			0.448	
37	Kochugaon-Guwahati	NL01A81323	Delhi	Guwahati	2Axle	1.2	Parcel	Yes	3430	4575					1.035	1.122			1.149	1.585			2.734	
41	Kochugaon-Guwahati	AS01FC7689	Kolkata	Guwahati	2Axle	1.2	Empty	No	2450	1835					0.740	0.450			0.299	0.041			0.340	
42	Kochugaon-Guwahati	NL01AE5786	Kolkata	Guwahati	2Axle	1.2	Parcel	Yes	2325	4815					0.702	1.181			0.243	1.945			2.187	
58	Kochugaon-Guwahati	DL16C4684	Delhi	Guwahati	2Axle	1.2	Empty	No	1875	2175					0.566	0.533			0.103	0.081			0.184	
60	Kochugaon-Guwahati	HR38AC2938	Gurgaon	Guwahati	2Axle	1.2	Bikes	No	3215	4925					0.970	1.208			0.887	2.128			3.015	
85	Kochugaon-Guwahati	NL01N6681	Siliguri	Guwahati	2Axle	1.2	Parcel	No	2330	5210					0.703	1.278			0.245	2.665			2.910	
88	Kochugaon-Guwahati	NL01AC9881	Chennai	Guwahati	2Axle	1.2	Plastic drums	Yes	2645	4210					0.798	1.032			0.406	1.136			1.543	
89	Kochugaon-Guwahati	NL01AC9165	Chennai	Guwahati	2Axle	1.2	Plastic drums	No	2430	4155					0.733	1.019			0.289	1.078			1.368	
90	Kochugaon-Guwahati	NL01AD5990	Chennai	Guwahati	2Axle	1.2	Plastic drums	Yes	2045	4325					0.617	1.061			0.145	1.266			1.411	
96	Kochugaon-Guwahati	NL01K3298	Bijni	Guwahati	2Axle	1.2	Empty	No	2815	2210					0.850	0.542			0.521	0.086			0.608	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
102	Kochugaon-Guwahati	NL01K5438	Pune	Guwahati	2Axle	1.2	Parcel	Yes	3560	5345					1.075	1.311			1.333	2.953			4.286	
105	Kochugaon-Guwahati	AP15AC0240	Bongaigaon	Barpeta	2Axle	1.2	Fuel	No	2890	5315					0.872	1.303			0.579	2.887			3.466	
106	Kochugaon-Guwahati	NL01AB7307	Kolkata	Guwahati	2Axle	1.2	Fortune	Yes	3560	4615					1.075	1.132			1.333	1.641			2.974	
109	Kochugaon-Guwahati	AS28AC3465	Bongaigaon	Guwahati	2Axle	1.2	Parcel	Yes	3265	6075					0.986	1.490			0.943	4.927			5.871	
110	Kochugaon-Guwahati	NL01AC0789	Delhi	Guwahati	2Axle	1.2	Fortune	Yes	2850	6185					0.860	1.517			0.548	5.294			5.842	
115	Kochugaon-Guwahati	HR05T3850	Kolkata	Guwahati	2Axle	1.2	Parcel	No	2870	5685					0.866	1.394			0.563	3.779			4.342	
130	Kochugaon-Guwahati	WB23F1651	Kolkata	Guwahati	2Axle	1.2	Parcel	Yes	3745	4920					1.130	1.207			1.633	2.120			3.753	
135	Kochugaon-Guwahati	UP21BN6530	Uttarakhand	Guwahati	2Axle	1.2	Books	Yes	3205	4675					0.967	1.147			0.876	1.728			2.604	
146	Kochugaon-Guwahati	HR38Z4790	Haryana	Guwahati	2Axle	1.2	Electrical	Yes	3850	5325					1.162	1.306			1.824	2.909			4.732	
165	Kochugaon-Guwahati	NL01AC8877	Gujarat	Guwahati	2Axle	1.2	Parcel	Yes	3120	4560					0.942	1.118			0.787	1.564			2.351	
167	Kochugaon-Guwahati	WB11D7384	Kolkata	Tezpur	2Axle	1.2	Parcel	No	3450	4650					1.041	1.140			1.176	1.691			2.867	
170	Kochugaon-Guwahati	NL01AB2213	Siliguri	Nagaon	2Axle	1.2	Powder	Yes	2350	4450					0.709	1.091			0.253	1.419			1.672	
175	Kochugaon-Guwahati	NL01AC8861	Pune	Mizoram	2Axle	1.2	Parcel	No	2845	3650					0.859	0.895			0.544	0.642			1.186	
176	Kochugaon-Guwahati	AS28C7133	Patgaon	Tezpur	2Axle	1.2	Empty	Yes	2450	2240					0.740	0.549			0.299	0.091			0.390	2.882
181	Kochugaon-Guwahati	UP78SN5493	Indore	Guwahati	2Axle	1.2	Patanjali	No	4160	5840					1.256	1.432			2.486	4.208			6.694	
193	Kochugaon-Guwahati	HR55T8790	Uttar Pradesh	Guwahati	2Axle	1.2	Paint	No	4035	6430					1.218	1.577			2.200	6.184			8.384	
197	Kochugaon-Guwahati	AS26C9993	Sanastipur	Guwahati	2Axle	1.2	Empty	No	2815	2215					0.850	0.543			0.521	0.087			0.608	
228	Kochugaon-Guwahati	HR55AD9114	Delhi	Guwahati	2Axle	1.2	Parcel	Yes	2690	5160					0.812	1.265			0.435	2.565			2.999	
229	Kochugaon-Guwahati	WB76A9286	West Bengal	Guwahati	2Axle	1.2	Perfume	No	2050	5230					0.619	1.283			0.147	2.707			2.853	
230	Kochugaon-Guwahati	NL01AG0452	Haryana	Imphal	2Axle	1.2	Parcel	Yes	2725	5520					0.823	1.354			0.458	3.359			3.816	
234	Kochugaon-Guwahati	NL01AD7015	Pune	Guwahati	2Axle	1.2	Chips	No	2495	4895					0.753	1.200			0.322	2.077			2.399	
241	Kochugaon-Guwahati	NL01AE0678	Nagpur	Guwahati	2Axle	1.2	Chairs	Yes	2615	4530					0.789	1.111			0.388	1.523			1.912	
245	Kochugaon-Guwahati	HR55AA6403	Gurugram	Tezpur	2Axle	1.2	Fortune	Yes	3840	4740					1.159	1.162			1.805	1.826			3.631	
250	Kochugaon-Guwahati	CG08AH7276	Nagpur	Guwahati	2Axle	1.2	Washing Machine	No	2760	5045					0.833	1.237			0.482	2.344			2.825	
288	Kochugaon-Guwahati	NL01AC2303	Kolkata	Guwahati	2Axle	1.2	Parcel	No	2840	4370					0.857	1.072			0.540	1.319			1.859	
292	Kochugaon-Guwahati	MH42AQ0759	Pune	Guwahati	2Axle	1.2	Auto	Yes	2645	5640					0.798	1.383			0.406	3.661			4.067	
298	Kochugaon-Guwahati	UP32AN3827	Noida	Guwahati	2Axle	1.2	Chemical	Yes	3245	4530					0.979	1.111			0.920	1.523			2.444	
300	Kochugaon-Guwahati	AS27C6281	Patgaon	Guwahati	2Axle	1.2	Empty	No	2340	1915					0.706	0.470			0.249	0.049			0.298	
301	Kochugaon-Guwahati	NL01AC3757	Kolkata	Guwahati	2Axle	1.2	Chips	Yes	2450	4720					0.740	1.158			0.299	1.796			2.095	
306	Kochugaon-Guwahati	NL01AF7336	Noida	Tezpur	2Axle	1.2	Fans	Yes	3620	4825					1.093	1.183			1.425	1.961			3.386	
308	Kochugaon-Guwahati	HR55AK5362	Noida	Guwahati	2Axle	1.2	Parcel	Yes	3720	5245					1.123	1.286			1.590	2.738			4.327	
316	Kochugaon-Guwahati	AS16AC4354	Dhupguri	Guwahati	2Axle	1.2	Parcel	No	2935	3650					0.886	0.895			0.616	0.642			1.258	
322	Kochugaon-Guwahati	UP19AT0590	Uttar Pradesh	Guwahati	2Axle	1.2	Parcel	Yes	3950	5730					1.192	1.405			2.021	3.900			5.921	
332	Kochugaon-Guwahati	AS02B3506	Patgaon	Manipur	2Axle	1.2	Empty	No	2345	1950					0.708	0.478			0.251	0.052			0.303	
334	Kochugaon-Guwahati	AS01EC2784	Cooch Behar	Nalbari	2Axle	1.2	Empty	No	2575	1930					0.777	0.473			0.365	0.050			0.415	
339	Kochugaon-Guwahati	NL01A8248	Uttar Pradesh	Shillong	2Axle	1.2	Parcel	No	3250	4830					0.981	1.185			0.926	1.969			2.895	
345	Kochugaon-Guwahati	WB23D9806	Kolkata	Guwahati	2Axle	1.2	Plastic	No	2525	4325					0.762	1.061			0.337	1.266			1.603	
354	Kochugaon-Guwahati	UP14T9507	Uttar Pradesh	Guwahati	2Axle	1.2	Parcel	Yes	3530	4930					1.065	1.209			1.289	2.137			3.426	
360	Kochugaon-Guwahati	AS09AC6255	Jalpaiguri	Guwahati	2Axle	1.2	Oil	No	3850	5130					1.162	1.258			1.824	2.505			4.329	
361	Kochugaon-Guwahati	HR38AD6108	Delhi	Guwahati	2Axle	1.2	Parcel	Yes	3120	4545					0.942	1.115			0.787	1.544			2.330	
362	Kochugaon-Guwahati	RJ18GB5543	Jaipur	Guwahati	2Axle	1.2	Parcel	Yes	3450	4750					1.041	1.165			1.176	1.842			3.018	
364	Kochugaon-Guwahati	CG04NY0788	Raipur	Guwahati	2Axle	1.2	Steel	Yes	3475	6240					1.049	1.530			1.210	5.485			6.695	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
376	Kochugaon-Guwahati	NL01R1063	Nagpur	Guwahati	2Axle	1.2	Parcel	Yes	3875	4315					1.170	1.058			1.872	1.254			3.126	
388	Kochugaon-Guwahati	HR74B1067	Haryana	Nagaland	2Axle	1.2	Parcel	Yes	3150	4950					0.951	1.214			0.817	2.172			2.989	
397	Kochugaon-Guwahati	NL01AG0951	Noida	Guwahati	2Axle	1.2	Fortune	Yes	3870	4975					1.168	1.220			1.862	2.216			4.078	
3	Kochugaon-Guwahati	AS01MC3021	Chattisgarh	Guwahati	3Axle	1.22	Empty	No	2540	2045	1675				0.767		0.493		0.346		0.059		0.405	
4	Kochugaon-Guwahati	AS01MC3462	Chattisgarh	Guwahati	3Axle	1.22	Empty	No	2450	2045	1980				0.740		0.534		0.299		0.081		0.380	
9	Kochugaon-Guwahati	AS26C9511	Borapeta	Guwahati	3Axle	1.22	Empty	No	2840	2465	2015				0.857		0.594		0.540		0.124		0.664	
25	Kochugaon-Guwahati	NL01AC1935	Hyderabad	Guwahati	3Axle	1.22	Paper	No	3960	6880	6380				1.195		1.758		2.041		9.550		11.591	
26	Kochugaon-Guwahati	NL01AB0508	Bengaluru	Guwahati	3Axle	1.22	Masala	No	3270	7065	6850				0.987		1.845		0.949		11.581		12.530	
28	Kochugaon-Guwahati	AS26C8477	Golapara	Bolpita	3Axle	1.22	Empty	No	2675	2380	2150				0.807		0.601		0.425		0.130		0.555	
30	Kochugaon-Guwahati	BP03A6746	Bilasipara	Guwahati	3Axle	1.22	Empty	No	4250	6165	5930				1.283		1.603		2.708		6.611		9.319	
31	Kochugaon-Guwahati	BP02A0986	Bilasipara	Guwahati	3Axle	1.22	Empty	No	2460	2170	1830				0.743		0.530		0.304		0.079		0.383	
32	Kochugaon-Guwahati	BP02A0987	Bilasipara	Guwahati	3Axle	1.22	Empty	No	4215	6130	5910				1.272		1.596		2.620		6.491		9.111	
39	Kochugaon-Guwahati	WB29A0608	Kolkata	Tinsukia	3Axle	1.22	Fuel	No	4230	3955	3520				1.277		0.991		2.658		0.964		3.622	
44	Kochugaon-Guwahati	AS01MC5271	Salmara	Guwahati	3Axle	1.22	Empty	No	2250	2055	1935				0.679		0.529		0.213		0.078		0.291	
45	Kochugaon-Guwahati	BP02A9645	Bilasipara	Guwahati	3Axle	1.22	Empty	No	2315	1985	1880				0.699		0.512		0.238		0.069		0.307	
46	Kochugaon-Guwahati	NL01AC4232	Delhi	Guwahati	3Axle	1.22	Parcel	No	3880	4235	3720				1.171		1.055		1.881		1.237		3.118	
48	Kochugaon-Guwahati	AS25DC7695	Kolkata	Guwahati	3Axle	1.22	Empty	No	2215	1935	1835				0.669		0.500		0.200		0.062		0.262	
51	Kochugaon-Guwahati	AS18AC6611	Sil Koti	Shillong	3Axle	1.22	Empty	No	4255	6390	5955				1.284		1.637		2.721		7.174		9.895	
53	Kochugaon-Guwahati	WB23C3293	Kolkata	Guwahati	3Axle	1.22	Fortune	No	3345	5420	4930				1.010		1.372		1.039		3.545		4.584	
54	Kochugaon-Guwahati	UP21BN4942	Uttar Pradesh	Guwahati	3Axle	1.22	Medicine	No	4135	5230	4740				1.248		1.322		2.427		3.052		5.479	
55	Kochugaon-Guwahati	MP09HH0023	Uttar Pradesh	Guwahati	3Axle	1.22	Potatoes	No	4215	6430	6215				1.272		1.676		2.620		7.898		10.518	
57	Kochugaon-Guwahati	AS01BC9321	Golpura	Barpeta	3Axle	1.22	Empty	No	4370	7315	6890				1.319		1.883		3.027		12.577		15.605	
62	Kochugaon-Guwahati	UP21CT1847	Delhi	Guwahati	3Axle	1.22	Nescafe parcel	No	3540	4735	5400				1.069		1.344		1.304		3.259		4.563	
63	Kochugaon-Guwahati	UP21CN5270	Uttarakhand	Guwahati	3Axle	1.22	Parcel	No	3945	5850	5230				1.191		1.469		2.010		4.656		6.666	
68	Kochugaon-Guwahati	MH04HY9816	Mumbai	Guwahati	3Axle	1.22	Parcel	No	3810	5840	5430				1.150		1.494		1.749		4.983		6.732	
69	Kochugaon-Guwahati	BP02A1604	Bilasipara	Guwahati	3Axle	1.22	Empty	No	2240	2010	1950				0.676		0.525		0.209		0.076		0.285	
72	Kochugaon-Guwahati	WB05J9805	Kolkata	Guwahati	3Axle	1.22	Parcel	No	3910	4850	4630				1.180		1.257		1.940		2.495		4.435	
78	Kochugaon-Guwahati	KA01AL4160	Kolkata	Tezpur	3Axle	1.22	Empty	No	3510	6430	5840				1.059		1.627		1.260		7.002		8.262	
81	Kochugaon-Guwahati	UP79GT8124	Lucknow	Guwahati	3Axle	1.22	Cool drinks	No	4130	5610	5345				1.247		1.452		2.415		4.449		6.864	
82	Kochugaon-Guwahati	UP23AT3213	Mumbai	Guwahati	3Axle	1.22	Cotton	No	4130	5140	5435				1.247		1.402		2.415		3.863		6.278	
86	Kochugaon-Guwahati	HR55AD9064	Delhi	Guwahati	3Axle	1.22	Parcel	No	4200	7100	6855				1.268		1.850		2.583		11.715		14.298	
93	Kochugaon-Guwahati	NL01G9737	Chennai	Guwahati	3Axle	1.22	Wires	No	3610	5215	4815				1.090		1.330		1.410		3.126		4.536	
95	Kochugaon-Guwahati	AP39Y7652	Chittoor	Guwahati	3Axle	1.22	Pipes	No	3455	5320	5140				1.043		1.387		1.183		3.698		4.881	
103	Kochugaon-Guwahati	AP07TU7299	Tanuku	Guwahati	3Axle	1.22	Fish	No	3650	6150	5830				1.102		1.588		1.473		6.363		7.836	
111	Kochugaon-Guwahati	UP21BN8872	Delhi	Guwahati	3Axle	1.22	Fortune	Yes	3675	6675	5920				1.109		1.670		1.514		7.773		9.288	
112	Kochugaon-Guwahati	UP21CT6016	Kolkata	Guwahati	3Axle	1.22	Fortune	No	3580	6515	6270				1.081		1.695		1.363		8.253		9.617	
116	Kochugaon-Guwahati	NL01BC1269	Kolkata	Guwahati	3Axle	1.22	Parcel	No	3560	4560	4125				1.075		1.151		1.333		1.758		3.091	
117	Kochugaon-Guwahati	BP02B1712	Bilasipara	Guwahati	3Axle	1.22	Iron	No	4165	7850	7640				1.257		2.054		2.498		17.784		20.282	
118	Kochugaon-Guwahati	NL10B8275	Galapada	Nagaon	3Axle	1.22	Empty	No	2475	1975	1720				0.747		0.490		0.311		0.058		0.369	
123	Kochugaon-Guwahati	NL01AS5951	Kolkata	Guwahati	3Axle	1.22	Apples	No	4025	6535	6230				1.215		1.692		2.179		8.202		10.380	
125	Kochugaon-Guwahati	NL01GB6154	Uttarakhand	Guwahati	3Axle	1.22	Biscuits	No	3275	4830	4450				0.989		1.230		0.955		2.291		3.246	
127	Kochugaon-Guwahati	AS17C0378	Patgaon	Barpeta	3Axle	1.22	Empty	No	3875	5975	5720				1.170		1.550		1.872		5.779		7.650	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
129	Kochugaon-Guwahati	BP02A7126	Bilasipara	Guwahati	3Axle	1.22	Empty	No	2560	2175	1980				0.773		0.551		0.357		0.092		0.449	
134	Kochugaon-Guwahati	WB25D7632	Kolkata	Guwahati	3Axle	1.22	Cable drums	No	3245	4435	4760				0.979		1.219		0.920		2.208		3.129	
136	Kochugaon-Guwahati	WB23E2352	Kolkata	Guwahati	3Axle	1.22	Tyres	No	3140	4730	4940				0.948		1.282		0.807		2.701		3.508	
137	Kochugaon-Guwahati	NL01L9028	Noida	Guwahati	3Axle	1.22	Bikes	No	3450	5325	5140				1.041		1.387		1.176		3.705		4.881	
139	Kochugaon-Guwahati	NL01AS6234	Noida	Guwahati	3Axle	1.22	Parcel	No	3550	5460	5270				1.072		1.423		1.318		4.095		5.413	
140	Kochugaon-Guwahati	NL01K1619	West Bengal	Nagaland	3Axle	1.22	Fortune	No	3560	4920	4750				1.075		1.282		1.333		2.701		4.034	
143	Kochugaon-Guwahati	HR55SB8553	Haryana	Shillong	3Axle	1.22	Rice	No	4230	6530	5270				1.277		1.564		2.658		5.989		8.646	
144	Kochugaon-Guwahati	JK05G2345	Jharkhand	Tripura	3Axle	1.22	Fortune	No	3560	5625	5420				1.075		1.464		1.333		4.597		5.930	
147	Kochugaon-Guwahati	UP21BN8070	Uttarpradesh	Guwahati	3Axle	1.22	Pipes	No	3470	6235	5820				1.047		1.598		1.203		6.524		7.727	
148	Kochugaon-Guwahati	UP21CN5610	Uttarpradesh	Guwahati	3Axle	1.22	Dal	No	4130	6725	6235				1.247		1.718		2.415		8.715		11.130	
153	Kochugaon-Guwahati	NL01AF3799	Delhi	Guwahati	3Axle	1.22	Parcel	No	3785	5430	5125				1.142		1.399		1.704		3.834		5.538	
154	Kochugaon-Guwahati	UP16GE1288	Uttar Pradesh	Shillong	3Axle	1.22	Dal	No	3850	4560	6250				1.162		1.433		1.824		4.218		6.042	
157	Kochugaon-Guwahati	WB27B0692	Siliguri	Nagaon	3Axle	1.22	Oil	No	2860	2320	1850				0.863		0.553		0.555		0.093		0.649	
158	Kochugaon-Guwahati	RJ52UA5235	Nagpur	Silchar	3Axle	1.22	Furniture	No	3235	4370	4625				0.976		1.192		0.909		2.022		2.931	**5.549**
160	Kochugaon-Guwahati	NL01L3786	Kishangarh	Tezpur	3Axle	1.22	Parcel	No	3835	5435	5160				1.158		1.405		1.795		3.892		5.688	
161	Kochugaon-Guwahati	HR38AD3586	Raniganj	Barpeta	3Axle	1.22	Biscuits	Yes	3175	5175	4970				0.958		1.345		0.844		3.272		4.116	
162	Kochugaon-Guwahati	RJ07D7928	Noida	Guwahati	3Axle	1.22	Parcel	No	4040	5230	4830				1.219		1.334		2.211		3.164		5.375	
163	Kochugaon-Guwahati	WB15F6255	Kolkata	Guwahati	3Axle	1.22	Soap	No	3285	5675	5430				0.992		1.472		0.967		4.698		5.664	
171	Kochugaon-Guwahati	AP05TG3998	Vijayawada	Guwahati	3Axle	1.22	Eggs	No	2780	4535	4340				0.839		1.177		0.496		1.916		2.412	
172	Kochugaon-Guwahati	AS01CC1189	Cooch Behar	Nagaon	3Axle	1.22	Potatoes	No	3840	5950	5740				1.159		1.550		1.805		5.769		7.574	
179	Kochugaon-Guwahati	UP61T9163	Jaunpur	Guwahati	3Axle	1.22	Tiles	No	3450	4750	4555				1.041		1.234		1.176		2.316		3.492	
182	Kochugaon-Guwahati	WB60TC4370	Kolkata	Guwahati	3Axle	1.22	Plastic Water bottles	No	4140	5735	5530				1.250		1.493		2.438		4.974		7.413	
187	Kochugaon-Guwahati	AP39Y1999	Vijayawada	Guwahati	3Axle	1.22	Eggs	No	3840	4750	4650				1.159		1.246		1.805		2.412		4.217	
206	Kochugaon-Guwahati	RJ18GB1875	Jaipur	Guwahati	3Axle	1.22	Marble	No	4230	7460	7150				1.277		1.937		2.658		14.074		16.732	
208	Kochugaon-Guwahati	AP19AC3834	Guhiyapal	Borbila	3Axle	1.22	Empty	No	4350	6095	5775				1.313		1.574		2.972		6.132		9.104	
218	Kochugaon-Guwahati	HR55H2925	Mumbai	Guwahati	3Axle	1.22	Parcel	Yes	4030	5430	5215				1.216		1.411		2.189		3.966		6.156	
224	Kochugaon-Guwahati	PB65AU9588	Delhi	Mizoram	3Axle	1.22	Parcel	No	3840	5235	4930				1.159		1.348		1.805		3.298		5.103	
227	Kochugaon-Guwahati	UP21BN5936	Kolkata	Guwahati	3Axle	1.22	Empty	No	3480	3920	4120				1.050		1.066		1.217		1.291		2.508	
231	Kochugaon-Guwahati	OD01R0943	Cuttack	Guwahati	3Axle	1.22	Parcel	No	2450	1925	1590				0.740		0.466		0.299		0.047		0.346	
236	Kochugaon-Guwahati	MP07NB8322	Bhopal	Mizoram	3Axle	1.22	Parcel	No	3595	4925	4820				1.085		1.292		1.386		2.786		4.172	
238	Kochugaon-Guwahati	UP41A8153	Jodhpur	Shillong	3Axle	1.22	Potatoes	No	3685	5530	5420				1.112		1.452		1.531		4.441		5.972	
242	Kochugaon-Guwahati	WB29C1420	Durgapur	Guwahati	3Axle	1.22	Parcel	No	3695	4640	4510				1.115		1.213		1.547		2.165		3.713	
244	Kochugaon-Guwahati	OD07MH4555	Bhubaneswar	Imphal	3Axle	1.22	Food	No	3425	4820	4750				1.034		1.269		1.142		2.591		3.733	
255	Kochugaon-Guwahati	NL01L4317	Siliguri	Guwahati	3Axle	1.22	Food	No	2930	4130	3725				0.884		1.041		0.612		1.176		1.788	
262	Kochugaon-Guwahati	NL01B7901	Delhi	Sildharampur	3Axle	1.22	Fortune	No	3325	4520	3750				1.004		1.096		1.015		1.445		2.459	
263	Kochugaon-Guwahati	NL01Q9264	Gujarat	Guwahati	3Axle	1.22	Parcel	No	3615	5920	5755				1.091		1.548		1.418		5.739		7.157	
270	Kochugaon-Guwahati	WB76GB1803	Kolkata	Nagaon	3Axle	1.22	Parcel	No	3595	4325	3520				1.085		1.040		1.386		1.170		2.556	
276	Kochugaon-Guwahati	NL01A7213	Srirampur	Guwahati	3Axle	1.22	Empty	No	2620	1720	1920				0.791		0.483		0.391		0.054		0.445	
280	Kochugaon-Guwahati	NL01G2701	West Bengal	Guwahati	3Axle	1.22	Chairs	No	3840	4950	4810				1.159		1.294		1.805		2.803		4.608	
281	Kochugaon-Guwahati	NL01AF9992	West Bengal	Guwahati	3Axle	1.22	Chairs	No	3755	5120	4910				1.133		1.330		1.650		3.126		4.777	
282	Kochugaon-Guwahati	UP37A6410	Lucknow	Nagaland	3Axle	1.22	Parcel	No	3860	4215	3530				1.165		1.027		1.843		1.111		2.954	
290	Kochugaon-Guwahati	RJ09EB0738	Jaipur	Guwahati	3Axle	1.22	Tiles	No	3730	6530	6740				1.126		1.759		1.607		9.579		11.185	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
293	Kochugaon-Guwahati	HR55U8529	Delhi	Guwahati	3Axle	1.22	Parcel	No	3590	4170	3630				1.084		1.034		1.379		1.143		2.522	
294	Kochugaon-Guwahati	AS01KC8711	Bongaigaon	Tezpur	3Axle	1.122	Empty	No	2750	2015	1930				0.830		0.523		0.475		0.075		0.550	
302	Kochugaon-Guwahati	UP21CJ5568	Delhi	Shillong	3Axle	1.22	Dal	No	2890	4530	4235				0.872		1.162		0.579		1.823		2.402	
304	Kochugaon-Guwahati	UP28FN7389	Mumbai	Guwahati	3Axle	1.22	Flipkart	No	3875	5620	5320				1.170		1.450		1.872		4.425		6.296	
310	Kochugaon-Guwahati	WB57A5946	West Bengal	Guwahati	3Axle	1.22	Parcel	No	3150	4585	3895				0.951		1.124		0.817		1.597		2.415	
321	Kochugaon-Guwahati	WB97B1857	Kolkata	Barpeta	3Axle	1.22	Powder	No	4130	6950	6540				1.247		1.788		2.415		10.230		12.645	
324	Kochugaon-Guwahati	MH04KV1941	Mumbai	Guwahati	3Axle	1.22	Parcel	No	3670	5120	4975				1.108		1.338		1.506		3.208		4.714	
331	Kochugaon-Guwahati	PB22K9782	Punjab	Guwahati	3Axle	1.22	Rice	No	4120	7515	7120				1.244		1.940		2.392		14.171		16.562	
336	Kochugaon-Guwahati	UP21CN6990	Cooch Behar	Guwahati	3Axle	1.22	Parcel	No	3930	5730	5325				1.186		1.466		1.980		4.614		6.594	
347	Kochugaon-Guwahati	AS26C9962	Siliguri	Guwahati	3Axle	1.22	Empty	No	3840	5675	5240				1.159		1.447		1.805		4.384		6.189	
350	Kochugaon-Guwahati	NL01L6624	Uttar Pradesh	Guwahati	3Axle	1.22	Parcel	No	3450	5430	5150				1.041		1.403		1.176		3.870		5.046	
352	Kochugaon-Guwahati	WB73D5069	Kolkata	Guwahati	3Axle	1.22	Parcel	No	3730	4935	4325				1.126		1.228		1.607		2.271		3.878	
357	Kochugaon-Guwahati	NL01AF7362	Kolkata	Guwahati	3Axle	1.22	Parcel	No	3740	5130	4875				1.129		1.326		1.624		3.095		4.719	
363	Kochugaon-Guwahati	BP02A8687	Raipur	Guwahati	3Axle	1.22	Empty	No	3540	6015	5715				1.069		1.555		1.304		5.848		7.152	
372	Kochugaon-Guwahati	NL02G5437	Kolkata	Guwahati	3Axle	1.22	Fuel	No	3645	5875	5615				1.100		1.523		1.465		5.384		6.849	
375	Kochugaon-Guwahati	BP02A4067	Delhi	Barpeta	3Axle	1.22	Empty	No	2540	2050	1895				0.767		0.523		0.346		0.075		0.420	
380	Kochugaon-Guwahati	WB61B6335	Kolkata	Guwahati	3Axle	1.22	Fish	No	2740	1915	1720				0.827		0.482		0.468		0.054		0.522	
382	Kochugaon-Guwahati	WB39C1094	Alipurduar	Guwahati	3Axle	1.22	Empty	No	2730	5625	5335				0.824		1.453		0.461		4.457		4.918	
383	Kochugaon-Guwahati	WB11C7663	West Bengal	Nagaland	3Axle	1.22	Parcel	No	3730	4970	4510				1.126		1.257		1.607		2.495		4.102	
384	Kochugaon-Guwahati	AS01SC6022	Kolkata	Guwahati	3Axle	1.22	Fuel	No	3740	4975	4710				1.129		1.284		1.624		2.718		4.342	
385	Kochugaon-Guwahati	NL01AC9349	Delhi	Guwahati	3Axle	1.22	Flipkart	Yes	2875	7430	7150				0.868		1.933		0.567		13.959		14.526	
386	Kochugaon-Guwahati	MH04GR4389	Gujarat	Mizoram	3Axle	1.22	Perfume	No	2740	4730	4535				0.827		1.228		0.468		2.276		2.744	
387	Kochugaon-Guwahati	WB71B8313	Kolkata	Guwahati	3Axle	1.22	Parcel	Yes	3935	5430	5145				1.188		1.402		1.990		3.863		5.853	
395	Kochugaon-Guwahati	AS15AC5391	Kokrajhar	Barpeta	3Axle	1.22	Empty	No	3935	5870	5435				1.188		1.499		1.990		5.046		7.036	
11	Kochugaon-Guwahati	JK14E0649	Pune	Guwahati	MAV	1.1.22	Tomatoes	No	3285	3515	7235	6535			0.992	1.061	1.826		0.967	1.267	11.106		13.340	
12	Kochugaon-Guwahati	AP37TF3726	Vizag	Guwahati	MAV	1.1.22	Fish	No	3625	4246	5675	5230			1.094	1.282	1.446		1.433	2.698	4.368		8.500	
22	Kochugaon-Guwahati	AP39T2989	Kakinada	Guwahati	MAV	1.1.22	Fish	No	3420	4250	7430	6650			1.032	1.283	1.867		1.136	2.708	12.140		15.984	
24	Kochugaon-Guwahati	AS17C1375	Kolkata	Guwahati	MAV	1.1.22	Potatoes	No	3870	4835	7945	7420			1.168	1.459	2.037		1.862	4.536	17.217		23.615	
29	Kochugaon-Guwahati	AS17B6979	Golapara	Bolpita	MAV	1.1.22	Potatoes	No	3695	5190	7015	6545			1.115	1.567	1.798		1.547	6.023	10.444		18.014	
36	Kochugaon-Guwahati	AS018C5579	Hubballi	Tinsukia	MAV	1.1.22	Tobacco	No	4034	5235	7460	7065			1.218	1.580	1.926		2.198	6.234	13.750		22.182	
43	Kochugaon-Guwahati	AP05TF3169	Tadepalle	Imphal	MAV	1.1.22	Fish	No	3250	4010	7215	6320			0.981	1.210	1.794		0.926	2.146	10.367		13.439	
47	Kochugaon-Guwahati	PB11BU8922	Odisha	Guwahati	MAV	1.1.22	Empty	No	2785	2530	2135	1835			0.841	0.764	0.526		0.499	0.340	0.077		0.916	
49	Kochugaon-Guwahati	WB39C1001	Sil Koti	Shillong	MAV	1.1.22	Biscuits	No	3275	4265	5470	5130			0.989	1.287	1.405		0.955	2.747	3.900		7.601	
52	Kochugaon-Guwahati	WB41H6555	Kolkata	Sherpur	MAV	1.1.22	Sleeper	No	3785	4210	6860	5935			1.142	1.271	1.696		1.704	2.608	8.279		12.590	
56	Kochugaon-Guwahati	AP07TB8379	Tanuku	Guwahati	MAV	1.1.22	Fish	No	3225	4210	7345	6830			0.973	1.271	1.879		0.898	2.608	12.471		15.977	
61	Kochugaon-Guwahati	WB39C1003	West Bengal	Guwahati	MAV	1.1.22	Empty	No	2760	2535	2830	2525			0.833	0.765	0.710		0.482	0.343	0.254		1.078	
70	Kochugaon-Guwahati	WB03C9097	Kolkata	Tinsukia	MAV	1.1.22	Paper	No	3940	4650	5940	5725			1.189	1.404	1.546		2.000	3.881	5.720		11.601	
73	Kochugaon-Guwahati	PB11BA6425	Chandigarh	Shillong	MAV	1.1.22	Chemical	No	3475	4645	4895	4710			1.049	1.402	1.273		1.210	3.864	2.629		7.704	
74	Kochugaon-Guwahati	UP17AT7473	Muradabad	Mizoram	MAV	1.1.22	Plastic	No	3450	4025	5650	5430			1.041	1.215	1.469		1.176	2.179	4.656		8.010	
77	Kochugaon-Guwahati	BP02B0797	Patgaon	Guwahati	MAV	1.1.22	Empty	No	2435	2235	1960	1875			0.735	0.675	0.508		0.292	0.207	0.067		0.566	
84	Kochugaon-Guwahati	BP02B1022	Naglamitan	Nganglam	MAV	1.1.22	Empty	No	2460	2155	2340	2110			0.743	0.650	0.590		0.304	0.179	0.121		0.604	
91	Kochugaon-Guwahati	AP39TB0797	Tirupati	Guwahati	MAV	1.1.22	Amaron batteries	No	3805	4405	5680	5310			1.149	1.330	1.457		1.740	3.125	4.506		9.372	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
92	Kochugaon-Guwahati	AS17B9954	Tirupati	Guwahati	MAV	1.1.22	Potatoes	No	3530	5035	8940	8755			1.065	1.520	2.346		1.289	5.335	30.285		36.908	
94	Kochugaon-Guwahati	CG04JD9422	Jharkhand	Guwahati	MAV	1.1.22	Gov equipment	No	2800	5335	6645	6110			0.845	1.610	1.691		0.510	6.724	8.176		15.411	
100	Kochugaon-Guwahati	NL02L5337	Kolkata	Nagaland	MAV	1.1.22	Fuel	No	4130	4530	6530	6315			1.247	1.367	1.703		2.415	3.495	8.409		14.320	
104	Kochugaon-Guwahati	AP16TG4587	Guntur	Nagaland	MAV	1.1.22	Fish	No	4135	5670	5810	5710			1.248	1.711	1.527		2.427	8.579	5.440		16.446	
107	Kochugaon-Guwahati	AP16TH0077	Guntur	Guwahati	MAV	1.1.22	Tobacco	No	4160	5275	6530	6350			1.256	1.592	1.708		2.486	6.427	8.501		17.414	
108	Kochugaon-Guwahati	AP16TP2266	Vijayawada	Guwahati	MAV	1.1.22	Fish	No	3015	4650	6875	6615			0.910	1.404	1.788		0.686	3.881	10.230		14.797	
120	Kochugaon-Guwahati	AP16TC4749	Vijayawada	Guwahati	MAV	1.1.22	Fish	No	2403	4650	6690	6430			0.725	1.404	1.739		0.277	3.881	9.153		13.311	
122	Kochugaon-Guwahati	WB33C5407	Kolkata	Guwahati	MAV	1.1.22	Pipes	No	4105	5125	6545	6315			1.239	1.547	1.705		2.357	5.727	8.449		16.532	
132	Kochugaon-Guwahati	BR23E3055	Kolkata	Shillong	MAV	1.1.22	Powder	No	3675	4235	6530	6320			1.109	1.278	1.704		1.514	2.670	8.422		12.607	
141	Kochugaon-Guwahati	WB41J9599	Cooch Behar	Shillong	MAV	1.1.22	Potatoes	No	3560	4230	6075	5425			1.075	1.277	1.525		1.333	2.658	5.403		9.394	
142	Kochugaon-Guwahati	WB78W4759	Kolkata	Guwahati	MAV	1.1.22	Oil	No	3675	4135	6735	6575			1.109	1.248	1.765		1.514	2.427	9.695		13.635	
152	Kochugaon-Guwahati	AS16T2752	Bongaigaon	Bhawanipur	MAV	1.1.22	Empty	No	2730	2035	2175	1930			0.824	0.614	0.544		0.461	0.142	0.088		0.691	
164	Kochugaon-Guwahati	RJ18C5040	Ahmedabad	Guwahati	MAV	1.1.22	Electrical	No	3480	3840	5930	5640			1.050	1.159	1.534		1.217	1.805	5.536		8.558	
168	Kochugaon-Guwahati	AP39W1555	Guntur	Guwahati	MAV	1.1.22	Eggs	No	4130	4325	5845	5640			1.247	1.305	1.523		2.415	2.904	5.375		10.694	
180	Kochugaon-Guwahati	RJ09GD1440	Jodhpur	Guwahati	MAV	1.1.22	Medicine	No	3240	4535	4735	4500			0.978	1.369	1.224		0.915	3.511	2.247		6.673	
185	Kochugaon-Guwahati	WB60D4229	Kolkata	Guwahati	MAV	1.1.22	Drums	No	2750	3210	7445	6635			0.830	0.969	1.867		0.475	0.881	12.140		13.496	
186	Kochugaon-Guwahati	AP39T3979	Kolkata	Guwahati	MAV	1.1.22	Fish	No	3670	5470	6750	6540			1.108	1.651	1.762		1.506	7.431	9.637		18.574	
189	Kochugaon-Guwahati	RJ34GA4832	Jodhpur	Guwahati	MAV	1.1.22	Potatoes	No	3870	5470	6540	5840			1.168	1.651	1.641		1.862	7.431	7.256		16.549	
190	Kochugaon-Guwahati	NL01Q1209	Siliguri	Guwahati	MAV	1.1.22	Cow food	No	3640	5450	7545	7340			1.099	1.645	1.973		1.457	7.323	15.164		23.945	
191	Kochugaon-Guwahati	WB11DA9383	Kolkata	Guwahati	MAV	1.1.22	House material	No	2440	5430	7640	7240			0.736	1.639	1.973		0.294	7.216	15.144		22.654	
192	Kochugaon-Guwahati	JH11AA9496	West Bengal	Guwahati	MAV	1.1.22	Steel	No	3950	5530	8310	7540			1.192	1.669	2.101		2.021	7.763	19.496		29.279	
194	Kochugaon-Guwahati	PB11CZ5102	Srirampur	Guwahati	MAV	1.1.22	Fuel	No	3675	3320	7640	7450			1.109	1.002	2.001		1.514	1.008	16.017		18.540	
200	Kochugaon-Guwahati	AP07TF4968	Andhra Pradesh	Guwahati	MAV	1.1.22	Eggs	No	2460	4335	5730	5415			0.743	1.308	1.478		0.304	2.931	4.766		8.001	
201	Kochugaon-Guwahati	AP37TF1799	Narsapur	Guwahati	MAV	1.1.22	Fish	No	3415	4210	6475	6250			1.031	1.271	1.687		1.129	2.608	8.099		11.836	
202	Kochugaon-Guwahati	NL01K5798	Uttar Pradesh	Guwahati	MAV	1.1.22	Powder	No	3375	4735	6560	6390			1.019	1.429	1.717		1.077	4.172	8.688		13.937	
216	Kochugaon-Guwahati	HP38G3884	Kolkata	Guwahati	MAV	1.1.22	Wires	No	2850	4020	5435	5230			0.860	1.213	1.414		0.548	2.168	3.996		6.712	
222	Kochugaon-Guwahati	NL01AA8422	Agra	Shillong	MAV	1.1.22	Potatoes	No	3625	3985	5290	4640			1.094	1.203	1.316		1.433	2.093	3.003		6.530	
235	Kochugaon-Guwahati	WB65D6440	Kolkata	Guwahati	MAV	1.1.22	Perfume	No	3235	3520	6235	5650			0.976	1.062	1.576		0.909	1.274	6.163		8.347	
246	Kochugaon-Guwahati	TN15P2282	Chennai	Guwahati	MAV	1.1.22	Machinery	No	3350	5825	6670	6415			1.011	1.758	1.735		1.045	9.556	9.056		19.658	
252	Kochugaon-Guwahati	PB08E1198	Jalandhar	Guwahati	MAV	1.1.22	Food Grains	No	3840	6240	6875	6640			1.159	1.883	1.792		1.805	12.585	10.306		24.696	
253	Kochugaon-Guwahati	BR01GB8764	Patna	Guwahati	MAV	1.1.22	Animal food	No	4080	5335	8235	7640			1.232	1.610	2.105		2.300	6.724	19.619		28.644	
256	Kochugaon-Guwahati	RJ19GH1491	Rajasthan	Mizoram	MAV	1.1.22	Plastic	No	3260	4015	5725	5630			0.984	1.212	1.505		0.938	2.157	5.135		8.230	
258	Kochugaon-Guwahati	WB37T6919	Kolkata	Shillong	MAV	1.1.22	Slippers	No	2550	5275	6650	6235			0.770	1.592	1.708		0.351	6.427	8.515		15.292	
272	Kochugaon-Guwahati	TS08UD3771	Hyderabad	Guwahati	MAV	1.1.22	Medicine	No	3730	4365	6250	5810			1.126	1.318	1.599		1.607	3.013	6.535		11.155	
283	Kochugaon-Guwahati	UP63AT6382	Kanpur	Guwahati	MAV	1.1.22	Dal	No	3560	5870	6625	6010			1.075	1.772	1.675		1.333	9.855	7.873		19.061	
287	Kochugaon-Guwahati	RJ14GG6586	Patna	Guwahati	MAV	1.1.22	Animal Food	No	3940	5430	7325	6540			1.189	1.639	1.838		2.000	7.216	11.416		20.632	
299	Kochugaon-Guwahati	NL01AA9788	Alipurduar	Manipur	MAV	1.1.22	Potatoes	No	3670	4225	8320	7950			1.108	1.275	2.157		1.506	2.645	21.646		25.797	
303	Kochugaon-Guwahati	NL01E7309	Delhi	Guwahati	MAV	1.1.22	Electrical	No	3560	4335	5235	4670			1.075	1.308	1.313		1.333	2.931	2.973		7.238	
315	Kochugaon-Guwahati	AP37QC0349	Andhra Pradesh	Guwahati	MAV	1.1.22	Eggs	No	4225	4685	5875	5625			1.275	1.414	1.525		2.645	3.999	5.403		12.047	
317	Kochugaon-Guwahati	AS17B3799	Delhi	Nagaland	MAV	1.1.22	Liquor	No	3975	4235	6540	6325			1.200	1.278	1.706		2.072	2.670	8.462		13.204	
319	Kochugaon-Guwahati	AS17B2243	Bongaigaon	Guwahati	MAV	1.1.22	Medicine	No	3530	4335	4735	4530			1.065	1.308	1.228		1.289	2.931	2.276		6.496	
325	Kochugaon-Guwahati	AS17B2597	Cooch Behar	Dimapur	MAV	1.1.22	Empty	No	2530	2230	1920	1750			0.764	0.673	0.487		0.340	0.205	0.056		0.601	
329	Kochugaon-Guwahati	NL01AG0184	Uttar Pradesh	Nagaland	MAV	1.1.22	Parcel	No	3560	4275	4930	4525			1.075	1.290	1.253		1.333	2.772	2.469		6.574	
330	Kochugaon-Guwahati	WB43A3349	Agra	Guwahati	MAV	1.1.22	Potatoes	No	3735	4520	7240	6545			1.127	1.364	1.828		1.615	3.465	11.155		16.235	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
337	Kochugaon-Guwahati	NL01N3131	Delhi	Guwahati	MAV	1.1.22	Food Grains	No	3940	4465	5675	5320			1.189	1.348	1.458		2.000	3.299	4.514		9.814	
340	Kochugaon-Guwahati	UP25ET9814	Uttar Pradesh	Guwahati	MAV	1.1.22	Rice	No	3760	4530	7765	7295			1.135	1.367	1.997		1.659	3.495	15.890		21.045	
346	Kochugaon-Guwahati	WB57L4867	Kolkata	Guwahati	MAV	1.1.22	Clothes	No	3875	5920	5995	5745			1.170	1.787	1.556		1.872	10.195	5.868		17.935	
348	Kochugaon-Guwahati	UP45AT1370	Cooch Behar	Shillong	MAV	1.1.22	Potatoes	No	3875	4230	6935	6740			1.170	1.277	1.813		1.872	2.658	10.803		15.332	
356	Kochugaon-Guwahati	AS01AC3769	Agra	Guwahati	MAV	1.1.22	Potatoes	No	3880	4215	6840	6475			1.171	1.272	1.765		1.881	2.620	9.709		14.211	
371	Kochugaon-Guwahati	NL01AE4817	Jaipur	Guwahati	MAV	1.1.22	Parcel	No	3450	4340	5740	5490			1.041	1.310	1.489		1.176	2.945	4.913		9.034	
379	Kochugaon-Guwahati	AS16AC2914	Patgaon	Guwahati	MAV	1.1.22	Empty	No	2730	3525	6930	6715			0.824	1.064	1.809		0.461	1.282	10.708		12.451	
381	Kochugaon-Guwahati	NL01A9481	Kolkata	Guwahati	MAV	1.1.22	Fuel	No	3345	3920	5670	5430			1.010	1.183	1.472		1.039	1.960	4.689		7.689	
390	Kochugaon-Guwahati	AP26TD4879	Tadepalle	Guwahati	MAV	1.1.22	Fish	No	3450	3725	6120	5750			1.041	1.124	1.574		1.176	1.598	6.132		8.906	
391	Kochugaon-Guwahati	WB59B2355	Durgapur	Shillong	MAV	1.1.22	Iron	No	4035	5140	8460	8135			1.218	1.551	2.200		2.200	5.794	23.428		31.422	
393	Kochugaon-Guwahati	AP31TG9383	Tadepalle	Guwahati	MAV	1.1.22	Fish	No	3875	4135	5635	5450			1.170	1.248	1.470		1.872	2.427	4.664		8.962	
273	Kochugaon-Guwahati	RJ14GG1173	Jodhpur	Guwahati	MAV	1.2.11	Cars	No	2475	6190	4535	4135			0.747	1.518	1.149		0.311	5.311	1.745		7.368	
34	Kochugaon-Guwahati	AS03AC9471	Kolkata	Guwahati	MAV	1.2.22	Fuel	No	2975	6530	6560	6175			0.898	1.601	1.688		0.650	6.578	8.125		15.353	
65	Kochugaon-Guwahati	AS01JC5433	Kolkata	Guwahati	MAV	1.2.22	Fuel	No	2810	3950	5615	5410			0.848	0.969	1.462		0.518	0.881	4.564		5.962	
79	Kochugaon-Guwahati	GJ12AT9025	Jamnagar	Guwahati	MAV	1.2.22	Fuel	No	3810	5740	5635	5430			1.150	1.408	1.467		1.749	3.927	4.631		10.307	
126	Kochugaon-Guwahati	AS01MC9725	Kolkata	Mizoram	MAV	1.2.22	Fuel	No	4130	4475	7325	7130			1.247	1.097	1.916		2.415	1.451	13.486		17.352	
145	Kochugaon-Guwahati	AS23CC6324	Kolkata	Assam	MAV	1.2.22	House material	No	3730	5225	6720	6430			1.126	1.281	1.743		1.607	2.696	9.237		13.540	
149	Kochugaon-Guwahati	CG04MM5439	Delhi	Dimapur	MAV	1.2.22	Cars	No	2730	4050	4430	4120			0.824	0.993	1.134		0.461	0.973	1.651		3.085	
198	Kochugaon-Guwahati	AS01MC9630	Kolkata	Guwahati	MAV	1.2.22	Oil	No	2875	6875	6540	6170			0.868	1.686	1.685		0.567	8.082	8.061		16.710	
217	Kochugaon-Guwahati	KA01AF5149	Pathsala	Manipur	MAV	1.2.22	Fuel	No	2535	7020	6405	5210			0.765	1.722	1.540		0.343	8.786	5.622		14.751	
226	Kochugaon-Guwahati	AS01JC4986	Pathsala	Imphal	MAV	1.2.22	Fuel	No	2430	6925	6530	6290			0.733	1.698	1.700		0.289	8.320	8.344		16.953	
232	Kochugaon-Guwahati	NL01U3840	Delhi	Shillong	MAV	1.2.22	Fuel	No	2550	7225	6830	6620			0.770	1.772	1.783		0.351	9.858	10.109		20.318	
266	Kochugaon-Guwahati	AS02BC4546	Kolkata	Guwahati	MAV	1.2.22	Fuel	No	2410	5225	6215	5515			0.727	1.281	1.555		0.280	2.696	5.848		8.824	**14.830**
291	Kochugaon-Guwahati	HR39ES0426	Gurugram	Mizoram	MAV	1.2.22	Steel	No	3910	5260	8045	7450			1.180	1.290	2.054		1.940	2.769	17.807		22.516	
305	Kochugaon-Guwahati	HR55AK7882	Kolkata	Guwahati	MAV	1.2.22	Cars	No	4325	6420	6735	6540			1.305	1.574	1.760		2.904	6.146	9.593		18.643	
311	Kochugaon-Guwahati	AS25CC9642	Kolkata	Tinsukia	MAV	1.2.22	Oil	No	2950	3540	6750	6340			0.890	0.868	1.735		0.629	0.568	9.069		10.266	
314	Kochugaon-Guwahati	AS01SK6021	Kolkata	Shillong	MAV	1.2.22	Oil	No	3245	3450	6680	6275			0.979	0.846	1.717		0.920	0.513	8.701		10.134	
326	Kochugaon-Guwahati	NL01AA0662	Kolkata	Tinsukia	MAV	1.2.22	Oil	No	3560	4125	6795	6585			1.075	1.012	1.774		1.333	1.047	9.900		12.281	
327	Kochugaon-Guwahati	NL01AA0664	Kolkata	Tinsukia	MAV	1.2.22	Oil	No	3425	4320	6840	6670			1.034	1.059	1.791		1.142	1.260	10.291		12.693	
365	Kochugaon-Guwahati	RJ06GB5777	Kolkata	Guwahati	MAV	1.2.22	Steel Frames	No	4250	6590	7550	6640			1.283	1.616	1.881		2.708	6.823	12.524		22.055	
373	Kochugaon-Guwahati	NL01L2258	Kolkata	Tezpur	MAV	1.2.22	Fuel	No	3875	7560	7345	7120			1.170	1.854	1.918		1.872	11.817	13.524		27.212	
377	Kochugaon-Guwahati	NL01G7577	Uttar Pradesh	Guwahati	MAV	1.2.22	Frames	No	2975	3265	5670	5425			0.898	0.801	1.471		0.650	0.411	4.681		5.742	
396	Kochugaon-Guwahati	AS01NC7049	Mumbai	Shillong	MAV	1.2.22	Fuel	No	3860	4735	8530	8140			1.165	1.161	2.210		1.843	1.818	23.854		27.515	
398	Kochugaon-Guwahati	NL61Q2398	Kolkata	Tezpur	MAV	1.2.22	Oil	No	3560	4360	8730	8435			1.075	1.069	2.276		1.333	1.307	26.816		29.457	
16	Kochugaon-Guwahati	BR06GD4336	Siliguri	Imphal	MAV	1.1.122	Potatoes	No	3570	4130	5665	8430	8135		1.078	1.247		1.947096435	1.348	2.415		14.37308012	18.136	
19	Kochugaon-Guwahati	BR06GD4885	Delhi	Guwahati	MAV	1.1.122	Chemical	No	3670	4150	5235	6530	6130		1.108	1.253		1.567399492	1.506	2.462		6.035577164	10.004	
35	Kochugaon-Guwahati	AS17C1447	Hubballi	Tinsukia	MAV	1.1.122	Hen	No	3460	3840	4565	8340	8060		1.044	1.159		1.83629675	1.190	1.805		11.37028794	14.365	
67	Kochugaon-Guwahati	UP15DT6553	Lucknow	Guwahati	MAV	1.1.122	Potatoes	No	3590	4710	5985	7450	7135		1.084	1.422		1.80169922	1.379	4.085		10.53729558	16.001	
71	Kochugaon-Guwahati	HR74B1409	Delhi	Guwahati	MAV	1.1.122	Machinery	No	2510	2265	2070	2110	1630		0.758	0.684		0.508890251	0.329	0.218		0.067065092	0.615	
101	Kochugaon-Guwahati	KA25AA6856	Chattogram	Mizoram	MAV	1.1.122	Amaron batteries	No	4245	4830	5335	6135	5850		1.281	1.458		1.517035999	2.695	4.518		5.296433777	12.509	
114	Kochugaon-Guwahati	BR14G9702	Cooch Behar	Guwahati	MAV	1.1.122	Potatoes	No	4060	4730	5205	8435	8160		1.225	1.428		1.909433301	2.255	4.155		13.2928459	19.703	
119	Kochugaon-Guwahati	NL01AD4719	Kolkata	Guwahati	MAV	1.1.122	Atta	No	4175	4870	5125	8375	8015		1.260	1.470		1.884470526	2.522	4.669		12.61122858	19.802	
121	Kochugaon-Guwahati	UP80AT5231	Uttar Pradesh	Guwahati	MAV	1.1.122	Potatoes	No	3605	4875	5025	8450	7875		1.088	1.471		1.870018394	1.402	4.688		12.22879074	18.319	
124	Kochugaon-Guwahati	BR21GB1531	Bihar	Guwahati	MAV	1.1.122	Parcel	No	4025	4375	5035	7460	6875		1.215	1.321		1.6965928	2.179	3.041		8.285342741	13.505	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
131	Kochugaon-Guwahati	BR23E1875	Cooch Behar	Guwahati	MAV	1.1.122	Potatoes	No	4015	4120	5025	8650	8210		1.212	1.244		1.916878339	2.157	2.392		13.50138121	18.050	
151	Kochugaon-Guwahati	GJ12BY5745	Jamnagar	Guwahati	MAV	1.1.122	Oil	No	3560	4230	5450	7560	7170		1.075	1.277		1.767539634	1.333	2.658		9.760602879	13.751	
166	Kochugaon-Guwahati	UK06CB4820	Uttarakhand	Guwahati	MAV	1.1.122	Electrical	No	2870	4640	4985	5340	5150		0.866	1.401		1.355434878	0.563	3.848		3.375317465	7.786	
173	Kochugaon-Guwahati	OD14S4657	Bhubaneswar	Guwahati	MAV	1.1.122	Biscuits	No	3450	3120	4885	5430	5235		1.041	0.942		1.362004029	1.176	0.787		3.441228961	5.404	
177	Kochugaon-Guwahati	PB13TB8755	Punjab	Imphal	MAV	1.1.122	Tomatoes	No	3575	4335	5235	6870	6655		1.079	1.308		1.643163703	1.356	2.931		7.289929561	11.577	
178	Kochugaon-Guwahati	AS01PC5888	Punjab	Imphal	MAV	1.1.122	Steel Material	No	4150	4855	5985	8750	8315		1.253	1.465		2.018919156	2.462	4.612		16.61405771	23.688	
199	Kochugaon-Guwahati	WB65C8288	Kolkata	Agartala	MAV	1.1.122	Drums	No	2850	2640	4565	4340	4175		0.860	0.797		1.145659981	0.548	0.403		1.722752829	2.674	
203	Kochugaon-Guwahati	WB61B6494	Kolkata	Tezpur	MAV	1.1.122	Pipes	No	3560	3250	3850	6730	6350		1.075	0.981		1.482876412	1.333	0.926		4.83525996	7.095	
209	Kochugaon-Guwahati	UP36AT1717	West Bengal	Guwahati	MAV	1.1.122	Potatoes	No	4115	4735	6785	8610	8230		1.242	1.429		2.069282649	2.380	4.172		18.33493035	24.888	
221	Kochugaon-Guwahati	NL01AD9173	Delhi	Guwahati	MAV	1.1.122	Parcel	No	3845	3430	5235	5875	5640		1.161	1.035		1.467110449	1.814	1.149		4.632882026	7.596	
223	Kochugaon-Guwahati	WB41H1696	Cooch Behar	Nagaon	MAV	1.1.122	Potatoes	No	3890	4220	5235	6215	5820		1.174	1.274		1.512656565	1.901	2.632		5.235538361	9.769	
225	Kochugaon-Guwahati	BR11GC9585	Bihar	Guwahati	MAV	1.1.122	Garlic	No	3855	4825	5650	6520	6310		1.164	1.456		1.618638872	1.833	4.499		6.864357019	13.196	
233	Kochugaon-Guwahati	RJ23GC5826	Jansath	Mizoram	MAV	1.1.122	Iron	No	3295	3880	4235	6220	5585		0.995	1.171		1.404922484	0.978	1.881		3.895914808	6.756	
237	Kochugaon-Guwahati	UP74T4711	Lucknow	Guwahati	MAV	1.1.122	Parcel	No	4235	3985	5695	8240	7895		1.278	1.203		1.912060962	2.670	2.093		13.36616871	18.130	
239	Kochugaon-Guwahati	RJ02GB8999	Jaipur	Borkola	MAV	1.1.122	Drums	No	3425	3255	4850	5230	5095		1.034	0.982		1.329158273	1.142	0.932		3.121093612	5.195	
240	Kochugaon-Guwahati	MH04GE3291	Mumbai	Guwahati	MAV	1.1.122	Oil	No	3770	4665	5125	5925	5850		1.138	1.408		1.480248752	1.677	3.931		4.80107858	10.409	
243	Kochugaon-Guwahati	RJ14GN5532	Jodhpur	Guwahati	MAV	1.1.122	Animal Food	No	3640	4335	4985	5235	4745		1.099	1.308		1.310764649	1.457	2.931		2.951881237	7.340	
248	Kochugaon-Guwahati	BR11CG1686	Patna	Guwahati	MAV	1.1.122	Animal Food	No	3450	3410	4225	5640	5540		1.041	1.029		1.34930367	1.176	1.122		3.314658618	5.613	
254	Kochugaon-Guwahati	WB68GC9869	Kolkata	Guwahati	MAV	1.1.122	Machinery	No	4085	3525	4325	7240	6585		1.233	1.064		1.589734606	2.311	1.282		6.387023488	9.980	
257	Kochugaon-Guwahati	HR21GB1727	Durgapur	Nagaon	MAV	1.1.122	Iron	No	3325	4220	5380	8235	7720		1.004	1.274		1.868704563	1.015	2.632		12.19446031	15.842	
259	Kochugaon-Guwahati	WB23F6313	Sil Koti	Shillong	MAV	1.1.122	Parcel	No	3760	3625	5025	5780	5525		1.135	1.094		1.430323202	1.659	1.433		4.185397733	7.278	
260	Kochugaon-Guwahati	WB65C3213	Kolkata	Guwahati	MAV	1.1.122	Parcel	No	4090	4270	5145	7230	7125		1.235	1.289		1.707979329	2.323	2.759		8.510017266	13.592	
261	Kochugaon-Guwahati	WB57Q6025	Kolkata	Guwahati	MAV	1.1.122	Empty	No	2765	2535	2035	2160	1990		0.835	0.765		0.541736008	0.485	0.343		0.086129279	0.914	
268	Kochugaon-Guwahati	WB23E4315	West Bengal	Guwahati	MAV	1.1.122	Iron	No	3825	4690	5665	7320	6550		1.155	1.416		1.711044933	1.777	4.016		8.571279516	14.364	
271	Kochugaon-Guwahati	BR11GE4604	Patna	Kohima	MAV	1.1.122	Pulses	No	3240	4350	4985	6850	6675		0.978	1.313		1.621266532	0.915	2.972		6.909039423	10.796	
275	Kochugaon-Guwahati	NL01AC5177	Gurugram	Guwahati	MAV	1.1.122	Steel	No	4210	4360	5335	8765	8155		1.271	1.316		1.949286152	2.608	3.000		14.43784551	20.045	
285	Kochugaon-Guwahati	WB65C5765	Kolkata	Assam	MAV	1.1.122	Steel Rods	No	3910	4540	6250	7940	7510		1.180	1.370		1.900674433	1.940	3.526		13.05061359	18.517	
295	Kochugaon-Guwahati	RJ04GB4649	Jaipur	Guwahati	MAV	1.1.122	Tiles	No	4035	4640	4350	7280	6710		1.218	1.401		1.606376456	2.200	3.848		6.658698044	12.707	
307	Kochugaon-Guwahati	AS26C7724	Salakati	Bongaigaon	MAV	1.1.122	Concentarte Mixture	No	3535	4730	5525	8760	8435		1.067	1.428		1.99001489	1.296	4.155		15.68286139	21.134	
309	Kochugaon-Guwahati	WB61A2164	West Bengal	Guwahati	MAV	1.1.122	Rice	No	3920	4215	4875	6720	6535		1.183	1.272		1.587982833	1.960	2.620		6.358917817	10.939	
313	Kochugaon-Guwahati	PB01AC9802	Salakati	Bongaigaon	MAV	1.1.122	Concentarte Mixture	No	3840	4650	5685	8675	8240		1.159	1.404		1.979504248	1.805	3.881		15.35414906	21.040	
349	Kochugaon-Guwahati	NL01AE1413	Cooch Behar	Shillong	MAV	1.1.122	Concentarte Mixture	No	3650	4575	4325	8650	8275		1.102	1.381		1.861259525	1.473	3.636		12.00128456	17.111	
351	Kochugaon-Guwahati	NL01AC1416	Kolkata	Guwahati	MAV	1.1.122	Concentarte Mixture	No	3740	4380	5985	7815	7230		1.129	1.322		1.841990015	1.624	3.055		11.51195509	16.191	
353	Kochugaon-Guwahati	NL01AB9451	Kolkata	Guwahati	MAV	1.1.122	Concentarte Mixture	No	4335	4315	5635	8895	8370		1.308	1.302		2.005780853	2.931	2.878		16.18579088	21.995	
370	Kochugaon-Guwahati	AS01TC8797	Siliguri	Imphal	MAV	1.1.122	Parcel	No	3560	3275	5250	5820	5675		1.075	0.989		1.466672506	1.333	0.955		4.627352703	6.916	
374	Kochugaon-Guwahati	MP09HJ2031	Delhi	Barpeta	MAV	1.1.122	Potatoes	No	3875	4320	5330	7530	7255		1.170	1.304		1.761846369	1.872	2.891		9.635453135	14.398	
378	Kochugaon-Guwahati	BR11GC9587	Bihar	Guwahati	MAV	1.1.122	Steel Pipes	No	3730	3525	4985	6930	6715		1.126	1.064		1.631777174	1.607	1.282		7.089953966	9.978	
13	Kochugaon-Guwahati	WB61B6339	Durgapur	Nagon	MAV	1.1.222	Iron	No	3780	4560	2530	9435	8630		1.141	1.376		1.803888938	1.695	3.589		10.58861557	15.872	
59	Kochugaon-Guwahati	NL01L3338	Delhi	Imphal	MAV	1.1.222	Parcel	No	4515	4625	2735	8945	8730		1.363	1.396		1.787685031	3.449	3.798		10.21325122	17.461	
128	Kochugaon-Guwahati	UP15FT8643	Agra	Guwahati	MAV	1.1.222	Potatoes	No	4415	4730	5985	8560	8175		1.333	1.428		1.99001489	3.154	4.155		15.68286139	22.992	
249	Kochugaon-Guwahati	WB39C1994	Durgapur	Guwahati	MAV	1.1.222	Steel	No	2535	2240	2040	1870	1420		0.765	0.676		0.466847683	0.343	0.209		0.04750079	0.599	
10	Kochugaon-Guwahati	PB19M8540	Kolkata	Guwahati	MAV	1.2.222	Iron	No	3255	4775	5350	5710	5175		0.982	1.171		1.422002277	0.932	1.881		4.088849896	6.901	
66	Kochugaon-Guwahati	RJ07GB3015	Jaipur	Guwahati	MAV	1.2.222	Steel	No	3145	5490	6140	6450	6245		0.949	1.346		1.649732855	0.812	3.286		7.407207212	11.506	
98	Kochugaon-Guwahati	UP51AT5177	Agra	Nagaon	MAV	1.2.222	Potatoes	No	2660	2330	1950	2260	1635		0.803	0.571		0.511955855	0.416	0.107		0.06869578	0.591	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
133	Kochugaon-Guwahati	PB02DT9421	Patgaon	Guwahati	MAV	1.2.222	Empty	No	2760	2430	2135	1975	1720		0.833	0.596		0.510642025	0.482	0.126		0.067993315	0.676	
184	Kochugaon-Guwahati	WB25L0924	West Bengal	Nagaland	MAV	1.2.222	Steel	No	3210	4230	6565	8840	8455		0.969	1.037		2.089865989	0.881	1.158		19.07540437	21.115	
195	Kochugaon-Guwahati	PB10EC9813	Srirampur	Guwahati	MAV	1.2.222	Steel	No	3720	4860	4635	8250	7645		1.123	1.192		1.798195673	1.590	2.018		10.45557191	14.063	
211	Kochugaon-Guwahati	PB12D7485	Jalalpur	Guwahati	MAV	1.2.222	Soil	No	3640	4630	7455	9430	8710		1.099	1.135		2.241832355	1.457	1.662		25.25878937	28.378	
212	Kochugaon-Guwahati	RJ02GB5784	Jamshedpur	Niz Damaka	MAV	1.2.222	Iron	No	3845	4935	7340	9140	8545		1.161	1.210		2.191906806	1.814	2.146		23.08279212	27.043	
213	Kochugaon-Guwahati	GJ02AK8264	Delhi	Imphal	MAV	1.2.222	Soil	No	4010	4840	7940	9430	9240		1.210	1.187		2.330734869	2.146	1.985		29.51015523	33.642	
214	Kochugaon-Guwahati	NL01AD1425	Jharkhand	Shillong	MAV	1.2.222	Iron	No	3850	4735	8235	8925	6720		1.162	1.161		2.091617763	1.824	1.818		19.1394426	22.782	
215	Kochugaon-Guwahati	NL01Q6604	Kolkata	Guwahati	MAV	1.2.222	Powder	No	2530	4325	6530	6420	5125		0.764	1.061		1.583165455	0.340	1.266		6.282105415	7.888	
267	Kochugaon-Guwahati	RJ02AJ3321	Rajasthan	Shillong	MAV	1.2.222	Tiles	No	3420	4560	5925	5690	5210		1.032	1.118		1.473679601	1.136	1.564		4.716417991	7.416	
279	Kochugaon-Guwahati	NL01AC5254	Rajasthan	Guwahati	MAV	1.2.222	Tiles	No	3650	5615	9230	9225	8640		1.102	1.377		2.373215381	1.473	3.596		31.72112762	36.790	
296	Kochugaon-Guwahati	NL01C3332	Jamshedpur	Guwahati	MAV	1.2.222	Steel	No	4350	5310	9340	9180	8555		1.313	1.302		2.371463607	2.972	2.876		31.62757228	37.476	
297	Kochugaon-Guwahati	NL01C3129	Jamshedpur	Guwahati	MAV	1.2.222	Steel	No	3255	4275	4450	5315	4640		0.982	1.048		1.261714986	0.932	1.208		2.534224273	4.674	
14	Kochugaon-Guwahati	NL01AE1467	Odisha	Guwahati	MAV	1.22.222	Iron	No	3420	4980	7340	8535	9230	8450	1.032		1.633	2.296	1.136		7.116	27.797	36.049	
15	Kochugaon-Guwahati	PB10DS3791	Odisha	Guwahati	MAV	1.22.222	Iron	No	3435	5225	6985	7335	8890	8110	1.037		1.619	2.131	1.156		6.866	20.640	28.662	
183	Kochugaon-Guwahati	RJ02GB4452	Rajkot	Nagaland	MAV	1.22.222	Tea Powder	No	4050	5340	6750	4565	6850	6670	1.222		1.603	1.584	2.233		6.600	6.296	15.129	
277	Kochugaon-Guwahati	RJ07GC3462	Jodhpur	Guwahati	MAV	1.22.222	Steel	No	4050	5030	7365	8530	9430	8740	1.222		1.643	2.339	2.233		7.291	29.911	39.436	
278	Kochugaon-Guwahati	RJ14GP6885	Rajasthan	Guwahati	MAV	1.22.222	Marble	No	4375	5330	9530	9350	9860	9250	1.321		1.970	2.493	3.041		15.063	38.613	56.716	
284	Kochugaon-Guwahati	RJ12GC5493	Gujarat	Guwahati	MAV	1.22.222	Tiles	No	3930	6130	7035	7325	8640	7965	1.186		1.745	2.096	1.980		9.279	19.300	30.559	
366	Kochugaon-Guwahati	UP22AT3459	Durgapur	Guwahati	MAV	1.22.222	Steel	No	4105	5450	7250	8255	9630	9235	1.239		1.684	2.375	2.357		8.036	31.838	42.231	
368	Kochugaon-Guwahati	AS25CC9400	Srirampur	Mizoram	MAV	1.22.222	Fuel	No	3455	4315	5540	5640	6310	6245	1.043		1.307	1.594	1.183		2.914	6.451	10.547	

Annexure – 4.6

Methodology of FWD

1 PRINCIPLE OF FLEXIBLE PAVEMENT EVALUATION USING FWD

Performance of flexible pavements can be evaluated by applying loads on the pavements that simulate the traffic loading, recording the response to such loading by measuring the elastic deflection under such loads, and analyzing these data duly considering the factors influencing the performance such as subgrade strength, thickness and quality of each of the pavement layers, drainage conditions, pavement surface temperature etc.

Among the equipment available for structural evaluation of pavements, the Falling Weight Deflectometer (FWD) is extensively used world-wide because it simulates, to a large extent, the actual loading conditions of the pavement. When a moving wheel load passes over the pavement it produces load pulses. Normal stresses (vertical as well as horizontal) at a location in the pavement will increase in magnitude from zero to a peak value as the moving wheel load approaches the location. The time taken for the stress pulse to vary from zero to peak value is termed as 'rise time of the pulse'. As the wheel moves away from the location, magnitude of stress reduces from peak value to zero. The time period during which the magnitude of stress pulse varies from 'zero-to-peak-to-zero' is the pulse duration. Peak load and the corresponding pavement responses are of interest for pavement evaluation.

The resulting load-deflection data can be interpreted through appropriate analytical techniques, such as back calculation technique, to estimate the elastic moduli of the pavement layers. The computed moduli are, in turn, used for (i) the strength evaluation of different layers of in-service pavements (ii) the estimation of the remaining life of in-service pavement (iii) determination of strengthening requirement, if any and (iv) evaluation of different rehabilitation alternatives (overlay, recycling, partial reconstruction, etc.)

2 BRIEF DISCRIPTION OF FALLING WEIGHT DEFLECTOMETER (FWD)

Falling Weight Deflectometer is an impulse-generating device with a guide system. This device allows a variable weight to be dropped from a variable height. The apparatus has a loading plate which is used for uniform force distribution on the test layer. When the weight affects this plate, this loading plate ensures that the resulting force is applied perpendicularly to the test layer’s surface. It also has a load cell for measuring the actual applied impulse. It also has one or more deflection sensors. (Note: Deflection basin tests require at least seven sensors.) It also has a system for collecting, processing, and storing deflection data. Structural evaluation of pavements involves application of a standard load to the pavement and measuring its response in terms of stress, strain or deflection.

Benkelman beam has been among the earliest equipment used for measuring deflection and structural evaluation of pavements. In this technique, a static load is applied to the pavement surface and rebound deflections are measured at one or more locations. Measurement of deflection under a static load does not simulate the loading conditions produced in pavements by a moving vehicle. The evaluation of pavements by such methods is labor-intensive and, in general, time consuming. Impulse loading equipment commonly known as Falling Weight Deflectometer (FWD) have been developed, which closely simulates the duration and amplitude of the load pulses produced by moving wheel loads.

The basic working principle of the impulse loading equipment is to drop a mass on the pavement to produce an impulse load and measure the surface deflections. The mass is dropped on a spring system, which in turn transmits the load to the pavement through a loading plate. The resulting deflection bowl characteristics are observed and used in the back calculation of pavement material properties. The principle is illustrated in **Figure-1.**

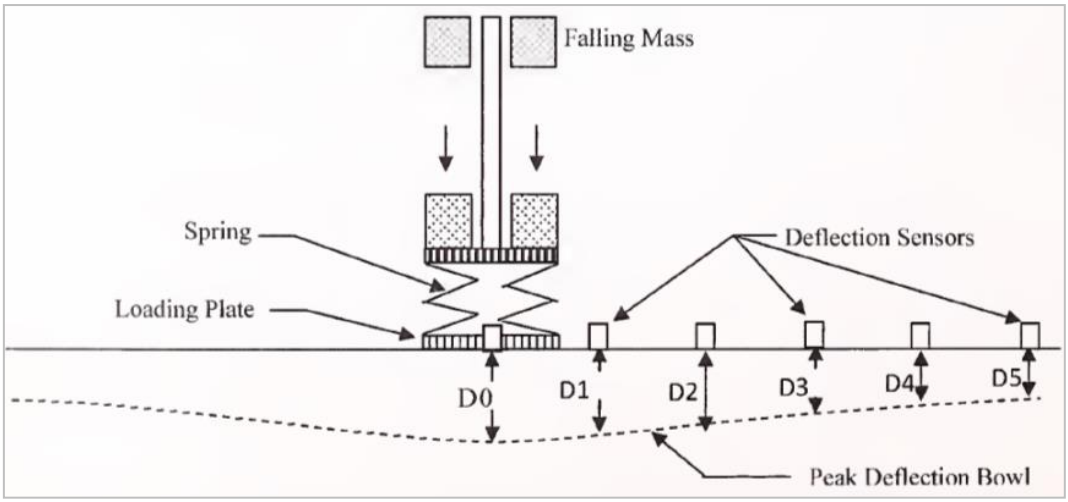


FIGURE 1 : WORKING PRINCIPLE OF FWD

2.1 FWD INSTRUMENT USED FOR THE DEFLECTION SURVEY: ERAY-FWD

For the purpose of conducting FWD survey on the project road **ERAY** TEST FWD Fully-Automatic Vehicle-mounted FWD was used. **ERAY FWD** developed by **ERAY** Machinery. The FWD can apply a loading in the range of 12-150 KN, enabling it to simulate all type of vehicle loads on pavement surface. This model is complete with back-up battery and with all other accessories for evaluation of pavements.

Main Components of the system

The main components of the **ERAY FWD** system are described in the following paragraphs

i. The vehicle

A vehicle is suitably modified for housing the entire FWD system including hydraulic and electronic circuits. Modifications are made in the vehicle to accommodate necessary furniture for personal computer, electronic circuits and for working personnel. An alternator was used to draw power from the engine of the vehicle for charging the batteries. Sine wave inverter is used to supply power to the computer and the electronic circuit. A 550 mm diameter hole is made in the floor of the vehicle to allow the loading plate and the falling mass to pass through it. The vehicle is equipped with flashing lights to caution the road users during the test and it is very useful during the night time.

ii. Supporting Frame

A rectangular frame is fabricated and fixed to the floor of the machine vehicle to protect from weathering actions.

iii. Mass and Rubber Pad Arrangement

The base of a two-stage cylinder is attached to the top horizontal member of the supporting frame. The loading plate assembly is connected to the bottom flange of the cylinder. A load sensor (Strain Impact Sensor) of 150 KN capacity is placed on the loading plate assembly. The loading plate assembly consists of a bottom plate of 300 mm diameter with a rubber sole fixed to its bottom for uniform distribution of load.

iv. Loading Plate Assembly

A universal joint is fixed at the bottom of top plate of the assembly to provide flexibility and to ensure that the loading plate rests evenly on the pavement surface. A casing is made to hold the central geophone.

v. Geophone Arrangement

Nine geophones are arranged in a geophone frame at radial distances of 0, 200, 300, 450, 600, 900, 1200, 1500 and 1800 mm from the centre of the loading plate to measure the pavement surface deflections. The first geophone is located in the loading plate assembly. Straightening/ folding and vertical movements of the geophone frame are performed by the hydraulic system. More over this particular instrument mostly exceeds or matches all the criteria given in the IRC: 115-2014. Following table summarizes the technical specifications of the instrument against the specifications of FWD mentioned by IRC: 115-2014.

TABLE 1 : COMPARISON BETWEEN IRC AND ERAY FWD SPECIFICATIONS

S. No.	FWD Components	IRC Recommended Specifications for FWD	ERAY's FWD Specifications	Remarks
1	Plate Diameter	300/450 mm	300 mm	In IRC:115-2014, 300 mm dia plate is recommended
2	Mass System	Single Mass	Single Mass	Matched
3	Falling Weight Mass	50 to 700 Kg	50 to 350 Kg	Matched
4	Height of fall	100 to 600 mm	Variable	Matched
5	Target Peak Load	40 KN	40-150 KN	Matched
6	Load Cell Accuracy	+ 2 %	+ 1 %	Matched
7	Number of Deflection Transducers	6 to 9	9	Matched
8	Deflection Sensor Types	Geophones	Geophones	Matched
9	Reading Resolution of Deflection Transducers	Min 1 um	1 um	Matched
10	Deflection Transducers Accuracy	+ 2 %	+ 1 %	Matched

2.2 TESTING PROCEDURE AND METHODOLOGY

The detailed test methodology and procedure was described in IRC: 115-2014 "Guidelines for Structural Evaluation and Strengthening of Flexible Road Pavements Using Falling Weight Deflectometer (FWD) Technique". However, as per the client's requirement the sampling procedure was customized in this project. In adherence to the same, structural evaluation of the existing 'pavement and subgrade system' by measuring its response in terms of deflection was carried out using FWD for the project road **From 22/11/2022 to 05/12/2022.**

Evaluation of pavement structural strength would be carried out in accordance with requirements of TOR and IRC: 115-2014.

(a) Testing Equipment

The equipment used for the testing is:

- **ERAY TEST FWD** Vehicle Mounted Falling Weight Deflectometer with 1 loading plate and 9 numbers of geophones placed at the spacing of 0,200, 300, 450, 600, 900, 1200,

1500 and 1800mm from the centre of the loading plate.

- GPS, Air **Temperature** and Pavement Surface Temperature sensors as part of the FWD instrument.
- Glycerol **and digital thermometer.**
- **Red flags** and red cones and flashing lamps for traffic arrangement.

(b) Testing Frequency – as per IRC:115-2014

The entire length has been classified into section of uniform performance. As it is inexpedient to change the sample size for deflection measurement at frequent intervals, the minimum length of uniform section has been kept as 1.0km. The interval at which deflection measurements has been carried out was calculated by using the following formula of equation 1 of IRC: 115-2014 and the same is extracted below for ready reference.

$$\boldsymbol{n = (z * CV)^2 / ME^2}$$

Where,

n = sample size

z = standard normal deviate, 1.285 corresponding to 90 per cent (two-sided) confidence level

ME = 10 percent acceptable margin of error (as percentage of mean)

CV = Coefficient of variation of deflection (standard deviation/mean) expressed as percentage; 15 percent, 30 percent and 45 percent for good, fair and poor condition respectively.

Though the length of uniform section divided by calculated sample size results the interval of FWD test, however the deflection measurement scheme depends upon the type of carriageway, number of lanes and the measurement along a lane is given in Table 2 of IRC 115-2014 and the same has been followed and the same is presented in table below.

TABLE 2 : GUIDELINES FOR SELECTION OF DEFLECTION MEASUREMENT SCHEME FOR 4-LANE DUAL (DIVIDED) CARRIAGEWAY

Recommended Measurement Scheme	Maximum Spacing(m) for test points along selected wheel path for pavements of different classification		
	Poor	Fair	Good
(i)measure along outer wheel paths of outer lanes	30	65	250
(ii) measure along the outer wheel path of inner lane	60	130	500
(iii)measure along the centre line of paved shoulder (in case of widening projects)	120	260	500

Courtesy: Table 2 of IRC: 115-2014

Also, during survey, pavement temperature of bituminous layer has been recorded as per the procedure specified in section 5.4.7 of IRC: 115-2014.

The following steps are carried out for measuring deflections at a test point:

i. Mark the test point on the pavement

ii. Centre the load plate over the test point

iii. Lower the loading plate onto the pavement ensuring there should be no standing water on the pavement surface. The loading plate should be in proper contact with pavement surface. The

longitudinal and transverse slope of the pavement should not exceed 10 percent at the test location.

iv. Lower the frame holding the geophones so that the transducers are in contact with pavement surface.

v. Raise the mass to a pre-determined height required for producing a target load of 40 kN (+10%).

vi. Drop one seating load, load and deflection data for which need not be recorded.

vii. Raise the mass and drop. Record the load and deflection data into the computer through data acquisition system. While peak load and peak deflections at different selected radial positions must be recorded. At least 2 drops should be made at one location for precision.

viii. If, during previous 2 steps, the deflections measured are giving variations or the deflections/load pulses are not proper, repeat the drop.

ix. Raise the geophone frame and load plate and move to the next test location

x. Deflection measurements should not be made when the pavement temperature is more than 45°C.

2.3 STRUCTURAL EVALUATION OF RIGID PAVEMENTS USING FWD

The structural evaluation and analysis of remaining life of project was carried out in conformity with IRC: 117-2015, “Guidelines for The Structural Evaluation of Rigid Pavement by Falling Weight Deflectometer (FWD)”.

2.3.1 PRINCIPLE OF RIGID PAVEMENT EVALUATION USING FWD

Performance of Rigid pavements can be evaluated by applying loads on the pavements that simulate the traffic loading, recording the response to such loading by measuring the deflection under such loads, and analyzing these data duly considering the factors influencing the performance such as PQC thickness and Load on the pavement.

Among the equipment available for structural evaluation of pavements, the Falling Weight Deflectometer (FWD) is extensively used worldwide because it simulates, to a large extent, the actual loading conditions of pavement.

The resulting load-deflection data can be interpreted through appropriate analytical techniques, to estimate the Subgrade modulus. The computed moduli are, in turn used for (i) the Elastic Modulus of Concrete and the Strength of Concrete (ii) the Flexural strength of the concrete slab of in-service pavements (iii) determination of Strengthening requirement, in the presence of voids if the deflections are much higher than normal and (iv) evaluation of different rehabilitation alternatives (Slab replacement etc.)

Structural evaluation exercise also includes Load transfer Efficiency at the transverse and longitudinal joints, (i) determination of Strengthening requirement, if any and (ii) evaluation of different rehabilitation alternatives (Retrofitting of Joints etc.)

2.3.2 TESTING PROCEDURE AND METHODOLOGY FOR RIGID PAVEMENTS

The detailed test methodology and procedure was described in IRC: 117-2015, “Guidelines for Structural Evaluation of Rigid Pavement by Falling Weight Deflectometer (FWD) Technique”. Deflection measurement points were taken as per the existing pavement condition. In adherence to the same, structural evaluation of the existing ‘pavement and subgrade system’ by measuring its response in terms of deflection was carried out by using FWD. Evaluation of pavement

structural strength would be carried out in accordance with requirements of TOR and IRC: 117-2015.

(a) Testing Equipment

The equipment used for the testing is:

- **ERAY TEST FWD** Vehicle Mounted Falling Weight Deflectometer with 1 loading plate and 9 numbers of geophones placed at the spacing of 0,200, 300, 450, 600, 900, 1200, 1500 and 1800mm from the centre of the loading plate.
- GPS, Air Temperature and Pavement Surface Temperature sensors as part of the FWD instrument.
- Glycerol and digital thermometer.
- Red flags and red cones and flashing lamps for traffic arrangement

(b) Testing Frequency – as per IRC:117-2015

FWD deflection data may be collected at interiors, corners, transverse joints, and longitudinal joints, in the outer lane at intervals of 500 m. Heavy loads travel mostly in outer lanes and very often greater distresses also are found in the outer lanes. If there are distresses in the inner lanes also FWD test should be done in those lanes.

(c) Loading Positions – as per IRC:117-2015

The loading positions are presented in **Figure 2.**

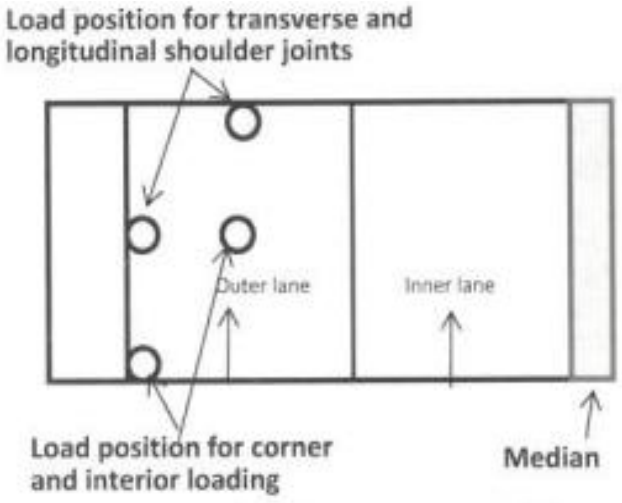


FIGURE 2 : LOAD POSITIONS FOR CORNER, INTERIOR, TRANSVERSE AND LONGITUDINAL SHOULDER JOINTS

FWD DEFLECTION TESTING POINTS & MEASUREMENT-RIGID PAVEMENT

As it is specified in IRC:117-2015 FWD deflection measurement has carried out for Corner, Interior, Transverse Joint and Longitudinal joint in the outer lane at an interval of 500 m. At every measurement location, four drops were made, such that the first drop was the 'seating drop' and with the remaining three drops deflections were recorded.

Photographs of FWD test under progress at some locations were shown in **Figure 3.**

FIGURE 3 : PHOTOGRAPHS SHOWING FWD SURVEY UNDER PROGRESS -RIGID PAVEMENT

The following steps are carried out for measuring deflections at a test point:

i. Mark the test point on the pavement

ii. Centre the load plate over the test point

iii. Lower the loading plate onto the pavement ensuring there should be no standing water on the pavement surface. The loading plate should be in proper contact with pavement surface. The longitudinal and transverse slope of the pavement should not exceed 10 percent at the test location.

iv. Lower the frame holding the geophones so that the transducers are in contact with pavement surface.

v. Raise the mass to a pre-determined height required for producing a target load of 70 kN (+5%).

vi. Drop one seating load, load and deflection data for which need not be recorded.

vii. Raise the mass and drop. Record the load and deflection data into the computer through data acquisition system. While peak load and peak deflections at different selected radial positions must be recorded. At least 2 drops should be made at one location for precision.

viii. If, during previous 2 steps, the deflections measured are giving variations or the deflections/load pulses are not proper, repeat the drop.

ix. Raise the geophone frame and load plate and move to the next test location.

x. Deflection measurements should not be made when the pavement temperature is more than 40°C.

2.4 RIGID PAVEMENT COMPOSITION DETAILS

Adopted PQC crust thickness during construction was 300mm and same is considered for analysis

2.5 INPUT DATA FOR RIGID PAVEMENT ANALYSIS

a) Processing of Area and Deflection data.

The FWD test should be done at 0mm, 300mm, 600mm, 900mm radial distances from the center of loading point should be measured.

The area of Deflection basin is calculated by

$$A=6(1+2(D_1/D_0)+2(D_2/D_0)+(D_3/D_0))$$

Where,

A=Area parameter of the deflection basin

D_0=Deflection at center of the loading plate in mm

D_1= Deflection in mm at 300mm from center of the loading plate

D_2= Deflection in mm at 600mm from center of the loading plate

D_3= Deflection in mm at 900mm from center of the loading plate

From the area of deflection basin, Radius of relativeness (l) can be evaluated from the charts given in IRC: 117 (Appendix V) and the normalized deflections are found.

b) Evaluation of Subgrade Modulus, Elastic Modulus of concrete, Strength of concrete, Flexural Strength of concrete.

Subgrade moduli value can be found for normalized deflections and average of all should be taken as subgrade modulus.

$$k_i=Pd_i/l^2D_i$$

Where,

i=1,2,3,4

l=Radius of relative stiffness, mm

P=Load in kN

D_i=Measured deflections in mm at various radial distance

d_i=Normalized deflections in mm at various radial distances

Elastic Modulus (MPa) of concrete can be found by using the formulae

$$E_c=12(1-\mu_c)\,kl^4/1000h^3$$

Where,

μ_c= Poisson's Ratio of Concrete

h= Thickness of concrete layer in mm

l= Radius of relative stiffness in mm

k=modulus of subgrade reaction in MPa/m

E= Elastic modulus of concrete, MPa

Strength of concrete can be determined from the E_C from the following

$$f_c = (E_C /5000)0.50$$

Flexural strength can be determined from the f_c of the concrete slab as given below:

$$f_{mr}=0.7(f_c)0.50$$

Poisson's ratio for different layers i.e., 0.15 for concrete and 0.45 for subgrade.

c) Evaluation of Load Transfer Efficiency of Joints

Transverse as well as longitudinal joints deteriorate with traffic due to continuous loading. For a new pavement, the joint efficiency is nearly 100 percent since the deflections on either side of the joint under a wheel load are almost equal and the ratio decreases as the joints deteriorate under repeated loading.

When deflection sensors are the either side of a joint with deflections D_1 and D_2 on the loaded and unloaded sides. Deflections on the Loaded and Unloaded side at a Joint is presented in **Figure 4.**

$$LTE=100(D_2/D_1)$$

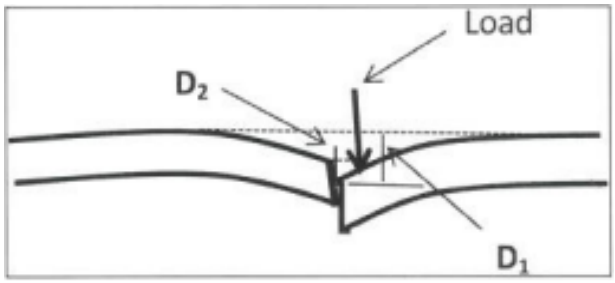


FIGURE 4 DEFLECTIONS ON THE LOADED AND UNLOADED SIDE AT A JOINT

For a new pavement, $D_1 = D_2$ but D_2 becomes less and less as the joints deteriorate.

If $D_2/D_1 < 0.5$ transverse joints in critical condition

If $D_2/D_1 < 0.4$ longitudinal joints in critical condition

Where,

D_1 is the deflection on the loaded side of the slab

& D_2 is the deflection on the unloaded side of the slab

Annexure – 4.7

Summary of Back Calculation of E Values

E-values & Remaining Life Analysis: On LHS Direction: NH-27 Kochugaon to Rakhaldubi (Pkg-1)																		
S.NO	Station	Side (LHS/ RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)	Pavement Condition
							D1	D2	D3	D4	D5	D6	D7	D8	D9			
1	30.600	LHS	INNER	22/11/2022 09:35:26	560.0	40.0	0.11	0.09824	0.09260	0.07989	0.07619	0.06998	0.05866	0.04904	0.04317	29.6	6.0	FAIR
2	30.700	LHS	OUTER	22/11/2022 09:36:38	560.0	40.0	0.11	0.09990	0.09244	0.08489	0.08199	0.07250	0.05874	0.05132	0.04137	29.6	6.0	FAIR
3	30.901	LHS	OUTER	22/11/2022 09:38:36	560.0	40.0	0.32	0.27781	0.26098	0.22627	0.18072	0.12837	0.08874	0.06995	0.06646	29.7	6.0	FAIR
4	31.000	LHS	OUTER	22/11/2022 09:43:48	560.0	40.0	0.24	0.20513	0.19167	0.16900	0.14718	0.10996	0.08443	0.06281	0.05428	29.8	6.0	FAIR
5	31.102	LHS	INNER	22/11/2022 09:45:15	560.0	40.0	0.21	0.19007	0.17873	0.16153	0.14593	0.10976	0.08629	0.06630	0.05640	29.9	6.0	FAIR
6	31.357	LHS	OUTER	22/11/2022 09:46:10	560.0	40.0	0.19	0.17050	0.15938	0.14286	0.13007	0.10182	0.07835	0.05977	0.05306	30.0	6.0	FAIR
7	31.603	LHS	INNER	22/11/2022 09:47:07	560.0	40.0	0.26	0.21755	0.19718	0.17224	0.14746	0.11257	0.08403	0.06812	0.06045	30.0	6.0	FAIR
8	31.700	LHS	OUTER	22/11/2022 09:54:15	560.0	40.0	0.36	0.28865	0.24836	0.19915	0.16628	0.11067	0.07745	0.05843	0.05118	30.1	6.0	FAIR
9	38.001	LHS	OUTER	22/11/2022 11:23:31	560.0	40.0	0.16	0.14642	0.13995	0.12939	0.11940	0.10068	0.08492	0.06825	0.06161	34.7	6.0	FAIR
10	38.099	LHS	INNER	22/11/2022 11:24:24	560.0	40.0	0.48	0.36037	0.31048	0.25411	0.20750	0.14582	0.10765	0.08114	0.07139	34.7	6.0	FAIR
11	38.361	LHS	OUTER	22/11/2022 11:25:16	560.0	40.0	0.39	0.34042	0.30777	0.26460	0.22399	0.15974	0.11776	0.08769	0.07410	34.7	6.0	FAIR
12	38.604	LHS	INNER	22/11/2022 11:26:10	560.0	40.0	0.57	0.46196	0.39300	0.31558	0.25610	0.16397	0.11484	0.08200	0.07245	34.7	6.0	FAIR
13	38.754	LHS	OUTER	22/11/2022 12:12:55	560.0	40.0	0.42	0.33839	0.28958	0.23475	0.18857	0.12813	0.09224	0.07240	0.06526	36.8	6.0	FAIR
14	39.000	LHS	OUTER	22/11/2022 12:17:51	560.0	40.0	0.42	0.31727	0.27037	0.22075	0.18655	0.12388	0.08779	0.06989	0.06107	37.0	6.0	GOOD
15	39.109	LHS	INNER	22/11/2022 12:21:30	560.0	40.0	0.30	0.26399	0.24203	0.20854	0.17617	0.13211	0.09778	0.07192	0.06528	37.0	6.0	GOOD
16	39.357	LHS	OUTER	22/11/2022 12:23:28	560.0	40.0	0.42	0.30686	0.25600	0.19862	0.15488	0.10250	0.07538	0.05832	0.05227	37.1	6.0	GOOD
17	40.712	LHS	OUTER	22/11/2022 12:41:13	560.0	40.0	0.34	0.29582	0.27171	0.23030	0.19571	0.13484	0.10111	0.07288	0.06526	37.2	6.0	GOOD
18	41.004	LHS	OUTER	22/11/2022 12:46:10	560.0	40.0	0.48	0.39610	0.34041	0.27190	0.21426	0.13718	0.09733	0.07590	0.06588	37.3	6.0	GOOD
19	41.099	LHS	INNER	22/11/2022 12:47:58	560.0	40.0	0.30	0.25899	0.23411	0.20178	0.17165	0.12218	0.09157	0.06939	0.06066	37.7	6.0	GOOD
20	41.363	LHS	OUTER	22/11/2022 12:49:53	560.0	40.0	0.40	0.30638	0.24403	0.17531	0.13030	0.08204	0.06139	0.04981	0.04226	37.7	6.0	GOOD
21	41.592	LHS	INNER	22/11/2022 12:52:39	560.0	40.0	0.44	0.32830	0.26657	0.20468	0.15646	0.09165	0.06644	0.05488	0.05058	37.7	6.0	GOOD
22	41.706	LHS	OUTER	22/11/2022 12:54:18	560.0	40.0	0.46	0.35767	0.31086	0.26068	0.21440	0.14739	0.10748	0.08083	0.07378	37.8	6.0	GOOD

S.NO	Station	Side (LHS/ RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)	Pavement Condition
							D1	D2	D3	D4	D5	D6	D7	D8	D9			
23	42.007	LHS	OUTER	22/11/2022 12:58:13	560.0	40.0	0.29	0.23171	0.19660	0.15712	0.12312	0.08166	0.05961	0.04625	0.04355	38.0	6.0	GOOD
24	42.103	LHS	INNER	22/11/2022 13:00:51	560.0	40.0	0.28	0.25900	0.21990	0.16426	0.13663	0.09123	0.07998	0.05215	0.05016	38.2	6.0	GOOD
25	42.356	LHS	OUTER	22/11/2022 13:02:34	560.0	40.0	0.30	0.26091	0.22482	0.17149	0.14194	0.11186	0.08856	0.05837	0.04651	38.3	6.0	GOOD
26	42.612	LHS	INNER	22/11/2022 13:07:48	560.0	40.0	0.28	0.26516	0.23380	0.17745	0.15056	0.11888	0.08270	0.06660	0.05051	38.5	6.0	GOOD
27	42.755	LHS	OUTER	22/11/2022 13:09:58	560.0	40.0	0.31	0.25121	0.22213	0.18952	0.15823	0.11285	0.08359	0.06663	0.06112	38.6	6.0	GOOD
28	43.001	LHS	OUTER	22/11/2022 13:17:01	560.0	40.0	0.44	0.35021	0.30950	0.25988	0.21626	0.15035	0.11485	0.08579	0.07790	38.7	6.0	GOOD
29	43.094	LHS	INNER	22/11/2022 13:23:16	560.0	40.0	0.38	0.32575	0.29621	0.25836	0.22338	0.16427	0.12828	0.10168	0.09105	38.9	6.0	GOOD
30	47.734	LHS	OUTER	22/11/2022 14:24:55	560.0	40.0	0.33	0.24464	0.21300	0.17991	0.15051	0.10744	0.08228	0.06236	0.05689	40.1	6.0	GOOD
31	48.035	LHS	OUTER	22/11/2022 14:28:54	560.0	40.0	0.29	0.24727	0.22616	0.19908	0.16977	0.12338	0.09076	0.06668	0.05579	40.1	6.0	FAIR
32	48.101	LHS	INNER	22/11/2022 14:31:56	560.0	40.0	0.27	0.23608	0.21877	0.19755	0.17228	0.13158	0.10107	0.07641	0.06666	40.1	6.0	FAIR
33	48.350	LHS	OUTER	22/11/2022 14:44:01	560.0	40.0	0.26	0.21897	0.19436	0.16390	0.13512	0.09256	0.06560	0.04905	0.04481	39.9	6.0	FAIR
34	48.624	LHS	INNER	22/11/2022 14:48:11	560.0	40.0	0.22	0.18942	0.16836	0.14565	0.12398	0.08680	0.06159	0.04678	0.03843	39.7	6.0	FAIR
35	48.705	LHS	OUTER	22/11/2022 14:50:16	560.0	40.0	0.30	0.25428	0.23006	0.19643	0.16501	0.11632	0.08361	0.06092	0.05225	39.6	6.0	FAIR
36	49.618	LHS	INNER	22/11/2022 15:04:26	560.0	40.0	0.50	0.38950	0.33556	0.27488	0.22163	0.14855	0.10723	0.08334	0.07032	39.5	6.0	GOOD
37	49.765	LHS	OUTER	22/11/2022 15:05:20	560.0	40.0	0.44	0.34742	0.30208	0.25149	0.20855	0.14574	0.10709	0.08083	0.07201	39.2	6.0	GOOD
38	50.003	LHS	OUTER	22/11/2022 15:08:26	560.0	40.0	0.32	0.27864	0.24597	0.21021	0.17679	0.12885	0.09615	0.07708	0.06717	39.0	6.0	GOOD
39	50.104	LHS	INNER	22/11/2022 15:11:33	560.0	40.0	0.34	0.26524	0.22208	0.17952	0.14673	0.10027	0.07678	0.06002	0.05418	39.0	6.0	GOOD
40	50.350	LHS	OUTER	22/11/2022 15:13:16	560.0	40.0	0.34	0.27128	0.23507	0.19553	0.16456	0.11958	0.09220	0.07401	0.06577	38.8	6.0	GOOD
41	50.597	LHS	INNER	22/11/2022 15:22:39	560.0	40.0	0.31	0.25494	0.22653	0.19252	0.15936	0.11050	0.08168	0.06159	0.05702	38.7	6.0	GOOD
42	50.761	LHS	OUTER	22/11/2022 15:24:13	560.0	40.0	0.25	0.19792	0.17448	0.14582	0.12061	0.08055	0.05797	0.04261	0.03637	38.7	6.0	GOOD
43	51.004	LHS	OUTER	22/11/2022 15:28:17	560.0	40.0	0.29	0.22648	0.19048	0.15169	0.11860	0.07745	0.05728	0.04530	0.04063	38.5	6.0	GOOD
44	51.094	LHS	INNER	22/11/2022 15:31:14	560.0	40.0	0.31	0.26449	0.22477	0.18662	0.15366	0.10772	0.08000	0.05739	0.04830	38.4	6.0	GOOD
45	51.352	LHS	OUTER	22/11/2022 15:32:56	560.0	40.0	0.43	0.35225	0.30614	0.25694	0.21631	0.15657	0.12047	0.09132	0.08315	38.3	6.0	GOOD

S.NO	Station	Side (LHS/ RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)	Pavement Condition
							D1	D2	D3	D4	D5	D6	D7	D8	D9			
46	51.600	LHS	INNER	22/11/2022 15:36:44	560.0	40.0	0.31	0.26660	0.24593	0.21830	0.18987	0.14086	0.10774	0.08202	0.07093	38.3	6.0	GOOD
47	51.759	LHS	OUTER	22/11/2022 15:38:21	560.0	40.0	0.32	0.26372	0.24098	0.21047	0.18013	0.13237	0.09939	0.07525	0.06753	38.1	6.0	GOOD
48	62.028	LHS	OUTER	23/11/2022 06:26:56	560.0	40.0	0.15	0.13704	0.12762	0.11608	0.10572	0.08349	0.06674	0.05331	0.04739	25.5	6.0	GOOD
49	62.101	LHS	INNER	23/11/2022 06:27:50	560.0	40.0	0.11	0.10579	0.10437	0.09920	0.09633	0.08895	0.07801	0.06324	0.05659	25.5	6.0	GOOD
50	62.352	LHS	OUTER	23/11/2022 06:28:42	560.0	40.0	0.11	0.10407	0.10268	0.09759	0.09477	0.08751	0.07675	0.06222	0.05567	25.6	6.0	GOOD
51	62.608	LHS	INNER	23/11/2022 06:29:38	560.0	40.0	0.28	0.23514	0.18373	0.14859	0.12574	0.09840	0.07753	0.06286	0.05624	25.6	6.0	GOOD
52	62.700	LHS	OUTER	23/11/2022 06:33:59	560.0	40.0	0.51	0.39660	0.33994	0.25910	0.22049	0.15947	0.11607	0.08665	0.07749	25.7	6.0	GOOD
53	63.000	LHS	OUTER	23/11/2022 06:37:34	560.0	40.0	0.43	0.37430	0.31939	0.25786	0.22071	0.15488	0.11499	0.08474	0.07345	25.7	6.0	FAIR
54	63.106	LHS	INNER	23/11/2022 06:38:26	560.0	40.0	0.43	0.35714	0.31867	0.26950	0.22669	0.16099	0.11662	0.08871	0.07190	25.8	6.0	FAIR
55	63.373	LHS	OUTER	23/11/2022 06:39:19	560.0	40.0	0.31	0.27156	0.24775	0.21580	0.18810	0.13968	0.10763	0.08156	0.07199	25.9	6.0	FAIR
56	63.580	LHS	INNER	23/11/2022 06:42:04	560.0	40.0	0.38	0.29364	0.24323	0.19063	0.15074	0.10050	0.07557	0.05820	0.05705	25.9	6.0	FAIR
57	78.344	LHS	OUTER	23/11/2022 08:34:42	560.0	40.0	0.47	0.38715	0.33809	0.28453	0.23825	0.16543	0.12099	0.09257	0.08315	27.1	6.0	FAIR
58	78.598	LHS	INNER	23/11/2022 08:36:46	560.0	40.0	0.46	0.39560	0.30124	0.24867	0.19564	0.15878	0.12967	0.07609	0.06954	27.1	6.0	FAIR
59	83.362	LHS	OUTER	23/11/2022 09:27:53	560.0	40.0	0.35	0.27076	0.23563	0.19738	0.15838	0.11100	0.08008	0.05782	0.05121	28.2	6.0	FAIR
60	83.609	LHS	INNER	23/11/2022 09:30:21	560.0	40.0	0.31	0.24527	0.20386	0.15978	0.12356	0.08334	0.06216	0.05088	0.04818	28.2	6.0	FAIR
61	83.717	LHS	OUTER	23/11/2022 09:32:51	560.0	40.0	0.45	0.37180	0.32190	0.26183	0.21541	0.15076	0.11145	0.08776	0.07906	28.3	6.0	FAIR
62	84.011	LHS	OUTER	23/11/2022 09:33:47	560.0	40.0	0.37	0.32886	0.29416	0.25306	0.21690	0.15692	0.11709	0.09018	0.07858	28.4	6.0	FAIR
63	84.109	LHS	INNER	23/11/2022 09:34:44	560.0	40.0	0.37	0.32866	0.29661	0.25354	0.22016	0.16339	0.12199	0.09480	0.08205	28.4	6.0	FAIR
64	84.349	LHS	OUTER	23/11/2022 09:35:37	560.0	40.0	0.38	0.33018	0.29798	0.25471	0.22118	0.16415	0.12255	0.09524	0.08243	28.5	6.0	FAIR
65	84.611	LHS	INNER	23/11/2022 09:38:20	560.0	40.0	0.46	0.38621	0.33236	0.26950	0.22196	0.15693	0.12193	0.09772	0.08715	28.6	6.0	FAIR
66	84.709	LHS	OUTER	23/11/2022 09:41:45	560.0	40.0	0.46	0.38535	0.33743	0.28579	0.24131	0.17415	0.13133	0.10407	0.09317	28.6	6.0	FAIR
67	85.001	LHS	OUTER	23/11/2022 09:42:38	560.0	40.0	0.42	0.35089	0.30861	0.25851	0.22157	0.16263	0.12609	0.09908	0.08872	28.7	6.0	FAIR
68	85.101	LHS	INNER	23/11/2022 09:43:40	560.0	40.0	0.28	0.25357	0.24032	0.21544	0.19595	0.15568	0.12933	0.10221	0.09106	28.8	6.0	FAIR

S.NO	Station	Side (LHS/ RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)	Pavement Condition
							D1	D2	D3	D4	D5	D6	D7	D8	D9			
69	85.342	LHS	OUTER	23/11/2022 09:44:34	560.0	40.0	0.40	0.33337	0.29305	0.24985	0.21519	0.15867	0.12694	0.10195	0.09020	28.9	6.0	FAIR
70	85.605	LHS	INNER	23/11/2022 09:46:29	560.0	40.0	0.31	0.25214	0.22016	0.18453	0.15665	0.11353	0.08953	0.06859	0.06207	29.0	6.0	FAIR
71	85.762	LHS	OUTER	23/11/2022 10:40:40	560.0	40.0	0.49	0.42176	0.37121	0.31740	0.26565	0.18628	0.13739	0.10371	0.08971	30.6	6.0	FAIR
72	89.769	LHS	OUTER	23/11/2022 10:31:01	560.0	40.0	0.23	0.19503	0.16967	0.13832	0.11106	0.07527	0.05452	0.04043	0.03612	30.6	6.0	FAIR
73	90.003	LHS	OUTER	23/11/2022 10:33:00	560.0	40.0	0.25	0.20594	0.18152	0.15097	0.12297	0.08453	0.06122	0.04708	0.04192	30.6	6.0	FAIR
74	90.146	LHS	INNER	23/11/2022 10:34:03	560.0	40.0	0.27	0.23612	0.21795	0.17154	0.15288	0.12249	0.09629	0.06467	0.04861	30.6	6.0	FAIR
75	90.329	LHS	OUTER	23/11/2022 10:36:18	560.0	40.0	0.28	0.25372	0.21229	0.16807	0.14665	0.11655	0.08010	0.06598	0.04014	30.7	6.0	FAIR
76	90.516	LHS	INNER	23/11/2022 10:38:20	560.0	40.0	0.25	0.19760	0.16812	0.12562	0.10407	0.07202	0.05513	0.04099	0.03673	30.8	6.0	FAIR
77	91.009	LHS	OUTER	23/11/2022 10:41:36	560.0	40.0	0.46	0.39899	0.35319	0.29860	0.24888	0.17263	0.13459	0.10086	0.09406	30.8	6.0	FAIR
78	91.105	LHS	INNER	23/11/2022 10:42:45	560.0	40.0	0.36	0.32469	0.31449	0.28090	0.25124	0.18959	0.14993	0.11209	0.10029	30.8	6.0	FAIR
79	91.357	LHS	OUTER	23/11/2022 10:43:50	560.0	40.0	0.48	0.40883	0.35805	0.29961	0.25567	0.18574	0.14265	0.11120	0.09663	30.8	6.0	FAIR
80	91.610	LHS	INNER	23/11/2022 10:46:03	560.0	40.0	0.78	0.61787	0.49708	0.39386	0.32004	0.22209	0.16639	0.11923	0.10603	30.8	6.0	FAIR
81	91.755	LHS	OUTER	23/11/2022 10:48:18	560.0	40.0	0.33	0.27182	0.24317	0.21337	0.18145	0.13310	0.09290	0.07277	0.05943	30.9	6.0	FAIR
82	92.015	LHS	OUTER	23/11/2022 10:50:21	560.0	40.0	0.29	0.23829	0.19636	0.14727	0.10761	0.06294	0.04154	0.02800	0.02087	30.9	6.0	FAIR
83	92.122	LHS	INNER	23/11/2022 10:51:04	560.0	40.0	0.32	0.24695	0.20067	0.14831	0.10110	0.06026	0.03609	0.02688	0.02374	30.9	6.0	FAIR
84	92.359	LHS	OUTER	23/11/2022 10:51:58	560.0	40.0	0.28	0.22314	0.19144	0.15311	0.11275	0.06442	0.04114	0.03194	0.02668	30.9	6.0	FAIR
85	92.609	LHS	INNER	23/11/2022 10:52:47	560.0	40.0	0.33	0.26490	0.20415	0.15705	0.10559	0.06352	0.04123	0.03456	0.02543	30.9	6.0	FAIR

				E-values & Remaining Life Analysis: On LHS Direction: NH-27 Kochugaon to Rakhaldubi (Pkg-1)													
S.NO	Station	Side (LHS/ RHS)	Lane	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
				E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
1	30.600	LHS	INNER	400	1500	100	500	30	120	300	410	1498.9	492.6	119.6	0.79	1190.3	391.3	103.7
2	30.700	LHS	OUTER	400	1500	100	500	30	120	300	410	1500.0	494.5	120.0	0.79	1191.2	392.6	104.0
3	30.901	LHS	OUTER	400	1500	100	500	30	120	300	410	1388.2	101.2	102.1	0.80	1107.0	74.3	88.5
4	31.000	LHS	OUTER	400	1500	100	500	30	120	300	410	1500.0	222.0	114.3	0.80	1201.1	193.4	99.2
5	31.102	LHS	INNER	400	1500	100	500	30	120	300	410	1497.8	355.3	107.2	0.80	1204.3	298.2	93.0
6	31.357	LHS	OUTER	400	1500	100	500	30	120	300	410	1500.0	478.9	117.4	0.81	1211.1	382.5	101.8
7	31.603	LHS	INNER	400	1500	100	500	30	120	300	410	1494.6	231.4	107.3	0.81	1206.8	201.4	93.1
8	31.700	LHS	OUTER	400	1500	100	500	30	120	300	410	928.0	100.8	119.4	0.81	752.4	73.9	103.5
9	38.001	LHS	OUTER	400	1500	100	500	30	120	340	400	1498.9	492.2	114.1	0.99	1479.2	391.1	99.0
10	38.099	LHS	INNER	400	1500	100	500	30	120	340	400	549.5	100.4	86.3	0.99	542.3	73.4	74.3
11	38.361	LHS	OUTER	400	1500	100	500	30	120	340	400	815.1	101.2	80.9	0.99	804.4	74.3	69.3
12	38.604	LHS	INNER	400	1500	100	500	30	120	340	400	423.7	102.0	75.9	0.99	418.1	75.3	64.6
13	38.754	LHS	OUTER	400	1500	100	500	30	120	340	400	606.5	102.3	99.7	1.08	657.5	75.6	86.4
14	39.000	LHS	OUTER	750	3000	100	500	30	120	340	400	772.0	102.7	102.8	1.09	844.6	76.1	89.1
15	39.109	LHS	INNER	750	3000	100	500	30	120	340	400	1308.7	101.6	99.5	1.09	1431.8	74.8	86.2
16	39.357	LHS	OUTER	750	3000	100	500	30	120	340	400	769.8	102.3	119.7	1.10	846.1	75.6	103.8
17	40.712	LHS	OUTER	750	3000	100	500	30	120	340	400	985.3	100.8	96.1	1.10	1087.9	73.9	83.2
18	41.004	LHS	OUTER	750	3000	100	500	30	120	340	400	754.4	101.2	90.0	1.11	836.8	74.3	77.7
19	41.099	LHS	INNER	750	3000	100	500	30	120	340	400	1308.7	104.7	104.6	1.13	1478.7	78.4	90.7
20	41.363	LHS	OUTER	750	3000	100	500	30	120	340	400	758.8	162.6	119.7	1.13	857.4	139.1	103.8
21	41.592	LHS	INNER	750	3000	100	500	30	120	340	400	752.2	100.8	117.4	1.13	849.9	73.9	101.8
22	41.706	LHS	OUTER	750	3000	100	500	30	120	340	400	767.6	100.8	83.1	1.14	871.4	73.9	71.3

S.NO	Station	Side (LHS/ RHS)	Lane	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
				E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
23	42.007	LHS	OUTER	750	3000	100	500	30	120	340	400	857.8	236.9	120.0	1.15	982.9	206.1	104.0
24	42.103	LHS	INNER	750	3000	100	500	30	120	340	400	919.4	161.0	119.8	1.16	1063.3	137.6	103.9
25	42.356	LHS	OUTER	750	3000	100	500	30	120	340	400	1172.3	102.7	120.0	1.16	1362.2	76.1	104.0
26	42.612	LHS	INNER	750	3000	100	500	30	120	340	400	1207.5	100.4	118.2	1.17	1416.4	73.4	102.5
27	42.755	LHS	OUTER	750	3000	100	500	30	120	340	400	1141.5	119.6	110.0	1.18	1345.3	95.0	95.4
28	43.001	LHS	OUTER	750	3000	100	500	30	120	340	400	758.8	100.0	80.3	1.18	898.5	72.9	68.7
29	43.094	LHS	INNER	750	3000	100	500	30	120	340	400	1172.3	103.1	71.9	1.20	1401.4	76.5	60.8
30	47.734	LHS	OUTER	750	3000	100	500	30	120	270	450	1271.3	174.7	113.6	1.27	1610.2	150.7	98.6
31	48.035	LHS	OUTER	400	1500	100	500	30	120	270	450	1489.2	150.8	107.9	1.27	1886.2	127.5	93.6
32	48.101	LHS	INNER	400	1500	100	500	30	120	270	450	1489.2	250.9	91.9	1.27	1886.2	217.8	79.4
33	48.350	LHS	OUTER	400	1500	100	500	30	120	270	450	1357.0	239.2	120.0	1.25	1702.0	208.0	104.0
34	48.624	LHS	INNER	400	1500	100	500	30	120	270	450	1468.8	389.3	120.0	1.24	1824.5	322.3	104.0
35	48.705	LHS	OUTER	400	1500	100	500	30	120	270	450	1491.4	118.0	117.0	1.24	1843.6	93.3	101.5
36	49.618	LHS	INNER	750	3000	100	500	30	120	270	450	778.6	101.6	84.7	1.23	957.8	74.8	72.8
37	49.765	LHS	OUTER	750	3000	100	500	30	120	270	450	965.5	101.2	88.0	1.21	1170.8	74.3	75.8
38	50.003	LHS	OUTER	750	3000	100	500	30	120	270	450	1684.8	131.3	95.8	1.20	2023.6	107.5	82.9
39	50.104	LHS	INNER	750	3000	100	500	30	120	270	450	1018.3	158.7	119.6	1.20	1223.1	135.3	103.7
40	50.350	LHS	OUTER	750	3000	100	500	30	120	270	450	1200.9	180.2	98.7	1.19	1428.7	155.9	85.5
41	50.597	LHS	INNER	750	3000	100	500	30	120	270	450	1530.8	129.7	115.1	1.18	1812.6	105.8	99.8
42	50.761	LHS	OUTER	750	3000	100	500	30	120	270	450	1447.2	331.5	120.0	1.18	1713.6	280.7	104.0
43	51.004	LHS	OUTER	750	3000	100	500	30	120	270	450	884.2	305.7	120.0	1.17	1037.1	261.3	104.0
44	51.094	LHS	INNER	750	3000	100	500	30	120	270	450	1449.4	126.2	119.9	1.17	1692.1	102.1	104.0
45	51.352	LHS	OUTER	750	3000	100	500	30	120	270	450	1178.9	105.1	79.1	1.16	1369.9	78.8	67.6

S.NO	Station	Side (LHS/ RHS)	Lane	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
				E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
46	51.600	LHS	INNER	750	3000	100	500	30	120	270	450	2430.4	106.3	91.0	1.16	2824.1	80.2	78.6
47	51.759	LHS	OUTER	750	3000	100	500	30	120	270	450	2010.3	111.3	97.3	1.15	2314.2	85.8	84.2
48	62.028	LHS	OUTER	750	3000	100	500	30	120	300	400	2986.8	500.0	120.0	0.67	2004.6	396.1	104.0
49	62.101	LHS	INNER	750	3000	100	500	30	120	300	400	2975.8	497.7	119.6	0.67	1997.3	394.6	103.7
50	62.352	LHS	OUTER	750	3000	100	500	30	120	300	400	2986.8	498.8	119.0	0.67	2012.8	395.3	103.2
51	62.608	LHS	INNER	750	3000	100	500	30	120	300	400	1088.7	266.6	117.8	0.67	733.7	230.6	102.2
52	62.700	LHS	OUTER	750	3000	100	500	30	120	300	400	789.6	110.2	76.3	0.68	534.3	84.6	65.0
53	63.000	LHS	OUTER	400	1500	100	500	30	120	300	400	836.6	100.4	82.5	0.68	566.1	73.4	70.8
54	63.106	LHS	INNER	400	1500	100	500	30	120	300	400	880.6	102.0	80.8	0.68	598.3	75.3	69.2
55	63.373	LHS	OUTER	400	1500	100	500	30	120	300	400	1478.5	134.4	89.6	0.68	1008.6	110.8	77.3
56	63.580	LHS	INNER	400	1500	100	500	30	120	300	400	720.4	132.1	119.6	0.68	491.4	108.4	103.7
57	78.344	LHS	OUTER	400	1500	100	500	30	120	300	430	743.0	101.2	74.3	0.72	532.3	74.3	63.1
58	78.598	LHS	INNER	400	1500	100	500	30	120	300	430	676.3	100.4	86.4	0.72	484.5	73.4	74.4
59	83.362	LHS	OUTER	400	1500	100	500	30	120	300	430	981.7	109.8	120.0	0.75	735.8	84.2	104.0
60	83.609	LHS	INNER	400	1500	100	500	30	120	300	430	750.5	254.8	120.0	0.75	562.5	221.0	104.0
61	83.717	LHS	OUTER	400	1500	100	500	30	120	300	430	767.7	103.1	80.9	0.75	577.8	76.5	69.3
62	84.011	LHS	OUTER	400	1500	100	500	30	120	300	430	1209.7	102.7	79.8	0.76	914.2	76.1	68.2
63	84.109	LHS	INNER	400	1500	100	500	30	120	300	430	1239.8	113.7	75.6	0.76	936.9	88.5	64.3
64	84.349	LHS	OUTER	400	1500	100	500	30	120	300	430	1273.1	106.3	74.8	0.76	966.0	80.2	63.5
65	84.611	LHS	INNER	400	1500	100	500	30	120	300	430	736.6	113.7	74.7	0.76	561.2	88.5	63.4
66	84.709	LHS	OUTER	400	1500	100	500	30	120	300	430	892.5	100.8	70.3	0.76	680.0	73.9	59.2
67	85.001	LHS	OUTER	400	1500	100	500	30	120	300	430	919.4	121.9	73.7	0.77	703.4	97.5	62.5
68	85.101	LHS	INNER	400	1500	100	500	30	120	300	430	1496.8	305.7	70.0	0.77	1149.9	261.3	58.9

S.NO	Station	Side (LHS/ RHS)	Lane	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
				E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
69	85.342	LHS	OUTER	400	1500	100	500	30	120	300	430	1068.8	138.3	72.7	0.77	824.5	114.8	61.5
70	85.605	LHS	INNER	400	1500	100	500	30	120	300	430	1344.1	154.3	105.4	0.77	1041.2	131.0	91.4
71	85.762	LHS	OUTER	400	1500	100	500	30	120	300	430	732.3	100.0	67.6	0.83	606.3	72.9	56.6
72	89.769	LHS	OUTER	400	1500	100	500	30	120	260	460	1473.1	437.8	120.0	0.83	1219.6	355.5	104.0
73	90.003	LHS	OUTER	400	1500	100	500	30	120	260	460	1341.9	317.4	120.0	0.83	1111.0	270.2	104.0
74	90.146	LHS	INNER	400	1500	100	500	30	120	260	460	1497.8	195.4	110.4	0.83	1240.0	169.9	95.8
75	90.329	LHS	OUTER	400	1500	100	500	30	120	260	460	1475.3	160.2	119.7	0.83	1226.5	136.8	103.8
76	90.516	LHS	INNER	400	1500	100	500	30	120	260	460	1419.4	480.4	120.0	0.83	1185.0	383.5	104.0
77	91.009	LHS	OUTER	400	1500	100	500	30	120	260	460	1046.2	105.9	68.9	0.83	873.4	79.7	57.9
78	91.105	LHS	INNER	400	1500	100	500	30	120	260	460	1498.9	180.5	62.0	0.83	1251.4	156.2	51.1
79	91.357	LHS	OUTER	400	1500	100	500	30	120	260	460	1029.0	107.8	65.2	0.83	859.1	81.9	54.3
80	91.610	LHS	INNER	400	1500	100	500	30	120	260	460	404.3	102.3	51.9	0.83	337.5	75.6	40.9
81	91.755	LHS	OUTER	400	1500	100	500	30	120	260	460	1482.8	123.9	102.1	0.84	1243.2	99.7	88.5
82	92.015	LHS	OUTER	400	1500	100	500	30	120	260	460	844.1	251.7	120.0	0.84	707.7	218.4	104.0
83	92.122	LHS	INNER	400	1500	100	500	30	120	260	460	678.5	261.1	120.0	0.84	568.8	226.1	104.0
84	92.359	LHS	OUTER	400	1500	100	500	30	120	260	460	961.3	324.0	120.0	0.84	805.9	275.1	104.0
85	92.609	LHS	INNER	400	1500	100	500	30	120	260	460	737.6	263.8	120.0	0.84	618.4	228.3	104.0

E-values & Remaining Life Analysis: On RHS Direction: NH-27 Kochugaon to Rakhaldubi (Pkg-1)																		
S.NO	Station	Side (LHS/RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)	Pavement Condition
							D1	D2	D3	D4	D5	D6	D7	D8	D9			
1	30.101	RHS	INNER	24/11/2022 11:32:55	560.0	40.0	0.26676	0.24289	0.21588	0.16138	0.13721	0.10427	0.06275	0.05330	0.03857	34.6	6.0	FAIR
2	30.355	RHS	OUTER	24/11/2022 11:27:42	560.0	40.0	0.34911	0.28552	0.23262	0.17491	0.14533	0.10837	0.07798	0.05047	0.03518	34.5	6.0	FAIR
3	43.130	RHS	INNER	24/11/2022 09:42:37	560.0	40.0	0.24906	0.21991	0.19782	0.15463	0.12627	0.09756	0.06409	0.04517	0.03139	30.9	6.0	FAIR
4	43.371	RHS	OUTER	24/11/2022 09:41:29	560.0	40.0	0.25313	0.22107	0.17229	0.13504	0.10676	0.07414	0.05309	0.03656	0.02475	30.9	6.0	FAIR
5	43.600	RHS	INNER	24/11/2022 09:40:20	560.0	40.0	0.11505	0.10292	0.09260	0.08214	0.07161	0.05368	0.04083	0.03050	0.02719	30.8	6.0	FAIR
6	43.798	RHS	OUTER	24/11/2022 09:36:51	560.0	40.0	0.26874	0.22196	0.17884	0.13596	0.10122	0.06104	0.04507	0.03389	0.03020	30.8	6.0	FAIR
7	43.996	RHS	OUTER	24/11/2022 09:35:44	560.0	40.0	0.30697	0.26072	0.22768	0.17217	0.12142	0.09718	0.06285	0.04792	0.03467	30.6	6.0	FAIR
8	44.368	RHS	OUTER	24/11/2022 09:33:59	560.0	40.0	0.27967	0.23051	0.19502	0.15197	0.12572	0.08852	0.05309	0.03607	0.02287	30.6	6.0	FAIR
9	44.600	RHS	INNER	24/11/2022 09:31:53	560.0	40.0	0.23782	0.21159	0.19366	0.16063	0.13145	0.11649	0.07889	0.05490	0.03990	30.5	6.0	FAIR
10	44.806	RHS	OUTER	24/11/2022 09:29:24	560.0	40.0	0.24352	0.20199	0.16542	0.12422	0.09312	0.06735	0.04369	0.02261	0.01582	30.4	6.0	FAIR
11	45.001	RHS	OUTER	24/11/2022 09:28:11	560.0	40.0	0.17272	0.15058	0.13298	0.10553	0.08132	0.05286	0.03604	0.02560	0.02369	30.3	6.0	FAIR
12	45.149	RHS	INNER	24/11/2022 09:26:30	560.0	40.0	0.32541	0.27571	0.24238	0.19842	0.16602	0.11278	0.08265	0.06077	0.05324	30.3	6.0	FAIR
13	45.383	RHS	OUTER	24/11/2022 09:25:22	560.0	40.0	0.15476	0.13458	0.12658	0.10387	0.08538	0.06208	0.03930	0.02559	0.02367	30.2	6.0	FAIR
14	45.579	RHS	INNER	24/11/2022 09:24:05	560.0	40.0	0.12435	0.10069	0.08835	0.07288	0.05867	0.03817	0.02550	0.01608	0.01208	30.1	6.0	FAIR
15	45.751	RHS	OUTER	24/11/2022 09:22:51	560.0	40.0	0.12361	0.10764	0.09664	0.08033	0.07055	0.04511	0.02917	0.01741	0.01543	30.1	6.0	FAIR
16	45.927	RHS	OUTER	24/11/2022 09:21:39	560.0	40.0	0.32521	0.26278	0.22977	0.18119	0.15946	0.11388	0.06622	0.04156	0.03754	30.1	6.0	FAIR
17	46.596	RHS	INNER	24/11/2022 09:18:52	560.0	40.0	0.28111	0.24607	0.21441	0.16625	0.13333	0.10041	0.06897	0.05006	0.04086	30.1	6.0	FAIR
18	46.800	RHS	OUTER	24/11/2022 09:17:45	560.0	40.0	0.28123	0.23002	0.18156	0.14756	0.11209	0.08077	0.06232	0.04241	0.03055	30.0	6.0	FAIR
19	47.105	RHS	INNER	24/11/2022 09:13:57	560.0	40.0	0.24387	0.22042	0.20235	0.16745	0.13944	0.10977	0.07714	0.04401	0.03987	30.0	6.0	FAIR
20	47.391	RHS	OUTER	24/11/2022 09:12:48	560.0	40.0	0.14669	0.12227	0.10753	0.09127	0.07577	0.05453	0.04196	0.03581	0.03139	29.8	6.0	FAIR
21	52.125	RHS	INNER	23/11/2022 16:50:53	560.0	40.0	0.30068	0.24404	0.20059	0.15949	0.12226	0.08385	0.05946	0.02331	0.02026	32.9	6.0	FAIR
22	52.394	RHS	OUTER	23/11/2022 16:49:50	560.0	40.0	0.26057	0.22472	0.18923	0.14532	0.11378	0.09724	0.05275	0.03961	0.02662	32.9	6.0	FAIR

S.NO	Station	Side (LHS/RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)	Pavement Condition
							D1	D2	D3	D4	D5	D6	D7	D8	D9			
23	52.598	RHS	INNER	23/11/2022 16:48:44	560.0	40.0	0.24689	0.21812	0.18711	0.14513	0.12704	0.10398	0.07266	0.05388	0.03262	32.9	6.0	FAIR
24	52.802	RHS	OUTER	23/11/2022 16:45:59	560.0	40.0	0.23994	0.19588	0.15590	0.12594	0.09691	0.06024	0.04309	0.03201	0.02839	32.9	6.0	FAIR
25	52.995	RHS	OUTER	23/11/2022 16:44:22	560.0	40.0	0.24277	0.19230	0.16280	0.12766	0.09499	0.07625	0.06078	0.04115	0.03688	33.0	6.0	FAIR
26	55.101	RHS	INNER	23/11/2022 16:30:42	560.0	40.0	0.29212	0.23019	0.18976	0.13409	0.09254	0.06425	0.04117	0.03259	0.02643	33.2	6.0	FAIR
27	55.396	RHS	OUTER	23/11/2022 16:29:33	560.0	40.0	0.27284	0.24308	0.21275	0.17692	0.14917	0.10492	0.06995	0.04781	0.03399	33.2	6.0	FAIR
28	55.604	RHS	INNER	23/11/2022 16:28:28	560.0	40.0	0.26245	0.21282	0.18280	0.15726	0.11018	0.09878	0.07641	0.05441	0.03214	33.2	6.0	FAIR
29	55.800	RHS	OUTER	23/11/2022 16:27:18	560.0	40.0	0.22290	0.19656	0.15739	0.11370	0.09312	0.07670	0.05713	0.03135	0.02658	33.3	6.0	FAIR
30	56.000	RHS	OUTER	23/11/2022 16:26:06	560.0	40.0	0.19683	0.15361	0.13011	0.10516	0.08435	0.05995	0.04474	0.03484	0.03168	33.3	6.0	FAIR
31	56.107	RHS	INNER	23/11/2022 16:24:50	560.0	40.0	0.32108	0.27756	0.24352	0.19349	0.14965	0.11492	0.08642	0.05787	0.03057	33.4	6.0	FAIR
32	56.405	RHS	OUTER	23/11/2022 16:23:35	560.0	40.0	0.25615	0.21019	0.17723	0.14618	0.11520	0.09300	0.07418	0.05848	0.03389	33.4	6.0	FAIR
33	56.600	RHS	INNER	23/11/2022 16:22:18	560.0	40.0	0.19813	0.15143	0.13320	0.09272	0.07717	0.05685	0.04335	0.03475	0.02250	33.4	6.0	FAIR
34	56.779	RHS	OUTER	23/11/2022 16:21:04	560.0	40.0	0.23497	0.18659	0.14665	0.11616	0.09893	0.07705	0.05090	0.03774	0.02550	33.5	6.0	FAIR
35	56.993	RHS	OUTER	23/11/2022 16:19:55	560.0	40.0	0.28881	0.25185	0.23732	0.17843	0.13427	0.11164	0.08575	0.06415	0.04218	33.5	6.0	FAIR
36	57.127	RHS	INNER	23/11/2022 16:18:43	560.0	40.0	0.30228	0.27903	0.22819	0.16202	0.13218	0.10453	0.07336	0.05653	0.03162	33.6	6.0	FAIR
37	57.403	RHS	OUTER	23/11/2022 16:17:29	560.0	40.0	0.27809	0.21468	0.17048	0.13903	0.09751	0.06324	0.04102	0.02695	0.02636	33.7	6.0	FAIR
38	57.572	RHS	INNER	23/11/2022 16:16:17	560.0	40.0	0.26076	0.22126	0.17287	0.13125	0.10152	0.07399	0.05699	0.04426	0.03693	33.7	6.0	FAIR
39	57.786	RHS	OUTER	23/11/2022 16:15:05	560.0	40.0	0.24480	0.21201	0.18057	0.15076	0.11260	0.07754	0.05615	0.04721	0.03051	33.8	6.0	FAIR
40	58.001	RHS	OUTER	23/11/2022 16:13:49	560.0	40.0	0.17264	0.13808	0.12126	0.10189	0.08524	0.06202	0.04823	0.03755	0.03463	33.9	6.0	FAIR
41	58.132	RHS	INNER	23/11/2022 16:12:43	560.0	40.0	0.28149	0.22955	0.19154	0.14089	0.11317	0.08577	0.05917	0.03700	0.03116	33.9	6.0	FAIR
42	58.380	RHS	OUTER	23/11/2022 16:11:36	560.0	40.0	0.23157	0.19227	0.14696	0.11000	0.09348	0.06184	0.04743	0.03826	0.02415	33.9	6.0	FAIR
43	58.603	RHS	INNER	23/11/2022 16:10:26	560.0	40.0	0.29063	0.24973	0.19165	0.15909	0.11279	0.08136	0.06896	0.04299	0.02675	33.9	6.0	FAIR
44	58.791	RHS	OUTER	23/11/2022 16:09:16	560.0	40.0	0.36378	0.33214	0.25555	0.19537	0.14756	0.10719	0.06267	0.04365	0.03018	34.0	6.0	FAIR
45	58.999	RHS	OUTER	23/11/2022 16:08:03	560.0	40.0	0.13766	0.11599	0.10659	0.09401	0.08234	0.06358	0.05003	0.03843	0.03308	34.0	6.0	FAIR

S.NO	Station	Side (LHS/RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)	Pavement Condition
							D1	D2	D3	D4	D5	D6	D7	D8	D9			
46	59.113	RHS	INNER	23/11/2022 16:06:57	560.0	40.0	0.26662	0.23026	0.19171	0.15307	0.12088	0.08628	0.05764	0.04623	0.04422	34.0	6.0	FAIR
47	59.396	RHS	OUTER	23/11/2022 16:05:49	560.0	40.0	0.31320	0.26513	0.22691	0.16148	0.12865	0.09326	0.06366	0.04617	0.03509	34.1	6.0	FAIR
48	59.587	RHS	INNER	23/11/2022 16:04:37	560.0	40.0	0.35602	0.30099	0.25384	0.20189	0.15113	0.11305	0.07867	0.05805	0.03258	34.2	6.0	FAIR
49	59.752	RHS	OUTER	23/11/2022 16:03:22	560.0	40.0	0.27830	0.23862	0.18867	0.13347	0.10988	0.07757	0.05927	0.04664	0.04099	34.2	6.0	FAIR
50	59.997	RHS	OUTER	23/11/2022 16:01:58	560.0	40.0	0.29305	0.21713	0.14995	0.12140	0.09291	0.05938	0.04661	0.04094	0.03757	34.3	6.0	FAIR
51	60.123	RHS	INNER	23/11/2022 16:00:42	560.0	40.0	0.25514	0.18809	0.15568	0.11978	0.09224	0.05603	0.03620	0.02500	0.02165	34.3	6.0	FAIR
52	60.400	RHS	OUTER	23/11/2022 15:59:22	560.0	40.0	0.34728	0.28480	0.24422	0.19817	0.15868	0.10035	0.06549	0.04389	0.03571	34.3	6.0	FAIR
53	60.595	RHS	INNER	23/11/2022 15:58:12	560.0	40.0	0.15846	0.12671	0.10706	0.08088	0.06743	0.03884	0.03039	0.02162	0.01903	34.3	6.0	FAIR
54	60.749	RHS	OUTER	23/11/2022 15:56:57	560.0	40.0	0.29272	0.22413	0.18822	0.14638	0.11277	0.06708	0.04757	0.03766	0.03445	34.3	6.0	FAIR
55	60.988	RHS	OUTER	23/11/2022 15:55:42	560.0	40.0	0.30032	0.23279	0.19248	0.15024	0.11512	0.07176	0.04902	0.03691	0.03200	34.4	6.0	FAIR
56	61.150	RHS	INNER	23/11/2022 15:54:27	560.0	40.0	0.28710	0.23002	0.19805	0.15986	0.12849	0.08414	0.05865	0.04218	0.03579	34.4	6.0	FAIR
57	61.397	RHS	OUTER	23/11/2022 15:51:56	560.0	40.0	0.23130	0.19165	0.16679	0.13461	0.11169	0.07507	0.05598	0.04198	0.03724	34.4	6.0	FAIR
58	61.590	RHS	INNER	23/11/2022 15:49:55	560.0	40.0	0.28035	0.24082	0.18166	0.14558	0.10425	0.06931	0.04328	0.03556	0.02295	34.5	6.0	FAIR
59	61.761	RHS	OUTER	23/11/2022 15:47:34	560.0	40.0	0.24531	0.19722	0.16931	0.13734	0.11082	0.07476	0.05361	0.04061	0.03580	34.6	6.0	FAIR
60	63.759	RHS	OUTER	23/11/2022 15:30:27	560.0	40.0	0.34317	0.27773	0.22795	0.17303	0.13172	0.08262	0.05889	0.04603	0.04108	34.6	6.0	FAIR
61	63.987	RHS	OUTER	23/11/2022 15:29:18	560.0	40.0	0.34097	0.26722	0.21716	0.15984	0.11911	0.07883	0.05918	0.04608	0.04531	34.6	6.0	FAIR
62	64.139	RHS	INNER	23/11/2022 15:28:06	560.0	40.0	0.27971	0.22021	0.18320	0.14362	0.11388	0.07602	0.05594	0.04365	0.03543	34.6	6.0	FAIR
63	64.388	RHS	OUTER	23/11/2022 15:26:54	560.0	40.0	0.24538	0.18799	0.15745	0.12193	0.09636	0.06809	0.04723	0.03333	0.03107	34.7	6.0	FAIR
64	64.591	RHS	INNER	23/11/2022 15:25:39	560.0	40.0	0.31493	0.26444	0.22137	0.17849	0.14867	0.09801	0.05356	0.03466	0.03086	35.0	6.0	FAIR
65	64.786	RHS	OUTER	23/11/2022 15:24:35	560.0	40.0	0.33004	0.26010	0.23192	0.18218	0.13221	0.10002	0.05532	0.04269	0.03833	35.0	6.0	FAIR
66	64.992	RHS	OUTER	23/11/2022 15:23:29	560.0	40.0	0.26783	0.21483	0.17291	0.13950	0.11092	0.07485	0.05810	0.04736	0.04244	35.2	6.0	FAIR
67	65.112	RHS	INNER	23/11/2022 15:22:15	560.0	40.0	0.18205	0.15652	0.13831	0.12095	0.10373	0.07704	0.06166	0.04493	0.04118	35.2	6.0	FAIR
68	65.396	RHS	OUTER	23/11/2022 15:20:58	560.0	40.0	0.32024	0.27442	0.21471	0.17854	0.13455	0.09997	0.06282	0.04161	0.02752	35.3	6.0	FAIR

S.NO	Station	Side (LHS/RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)	Pavement Condition
							D1	D2	D3	D4	D5	D6	D7	D8	D9			
69	65.561	RHS	INNER	23/11/2022 15:19:51	560.0	40.0	0.30691	0.26219	0.22935	0.18986	0.14387	0.10132	0.06928	0.04929	0.02948	35.3	6.0	FAIR
70	65.795	RHS	OUTER	23/11/2022 15:18:31	560.0	40.0	0.21533	0.16963	0.14473	0.11668	0.09481	0.06347	0.04736	0.03424	0.03050	35.4	6.0	FAIR
71	65.991	RHS	OUTER	23/11/2022 15:17:14	560.0	40.0	0.20865	0.16618	0.14213	0.11489	0.09315	0.06500	0.04846	0.03818	0.03329	35.4	6.0	FAIR
72	66.127	RHS	INNER	23/11/2022 15:15:54	560.0	40.0	0.22258	0.17306	0.13694	0.09758	0.06801	0.04030	0.03201	0.02430	0.02172	35.5	6.0	FAIR
73	66.379	RHS	OUTER	23/11/2022 15:14:46	560.0	40.0	0.13097	0.11398	0.10519	0.09148	0.07818	0.05932	0.04582	0.03348	0.02904	35.6	6.0	FAIR
74	66.578	RHS	INNER	23/11/2022 15:13:34	560.0	40.0	0.20475	0.16692	0.14855	0.12087	0.09760	0.06023	0.04180	0.02831	0.02524	35.6	6.0	FAIR
75	66.793	RHS	OUTER	23/11/2022 15:12:29	560.0	40.0	0.26908	0.23553	0.19225	0.14602	0.11552	0.08933	0.05345	0.04381	0.03811	35.6	6.0	FAIR
76	66.998	RHS	OUTER	23/11/2022 15:11:14	560.0	40.0	0.31292	0.28542	0.25111	0.18917	0.11178	0.08355	0.06248	0.03213	0.01177	35.6	6.0	FAIR
77	67.111	RHS	INNER	23/11/2022 15:10:03	560.0	40.0	0.29157	0.24331	0.20078	0.16187	0.13618	0.09984	0.06517	0.04329	0.02892	35.7	6.0	FAIR
78	67.394	RHS	OUTER	23/11/2022 15:08:49	560.0	40.0	0.34688	0.28951	0.25354	0.17869	0.14238	0.10085	0.06746	0.04375	0.03278	35.8	6.0	FAIR
79	67.596	RHS	INNER	23/11/2022 15:07:44	560.0	40.0	0.28289	0.21347	0.17243	0.13035	0.10004	0.06369	0.04894	0.03973	0.03480	35.8	6.0	FAIR
80	67.789	RHS	OUTER	23/11/2022 15:06:36	560.0	40.0	0.14616	0.11381	0.09706	0.07513	0.06028	0.03868	0.02885	0.01909	0.01689	35.8	6.0	FAIR
81	67.990	RHS	OUTER	23/11/2022 15:05:27	560.0	40.0	0.19205	0.15811	0.13542	0.10784	0.08337	0.05318	0.03658	0.02535	0.02141	35.9	6.0	FAIR
82	68.119	RHS	INNER	23/11/2022 15:04:19	560.0	40.0	0.18482	0.16516	0.14719	0.11966	0.09703	0.06703	0.04640	0.03453	0.02940	35.9	6.0	FAIR
83	68.390	RHS	OUTER	23/11/2022 15:03:09	560.0	40.0	0.18193	0.15319	0.13766	0.11768	0.10047	0.07112	0.05546	0.04303	0.03688	35.9	6.0	FAIR
84	68.600	RHS	INNER	23/11/2022 15:02:00	560.0	40.0	0.30223	0.23639	0.20510	0.15811	0.12432	0.08011	0.05162	0.03887	0.02872	36.0	6.0	FAIR
85	68.770	RHS	OUTER	23/11/2022 15:00:47	560.0	40.0	0.26769	0.23859	0.19555	0.15173	0.11868	0.08048	0.05429	0.03272	0.02922	36.0	6.0	FAIR
86	68.977	RHS	OUTER	23/11/2022 14:59:39	560.0	40.0	0.19641	0.15862	0.13842	0.11598	0.09601	0.06758	0.05437	0.04389	0.03852	36.1	6.0	FAIR
87	69.137	RHS	INNER	23/11/2022 14:58:29	560.0	40.0	0.28417	0.25153	0.21333	0.16222	0.12935	0.10647	0.06808	0.04731	0.03311	36.3	6.0	FAIR
88	69.408	RHS	OUTER	23/11/2022 14:57:20	560.0	40.0	0.18694	0.15850	0.13847	0.11407	0.09041	0.06130	0.04737	0.03580	0.03338	36.3	6.0	FAIR
89	69.603	RHS	INNER	23/11/2022 14:56:08	560.0	40.0	0.20828	0.17064	0.14949	0.12198	0.09675	0.06228	0.04340	0.02813	0.02622	36.3	6.0	FAIR
90	69.808	RHS	OUTER	23/11/2022 14:54:52	560.0	40.0	0.27602	0.23313	0.19523	0.15599	0.11523	0.08517	0.05423	0.03345	0.02921	36.4	6.0	FAIR
91	69.994	RHS	OUTER	23/11/2022 14:53:32	560.0	40.0	0.25802	0.21838	0.18123	0.14336	0.11313	0.07137	0.05660	0.04376	0.03832	36.4	6.0	FAIR

S.NO	Station	Side (LHS/RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)	Pavement Condition
							D1	D2	D3	D4	D5	D6	D7	D8	D9			
92	70.198	RHS	INNER	23/11/2022 14:52:18	560.0	40.0	0.26409	0.22000	0.19433	0.15818	0.13156	0.08193	0.05843	0.04165	0.03526	36.4	6.0	FAIR
93	70.402	RHS	OUTER	23/11/2022 14:50:48	560.0	40.0	0.26984	0.23431	0.19469	0.15124	0.12825	0.09589	0.07435	0.04265	0.02619	36.4	6.0	FAIR
94	70.586	RHS	INNER	23/11/2022 14:49:40	560.0	40.0	0.27942	0.24608	0.22140	0.17221	0.14032	0.10151	0.05280	0.03977	0.03335	36.5	6.0	FAIR
95	70.791	RHS	OUTER	23/11/2022 14:48:26	560.0	40.0	0.20689	0.16651	0.14467	0.11860	0.09816	0.06797	0.05062	0.03950	0.03571	36.5	6.0	FAIR
96	70.994	RHS	OUTER	23/11/2022 14:47:15	560.0	40.0	0.28781	0.24619	0.20122	0.15407	0.11733	0.07608	0.04569	0.03637	0.03421	36.6	6.0	FAIR
97	71.194	RHS	INNER	23/11/2022 14:46:03	560.0	40.0	0.30943	0.26315	0.23316	0.17391	0.14911	0.11395	0.07464	0.05868	0.03438	36.6	6.0	FAIR
98	71.368	RHS	OUTER	23/11/2022 14:44:52	560.0	40.0	0.24948	0.19618	0.17448	0.14304	0.11602	0.07702	0.05334	0.04078	0.03491	36.6	6.0	FAIR
99	71.596	RHS	INNER	23/11/2022 14:43:43	560.0	40.0	0.24292	0.20924	0.18262	0.15294	0.12615	0.08640	0.06260	0.04319	0.03916	36.7	6.0	FAIR
100	71.783	RHS	OUTER	23/11/2022 14:42:35	560.0	40.0	0.30941	0.24826	0.20953	0.16836	0.13611	0.08736	0.05873	0.04186	0.03680	36.8	6.0	FAIR
101	71.994	RHS	OUTER	23/11/2022 14:40:46	560.0	40.0	0.19436	0.17613	0.16387	0.14155	0.12166	0.08710	0.06524	0.04444	0.03796	36.8	6.0	FAIR
102	72.122	RHS	INNER	23/11/2022 14:38:57	560.0	40.0	0.33901	0.27666	0.22535	0.17137	0.12781	0.09714	0.06332	0.04244	0.02605	36.8	6.0	FAIR
103	72.343	RHS	OUTER	23/11/2022 14:23:36	560.0	40.0	0.30283	0.24538	0.21457	0.17357	0.13994	0.09183	0.06041	0.04199	0.03461	36.8	6.0	FAIR
104	72.593	RHS	INNER	23/11/2022 14:22:17	560.0	40.0	0.27177	0.23895	0.17268	0.13114	0.09022	0.06562	0.04337	0.02382	0.02031	36.8	6.0	FAIR
105	72.769	RHS	OUTER	23/11/2022 14:21:04	560.0	40.0	0.29333	0.25813	0.20114	0.15350	0.11103	0.07305	0.05200	0.03776	0.03219	36.8	6.0	FAIR
106	73.000	RHS	OUTER	23/11/2022 14:19:54	560.0	40.0	0.25061	0.20102	0.17154	0.13735	0.10819	0.06878	0.05009	0.03386	0.03091	36.9	6.0	FAIR
107	73.231	RHS	INNER	23/11/2022 14:18:57	560.0	40.0	0.21532	0.18478	0.16451	0.13684	0.11261	0.07555	0.05649	0.03781	0.03551	36.9	6.0	FAIR
108	73.351	RHS	OUTER	23/11/2022 14:17:42	560.0	40.0	0.22426	0.18383	0.16059	0.13061	0.10650	0.06998	0.05302	0.03886	0.03630	36.9	6.0	FAIR
109	73.594	RHS	INNER	23/11/2022 14:16:30	560.0	40.0	0.25028	0.19968	0.17214	0.14028	0.11241	0.07071	0.04631	0.03127	0.02548	36.9	6.0	FAIR
110	73.734	RHS	OUTER	23/11/2022 14:15:19	560.0	40.0	0.32285	0.26713	0.22808	0.18055	0.14930	0.10061	0.07729	0.05188	0.04410	36.9	6.0	FAIR
111	73.994	RHS	OUTER	23/11/2022 14:10:19	560.0	40.0	0.39030	0.31524	0.26847	0.22094	0.18498	0.13050	0.09710	0.07546	0.06495	36.9	6.0	FAIR
112	74.101	RHS	INNER	23/11/2022 14:08:56	560.0	40.0	0.18843	0.15787	0.13875	0.11567	0.09685	0.06940	0.05255	0.03947	0.03524	36.9	6.0	FAIR
113	74.381	RHS	OUTER	23/11/2022 14:07:16	560.0	40.0	0.39955	0.31646	0.27370	0.21522	0.17226	0.10178	0.07171	0.04956	0.04493	36.9	6.0	FAIR
114	74.595	RHS	INNER	23/11/2022 14:05:58	560.0	40.0	0.15466	0.12248	0.10306	0.08314	0.06596	0.04664	0.03267	0.02560	0.02157	37.0	6.0	FAIR

S.NO	Station	Side (LHS/RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)	Pavement Condition
							D1	D2	D3	D4	D5	D6	D7	D8	D9			
115	75.000	RHS	OUTER	23/11/2022 14:04:01	560.0	40.0	0.25375	0.20547	0.17866	0.14600	0.11687	0.07487	0.05016	0.03466	0.02908	37.0	6.0	FAIR
116	75.106	RHS	INNER	23/11/2022 14:02:15	560.0	40.0	0.15860	0.12821	0.11000	0.08815	0.07101	0.04715	0.03372	0.02620	0.02283	37.0	6.0	FAIR
117	75.361	RHS	OUTER	23/11/2022 14:00:51	560.0	40.0	0.11477	0.09701	0.08728	0.07514	0.06344	0.04504	0.03374	0.02634	0.02297	37.0	6.0	FAIR
118	75.574	RHS	INNER	23/11/2022 13:59:27	560.0	40.0	0.30371	0.23847	0.19996	0.15890	0.12755	0.08615	0.06360	0.04747	0.04165	37.0	6.0	FAIR
119	75.793	RHS	OUTER	23/11/2022 13:58:00	560.0	40.0	0.34410	0.28591	0.24848	0.20041	0.16175	0.11032	0.08084	0.06206	0.05696	37.0	6.0	FAIR
120	76.000	RHS	OUTER	23/11/2022 13:56:25	560.0	40.0	0.28320	0.24118	0.20729	0.16887	0.13716	0.09251	0.06319	0.04574	0.03967	37.0	6.0	FAIR
121	76.840	RHS	OUTER	23/11/2022 13:51:59	560.0	40.0	0.31869	0.26898	0.22019	0.17610	0.13696	0.10085	0.08549	0.07135	0.04129	37.0	6.0	FAIR
122	76.993	RHS	OUTER	23/11/2022 13:50:37	560.0	40.0	0.23678	0.21288	0.16696	0.12761	0.10172	0.08608	0.06496	0.05246	0.04740	37.0	6.0	FAIR
123	77.102	RHS	INNER	23/11/2022 13:49:08	560.0	40.0	0.27242	0.21337	0.17609	0.13526	0.10342	0.06620	0.04875	0.03857	0.03552	37.1	6.0	FAIR
124	77.373	RHS	OUTER	23/11/2022 13:47:40	560.0	40.0	0.27719	0.23629	0.20511	0.17000	0.14936	0.09511	0.06180	0.04749	0.01284	37.1	6.0	FAIR
125	77.595	RHS	INNER	23/11/2022 13:45:08	560.0	40.0	0.25512	0.22735	0.19423	0.15803	0.12633	0.08242	0.05282	0.03980	0.02462	37.1	6.0	FAIR
126	77.793	RHS	OUTER	23/11/2022 13:43:38	560.0	40.0	0.24307	0.21592	0.17348	0.14934	0.11812	0.07829	0.04353	0.03482	0.02103	37.1	6.0	FAIR
127	77.996	RHS	OUTER	23/11/2022 13:42:21	560.0	40.0	0.19532	0.16630	0.14864	0.12167	0.10138	0.07136	0.05282	0.04110	0.03697	37.1	6.0	FAIR
128	80.996	RHS	OUTER	23/11/2022 13:20:19	560.0	40.0	0.25789	0.22979	0.17963	0.14728	0.11486	0.09565	0.06303	0.03530	0.01277	36.8	6.0	FAIR
129	81.192	RHS	INNER	23/11/2022 13:19:00	560.0	40.0	0.12956	0.10030	0.08527	0.06953	0.05622	0.04000	0.03108	0.02511	0.02359	36.8	6.0	FAIR
130	81.404	RHS	OUTER	23/11/2022 13:17:39	560.0	40.0	0.15850	0.12620	0.10791	0.08738	0.06982	0.04688	0.03466	0.02701	0.02421	36.7	6.0	FAIR
131	81.604	RHS	INNER	23/11/2022 13:16:17	560.0	40.0	0.21683	0.16646	0.13694	0.10580	0.08231	0.05436	0.04066	0.03152	0.02882	36.6	6.0	FAIR
132	81.795	RHS	OUTER	23/11/2022 13:14:52	560.0	40.0	0.27862	0.23574	0.19378	0.14032	0.10266	0.08396	0.05560	0.03020	0.01650	36.6	6.0	FAIR
133	81.939	RHS	OUTER	23/11/2022 13:13:40	560.0	40.0	0.21165	0.17068	0.14945	0.12576	0.09735	0.07480	0.04418	0.02766	0.01493	36.5	6.0	FAIR
134	82.114	RHS	INNER	23/11/2022 13:12:19	560.0	40.0	0.20030	0.15870	0.13744	0.11039	0.08674	0.05484	0.03949	0.03018	0.02776	36.4	6.0	FAIR
135	82.386	RHS	OUTER	23/11/2022 13:10:32	560.0	40.0	0.26031	0.23825	0.19521	0.15036	0.11107	0.09497	0.06020	0.03241	0.01799	36.2	6.0	FAIR
136	82.586	RHS	INNER	23/11/2022 13:09:14	560.0	40.0	0.14610	0.12545	0.11277	0.09692	0.08245	0.05971	0.04635	0.03511	0.03202	36.2	6.0	FAIR
137	82.793	RHS	OUTER	23/11/2022 13:07:50	560.0	40.0	0.32042	0.27640	0.24239	0.21580	0.17467	0.12830	0.09494	0.05572	0.02226	36.2	6.0	FAIR

S.NO	Station	Side (LHS/RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)	Pavement Condition
							D1	D2	D3	D4	D5	D6	D7	D8	D9			
138	83.000	RHS	OUTER	23/11/2022 13:06:22	560.0	40.0	0.17749	0.13535	0.11458	0.08861	0.07026	0.04661	0.03537	0.02784	0.02458	36.1	6.0	FAIR
139	92.375	RHS	INNER	23/11/2022 13:05:08	560.0	40.0	0.26592	0.21341	0.18341	0.15081	0.12952	0.09245	0.06724	0.03579	0.02981	36.1	6.0	GOOD
140	92.618	RHS	OUTER	23/11/2022 13:02:13	560.0	40.0	0.24957	0.18096	0.15007	0.13423	0.09968	0.06435	0.04811	0.03716	0.01224	36.1	6.0	GOOD

E-values & Remaining Life Analysis: On RHS Direction: NH-27 Kochugaon to Rakhaldubi (Pkg-1)																		
S.NO	Station	Side (LHS/RHS)	Lane	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
				E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
1	30.101	RHS	INNER	400	1500	100	500	30	120	340	360	1022.6	175.5	120.0	0.98	1004.7	151.5	104.0
2	30.355	RHS	OUTER	400	1500	100	500	30	120	340	360	768.8	105.9	120.0	0.98	752.1	79.7	104.0
3	43.130	RHS	INNER	400	1500	100	500	30	120	300	450	1323.7	220.0	120.0	0.84	1109.8	191.6	104.0
4	43.371	RHS	OUTER	400	1500	100	500	30	120	300	450	1160.2	355.7	120.0	0.84	972.7	298.5	104.0
5	43.600	RHS	INNER	400	1500	100	500	30	120	300	450	1479.6	498.8	119.9	0.83	1235.3	395.3	104.0
6	43.798	RHS	OUTER	400	1500	100	500	30	120	300	450	947.3	491.0	120.0	0.83	790.9	390.3	104.0
7	43.996	RHS	OUTER	400	1500	100	500	30	120	300	450	838.7	181.3	120.0	0.83	694.4	156.9	104.0
8	44.368	RHS	OUTER	400	1500	100	500	30	120	300	450	935.5	184.1	120.0	0.83	774.5	159.5	104.0
9	44.600	RHS	INNER	400	1500	100	500	30	120	300	450	1472.0	191.1	120.0	0.82	1213.6	165.9	104.0
10	44.806	RHS	OUTER	400	1500	100	500	30	120	300	450	1215.1	481.2	120.0	0.82	997.6	384.0	104.0
11	45.001	RHS	OUTER	400	1500	100	500	30	120	300	450	1441.9	498.8	120.0	0.82	1178.9	395.3	104.0
12	45.149	RHS	INNER	400	1500	100	500	30	120	300	450	1232.3	101.6	116.4	0.82	1007.5	74.8	101.0
13	45.383	RHS	OUTER	400	1500	100	500	30	120	300	450	1473.1	499.6	120.0	0.81	1199.4	395.8	104.0
14	45.579	RHS	INNER	400	1500	100	500	30	120	300	450	1489.2	494.5	120.0	0.81	1207.4	392.6	104.0
15	45.751	RHS	OUTER	400	1500	100	500	30	120	300	450	1500.0	498.4	120.0	0.81	1216.2	395.0	104.0
16	45.927	RHS	OUTER	400	1500	100	500	30	120	300	450	882.8	137.5	120.0	0.81	715.8	114.0	104.0
17	46.596	RHS	INNER	400	1500	100	500	30	120	300	450	1119.4	180.9	120.0	0.81	907.6	156.5	104.0
18	46.800	RHS	OUTER	400	1500	100	500	30	120	300	450	951.6	279.1	120.0	0.81	768.3	240.5	104.0
19	47.105	RHS	INNER	400	1500	100	500	30	120	300	450	1417.2	181.3	120.0	0.81	1144.3	156.9	104.0
20	47.391	RHS	OUTER	400	1500	100	500	30	120	300	450	1487.1	485.9	119.9	0.80	1190.8	387.0	104.0
21	52.125	RHS	INNER	400	1500	100	500	30	120	300	400	615.1	154.3	120.0	0.91	561.4	131.0	104.0
22	52.394	RHS	OUTER	400	1500	100	500	30	120	300	400	906.5	284.6	120.0	0.91	827.3	244.9	104.0

S.NO	Station	Side (LHS/RHS)	Lane	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
				E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
23	52.598	RHS	INNER	400	1500	100	500	30	120	300	400	1437.6	229.0	120.0	0.91	1312.0	199.4	104.0
24	52.802	RHS	OUTER	400	1500	100	500	30	120	300	400	1276.3	478.9	120.0	0.91	1164.8	382.5	104.0
25	52.995	RHS	OUTER	400	1500	100	500	30	120	300	400	1222.6	485.5	119.9	0.92	1120.6	386.8	104.0
26	55.101	RHS	INNER	400	1500	100	500	30	120	300	400	735.5	414.8	120.0	0.92	680.0	340.0	104.0
27	55.396	RHS	OUTER	400	1500	100	500	30	120	300	400	1221.5	161.0	119.9	0.92	1129.3	137.6	104.0
28	55.604	RHS	INNER	400	1500	100	500	30	120	300	400	1188.2	267.0	120.0	0.92	1098.5	230.9	104.0
29	55.800	RHS	OUTER	400	1500	100	500	30	120	300	400	1472.0	467.5	120.0	0.93	1366.7	375.1	104.0
30	56.000	RHS	OUTER	400	1500	100	500	30	120	300	400	1489.2	485.5	119.9	0.93	1382.7	386.8	104.0
31	56.107	RHS	INNER	400	1500	100	500	30	120	300	400	1030.1	107.4	119.9	0.93	960.6	81.4	104.0
32	56.405	RHS	OUTER	400	1500	100	500	30	120	300	400	1278.5	286.5	120.0	0.93	1192.2	246.4	104.0
33	56.600	RHS	INNER	400	1500	100	500	30	120	300	400	1362.4	494.1	120.0	0.93	1270.4	392.3	104.0
34	56.779	RHS	OUTER	400	1500	100	500	30	120	300	400	1360.2	487.9	120.0	0.94	1273.9	388.3	104.0
35	56.993	RHS	OUTER	400	1500	100	500	30	120	300	400	1429.0	116.0	120.0	0.94	1338.3	91.1	104.0
36	57.127	RHS	INNER	400	1500	100	500	30	120	300	400	1184.9	133.2	120.0	0.94	1114.5	109.5	104.0
37	57.403	RHS	OUTER	400	1500	100	500	30	120	300	400	918.3	453.5	120.0	0.94	867.5	365.9	104.0
38	57.572	RHS	INNER	400	1500	100	500	30	120	300	400	914.0	469.9	120.0	0.94	863.4	376.7	104.0
39	57.786	RHS	OUTER	400	1500	100	500	30	120	300	400	1167.7	350.6	120.0	0.95	1107.9	294.8	104.0
40	58.001	RHS	OUTER	400	1500	100	500	30	120	300	400	1493.5	491.8	119.7	0.95	1423.2	390.8	103.8
41	58.132	RHS	INNER	400	1500	100	500	30	120	300	400	966.7	278.7	120.0	0.95	921.2	240.2	104.0
42	58.380	RHS	OUTER	400	1500	100	500	30	120	300	400	1439.8	496.1	119.8	0.95	1372.0	393.6	103.9
43	58.603	RHS	INNER	400	1500	100	500	30	120	300	400	879.6	222.4	120.0	0.95	838.2	193.7	104.0
44	58.791	RHS	OUTER	400	1500	100	500	30	120	300	400	665.6	108.6	120.0	0.96	637.0	82.8	104.0
45	58.999	RHS	OUTER	400	1500	100	500	30	120	300	400	1483.9	494.5	119.9	0.96	1420.2	392.6	104.0

S.NO	Station	Side (LHS/RHS)	Lane	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
				E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
46	59.113	RHS	INNER	400	1500	100	500	30	120	300	400	1018.3	302.2	120.0	0.96	974.6	258.6	104.0
47	59.396	RHS	OUTER	400	1500	100	500	30	120	300	400	826.9	189.9	120.0	0.96	794.9	164.8	104.0
48	59.587	RHS	INNER	400	1500	100	500	30	120	300	400	866.7	102.7	120.0	0.97	836.8	76.1	104.0
49	59.752	RHS	OUTER	400	1500	100	500	30	120	300	400	887.1	377.2	120.0	0.97	856.5	313.8	104.0
50	59.997	RHS	OUTER	400	1500	100	500	30	120	300	400	953.8	487.1	120.0	0.97	924.9	387.8	104.0
51	60.123	RHS	INNER	400	1500	100	500	30	120	270	420	1487.1	495.7	120.0	0.97	1442.0	393.3	104.0
52	60.400	RHS	OUTER	400	1500	100	500	30	120	270	420	955.9	120.3	120.0	0.97	926.9	95.8	104.0
53	60.595	RHS	INNER	400	1500	100	500	30	120	270	420	1466.7	494.1	119.9	0.97	1422.2	392.3	104.0
54	60.749	RHS	OUTER	400	1500	100	500	30	120	270	420	866.7	365.9	120.0	0.97	840.4	305.8	104.0
55	60.988	RHS	OUTER	400	1500	100	500	30	120	270	420	894.6	282.6	120.0	0.97	871.3	243.3	104.0
56	61.150	RHS	INNER	400	1500	100	500	30	120	270	420	1165.6	261.9	120.0	0.97	1135.2	226.8	104.0
57	61.397	RHS	OUTER	400	1500	100	500	30	120	270	420	1497.8	468.7	120.0	0.97	1458.8	375.9	104.0
58	61.590	RHS	INNER	400	1500	100	500	30	120	270	420	951.6	288.1	120.0	0.98	930.9	247.6	104.0
59	61.761	RHS	OUTER	400	1500	100	500	30	120	270	420	1383.9	441.7	120.0	0.98	1359.7	358.1	104.0
60	63.759	RHS	OUTER	400	1500	100	500	30	120	270	420	700.0	208.3	119.9	0.98	687.8	181.4	104.0
61	63.987	RHS	OUTER	400	1500	100	500	30	120	270	420	675.3	248.2	120.0	0.98	663.5	215.5	104.0
62	64.139	RHS	INNER	400	1500	100	500	30	120	270	420	943.0	355.3	120.0	0.98	926.5	298.2	104.0
63	64.388	RHS	OUTER	400	1500	100	500	30	120	270	420	1484.9	488.3	120.0	0.99	1465.4	388.6	104.0
64	64.591	RHS	INNER	400	1500	100	500	30	120	270	420	1028.0	152.8	120.0	1.00	1028.0	129.5	104.0
65	64.786	RHS	OUTER	400	1500	100	500	30	120	270	420	879.6	182.1	120.0	1.00	879.6	157.6	104.0
66	64.992	RHS	OUTER	400	1500	100	500	30	120	270	420	967.7	419.5	120.0	1.01	976.3	343.2	104.0
67	65.112	RHS	INNER	400	1500	100	500	30	120	270	420	1497.8	494.1	119.9	1.01	1511.1	392.3	104.0
68	65.396	RHS	OUTER	400	1500	100	500	30	120	270	420	1001.1	155.9	120.0	1.01	1014.5	132.6	104.0

S.NO	Station	Side (LHS/RHS)	Lane	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
				E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
69	65.561	RHS	INNER	400	1500	100	500	30	120	270	420	1187.1	139.9	119.9	1.01	1203.0	116.5	104.0
70	65.795	RHS	OUTER	400	1500	100	500	30	120	270	420	1493.5	497.3	120.0	1.02	1520.2	394.3	104.0
71	65.991	RHS	OUTER	400	1500	100	500	30	120	270	420	1416.1	489.8	120.0	1.02	1441.4	389.5	104.0
72	66.127	RHS	INNER	400	1500	100	500	30	120	270	420	1480.6	498.0	120.0	1.02	1513.8	394.8	104.0
73	66.379	RHS	OUTER	400	1500	100	500	30	120	270	420	1481.7	499.6	119.9	1.03	1521.7	395.8	104.0
74	66.578	RHS	INNER	400	1500	100	500	30	120	270	420	1475.3	497.3	119.9	1.03	1515.1	394.3	104.0
75	66.793	RHS	OUTER	400	1500	100	500	30	120	270	420	1128.0	304.5	120.0	1.03	1158.5	260.3	104.0
76	66.998	RHS	OUTER	400	1500	100	500	30	120	270	420	715.1	100.0	120.0	1.03	734.4	72.9	104.0
77	67.111	RHS	INNER	400	1500	100	500	30	120	270	420	1189.2	180.2	120.0	1.03	1226.8	155.9	104.0
78	67.394	RHS	OUTER	400	1500	100	500	30	120	270	420	891.4	145.0	119.9	1.04	923.7	121.7	104.0
79	67.596	RHS	INNER	400	1500	100	500	30	120	270	420	1004.3	473.0	120.0	1.04	1040.7	378.7	104.0
80	67.789	RHS	OUTER	400	1500	100	500	30	120	270	420	1474.2	493.0	120.0	1.04	1527.6	391.6	104.0
81	67.990	RHS	OUTER	400	1500	100	500	30	120	270	420	1447.3	489.8	119.9	1.04	1506.5	389.5	104.0
82	68.119	RHS	INNER	400	1500	100	500	30	120	270	420	1492.5	493.4	119.9	1.04	1553.5	391.9	104.0
83	68.390	RHS	OUTER	400	1500	100	500	30	120	270	420	1494.6	488.3	120.0	1.04	1555.7	388.6	104.0
84	68.600	RHS	INNER	400	1500	100	500	30	120	270	420	946.2	206.4	120.0	1.05	989.3	179.7	104.0
85	68.770	RHS	OUTER	400	1500	100	500	30	120	270	420	1150.5	233.7	120.0	1.05	1202.9	203.4	104.0
86	68.977	RHS	OUTER	400	1500	100	500	30	120	270	420	1466.7	496.9	120.0	1.05	1540.5	394.1	104.0
87	69.137	RHS	INNER	400	1500	100	500	30	120	270	420	1266.7	171.9	120.0	1.06	1342.4	148.1	104.0
88	69.408	RHS	OUTER	400	1500	100	500	30	120	270	420	1497.8	498.0	120.0	1.06	1587.4	394.8	104.0
89	69.603	RHS	INNER	400	1500	100	500	30	120	270	420	1495.7	493.4	119.9	1.06	1585.1	391.9	104.0
90	69.808	RHS	OUTER	400	1500	100	500	30	120	270	420	1208.6	224.3	120.0	1.06	1286.7	195.4	104.0
91	69.994	RHS	OUTER	400	1500	100	500	30	120	270	420	1167.7	386.6	120.0	1.06	1243.1	320.5	104.0

S.NO	Station	Side (LHS/RHS)	Lane	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
				E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
92	70.198	RHS	INNER	400	1500	100	500	30	120	280	430	1201.1	251.7	120.0	1.06	1278.7	218.4	104.0
93	70.402	RHS	OUTER	400	1500	100	500	30	120	280	430	1208.6	205.6	120.0	1.06	1286.7	179.0	104.0
94	70.586	RHS	INNER	400	1500	100	500	30	120	280	430	1193.5	164.1	120.0	1.07	1276.4	140.6	104.0
95	70.791	RHS	OUTER	400	1500	100	500	30	120	280	430	1446.2	489.8	120.0	1.07	1546.6	389.5	104.0
96	70.994	RHS	OUTER	400	1500	100	500	30	120	280	430	873.1	285.7	120.0	1.07	938.0	245.8	104.0
97	71.194	RHS	INNER	400	1500	100	500	30	120	280	430	1202.2	128.5	120.0	1.07	1291.5	104.6	104.0
98	71.368	RHS	OUTER	400	1500	100	500	30	120	280	430	1228.0	390.5	120.0	1.07	1319.2	323.2	104.0
99	71.596	RHS	INNER	400	1500	100	500	30	120	280	430	1472.0	491.0	111.9	1.08	1588.6	390.3	97.1
100	71.783	RHS	OUTER	400	1500	100	500	30	120	280	430	889.2	198.1	120.0	1.08	964.0	172.3	104.0
101	71.994	RHS	OUTER	400	1500	100	500	30	120	280	430	1460.2	491.4	120.0	1.08	1583.0	390.6	104.0
102	72.122	RHS	INNER	400	1500	100	500	30	120	280	430	830.1	150.4	120.0	1.08	899.9	127.1	104.0
103	72.343	RHS	OUTER	400	1500	100	500	30	120	280	430	1471.0	455.8	119.7	1.08	1594.7	367.5	103.8
104	72.593	RHS	INNER	400	1500	100	500	30	120	280	430	935.5	348.7	120.0	1.08	1014.2	293.4	104.0
105	72.769	RHS	OUTER	400	1500	100	500	30	120	280	430	863.4	290.4	120.0	1.08	936.0	249.4	104.0
106	73.000	RHS	OUTER	400	1500	100	500	30	120	280	430	1222.6	446.8	120.0	1.09	1331.5	361.5	104.0
107	73.231	RHS	INNER	400	1500	100	500	30	120	280	430	1473.1	394.4	117.3	1.09	1604.3	325.9	101.7
108	73.351	RHS	OUTER	400	1500	100	500	30	120	280	430	1467.7	494.5	120.0	1.09	1598.4	392.6	104.0
109	73.594	RHS	INNER	400	1500	100	500	30	120	280	430	1219.4	356.1	120.0	1.09	1328.0	298.7	104.0
110	73.734	RHS	OUTER	400	1500	100	500	30	120	280	430	1073.1	139.5	120.0	1.09	1168.7	116.1	104.0
111	73.994	RHS	OUTER	400	1500	100	500	30	120	280	430	1003.2	118.4	96.6	1.09	1092.6	93.7	83.6
112	74.101	RHS	INNER	400	1500	100	500	30	120	280	430	1484.9	494.5	119.9	1.09	1617.2	392.6	104.0
113	74.381	RHS	OUTER	400	1500	100	500	30	120	280	430	760.2	100.4	120.0	1.09	827.9	73.4	104.0
114	74.595	RHS	INNER	400	1500	100	500	30	120	280	430	1438.7	495.3	120.0	1.09	1574.0	393.1	104.0

S.NO	Station	Side (LHS/RHS)	Lane	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
				E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
115	75.000	RHS	OUTER	400	1500	100	500	30	120	280	430	1469.9	499.2	119.3	1.09	1608.2	395.6	103.4
116	75.106	RHS	INNER	400	1500	100	500	30	120	280	430	1483.9	484.8	120.0	1.09	1623.5	386.3	104.0
117	75.361	RHS	OUTER	400	1500	100	500	30	120	280	430	1422.6	497.3	120.0	1.09	1556.4	394.3	104.0
118	75.574	RHS	INNER	400	1500	100	500	30	120	280	430	1021.5	225.1	120.0	1.09	1117.6	196.0	104.0
119	75.793	RHS	OUTER	400	1500	100	500	30	120	280	430	1124.7	119.2	114.8	1.09	1230.5	94.6	99.6
120	76.000	RHS	OUTER	400	1500	100	500	30	120	280	430	1123.7	209.9	119.9	1.09	1229.4	182.8	104.0
121	76.840	RHS	OUTER	400	1500	100	500	30	120	280	430	1177.4	152.0	120.0	1.09	1288.2	128.7	104.0
122	76.993	RHS	OUTER	400	1500	100	500	30	120	280	430	1228.0	475.4	120.0	1.09	1343.5	380.3	104.0
123	77.102	RHS	INNER	400	1500	100	500	30	120	280	430	1469.9	471.1	119.8	1.10	1615.5	377.5	103.9
124	77.373	RHS	OUTER	400	1500	100	500	30	120	280	430	875.3	115.2	120.0	1.10	962.0	90.2	104.0
125	77.595	RHS	INNER	400	1500	100	500	30	120	280	430	1206.5	227.1	120.0	1.10	1326.0	197.8	104.0
126	77.793	RHS	OUTER	400	1500	100	500	30	120	280	430	1202.2	267.7	120.0	1.10	1321.3	231.4	104.0
127	77.996	RHS	OUTER	400	1500	100	500	30	120	280	430	1472.0	403.8	119.0	1.10	1617.9	332.4	103.2
128	80.996	RHS	OUTER	400	1500	100	500	30	120	280	420	938.7	118.4	120.0	1.08	1017.7	93.7	104.0
129	81.192	RHS	INNER	400	1500	100	500	30	120	280	420	1453.8	487.5	119.9	1.08	1576.1	388.1	104.0
130	81.404	RHS	OUTER	400	1500	100	500	30	120	280	420	1453.8	489.1	119.9	1.08	1568.9	389.1	104.0
131	81.604	RHS	INNER	400	1500	100	500	30	120	280	420	1471.0	430.8	118.6	1.07	1580.3	350.8	102.8
132	81.795	RHS	OUTER	400	1500	100	500	30	120	280	420	877.4	184.1	120.0	1.07	942.6	159.5	104.0
133	81.939	RHS	OUTER	400	1500	100	500	30	120	280	420	1497.8	372.5	120.0	1.07	1601.8	310.5	104.0
134	82.114	RHS	INNER	400	1500	100	500	30	120	280	420	1382.8	495.3	120.0	1.06	1472.1	393.1	104.0
135	82.386	RHS	OUTER	400	1500	100	500	30	120	280	420	973.1	180.9	120.0	1.06	1026.6	156.5	104.0
136	82.586	RHS	INNER	400	1500	100	500	30	120	280	420	1498.9	489.8	119.6	1.06	1581.4	389.5	103.7
137	82.793	RHS	OUTER	400	1500	100	500	30	120	280	420	963.4	102.7	120.0	1.06	1016.4	76.1	104.0

S.NO	Station	Side (LHS/RHS)	Lane	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
				E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
138	83.000	RHS	OUTER	400	1500	100	500	30	120	280	420	1493.5	487.9	119.9	1.05	1568.6	388.3	104.0
139	92.375	RHS	INNER	750	3000	100	500	30	120	280	420	1172.3	254.4	120.0	1.05	1231.2	220.6	104.0
140	92.618	RHS	OUTER	750	3000	100	500	30	120	280	420	1176.7	209.5	120.0	1.05	1235.9	182.5	104.0

Modulus of Subgrade Reaction & Elastic Modulus of Concrete Analysis: NH-27 Kochugaon - Rakhaldubi : LHS

S. No.	Chinage	Side	Lane	Test Point Location	Pressure	Radius of Loading Plate (in)	Load	Load	Deflection in (mm)				Deflection in (inches)			
					N/mm2		(KN)	(Pound)	0	300	600	900	0	300	600	900
1	30.001	LHS	Outer	INTERIOR	1085.1	11.811	76.7	17230.2	0.1580	0.1488	0.1315	0.1143	0.00622047	0.00585827	0.00517717	0.00450000
2	30.012	LHS	Outer	CORNER	1142.3	11.811	80.8	18138.5	0.1635	0.1521	0.1395	0.1192	0.00643701	0.00598819	0.00549213	0.00469291
3	32.000	LHS	Outer	INTERIOR	1177.2	11.811	83.2	18692.6	0.1552	0.1345	0.1239	0.1169	0.00611024	0.00529528	0.00487795	0.00460236
4	32.010	LHS	Outer	CORNER	1153.0	11.811	81.5	18308.4	0.1484	0.1351	0.1235	0.1212	0.00584252	0.00531890	0.00486220	0.00477165
5	32.401	LHS	Outer	INTERIOR	1158.9	11.811	82.0	18402.0	0.1651	0.1573	0.1381	0.1158	0.00650000	0.00619291	0.00543701	0.00455906
6	32.411	LHS	Outer	CORNER	1104.8	11.811	78.1	17543.0	0.1747	0.1632	0.1418	0.1217	0.00687795	0.00642520	0.00558268	0.00479134
7	32.800	LHS	Outer	INTERIOR	1134.2	11.811	80.2	18009.8	0.1636	0.1524	0.1324	0.1277	0.00644094	0.00600000	0.00521260	0.00502756
8	32.814	LHS	Outer	CORNER	1139.9	11.811	80.6	18100.3	0.1668	0.1552	0.1439	0.1157	0.00656693	0.00611024	0.00566535	0.00455512
9	33.000	LHS	Outer	INTERIOR	1130.6	11.811	79.9	17952.7	0.1959	0.1779	0.1475	0.1197	0.00771260	0.00700394	0.00580709	0.00471260
10	33.014	LHS	Outer	CORNER	1144.0	11.811	80.9	18165.5	0.2219	0.2118	0.1998	0.1611	0.00873622	0.00833858	0.00786614	0.00634252
11	33.406	LHS	Outer	INTERIOR	1132.9	11.811	80.1	17989.2	0.1559	0.1446	0.1217	0.1127	0.00613780	0.00569291	0.00479134	0.00443701
12	33.419	LHS	Outer	CORNER	1168.2	11.811	82.6	18549.7	0.1684	0.1598	0.1405	0.1201	0.00662992	0.00629134	0.00553150	0.00472835
13	33.809	LHS	Outer	INTERIOR	1115.7	11.811	78.9	17716.1	0.1821	0.1719	0.1572	0.1292	0.00716929	0.00676772	0.00618898	0.00508661
14	33.820	LHS	Outer	CORNER	1150.8	11.811	81.4	18273.4	0.1921	0.1867	0.1604	0.1031	0.00756299	0.00735039	0.00631496	0.00405906
15	34.402	LHS	Outer	INTERIOR	1154.9	11.811	81.7	18338.5	0.1508	0.1260	0.1097	0.0914	0.00593701	0.00496063	0.00431890	0.00359843
16	34.415	LHS	Outer	CORNER	1107.5	11.811	78.3	17585.9	0.1505	0.1405	0.1259	0.1107	0.00592520	0.00553150	0.00495669	0.00435827
17	34.807	LHS	Outer	INTERIOR	1105.9	11.811	78.2	17560.5	0.1557	0.1399	0.1208	0.1178	0.00612992	0.00550787	0.00475591	0.00463780
18	34.820	LHS	Outer	CORNER	1136.3	11.811	80.4	18043.2	0.1620	0.1507	0.1327	0.1126	0.00637795	0.00593307	0.00522441	0.00443307
19	35.001	LHS	Outer	INTERIOR	1124.0	11.811	79.5	17847.9	0.1545	0.1346	0.1283	0.1196	0.00608268	0.00529921	0.00505118	0.00470866
20	35.015	LHS	Outer	CORNER	1145.9	11.811	81.0	18195.6	0.1664	0.1474	0.1344	0.1188	0.00655118	0.00580315	0.00529134	0.00467717
21	35.403	LHS	Outer	INTERIOR	1111.8	11.811	78.6	17654.2	0.1651	0.1450	0.1350	0.1162	0.00650000	0.00570866	0.00531496	0.00457480
22	35.419	LHS	Outer	CORNER	1130.8	11.811	80.0	17955.9	0.1524	0.1391	0.1288	0.1077	0.00600000	0.00547638	0.00507087	0.00424016
23	35.800	LHS	Outer	INTERIOR	1117.8	11.811	79.0	17749.4	0.1543	0.1435	0.1325	0.1003	0.00607480	0.00564961	0.00521654	0.00394882
24	35.815	LHS	Outer	CORNER	1130.3	11.811	79.9	17947.9	0.1755	0.1668	0.1489	0.1206	0.00690945	0.00656693	0.00586220	0.00474803
25	36.006	LHS	Outer	INTERIOR	1125.4	11.811	79.6	17870.1	0.1797	0.1669	0.1559	0.1358	0.00707480	0.00657087	0.00613780	0.00534646
26	36.022	LHS	Outer	CORNER	1137.8	11.811	80.5	18067.0	0.2034	0.1832	0.1721	0.1596	0.00800787	0.00721260	0.00677559	0.00628346
27	36.400	LHS	Outer	INTERIOR	1164.6	11.811	82.4	18492.6	0.1754	0.1550	0.1334	0.1096	0.00690551	0.00610236	0.00525197	0.00431496
28	36.414	LHS	Outer	CORNER	1137.3	11.811	80.4	18059.1	0.1838	0.1795	0.1515	0.1383	0.00723622	0.00706693	0.00596457	0.00544488
29	36.803	LHS	Outer	INTERIOR	1124.2	11.811	79.5	17851.1	0.1543	0.1318	0.1288	0.1178	0.00607480	0.00518898	0.00507087	0.00463780
30	36.816	LHS	Outer	CORNER	1127.6	11.811	79.7	17905.0	0.1677	0.1571	0.1398	0.1017	0.00660236	0.00618504	0.00550394	0.00400394
31	37.005	LHS	Outer	INTERIOR	1139.8	11.811	80.6	18098.8	0.1576	0.1404	0.1279	0.1121	0.00620472	0.00552756	0.00503543	0.00441339
32	37.016	LHS	Outer	CORNER	1126.7	11.811	79.7	17890.7	0.1659	0.1508	0.1381	0.1212	0.00653150	0.00593701	0.00543701	0.00477165

S. No.	Chinage	Side	Lane	Test Point Location	Pressure	Radius of Loading Plate (in)	Load	Load	Deflection in (mm)				Deflection in (inches)			
					N/mm2		(KN)	(Pound)	0	300	600	900	0	300	600	900
33	37.399	LHS	Outer	INTERIOR	1141.0	11.811	80.7	18117.8	0.1582	0.1398	0.1275	0.1155	0.00622835	0.00550394	0.00501969	0.00454724
34	37.413	LHS	Outer	CORNER	1117.9	11.811	79.1	17751.0	0.1715	0.1631	0.1419	0.1256	0.00675197	0.00642126	0.00558661	0.00494488
35	37.804	LHS	Outer	INTERIOR	1129.8	11.811	79.9	17940.0	0.1963	0.1854	0.1763	0.1508	0.00772835	0.00729921	0.00694094	0.00593701
36	37.816	LHS	Outer	CORNER	1115.8	11.811	78.9	17717.7	0.2381	0.2219	0.2052	0.1733	0.00937402	0.00873622	0.00807874	0.00682283
37	39.800	LHS	Outer	INTERIOR	1158.3	11.811	81.9	18392.5	0.1988	0.1843	0.1727	0.1657	0.00782677	0.00725591	0.00679921	0.00652362
38	39.814	LHS	Outer	CORNER	1150.3	11.811	81.3	18265.5	0.2028	0.1925	0.1754	0.1562	0.00798425	0.00757874	0.00690551	0.00614961
39	40.001	LHS	Outer	INTERIOR	1155.6	11.811	81.7	18349.6	0.1557	0.1205	0.1095	0.0935	0.00612992	0.00474409	0.00431102	0.00368110
40	40.016	LHS	Outer	CORNER	1150.9	11.811	81.4	18275.0	0.1658	0.1432	0.1372	0.1074	0.00652756	0.00563780	0.00540157	0.00422835
41	40.403	LHS	Outer	INTERIOR	1116.1	11.811	78.9	17722.4	0.1650	0.1540	0.1336	0.1177	0.00649606	0.00606299	0.00525984	0.00463386
42	40.419	LHS	Outer	CORNER	1128.5	11.811	79.8	17919.3	0.1816	0.1678	0.1503	0.1307	0.00714961	0.00660630	0.00591732	0.00514567
43	43.407	LHS	Outer	INTERIOR	1139.0	11.811	80.5	18086.1	0.1562	0.1432	0.1321	0.1178	0.00614961	0.00563780	0.00520079	0.00463780
44	43.420	LHS	Outer	CORNER	1136.4	11.811	80.4	18044.8	0.1632	0.1576	0.1239	0.1066	0.00642520	0.00620472	0.00487795	0.00419685
45	43.801	LHS	Outer	INTERIOR	1135.4	11.811	80.3	18028.9	0.1554	0.1412	0.1364	0.1041	0.00611811	0.00555906	0.00537008	0.00409843
46	43.816	LHS	Outer	CORNER	1127.0	11.811	79.7	17895.5	0.1667	0.1553	0.1401	0.1206	0.00656299	0.00611417	0.00551575	0.00474803
47	44.000	LHS	Outer	INTERIOR	1130.2	11.811	79.9	17946.3	0.1674	0.1598	0.1469	0.1298	0.00659055	0.00629134	0.00578346	0.00511024
48	44.013	LHS	Outer	CORNER	1145.9	11.811	81.0	18195.6	0.1730	0.1503	0.1489	0.1316	0.00681102	0.00591732	0.00586220	0.00518110
49	44.401	LHS	Outer	INTERIOR	1143.6	11.811	80.9	18159.1	0.1566	0.1416	0.1298	0.1052	0.00616535	0.00557480	0.00511024	0.00414173
50	44.416	LHS	Outer	CORNER	1141.3	11.811	80.7	18122.6	0.1726	0.1648	0.1552	0.1436	0.00679528	0.00648819	0.00611024	0.00565354
51	44.811	LHS	Outer	INTERIOR	1159.6	11.811	82.0	18413.2	0.1980	0.1744	0.1581	0.1416	0.00779528	0.00686614	0.00622441	0.00557480
52	44.826	LHS	Outer	CORNER	1138.7	11.811	80.5	18081.3	0.1631	0.1492	0.1341	0.1008	0.00642126	0.00587402	0.00527953	0.00396850
53	45.015	LHS	Outer	INTERIOR	1146.4	11.811	81.1	18203.6	0.1718	0.1616	0.1427	0.1286	0.00676378	0.00636220	0.00561811	0.00506299
54	45.029	LHS	Outer	CORNER	1164.0	11.811	82.3	18483.0	0.1650	0.1358	0.1252	0.1137	0.00649606	0.00534646	0.00492913	0.00447638
55	45.408	LHS	Outer	INTERIOR	1141.2	11.811	80.7	18121.0	0.1588	0.1332	0.1168	0.0986	0.00625197	0.00524409	0.00459843	0.00388189
56	45.420	LHS	Outer	CORNER	1131.4	11.811	80.0	17965.4	0.1776	0.1559	0.1438	0.1308	0.00699213	0.00613780	0.00566142	0.00514961
57	45.810	LHS	Outer	INTERIOR	1107.6	11.811	78.3	17587.5	0.1535	0.1427	0.1301	0.1182	0.00604331	0.00561811	0.00512205	0.00465354
58	45.826	LHS	Outer	CORNER	1129.4	11.811	79.9	17933.6	0.1634	0.1515	0.1202	0.1087	0.00643307	0.00596457	0.00473228	0.00427953
59	46.004	LHS	Outer	INTERIOR	1125.8	11.811	79.6	17876.5	0.1772	0.1488	0.1393	0.1162	0.00697638	0.00585827	0.00548425	0.00457480
60	46.016	LHS	Outer	CORNER	1162.2	11.811	82.2	18454.4	0.1947	0.1832	0.1521	0.1454	0.00766535	0.00721260	0.00598819	0.00572441
61	46.402	LHS	Outer	INTERIOR	1149.1	11.811	81.3	18246.4	0.1851	0.1725	0.1516	0.1378	0.00728740	0.00679134	0.00596850	0.00542520
62	46.418	LHS	Outer	CORNER	1146.8	11.811	81.1	18209.9	0.2024	0.1802	0.1497	0.1211	0.00796850	0.00709449	0.00589370	0.00476772
63	46.803	LHS	Outer	INTERIOR	1133.2	11.811	80.1	17994.0	0.1522	0.1434	0.1301	0.1075	0.00599213	0.00564567	0.00512205	0.00423228
64	46.815	LHS	Outer	CORNER	1104.0	11.811	78.1	17530.3	0.1726	0.1710	0.1136	0.0985	0.00679528	0.00673228	0.00447244	0.00387795
65	47.402	LHS	Outer	INTERIOR	1121.7	11.811	79.3	17811.4	0.1887	0.1768	0.1542	0.1290	0.00742913	0.00696063	0.00607087	0.00507874
66	47.414	LHS	Outer	CORNER	1131.3	11.811	80.0	17963.8	0.1947	0.1807	0.1688	0.1469	0.00766535	0.00711417	0.00664567	0.00578346
67	52.014	LHS	Outer	INTERIOR	1141.8	11.811	80.7	18130.5	0.1548	0.1435	0.1288	0.1101	0.00609449	0.00564961	0.00507087	0.00433465

S. No.	Chinage	Side	Lane	Test Point Location	Pressure	Radius of Loading Plate (in)	Load	Load	Deflection in (mm)				Deflection in (inches)			
					N/mm2		(KN)	(Pound)	0	300	600	900	0	300	600	900
68	52.029	LHS	Outer	CORNER	1121.8	11.811	79.3	17812.9	0.2061	0.1929	0.1607	0.1563	0.00811417	0.00759449	0.00632677	0.00615354
69	52.408	LHS	Outer	INTERIOR	1149.5	11.811	81.3	18252.8	0.1549	0.1394	0.1211	0.1153	0.00609843	0.00548819	0.00476772	0.00453937
70	52.423	LHS	Outer	CORNER	1135.8	11.811	80.3	18035.2	0.1548	0.1405	0.1308	0.1071	0.00609449	0.00553150	0.00514961	0.00421654
71	53.004	LHS	Outer	INTERIOR	1123.7	11.811	79.5	17843.1	0.1554	0.1462	0.1289	0.1112	0.00611811	0.00575591	0.00507480	0.00437795
72	53.021	LHS	Outer	CORNER	1128.2	11.811	79.8	17914.6	0.1665	0.1576	0.1438	0.1268	0.00655512	0.00620472	0.00566142	0.00499213
73	53.507	LHS	Outer	INTERIOR	1137.8	11.811	80.5	18067.0	0.1667	0.1531	0.1393	0.1147	0.00656299	0.00602756	0.00548425	0.00451575
74	54.010	LHS	Outer	INTERIOR	1118.4	11.811	79.1	17759.0	0.1745	0.1633	0.1481	0.1325	0.00687008	0.00642913	0.00583071	0.00521654
75	54.025	LHS	Outer	CORNER	1138.9	11.811	80.5	18084.5	0.1944	0.1784	0.1692	0.1505	0.00765354	0.00702362	0.00666142	0.00592520
76	54.518	LHS	Outer	INTERIOR	1143.6	11.811	80.9	18159.1	0.1656	0.1531	0.1402	0.1239	0.00651969	0.00602756	0.00551969	0.00487795
77	55.005	LHS	Outer	INTERIOR	1103.4	11.811	78.0	17520.8	0.1962	0.1745	0.1624	0.1578	0.00772441	0.00687008	0.00639370	0.00621260
78	55.019	LHS	Outer	CORNER	1139.5	11.811	80.6	18094.0	0.1963	0.1866	0.1688	0.1585	0.00772835	0.00734646	0.00664567	0.00624016
79	55.503	LHS	Outer	INTERIOR	1089.5	11.811	77.0	17300.1	0.1554	0.1426	0.1287	0.1191	0.00611811	0.00561417	0.00506693	0.00468898
80	56.002	LHS	Outer	INTERIOR	1100.7	11.811	77.8	17477.9	0.1670	0.1561	0.1391	0.1247	0.00657480	0.00614567	0.00547638	0.00490945
81	56.014	LHS	Outer	CORNER	1114.1	11.811	78.8	17690.7	0.1763	0.1644	0.1509	0.1163	0.00694094	0.00647244	0.00594094	0.00457874
82	56.501	LHS	Outer	INTERIOR	1102.2	11.811	77.9	17501.7	0.1533	0.1431	0.1308	0.1086	0.00603543	0.00563386	0.00514961	0.00427559
83	57.050	LHS	Outer	INTERIOR	1088.7	11.811	77.0	17287.4	0.1665	0.1494	0.1387	0.1156	0.00655512	0.00588189	0.00546063	0.00455118
84	57.062	LHS	Outer	CORNER	1091.7	11.811	77.2	17335.0	0.1909	0.1806	0.1649	0.1507	0.00751575	0.00711024	0.00649213	0.00593307
85	57.506	LHS	Outer	INTERIOR	1096.0	11.811	77.5	17403.3	0.1591	0.1440	0.1257	0.1169	0.00626378	0.00566929	0.00494882	0.00460236
86	57.998	LHS	Outer	INTERIOR	1088.0	11.811	76.9	17276.2	0.1680	0.1530	0.1462	0.1254	0.00661417	0.00602362	0.00575591	0.00493701
87	58.016	LHS	Outer	CORNER	1118.8	11.811	79.1	17765.3	0.1806	0.1709	0.1564	0.1454	0.00711024	0.00672835	0.00615748	0.00572441
88	58.505	LHS	Outer	INTERIOR	1087.2	11.811	76.9	17263.5	0.1541	0.1405	0.1282	0.1139	0.00606693	0.00553150	0.00504724	0.00448425
89	59.005	LHS	Outer	INTERIOR	1093.3	11.811	77.3	17360.4	0.1629	0.1408	0.1218	0.1011	0.00641339	0.00554331	0.00479528	0.00398031
90	59.022	LHS	Outer	CORNER	1080.0	11.811	76.4	17149.2	0.1744	0.1599	0.1394	0.1297	0.00686614	0.00629528	0.00548819	0.00510630
91	59.505	LHS	Outer	INTERIOR	1084.2	11.811	76.7	17215.9	0.1776	0.1677	0.1546	0.1297	0.00699213	0.00660236	0.00608661	0.00510630
92	60.004	LHS	Outer	INTERIOR	1090.1	11.811	77.1	17309.6	0.1622	0.1553	0.1365	0.1188	0.00638583	0.00611417	0.00537402	0.00467717
93	60.020	LHS	Outer	CORNER	1157.5	11.811	81.9	18379.8	0.1737	0.1582	0.1464	0.1293	0.00683858	0.00622835	0.00576378	0.00509055
94	60.483	LHS	Outer	INTERIOR	1091.6	11.811	77.2	17333.4	0.1588	0.1285	0.1179	0.1032	0.00625197	0.00505906	0.00464173	0.00406299
95	61.043	LHS	Outer	INTERIOR	1134.3	11.811	80.2	18011.4	0.1830	0.1743	0.1584	0.1319	0.00720472	0.00686220	0.00623622	0.00519291
96	61.054	LHS	Outer	CORNER	1108.6	11.811	78.4	17603.3	0.1881	0.1623	0.1472	0.1272	0.00740551	0.00638976	0.00579528	0.00500787
97	61.505	LHS	Outer	INTERIOR	1132.0	11.811	80.0	17974.9	0.1909	0.1805	0.1748	0.1252	0.00751575	0.00710630	0.00688189	0.00492913
98	64.006	LHS	Outer	INTERIOR	1087.2	11.811	76.9	17263.5	0.1590	0.1400	0.1218	0.1011	0.00625984	0.00551181	0.00479528	0.00398031
99	64.020	LHS	Outer	CORNER	1150.7	11.811	81.4	18271.8	0.1687	0.1542	0.1224	0.1073	0.00664173	0.00607087	0.00481890	0.00422441
100	64.506	LHS	Outer	INTERIOR	1083.1	11.811	76.6	17198.4	0.1949	0.1835	0.1656	0.1412	0.00767323	0.00722441	0.00651969	0.00555906
101	65.008	LHS	Outer	INTERIOR	1119.1	11.811	79.1	17770.1	0.1510	0.1448	0.1212	0.1065	0.00594488	0.00570079	0.00477165	0.00419291
102	65.020	LHS	Outer	CORNER	1160.5	11.811	82.1	18427.5	0.1762	0.1617	0.1337	0.1072	0.00693701	0.00636614	0.00526378	0.00422047

S. No.	Chinage	Side	Lane	Test Point Location	Pressure	Radius of Loading Plate (in)	Load	Load	Deflection in (mm)				Deflection in (inches)			
					N/mm2		(KN)	(Pound)	0	300	600	900	0	300	600	900
103	65.507	LHS	Outer	INTERIOR	1178.1	11.811	83.3	18706.9	0.1848	0.1671	0.1558	0.1395	0.00727559	0.00657874	0.00613386	0.00549213
104	66.000	LHS	Outer	INTERIOR	1149.2	11.811	81.3	18248.0	0.1609	0.1518	0.1385	0.1109	0.00633465	0.00597638	0.00545276	0.00436614
105	66.015	LHS	Outer	CORNER	1125.2	11.811	79.6	17866.9	0.1880	0.1644	0.1463	0.1273	0.00740157	0.00647244	0.00575984	0.00501181
106	66.506	LHS	Outer	INTERIOR	1158.9	11.811	82.0	18402.0	0.1851	0.1696	0.1512	0.1378	0.00728740	0.00667717	0.00595276	0.00542520
107	67.011	LHS	Outer	INTERIOR	1120.6	11.811	79.2	17793.9	0.1555	0.1412	0.1294	0.1195	0.00612205	0.00555906	0.00509449	0.00470472
108	67.027	LHS	Outer	CORNER	1181.2	11.811	83.5	18756.1	0.1573	0.1424	0.1286	0.1141	0.00619291	0.00560630	0.00506299	0.00449213
109	67.505	LHS	Outer	INTERIOR	1114.1	11.811	78.8	17690.7	0.1500	0.1412	0.1288	0.1107	0.00590551	0.00555906	0.00507087	0.00435827
110	68.000	LHS	Outer	INTERIOR	1124.9	11.811	79.5	17862.2	0.1944	0.1785	0.1593	0.1389	0.00765354	0.00702756	0.00627165	0.00546850
111	68.016	LHS	Outer	CORNER	1121.1	11.811	79.3	17801.8	0.2102	0.2058	0.1853	0.1467	0.00827559	0.00810236	0.00729528	0.00577559
112	68.504	LHS	Outer	INTERIOR	1097.6	11.811	77.6	17428.7	0.1518	0.1412	0.1233	0.1131	0.00597638	0.00555906	0.00485433	0.00445276
113	69.010	LHS	Outer	INTERIOR	1172.1	11.811	82.9	18611.7	0.1558	0.1432	0.1302	0.1139	0.00613386	0.00563780	0.00512598	0.00448425
114	69.026	LHS	Outer	CORNER	1182.8	11.811	83.6	18781.6	0.1656	0.1548	0.1495	0.0979	0.00651969	0.00609449	0.00588583	0.00385433
115	69.505	LHS	Outer	INTERIOR	1146.8	11.811	81.1	18209.9	0.1534	0.1274	0.1154	0.1012	0.00603937	0.00501575	0.00454331	0.00398425
116	69.998	LHS	Outer	INTERIOR	1138.2	11.811	80.5	18073.4	0.1747	0.1632	0.1501	0.1356	0.00687795	0.00642520	0.00590945	0.00533858
117	70.013	LHS	Outer	CORNER	1123.3	11.811	79.4	17836.8	0.1608	0.1482	0.1308	0.1172	0.00633071	0.00583465	0.00514961	0.00461417
118	70.513	LHS	Outer	INTERIOR	1108.0	11.811	78.4	17593.8	0.1932	0.1792	0.1597	0.1348	0.00760630	0.00705512	0.00628740	0.00530709
119	71.011	LHS	Outer	INTERIOR	1111.2	11.811	78.6	17644.6	0.1563	0.1435	0.1233	0.1095	0.00615354	0.00564961	0.00485433	0.00431102
120	71.030	LHS	Outer	CORNER	1114.2	11.811	78.8	17692.3	0.1763	0.1513	0.1326	0.1232	0.00694094	0.00595669	0.00522047	0.00485039
121	71.512	LHS	Outer	INTERIOR	1108.9	11.811	78.4	17608.1	0.1615	0.1506	0.1379	0.1195	0.00635827	0.00592913	0.00542913	0.00470472
122	72.006	LHS	Outer	INTERIOR	1106.8	11.811	78.3	17574.8	0.1538	0.1290	0.1140	0.0960	0.00605512	0.00507874	0.00448819	0.00377953
123	72.024	LHS	Outer	CORNER	1112.4	11.811	78.7	17663.7	0.1592	0.1461	0.1301	0.1101	0.00626772	0.00575197	0.00512205	0.00433465
124	72.500	LHS	Outer	INTERIOR	1093.1	11.811	77.3	17357.2	0.1947	0.1801	0.1631	0.1474	0.00766535	0.00709055	0.00642126	0.00580315
125	73.000	LHS	Outer	INTERIOR	1111.0	11.811	78.6	17641.4	0.1537	0.1239	0.1138	0.0958	0.00605118	0.00487795	0.00448031	0.00377165
126	73.016	LHS	Outer	CORNER	1114.7	11.811	78.8	17700.2	0.1927	0.1839	0.1765	0.1643	0.00758661	0.00724016	0.00694882	0.00646850
127	73.505	LHS	Outer	INTERIOR	1107.1	11.811	78.3	17579.5	0.1968	0.1841	0.1713	0.1582	0.00774803	0.00724803	0.00674409	0.00622835
128	74.009	LHS	Outer	INTERIOR	1126.6	11.811	79.7	17889.2	0.1525	0.1348	0.1182	0.1029	0.00600394	0.00530709	0.00465354	0.00405118
129	74.025	LHS	Outer	CORNER	1111.9	11.811	78.6	17655.7	0.2072	0.1913	0.1698	0.1463	0.00815748	0.00753150	0.00668504	0.00575984
130	74.513	LHS	Outer	INTERIOR	1117.4	11.811	79.0	17743.1	0.1563	0.1388	0.1271	0.1135	0.00615354	0.00546457	0.00500394	0.00446850
131	75.014	LHS	Outer	INTERIOR	1104.4	11.811	78.1	17536.6	0.1551	0.1407	0.1311	0.1182	0.00610630	0.00553937	0.00516142	0.00465354
132	75.030	LHS	Outer	CORNER	1100.8	11.811	77.8	17479.5	0.1576	0.1439	0.1240	0.0904	0.00620472	0.00566535	0.00488189	0.00355906
133	75.504	LHS	Outer	INTERIOR	1102.9	11.811	78.0	17512.8	0.1533	0.1429	0.1317	0.1005	0.00603543	0.00562598	0.00518504	0.00395669
134	76.026	LHS	Outer	INTERIOR	1104.7	11.811	78.1	17541.4	0.1509	0.1408	0.1293	0.0843	0.00594094	0.00554331	0.00509055	0.00331890
135	76.041	LHS	Outer	CORNER	1135.8	11.811	80.3	18035.2	0.1608	0.1332	0.1155	0.1056	0.00633071	0.00524409	0.00454724	0.00415748
136	76.502	LHS	Outer	INTERIOR	1112.0	11.811	78.6	17657.3	0.1531	0.1310	0.1180	0.1035	0.00602756	0.00515748	0.00464567	0.00407480
137	77.000	LHS	Outer	INTERIOR	1127.4	11.811	79.7	17901.9	0.1511	0.1379	0.1169	0.1064	0.00594882	0.00542913	0.00460236	0.00418898

S. No.	Chinage	Side	Lane	Test Point Location	Pressure	Radius of Loading Plate (in)	Load	Load	Deflection in (mm)				Deflection in (inches)			
					N/mm2		(KN)	(Pound)	0	300	600	900	0	300	600	900
138	77.011	LHS	Outer	CORNER	1110.2	11.811	78.5	17628.7	0.1684	0.1425	0.1222	0.1025	0.00662992	0.00561024	0.00481102	0.00403543
139	77.522	LHS	Outer	INTERIOR	1111.6	11.811	78.6	17651.0	0.1412	0.1227	0.1151	0.1015	0.00555906	0.00483071	0.00453150	0.00399606
140	78.017	LHS	Outer	INTERIOR	1119.2	11.811	79.1	17771.7	0.1405	0.1221	0.1057	0.0903	0.00553150	0.00480709	0.00416142	0.00355512
141	78.031	LHS	Outer	CORNER	1107.1	11.811	78.3	17579.5	0.1511	0.1373	0.1119	0.1067	0.00594882	0.00540551	0.00440551	0.00420079
142	79.011	LHS	Outer	INTERIOR	1102.6	11.811	78.0	17508.1	0.1563	0.1476	0.1368	0.1013	0.00615354	0.00581102	0.00538583	0.00398819
143	79.026	LHS	Outer	CORNER	1119.9	11.811	79.2	17782.8	0.1578	0.1517	0.1350	0.1122	0.00621260	0.00597244	0.00531496	0.00441732
144	79.509	LHS	Outer	INTERIOR	1117.8	11.811	79.0	17749.4	0.1570	0.1462	0.1289	0.1168	0.00618110	0.00575591	0.00507480	0.00459843
145	80.000	LHS	Outer	INTERIOR	1117.8	11.811	79.0	17749.4	0.1586	0.1443	0.1332	0.1204	0.00624409	0.00568110	0.00524409	0.00474016
146	80.012	LHS	Outer	CORNER	1100.7	11.811	77.8	17477.9	0.1814	0.1717	0.1518	0.1391	0.00714173	0.00675984	0.00597638	0.00547638
147	80.514	LHS	Outer	INTERIOR	1113.3	11.811	78.7	17678.0	0.1555	0.1384	0.1267	0.1133	0.00612205	0.00544882	0.00498819	0.00446063
148	81.005	LHS	Outer	INTERIOR	1100.3	11.811	77.8	17471.5	0.1521	0.1298	0.1155	0.1031	0.00598819	0.00511024	0.00454724	0.00405906
149	81.015	LHS	Outer	CORNER	1121.5	11.811	79.3	17808.2	0.1669	0.1485	0.1255	0.1187	0.00657087	0.00584646	0.00494094	0.00467323
150	81.507	LHS	Outer	INTERIOR	1087.5	11.811	76.9	17268.3	0.1578	0.1446	0.1344	0.1182	0.00621260	0.00569291	0.00529134	0.00465354
151	82.000	LHS	Outer	INTERIOR	1127.1	11.811	79.7	17897.1	0.1514	0.1386	0.1157	0.1089	0.00596063	0.00545669	0.00455512	0.00428740
152	82.016	LHS	Outer	CORNER	1111.7	11.811	78.6	17652.6	0.1882	0.1752	0.1568	0.1354	0.00740945	0.00689764	0.00617323	0.00533071
153	82.505	LHS	Outer	INTERIOR	1127.7	11.811	79.7	17906.6	0.1555	0.1413	0.1324	0.0986	0.00612205	0.00556299	0.00521260	0.00388189
154	83.009	LHS	Outer	INTERIOR	1105.1	11.811	78.1	17547.8	0.1571	0.1456	0.1291	0.1193	0.00618504	0.00573228	0.00508268	0.00469685
155	83.027	LHS	Outer	CORNER	1105.9	11.811	78.2	17560.5	0.1934	0.1778	0.1617	0.1499	0.00761417	0.00700000	0.00636614	0.00590157
156	83.149	LHS	Outer	INTERIOR	1105.2	11.811	78.2	17549.4	0.1568	0.1389	0.1263	0.1193	0.00617323	0.00546850	0.00497244	0.00469685
157	86.006	LHS	Outer	INTERIOR	1131.7	11.811	80.0	17970.1	0.1518	0.1449	0.1221	0.1008	0.00597638	0.00570472	0.00480709	0.00396850
158	86.022	LHS	Outer	CORNER	1105.9	11.811	78.2	17560.5	0.1683	0.1583	0.1397	0.1269	0.00662598	0.00623228	0.00550000	0.00499606
159	86.503	LHS	Outer	INTERIOR	1113.0	11.811	78.7	17673.2	0.1967	0.1865	0.1769	0.1516	0.00774409	0.00734252	0.00696457	0.00596850
160	87.008	LHS	Outer	INTERIOR	1105.8	11.811	78.2	17558.9	0.1839	0.1682	0.1522	0.1413	0.00724016	0.00662205	0.00599213	0.00556299
161	87.023	LHS	Outer	CORNER	1116.5	11.811	79.0	17728.8	0.1504	0.1403	0.1286	0.1121	0.00592126	0.00552362	0.00506299	0.00441339
162	87.511	LHS	Outer	INTERIOR	1118.5	11.811	79.1	17760.5	0.1961	0.1801	0.1682	0.1459	0.00772047	0.00709055	0.00662205	0.00574409
163	88.017	LHS	Outer	INTERIOR	1180.6	11.811	83.5	18746.6	0.1558	0.1465	0.1308	0.1074	0.00613386	0.00576772	0.00514961	0.00422835
164	88.032	LHS	Outer	CORNER	1182.1	11.811	83.6	18770.4	0.1552	0.1445	0.1315	0.1065	0.00611024	0.00568898	0.00517717	0.00419291
165	88.505	LHS	Outer	INTERIOR	1105.9	11.811	78.2	17560.5	0.1524	0.1346	0.1162	0.1039	0.00600000	0.00529921	0.00457480	0.00409055
166	89.038	LHS	Outer	INTERIOR	1166.4	11.811	82.5	18521.1	0.1347	0.1223	0.1105	0.1027	0.00530315	0.00481496	0.00435039	0.00404331
167	89.055	LHS	Outer	CORNER	1182.1	11.811	83.6	18770.4	0.1552	0.1445	0.1315	0.1065	0.00611024	0.00568898	0.00517717	0.00419291
168	89.512	LHS	Outer	INTERIOR	1118.4	11.811	79.1	17759.0	0.1835	0.1695	0.1579	0.1419	0.00722441	0.00667323	0.00621654	0.00558661

					Modulus of Subgrade Reaction & Elastic Modulus of Concrete Analysis: NH-27 Kochugaon - Rakhaldubi : LHS											
S. No.	Chinage	Side	Lane	Test Point Location	Poisson ratio		PQC Thickness	Area of defelection basin (inch)	Radius of relative stiffness, l (inch)	Normalised defelction, (inches)				Modulus of subgrade reaction k (MPa/m)	Elastic modulus of concrete Ec (MPa)	Strenght of concrete fc (MPa)	Flexural Strenght of concrete f_{mr} (MPa)
					Concrete	Subgrade	mm			0	300	600	900				
1	30.001	LHS	Outer	INTERIOR	0.15	0.45	300	31.629	41.975	0.121	0.117	0.104	0.088	52.39	29,451	34.70	4.12
2	30.012	LHS	Outer	CORNER	0.15	0.45	300	31.776	43.068	0.121	0.117	0.104	0.089	50.69	31,580	39.89	4.42
3	32.000	LHS	Outer	INTERIOR	0.15	0.45	300	30.499	35.009	0.119	0.114	0.098	0.079	80.98	22,027	19.41	3.08
4	32.010	LHS	Outer	CORNER	0.15	0.45	300	31.811	43.337	0.121	0.117	0.105	0.090	54.93	35,080	49.22	4.91
5	32.401	LHS	Outer	INTERIOR	0.15	0.45	300	31.679	42.340	0.121	0.117	0.104	0.089	52.94	30,805	37.96	4.31
6	32.411	LHS	Outer	CORNER	0.15	0.45	300	31.130	38.612	0.120	0.116	0.101	0.084	56.78	22,849	20.88	3.20
7	32.800	LHS	Outer	INTERIOR	0.15	0.45	300	31.573	41.574	0.121	0.117	0.103	0.088	53.35	28,857	33.31	4.04
8	32.814	LHS	Outer	CORNER	0.15	0.45	300	31.680	42.347	0.121	0.117	0.104	0.089	51.58	30,036	36.09	4.21
9	33.000	LHS	Outer	INTERIOR	0.15	0.45	300	29.599	30.856	0.118	0.112	0.093	0.072	79.99	13,130	6.90	1.84
10	33.014	LHS	Outer	CORNER	0.15	0.45	300	32.615	50.369	0.122	0.119	0.109	0.096	27.78	32,376	41.93	4.53
11	33.406	LHS	Outer	INTERIOR	0.15	0.45	300	30.835	36.847	0.120	0.115	0.100	0.082	70.90	23,667	22.40	3.31
12	33.419	LHS	Outer	CORNER	0.15	0.45	300	31.678	42.334	0.121	0.117	0.104	0.089	52.19	30,355	36.86	4.25
13	33.809	LHS	Outer	INTERIOR	0.15	0.45	300	31.944	44.377	0.121	0.118	0.105	0.091	42.18	29,622	35.10	4.15
14	33.820	LHS	Outer	CORNER	0.15	0.45	300	30.903	37.238	0.120	0.115	0.100	0.082	60.42	21,035	17.70	2.94
15	34.402	LHS	Outer	INTERIOR	0.15	0.45	300	28.393	26.607	0.116	0.108	0.087	0.063	138.89	12,603	6.35	1.76
16	34.415	LHS	Outer	CORNER	0.15	0.45	300	31.654	42.160	0.121	0.117	0.104	0.088	55.53	31,770	40.37	4.45
17	34.807	LHS	Outer	INTERIOR	0.15	0.45	300	30.632	35.716	0.120	0.114	0.098	0.080	73.06	21,526	18.53	3.01
18	34.820	LHS	Outer	CORNER	0.15	0.45	300	31.163	38.819	0.120	0.116	0.101	0.084	62.35	25,636	26.29	3.59
19	35.001	LHS	Outer	INTERIOR	0.15	0.45	300	31.064	38.204	0.120	0.115	0.101	0.084	65.72	25,349	25.70	3.55
20	35.015	LHS	Outer	CORNER	0.15	0.45	300	30.606	35.575	0.120	0.114	0.098	0.080	71.78	20,816	17.33	2.91
21	35.403	LHS	Outer	INTERIOR	0.15	0.45	300	30.574	35.406	0.120	0.114	0.098	0.080	70.94	20,185	16.30	2.83
22	35.419	LHS	Outer	CORNER	0.15	0.45	300	31.335	39.930	0.121	0.116	0.102	0.086	62.38	28,712	32.97	4.02
23	35.800	LHS	Outer	INTERIOR	0.15	0.45	300	31.365	40.132	0.121	0.116	0.102	0.086	61.15	28,720	32.99	4.02
24	35.815	LHS	Outer	CORNER	0.15	0.45	300	31.709	42.566	0.121	0.117	0.104	0.089	48.24	28,671	32.88	4.01
25	36.006	LHS	Outer	INTERIOR	0.15	0.45	300	32.090	45.575	0.121	0.118	0.106	0.092	40.60	31,713	40.23	4.44
26	36.022	LHS	Outer	CORNER	0.15	0.45	300	31.670	42.271	0.121	0.117	0.104	0.089	41.65	24,077	23.19	3.37
27	36.400	LHS	Outer	INTERIOR	0.15	0.45	300	29.480	30.379	0.118	0.111	0.092	0.071	94.30	14,543	8.46	2.04
28	36.414	LHS	Outer	CORNER	0.15	0.45	300	32.125	45.871	0.121	0.118	0.106	0.092	39.71	31,834	40.54	4.46
29	36.803	LHS	Outer	INTERIOR	0.15	0.45	300	30.848	36.919	0.120	0.115	0.100	0.082	70.32	23,656	22.38	3.31
30	36.816	LHS	Outer	CORNER	0.15	0.45	300	30.884	37.128	0.120	0.115	0.100	0.082	66.42	22,853	20.89	3.20
31	37.005	LHS	Outer	INTERIOR	0.15	0.45	300	30.697	36.069	0.120	0.115	0.099	0.081	73.50	22,525	20.29	3.15
32	37.016	LHS	Outer	CORNER	0.15	0.45	300	31.280	39.572	0.120	0.116	0.102	0.085	57.80	25,666	26.35	3.59

S. No.	Chinage	Side	Lane	Test Point Location	Poisson ratio		PQC Thickness	Area of defelection basin (inch)	Radius of relative stiffness, l (inch)	Normalised defelction, (inches)				Modulus of subgrade reaction k (MPa/m)	Elastic modulus of concrete Ec (MPa)	Strenght of concrete fc (MPa)	Flexural Strenght of concrete f_{mr} (MPa)
					Concrete	Subgrade	mm			0	300	600	900				
33	37.399	LHS	Outer	INTERIOR	0.15	0.45	300	30.656	35.847	0.120	0.114	0.099	0.080	73.91	22,100	19.54	3.09
34	37.413	LHS	Outer	CORNER	0.15	0.45	300	31.735	42.759	0.121	0.117	0.104	0.089	47.95	29,023	33.69	4.06
35	37.804	LHS	Outer	INTERIOR	0.15	0.45	300	32.720	51.438	0.122	0.119	0.109	0.097	29.52	37,417	56.00	5.24
36	37.816	LHS	Outer	CORNER	0.15	0.45	300	31.892	43.968	0.121	0.117	0.105	0.090	32.70	22,130	19.59	3.10
37	39.800	LHS	Outer	INTERIOR	0.15	0.45	300	32.550	49.736	0.122	0.119	0.108	0.096	31.54	34,946	48.85	4.89
38	39.814	LHS	Outer	CORNER	0.15	0.45	300	32.391	48.220	0.122	0.118	0.108	0.094	32.93	32,235	41.56	4.51
39	40.001	LHS	Outer	INTERIOR	0.15	0.45	300	27.329	23.726	0.115	0.105	0.081	0.056	165.66	9,505	3.61	1.33
40	40.016	LHS	Outer	CORNER	0.15	0.45	300	30.181	33.425	0.119	0.113	0.096	0.076	82.30	18,601	13.84	2.60
41	40.403	LHS	Outer	INTERIOR	0.15	0.45	300	31.196	39.031	0.120	0.116	0.101	0.085	59.31	24,924	24.85	3.49
42	40.419	LHS	Outer	CORNER	0.15	0.45	300	31.338	39.953	0.121	0.116	0.102	0.086	52.06	24,019	23.08	3.36
43	43.407	LHS	Outer	INTERIOR	0.15	0.45	300	31.675	42.309	0.121	0.117	0.104	0.089	54.46	31,600	39.94	4.42
44	43.420	LHS	Outer	CORNER	0.15	0.45	300	30.618	35.639	0.120	0.114	0.098	0.080	73.49	21,465	18.43	3.01
45	43.801	LHS	Outer	INTERIOR	0.15	0.45	300	31.456	40.748	0.121	0.116	0.103	0.087	59.63	29,768	35.44	4.17
46	43.816	LHS	Outer	CORNER	0.15	0.45	300	31.605	41.803	0.121	0.117	0.104	0.088	51.97	28,733	33.02	4.02
47	44.000	LHS	Outer	INTERIOR	0.15	0.45	300	32.638	50.602	0.122	0.119	0.109	0.096	35.69	42,373	71.82	5.93
48	44.013	LHS	Outer	CORNER	0.15	0.45	300	31.318	39.819	0.120	0.116	0.102	0.086	55.45	25,244	25.49	3.53
49	44.401	LHS	Outer	INTERIOR	0.15	0.45	300	30.828	36.804	0.120	0.115	0.100	0.082	72.04	23,933	22.91	3.35
50	44.416	LHS	Outer	CORNER	0.15	0.45	300	33.240	57.287	0.123	0.120	0.111	0.101	27.22	53,084	112.72	7.43
51	44.811	LHS	Outer	INTERIOR	0.15	0.45	300	30.442	34.718	0.119	0.114	0.097	0.079	63.87	16,803	11.29	2.35
52	44.826	LHS	Outer	CORNER	0.15	0.45	300	30.552	35.288	0.120	0.114	0.098	0.079	75.47	21,188	17.96	2.97
53	45.015	LHS	Outer	INTERIOR	0.15	0.45	300	31.746	42.841	0.121	0.117	0.104	0.089	48.75	29,732	35.36	4.16
54	45.029	LHS	Outer	CORNER	0.15	0.45	300	29.116	29.004	0.118	0.110	0.090	0.068	107.80	13,813	7.63	1.93
55	45.408	LHS	Outer	INTERIOR	0.15	0.45	300	28.617	27.307	0.117	0.109	0.088	0.065	123.98	12,482	6.23	1.75
56	45.420	LHS	Outer	CORNER	0.15	0.45	300	30.669	35.917	0.120	0.114	0.099	0.080	64.98	19,581	15.34	2.74
57	45.810	LHS	Outer	INTERIOR	0.15	0.45	300	31.947	44.398	0.121	0.118	0.105	0.091	49.05	34,508	47.63	4.83
58	45.826	LHS	Outer	CORNER	0.15	0.45	300	29.945	32.336	0.119	0.113	0.095	0.075	87.02	17,225	11.87	2.41
59	46.004	LHS	Outer	INTERIOR	0.15	0.45	300	29.445	30.240	0.118	0.111	0.092	0.071	90.40	13,687	7.49	1.92
60	46.016	LHS	Outer	CORNER	0.15	0.45	300	31.146	38.715	0.120	0.116	0.101	0.084	52.89	21,515	18.52	3.01
61	46.402	LHS	Outer	INTERIOR	0.15	0.45	300	31.478	40.904	0.121	0.116	0.103	0.087	49.54	25,111	25.22	3.52
62	46.418	LHS	Outer	CORNER	0.15	0.45	300	29.149	29.123	0.118	0.110	0.091	0.069	87.48	11,395	5.19	1.60
63	46.803	LHS	Outer	INTERIOR	0.15	0.45	300	31.802	43.262	0.121	0.117	0.105	0.090	53.83	34,142	46.63	4.78
64	46.815	LHS	Outer	CORNER	0.15	0.45	300	29.211	29.350	0.118	0.111	0.091	0.069	99.21	13,329	7.11	1.87
65	47.402	LHS	Outer	INTERIOR	0.15	0.45	300	31.151	38.744	0.120	0.116	0.101	0.084	53.17	21,694	18.83	3.04
66	47.414	LHS	Outer	CORNER	0.15	0.45	300	32.068	45.389	0.121	0.118	0.106	0.092	37.97	29,178	34.05	4.08
67	52.014	LHS	Outer	INTERIOR	0.15	0.45	300	31.376	40.206	0.121	0.116	0.102	0.086	61.17	28,941	33.50	4.05

S. No.	Chinage	Side	Lane	Test Point Location	Poisson ratio		PQC Thickness	Area of defelection basin (inch)	Radius of relative stiffness, l (inch)	Normalised defelction, (inches)				Modulus of subgrade reaction k (MPa/m)	Elastic modulus of concrete Ec (MPa)	Strenght of concrete fc (MPa)	Flexural Strenght of concrete f_{mr} (MPa)
					Concrete	Subgrade	mm			0	300	600	900				
68	52.029	LHS	Outer	CORNER	0.15	0.45	300	31.138	38.664	0.120	0.116	0.101	0.084	48.26	19,527	15.25	2.73
69	52.408	LHS	Outer	INTERIOR	0.15	0.45	300	30.647	35.797	0.120	0.114	0.099	0.080	76.13	22,634	20.49	3.17
70	52.423	LHS	Outer	CORNER	0.15	0.45	300	31.182	38.940	0.120	0.116	0.101	0.085	64.86	27,002	29.16	3.78
71	53.004	LHS	Outer	INTERIOR	0.15	0.45	300	31.537	41.314	0.121	0.117	0.103	0.087	56.94	30,034	36.08	4.20
72	53.021	LHS	Outer	CORNER	0.15	0.45	300	32.292	47.323	0.122	0.118	0.107	0.094	40.84	37,088	55.02	5.19
73	53.507	LHS	Outer	INTERIOR	0.15	0.45	300	31.177	38.907	0.120	0.116	0.101	0.084	60.48	25,096	25.19	3.51
74	54.010	LHS	Outer	INTERIOR	0.15	0.45	300	31.970	44.588	0.121	0.118	0.105	0.091	43.30	30,986	38.41	4.34
75	54.025	LHS	Outer	CORNER	0.15	0.45	300	32.102	45.674	0.121	0.118	0.106	0.092	37.69	29,702	35.29	4.16
76	54.518	LHS	Outer	INTERIOR	0.15	0.45	300	31.743	42.815	0.121	0.117	0.104	0.089	50.49	30,719	37.75	4.30
77	55.005	LHS	Outer	INTERIOR	0.15	0.45	300	31.431	40.581	0.121	0.116	0.103	0.087	45.13	22,161	19.64	3.10
78	55.019	LHS	Outer	CORNER	0.15	0.45	300	32.571	49.933	0.122	0.119	0.108	0.096	31.32	35,252	49.71	4.94
79	55.503	LHS	Outer	INTERIOR	0.15	0.45	300	31.548	41.396	0.121	0.117	0.103	0.088	54.48	28,965	33.56	4.06
80	56.002	LHS	Outer	INTERIOR	0.15	0.45	300	31.692	42.438	0.121	0.117	0.104	0.089	49.03	28,794	33.16	4.03
81	56.014	LHS	Outer	CORNER	0.15	0.45	300	31.419	40.499	0.121	0.116	0.103	0.086	52.31	25,478	25.97	3.57
82	56.501	LHS	Outer	INTERIOR	0.15	0.45	300	31.691	42.428	0.121	0.117	0.104	0.089	53.90	31,625	40.01	4.43
83	57.050	LHS	Outer	INTERIOR	0.15	0.45	300	30.930	37.397	0.120	0.115	0.100	0.082	62.31	22,066	19.48	3.09
84	57.062	LHS	Outer	CORNER	0.15	0.45	300	32.455	48.819	0.122	0.119	0.108	0.095	32.31	33,232	44.18	4.65
85	57.506	LHS	Outer	INTERIOR	0.15	0.45	300	30.750	36.368	0.120	0.115	0.099	0.081	68.70	21,759	18.94	3.05
86	57.998	LHS	Outer	INTERIOR	0.15	0.45	300	31.850	43.636	0.121	0.117	0.105	0.090	45.68	29,987	35.97	4.20
87	58.016	LHS	Outer	CORNER	0.15	0.45	300	32.578	50.007	0.122	0.119	0.108	0.096	33.33	37,744	56.98	5.28
88	58.505	LHS	Outer	INTERIOR	0.15	0.45	300	31.359	40.092	0.121	0.116	0.102	0.086	58.50	27,367	29.96	3.83
89	59.005	LHS	Outer	INTERIOR	0.15	0.45	300	29.068	28.831	0.117	0.110	0.090	0.068	104.93	13,128	6.89	1.84
90	59.022	LHS	Outer	CORNER	0.15	0.45	300	31.056	38.156	0.120	0.115	0.101	0.083	56.36	21,628	18.71	3.03
91	59.505	LHS	Outer	INTERIOR	0.15	0.45	300	32.159	46.157	0.121	0.118	0.106	0.093	38.83	31,910	40.73	4.47
92	60.004	LHS	Outer	INTERIOR	0.15	0.45	300	31.983	44.690	0.121	0.118	0.105	0.091	45.46	32,831	43.12	4.60
93	60.020	LHS	Outer	CORNER	0.15	0.45	300	31.509	41.123	0.121	0.117	0.103	0.087	52.62	27,245	29.69	3.81
94	60.483	LHS	Outer	INTERIOR	0.15	0.45	300	28.519	26.996	0.117	0.109	0.087	0.064	120.49	11,588	5.37	1.62
95	61.043	LHS	Outer	INTERIOR	0.15	0.45	300	32.141	46.005	0.121	0.118	0.106	0.092	39.76	32,247	41.59	4.51
96	61.054	LHS	Outer	CORNER	0.15	0.45	300	29.802	31.709	0.119	0.112	0.094	0.074	76.56	14,014	7.86	1.96
97	61.505	LHS	Outer	INTERIOR	0.15	0.45	300	32.269	47.122	0.122	0.118	0.107	0.093	36.96	32,992	43.54	4.62
98	64.006	LHS	Outer	INTERIOR	0.15	0.45	300	29.574	30.754	0.118	0.112	0.093	0.072	94.73	15,343	9.42	2.15
99	64.020	LHS	Outer	CORNER	0.15	0.45	300	29.491	30.424	0.118	0.111	0.092	0.071	96.58	14,983	8.98	2.10
100	64.506	LHS	Outer	INTERIOR	0.15	0.45	300	31.841	43.565	0.121	0.117	0.105	0.090	39.50	25,762	26.55	3.61
101	65.008	LHS	Outer	INTERIOR	0.15	0.45	300	31.371	40.172	0.121	0.116	0.102	0.086	61.72	29,104	33.88	4.07
102	65.020	LHS	Outer	CORNER	0.15	0.45	300	29.768	31.565	0.118	0.112	0.094	0.073	87.66	15,756	9.93	2.21

S. No.	Chinage	Side	Lane	Test Point Location	Poisson ratio		PQC Thickness	Area of defelection basin (inch)	Radius of relative stiffness, l (inch)	Normalised defelction, (inches)				Modulus of subgrade reaction k (MPa/m)	Elastic modulus of concrete Ec (MPa)	Strenght of concrete fc (MPa)	Flexural Strenght of concrete f_{mr} (MPa)
					Concrete	Subgrade	mm			0	300	600	900				
103	65.507	LHS	Outer	INTERIOR	0.15	0.45	300	31.497	41.033	0.121	0.116	0.103	0.087	50.45	25,898	26.83	3.63
104	66.000	LHS	Outer	INTERIOR	0.15	0.45	300	31.786	43.144	0.121	0.117	0.105	0.089	52.11	32,693	42.75	4.58
105	66.015	LHS	Outer	CORNER	0.15	0.45	300	29.895	32.112	0.119	0.112	0.095	0.074	75.95	14,623	8.55	2.05
106	66.506	LHS	Outer	INTERIOR	0.15	0.45	300	31.264	39.467	0.120	0.116	0.102	0.085	53.44	23,477	22.05	3.29
107	67.011	LHS	Outer	INTERIOR	0.15	0.45	300	31.493	41.009	0.121	0.116	0.103	0.087	56.98	29,177	34.05	4.08
108	67.027	LHS	Outer	CORNER	0.15	0.45	300	31.026	37.972	0.120	0.115	0.101	0.083	69.14	26,028	27.10	3.64
109	67.505	LHS	Outer	INTERIOR	0.15	0.45	300	32.028	45.059	0.121	0.118	0.106	0.091	49.38	36,855	54.33	5.16
110	68.000	LHS	Outer	INTERIOR	0.15	0.45	300	31.139	38.668	0.120	0.116	0.101	0.084	51.60	20,889	17.45	2.92
111	68.016	LHS	Outer	CORNER	0.15	0.45	300	32.515	49.392	0.122	0.119	0.108	0.095	30.05	32,385	41.95	4.53
112	68.504	LHS	Outer	INTERIOR	0.15	0.45	300	31.379	40.230	0.121	0.116	0.102	0.086	59.54	28,239	31.90	3.95
113	69.010	LHS	Outer	INTERIOR	0.15	0.45	300	31.444	40.670	0.121	0.116	0.103	0.087	60.81	30,123	36.30	4.22
114	69.026	LHS	Outer	CORNER	0.15	0.45	300	31.598	41.749	0.121	0.117	0.104	0.088	57.07	31,394	39.42	4.40
115	69.505	LHS	Outer	INTERIOR	0.15	0.45	300	28.952	28.422	0.117	0.110	0.090	0.067	119.08	14,070	7.92	1.97
116	69.998	LHS	Outer	INTERIOR	0.15	0.45	300	32.177	46.318	0.121	0.118	0.106	0.093	40.80	34,004	46.25	4.76
117	70.013	LHS	Outer	CORNER	0.15	0.45	300	31.194	39.016	0.120	0.116	0.101	0.085	61.11	25,637	26.29	3.59
118	70.513	LHS	Outer	INTERIOR	0.15	0.45	300	31.236	39.285	0.120	0.116	0.102	0.085	49.82	21,484	18.46	3.01
119	71.011	LHS	Outer	INTERIOR	0.15	0.45	300	30.687	36.017	0.120	0.115	0.099	0.080	72.64	22,133	19.59	3.10
120	71.030	LHS	Outer	CORNER	0.15	0.45	300	29.517	30.525	0.118	0.111	0.093	0.071	87.77	13,798	7.62	1.93
121	71.512	LHS	Outer	INTERIOR	0.15	0.45	300	31.876	43.840	0.121	0.117	0.105	0.090	48.07	32,150	41.34	4.50
122	72.006	LHS	Outer	INTERIOR	0.15	0.45	300	28.705	27.590	0.117	0.109	0.088	0.065	121.76	12,776	6.53	1.79
123	72.024	LHS	Outer	CORNER	0.15	0.45	300	30.969	37.627	0.120	0.115	0.100	0.083	65.88	23,911	22.87	3.35
124	72.500	LHS	Outer	INTERIOR	0.15	0.45	300	31.695	42.458	0.121	0.117	0.104	0.089	41.64	24,502	24.01	3.43
125	73.000	LHS	Outer	INTERIOR	0.15	0.45	300	28.298	26.323	0.116	0.108	0.086	0.063	133.24	11,582	5.37	1.62
126	73.016	LHS	Outer	CORNER	0.15	0.45	300	33.559	61.433	0.123	0.120	0.113	0.104	20.71	53,401	114.07	7.48
127	73.505	LHS	Outer	INTERIOR	0.15	0.45	300	32.494	49.192	0.122	0.119	0.108	0.095	31.24	33,127	43.90	4.64
128	74.009	LHS	Outer	INTERIOR	0.15	0.45	300	29.957	32.388	0.119	0.113	0.095	0.075	92.33	18,396	13.54	2.58
129	74.025	LHS	Outer	CORNER	0.15	0.45	300	31.150	38.735	0.120	0.116	0.101	0.084	47.78	19,477	15.17	2.73
130	74.513	LHS	Outer	INTERIOR	0.15	0.45	300	30.772	36.486	0.120	0.115	0.099	0.081	70.92	22,759	20.72	3.19
131	75.014	LHS	Outer	INTERIOR	0.15	0.45	300	31.602	41.776	0.121	0.117	0.104	0.088	54.40	30,004	36.01	4.20
132	75.030	LHS	Outer	CORNER	0.15	0.45	300	29.840	31.873	0.119	0.112	0.094	0.074	92.16	17,223	11.86	2.41
133	75.504	LHS	Outer	INTERIOR	0.15	0.45	300	31.429	40.563	0.121	0.116	0.103	0.087	59.44	29,135	33.95	4.08
134	76.026	LHS	Outer	INTERIOR	0.15	0.45	300	30.831	36.824	0.120	0.115	0.100	0.082	74.63	24,846	24.69	3.48
135	76.041	LHS	Outer	CORNER	0.15	0.45	300	28.500	26.937	0.117	0.109	0.087	0.064	124.19	11,840	5.61	1.66
136	76.502	LHS	Outer	INTERIOR	0.15	0.45	300	29.573	30.751	0.118	0.112	0.093	0.072	99.84	16,165	10.45	2.26
137	77.000	LHS	Outer	INTERIOR	0.15	0.45	300	30.461	34.812	0.119	0.114	0.098	0.079	81.19	21,591	18.65	3.02

S. No.	Chinage	Side	Lane	Test Point Location	Poisson ratio		PQC Thickness	Area of defelection basin (inch)	Radius of relative stiffness, l (inch)	Normalised defelction, (inches)				Modulus of subgrade reaction k (MPa/m)	Elastic modulus of concrete Ec (MPa)	Strenght of concrete fc (MPa)	Flexural Strenght of concrete f_{mr} (MPa)
					Concrete	Subgrade	mm			0	300	600	900				
138	77.011	LHS	Outer	CORNER	0.15	0.45	300	28.514	26.982	0.117	0.109	0.087	0.064	116.53	11,183	5.00	1.57
139	77.522	LHS	Outer	INTERIOR	0.15	0.45	300	30.523	35.134	0.119	0.114	0.098	0.079	83.92	23,153	21.44	3.24
140	78.017	LHS	Outer	INTERIOR	0.15	0.45	300	29.312	29.730	0.118	0.111	0.091	0.070	117.24	16,584	11.00	2.32
141	78.031	LHS	Outer	CORNER	0.15	0.45	300	30.028	32.710	0.119	0.113	0.095	0.075	89.57	18,567	13.79	2.60
142	79.011	LHS	Outer	INTERIOR	0.15	0.45	300	31.724	42.672	0.121	0.117	0.104	0.089	53.12	31,888	40.67	4.46
143	79.026	LHS	Outer	CORNER	0.15	0.45	300	32.068	45.394	0.121	0.118	0.106	0.092	46.81	35,987	51.80	5.04
144	79.509	LHS	Outer	INTERIOR	0.15	0.45	300	31.490	40.990	0.121	0.116	0.103	0.087	56.60	28,927	33.47	4.05
145	80.000	LHS	Outer	INTERIOR	0.15	0.45	300	31.551	41.415	0.121	0.117	0.103	0.088	54.77	29,176	34.05	4.08
146	80.012	LHS	Outer	CORNER	0.15	0.45	300	32.001	44.839	0.121	0.118	0.106	0.091	40.52	29,654	35.17	4.15
147	80.514	LHS	Outer	INTERIOR	0.15	0.45	300	30.830	36.815	0.120	0.115	0.100	0.082	69.81	23,222	21.57	3.25
148	81.005	LHS	Outer	INTERIOR	0.15	0.45	300	29.420	30.144	0.118	0.111	0.092	0.071	103.14	15,419	9.51	2.16
149	81.015	LHS	Outer	CORNER	0.15	0.45	300	29.968	32.437	0.119	0.113	0.095	0.075	83.29	16,696	11.15	2.34
150	81.507	LHS	Outer	INTERIOR	0.15	0.45	300	31.711	42.578	0.121	0.117	0.104	0.089	50.90	30,292	36.70	4.24
151	82.000	LHS	Outer	INTERIOR	0.15	0.45	300	30.472	34.868	0.119	0.114	0.098	0.079	80.59	21,571	18.61	3.02
152	82.016	LHS	Outer	CORNER	0.15	0.45	300	31.486	40.956	0.121	0.116	0.103	0.087	47.23	24,064	23.16	3.37
153	82.505	LHS	Outer	INTERIOR	0.15	0.45	300	30.926	37.375	0.120	0.115	0.100	0.082	70.18	24,796	24.59	3.47
154	83.009	LHS	Outer	INTERIOR	0.15	0.45	300	31.539	41.331	0.121	0.117	0.103	0.087	54.90	29,006	33.65	4.06
155	83.027	LHS	Outer	CORNER	0.15	0.45	300	31.716	42.612	0.121	0.117	0.104	0.089	42.00	25,071	25.14	3.51
156	83.149	LHS	Outer	INTERIOR	0.15	0.45	300	30.861	36.996	0.120	0.115	0.100	0.082	67.77	22,988	21.14	3.22
157	86.006	LHS	Outer	INTERIOR	0.15	0.45	300	31.091	38.369	0.120	0.116	0.101	0.084	68.27	26,792	28.71	3.75
158	86.022	LHS	Outer	CORNER	0.15	0.45	300	31.772	43.035	0.121	0.117	0.104	0.089	47.55	29,529	34.88	4.13
159	86.503	LHS	Outer	INTERIOR	0.15	0.45	300	32.794	52.207	0.122	0.119	0.109	0.098	28.19	37,917	57.51	5.31
160	87.008	LHS	Outer	INTERIOR	0.15	0.45	300	31.517	41.176	0.121	0.117	0.103	0.087	47.18	24,558	24.12	3.44
161	87.023	LHS	Outer	CORNER	0.15	0.45	300	31.927	44.241	0.121	0.117	0.105	0.091	51.03	35,393	50.11	4.96
162	87.511	LHS	Outer	INTERIOR	0.15	0.45	300	31.778	43.079	0.121	0.117	0.104	0.089	41.24	25,719	26.46	3.60
163	88.017	LHS	Outer	INTERIOR	0.15	0.45	300	31.494	41.016	0.121	0.116	0.103	0.087	60.82	31,166	38.85	4.36
164	88.032	LHS	Outer	CORNER	0.15	0.45	300	31.457	40.761	0.121	0.116	0.103	0.087	61.88	30,931	38.27	4.33
165	88.505	LHS	Outer	INTERIOR	0.15	0.45	300	29.839	31.867	0.119	0.112	0.094	0.074	93.35	17,430	12.15	2.44
166	89.038	LHS	Outer	INTERIOR	0.15	0.45	300	31.314	39.794	0.120	0.116	0.102	0.086	72.55	32,941	43.40	4.61
167	89.055	LHS	Outer	CORNER	0.15	0.45	300	31.457	40.761	0.121	0.116	0.103	0.087	61.88	30,931	38.27	4.33
168	89.512	LHS	Outer	INTERIOR	0.15	0.45	300	32.050	45.242	0.121	0.118	0.106	0.092	39.94	30,298	36.72	4.24

Load Transfer Efficiency Analysis: NH-27 Kochugaon - Rakhaldubi : LHS									
S.No.	Chainage	Side	Lane	Test Point Location	Pressure	Load	0	300	LTE %
					N/mm2	KN	Loaded Slab	Unloaded Slab	
1	30.004	LHS	Outer	DOWEL	1113.1	78.7	0.1706	0.1469	86.1%
2	32.003	LHS	Outer	DOWEL	1122.2	79.4	0.1623	0.1388	85.5%
3	32.404	LHS	Outer	DOWEL	1141.4	80.7	0.1742	0.1416	81.3%
4	32.804	LHS	Outer	DOWEL	1147.4	81.1	0.1681	0.1418	84.4%
5	33.003	LHS	Outer	DOWEL	1149.7	81.3	0.2429	0.2358	97.1%
6	33.409	LHS	Outer	DOWEL	1128.3	79.8	0.1664	0.1355	81.4%
7	33.812	LHS	Outer	DOWEL	1129.2	79.9	0.1996	0.1810	90.7%
8	34.404	LHS	Outer	DOWEL	1152.6	81.5	0.1653	0.1338	80.9%
9	34.810	LHS	Outer	DOWEL	1142.5	80.8	0.1676	0.1444	86.2%
10	35.004	LHS	Outer	DOWEL	1146.3	81.1	0.1643	0.1397	85.0%
11	35.407	LHS	Outer	DOWEL	1147.1	81.1	0.1588	0.1383	87.1%
12	35.804	LHS	Outer	DOWEL	1159.1	82.0	0.1682	0.1399	83.2%
13	36.009	LHS	Outer	DOWEL	1121.2	79.3	0.1968	0.1401	71.2%
14	36.403	LHS	Outer	DOWEL	1143.3	80.8	0.1837	0.1606	87.4%
15	36.806	LHS	Outer	DOWEL	1129.3	79.9	0.1611	0.1028	63.8%
16	37.008	LHS	Outer	DOWEL	1145.1	81.0	0.1614	0.1183	73.3%
17	37.402	LHS	Outer	DOWEL	1136.9	80.4	0.1611	0.1480	91.9%
18	37.807	LHS	Outer	DOWEL	1161.9	82.2	0.2392	0.1593	66.6%
19	39.803	LHS	Outer	DOWEL	1126.5	79.7	0.2041	0.1167	57.2%
20	40.004	LHS	Outer	DOWEL	1139.3	80.6	0.1613	0.1443	89.5%
21	40.407	LHS	Outer	DOWEL	1127.9	79.8	0.2078	0.1720	82.8%
22	43.410	LHS	Outer	DOWEL	1133.9	80.2	0.1652	0.1466	88.7%
23	43.805	LHS	Outer	DOWEL	1148.9	81.2	0.1663	0.1511	90.9%
24	44.004	LHS	Outer	DOWEL	1138.4	80.5	0.1733	0.1546	89.2%
25	44.404	LHS	Outer	DOWEL	1141.7	80.7	0.1651	0.1323	80.1%
26	44.814	LHS	Outer	DOWEL	1133.3	80.1	0.2116	0.1935	91.4%
27	45.019	LHS	Outer	DOWEL	1135.8	80.3	0.1805	0.1652	91.5%
28	45.411	LHS	Outer	DOWEL	1137.1	80.4	0.1687	0.1470	87.1%
29	45.813	LHS	Outer	DOWEL	1158.1	81.9	0.1607	0.1475	91.8%
30	46.007	LHS	Outer	DOWEL	1130.6	79.9	0.1902	0.1794	94.3%
31	46.406	LHS	Outer	DOWEL	1128.9	79.8	0.1979	0.1255	63.4%
32	46.806	LHS	Outer	DOWEL	1153.0	81.5	0.1634	0.1563	95.7%
33	47.405	LHS	Outer	DOWEL	1130.1	79.9	0.1960	0.1083	55.3%
34	52.017	LHS	Outer	DOWEL	1132.8	80.1	0.1935	0.1667	86.1%
35	52.411	LHS	Outer	DOWEL	1130.6	79.9	0.1669	0.1497	89.7%
36	53.007	LHS	Outer	DOWEL	1137.1	80.4	0.1674	0.1584	94.6%
37	54.013	LHS	Outer	DOWEL	1143.6	80.9	0.1870	0.1753	93.7%
38	55.008	LHS	Outer	DOWEL	1129.5	79.9	0.1968	0.1013	51.5%
39	56.006	LHS	Outer	DOWEL	1081.8	76.5	0.1724	0.1425	82.7%
40	57.054	LHS	Outer	DOWEL	1087.4	76.9	0.1791	0.0983	54.9%
41	58.001	LHS	Outer	DOWEL	1107.8	78.3	0.1742	0.1592	91.4%
42	59.009	LHS	Outer	DOWEL	1102.0	77.9	0.1716	0.1455	84.8%
43	60.008	LHS	Outer	DOWEL	1123.0	79.4	0.1650	0.1375	83.3%
44	61.046	LHS	Outer	DOWEL	1165.1	82.4	0.1716	0.0763	44.5%
45	64.010	LHS	Outer	DOWEL	1107.0	78.3	0.1972	0.1314	66.6%
46	65.011	LHS	Outer	DOWEL	1088.0	76.9	0.1631	0.1447	88.7%
47	66.003	LHS	Outer	DOWEL	1135.1	80.3	0.1958	0.1439	73.5%
48	67.014	LHS	Outer	DOWEL	1157.6	81.9	0.1674	0.1298	77.5%
49	68.004	LHS	Outer	DOWEL	1106.3	78.2	0.1989	0.1162	58.4%
50	69.013	LHS	Outer	DOWEL	1138.0	80.5	0.1670	0.1374	82.3%
51	70.000	LHS	Outer	DOWEL	1114.1	78.8	0.1982	0.1491	75.2%
52	71.013	LHS	Outer	DOWEL	1103.7	78.0	0.1706	0.1025	60.1%
53	72.010	LHS	Outer	DOWEL	1108.6	78.4	0.1621	0.1415	87.3%
54	73.003	LHS	Outer	DOWEL	1128.6	79.8	0.1642	0.1348	82.1%
55	74.012	LHS	Outer	DOWEL	1109.1	78.4	0.1633	0.1327	81.3%
56	75.016	LHS	Outer	DOWEL	1114.1	78.8	0.1736	0.1027	59.2%
57	76.030	LHS	Outer	DOWEL	1114.9	78.8	0.1897	0.1828	96.4%

S.No.	Chainage	Side	Lane	Test Point Location	Pressure	Load	0	300	LTE %
					N/mm2	KN	Loaded Slab	Unloaded Slab	
58	77.003	LHS	Outer	DOWEL	1116.4	78.9	0.1615	0.1402	86.8%
59	78.020	LHS	Outer	DOWEL	1117.7	79.0	0.1933	0.1697	87.8%
60	79.014	LHS	Outer	DOWEL	1112.4	78.7	0.1669	0.1460	87.5%
61	80.003	LHS	Outer	DOWEL	1108.5	78.4	0.1711	0.1406	82.2%
62	81.008	LHS	Outer	DOWEL	1093.3	77.3	0.1562	0.1506	96.4%
63	82.003	LHS	Outer	DOWEL	1115.2	78.9	0.1962	0.1278	65.1%
64	83.013	LHS	Outer	DOWEL	1112.9	78.7	0.1669	0.1534	91.9%
65	86.010	LHS	Outer	DOWEL	1102.5	78.0	0.1795	0.1539	85.7%
66	87.011	LHS	Outer	DOWEL	1108.9	78.4	0.1910	0.1595	83.5%
67	88.021	LHS	Outer	DOWEL	1134.0	80.2	0.1657	0.1340	80.9%
68	89.041	LHS	Outer	DOWEL	1116.5	79.0	0.1513	0.1413	93.4%

Load Transfer Efficiency Analysis: NH-27 Kochugaon - Rakhaldubi : LHS									
S.No.	Chainage	Side	Lane	Test Point Location	Pressure	Load	0	300	LTE %
					N/mm2	KN	Loaded Slab	Unloaded Slab	
1	30.017	LHS	Outer	TIE	1135.5	80.3	0.1657	0.1536	92.7%
2	32.015	LHS	Outer	TIE	1126.5	79.7	0.1442	0.1350	93.6%
3	32.420	LHS	Outer	TIE	1151.2	81.4	0.1735	0.1480	85.3%
4	32.822	LHS	Outer	TIE	1114.0	78.8	0.1684	0.1462	86.8%
5	33.021	LHS	Outer	TIE	1134.3	80.2	0.2519	0.2034	80.7%
6	33.425	LHS	Outer	TIE	1114.1	78.8	0.1645	0.1385	84.2%
7	33.827	LHS	Outer	TIE	1119.9	79.2	0.1801	0.1576	87.5%
8	34.420	LHS	Outer	TIE	1165.3	82.4	0.1610	0.1319	81.9%
9	34.825	LHS	Outer	TIE	1153.1	81.5	0.1628	0.1465	90.0%
10	35.019	LHS	Outer	TIE	1135.6	80.3	0.1709	0.1398	81.8%
11	35.426	LHS	Outer	TIE	1150.6	81.4	0.2397	0.2234	93.2%
12	35.821	LHS	Outer	TIE	1123.3	79.4	0.1860	0.1624	87.3%
13	36.027	LHS	Outer	TIE	1135.7	80.3	0.2968	0.1574	53.0%
14	36.421	LHS	Outer	TIE	1136.0	80.3	0.1990	0.1366	68.6%
15	36.823	LHS	Outer	TIE	1155.2	81.7	0.1735	0.1289	74.3%
16	37.023	LHS	Outer	TIE	1149.0	81.3	0.1773	0.1379	77.8%
17	37.422	LHS	Outer	TIE	1136.0	80.3	0.1883	0.1776	94.3%
18	37.827	LHS	Outer	TIE	1139.2	80.6	0.2168	0.1192	55.0%
19	39.821	LHS	Outer	TIE	1106.2	78.2	0.2046	0.0988	48.3%
20	40.024	LHS	Outer	TIE	1128.4	79.8	0.1987	0.0928	46.7%
21	40.428	LHS	Outer	TIE	1168.2	82.6	0.1684	0.1596	94.8%
22	43.429	LHS	Outer	TIE	1143.6	80.9	0.1787	0.1571	87.9%
23	43.823	LHS	Outer	TIE	1156.0	81.7	0.1703	0.1444	84.8%
24	44.022	LHS	Outer	TIE	1107.7	78.3	0.1835	0.1654	90.1%
25	44.424	LHS	Outer	TIE	1109.0	78.4	0.1705	0.1541	90.4%
26	44.832	LHS	Outer	TIE	1135.1	80.3	0.1697	0.1595	94.0%
27	45.038	LHS	Outer	TIE	1108.2	78.4	0.2265	0.2047	90.4%
28	45.426	LHS	Outer	TIE	1142.0	80.8	0.2331	0.2003	85.9%
29	45.833	LHS	Outer	TIE	1139.1	80.6	0.1749	0.1568	89.7%
30	46.022	LHS	Outer	TIE	1128.9	79.8	0.2373	0.1280	53.9%
31	46.423	LHS	Outer	TIE	1144.8	81.0	0.1863	0.1584	85.0%
32	46.822	LHS	Outer	TIE	1149.7	81.3	0.1723	0.1592	92.4%
33	47.420	LHS	Outer	TIE	1151.6	81.4	0.2048	0.1864	91.0%
34	52.035	LHS	Outer	TIE	1151.9	81.5	0.1600	0.1498	93.6%
35	52.430	LHS	Outer	TIE	1152.4	81.5	0.1910	0.1767	92.5%
36	53.027	LHS	Outer	TIE	1145.0	81.0	0.1746	0.1581	90.5%
37	54.033	LHS	Outer	TIE	1134.6	80.2	0.2798	0.2689	96.1%
38	55.023	LHS	Outer	TIE	1094.8	77.4	0.2127	0.1516	71.3%
39	56.020	LHS	Outer	TIE	1087.7	76.9	0.1840	0.1643	89.3%
40	57.068	LHS	Outer	TIE	1099.7	77.8	0.1965	0.1417	72.1%
41	58.023	LHS	Outer	TIE	1085.4	76.8	0.2043	0.1261	61.7%
42	59.029	LHS	Outer	TIE	1100.6	77.8	0.1823	0.1656	90.8%
43	60.026	LHS	Outer	TIE	1124.7	79.5	0.1865	0.1574	84.4%
44	61.059	LHS	Outer	TIE	1078.0	76.2	0.1875	0.0962	51.3%
45	64.026	LHS	Outer	TIE	1164.0	82.3	0.1781	0.1480	83.1%
46	65.026	LHS	Outer	TIE	1139.1	80.6	0.1658	0.1236	74.5%
47	66.022	LHS	Outer	TIE	1106.7	78.3	0.1657	0.1460	88.1%
48	67.033	LHS	Outer	TIE	1170.0	82.7	0.1680	0.1433	85.3%
49	68.023	LHS	Outer	TIE	1128.2	79.8	0.1931	0.1199	62.1%
50	69.031	LHS	Outer	TIE	1121.6	79.3	0.1680	0.1424	84.8%
51	70.020	LHS	Outer	TIE	1114.4	78.8	0.1703	0.1544	90.7%
52	71.038	LHS	Outer	TIE	1118.7	79.1	0.1818	0.1628	89.5%
53	72.032	LHS	Outer	TIE	1119.3	79.2	0.2331	0.1880	80.7%
54	73.022	LHS	Outer	TIE	1109.2	78.4	0.1767	0.1462	82.7%
55	74.032	LHS	Outer	TIE	1106.5	78.2	0.2540	0.2090	82.3%
56	75.037	LHS	Outer	TIE	1100.0	77.8	0.1637	0.1356	82.8%
57	76.049	LHS	Outer	TIE	1117.8	79.0	0.1724	0.1501	87.1%

S.No.	Chainage	Side	Lane	Test Point Location	Pressure	Load	0	300	LTE %
					N/mm2	KN	Loaded Slab	Unloaded Slab	
58	77.022	LHS	Outer	TIE	1109.0	78.4	0.1788	0.1508	84.3%
59	78.036	LHS	Outer	TIE	1089.7	77.1	0.1780	0.1649	92.6%
60	79.032	LHS	Outer	TIE	1098.5	77.7	0.1967	0.1619	82.3%
61	80.019	LHS	Outer	TIE	1121.6	79.3	0.1926	0.1827	94.9%
62	81.023	LHS	Outer	TIE	1104.5	78.1	0.1982	0.1493	75.3%
63	82.022	LHS	Outer	TIE	1106.3	78.2	0.1973	0.1453	73.6%
64	83.033	LHS	Outer	TIE	1101.0	77.9	0.1885	0.1612	85.5%
65	86.028	LHS	Outer	TIE	1107.7	78.3	0.1649	0.1551	94.1%
66	87.032	LHS	Outer	TIE	1121.9	79.3	0.1946	0.1610	82.7%
67	88.040	LHS	Outer	TIE	1105.8	78.2	0.1913	0.1676	87.6%
68	89.063	LHS	Outer	TIE	1121.9	79.3	0.1476	0.1221	82.7%

					Modulus of Subgrade Reaction & Elastic Modulus of Concrete Analysis: NH-27 Kochugaon - Rakhaldubi : RHS													
S. No.	Chinage	Side	Lane	Test Point Location	Pressure	Radius of Loading Plate (in)	Load	Load	Deflection in (mm)				Deflection in (inches)				Poisson ratio	
					N/mm2		(KN)	(Pound)	0	300	600	900	0	300	600	900	Concrete	Subgrade
1	92.300	RHS	Outer	INTERIOR	1165.1	11.811	82.4	18500.5	0.1594	0.1432	0.1274	0.1116	0.00627559	0.00563780	0.00501575	0.00439370	0.15	0.45
2	92.000	RHS	Outer	INTERIOR	1117.7	11.811	79.0	17747.8	0.1687	0.1522	0.1371	0.1219	0.00664173	0.00599213	0.00539764	0.00479921	0.15	0.45
3	91.986	RHS	Outer	CORNER	1091.7	11.811	77.2	17335.0	0.1948	0.1884	0.1563	0.1369	0.00766929	0.00741732	0.00615354	0.00538976	0.15	0.45
4	91.503	RHS	Outer	INTERIOR	1142.1	11.811	80.8	18135.3	0.1787	0.1674	0.1423	0.1287	0.00703543	0.00659055	0.00560236	0.00506693	0.15	0.45
5	90.990	RHS	Outer	INTERIOR	1142.8	11.811	80.8	18146.4	0.1129	0.0914	0.0832	0.0737	0.00444488	0.00359843	0.00327559	0.00290157	0.15	0.45
6	90.979	RHS	Outer	CORNER	1130.3	11.811	79.9	17947.9	0.1109	0.1042	0.0846	0.0732	0.00436614	0.00410236	0.00333071	0.00288189	0.15	0.45
7	90.500	RHS	Outer	INTERIOR	1122.6	11.811	79.4	17825.6	0.1420	0.1296	0.1197	0.1054	0.00559055	0.00510236	0.00471260	0.00414961	0.15	0.45
8	89.990	RHS	Outer	INTERIOR	1133.7	11.811	80.2	18001.9	0.1515	0.1432	0.1287	0.1004	0.00596457	0.00563780	0.00506693	0.00395276	0.15	0.45
9	89.974	RHS	Outer	CORNER	1130.0	11.811	79.9	17943.1	0.1125	0.1045	0.0938	0.0809	0.00442913	0.00411417	0.00369291	0.00318504	0.15	0.45
10	89.496	RHS	Outer	INTERIOR	1132.3	11.811	80.1	17979.7	0.1189	0.1038	0.0889	0.0835	0.00468110	0.00408661	0.00350000	0.00328740	0.15	0.45
11	88.984	RHS	Outer	INTERIOR	1110.1	11.811	78.5	17627.2	0.1465	0.1296	0.1104	0.0938	0.00576772	0.00510236	0.00434646	0.00369291	0.15	0.45
12	88.971	RHS	Outer	CORNER	1128.2	11.811	79.8	17914.6	0.1357	0.1308	0.1062	0.0921	0.00534252	0.00514961	0.00418110	0.00362598	0.15	0.45
13	88.496	RHS	Outer	INTERIOR	1116.4	11.811	78.9	17727.2	0.1543	0.1374	0.1206	0.1074	0.00607480	0.00540945	0.00474803	0.00422835	0.15	0.45
14	87.000	RHS	Outer	INTERIOR	1151.3	11.811	81.4	18281.4	0.2159	0.2064	0.1974	0.1785	0.00850000	0.00812598	0.00777165	0.00702756	0.15	0.45
15	86.983	RHS	Outer	CORNER	1158.5	11.811	81.9	18395.7	0.2296	0.2255	0.2090	0.1774	0.00903937	0.00887795	0.00822835	0.00698425	0.15	0.45
16	86.546	RHS	Outer	INTERIOR	1157.1	11.811	81.8	18373.5	0.1475	0.1325	0.1172	0.1008	0.00580709	0.00521654	0.00461417	0.00396850	0.15	0.45
17	86.000	RHS	Outer	INTERIOR	1133.3	11.811	80.1	17995.5	0.1400	0.1278	0.1161	0.1020	0.00551181	0.00503150	0.00457087	0.00401575	0.15	0.45
18	85.986	RHS	Outer	CORNER	1153.8	11.811	81.6	18321.1	0.1674	0.1539	0.1357	0.1159	0.00659055	0.00605906	0.00534252	0.00456299	0.15	0.45
19	85.495	RHS	Outer	INTERIOR	1134.7	11.811	80.2	18017.8	0.1002	0.0882	0.0769	0.0701	0.00394488	0.00347244	0.00302756	0.00275984	0.15	0.45
20	84.992	RHS	Outer	INTERIOR	1106.7	11.811	78.3	17573.2	0.1459	0.1324	0.1170	0.1032	0.00574409	0.00521260	0.00460630	0.00406299	0.15	0.45
21	84.977	RHS	Outer	CORNER	1164.4	11.811	82.3	18489.4	0.1307	0.1165	0.1078	0.0934	0.00514567	0.00458661	0.00424409	0.00367717	0.15	0.45
22	84.490	RHS	Outer	INTERIOR	1139.8	11.811	80.6	18098.8	0.1388	0.1354	0.1219	0.1040	0.00546457	0.00533071	0.00479921	0.00409449	0.15	0.45
23	83.987	RHS	Outer	INTERIOR	1150.0	11.811	81.3	18260.7	0.1312	0.1134	0.1057	0.0903	0.00516535	0.00446457	0.00416142	0.00355512	0.15	0.45
24	83.973	RHS	Outer	CORNER	1144.9	11.811	81.0	18179.7	0.1288	0.1161	0.0998	0.0843	0.00507087	0.00457087	0.00392913	0.00331890	0.15	0.45
25	83.496	RHS	Outer	INTERIOR	1154.7	11.811	81.7	18335.4	0.1482	0.1356	0.1252	0.1012	0.00583465	0.00533858	0.00492913	0.00398425	0.15	0.45
26	80.501	RHS	Outer	INTERIOR	1153.4	11.811	81.6	18314.7	0.1234	0.1152	0.0967	0.0831	0.00485827	0.00453543	0.00380709	0.00327165	0.15	0.45
27	80.000	RHS	Outer	INTERIOR	1154.1	11.811	81.6	18325.8	0.1481	0.1346	0.1188	0.0996	0.00583071	0.00529921	0.00467717	0.00392126	0.15	0.45
28	79.987	RHS	Outer	CORNER	1130.9	11.811	80.0	17957.4	0.1178	0.1028	0.0993	0.0892	0.00463780	0.00404724	0.00390945	0.00351181	0.15	0.45
29	79.500	RHS	Outer	INTERIOR	1141.4	11.811	80.7	18124.2	0.1350	0.1178	0.0903	0.0852	0.00531496	0.00463780	0.00355512	0.00335433	0.15	0.45
30	78.994	RHS	Outer	INTERIOR	1174.2	11.811	83.0	18645.0	0.1338	0.1221	0.1097	0.0947	0.00526772	0.00480709	0.00431890	0.00372835	0.15	0.45
31	78.978	RHS	Outer	CORNER	1132.7	11.811	80.1	17986.0	0.1060	0.0975	0.0890	0.0803	0.00417323	0.00383858	0.00350394	0.00316142	0.15	0.45
32	78.599	RHS	Outer	INTERIOR	1170.8	11.811	82.8	18591.0	0.1810	0.1637	0.1507	0.1262	0.00712598	0.00644488	0.00593307	0.00496850	0.15	0.45

S. No.	Chinage	Side	Lane	Test Point Location	Pressure	Radius of Loading Plate (in)	Load	Load	Deflection in (mm)				Deflection in (inches)				Poisson ratio	
					N/mm2		(KN)	(Pound)	0	300	600	900	0	300	600	900	Concrete	Subgrade
33	78.198	RHS	Outer	INTERIOR	1086.1	11.811	76.8	17246.1	0.1587	0.1382	0.1171	0.1019	0.00624803	0.00544094	0.00461024	0.00401181	0.15	0.45
34	78.186	RHS	Outer	CORNER	1085.3	11.811	76.7	17233.4	0.1848	0.1584	0.1186	0.0969	0.00727559	0.00623622	0.00466929	0.00381496	0.15	0.45
35	76.597	RHS	Outer	INTERIOR	1157.3	11.811	81.8	18376.6	0.1503	0.1392	0.1137	0.1068	0.00591732	0.00548031	0.00447638	0.00420472	0.15	0.45
36	76.190	RHS	Outer	INTERIOR	1103.5	11.811	78.0	17522.4	0.1688	0.1533	0.1438	0.1366	0.00664567	0.00603543	0.00566142	0.00537795	0.15	0.45
37	76.175	RHS	Outer	CORNER	1085.4	11.811	76.8	17235.0	0.2077	0.1831	0.1616	0.1419	0.00817717	0.00720866	0.00636220	0.00558661	0.15	0.45
38	63.507	RHS	Outer	INTERIOR	1115.1	11.811	78.9	17706.6	0.1526	0.1421	0.1278	0.1066	0.00600787	0.00559449	0.00503150	0.00419685	0.15	0.45
39	63.000	RHS	Outer	INTERIOR	1120.6	11.811	79.2	17793.9	0.1579	0.1425	0.1321	0.1219	0.00621654	0.00561024	0.00520079	0.00479921	0.15	0.45
40	62.987	RHS	Outer	CORNER	1108.8	11.811	78.4	17606.5	0.1834	0.1737	0.1563	0.1358	0.00722047	0.00683858	0.00615354	0.00534646	0.15	0.45
41	62.498	RHS	Outer	INTERIOR	1138.4	11.811	80.5	18076.5	0.1191	0.1094	0.0980	0.0848	0.00468898	0.00430709	0.00385827	0.00333858	0.15	0.45
42	61.999	RHS	Outer	INTERIOR	1108.6	11.811	78.4	17603.3	0.1175	0.1101	0.1012	0.0892	0.00462598	0.00433465	0.00398425	0.00351181	0.15	0.45
43	61.985	RHS	Outer	CORNER	1168.5	11.811	82.6	18554.5	0.1136	0.1043	0.0958	0.0908	0.00447244	0.00410630	0.00377165	0.00357480	0.15	0.45
44	54.504	RHS	Outer	INTERIOR	1142.9	11.811	80.8	18148.0	0.1533	0.1422	0.1336	0.1196	0.00603543	0.00559843	0.00525984	0.00470866	0.15	0.45
45	53.990	RHS	Outer	INTERIOR	1158.6	11.811	81.9	18397.3	0.1313	0.1284	0.0864	0.0751	0.00516929	0.00505512	0.00340157	0.00295669	0.15	0.45
46	53.975	RHS	Outer	CORNER	1139.0	11.811	80.5	18086.1	0.1556	0.1395	0.1182	0.1002	0.00612598	0.00549213	0.00465354	0.00394488	0.15	0.45
47	53.499	RHS	Outer	INTERIOR	1152.8	11.811	81.5	18305.2	0.1726	0.1642	0.1579	0.1464	0.00679528	0.00646457	0.00621654	0.00576378	0.15	0.45
48	51.702	RHS	Outer	INTERIOR	1083.8	11.811	76.6	17209.5	0.1510	0.1374	0.1246	0.1071	0.00594488	0.00540945	0.00490551	0.00421654	0.15	0.45
49	51.000	RHS	Outer	INTERIOR	1110.9	11.811	78.6	17639.9	0.1518	0.1310	0.1150	0.1026	0.00597638	0.00515748	0.00452756	0.00403937	0.15	0.45
50	50.983	RHS	Outer	CORNER	1153.0	11.811	81.5	18308.4	0.1523	0.1472	0.1263	0.1066	0.00599606	0.00579528	0.00497244	0.00419685	0.15	0.45
51	50.498	RHS	Outer	INTERIOR	1158.3	11.811	81.9	18392.5	0.1306	0.1188	0.1071	0.0916	0.00514173	0.00467717	0.00421654	0.00360630	0.15	0.45
52	49.992	RHS	Outer	INTERIOR	1172.6	11.811	82.9	18619.6	0.1194	0.1027	0.0834	0.0694	0.00470079	0.00404331	0.00328346	0.00273228	0.15	0.45
53	49.976	RHS	Outer	CORNER	1145.5	11.811	81.0	18189.3	0.1262	0.1100	0.0971	0.0853	0.00496850	0.00433071	0.00382283	0.00335827	0.15	0.45
54	49.490	RHS	Outer	INTERIOR	1159.4	11.811	82.0	18410.0	0.1522	0.1419	0.1357	0.1252	0.00599213	0.00558661	0.00534252	0.00492913	0.15	0.45
55	48.995	RHS	Outer	INTERIOR	1158.7	11.811	81.9	18398.9	0.1748	0.1585	0.1162	0.0934	0.00688189	0.00624016	0.00457480	0.00367717	0.15	0.45
56	48.982	RHS	Outer	CORNER	1174.5	11.811	83.1	18649.8	0.1144	0.1080	0.0859	0.0716	0.00450394	0.00425197	0.00338189	0.00281890	0.15	0.45
57	48.490	RHS	Outer	INTERIOR	1170.2	11.811	82.7	18581.5	0.1734	0.1579	0.1473	0.1291	0.00682677	0.00621654	0.00579921	0.00508268	0.15	0.45
58	48.000	RHS	Outer	INTERIOR	1162.7	11.811	82.2	18462.4	0.1411	0.1335	0.1197	0.1040	0.00555512	0.00525591	0.00471260	0.00409449	0.15	0.45
59	47.987	RHS	Outer	CORNER	1161.4	11.811	82.1	18441.7	0.1849	0.1729	0.1516	0.1354	0.00727953	0.00680709	0.00596850	0.00533071	0.15	0.45
60	47.523	RHS	Outer	INTERIOR	1086.9	11.811	76.9	17258.8	0.2278	0.2161	0.1924	0.1616	0.00896850	0.00850787	0.00757480	0.00636220	0.15	0.45
61	46.316	RHS	Outer	INTERIOR	1148.0	11.811	81.2	18229.0	0.1874	0.1716	0.1663	0.1467	0.00737795	0.00675591	0.00654724	0.00577559	0.15	0.45
62	46.033	RHS	Outer	INTERIOR	1087.3	11.811	76.9	17265.1	0.1907	0.1706	0.1597	0.1475	0.00750787	0.00671654	0.00628740	0.00580709	0.15	0.45
63	46.019	RHS	Outer	CORNER	1099.4	11.811	77.7	17457.3	0.1908	0.1646	0.1272	0.1057	0.00751181	0.00648031	0.00500787	0.00416142	0.15	0.45
64	43.000	RHS	Outer	INTERIOR	1155.0	11.811	81.7	18340.1	0.1208	0.1091	0.0978	0.0837	0.00475591	0.00429528	0.00385039	0.00329528	0.15	0.45
65	42.990	RHS	Outer	CORNER	1175.7	11.811	83.1	18668.8	0.1795	0.1615	0.1390	0.1185	0.00706693	0.00635827	0.00547244	0.00466535	0.15	0.45
66	42.493	RHS	Outer	INTERIOR	1177.3	11.811	83.3	18694.2	0.1365	0.1243	0.1164	0.0900	0.00537402	0.00489370	0.00458268	0.00354331	0.15	0.45
67	42.000	RHS	Outer	INTERIOR	1137.9	11.811	80.5	18068.6	0.1680	0.1558	0.1359	0.1094	0.00661417	0.00613386	0.00535039	0.00430709	0.15	0.45

S. No.	Chinage	Side	Lane	Test Point Location	Pressure	Radius of Loading Plate (in)	Load	Load	Deflection in (mm)				Deflection in (inches)				Poisson ratio	
					N/mm2		(KN)	(Pound)	0	300	600	900	0	300	600	900	Concrete	Subgrade
68	41.985	RHS	Outer	CORNER	1112.6	11.811	78.7	17666.9	0.1224	0.1093	0.0949	0.0813	0.00481890	0.00430315	0.00373622	0.00320079	0.15	0.45
69	41.499	RHS	Outer	INTERIOR	1149.4	11.811	81.3	18251.2	0.1110	0.1046	0.0895	0.0806	0.00437008	0.00411811	0.00352362	0.00317323	0.15	0.45
70	40.988	RHS	Outer	INTERIOR	1118.2	11.811	79.1	17755.8	0.1360	0.1275	0.1094	0.0945	0.00535433	0.00501969	0.00430709	0.00372047	0.15	0.45
71	40.972	RHS	Outer	CORNER	1178.2	11.811	83.3	18708.5	0.1416	0.1170	0.1024	0.0807	0.00557480	0.00460630	0.00403150	0.00317717	0.15	0.45
72	40.498	RHS	Outer	INTERIOR	1129.4	11.811	79.9	17933.6	0.1520	0.1438	0.1327	0.1193	0.00598425	0.00566142	0.00522441	0.00469685	0.15	0.45
73	39.981	RHS	Outer	INTERIOR	1170.3	11.811	82.8	18583.1	0.1663	0.1507	0.1417	0.1119	0.00654724	0.00593307	0.00557874	0.00440551	0.15	0.45
74	39.965	RHS	Outer	CORNER	1108.8	11.811	78.4	17606.5	0.2078	0.1937	0.1739	0.1529	0.00818110	0.00762598	0.00684646	0.00601969	0.15	0.45
75	39.500	RHS	Outer	INTERIOR	1132.4	11.811	80.1	17981.3	0.1396	0.1262	0.1079	0.0948	0.00549606	0.00496850	0.00424803	0.00373228	0.15	0.45
76	38.982	RHS	Outer	INTERIOR	1153.8	11.811	81.6	18321.1	0.1400	0.1247	0.1178	0.0893	0.00551181	0.00490945	0.00463780	0.00351575	0.15	0.45
77	38.965	RHS	Outer	CORNER	1148.1	11.811	81.2	18230.6	0.1477	0.1317	0.1160	0.0978	0.00581496	0.00518504	0.00456693	0.00385039	0.15	0.45
78	38.502	RHS	Outer	INTERIOR	1122.0	11.811	79.3	17816.1	0.1226	0.1112	0.1011	0.0886	0.00482677	0.00437795	0.00398031	0.00348819	0.15	0.45
79	38.008	RHS	Outer	INTERIOR	1160.9	11.811	82.1	18433.8	0.1112	0.1000	0.0885	0.0802	0.00437795	0.00393701	0.00348425	0.00315748	0.15	0.45
80	37.990	RHS	Outer	CORNER	1106.2	11.811	78.2	17565.2	0.1210	0.1108	0.1012	0.0875	0.00476378	0.00436220	0.00398425	0.00344488	0.15	0.45
81	37.503	RHS	Outer	INTERIOR	1113.8	11.811	78.8	17685.9	0.1199	0.1078	0.0993	0.0806	0.00472047	0.00424409	0.00390945	0.00317323	0.15	0.45
82	36.997	RHS	Outer	INTERIOR	1118.1	11.811	79.1	17754.2	0.1339	0.1226	0.1083	0.0959	0.00527165	0.00482677	0.00426378	0.00377559	0.15	0.45
83	36.985	RHS	Outer	CORNER	1100.4	11.811	77.8	17473.1	0.1453	0.1352	0.1127	0.0978	0.00572047	0.00532283	0.00443701	0.00385039	0.15	0.45
84	36.496	RHS	Outer	INTERIOR	1124.7	11.811	79.5	17859.0	0.1100	0.1022	0.0914	0.0766	0.00433071	0.00402362	0.00359843	0.00301575	0.15	0.45
85	35.976	RHS	Outer	INTERIOR	1115.1	11.811	78.9	17706.6	0.1370	0.1260	0.1120	0.0954	0.00539370	0.00496063	0.00440945	0.00375591	0.15	0.45
86	35.963	RHS	Outer	CORNER	1182.1	11.811	83.6	18770.4	0.1455	0.1391	0.1345	0.0903	0.00572835	0.00547638	0.00529528	0.00355512	0.15	0.45
87	35.495	RHS	Outer	INTERIOR	1107.1	11.811	78.3	17579.5	0.1423	0.1298	0.1175	0.1062	0.00560236	0.00511024	0.00462598	0.00418110	0.15	0.45
88	35.000	RHS	Outer	INTERIOR	1118.3	11.811	79.1	17757.4	0.1563	0.1422	0.1289	0.1129	0.00615354	0.00559843	0.00507480	0.00444488	0.15	0.45
89	34.988	RHS	Outer	CORNER	1110.5	11.811	78.5	17633.5	0.1724	0.1587	0.1423	0.1230	0.00678740	0.00624803	0.00560236	0.00484252	0.15	0.45
90	34.503	RHS	Outer	INTERIOR	1092.8	11.811	77.3	17352.5	0.1141	0.1078	0.0931	0.0682	0.00449213	0.00424409	0.00366535	0.00268504	0.15	0.45
91	33.985	RHS	Outer	INTERIOR	1179.8	11.811	83.4	18733.9	0.1142	0.1031	0.0835	0.0755	0.00449606	0.00405906	0.00328740	0.00297244	0.15	0.45
92	33.970	RHS	Outer	CORNER	1157.3	11.811	81.8	18376.6	0.1379	0.1186	0.0993	0.0754	0.00542913	0.00466929	0.00390945	0.00296850	0.15	0.45
93	33.491	RHS	Outer	INTERIOR	1122.9	11.811	79.4	17830.4	0.1840	0.1761	0.1495	0.1359	0.00724409	0.00693307	0.00588583	0.00535039	0.15	0.45
94	33.000	RHS	Outer	INTERIOR	1106.0	11.811	78.2	17562.1	0.1585	0.1414	0.1298	0.1133	0.00624016	0.00556693	0.00511024	0.00446063	0.15	0.45
95	32.985	RHS	Outer	CORNER	1104.5	11.811	78.1	17538.2	0.1451	0.1344	0.1238	0.1106	0.00571260	0.00529134	0.00487402	0.00435433	0.15	0.45
96	32.496	RHS	Outer	INTERIOR	1104.3	11.811	78.1	17535.1	0.1763	0.1652	0.1483	0.1349	0.00694094	0.00650394	0.00583858	0.00531102	0.15	0.45
97	32.000	RHS	Outer	INTERIOR	1119.9	11.811	79.2	17782.8	0.1555	0.1425	0.1297	0.1184	0.00612205	0.00561024	0.00510630	0.00466142	0.15	0.45
98	31.984	RHS	Outer	CORNER	1119.9	11.811	79.2	17782.8	0.1408	0.1285	0.1166	0.0995	0.00554331	0.00505906	0.00459055	0.00391732	0.15	0.45
99	31.487	RHS	Outer	INTERIOR	1142.0	11.811	80.8	18133.7	0.1463	0.1312	0.1159	0.1001	0.00575984	0.00516535	0.00456299	0.00394094	0.15	0.45
100	31.001	RHS	Outer	INTERIOR	1152.8	11.811	81.5	18305.2	0.1646	0.1440	0.1196	0.1049	0.00648031	0.00566929	0.00470866	0.00412992	0.15	0.45
101	30.987	RHS	Outer	CORNER	1126.3	11.811	79.6	17884.4	0.1731	0.1629	0.1433	0.1178	0.00681496	0.00641339	0.00564173	0.00463780	0.15	0.45

					Modulus of Subgrade Reaction & Elastic Modulus of Concrete Analysis: NH-27 Kochugaon - Rakhaldubi : RHS										
S. No.	Chinage	Side	Lane	Test Point Location	PQC Thickness	Area of defelection basin (inch)	Radius of relative stiffness, l (inch)	Normalised defelction, (inches)				Modulus of subgrade reaction k (MPa/m)	Elastic modulus of concrete Ec (MPa)	Strenght of concrete fc (MPa)	Flexural Strenght of concrete f_{mr} (MPa)
					mm			0	300	600	900				
1	92.300	RHS	Outer	INTERIOR	300	30.572	35.395	0.120	0.114	0.098	0.080	77.11	21,915	19.21	3.07
2	92.000	RHS	Outer	INTERIOR	300	30.914	37.305	0.120	0.115	0.100	0.082	63.10	22,126	19.58	3.10
3	91.986	RHS	Outer	CORNER	300	31.451	40.715	0.121	0.116	0.103	0.087	45.55	22,661	20.54	3.17
4	91.503	RHS	Outer	INTERIOR	300	31.118	38.538	0.120	0.116	0.101	0.084	57.35	22,903	20.98	3.21
5	90.990	RHS	Outer	INTERIOR	300	28.475	26.859	0.117	0.109	0.087	0.064	179.01	16,867	11.38	2.36
6	90.979	RHS	Outer	CORNER	300	30.390	34.449	0.119	0.114	0.097	0.078	114.21	29,123	33.93	4.08
7	90.500	RHS	Outer	INTERIOR	300	31.521	41.204	0.121	0.117	0.103	0.087	62.21	32,470	42.17	4.55
8	89.990	RHS	Outer	INTERIOR	300	31.513	41.146	0.121	0.117	0.103	0.087	60.09	31,187	38.91	4.37
9	89.974	RHS	Outer	CORNER	300	31.467	40.825	0.121	0.116	0.103	0.087	80.81	40,642	66.07	5.69
10	89.496	RHS	Outer	INTERIOR	300	29.662	31.116	0.118	0.112	0.093	0.072	127.63	21,663	18.77	3.03
11	88.984	RHS	Outer	INTERIOR	300	29.500	30.460	0.118	0.111	0.092	0.071	106.77	16,641	11.08	2.33
12	88.971	RHS	Outer	CORNER	300	31.030	37.998	0.120	0.115	0.101	0.083	77.35	29,196	34.10	4.09
13	88.496	RHS	Outer	INTERIOR	300	30.241	33.715	0.119	0.113	0.096	0.077	83.63	19,564	15.31	2.74
14	87.000	RHS	Outer	INTERIOR	300	33.404	59.367	0.123	0.120	0.112	0.103	20.49	46,094	84.99	6.45
15	86.983	RHS	Outer	CORNER	300	33.345	58.602	0.123	0.120	0.112	0.102	20.10	42,916	73.67	6.01
16	86.546	RHS	Outer	INTERIOR	300	30.415	34.578	0.119	0.114	0.097	0.078	86.71	22,444	20.15	3.14
17	86.000	RHS	Outer	INTERIOR	300	31.277	39.552	0.120	0.116	0.102	0.085	68.99	30,571	37.38	4.28
18	85.986	RHS	Outer	CORNER	300	30.914	37.304	0.120	0.115	0.100	0.082	66.04	23,156	21.45	3.24
19	85.495	RHS	Outer	INTERIOR	300	29.970	32.448	0.119	0.113	0.095	0.075	140.45	28,192	31.79	3.95
20	84.992	RHS	Outer	INTERIOR	300	30.757	36.403	0.120	0.115	0.099	0.081	75.85	24,116	23.26	3.38
21	84.977	RHS	Outer	CORNER	300	30.881	37.114	0.120	0.115	0.100	0.082	85.77	29,468	34.73	4.13
22	84.490	RHS	Outer	INTERIOR	300	32.741	51.648	0.122	0.119	0.109	0.097	41.97	54,074	116.96	7.57
23	83.987	RHS	Outer	INTERIOR	300	30.169	33.370	0.119	0.113	0.096	0.076	103.38	23,209	21.55	3.25
24	83.973	RHS	Outer	CORNER	300	30.042	32.775	0.119	0.113	0.095	0.075	109.16	22,807	20.81	3.19
25	83.496	RHS	Outer	INTERIOR	300	31.215	39.147	0.120	0.116	0.102	0.085	68.33	29,057	33.77	4.07
26	80.501	RHS	Outer	INTERIOR	300	30.647	35.796	0.120	0.114	0.099	0.080	97.18	28,890	33.39	4.04
27	80.000	RHS	Outer	INTERIOR	300	30.567	35.369	0.120	0.114	0.098	0.080	82.78	23,457	22.01	3.28
28	79.987	RHS	Outer	CORNER	300	31.131	38.617	0.120	0.116	0.101	0.084	85.19	34,303	47.07	4.80
29	79.500	RHS	Outer	INTERIOR	300	28.284	26.282	0.116	0.108	0.086	0.062	156.54	13,524	7.32	1.89
30	78.994	RHS	Outer	INTERIOR	300	31.036	38.032	0.120	0.115	0.101	0.083	80.83	30,620	37.50	4.29
31	78.978	RHS	Outer	CORNER	300	31.658	42.190	0.121	0.117	0.104	0.088	80.20	46,010	84.68	6.44
32	78.599	RHS	Outer	INTERIOR	300	31.028	37.982	0.120	0.115	0.101	0.083	59.84	22,550	20.34	3.16

S. No.	Chinage	Side	Lane	Test Point Location	PQC Thickness	Area of defelection basin (inch)	Radius of relative stiffness, l (inch)	Normalised defelction, (inches)				Modulus of subgrade reaction k (MPa/m)	Elastic modulus of concrete Ec (MPa)	Strenght of concrete fc (MPa)	Flexural Strenght of concrete f_{mr} (MPa)
					mm			0	300	600	900				
33	78.198	RHS	Outer	INTERIOR	300	29.157	29.151	0.118	0.110	0.091	0.069	104.46	13,658	7.46	1.91
34	78.186	RHS	Outer	CORNER	300	27.133	23.260	0.115	0.105	0.080	0.055	138.28	7,329	2.15	1.03
35	76.597	RHS	Outer	INTERIOR	300	30.455	34.783	0.119	0.114	0.098	0.079	83.91	22,241	19.79	3.11
36	76.190	RHS	Outer	INTERIOR	300	31.976	44.637	0.121	0.118	0.105	0.091	43.71	31,423	39.50	4.40
37	76.175	RHS	Outer	CORNER	300	30.014	32.649	0.119	0.113	0.095	0.075	64.25	13,218	6.99	1.85
38	63.507	RHS	Outer	INTERIOR	300	31.415	40.473	0.121	0.116	0.103	0.086	60.01	29,155	34.00	4.08
39	63.000	RHS	Outer	INTERIOR	300	31.501	41.063	0.121	0.117	0.103	0.087	55.94	28,796	33.17	4.03
40	62.987	RHS	Outer	CORNER	300	32.035	45.116	0.121	0.118	0.106	0.092	40.08	30,069	36.17	4.21
41	62.498	RHS	Outer	INTERIOR	300	31.169	38.856	0.120	0.116	0.101	0.084	84.51	34,877	48.66	4.88
42	61.999	RHS	Outer	INTERIOR	300	32.134	45.950	0.121	0.118	0.106	0.092	60.18	48,576	94.38	6.80
43	61.985	RHS	Outer	CORNER	300	31.933	44.290	0.121	0.117	0.105	0.091	69.92	48,716	94.93	6.82
44	54.504	RHS	Outer	INTERIOR	300	32.270	47.129	0.122	0.118	0.107	0.093	45.13	40,314	65.01	5.64
45	53.990	RHS	Outer	INTERIOR	300	29.063	28.814	0.117	0.110	0.090	0.068	141.28	17,632	12.43	2.47
46	53.975	RHS	Outer	CORNER	300	29.738	31.434	0.118	0.112	0.094	0.073	97.30	17,201	11.84	2.41
47	53.499	RHS	Outer	INTERIOR	300	33.483	60.407	0.123	0.120	0.113	0.103	24.73	59,613	142.15	8.35
48	51.702	RHS	Outer	INTERIOR	300	31.077	38.282	0.120	0.115	0.101	0.084	65.28	25,386	25.78	3.55
49	51.000	RHS	Outer	INTERIOR	300	29.502	30.466	0.118	0.111	0.092	0.071	102.36	15,967	10.20	2.24
50	50.983	RHS	Outer	CORNER	300	31.749	42.864	0.121	0.117	0.104	0.089	55.83	34,126	46.58	4.78
51	50.498	RHS	Outer	INTERIOR	300	30.965	37.604	0.120	0.115	0.100	0.083	83.54	30,247	36.59	4.23
52	49.992	RHS	Outer	INTERIOR	300	28.191	26.008	0.116	0.108	0.085	0.062	186.71	15,468	9.57	2.17
53	49.976	RHS	Outer	CORNER	300	29.748	31.478	0.118	0.112	0.094	0.073	119.54	21,249	18.06	2.97
54	49.490	RHS	Outer	INTERIOR	300	32.823	52.510	0.122	0.119	0.110	0.098	37.19	51,192	104.83	7.17
55	48.995	RHS	Outer	INTERIOR	300	28.064	25.645	0.116	0.107	0.085	0.061	131.24	10,278	4.23	1.44
56	48.982	RHS	Outer	CORNER	300	30.094	33.018	0.119	0.113	0.096	0.076	125.46	26,998	29.16	3.78
57	48.490	RHS	Outer	INTERIOR	300	31.588	41.680	0.121	0.117	0.103	0.088	51.94	28,385	32.23	3.97
58	48.000	RHS	Outer	INTERIOR	300	31.956	44.474	0.121	0.118	0.105	0.091	56.18	39,798	63.35	5.57
59	47.987	RHS	Outer	CORNER	300	31.454	40.736	0.121	0.116	0.103	0.087	50.63	25,243	25.49	3.53
60	47.523	RHS	Outer	INTERIOR	300	31.775	43.061	0.121	0.117	0.104	0.089	34.79	21,656	18.76	3.03
61	46.316	RHS	Outer	INTERIOR	300	32.334	47.703	0.122	0.118	0.107	0.094	36.22	33,958	46.12	4.75
62	46.033	RHS	Outer	INTERIOR	300	31.425	40.540	0.121	0.116	0.103	0.087	46.03	22,514	20.28	3.15
63	46.019	RHS	Outer	CORNER	300	27.676	24.595	0.115	0.106	0.083	0.058	121.94	8,079	2.61	1.13
64	43.000	RHS	Outer	INTERIOR	300	30.710	36.144	0.120	0.115	0.099	0.081	97.14	30,017	36.04	4.20
65	42.990	RHS	Outer	CORNER	300	30.050	32.813	0.119	0.113	0.095	0.075	80.17	16,827	11.33	2.36
66	42.493	RHS	Outer	INTERIOR	300	31.116	38.528	0.120	0.116	0.101	0.084	78.36	31,264	39.10	4.38
67	42.000	RHS	Outer	INTERIOR	300	30.743	36.325	0.120	0.115	0.099	0.081	68.83	21,699	18.83	3.04

S. No.	Chinage	Side	Lane	Test Point Location	PQC Thickness	Area of defelection basin (inch)	Radius of relative stiffness, l (inch)	Normalised defelction, (inches)				Modulus of subgrade reaction k (MPa/m)	Elastic modulus of concrete Ec (MPa)	Strenght of concrete fc (MPa)	Flexural Strenght of concrete f_{mr} (MPa)
					mm			0	300	600	900				
68	41.985	RHS	Outer	CORNER	300	30.005	32.606	0.119	0.113	0.095	0.075	112.45	23,014	21.18	3.22
69	41.499	RHS	Outer	INTERIOR	300	31.341	39.969	0.121	0.116	0.102	0.086	86.65	40,042	64.13	5.61
70	40.988	RHS	Outer	INTERIOR	300	31.072	38.253	0.120	0.115	0.101	0.084	75.16	29,141	33.97	4.08
71	40.972	RHS	Outer	CORNER	300	28.013	25.501	0.116	0.107	0.085	0.061	164.10	12,565	6.32	1.76
72	40.498	RHS	Outer	INTERIOR	300	32.538	49.618	0.122	0.119	0.108	0.096	40.72	44,690	79.89	6.26
73	39.981	RHS	Outer	INTERIOR	300	31.137	38.653	0.120	0.116	0.101	0.084	63.35	25,601	26.22	3.58
74	39.965	RHS	Outer	CORNER	300	31.643	42.076	0.121	0.117	0.104	0.088	40.42	22,938	21.05	3.21
75	39.500	RHS	Outer	INTERIOR	300	30.198	33.506	0.119	0.113	0.096	0.077	95.18	21,720	18.87	3.04
76	38.982	RHS	Outer	INTERIOR	300	30.613	35.613	0.120	0.114	0.098	0.080	87.12	25,375	25.76	3.55
77	38.965	RHS	Outer	CORNER	300	30.097	33.032	0.119	0.113	0.096	0.076	93.91	20,244	16.39	2.83
78	38.502	RHS	Outer	INTERIOR	300	31.116	38.524	0.120	0.116	0.101	0.084	82.05	32,720	42.82	4.58
79	38.008	RHS	Outer	INTERIOR	300	30.669	35.918	0.120	0.114	0.099	0.080	106.78	32,177	41.42	4.50
80	37.990	RHS	Outer	CORNER	300	31.364	40.124	0.121	0.116	0.102	0.086	75.92	35,626	50.77	4.99
81	37.503	RHS	Outer	INTERIOR	300	30.761	36.425	0.120	0.115	0.099	0.081	93.41	29,773	35.46	4.17
82	36.997	RHS	Outer	INTERIOR	300	30.990	37.757	0.120	0.115	0.100	0.083	77.86	28,649	32.83	4.01
83	36.985	RHS	Outer	CORNER	300	30.512	35.079	0.119	0.114	0.098	0.079	81.77	22,419	20.10	3.14
84	36.496	RHS	Outer	INTERIOR	300	31.298	39.689	0.120	0.116	0.102	0.085	87.15	39,155	61.32	5.48
85	35.976	RHS	Outer	INTERIOR	300	31.025	37.965	0.120	0.115	0.101	0.083	75.40	28,361	32.17	3.97
86	35.963	RHS	Outer	CORNER	300	32.289	47.295	0.122	0.118	0.107	0.094	50.86	46,077	84.93	6.45
87	35.495	RHS	Outer	INTERIOR	300	31.332	39.915	0.120	0.116	0.102	0.086	64.98	29,864	35.67	4.18
88	35.000	RHS	Outer	INTERIOR	300	31.148	38.723	0.120	0.116	0.101	0.084	63.53	25,865	26.76	3.62
89	34.988	RHS	Outer	CORNER	300	31.232	39.259	0.120	0.116	0.102	0.085	55.84	24,018	23.07	3.36
90	34.503	RHS	Outer	INTERIOR	300	30.715	36.171	0.120	0.115	0.099	0.081	99.58	30,865	38.11	4.32
91	33.985	RHS	Outer	INTERIOR	300	29.574	30.757	0.118	0.112	0.093	0.072	142.59	23,107	21.36	3.23
92	33.970	RHS	Outer	CORNER	300	28.242	26.158	0.116	0.108	0.086	0.062	159.17	13,493	7.28	1.89
93	33.491	RHS	Outer	INTERIOR	300	31.666	42.247	0.121	0.117	0.104	0.088	45.90	26,474	28.04	3.71
94	33.000	RHS	Outer	INTERIOR	300	30.821	36.769	0.120	0.115	0.099	0.082	68.37	22,626	20.48	3.17
95	32.985	RHS	Outer	CORNER	300	31.927	44.241	0.121	0.117	0.105	0.091	52.16	36,180	52.36	5.07
96	32.496	RHS	Outer	INTERIOR	300	31.930	44.263	0.121	0.117	0.105	0.091	42.87	29,795	35.51	4.17
97	32.000	RHS	Outer	INTERIOR	300	31.574	41.581	0.121	0.117	0.103	0.088	55.53	30,056	36.13	4.21
98	31.984	RHS	Outer	CORNER	300	31.129	38.607	0.120	0.116	0.101	0.084	71.24	28,656	32.85	4.01
99	31.487	RHS	Outer	INTERIOR	300	30.373	34.367	0.119	0.114	0.097	0.078	87.26	22,039	19.43	3.09
100	31.001	RHS	Outer	INTERIOR	300	29.041	28.736	0.117	0.110	0.090	0.068	109.87	13,565	7.36	1.90
101	30.987	RHS	Outer	CORNER	300	31.310	39.769	0.120	0.116	0.102	0.086	55.46	25,118	25.24	3.52

Load Transfer Efficiency Analysis: NH-27 Kochugaon - Rakhaldubi : RHS									
S.No.	Chainage	Side	Lane	Test Point Location	Pressure	Load	0	300	LTE %
					N/mm2	KN	Loaded Slab	Unloaded Slab	
1	91.997	RHS	Outer	DOWEL	1136.2	80.3	0.1843	0.1069	58.0%
2	90.987	RHS	Outer	DOWEL	1160.8	82.1	0.1360	0.1198	88.1%
3	89.987	RHS	Outer	DOWEL	1126.4	79.7	0.1166	0.1036	88.9%
4	88.981	RHS	Outer	DOWEL	1140.9	80.7	0.1214	0.1104	90.9%
5	86.997	RHS	Outer	DOWEL	1124.4	79.5	0.2470	0.1899	76.9%
6	85.997	RHS	Outer	DOWEL	1142.0	80.8	0.1625	0.1574	96.9%
7	84.989	RHS	Outer	DOWEL	1147.5	81.1	0.1127	0.0947	84.0%
8	83.985	RHS	Outer	DOWEL	1149.8	81.3	0.1398	0.1250	89.4%
9	79.996	RHS	Outer	DOWEL	1181.9	83.6	0.1205	0.1120	92.9%
10	78.990	RHS	Outer	DOWEL	1177.6	83.3	0.1254	0.1162	92.7%
11	78.195	RHS	Outer	DOWEL	1122.6	79.4	0.1710	0.1069	62.5%
12	76.186	RHS	Outer	DOWEL	1134.4	80.2	0.1884	0.1752	93.0%
13	62.998	RHS	Outer	DOWEL	1151.5	81.4	0.1746	0.1665	95.4%
14	61.996	RHS	Outer	DOWEL	1106.8	78.3	0.1743	0.1567	89.9%
15	53.987	RHS	Outer	DOWEL	1177.3	83.3	0.1381	0.0989	71.6%
16	50.996	RHS	Outer	DOWEL	1162.6	82.2	0.1767	0.1621	91.7%
17	49.989	RHS	Outer	DOWEL	1164.5	82.3	0.1032	0.0921	89.2%
18	48.991	RHS	Outer	DOWEL	1176.4	83.2	0.1116	0.1003	89.9%
19	47.996	RHS	Outer	DOWEL	1161.0	82.1	0.1086	0.0987	90.9%
20	46.030	RHS	Outer	DOWEL	1119.9	79.2	0.2059	0.1262	61.3%
21	42.997	RHS	Outer	DOWEL	1177.1	83.2	0.1262	0.1163	92.2%
22	41.997	RHS	Outer	DOWEL	1150.1	81.3	0.1610	0.1059	65.8%
23	40.985	RHS	Outer	DOWEL	1120.1	79.2	0.1300	0.1174	90.3%
24	39.978	RHS	Outer	DOWEL	1154.7	81.7	0.1633	0.1429	87.5%
25	38.978	RHS	Outer	DOWEL	1153.4	81.6	0.1632	0.1213	74.3%
26	38.006	RHS	Outer	DOWEL	1133.6	80.2	0.1253	0.1186	94.7%
27	36.993	RHS	Outer	DOWEL	1114.7	78.8	0.1412	0.1328	94.1%
28	35.972	RHS	Outer	DOWEL	1117.8	79.0	0.1598	0.1546	96.7%
29	34.996	RHS	Outer	DOWEL	1121.8	79.3	0.1415	0.1317	93.1%
30	33.982	RHS	Outer	DOWEL	1139.8	80.6	0.1408	0.1267	90.0%
31	32.997	RHS	Outer	DOWEL	1114.7	78.8	0.1263	0.1131	89.5%
32	31.998	RHS	Outer	DOWEL	1093.2	77.3	0.1923	0.1706	88.7%
33	30.996	RHS	Outer	DOWEL	1165.6	82.4	0.1435	0.1329	92.6%

Load Transfer Efficiency Analysis: NH-27 Kochugaon - Rakhaldubi : RHS									
S.No.	Chainage	Side	Lane	Test Point Location	Pressure	Load	0	300	LTE %
					N/mm2	KN	Loaded Slab	Unloaded Slab	
1	91.981	RHS	Outer	TIE	1138.7	80.5	0.2116	0.1413	66.8%
2	90.971	RHS	Outer	TIE	1116.4	78.9	0.1214	0.1144	94.2%
3	89.968	RHS	Outer	TIE	1133.8	80.2	0.1427	0.1263	88.5%
4	88.965	RHS	Outer	TIE	1143.6	80.9	0.1528	0.1382	90.4%
5	86.975	RHS	Outer	TIE	1153.1	81.5	0.1407	0.1228	87.3%
6	85.979	RHS	Outer	TIE	1147.5	81.1	0.1430	0.1314	91.9%
7	84.969	RHS	Outer	TIE	1100.3	77.8	0.1416	0.1229	86.8%
8	83.966	RHS	Outer	TIE	1151.6	81.4	0.1216	0.1094	90.0%
9	79.981	RHS	Outer	TIE	1155.0	81.7	0.1309	0.1194	91.2%
10	78.970	RHS	Outer	TIE	1175.0	83.1	0.1388	0.1236	89.0%
11	78.179	RHS	Outer	TIE	1122.4	79.4	0.2201	0.1413	64.2%
12	76.169	RHS	Outer	TIE	1085.8	76.8	0.1644	0.1502	91.4%
13	62.980	RHS	Outer	TIE	1113.7	78.8	0.1506	0.1456	96.7%
14	61.979	RHS	Outer	TIE	1127.5	79.7	0.1513	0.1485	98.1%
15	53.967	RHS	Outer	TIE	1174.5	83.1	0.1686	0.1366	81.0%
16	50.978	RHS	Outer	TIE	1153.6	81.6	0.1388	0.1216	87.6%
17	49.969	RHS	Outer	TIE	1174.8	83.1	0.1907	0.1510	79.2%
18	48.975	RHS	Outer	TIE	1174.3	83.0	0.1190	0.1067	89.7%
19	47.982	RHS	Outer	TIE	1164.4	82.3	0.1355	0.1247	92.0%
20	46.014	RHS	Outer	TIE	1118.6	79.1	0.2237	0.1589	71.0%
21	42.980	RHS	Outer	TIE	1151.1	81.4	0.1666	0.1530	91.8%
22	41.979	RHS	Outer	TIE	1172.3	82.9	0.1120	0.1083	96.7%
23	40.966	RHS	Outer	TIE	1115.2	78.9	0.1376	0.1260	91.6%
24	39.956	RHS	Outer	TIE	1094.0	77.4	0.1740	0.1541	88.6%
25	38.960	RHS	Outer	TIE	1149.7	81.3	0.1276	0.1171	91.8%
26	37.980	RHS	Outer	TIE	1183.0	83.7	0.1386	0.1341	96.8%
27	36.981	RHS	Outer	TIE	1115.6	78.9	0.1185	0.1063	89.7%
28	35.958	RHS	Outer	TIE	1124.8	79.5	0.1651	0.1570	95.1%
29	34.981	RHS	Outer	TIE	1124.3	79.5	0.1789	0.1683	94.1%
30	33.957	RHS	Outer	TIE	1115.2	78.9	0.1175	0.1035	88.1%
31	32.979	RHS	Outer	TIE	1100.7	77.8	0.1389	0.1270	91.4%
32	31.977	RHS	Outer	TIE	1149.0	81.3	0.1676	0.1502	89.6%
33	30.978	RHS	Outer	TIE	1110.5	78.5	0.1592	0.1472	92.5%

				E-values & Remaining Life Analysis: On LHS Direction: Pkg-2 Rakhaldubi to Kaljha (NH-27)													
S.NO	Station	Side (LHS/RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)	Pavement Condition
							D1	D2	D3	D4	D5	D6	D7	D8	D9			
1	962.350	LHS	OUTER	24/11/2022 14:44:50	560.0	40.0	0.242	0.205	0.174	0.153	0.117	0.078	0.053	0.040	0.035	39.1	6	FAIR
2	962.606	LHS	INNER	25/11/2022 16:31:59	560.0	40.0	0.311	0.261	0.214	0.162	0.114	0.067	0.040	0.026	0.024	29.3	6	FAIR
3	962.738	LHS	OUTER	24/11/2022 14:48:04	560.0	40.0	0.152	0.127	0.112	0.095	0.078	0.052	0.038	0.030	0.024	38.3	6	FAIR
4	963.000	LHS	OUTER	24/11/2022 14:49:38	560.0	40.0	0.246	0.195	0.164	0.138	0.108	0.074	0.050	0.040	0.035	38.2	6	FAIR
5	963.101	LHS	INNER	25/11/2022 16:34:30	560.0	40.0	0.325	0.261	0.219	0.198	0.157	0.123	0.072	0.054	0.030	29.2	6	FAIR
6	963.359	LHS	OUTER	24/11/2022 14:50:57	560.0	40.0	0.258	0.198	0.159	0.122	0.093	0.061	0.046	0.036	0.031	37.7	6	FAIR
7	963.600	LHS	INNER	25/11/2022 16:36:06	560.0	40.0	0.202	0.165	0.131	0.106	0.085	0.056	0.039	0.029	0.026	29	6	FAIR
8	963.729	LHS	OUTER	24/11/2022 14:52:17	560.0	40.0	0.290	0.227	0.184	0.152	0.119	0.105	0.083	0.066	0.038	37.2	6	FAIR
9	964.105	LHS	INNER	25/11/2022 16:38:12	560.0	40.0	0.434	0.373	0.321	0.261	0.210	0.132	0.080	0.057	0.050	29	6	FAIR
10	964.348	LHS	OUTER	24/11/2022 14:54:36	560.0	40.0	0.210	0.156	0.133	0.106	0.087	0.064	0.048	0.039	0.036	37.1	6	FAIR
11	964.608	LHS	INNER	25/11/2022 16:39:34	560.0	40.0	0.193	0.158	0.137	0.122	0.099	0.068	0.057	0.044	0.032	28.6	6	FAIR
12	964.710	LHS	OUTER	24/11/2022 14:55:58	560.0	40.0	0.222	0.178	0.155	0.124	0.099	0.065	0.047	0.036	0.029	35.3	6	FAIR
13	965.013	LHS	OUTER	24/11/2022 14:57:10	560.0	40.0	0.269	0.223	0.203	0.183	0.168	0.136	0.099	0.068	0.033	34.5	6	FAIR
14	965.109	LHS	INNER	25/11/2022 16:41:02	560.0	40.0	0.259	0.215	0.170	0.160	0.125	0.080	0.068	0.046	0.026	28.3	6	FAIR
15	970.120	LHS	INNER	25/11/2022 16:50:33	560.0	40.0	0.475	0.352	0.273	0.210	0.159	0.093	0.065	0.045	0.040	28.1	6	FAIR
16	970.357	LHS	OUTER	24/11/2022 15:36:53	560.0	40.0	0.210	0.163	0.139	0.112	0.089	0.060	0.044	0.034	0.031	33.1	6	FAIR
17	970.596	LHS	INNER	25/11/2022 16:52:15	560.0	40.0	0.277	0.233	0.204	0.159	0.122	0.082	0.058	0.045	0.036	28.1	6	FAIR
18	970.704	LHS	OUTER	24/11/2022 15:38:37	560.0	40.0	0.204	0.155	0.129	0.104	0.086	0.059	0.045	0.035	0.030	32.9	6	FAIR
19	971.640	LHS	INNER	25/11/2022 16:55:31	560.0	40.0	0.222	0.173	0.148	0.123	0.098	0.069	0.049	0.039	0.035	28	6	FAIR
20	971.762	LHS	OUTER	24/11/2022 15:50:34	560.0	40.0	0.190	0.136	0.119	0.075	0.047	0.041	0.032	0.026	0.019	32.9	6	FAIR
21	972.027	LHS	OUTER	24/11/2022 15:53:49	560.0	40.0	0.268	0.226	0.189	0.151	0.113	0.088	0.061	0.039	0.025	32.9	6	FAIR
22	972.114	LHS	INNER	25/11/2022 16:57:17	560.0	40.0	0.276	0.228	0.195	0.159	0.136	0.107	0.083	0.064	0.050	27.9	6	FAIR

S.NO	Station	Side (LHS/RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)	Pavement Condition
							D1	D2	D3	D4	D5	D6	D7	D8	D9			
23	972.390	LHS	OUTER	24/11/2022 15:56:06	560.0	40.0	0.207	0.162	0.131	0.100	0.078	0.046	0.035	0.027	0.026	32.9	6	FAIR
24	972.597	LHS	INNER	25/11/2022 16:58:51	560.0	40.0	0.180	0.135	0.110	0.088	0.073	0.055	0.043	0.038	0.031	27.7	6	FAIR
25	972.707	LHS	OUTER	24/11/2022 15:57:31	560.0	40.0	0.196	0.147	0.123	0.098	0.076	0.055	0.043	0.037	0.034	32.8	6	FAIR
26	973.000	LHS	OUTER	24/11/2022 15:59:08	560.0	40.0	0.255	0.200	0.160	0.129	0.102	0.064	0.050	0.038	0.036	32.8	6	FAIR
27	973.119	LHS	INNER	00/01/1900 00:00:00	560.0	40.0	0.249	0.203	0.172	0.161	0.130	0.084	0.053	0.031	0.021	27.6	6	FAIR
28	973.354	LHS	OUTER	24/11/2022 16:00:39	560.0	40.0	0.227	0.181	0.160	0.117	0.078	0.053	0.040	0.031	0.029	32.7	6	FAIR
29	973.586	LHS	INNER	25/11/2022 17:01:19	560.0	40.0	0.237	0.182	0.138	0.108	0.083	0.059	0.043	0.033	0.029	27.5	6	FAIR
30	973.703	LHS	OUTER	24/11/2022 16:02:08	560.0	40.0	0.277	0.224	0.176	0.154	0.111	0.089	0.065	0.048	0.027	32.7	6	FAIR
31	974.013	LHS	OUTER	24/11/2022 16:03:42	560.0	40.0	0.170	0.152	0.130	0.105	0.081	0.055	0.040	0.032	0.028	32.6	6	FAIR
32	974.100	LHS	INNER	25/11/2022 17:03:03	560.0	40.0	0.424	0.337	0.271	0.180	0.120	0.075	0.052	0.037	0.035	27.2	6	FAIR
33	974.353	LHS	OUTER	24/11/2022 16:05:13	560.0	40.0	0.248	0.191	0.161	0.126	0.100	0.057	0.040	0.030	0.027	32.5	6	FAIR
34	974.600	LHS	INNER	25/11/2022 17:04:44	560.0	40.0	0.207	0.154	0.119	0.094	0.070	0.051	0.039	0.034	0.031	27.1	6	FAIR
35	974.701	LHS	OUTER	24/11/2022 16:06:41	560.0	40.0	0.378	0.268	0.207	0.157	0.114	0.081	0.055	0.045	0.036	32.5	6	FAIR
36	975.016	LHS	OUTER	24/11/2022 16:08:04	560.0	40.0	0.310	0.244	0.197	0.147	0.107	0.065	0.048	0.036	0.033	32.5	6	FAIR
37	975.098	LHS	INNER	25/11/2022 17:06:28	560.0	40.0	0.342	0.262	0.220	0.170	0.128	0.084	0.059	0.045	0.041	27.1	6	FAIR
38	975.371	LHS	OUTER	24/11/2022 16:10:03	560.0	40.0	0.286	0.236	0.201	0.138	0.111	0.073	0.050	0.039	0.036	32.5	6	FAIR
39	975.601	LHS	INNER	25/11/2022 17:08:34	560.0	40.0	0.404	0.303	0.254	0.203	0.151	0.088	0.057	0.041	0.035	26.9	6	FAIR
40	975.709	LHS	OUTER	24/11/2022 16:11:36	560.0	40.0	0.394	0.303	0.254	0.200	0.148	0.082	0.067	0.048	0.045	32.4	6	FAIR
41	975.999	LHS	OUTER	24/11/2022 16:12:59	560.0	40.0	0.187	0.158	0.125	0.093	0.076	0.042	0.034	0.020	0.019	32.3	6	FAIR
42	976.100	LHS	INNER	25/11/2022 17:10:24	560.0	40.0	0.302	0.243	0.186	0.143	0.097	0.060	0.046	0.039	0.032	26.8	6	FAIR
43	976.359	LHS	OUTER	24/11/2022 16:14:28	560.0	40.0	0.244	0.189	0.152	0.106	0.077	0.046	0.031	0.026	0.025	32.3	6	FAIR
44	976.605	LHS	INNER	25/11/2022 17:12:13	560.0	40.0	0.232	0.190	0.160	0.124	0.096	0.060	0.043	0.035	0.031	26.5	6	FAIR
45	976.705	LHS	OUTER	24/11/2022 16:16:07	560.0	40.0	0.280	0.229	0.178	0.128	0.102	0.065	0.044	0.037	0.033	32.3	6	FAIR

S.NO	Station	Side (LHS/RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)	Pavement Condition
							D1	D2	D3	D4	D5	D6	D7	D8	D9			
46	977.019	LHS	OUTER	24/11/2022 16:17:25	560.0	40.0	0.279	0.208	0.169	0.128	0.096	0.059	0.044	0.036	0.032	32.3	6	FAIR
47	977.114	LHS	INNER	25/11/2022 17:13:44	560.0	40.0	0.179	0.136	0.109	0.080	0.056	0.038	0.029	0.026	0.022	26.4	6	FAIR
48	977.353	LHS	OUTER	24/11/2022 16:19:11	560.0	40.0	0.266	0.192	0.149	0.117	0.089	0.057	0.047	0.036	0.035	32.1	6	FAIR
49	977.573	LHS	INNER	25/11/2022 17:15:13	560.0	40.0	0.151	0.119	0.097	0.073	0.060	0.042	0.032	0.029	0.024	26.3	6	FAIR
50	977.700	LHS	OUTER	24/11/2022 16:21:06	560.0	40.0	0.152	0.113	0.093	0.074	0.057	0.039	0.033	0.026	0.025	32.1	6	FAIR
51	978.006	LHS	OUTER	24/11/2022 16:22:37	560.0	40.0	0.272	0.190	0.149	0.113	0.081	0.057	0.046	0.037	0.035	32.1	6	FAIR
52	978.112	LHS	INNER	25/11/2022 17:16:49	560.0	40.0	0.142	0.114	0.091	0.069	0.057	0.038	0.032	0.027	0.024	26	6	FAIR
53	978.352	LHS	OUTER	24/11/2022 16:24:17	560.0	40.0	0.232	0.179	0.143	0.104	0.078	0.053	0.041	0.033	0.030	32.1	6	FAIR
54	978.609	LHS	INNER	25/11/2022 17:18:28	560.0	40.0	0.221	0.153	0.124	0.095	0.074	0.053	0.040	0.028	0.022	26	6	FAIR
55	978.708	LHS	OUTER	24/11/2022 16:25:54	560.0	40.0	0.338	0.256	0.208	0.155	0.119	0.075	0.053	0.041	0.037	32.1	6	FAIR
56	979.006	LHS	OUTER	24/11/2022 16:27:31	560.0	40.0	0.245	0.186	0.151	0.112	0.085	0.049	0.033	0.030	0.026	32.0	6	FAIR
57	979.098	LHS	INNER	25/11/2022 17:20:00	560.0	40.0	0.364	0.300	0.245	0.178	0.139	0.085	0.055	0.039	0.032	25.9	6	FAIR
58	979.352	LHS	OUTER	24/11/2022 16:29:08	560.0	40.0	0.235	0.181	0.135	0.098	0.080	0.052	0.037	0.024	0.021	32.0	6	FAIR
59	979.607	LHS	INNER	25/11/2022 17:21:48	560.0	40.0	0.239	0.175	0.143	0.110	0.084	0.060	0.044	0.032	0.029	25.9	6	FAIR
60	979.704	LHS	OUTER	24/11/2022 16:31:06	560.0	40.0	0.217	0.175	0.152	0.127	0.105	0.074	0.057	0.045	0.038	31.9	6	FAIR
61	980.013	LHS	OUTER	24/11/2022 16:32:46	560.0	40.0	0.143	0.131	0.109	0.092	0.076	0.055	0.046	0.037	0.035	31.9	6	FAIR
62	980.110	LHS	INNER	25/11/2022 17:23:33	560.0	40.0	0.164	0.134	0.116	0.096	0.083	0.065	0.049	0.038	0.033	25.9	6	FAIR
63	980.348	LHS	OUTER	24/11/2022 16:34:21	560.0	40.0	0.462	0.374	0.304	0.232	0.176	0.112	0.074	0.055	0.048	31.8	6	FAIR
64	980.602	LHS	INNER	25/11/2022 17:25:12	560.0	40.0	0.259	0.210	0.181	0.146	0.118	0.081	0.058	0.041	0.038	25.7	6	FAIR
65	980.702	LHS	OUTER	24/11/2022 16:35:51	560.0	40.0	0.200	0.158	0.138	0.115	0.092	0.065	0.049	0.035	0.031	31.7	6	FAIR
66	981.012	LHS	OUTER	24/11/2022 16:37:28	560.0	40.0	0.246	0.189	0.156	0.113	0.079	0.047	0.038	0.026	0.025	31.7	6	FAIR
67	981.120	LHS	INNER	25/11/2022 17:26:54	560.0	40.0	0.280	0.202	0.169	0.127	0.099	0.061	0.045	0.037	0.033	25.5	6	FAIR
68	981.354	LHS	OUTER	24/11/2022 16:39:05	560.0	40.0	0.220	0.171	0.139	0.113	0.087	0.058	0.042	0.034	0.029	31.7	6	FAIR

S.NO	Station	Side (LHS/RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)	Pavement Condition
							D1	D2	D3	D4	D5	D6	D7	D8	D9			
69	981.600	LHS	INNER	25/11/2022 17:28:31	560.0	40.0	0.224	0.191	0.168	0.140	0.112	0.075	0.053	0.038	0.034	25.2	6	FAIR
70	981.702	LHS	OUTER	24/11/2022 16:41:04	560.0	40.0	0.261	0.213	0.172	0.135	0.108	0.067	0.050	0.039	0.033	31.7	6	FAIR
71	982.001	LHS	OUTER	24/11/2022 16:47:24	560.0	40.0	0.256	0.176	0.150	0.112	0.078	0.045	0.037	0.022	0.020	31.6	6	FAIR
72	982.103	LHS	INNER	25/11/2022 17:30:08	560.0	40.0	0.272	0.205	0.160	0.119	0.085	0.050	0.033	0.026	0.023	25.2	6	FAIR
73	982.359	LHS	OUTER	24/11/2022 16:51:08	560.0	40.0	0.154	0.127	0.112	0.088	0.073	0.048	0.035	0.029	0.026	31.5	6	FAIR
74	982.523	LHS	OUTER	24/11/2022 16:52:40	560.0	40.0	0.201	0.158	0.131	0.103	0.080	0.054	0.040	0.031	0.028	31.4	6	FAIR
75	982.612	LHS	INNER	25/11/2022 17:31:43	560.0	40.0	0.269	0.212	0.167	0.132	0.098	0.064	0.048	0.035	0.034	25.2	6	FAIR
76	983.014	LHS	OUTER	24/11/2022 16:56:45	560.0	40.0	0.125	0.111	0.093	0.079	0.065	0.048	0.037	0.026	0.026	31.4	6	FAIR
77	983.117	LHS	INNER	25/11/2022 17:33:26	560.0	40.0	0.148	0.126	0.109	0.092	0.078	0.058	0.044	0.037	0.032	25.1	6	FAIR
78	983.374	LHS	OUTER	24/11/2022 16:58:24	560.0	40.0	0.111	0.089	0.076	0.067	0.056	0.043	0.037	0.028	0.027	31.3	6	FAIR
79	983.596	LHS	INNER	25/11/2022 17:34:55	560.0	40.0	0.189	0.136	0.112	0.091	0.073	0.057	0.042	0.033	0.026	24.9	6	FAIR
80	983.756	LHS	OUTER	24/11/2022 17:00:07	560.0	40.0	0.127	0.107	0.091	0.074	0.062	0.041	0.032	0.026	0.023	31.3	6	FAIR
81	984.021	LHS	OUTER	24/11/2022 17:01:28	560.0	40.0	0.195	0.147	0.116	0.091	0.069	0.046	0.041	0.035	0.029	31.2	6	FAIR
82	984.117	LHS	INNER	25/11/2022 17:36:35	560.0	40.0	0.123	0.085	0.065	0.062	0.053	0.049	0.041	0.036	0.028	24.9	6	FAIR
83	984.258	LHS	OUTER	24/11/2022 17:02:55	560.0	40.0	0.092	0.076	0.064	0.056	0.047	0.035	0.031	0.026	0.024	31.2	6	FAIR
84	984.611	LHS	INNER	25/11/2022 17:38:17	560.0	40.0	0.076	0.059	0.054	0.048	0.044	0.037	0.030	0.025	0.022	24.9	6	FAIR
85	984.718	LHS	OUTER	24/11/2022 17:05:50	560.0	40.0	0.115	0.089	0.075	0.071	0.056	0.039	0.037	0.028	0.024	31	6	FAIR
86	985.027	LHS	OUTER	24/11/2022 17:07:36	560.0	40.0	0.122	0.088	0.069	0.060	0.052	0.041	0.036	0.031	0.030	31	6	FAIR
87	985.125	LHS	INNER	25/11/2022 17:39:48	560.0	40.0	0.062	0.046	0.042	0.040	0.037	0.030	0.028	0.024	0.021	24.8	6	FAIR
88	985.369	LHS	OUTER	24/11/2022 17:09:21	560.0	40.0	0.148	0.124	0.117	0.103	0.092	0.068	0.054	0.036	0.033	30.9	6	FAIR
89	985.643	LHS	INNER	25/11/2022 17:41:25	560.0	40.0	0.190	0.158	0.141	0.119	0.105	0.075	0.058	0.042	0.034	24.8	6	FAIR
90	985.740	LHS	OUTER	24/11/2022 17:11:01	560.0	40.0	0.130	0.111	0.099	0.086	0.074	0.056	0.043	0.035	0.030	30.8	6	FAIR
91	986.041	LHS	OUTER	24/11/2022 17:12:30	560.0	40.0	0.133	0.118	0.106	0.097	0.083	0.061	0.050	0.039	0.035	30.8	6	FAIR

S.NO	Station	Side (LHS/RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)	Pavement Condition
							D1	D2	D3	D4	D5	D6	D7	D8	D9			
92	986.126	LHS	INNER	25/11/2022 17:42:56	560.0	40.0	0.121	0.102	0.091	0.081	0.072	0.058	0.045	0.036	0.031	24.8	6	FAIR
93	986.607	LHS	INNER	25/11/2022 17:44:36	560.0	40.0	0.216	0.167	0.143	0.114	0.088	0.058	0.042	0.037	0.030	24.7	6	FAIR
94	986.721	LHS	OUTER	24/11/2022 17:15:13	560.0	40.0	0.150	0.113	0.099	0.078	0.070	0.047	0.036	0.026	0.023	30.8	6	FAIR
95	987.040	LHS	OUTER	24/11/2022 17:16:51	560.0	40.0	0.169	0.136	0.114	0.097	0.076	0.053	0.037	0.030	0.027	30.8	6	FAIR
96	987.111	LHS	INNER	25/11/2022 17:46:03	560.0	40.0	0.144	0.123	0.107	0.090	0.073	0.048	0.035	0.026	0.023	24.6	6	FAIR
97	987.392	LHS	OUTER	24/11/2022 17:18:30	560.0	40.0	0.222	0.170	0.134	0.074	0.067	0.043	0.040	0.024	0.023	30.8	6	FAIR
98	987.598	LHS	INNER	25/11/2022 17:47:35	560.0	40.0	0.244	0.197	0.155	0.110	0.077	0.054	0.034	0.029	0.022	24.6	6	FAIR
99	987.736	LHS	OUTER	24/11/2022 17:20:01	560.0	40.0	0.279	0.233	0.188	0.150	0.120	0.072	0.052	0.032	0.010	30.8	6	FAIR
100	988.029	LHS	OUTER	24/11/2022 17:21:28	560.0	40.0	0.134	0.103	0.094	0.084	0.071	0.052	0.043	0.032	0.029	30.8	6	FAIR
101	988.108	LHS	INNER	25/11/2022 17:49:21	560.0	40.0	0.153	0.127	0.109	0.095	0.076	0.056	0.042	0.032	0.028	24.6	6	FAIR
102	988.361	LHS	OUTER	24/11/2022 17:22:58	560.0	40.0	0.113	0.103	0.090	0.077	0.071	0.057	0.041	0.033	0.030	30.7	6	FAIR
103	988.616	LHS	INNER	25/11/2022 17:50:53	560.0	40.0	0.194	0.156	0.132	0.111	0.092	0.067	0.050	0.037	0.032	24.6	6	FAIR
104	988.705	LHS	OUTER	24/11/2022 17:24:30	560.0	40.0	0.142	0.115	0.098	0.081	0.065	0.045	0.032	0.024	0.022	30.6	6	FAIR
105	989.015	LHS	OUTER	24/11/2022 17:26:02	560.0	40.0	0.141	0.118	0.105	0.095	0.082	0.059	0.045	0.033	0.031	30.6	6	FAIR
106	989.115	LHS	INNER	25/11/2022 17:52:47	560.0	40.0	0.134	0.110	0.100	0.082	0.072	0.051	0.038	0.028	0.026	24.5	6	FAIR
107	989.357	LHS	OUTER	24/11/2022 17:27:18	560.0	40.0	0.124	0.100	0.088	0.075	0.067	0.049	0.039	0.030	0.028	30.6	6	FAIR
108	989.602	LHS	INNER	25/11/2022 17:54:21	560.0	40.0	0.160	0.124	0.107	0.085	0.072	0.048	0.034	0.028	0.026	24.4	6	FAIR
109	989.704	LHS	OUTER	24/11/2022 17:28:41	560.0	40.0	0.127	0.111	0.101	0.089	0.075	0.058	0.046	0.038	0.034	30.6	6	FAIR
110	990.057	LHS	OUTER	24/11/2022 17:30:11	560.0	40.0	0.151	0.119	0.102	0.087	0.073	0.052	0.042	0.032	0.030	30.5	6	FAIR
111	990.115	LHS	INNER	25/11/2022 17:55:51	560.0	40.0	0.086	0.061	0.056	0.054	0.045	0.039	0.031	0.026	0.023	24.3	6	FAIR
112	990.355	LHS	OUTER	24/11/2022 17:31:29	560.0	40.0	0.140	0.118	0.103	0.091	0.078	0.058	0.047	0.039	0.035	30.5	6	FAIR
113	990.601	LHS	INNER	25/11/2022 17:57:27	560.0	40.0	0.297	0.227	0.183	0.143	0.103	0.068	0.049	0.038	0.032	24.2	6	FAIR
114	990.693	LHS	OUTER	24/11/2022 17:32:52	560.0	40.0	0.126	0.111	0.101	0.086	0.075	0.057	0.044	0.035	0.032	30.5	6	FAIR

S.NO	Station	Side (LHS/RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)	Pavement Condition
							D1	D2	D3	D4	D5	D6	D7	D8	D9			
115	991.092	LHS	OUTER	24/11/2022 17:34:27	560.0	40.0	0.101	0.085	0.076	0.065	0.055	0.036	0.028	0.022	0.017	30.3	6	FAIR
116	991.105	LHS	INNER	25/11/2022 17:59:20	560.0	40.0	0.221	0.174	0.148	0.124	0.102	0.070	0.048	0.035	0.031	24.1	6	FAIR
117	991.384	LHS	OUTER	24/11/2022 17:35:40	560.0	40.0	0.119	0.100	0.090	0.079	0.063	0.047	0.031	0.026	0.023	30.3	6	FAIR
118	991.606	LHS	INNER	25/11/2022 18:01:56	560.0	40.0	0.228	0.184	0.158	0.131	0.103	0.071	0.050	0.036	0.033	24.1	6	FAIR
119	991.732	LHS	OUTER	24/11/2022 18:09:37	560.0	40.0	0.114	0.104	0.091	0.075	0.072	0.048	0.038	0.026	0.019	29.1	6	FAIR
120	992.000	LHS	OUTER	25/11/2022 06:20:16	560.0	40.0	0.109	0.094	0.085	0.076	0.065	0.049	0.036	0.028	0.024	25.1	6	GOOD
121	992.187	LHS	INNER	26/11/2022 07:03:55	560.0	40.0	0.166	0.138	0.124	0.106	0.090	0.065	0.049	0.038	0.035	23.4	6	GOOD
122	992.343	LHS	OUTER	25/11/2022 06:23:28	560.0	40.0	0.229	0.173	0.146	0.102	0.071	0.050	0.036	0.025	0.022	25.1	6	GOOD
123	992.651	LHS	INNER	26/11/2022 07:07:14	560.0	40.0	0.139	0.111	0.096	0.074	0.058	0.042	0.034	0.029	0.025	23.4	6	GOOD
124	992.698	LHS	OUTER	25/11/2022 06:25:05	560.0	40.0	0.271	0.243	0.202	0.174	0.133	0.072	0.054	0.038	0.015	25.2	6	GOOD
125	992.954	LHS	OUTER	25/11/2022 06:26:24	560.0	40.0	0.245	0.219	0.180	0.145	0.102	0.078	0.058	0.038	0.026	25.2	6	GOOD
126	993.111	LHS	INNER	26/11/2022 07:08:44	560.0	40.0	0.289	0.253	0.211	0.177	0.149	0.106	0.086	0.055	0.031	23.4	6	GOOD
127	993.356	LHS	OUTER	25/11/2022 06:27:55	560.0	40.0	0.202	0.168	0.129	0.085	0.074	0.055	0.043	0.033	0.031	25.3	6	GOOD
128	993.587	LHS	INNER	26/11/2022 07:10:12	560.0	40.0	0.191	0.161	0.121	0.086	0.071	0.057	0.047	0.035	0.032	23.5	6	GOOD
129	993.713	LHS	OUTER	25/11/2022 06:29:18	560.0	40.0	0.225	0.177	0.153	0.119	0.077	0.058	0.039	0.022	0.013	25.5	6	GOOD
130	994.000	LHS	OUTER	25/11/2022 06:30:38	560.0	40.0	0.203	0.176	0.153	0.118	0.095	0.074	0.042	0.022	0.011	25.6	6	GOOD
131	994.104	LHS	INNER	26/11/2022 07:11:43	560.0	40.0	0.193	0.164	0.146	0.109	0.082	0.068	0.046	0.032	0.029	23.5	6	GOOD
132	994.353	LHS	OUTER	25/11/2022 06:32:10	560.0	40.0	0.142	0.106	0.091	0.075	0.052	0.035	0.029	0.026	0.013	25.7	6	GOOD
133	994.596	LHS	INNER	26/11/2022 07:13:11	560.0	40.0	0.224	0.202	0.188	0.163	0.127	0.071	0.056	0.044	0.022	23.5	6	GOOD
134	994.710	LHS	OUTER	25/11/2022 06:33:32	560.0	40.0	0.179	0.153	0.125	0.099	0.073	0.055	0.037	0.022	0.019	25.7	6	GOOD
135	995.011	LHS	OUTER	25/11/2022 06:34:53	560.0	40.0	0.169	0.136	0.113	0.084	0.071	0.053	0.040	0.032	0.023	25.7	6	FAIR
136	995.101	LHS	INNER	26/11/2022 07:14:40	560.0	40.0	0.109	0.090	0.079	0.063	0.053	0.041	0.032	0.027	0.020	23.6	6	FAIR
137	995.360	LHS	OUTER	25/11/2022 06:36:25	560.0	40.0	0.145	0.124	0.105	0.093	0.078	0.052	0.040	0.028	0.020	25.7	6	FAIR

S.NO	Station	Side (LHS/RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)	Pavement Condition
							D1	D2	D3	D4	D5	D6	D7	D8	D9			
138	995.600	LHS	INNER	26/11/2022 07:16:12	560.0	40.0	0.117	0.100	0.094	0.076	0.065	0.052	0.041	0.037	0.029	23.6	6	FAIR
139	995.706	LHS	OUTER	25/11/2022 06:37:56	560.0	40.0	0.275	0.214	0.184	0.147	0.114	0.083	0.059	0.048	0.041	25.9	6	FAIR
140	996.376	LHS	OUTER	25/11/2022 06:40:53	560.0	40.0	0.273	0.229	0.202	0.172	0.147	0.104	0.080	0.061	0.040	26	6	GOOD
141	996.600	LHS	INNER	26/11/2022 07:21:28	560.0	40.0	0.177	0.145	0.122	0.101	0.083	0.051	0.036	0.022	0.020	23.6	6	GOOD
142	996.700	LHS	OUTER	25/11/2022 06:43:35	560.0	40.0	0.388	0.317	0.265	0.217	0.169	0.106	0.069	0.053	0.045	26.1	6	GOOD
143	997.016	LHS	OUTER	25/11/2022 06:45:17	560.0	40.0	0.214	0.180	0.152	0.124	0.084	0.064	0.044	0.022	0.014	26.4	6	GOOD
144	997.108	LHS	INNER	26/11/2022 07:23:18	560.0	40.0	0.253	0.221	0.188	0.154	0.111	0.076	0.048	0.021	0.017	23.6	6	GOOD
145	997.351	LHS	OUTER	25/11/2022 06:46:44	560.0	40.0	0.268	0.225	0.180	0.155	0.115	0.086	0.057	0.037	0.026	26.4	6	GOOD
146	997.597	LHS	INNER	26/11/2022 07:24:55	560.0	40.0	0.223	0.187	0.164	0.130	0.103	0.086	0.068	0.032	0.026	23.6	6	GOOD
147	997.705	LHS	OUTER	25/11/2022 06:48:24	560.0	40.0	0.194	0.162	0.123	0.087	0.063	0.046	0.035	0.029	0.017	26.4	6	GOOD
148	998.008	LHS	OUTER	25/11/2022 06:49:41	560.0	40.0	0.227	0.176	0.153	0.121	0.085	0.059	0.039	0.029	0.027	26.6	6	GOOD
149	998.110	LHS	INNER	26/11/2022 07:26:29	560.0	40.0	0.118	0.100	0.089	0.076	0.062	0.048	0.035	0.028	0.024	23.6	6	GOOD
150	998.345	LHS	OUTER	25/11/2022 06:51:06	560.0	40.0	0.234	0.202	0.190	0.162	0.134	0.081	0.060	0.035	0.021	26.6	6	GOOD
151	998.612	LHS	INNER	26/11/2022 07:28:04	560.0	40.0	0.121	0.103	0.086	0.058	0.047	0.043	0.036	0.033	0.027	23.7	6	GOOD
152	998.708	LHS	OUTER	25/11/2022 06:52:37	560.0	40.0	0.259	0.216	0.178	0.149	0.112	0.082	0.054	0.038	0.020	26.7	6	GOOD
153	999.063	LHS	OUTER	25/11/2022 06:54:13	560.0	40.0	0.278	0.242	0.206	0.162	0.127	0.087	0.055	0.034	0.030	26.8	6	GOOD
154	999.126	LHS	INNER	26/11/2022 07:29:42	560.0	40.0	0.222	0.161	0.135	0.114	0.093	0.066	0.055	0.050	0.039	23.7	6	GOOD
155	999.359	LHS	OUTER	25/11/2022 06:55:35	560.0	40.0	0.249	0.192	0.157	0.129	0.089	0.053	0.032	0.026	0.019	26.8	6	GOOD
156	999.603	LHS	INNER	26/11/2022 07:31:23	560.0	40.0	0.260	0.229	0.176	0.156	0.128	0.089	0.053	0.035	0.032	23.7	6	GOOD
157	999.713	LHS	OUTER	25/11/2022 06:57:06	560.0	40.0	0.196	0.166	0.126	0.081	0.067	0.043	0.035	0.029	0.022	26.8	6	GOOD
158	1000.018	LHS	OUTER	25/11/2022 06:58:51	560.0	40.0	0.201	0.160	0.124	0.082	0.065	0.048	0.037	0.029	0.018	26.9	6	FAIR
159	1000.100	LHS	INNER	26/11/2022 07:32:58	560.0	40.0	0.198	0.152	0.104	0.085	0.054	0.040	0.032	0.028	0.024	23.8	6	FAIR
160	1000.356	LHS	OUTER	25/11/2022 07:00:17	560.0	40.0	0.224	0.162	0.124	0.085	0.065	0.049	0.038	0.031	0.026	27	6	FAIR

S.NO	Station	Side (LHS/RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)	Pavement Condition
							D1	D2	D3	D4	D5	D6	D7	D8	D9			
161	1000.603	LHS	INNER	26/11/2022 07:34:31	560.0	40.0	0.256	0.203	0.172	0.152	0.113	0.084	0.065	0.049	0.039	23.8	6	FAIR
162	1000.704	LHS	OUTER	25/11/2022 07:22:11	560.0	40.0	0.242	0.213	0.172	0.143	0.122	0.075	0.051	0.031	0.026	27.2	6	FAIR
163	1001.039	LHS	OUTER	25/11/2022 07:24:32	560.0	40.0	0.143	0.122	0.107	0.092	0.077	0.054	0.039	0.031	0.026	27.3	6	FAIR
164	1001.103	LHS	INNER	26/11/2022 07:36:05	560.0	40.0	0.480	0.361	0.260	0.129	0.085	0.043	0.030	0.028	0.025	23.9	6	FAIR
165	1001.358	LHS	OUTER	25/11/2022 07:26:21	560.0	40.0	0.342	0.259	0.206	0.135	0.097	0.043	0.032	0.023	0.020	27.3	6	FAIR
166	1001.604	LHS	INNER	26/11/2022 07:38:27	560.0	40.0	0.200	0.164	0.151	0.124	0.102	0.073	0.053	0.040	0.033	23.9	6	FAIR
167	1001.711	LHS	OUTER	25/11/2022 07:29:54	560.0	40.0	0.137	0.119	0.109	0.098	0.082	0.060	0.041	0.032	0.029	27.3	6	FAIR
168	1002.026	LHS	OUTER	25/11/2022 07:32:39	560.0	40.0	0.220	0.184	0.166	0.134	0.106	0.077	0.054	0.042	0.037	27.4	6	FAIR
169	1002.115	LHS	INNER	26/11/2022 07:39:59	560.0	40.0	0.194	0.166	0.139	0.115	0.059	0.044	0.031	0.027	0.025	23.9	6	FAIR
170	1002.353	LHS	OUTER	25/11/2022 07:34:15	560.0	40.0	0.243	0.216	0.183	0.126	0.093	0.063	0.047	0.040	0.026	27.4	6	FAIR
171	1002.609	LHS	INNER	26/11/2022 07:41:35	560.0	40.0	0.181	0.141	0.116	0.090	0.074	0.048	0.035	0.034	0.025	23.9	6	FAIR
172	1002.710	LHS	OUTER	25/11/2022 07:35:45	560.0	40.0	0.260	0.223	0.167	0.134	0.120	0.089	0.057	0.038	0.011	27.5	6	FAIR
173	1003.012	LHS	OUTER	25/11/2022 07:40:01	560.0	40.0	0.155	0.135	0.120	0.101	0.083	0.058	0.045	0.035	0.026	27.5	6	FAIR
174	1003.099	LHS	INNER	26/11/2022 07:43:09	560.0	40.0	0.223	0.183	0.161	0.138	0.114	0.086	0.066	0.049	0.046	23.9	6	FAIR
175	1003.350	LHS	OUTER	25/11/2022 07:41:30	560.0	40.0	0.344	0.258	0.221	0.184	0.150	0.101	0.074	0.055	0.036	27.5	6	FAIR
176	1003.598	LHS	INNER	26/11/2022 07:44:42	560.0	40.0	0.166	0.133	0.114	0.095	0.078	0.052	0.037	0.028	0.027	23.9	6	FAIR
177	1003.709	LHS	OUTER	25/11/2022 07:43:04	560.0	40.0	0.189	0.162	0.143	0.119	0.100	0.063	0.051	0.042	0.030	27.6	6	FAIR
178	1004.001	LHS	OUTER	25/11/2022 07:45:08	560.0	40.0	0.194	0.152	0.124	0.088	0.061	0.047	0.037	0.032	0.020	27.6	6	FAIR
179	1004.117	LHS	INNER	26/11/2022 07:46:13	560.0	40.0	0.216	0.157	0.127	0.093	0.067	0.058	0.036	0.033	0.026	24	6	FAIR
180	1004.363	LHS	OUTER	25/11/2022 07:46:48	560.0	40.0	0.249	0.214	0.174	0.150	0.117	0.073	0.059	0.039	0.012	27.8	6	FAIR
181	1004.600	LHS	INNER	26/11/2022 07:47:39	560.0	40.0	0.128	0.113	0.102	0.077	0.065	0.044	0.032	0.027	0.021	24	6	FAIR
182	1004.717	LHS	OUTER	25/11/2022 07:48:16	560.0	40.0	0.115	0.105	0.091	0.087	0.079	0.060	0.049	0.041	0.024	27.8	6	FAIR
183	1005.006	LHS	OUTER	25/11/2022 07:49:31	560.0	40.0	0.119	0.102	0.089	0.071	0.062	0.047	0.036	0.029	0.018	27.9	6	FAIR

S.NO	Station	Side (LHS/RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)	Pavement Condition
							D1	D2	D3	D4	D5	D6	D7	D8	D9			
184	1005.115	LHS	INNER	26/11/2022 07:49:12	560.0	40.0	0.150	0.119	0.101	0.081	0.068	0.048	0.037	0.030	0.023	24	6	FAIR
185	1005.346	LHS	OUTER	25/11/2022 07:51:01	560.0	40.0	0.252	0.211	0.178	0.143	0.112	0.074	0.053	0.043	0.032	28	6	FAIR
186	1005.601	LHS	INNER	26/11/2022 07:50:47	560.0	40.0	0.109	0.095	0.082	0.072	0.061	0.043	0.034	0.024	0.021	24.1	6	FAIR
187	1005.705	LHS	OUTER	25/11/2022 07:52:31	560.0	40.0	0.253	0.225	0.184	0.162	0.129	0.092	0.079	0.059	0.033	28	6	FAIR
188	1006.005	LHS	OUTER	25/11/2022 07:53:50	560.0	40.0	0.304	0.268	0.225	0.197	0.165	0.122	0.092	0.065	0.021	28.1	6	FAIR
189	1006.105	LHS	INNER	26/11/2022 07:52:15	560.0	40.0	0.134	0.099	0.083	0.065	0.048	0.031	0.023	0.019	0.017	24.1	6	FAIR
190	1006.359	LHS	OUTER	25/11/2022 07:55:22	560.0	40.0	0.113	0.098	0.085	0.075	0.065	0.048	0.038	0.031	0.023	28.2	6	FAIR
191	1006.629	LHS	INNER	26/11/2022 07:53:49	560.0	40.0	0.156	0.128	0.107	0.086	0.072	0.052	0.038	0.028	0.027	24.1	6	FAIR
192	1006.719	LHS	OUTER	25/11/2022 07:56:45	560.0	40.0	0.098	0.086	0.082	0.072	0.065	0.050	0.039	0.030	0.029	28.2	6	FAIR
193	1007.019	LHS	OUTER	25/11/2022 07:58:12	560.0	40.0	0.152	0.134	0.125	0.106	0.092	0.068	0.049	0.038	0.035	28.3	6	FAIR
194	1007.139	LHS	INNER	26/11/2022 07:55:12	560.0	40.0	0.159	0.132	0.110	0.090	0.070	0.050	0.037	0.033	0.028	24.1	6	FAIR
195	1007.357	LHS	OUTER	25/11/2022 07:59:47	560.0	40.0	0.187	0.155	0.128	0.103	0.080	0.055	0.038	0.029	0.022	28.9	6	FAIR
196	1007.611	LHS	INNER	26/11/2022 07:56:47	560.0	40.0	0.306	0.263	0.212	0.184	0.169	0.122	0.081	0.066	0.030	24.1	6	FAIR
197	1007.700	LHS	OUTER	25/11/2022 08:01:26	560.0	40.0	0.122	0.109	0.101	0.087	0.076	0.060	0.048	0.039	0.029	29	6	FAIR
198	1008.012	LHS	OUTER	25/11/2022 08:02:47	560.0	40.0	0.186	0.166	0.148	0.125	0.097	0.073	0.054	0.037	0.022	29.4	6	GOOD
199	1008.102	LHS	INNER	26/11/2022 07:58:18	560.0	40.0	0.104	0.086	0.079	0.077	0.061	0.047	0.042	0.034	0.030	24.1	6	GOOD
200	1008.603	LHS	INNER	26/11/2022 07:59:43	560.0	40.0	0.151	0.128	0.105	0.100	0.085	0.061	0.049	0.039	0.015	24.1	6	GOOD
201	1008.703	LHS	OUTER	25/11/2022 08:04:52	560.0	40.0	0.310	0.280	0.236	0.189	0.167	0.141	0.128	0.061	0.033	29.4	6	GOOD
202	1009.036	LHS	OUTER	25/11/2022 08:06:23	560.0	40.0	0.182	0.159	0.140	0.121	0.101	0.075	0.056	0.041	0.034	29.5	6	FAIR
203	1009.115	LHS	INNER	26/11/2022 08:01:20	560.0	40.0	0.121	0.098	0.093	0.066	0.057	0.039	0.028	0.022	0.020	24.2	6	FAIR
204	1009.365	LHS	OUTER	25/11/2022 08:07:46	560.0	40.0	0.236	0.198	0.163	0.117	0.096	0.059	0.048	0.038	0.034	29.6	6	FAIR
205	1009.618	LHS	INNER	26/11/2022 08:02:48	560.0	40.0	0.257	0.239	0.195	0.162	0.149	0.110	0.087	0.062	0.042	24.2	6	FAIR
206	1009.715	LHS	OUTER	25/11/2022 08:09:11	560.0	40.0	0.252	0.220	0.181	0.142	0.121	0.083	0.068	0.047	0.027	29.6	6	FAIR
207	1009.974	LHS	OUTER	25/11/2022 08:10:32	560.0	40.0	0.120	0.099	0.087	0.077	0.066	0.052	0.040	0.034	0.030	29.9	6	FAIR
208	1010.107	LHS	INNER	26/11/2022 08:04:12	560.0	40.0	0.164	0.142	0.131	0.094	0.085	0.061	0.044	0.035	0.032	24.2	6	FAIR
209	1010.345	LHS	OUTER	25/11/2022 08:12:06	560.0	40.0	0.199	0.152	0.128	0.103	0.075	0.051	0.034	0.028	0.024	29.9	6	FAIR

S.NO	Station	Side (LHS/RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)	Pavement Condition
							D1	D2	D3	D4	D5	D6	D7	D8	D9			
210	1010.607	LHS	INNER	26/11/2022 08:05:39	560.0	40.0	0.136	0.107	0.095	0.083	0.063	0.047	0.029	0.020	0.013	24.2	6	FAIR
211	1010.707	LHS	OUTER	25/11/2022 08:14:11	560.0	40.0	0.301	0.263	0.211	0.166	0.147	0.116	0.089	0.069	0.037	29.9	6	FAIR
212	1011.000	LHS	OUTER	25/11/2022 08:15:40	560.0	40.0	0.204	0.189	0.169	0.143	0.123	0.102	0.083	0.062	0.040	30.2	6	FAIR
213	1011.119	LHS	INNER	26/11/2022 08:07:04	560.0	40.0	0.120	0.103	0.097	0.083	0.070	0.052	0.038	0.029	0.026	24.2	6	FAIR
214	1011.361	LHS	OUTER	25/11/2022 08:17:15	560.0	40.0	0.111	0.094	0.087	0.063	0.053	0.040	0.026	0.021	0.018	30.3	6	FAIR
215	1011.610	LHS	INNER	26/11/2022 08:08:55	560.0	40.0	0.258	0.217	0.185	0.167	0.144	0.113	0.087	0.062	0.031	24.3	6	FAIR
216	1011.714	LHS	OUTER	25/11/2022 08:18:41	560.0	40.0	0.091	0.087	0.069	0.058	0.050	0.030	0.025	0.023	0.023	30.6	6	FAIR
217	1012.015	LHS	OUTER	25/11/2022 08:20:01	560.0	40.0	0.124	0.101	0.086	0.072	0.058	0.038	0.028	0.022	0.021	30.7	6	FAIR
218	1012.105	LHS	INNER	26/11/2022 08:10:24	560.0	40.0	0.055	0.045	0.040	0.038	0.036	0.029	0.026	0.025	0.017	24.3	6	FAIR
219	1012.355	LHS	OUTER	25/11/2022 08:21:35	560.0	40.0	0.120	0.099	0.089	0.075	0.060	0.040	0.028	0.020	0.015	30.8	6	FAIR
220	1012.593	LHS	INNER	26/11/2022 08:13:34	560.0	40.0	0.391	0.320	0.271	0.211	0.162	0.108	0.080	0.055	0.042	24.3	6	FAIR
221	1012.712	LHS	OUTER	25/11/2022 08:23:08	560.0	40.0	0.239	0.188	0.167	0.134	0.112	0.074	0.050	0.040	0.036	31	6	FAIR
222	1012.979	LHS	OUTER	25/11/2022 08:25:59	560.0	40.0	0.150	0.123	0.113	0.103	0.085	0.060	0.051	0.044	0.034	31.1	6	FAIR

				E-values & Remaining Life Analysis: On LHS Direction: Pkg-2 Rakhaldubi to Kaljha (NH-27)													
S.NO	Station	Side (LHS/RHS)	Lane	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections	
				E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
1	962.350	LHS	OUTER	400	1500	100	500	30	120	300	450	1116.1	362.4	120	1.21	1347.0	303.3	104.0
2	962.606	LHS	INNER	400	1500	100	500	30	120	300	450	617.2	189.5	120	0.78	484.1	164.5	104.0
3	962.738	LHS	OUTER	400	1500	100	500	30	120	300	450	1449.5	494.5	119.9	1.16	1684.3	392.6	104.0
4	963.000	LHS	OUTER	400	1500	100	500	30	120	300	450	1201.1	478.1	120	1.16	1389.1	382.0	104.0
5	963.101	LHS	INNER	400	1500	100	500	30	120	300	450	915.1	114.5	120	0.78	714.7	89.4	104.0
6	963.359	LHS	OUTER	400	1500	100	500	30	120	300	450	1134.4	493.7	120	1.13	1281.8	392.0	104.0
7	963.600	LHS	INNER	400	1500	100	500	30	120	300	450	1415.1	496.5	120	0.77	1096.2	393.8	104.0
8	963.729	LHS	OUTER	400	1500	100	500	30	120	300	450	1224.7	207.1	120	1.10	1352.2	180.3	104.0
9	964.105	LHS	INNER	400	1500	100	500	30	120	300	450	600	100	108.6	0.77	464.8	72.9	94.2
10	964.348	LHS	OUTER	400	1500	100	500	30	120	300	450	1486	494.1	119.8	1.10	1633.2	392.3	103.9
11	964.608	LHS	INNER	400	1500	100	500	30	120	300	450	1487.1	491.8	119.9	0.76	1133.1	390.8	104.0
12	964.710	LHS	OUTER	400	1500	100	500	30	120	300	450	1475.3	490.2	120	1.01	1495.0	389.8	104.0
13	965.013	LHS	OUTER	400	1500	100	500	30	120	300	450	1463.4	112.9	119.6	0.98	1431.5	87.6	103.7
14	965.109	LHS	INNER	400	1500	100	500	30	120	300	450	1206.5	245.5	120	0.75	908.0	213.3	104.0
15	970.120	LHS	INNER	400	1500	100	500	30	120	230	470	651.6	116	120	0.75	486.4	91.1	104.0
16	970.357	LHS	OUTER	400	1500	100	500	30	120	230	470	1440.9	498.8	120	0.92	1326.4	395.3	104.0
17	970.596	LHS	INNER	400	1500	100	500	30	120	230	470	1486	273.6	120	0.75	1109.2	236.2	104.0
18	970.704	LHS	OUTER	400	1500	100	500	30	120	230	470	1479.6	495.3	119.9	0.91	1350.3	393.1	104.0
19	971.640	LHS	INNER	400	1500	100	500	30	120	230	470	1486	496.5	119.9	0.74	1104.6	393.8	104.0
20	971.762	LHS	OUTER	400	1500	100	500	30	120	230	470	1407.5	493	120	0.91	1284.5	391.6	104.0
21	972.027	LHS	OUTER	400	1500	100	500	30	120	230	470	1425.8	277.9	120	0.91	1301.2	239.6	104.0
22	972.114	LHS	INNER	400	1500	100	500	30	120	230	470	1478.5	288.5	114.5	0.74	1094.6	248.0	99.3

S.NO	Station	Side (LHS/RHS)	Lane	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
				E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
23	972.390	LHS	OUTER	400	1500	100	500	30	120	230	470	1469.9	500	120	0.91	1341.5	396.1	104.0
24	972.597	LHS	INNER	400	1500	100	500	30	120	230	470	1468.8	497.7	120	0.73	1078.5	394.6	104.0
25	972.707	LHS	OUTER	400	1500	100	500	30	120	230	470	1461.3	497.7	119.6	0.91	1327.9	394.6	103.7
26	973.000	LHS	OUTER	400	1500	100	500	30	120	230	470	1455.9	495.3	120	0.91	1323.0	393.1	104.0
27	973.119	LHS	INNER	400	1500	100	500	30	120	230	470	1478.5	262.3	120	0.73	1081.2	227.1	104.0
28	973.354	LHS	OUTER	400	1500	100	500	30	120	230	470	1496.8	492.2	120	0.90	1354.4	391.1	104.0
29	973.586	LHS	INNER	400	1500	100	500	30	120	230	470	1489.2	494.9	119.9	0.73	1084.5	392.8	104.0
30	973.703	LHS	OUTER	400	1500	100	500	30	120	230	470	1466.7	295.9	119.9	0.90	1327.1	253.7	104.0
31	974.013	LHS	OUTER	400	1500	100	500	30	120	230	470	1490.3	500	119.7	0.90	1342.7	396.1	103.8
32	974.100	LHS	INNER	400	1500	100	500	30	120	230	470	587.1	152	120	0.72	422.3	128.7	104.0
33	974.353	LHS	OUTER	400	1500	100	500	30	120	230	470	1493.5	480.4	120	0.90	1339.9	383.5	104.0
34	974.600	LHS	INNER	400	1500	100	500	30	120	230	470	1406.5	499.2	120	0.72	1007.7	395.6	104.0
35	974.701	LHS	OUTER	400	1500	100	500	30	120	230	470	655.9	238	120	0.90	588.4	207.0	104.0
36	975.016	LHS	OUTER	400	1500	100	500	30	120	230	470	973.1	310.8	120	0.90	873.0	265.2	104.0
37	975.098	LHS	INNER	400	1500	100	500	30	120	230	470	907.5	219.6	120	0.72	650.2	191.3	104.0
38	975.371	LHS	OUTER	400	1500	100	500	30	120	230	470	1191.4	322.5	120	0.90	1068.8	274.0	104.0
39	975.601	LHS	INNER	400	1500	100	500	30	120	230	470	769.9	130.9	120	0.71	547.1	107.1	104.0
40	975.709	LHS	OUTER	400	1500	100	500	30	120	230	470	855.9	148.5	120	0.89	764.6	125.2	104.0
41	975.999	LHS	OUTER	400	1500	100	500	30	120	230	470	1472	473.8	119.9	0.89	1309.4	379.2	104.0
42	976.100	LHS	INNER	400	1500	100	500	30	120	230	470	976.3	423.4	120	0.71	690.9	345.8	104.0
43	976.359	LHS	OUTER	400	1500	100	500	30	120	230	470	1496.8	500	120	0.89	1331.4	396.1	104.0
44	976.605	LHS	INNER	400	1500	100	500	30	120	230	470	1479.6	497.7	120	0.70	1034.4	394.6	104.0
45	976.705	LHS	OUTER	400	1500	100	500	30	120	230	470	1192.5	476.9	120	0.89	1060.7	381.2	104.0

S.NO	Station	Side (LHS/RHS)	Lane	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
				E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
46	977.019	LHS	OUTER	400	1500	100	500	30	120	210	530	1400	480.8	120	0.89	1245.3	383.8	104.0
47	977.114	LHS	INNER	400	1500	100	500	30	120	210	530	1490.3	494.5	119.8	0.70	1037.6	392.6	103.9
48	977.353	LHS	OUTER	400	1500	100	500	30	120	210	530	1494.6	496.9	120	0.88	1318.2	394.1	104.0
49	977.573	LHS	INNER	400	1500	100	500	30	120	210	530	1465.6	486.7	119.9	0.69	1016.3	387.6	104.0
50	977.700	LHS	OUTER	400	1500	100	500	30	120	210	530	1479.6	499.6	119.9	0.88	1305.0	395.8	104.0
51	978.006	LHS	OUTER	400	1500	100	500	30	120	210	530	1492.5	499.6	119.9	0.88	1316.3	395.8	104.0
52	978.112	LHS	INNER	400	1500	100	500	30	120	210	530	1441.9	499.2	120	0.68	987.7	395.6	104.0
53	978.352	LHS	OUTER	400	1500	100	500	30	120	210	530	1414	500	119.7	0.88	1247.1	396.1	103.8
54	978.609	LHS	INNER	400	1500	100	500	30	120	210	530	1464.5	496.9	119.8	0.68	1003.1	394.1	103.9
55	978.708	LHS	OUTER	400	1500	100	500	30	120	210	530	949.5	246.2	120	0.88	837.4	213.9	104.0
56	979.006	LHS	OUTER	400	1500	100	500	30	120	210	530	1468.8	489.4	120	0.88	1290.0	389.3	104.0
57	979.098	LHS	INNER	400	1500	100	500	30	120	210	530	1061.3	154	120	0.68	724.0	130.7	104.0
58	979.352	LHS	OUTER	400	1500	100	500	30	120	210	530	1486	483.2	120	0.88	1305.1	385.3	104.0
59	979.607	LHS	INNER	400	1500	100	500	30	120	210	530	1483.9	496.1	119.9	0.68	1012.3	393.6	104.0
60	979.704	LHS	OUTER	400	1500	100	500	30	120	210	530	1481.7	500	120	0.87	1295.8	396.1	104.0
61	980.013	LHS	OUTER	400	1500	100	500	30	120	210	530	1468.8	497.7	119.8	0.87	1284.5	394.6	103.9
62	980.110	LHS	INNER	400	1500	100	500	30	120	210	530	1498.9	496.9	119.9	0.68	1022.5	394.1	104.0
63	980.348	LHS	OUTER	400	1500	100	500	30	120	210	530	939.8	100.4	118.5	0.87	818.4	73.4	102.8
64	980.602	LHS	INNER	400	1500	100	500	30	120	210	530	1439.8	370.6	120	0.68	974.2	309.1	104.0
65	980.702	LHS	OUTER	400	1500	100	500	30	120	210	530	1439.8	496.1	119.9	0.87	1248.5	393.6	104.0
66	981.012	LHS	OUTER	400	1500	100	500	30	120	210	530	1473.1	498.8	120	0.87	1277.4	395.3	104.0
67	981.120	LHS	INNER	400	1500	100	500	30	120	210	530	1422.6	488.7	120	0.67	954.8	388.8	104.0
68	981.354	LHS	OUTER	400	1500	100	500	30	120	210	530	1458.1	497.3	120	0.87	1264.4	394.3	104.0

S.NO	Station	Side (LHS/RHS)	Lane	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
				E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
69	981.600	LHS	INNER	400	1500	100	500	30	120	210	530	1495.7	468.3	119.9	0.66	991.7	375.6	104.0
70	981.702	LHS	OUTER	400	1500	100	500	30	120	210	530	1464.5	432	120	0.87	1269.9	351.6	104.0
71	982.001	LHS	OUTER	400	1500	100	500	30	120	210	530	1492.5	493.4	120	0.86	1288.7	391.9	104.0
72	982.103	LHS	INNER	400	1500	100	500	30	120	210	530	1484.9	477.7	120	0.66	984.5	381.8	104.0
73	982.359	LHS	OUTER	400	1500	100	500	30	120	210	530	1500	495.7	120	0.86	1289.8	393.3	104.0
74	982.523	LHS	OUTER	400	1500	100	500	30	120	210	530	1496.8	487.9	120	0.86	1281.6	388.3	104.0
75	982.612	LHS	INNER	400	1500	100	500	30	120	210	530	1440.9	492.2	120	0.66	955.3	391.1	104.0
76	983.014	LHS	OUTER	400	1500	100	500	30	120	210	530	1473.1	492.2	120	0.86	1261.3	391.1	104.0
77	983.117	LHS	INNER	400	1500	100	500	30	120	210	530	1444.1	496.9	119.9	0.66	953.6	394.1	104.0
78	983.374	LHS	OUTER	400	1500	100	500	30	120	210	530	1425.8	498.8	120	0.85	1215.7	395.3	104.0
79	983.596	LHS	INNER	400	1500	100	500	30	120	210	530	1412.9	497.7	119.9	0.65	925.4	394.6	104.0
80	983.756	LHS	OUTER	400	1500	100	500	30	120	210	530	1496.8	500	119.6	0.85	1276.2	396.1	103.7
81	984.021	LHS	OUTER	400	1500	100	500	30	120	210	530	1431.2	496.5	119.8	0.85	1215.1	393.8	103.9
82	984.117	LHS	INNER	400	1500	100	500	30	120	210	530	1450.5	494.9	120	0.65	950.0	392.8	104.0
83	984.258	LHS	OUTER	400	1500	100	500	30	120	210	530	1487.1	498	119.8	0.85	1262.6	394.8	103.9
84	984.611	LHS	INNER	400	1500	100	500	30	120	210	530	1431.2	498	119.9	0.65	937.4	394.8	104.0
85	984.718	LHS	OUTER	400	1500	100	500	30	120	210	530	1488.2	495.3	119.8	0.84	1252.9	393.1	103.9
86	985.027	LHS	OUTER	400	1500	100	500	30	120	210	530	1474.2	496.5	120	0.84	1241.2	393.8	104.0
87	985.125	LHS	INNER	400	1500	100	500	30	120	210	530	1458.1	498.4	119.7	0.65	951.1	395.0	103.8
88	985.369	LHS	OUTER	400	1500	100	500	30	120	210	530	1498.9	498.8	119.9	0.84	1256.7	395.3	104.0
89	985.643	LHS	INNER	400	1500	100	500	30	120	210	530	1436.6	499.6	120	0.65	937.1	395.8	104.0
90	985.740	LHS	OUTER	400	1500	100	500	30	120	210	530	1436.6	493.7	119.8	0.83	1199.4	392.0	103.9
91	986.041	LHS	OUTER	400	1500	100	500	30	120	210	530	1445.2	496.9	119.8	0.83	1206.6	394.1	103.9

S.NO	Station	Side (LHS/RHS)	Lane	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
				E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
92	986.126	LHS	INNER	400	1500	100	500	30	120	210	530	1441.9	498.8	120	0.65	940.6	395.3	104.0
93	986.607	LHS	INNER	400	1500	100	500	30	120	210	530	1462.4	496.9	119.9	0.65	950.1	394.1	104.0
94	986.721	LHS	OUTER	400	1500	100	500	30	120	210	530	1490.3	496.9	119.8	0.83	1244.2	394.1	103.9
95	987.040	LHS	OUTER	400	1500	100	500	30	120	230	450	1479.6	498	119.9	0.83	1235.3	394.8	104.0
96	987.111	LHS	INNER	400	1500	100	500	30	120	230	450	1475.3	498.4	120	0.65	954.6	395.0	104.0
97	987.392	LHS	OUTER	400	1500	100	500	30	120	230	450	1486	496.9	120	0.83	1240.6	394.1	104.0
98	987.598	LHS	INNER	400	1500	100	500	30	120	230	450	1486	498.8	120	0.65	961.5	395.3	104.0
99	987.736	LHS	OUTER	400	1500	100	500	30	120	230	450	1292.5	105.1	120	0.83	1079.1	78.8	104.0
100	988.029	LHS	OUTER	400	1500	100	500	30	120	230	450	1471	496.1	120	0.83	1228.1	393.6	104.0
101	988.108	LHS	INNER	400	1500	100	500	30	120	230	450	1496.8	498.8	119.6	0.65	968.5	395.3	103.7
102	988.361	LHS	OUTER	400	1500	100	500	30	120	230	450	1452.7	500	119.9	0.83	1207.8	396.1	104.0
103	988.616	LHS	INNER	400	1500	100	500	30	120	230	450	1481.7	486.7	120	0.65	958.7	387.6	104.0
104	988.705	LHS	OUTER	400	1500	100	500	30	120	230	450	1495.7	494.5	120	0.83	1238.3	392.6	104.0
105	989.015	LHS	OUTER	400	1500	100	500	30	120	230	450	1483.9	498.8	119.6	0.83	1228.5	395.3	103.7
106	989.115	LHS	INNER	400	1500	100	500	30	120	230	450	1481.7	497.3	119.9	0.64	954.8	394.3	104.0
107	989.357	LHS	OUTER	400	1500	100	500	30	120	230	450	1454.8	499.6	119.7	0.83	1204.4	395.8	103.8
108	989.602	LHS	INNER	400	1500	100	500	30	120	230	450	1500	489.1	119.9	0.64	962.7	389.1	104.0
109	989.704	LHS	OUTER	400	1500	100	500	30	120	230	450	1492.5	496.9	119.6	0.83	1235.7	394.1	103.7
110	990.057	LHS	OUTER	400	1500	100	500	30	120	230	450	1462.4	494.9	119.9	0.82	1205.7	392.8	104.0
111	990.115	LHS	INNER	400	1500	100	500	30	120	230	450	1480.6	500	119.9	0.64	946.4	396.1	104.0
112	990.355	LHS	OUTER	400	1500	100	500	30	120	230	450	1464.5	498.8	119.9	0.82	1207.4	395.3	104.0
113	990.601	LHS	INNER	400	1500	100	500	30	120	230	450	1166.7	375.7	120	0.64	742.7	312.8	104.0
114	990.693	LHS	OUTER	400	1500	100	500	30	120	230	450	1458.1	500	119.5	0.82	1202.1	396.1	103.6

S.NO	Station	Side (LHS/RHS)	Lane	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
				E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
115	991.092	LHS	OUTER	400	1500	100	500	30	120	230	450	1497.8	488.3	120	0.82	1224.6	388.6	104.0
116	991.105	LHS	INNER	400	1500	100	500	30	120	230	450	1437.6	495.7	120	0.63	911.4	393.3	104.0
117	991.384	LHS	OUTER	400	1500	100	500	30	120	230	450	1459.1	496.9	119.9	0.82	1192.9	394.1	104.0
118	991.606	LHS	INNER	400	1500	100	500	30	120	230	450	1483.9	498	120	0.63	940.8	394.8	104.0
119	991.732	LHS	OUTER	400	1500	100	500	30	120	230	450	1488.2	493.7	119.8	0.78	1157.6	392.0	103.9
120	992.000	LHS	OUTER	750	3000	100	500	30	120	230	450	2892.2	498	120	0.66	1909.8	394.8	104.0
121	992.187	LHS	INNER	750	3000	100	500	30	120	230	450	2868	498.8	120	0.62	1767.2	395.3	104.0
122	992.343	LHS	OUTER	750	3000	100	500	30	120	230	450	2832.8	496.5	120	0.66	1870.6	393.8	104.0
123	992.651	LHS	INNER	750	3000	100	500	30	120	230	450	2916.4	499.2	120	0.62	1797.0	395.6	104.0
124	992.698	LHS	OUTER	750	3000	100	500	30	120	230	450	1643	128.5	120	0.66	1089.3	104.6	104.0
125	992.954	LHS	OUTER	750	3000	100	500	30	120	230	450	1900.3	319	120	0.66	1259.9	271.4	104.0
126	993.111	LHS	INNER	750	3000	100	500	30	120	230	450	2126.8	134.4	120	0.62	1310.5	110.8	104.0
127	993.356	LHS	OUTER	750	3000	100	500	30	120	230	450	2828.4	495.3	120	0.67	1882.9	393.1	104.0
128	993.587	LHS	INNER	750	3000	100	500	30	120	230	450	2938.4	492.6	119.8	0.62	1818.0	391.3	103.9
129	993.713	LHS	OUTER	750	3000	100	500	30	120	230	450	2604.1	495.3	120	0.67	1747.8	393.1	104.0
130	994.000	LHS	OUTER	750	3000	100	500	30	120	230	450	1717.7	210.7	120	0.67	1157.6	183.5	104.0
131	994.104	LHS	INNER	750	3000	100	500	30	120	230	450	2984.6	495.7	120	0.62	1846.5	393.3	104.0
132	994.353	LHS	OUTER	750	3000	100	500	30	120	230	450	2934	487.5	120	0.68	1985.3	388.1	104.0
133	994.596	LHS	INNER	750	3000	100	500	30	120	230	450	2305	293.2	120	0.62	1426.1	251.6	104.0
134	994.710	LHS	OUTER	750	3000	100	500	30	120	230	450	2643.7	495.7	120	0.68	1788.9	393.3	104.0
135	995.011	LHS	OUTER	400	1500	100	500	30	120	230	450	1446.2	496.9	120	0.68	978.6	394.1	104.0
136	995.101	LHS	INNER	400	1500	100	500	30	120	230	450	1498.9	498.8	119.9	0.62	931.1	395.3	104.0
137	995.360	LHS	OUTER	400	1500	100	500	30	120	230	450	1489.2	494.1	119.9	0.68	1007.7	392.3	104.0

S.NO	Station	Side (LHS/RHS)	Lane	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
				E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
138	995.600	LHS	INNER	400	1500	100	500	30	120	230	450	1496.8	496.9	119.6	0.62	929.8	394.1	103.7
139	995.706	LHS	OUTER	400	1500	100	500	30	120	230	450	1377.4	354.2	120	0.68	939.6	297.4	104.0
140	996.376	LHS	OUTER	750	3000	100	500	30	120	230	450	2294	175.9	119.9	0.68	1571.3	151.8	104.0
141	996.600	LHS	INNER	750	3000	100	500	30	120	230	450	2832.8	499.6	120	0.62	1759.8	395.8	104.0
142	996.700	LHS	OUTER	750	3000	100	500	30	120	230	450	1251.5	104.7	119.6	0.69	860.7	78.4	103.7
143	997.016	LHS	OUTER	750	3000	100	500	30	120	230	450	2777.9	497.7	120	0.70	1934.1	394.6	104.0
144	997.108	LHS	INNER	750	3000	100	500	30	120	230	450	1552.8	193.5	120	0.62	964.6	168.1	104.0
145	997.351	LHS	OUTER	750	3000	100	500	30	120	250	450	2964.8	500	119.9	0.70	2064.2	396.1	104.0
146	997.597	LHS	INNER	750	3000	100	500	30	120	250	450	1669.4	437.8	120	0.62	1037.1	355.5	104.0
147	997.705	LHS	OUTER	750	3000	100	500	30	120	250	450	2815.2	485.9	120	0.70	1960.1	387.0	104.0
148	998.008	LHS	OUTER	750	3000	100	500	30	120	250	450	2692.1	498.4	120	0.70	1889.7	395.0	104.0
149	998.110	LHS	INNER	750	3000	100	500	30	120	250	450	2962.6	492.6	119.8	0.62	1840.4	391.3	103.9
150	998.345	LHS	OUTER	750	3000	100	500	30	120	250	450	1673.8	231.8	120	0.70	1174.9	201.8	104.0
151	998.612	LHS	INNER	750	3000	100	500	30	120	250	450	2967	493.7	119.7	0.62	1850.7	392.0	103.8
152	998.708	LHS	OUTER	750	3000	100	500	30	120	250	450	1649.6	213.8	120	0.70	1162.7	186.2	104.0
153	999.063	LHS	OUTER	750	3000	100	500	30	120	250	450	1209.7	200.5	120	0.71	856.1	174.5	104.0
154	999.126	LHS	INNER	750	3000	100	500	30	120	250	450	2982.4	494.1	120	0.62	1860.3	392.3	104.0
155	999.359	LHS	OUTER	750	3000	100	500	30	120	250	450	2773.5	497.3	120	0.71	1962.8	394.3	104.0
156	999.603	LHS	INNER	750	3000	100	500	30	120	250	450	1522	284.9	120	0.62	949.3	245.1	104.0
157	999.713	LHS	OUTER	750	3000	100	500	30	120	250	450	2993.4	496.1	120	0.71	2118.4	393.6	104.0
158	1000.018	LHS	OUTER	400	1500	100	500	30	120	250	450	1471	489.8	120	0.71	1045.3	389.5	104.0
159	1000.100	LHS	INNER	400	1500	100	500	30	120	250	450	1403.2	498	119.9	0.63	878.8	394.8	104.0
160	1000.356	LHS	OUTER	400	1500	100	500	30	120	250	450	1344.1	494.5	119.9	0.71	959.0	392.6	104.0

S.NO	Station	Side (LHS/RHS)	Lane	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
				E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
161	1000.603	LHS	INNER	400	1500	100	500	30	120	250	450	1387.1	365.1	120	0.63	868.7	305.2	104.0
162	1000.704	LHS	OUTER	400	1500	100	500	30	120	250	450	1490.3	332.6	120	0.72	1072.1	281.5	104.0
163	1001.039	LHS	OUTER	400	1500	100	500	30	120	250	450	1491.4	494.9	119.9	0.72	1077.3	392.8	104.0
164	1001.103	LHS	INNER	400	1500	100	500	30	120	250	450	436.6	246.6	120	0.63	274.6	214.2	104.0
165	1001.358	LHS	OUTER	400	1500	100	500	30	120	250	450	641.9	243.9	120	0.72	463.7	212.0	104.0
166	1001.604	LHS	INNER	400	1500	100	500	30	120	250	450	1488.2	497.3	120	0.63	935.9	394.3	104.0
167	1001.711	LHS	OUTER	400	1500	100	500	30	120	250	450	1498.9	496.1	120	0.72	1082.7	393.6	104.0
168	1002.026	LHS	OUTER	400	1500	100	500	30	120	250	450	1500	475	120	0.73	1087.9	380.0	104.0
169	1002.115	LHS	INNER	400	1500	100	500	30	120	250	450	1455.9	497.7	119.9	0.63	915.5	394.6	104.0
170	1002.353	LHS	OUTER	400	1500	100	500	30	120	250	450	1430.1	480.4	120	0.73	1037.2	383.5	104.0
171	1002.609	LHS	INNER	400	1500	100	500	30	120	250	450	1478.5	495.7	120	0.63	929.8	393.3	104.0
172	1002.710	LHS	OUTER	400	1500	100	500	30	120	250	450	1260.2	115.6	120	0.73	917.8	90.6	104.0
173	1003.012	LHS	OUTER	400	1500	100	500	30	120	250	450	1469.9	494.1	119.9	0.73	1070.5	392.3	104.0
174	1003.099	LHS	INNER	400	1500	100	500	30	120	250	450	1481.7	469.9	120	0.63	931.8	376.7	104.0
175	1003.350	LHS	OUTER	400	1500	100	500	30	120	250	450	1267.7	156.3	120	0.73	923.2	133.0	104.0
176	1003.598	LHS	INNER	400	1500	100	500	30	120	250	450	1486	494.5	120	0.63	934.5	392.6	104.0
177	1003.709	LHS	OUTER	400	1500	100	500	30	120	250	450	1448.4	496.9	120	0.73	1059.2	394.1	104.0
178	1004.001	LHS	OUTER	400	1500	100	500	30	120	250	450	1477.4	495.3	120	0.73	1080.4	393.1	104.0
179	1004.117	LHS	INNER	400	1500	100	500	30	120	250	450	1394.6	496.9	120	0.63	880.6	394.1	104.0
180	1004.363	LHS	OUTER	400	1500	100	500	30	120	250	450	1372	146.9	120	0.74	1011.5	123.6	104.0
181	1004.600	LHS	INNER	400	1500	100	500	30	120	250	450	1497.8	497.7	119.9	0.63	945.7	394.6	104.0
182	1004.717	LHS	OUTER	400	1500	100	500	30	120	250	450	1489.2	485.1	119.7	0.74	1098.0	386.5	103.8
183	1005.006	LHS	OUTER	400	1500	100	500	30	120	250	450	1494.6	499.2	120	0.74	1106.5	395.6	104.0

S.NO	Station	Side (LHS/RHS)	Lane	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
				E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
184	1005.115	LHS	INNER	400	1500	100	500	30	120	250	450	1496.8	498	119.8	0.63	945.1	394.8	103.9
185	1005.346	LHS	OUTER	400	1500	100	500	30	120	250	450	1374.2	379.2	120	0.74	1021.5	315.2	104.0
186	1005.601	LHS	INNER	400	1500	100	500	30	120	250	450	1495.7	494.5	119.9	0.63	948.3	392.6	104.0
187	1005.705	LHS	OUTER	400	1500	100	500	30	120	250	450	1484.9	259.9	120	0.74	1103.8	225.1	104.0
188	1006.005	LHS	OUTER	400	1500	100	500	30	120	250	450	1371	104.3	120	0.75	1023.3	77.9	104.0
189	1006.105	LHS	INNER	400	1500	100	500	30	120	250	450	1434.4	498	120	0.63	909.4	394.8	104.0
190	1006.359	LHS	OUTER	400	1500	100	500	30	120	250	450	1469.9	498	120	0.75	1101.7	394.8	104.0
191	1006.629	LHS	INNER	400	1500	100	500	30	120	250	450	1460.2	489.4	119.9	0.63	925.8	389.3	104.0
192	1006.719	LHS	OUTER	400	1500	100	500	30	120	250	450	1474.2	499.6	119.6	0.75	1104.9	395.8	103.7
193	1007.019	LHS	OUTER	400	1500	100	500	30	120	250	450	1491.4	493.4	120	0.75	1122.4	391.9	104.0
194	1007.139	LHS	INNER	400	1500	100	500	30	120	250	450	1443	491.4	120	0.63	914.8	390.6	104.0
195	1007.357	LHS	OUTER	400	1500	100	500	30	120	250	450	1487.1	498.4	120	0.77	1147.2	395.0	104.0
196	1007.611	LHS	INNER	400	1500	100	500	30	120	250	500	1483.9	128.2	120	0.63	940.8	104.2	104.0
197	1007.700	LHS	OUTER	400	1500	100	500	30	120	250	500	1465.6	493.7	120	0.77	1135.3	392.0	104.0
198	1008.012	LHS	OUTER	750	3000	100	500	30	120	250	500	2740.5	498.4	120	0.79	2158.3	395.0	104.0
199	1008.102	LHS	INNER	750	3000	100	500	30	120	250	500	2962.6	494.5	120	0.63	1878.3	392.6	104.0
200	1008.603	LHS	INNER	750	3000	100	500	30	120	250	500	2883.4	495.7	120	0.63	1828.0	393.3	104.0
201	1008.703	LHS	OUTER	750	3000	100	500	30	120	250	500	1704.5	100.4	119.9	0.79	1342.4	73.4	104.0
202	1009.036	LHS	OUTER	400	1500	100	500	30	120	250	500	1488.2	487.1	120	0.79	1176.9	387.8	104.0
203	1009.115	LHS	INNER	400	1500	100	500	30	120	250	500	1475.3	496.1	119.7	0.64	939.1	393.6	103.8
204	1009.365	LHS	OUTER	400	1500	100	500	30	120	250	500	1488.2	499.2	119.9	0.79	1181.8	395.6	104.0
205	1009.618	LHS	INNER	400	1500	100	500	30	120	250	500	1491.4	204.8	119.5	0.64	949.4	178.3	103.6
206	1009.715	LHS	OUTER	400	1500	100	500	30	120	250	500	1411.8	297.5	120	0.79	1121.1	255.0	104.0
207	1009.974	LHS	OUTER	400	1500	100	500	30	120	250	500	1469.9	495.7	119.7	0.80	1181.9	393.3	103.8
208	1010.107	LHS	INNER	400	1500	100	500	30	120	250	500	1439.8	498.8	120	0.64	916.5	395.3	104.0
209	1010.345	LHS	OUTER	400	1500	100	500	30	120	250	500	1447.3	496.5	120	0.80	1163.7	393.8	104.0

S.NO	Station	Side (LHS/RHS)	Lane	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
				E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
210	1010.607	LHS	INNER	400	1500	100	500	30	120	250	500	1493.5	493	120	0.64	950.7	391.6	104.0
211	1010.707	LHS	OUTER	400	1500	100	500	30	120	250	500	1494.6	145.4	120	0.80	1201.8	122.1	104.0
212	1011.000	LHS	OUTER	400	1500	100	500	30	120	250	500	1495.7	382.3	120	0.81	1217.8	317.4	104.0
213	1011.119	LHS	INNER	400	1500	100	500	30	120	250	500	1490.3	488.3	120	0.64	948.7	388.6	104.0
214	1011.361	LHS	OUTER	400	1500	100	500	30	120	250	500	1374.2	499.6	120	0.82	1123.5	395.8	104.0
215	1011.610	LHS	INNER	400	1500	100	500	30	120	250	500	1467.7	213.4	120	0.64	938.1	185.9	104.0
216	1011.714	LHS	OUTER	400	1500	100	500	30	120	250	500	1452.7	494.1	120	0.83	1202.7	392.3	104.0
217	1012.015	LHS	OUTER	400	1500	100	500	30	120	250	500	1460.2	494.5	119.9	0.83	1214.0	392.6	104.0
218	1012.105	LHS	INNER	400	1500	100	500	30	120	250	500	1489.2	499.2	119.6	0.64	951.9	395.6	103.7
219	1012.355	LHS	OUTER	400	1500	100	500	30	120	250	500	1493.5	498.4	120	0.83	1246.9	395.0	104.0
220	1012.593	LHS	INNER	400	1500	100	500	30	120	250	500	954.8	106.3	120	0.64	610.3	80.2	104.0
221	1012.712	LHS	OUTER	400	1500	100	500	30	120	250	500	1477.4	482.4	120	0.84	1243.8	384.8	104.0
222	1012.979	LHS	OUTER	400	1500	100	500	30	120	250	500	1483.9	496.9	119.7	0.85	1254.6	394.1	103.8

					E-values & Remaining Life Analysis: On RHS Direction: Pkg-2 Rakhaldubi to Kaljha (NH-27)												
S.NO	Station	Side (LHS/RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)
							D1	D2	D3	D4	D5	D6	D7	D8	D9		
1	965.15	RHS	INNER	26/11/2022 09:46:19	560.0	40.0	0.47556	0.38023	0.31721	0.24371	0.17702	0.112	0.06821	0.04978	0.04114	27.9	6
2	965.349	RHS	OUTER	25/11/2022 15:50:42	560.0	40.0	0.15748	0.11924	0.09409	0.07630	0.06122	0.04624	0.03320	0.03205	0.02403	32.9	6
3	965.600	RHS	INNER	26/11/2022 09:44:22	560.0	40.0	0.22506	0.18788	0.16039	0.12993	0.10675	0.07212	0.05053	0.03203	0.03054	27.9	6
4	965.701	RHS	OUTER	25/11/2022 15:49:13	560.0	40.0	0.15646	0.11499	0.09830	0.07096	0.06097	0.04674	0.04390	0.03732	0.03221	32.9	6
5	965.993	RHS	OUTER	25/11/2022 15:47:46	560.0	40.0	0.27796	0.20375	0.16351	0.12485	0.09649	0.06374	0.04776	0.03684	0.03235	32.9	6
6	966.084	RHS	INNER	26/11/2022 09:42:48	560.0	40.0	0.30120	0.24245	0.19655	0.14830	0.11337	0.06618	0.05147	0.03975	0.03607	27.8	6
7	966.342	RHS	OUTER	25/11/2022 15:46:19	560.0	40.0	0.20245	0.13949	0.11191	0.09052	0.06876	0.04990	0.03915	0.03368	0.02834	33.3	6
8	966.576	RHS	INNER	26/11/2022 09:41:12	560.0	40.0	0.10026	0.07499	0.06229	0.05076	0.04077	0.03622	0.02940	0.02397	0.01952	27.7	6
9	966.700	RHS	OUTER	25/11/2022 15:44:45	560.0	40.0	0.16670	0.11680	0.08938	0.07364	0.06456	0.04760	0.03919	0.03477	0.03012	33.3	6
10	966.999	RHS	OUTER	25/11/2022 15:43:21	560.0	40.0	0.16658	0.13862	0.11799	0.09977	0.07770	0.05392	0.04099	0.03043	0.02875	33.6	6
11	967.049	RHS	INNER	26/11/2022 09:39:21	560.0	40.0	0.24762	0.18890	0.15262	0.12112	0.10532	0.06790	0.04896	0.03366	0.02990	27.7	6
12	967.350	RHS	OUTER	25/11/2022 15:41:52	560.0	40.0	0.22134	0.16205	0.12825	0.09480	0.07077	0.04487	0.03128	0.02490	0.01997	34.1	6
13	967.601	RHS	INNER	26/11/2022 09:37:20	560.0	40.0	0.18915	0.15049	0.12497	0.09290	0.07433	0.04337	0.03159	0.02219	0.01971	27.6	6
14	967.709	RHS	OUTER	25/11/2022 15:40:19	560.0	40.0	0.30293	0.26258	0.21766	0.18321	0.14396	0.12831	0.09006	0.07315	0.04012	34.1	6
15	968.000	RHS	OUTER	25/11/2022 15:38:52	560.0	40.0	0.18343	0.14873	0.12957	0.10593	0.08003	0.05337	0.03800	0.02903	0.02807	34.2	6
16	968.090	RHS	INNER	26/11/2022 09:35:47	560.0	40.0	0.25056	0.18053	0.14123	0.10685	0.08049	0.05064	0.03730	0.03148	0.02885	27.6	6
17	968.352	RHS	OUTER	25/11/2022 15:37:11	560.0	40.0	0.25566	0.21065	0.18816	0.16521	0.12168	0.08579	0.06362	0.03246	0.02913	34.3	6
18	968.579	RHS	INNER	26/11/2022 09:34:06	560.0	40.0	0.30452	0.25483	0.21132	0.18028	0.14050	0.11671	0.08731	0.06851	0.03670	27.5	6
19	968.584	RHS	OUTER	25/11/2022 15:35:49	560.0	40.0	0.24857	0.19810	0.17411	0.13704	0.10983	0.07812	0.05819	0.04570	0.03987	34.3	6
20	968.993	RHS	OUTER	25/11/2022 15:34:17	560.0	40.0	0.16728	0.13894	0.11718	0.09480	0.07917	0.05641	0.04326	0.03626	0.03254	34.4	6
21	969.089	RHS	INNER	26/11/2022 09:31:36	560.0	40.0	0.18394	0.16589	0.14245	0.12617	0.10519	0.08345	0.06287	0.04764	0.02396	27.4	6
22	969.343	RHS	OUTER	25/11/2022 15:32:50	560.0	40.0	0.19651	0.16149	0.13256	0.10537	0.08634	0.06525	0.04771	0.02117	0.01035	34.4	6

S.NO	Station	Side (LHS/RHS)	Lane	TIME	Stress	Load	0	200	300	450	600	900	1200	1500	1800	Pav Temp	4-day Soaked CBR (%)
							D1	D2	D3	D4	D5	D6	D7	D8	D9		
23	969.594	RHS	INNER	26/11/2022 09:30:00	560.0	40.0	0.20587	0.18867	0.16052	0.14766	0.11642	0.09736	0.06915	0.04941	0.02704	27.4	6
24	969.665	RHS	OUTER	25/11/2022 15:31:10	560.0	40.0	0.30110	0.28878	0.23770	0.19754	0.16951	0.13294	0.09915	0.06347	0.03449	34.7	6
25	970.000	RHS	OUTER	25/11/2022 15:29:33	560.0	40.0	0.31732	0.22851	0.18807	0.13888	0.10481	0.07154	0.05599	0.04241	0.03804	35.1	6
26	970.020	RHS	INNER	26/11/2022 09:27:21	560.0	40.0	0.48647	0.39009	0.28212	0.19738	0.16025	0.09536	0.07016	0.06008	0.03833	27.3	6
27	1000.940	RHS	INNER	26/11/2022 08:46:46	560.0	40.0	0.45104	0.41590	0.35437	0.30298	0.24839	0.21209	0.16857	0.09474	0.05801	26.8	6
28	1000.991	RHS	OUTER	25/11/2022 10:18:38	560.0	40.0	0.40712	0.35782	0.28337	0.24273	0.19576	0.16246	0.12676	0.08241	0.06903	33.1	6
29	1001.170	RHS	INNER	26/11/2022 08:44:54	560.0	40.0	0.67240	0.50920	0.43570	0.30829	0.21464	0.10981	0.07185	0.05648	0.04274	26.9	6
30	1001.350	RHS	OUTER	25/11/2022 10:16:44	560.0	40.0	0.33490	0.29367	0.23085	0.16794	0.12265	0.07211	0.05401	0.04312	0.03678	33.1	6
31	1001.583	RHS	INNER	26/11/2022 08:41:39	560.0	40.0	0.43929	0.29742	0.22417	0.14395	0.09475	0.05636	0.04430	0.03614	0.03084	26.9	6

				E-values & Remaining Life Analysis: On RHS Direction: Pkg-2 Rakhaldubi to Kaljha (NH-27)														
S.NO	Station	Side (LHS/RHS)	Lane	Pavement Condition	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
					E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
1	965.15	RHS	INNER	GOOD	750	3000	100	500	30	120	250	550	761	100	118.2	0.74	563.4	72.9	102.5
2	965.349	RHS	OUTER	FAIR	400	1500	100	500	30	120	250	550	1489.2	498.4	120	0.91	1359.1	395.0	104.0
3	965.600	RHS	INNER	GOOD	750	3000	100	500	30	120	250	550	1687	482	120	0.74	1248.9	384.5	104.0
4	965.701	RHS	OUTER	FAIR	400	1500	100	500	30	120	250	550	1498.9	493	119.9	0.91	1367.9	391.6	104.0
5	965.993	RHS	OUTER	FAIR	400	1500	100	500	30	120	250	550	1182.8	495.3	120	0.91	1079.5	393.1	104.0
6	966.084	RHS	INNER	GOOD	750	3000	100	500	30	120	250	550	860	339.3	120	0.74	634.1	286.5	104.0
7	966.342	RHS	OUTER	FAIR	400	1500	100	500	30	120	250	550	1468.8	498	119.9	0.93	1363.7	394.8	104.0
8	966.576	RHS	INNER	GOOD	750	3000	100	500	30	120	250	550	2953.8	498	119.8	0.73	2168.9	394.8	103.9
9	966.700	RHS	OUTER	FAIR	400	1500	100	500	30	120	250	550	1419.4	500	119.9	0.93	1317.9	396.1	104.0
10	966.999	RHS	OUTER	FAIR	400	1500	100	500	30	120	250	550	1479.6	493	120	0.94	1391.7	391.6	104.0
11	967.049	RHS	INNER	FAIR	400	1500	100	500	30	120	250	550	1298.9	497.7	120	0.73	953.7	394.6	104.0
12	967.350	RHS	OUTER	FAIR	400	1500	100	500	30	120	250	550	1447.3	498	120	0.96	1391.2	394.8	104.0
13	967.601	RHS	INNER	FAIR	400	1500	100	500	30	120	250	550	1496.8	499.2	119.8	0.73	1094.5	395.6	103.9
14	967.709	RHS	OUTER	FAIR	400	1500	100	500	30	120	250	550	1464.5	143.8	119.3	0.96	1407.8	120.5	103.4
15	968.000	RHS	OUTER	FAIR	400	1500	100	500	30	120	250	550	1495.7	494.1	120	0.97	1444.0	392.3	104.0
16	968.090	RHS	INNER	FAIR	400	1500	100	500	30	120	250	550	1496.8	497.7	120	0.73	1094.5	394.6	104.0
17	968.352	RHS	OUTER	FAIR	400	1500	100	500	30	120	250	550	1389.2	255.6	120	0.97	1347.1	221.6	104.0
18	968.579	RHS	INNER	FAIR	400	1500	100	500	30	120	250	550	1481.7	156.3	119.9	0.73	1079.1	133.0	104.0
19	968.584	RHS	OUTER	FAIR	400	1500	100	500	30	120	250	550	1334.4	392.9	120	0.97	1294.0	324.9	104.0
20	968.993	RHS	OUTER	FAIR	400	1500	100	500	30	120	250	550	1475.3	498	120	0.97	1436.9	394.8	104.0
21	969.089	RHS	INNER	GOOD	750	3000	100	500	30	120	250	550	2892.2	483.6	120	0.73	2097.7	385.6	104.0
22	969.343	RHS	OUTER	FAIR	400	1500	100	500	30	120	250	550	1477.4	478.5	120	0.97	1438.9	382.3	104.0

S.NO	Station	Side (LHS/RHS)	Lane	Pavement Condition	BT E Moduli Ranges		Granual E Moduli Ranges		Subgrade E Moduli Ranges		Crust thickness		Field Moduli			Lemda	Field Moduli After Temp & Seasonal Corrections		
					E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	E lower Bound	E Upper Bound	BT	Granular	E1	E2	E3		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Sub grade)
23	969.594	RHS	INNER	GOOD	750	3000	100	500	30	120	250	550	2632.7	302.5	120	0.73	1909.5	258.8	104.0
24	969.665	RHS	OUTER	FAIR	400	1500	100	500	30	120	250	550	1478.5	110.2	119.9	0.99	1459.1	84.6	104.0
25	970.000	RHS	OUTER	FAIR	400	1500	100	500	30	120	250	550	751.6	345.9	120	1.00	754.9	291.3	104.0
26	970.020	RHS	INNER	GOOD	750	3000	100	500	30	120	250	550	783	105.5	119.6	0.72	565.6	79.3	103.7
27	1000.940	RHS	INNER	FAIR	400	1500	100	500	30	120	480	210	415.1	101.6	74.3	0.71	293.8	74.8	63.1
28	1000.991	RHS	OUTER	FAIR	400	1500	100	500	30	120	480	210	481.7	102	82.7	0.92	443.4	75.3	71.0
29	1001.170	RHS	INNER	FAIR	400	1500	100	500	30	120	480	210	400	101.6	111.2	0.71	284.2	74.8	96.5
30	1001.350	RHS	OUTER	FAIR	400	1500	100	500	30	120	480	210	441.9	200.1	120	0.92	406.8	174.1	104.0
31	1001.583	RHS	INNER	FAIR	400	1500	100	500	30	120	480	210	400	394	120	0.71	284.2	325.6	104.0

Modulus of Subgrade Reaction & Elastic Modulus of Concrete Analysis: NH-27 Rakhaldubi - Kalijhar : LHS																	
S. No.	Chinage	Side	Lane	Test Point Location	Pressure	Radius of Loading Plate (in)	Load	Load	Deflection in (mm)				Deflection in (inches)				Poisson ratio	
					N/mm2		(KN)	(Pound)	0	300	600	900	0	300	600	900	Concrete	Subgrade
1	965.500	LHS	Outer	INTERIOR	1109.9	11.811	78.5	17624.0	0.2304	0.2195	0.1936	0.1688	0.00907087	0.00864173	0.00762205	0.00664567	0.15	0.45
2	966.005	LHS	Outer	INTERIOR	1106.6	11.811	78.3	17571.6	0.1791	0.1651	0.1529	0.1365	0.00705118	0.00650000	0.00601969	0.00537402	0.15	0.45
3	966.016	LHS	Outer	CORNER	1107.4	11.811	78.3	17584.3	0.1997	0.1838	0.1751	0.1549	0.00786220	0.00723622	0.00689370	0.00609843	0.15	0.45
4	966.506	LHS	Outer	INTERIOR	1113.8	11.811	78.8	17685.9	0.1202	0.1093	0.0987	0.0868	0.00473228	0.00430315	0.00388583	0.00341732	0.15	0.45
5	966.997	LHS	Outer	INTERIOR	1116.8	11.811	79.0	17733.5	0.1338	0.1157	0.1006	0.0868	0.00526772	0.00455512	0.00396063	0.00341732	0.15	0.45
6	967.007	LHS	Outer	CORNER	1112.2	11.811	78.6	17660.5	0.1223	0.1044	0.0975	0.0846	0.00481496	0.00411024	0.00383858	0.00333071	0.15	0.45
7	967.500	LHS	Outer	INTERIOR	1090.5	11.811	77.1	17315.9	0.1074	0.0948	0.0826	0.0728	0.00422835	0.00373228	0.00325197	0.00286614	0.15	0.45
8	968.007	LHS	Outer	INTERIOR	1180.2	11.811	83.5	18740.3	0.0922	0.0852	0.0762	0.0663	0.00362992	0.00335433	0.00300000	0.00261024	0.15	0.45
9	968.021	LHS	Outer	CORNER	1111.3	11.811	78.6	17646.2	0.1585	0.1292	0.1072	0.0862	0.00624016	0.00508661	0.00422047	0.00339370	0.15	0.45
10	968.507	LHS	Outer	INTERIOR	1112.7	11.811	78.7	17668.4	0.1225	0.1054	0.0886	0.0737	0.00482283	0.00414961	0.00348819	0.00290157	0.15	0.45
11	969.090	LHS	Outer	INTERIOR	1111.2	11.811	78.6	17644.6	0.1625	0.1534	0.1363	0.1215	0.00639764	0.00603937	0.00536614	0.00478346	0.15	0.45
12	969.021	LHS	Outer	CORNER	1106.5	11.811	78.2	17570.0	0.1251	0.1148	0.1047	0.0945	0.00492520	0.00451969	0.00412205	0.00372047	0.15	0.45
13	969.513	LHS	Outer	INTERIOR	1136.9	11.811	80.4	18052.7	0.1385	0.1235	0.1113	0.0955	0.00545276	0.00486220	0.00438189	0.00375984	0.15	0.45
14	969.994	LHS	Outer	INTERIOR	1087.5	11.811	76.9	17268.3	0.2046	0.1899	0.1668	0.1559	0.00805512	0.00747638	0.00656693	0.00613780	0.15	0.45
15	970.005	LHS	Outer	CORNER	1110.2	11.811	78.5	17628.7	0.2654	0.2424	0.2168	0.1866	0.01044882	0.00954331	0.00853543	0.00734646	0.15	0.45
16	971.010	LHS	Outer	INTERIOR	1152.9	11.811	81.5	18306.8	0.2071	0.1720	0.1518	0.1327	0.00815354	0.00677165	0.00597638	0.00522441	0.15	0.45
17	971.022	LHS	Outer	CORNER	1109.4	11.811	78.5	17616.0	0.2544	0.2414	0.2214	0.2072	0.01001575	0.00950394	0.00871654	0.00815748	0.15	0.45
18	971.512	LHS	Outer	INTERIOR	1122.9	11.811	79.4	17830.4	0.1923	0.1791	0.1584	0.1368	0.00757087	0.00705118	0.00623622	0.00538583	0.15	0.45

					Modulus of Subgrade Reaction & Elastic Modulus of Concrete Analysis: NH-27 Rakhaldubi - Kalijhar : LHS									
S. No.	Chinage	Side	Lane	Test Point Location	PQC Thickness	Area of defelection basin (inch)	Radius of relative stiffness, l (inch)	Normalised defelction, (inches)				Modulus of subgrade reaction k (MPa/m)	Elastic modulus of concrete Ec (MPa)	Strenght of concrete fc (MPa)	Flexural Strenght of concrete f_{mr} (MPa)
					mm			0	300	600	900				
1	965.500	LHS	Outer	INTERIOR	300	31.911	44.118	0.121	0.117	0.105	0.091	33.39	22,902	20.98	3.21
2	966.005	LHS	Outer	INTERIOR	300	31.879	43.865	0.121	0.117	0.105	0.090	43.03	28,846	33.28	4.04
3	966.016	LHS	Outer	CORNER	300	32.220	46.690	0.122	0.118	0.107	0.093	34.20	29,429	34.64	4.12
4	966.506	LHS	Outer	INTERIOR	300	31.098	38.414	0.120	0.116	0.101	0.084	83.53	32,935	43.39	4.61
5	966.997	LHS	Outer	INTERIOR	300	29.291	29.651	0.118	0.111	0.091	0.070	123.31	17,256	11.91	2.42
6	967.007	LHS	Outer	CORNER	300	29.961	32.406	0.119	0.113	0.095	0.075	113.17	22,599	20.43	3.16
7	967.500	LHS	Outer	INTERIOR	300	29.888	32.084	0.119	0.112	0.095	0.074	129.07	24,763	24.53	3.47
8	968.007	LHS	Outer	INTERIOR	300	31.321	39.840	0.120	0.116	0.102	0.086	107.83	49,186	96.77	6.89
9	968.021	LHS	Outer	CORNER	300	27.161	23.325	0.115	0.105	0.080	0.055	163.07	8,739	3.06	1.22
10	968.507	LHS	Outer	INTERIOR	300	28.614	27.297	0.117	0.109	0.088	0.065	157.50	15,832	10.03	2.22
11	969.090	LHS	Outer	INTERIOR	300	31.879	43.865	0.121	0.117	0.105	0.090	47.77	32,021	41.01	4.48
12	969.021	LHS	Outer	CORNER	300	31.588	41.675	0.121	0.117	0.103	0.088	67.97	37,127	55.14	5.20
13	969.513	LHS	Outer	INTERIOR	300	30.481	34.916	0.119	0.114	0.098	0.079	88.99	23,949	22.94	3.35
14	969.994	LHS	Outer	INTERIOR	300	31.493	41.005	0.121	0.116	0.103	0.087	42.10	21,549	18.57	3.02
15	970.005	LHS	Outer	CORNER	300	30.981	37.702	0.120	0.115	0.100	0.083	39.20	14,341	8.23	2.01
16	971.010	LHS	Outer	INTERIOR	300	28.606	27.273	0.117	0.109	0.088	0.065	95.92	9,608	3.69	1.35
17	971.022	LHS	Outer	CORNER	300	32.717	51.404	0.122	0.119	0.109	0.097	22.22	28,087	31.56	3.93
18	971.512	LHS	Outer	INTERIOR	300	31.329	39.894	0.120	0.116	0.102	0.086	49.15	22,540	20.32	3.16

Load Transfer Efficiency Analysis: NH-27 Rakhaldubi - Kaljhar : LHS									
S.No.	Chainage	Side	Lane	Test Point Location	Pressure	Load	0	300	LTE %
					N/mm2	KN	Loaded Slab	Unloaded Slab	
1	966.009	LHS	Outer	DOWEL	1105.7	78.2	0.1890	0.1679	88.8%
2	967.000	LHS	Outer	DOWEL	1106.8	78.3	0.1161	0.1055	90.9%
3	968.011	LHS	Outer	DOWEL	1099.9	77.8	0.0919	0.0831	90.4%
4	969.012	LHS	Outer	DOWEL	1124.2	79.5	0.1880	0.1684	89.6%
5	969.996	LHS	Outer	DOWEL	1104.8	78.1	0.3075	0.2944	95.7%
6	971.014	LHS	Outer	DOWEL	1126.7	79.7	0.2654	0.2233	84.1%

Load Transfer Efficiency Analysis: NH-27 Rakhaldubi - Kaljhar : LHS									
S.No.	Chainage	Side	Lane	Test Point Location	Pressure	Load	0	300	LTE %
					N/mm2	KN	Loaded Slab	Unloaded Slab	
1	966.022	LHS	Outer	TIE	1104.7	78.1	0.2080	0.1864	89.6%
2	967.015	LHS	Outer	TIE	1084.6	76.7	0.1084	0.0994	91.7%
3	968.026	LHS	Outer	TIE	1125.2	79.6	0.0914	0.0824	90.2%
4	969.029	LHS	Outer	TIE	1120.7	79.2	0.1418	0.1292	91.1%
5	970.014	LHS	Outer	TIE	1175.0	83.1	0.3681	0.2798	76.0%
6	971.028	LHS	Outer	TIE	1113.9	78.8	0.2780	0.2546	91.6%

					Modulus of Subgrade Reaction & Elastic Modulus of Concrete Analysis: NH-27 Rakhaldubi - Kalijhar : RHS													
S. No.	Chinage	Side	Lane	Test Point Location	Pressure	Radius of Loading Plate (in)	Load	Load	Deflection in (mm)				Deflection in (inches)				Poisson ratio	
					N/mm2		(KN)	(Pound)	0	300	600	900	0	300	600	900	Concrete	Subgrade
1	1013.000	RHS	Outer	INTERIOR	1138.8	11.811	80.5	18082.9	0.1889	0.1759	0.1677	0.1389	0.00743701	0.00692520	0.00660236	0.00546850	0.15	0.45
2	1012.990	RHS	Outer	CORNER	1128.5	11.811	79.8	17919.3	0.1677	0.1547	0.1403	0.1272	0.00660236	0.00609055	0.00552362	0.00500787	0.15	0.45
3	1012.495	RHS	Outer	INTERIOR	1139.3	11.811	80.6	18090.8	0.2995	0.2782	0.2466	0.2090	0.01179134	0.01095276	0.00970866	0.00822835	0.15	0.45
4	1011.999	RHS	Outer	INTERIOR	1119.0	11.811	79.1	17768.5	0.1326	0.1190	0.1101	0.0938	0.00522047	0.00468504	0.00433465	0.00369291	0.15	0.45
5	1011.986	RHS	Outer	CORNER	1154.9	11.811	81.7	18338.5	0.1428	0.1336	0.1193	0.0998	0.00562205	0.00525984	0.00469685	0.00392913	0.15	0.45
6	1011.489	RHS	Outer	INTERIOR	1120.0	11.811	79.2	17784.4	0.2434	0.2135	0.1787	0.1440	0.00958268	0.00840551	0.00703543	0.00566929	0.15	0.45
7	1011.001	RHS	Outer	INTERIOR	1160.6	11.811	82.1	18429.0	0.2225	0.2116	0.1833	0.1599	0.00875984	0.00833071	0.00721654	0.00629528	0.15	0.45
8	1010.987	RHS	Outer	CORNER	1125.2	11.811	79.6	17866.9	0.1430	0.1294	0.1172	0.1082	0.00562992	0.00509449	0.00461417	0.00425984	0.15	0.45
9	1010.498	RHS	Outer	INTERIOR	1140.3	11.811	80.6	18106.7	0.1771	0.1648	0.1533	0.1244	0.00697244	0.00648819	0.00603543	0.00489764	0.15	0.45
10	1009.987	RHS	Outer	INTERIOR	1146.4	11.811	81.1	18203.6	0.2376	0.2263	0.2098	0.1798	0.00935433	0.00890945	0.00825984	0.00707874	0.15	0.45
11	1009.975	RHS	Outer	CORNER	1142.2	11.811	80.8	18136.9	0.1313	0.1172	0.1066	0.0953	0.00516929	0.00461417	0.00419685	0.00375197	0.15	0.45
12	1009.494	RHS	Outer	INTERIOR	1136.0	11.811	80.3	18038.4	0.1228	0.1102	0.0980	0.0855	0.00483465	0.00433858	0.00385827	0.00336614	0.15	0.45
13	1008.998	RHS	Outer	INTERIOR	1121.9	11.811	79.3	17814.5	0.1296	0.1135	0.1041	0.0870	0.00510236	0.00446850	0.00409843	0.00342520	0.15	0.45
14	1008.983	RHS	Outer	CORNER	1129.4	11.811	79.9	17933.6	0.1347	0.1218	0.1126	0.1006	0.00530315	0.00479528	0.00443307	0.00396063	0.15	0.45
15	1008.503	RHS	Outer	INTERIOR	1140.3	11.811	80.6	18106.7	0.1139	0.1040	0.0950	0.0830	0.00448425	0.00409449	0.00374016	0.00326772	0.15	0.45
16	1007.992	RHS	Outer	INTERIOR	1156.3	11.811	81.8	18360.8	0.2120	0.2009	0.1864	0.1582	0.00834646	0.00790945	0.00733858	0.00622835	0.15	0.45
17	1007.973	RHS	Outer	CORNER	1176.6	11.811	83.2	18683.1	0.1820	0.1707	0.1367	0.1186	0.00716535	0.00672047	0.00538189	0.00466929	0.15	0.45
18	1007.504	RHS	Outer	INTERIOR	1139.3	11.811	80.6	18090.8	0.3393	0.3277	0.3080	0.2850	0.01335827	0.01290157	0.01212598	0.01122047	0.15	0.45
19	1006.983	RHS	Outer	INTERIOR	1128.9	11.811	79.8	17925.7	0.2250	0.2138	0.1909	0.1729	0.00885827	0.00841732	0.00751575	0.00680709	0.15	0.45
20	1006.970	RHS	Outer	CORNER	1146.9	11.811	81.1	18211.5	0.1551	0.1400	0.1264	0.1082	0.00610630	0.00551181	0.00497638	0.00425984	0.15	0.45
21	1006.502	RHS	Outer	INTERIOR	1146.9	11.811	81.1	18211.5	0.1537	0.1431	0.1255	0.1056	0.00605118	0.00563386	0.00494094	0.00415748	0.15	0.45
22	1005.997	RHS	Outer	INTERIOR	1142.6	11.811	80.8	18143.2	0.1531	0.1340	0.1171	0.1004	0.00602756	0.00527559	0.00461024	0.00395276	0.15	0.45
23	1005.982	RHS	Outer	CORNER	1183.1	11.811	83.7	18786.3	0.1609	0.1419	0.1255	0.1074	0.00633465	0.00558661	0.00494094	0.00422835	0.15	0.45
24	1005.484	RHS	Outer	INTERIOR	1129.4	11.811	79.9	17933.6	0.1261	0.1114	0.1097	0.0821	0.00496457	0.00438583	0.00431890	0.00323228	0.15	0.45
25	1005.001	RHS	Outer	INTERIOR	1136.0	11.811	80.3	18038.4	0.1420	0.1226	0.1057	0.0903	0.00559055	0.00482677	0.00416142	0.00355512	0.15	0.45
26	1004.988	RHS	Outer	CORNER	1166.2	11.811	82.5	18518.0	0.1375	0.1219	0.1080	0.0929	0.00541339	0.00479921	0.00425197	0.00365748	0.15	0.45
27	1004.506	RHS	Outer	INTERIOR	1128.5	11.811	79.8	17919.3	0.1631	0.1523	0.1346	0.1258	0.00642126	0.00599606	0.00529921	0.00495276	0.15	0.45
28	1003.990	RHS	Outer	INTERIOR	1131.8	11.811	80.0	17971.7	0.1435	0.1357	0.1159	0.1016	0.00564961	0.00534252	0.00456299	0.00400000	0.15	0.45
29	1003.976	RHS	Outer	CORNER	1179.4	11.811	83.4	18727.6	0.1439	0.1328	0.1216	0.0991	0.00566535	0.00522835	0.00478740	0.00390157	0.15	0.45
30	1003.504	RHS	Outer	INTERIOR	1133.7	11.811	80.2	18001.9	0.1343	0.1251	0.1128	0.0877	0.00528740	0.00492520	0.00444094	0.00345276	0.15	0.45
31	1002.987	RHS	Outer	INTERIOR	1144.1	11.811	80.9	18167.0	0.1341	0.1177	0.1052	0.0929	0.00527953	0.00463386	0.00414173	0.00365748	0.15	0.45
32	1002.975	RHS	Outer	CORNER	1112.4	11.811	78.7	17663.7	0.1888	0.1786	0.1583	0.1332	0.00743307	0.00703150	0.00623228	0.00524409	0.15	0.45
33	1002.493	RHS	Outer	INTERIOR	1143.6	11.811	80.9	18159.1	0.1349	0.1156	0.0974	0.0847	0.00531102	0.00455118	0.00383465	0.00333465	0.15	0.45

S. No.	Chinage	Side	Lane	Test Point Location	Pressure	Radius of Loading Plate (in)	Load	Load	Deflection in (mm)				Deflection in (inches)				Poisson ratio	
					N/mm2		(KN)	(Pound)	0	300	600	900	0	300	600	900	Concrete	Subgrade
34	1001.987	RHS	Outer	INTERIOR	1149.2	11.811	81.3	18248.0	0.1669	0.1504	0.1261	0.1049	0.00657087	0.00592126	0.00496457	0.00412992	0.15	0.45
35	1001.974	RHS	Outer	CORNER	1149.7	11.811	81.3	18256.0	0.1316	0.1173	0.1026	0.0855	0.00518110	0.00461811	0.00403937	0.00336614	0.15	0.45
36	1000.501	RHS	Outer	INTERIOR	1127.5	11.811	79.7	17903.5	0.1696	0.1538	0.1356	0.1084	0.00667717	0.00605512	0.00533858	0.00426772	0.15	0.45
37	999.996	RHS	Outer	INTERIOR	1116.7	11.811	79.0	17732.0	0.1315	0.1201	0.1072	0.0936	0.00517717	0.00472835	0.00422047	0.00368504	0.15	0.45
38	999.981	RHS	Outer	CORNER	1115.7	11.811	78.9	17716.1	0.1474	0.1346	0.1180	0.1035	0.00580315	0.00529921	0.00464567	0.00407480	0.15	0.45
39	999.501	RHS	Outer	INTERIOR	1141.2	11.811	80.7	18121.0	0.1607	0.1557	0.1266	0.1185	0.00632677	0.00612992	0.00498425	0.00466535	0.15	0.45
40	998.963	RHS	Outer	INTERIOR	1119.1	11.811	79.1	17770.1	0.1519	0.1412	0.1301	0.1017	0.00598031	0.00555906	0.00512205	0.00400394	0.15	0.45
41	998.950	RHS	Outer	CORNER	1120.0	11.811	79.2	17784.4	0.1651	0.1509	0.1318	0.1134	0.00650000	0.00594094	0.00518898	0.00446457	0.15	0.45
42	998.496	RHS	Outer	INTERIOR	1145.9	11.811	81.0	18195.6	0.1265	0.1167	0.1021	0.0876	0.00498031	0.00459449	0.00401969	0.00344882	0.15	0.45
43	998.005	RHS	Outer	INTERIOR	1145.9	11.811	81.0	18195.6	0.1295	0.1163	0.1004	0.0878	0.00509843	0.00457874	0.00395276	0.00345669	0.15	0.45
44	997.993	RHS	Outer	CORNER	1128.5	11.811	79.8	17919.3	0.1351	0.1226	0.1074	0.0923	0.00531890	0.00482677	0.00422835	0.00363386	0.15	0.45
45	997.499	RHS	Outer	INTERIOR	1115.8	11.811	78.9	17717.7	0.1690	0.1579	0.1349	0.1152	0.00665354	0.00621654	0.00531102	0.00453543	0.15	0.45
46	996.990	RHS	Outer	INTERIOR	1147.8	11.811	81.2	18225.8	0.1422	0.1278	0.1123	0.0954	0.00559843	0.00503150	0.00442126	0.00375591	0.15	0.45
47	996.973	RHS	Outer	CORNER	1158.7	11.811	81.9	18398.9	0.1518	0.1345	0.1183	0.1043	0.00597638	0.00529528	0.00465748	0.00410630	0.15	0.45
48	996.477	RHS	Outer	INTERIOR	1155.8	11.811	81.7	18352.8	0.1311	0.1188	0.1041	0.0868	0.00516142	0.00467717	0.00409843	0.00341732	0.15	0.45
49	995.963	RHS	Outer	INTERIOR	1131.3	11.811	80.0	17963.8	0.1508	0.1372	0.1194	0.1091	0.00593701	0.00540157	0.00470079	0.00429528	0.15	0.45
50	995.950	RHS	Outer	CORNER	1129.4	11.811	79.9	17933.6	0.1603	0.1497	0.1345	0.1132	0.00631102	0.00589370	0.00529528	0.00445669	0.15	0.45
51	995.495	RHS	Outer	INTERIOR	1133.2	11.811	80.1	17994.0	0.1318	0.1177	0.1002	0.0881	0.00518898	0.00463386	0.00394488	0.00346850	0.15	0.45
52	994.998	RHS	Outer	INTERIOR	1122.4	11.811	79.4	17822.5	0.1346	0.1258	0.1120	0.0954	0.00529921	0.00495276	0.00440945	0.00375591	0.15	0.45
53	994.982	RHS	Outer	CORNER	1146.4	11.811	81.1	18203.6	0.1341	0.1275	0.1102	0.0920	0.00527953	0.00501969	0.00433858	0.00362205	0.15	0.45
54	994.474	RHS	Outer	INTERIOR	1135.6	11.811	80.3	18032.1	0.1656	0.1515	0.1336	0.1143	0.00651969	0.00596457	0.00525984	0.00450000	0.15	0.45
55	993.881	RHS	Outer	INTERIOR	1143.1	11.811	80.8	18151.2	0.1447	0.1296	0.1153	0.0975	0.00569685	0.00510236	0.00453937	0.00383858	0.15	0.45
56	993.869	RHS	Outer	CORNER	1123.3	11.811	79.4	17836.8	0.1893	0.1702	0.1597	0.1380	0.00745276	0.00670079	0.00628740	0.00543307	0.15	0.45
57	993.490	RHS	Outer	INTERIOR	1129.4	11.811	79.9	17933.6	0.1820	0.1743	0.1551	0.1264	0.00716535	0.00686220	0.00610630	0.00497638	0.15	0.45
58	992.980	RHS	Outer	INTERIOR	1123.7	11.811	79.5	17843.1	0.1480	0.1412	0.1249	0.1071	0.00582677	0.00555906	0.00491732	0.00421654	0.15	0.45
59	992.966	RHS	Outer	CORNER	1112.5	11.811	78.7	17665.3	0.1410	0.1295	0.1128	0.0991	0.00555118	0.00509843	0.00444094	0.00390157	0.15	0.45
60	992.502	RHS	Outer	INTERIOR	1136.0	11.811	80.3	18038.4	0.1602	0.1445	0.1317	0.1072	0.00630709	0.00568898	0.00518504	0.00422047	0.15	0.45
61	991.984	RHS	Outer	INTERIOR	1136.5	11.811	80.4	18046.4	0.1507	0.1400	0.1297	0.1122	0.00593307	0.00551181	0.00510630	0.00441732	0.15	0.45
62	991.966	RHS	Outer	CORNER	1130.4	11.811	79.9	17949.5	0.1875	0.1713	0.1551	0.1353	0.00738189	0.00674409	0.00610630	0.00532677	0.15	0.45
63	991.496	RHS	Outer	INTERIOR	1147.3	11.811	81.1	18217.9	0.1537	0.1379	0.1240	0.1053	0.00605118	0.00542913	0.00488189	0.00414567	0.15	0.45
64	990.979	RHS	Outer	INTERIOR	1135.6	11.811	80.3	18032.1	0.1404	0.1282	0.1123	0.0971	0.00552756	0.00504724	0.00442126	0.00382283	0.15	0.45
65	990.967	RHS	Outer	CORNER	1140.3	11.811	80.6	18106.7	0.1433	0.1340	0.1172	0.1020	0.00564173	0.00527559	0.00461417	0.00401575	0.15	0.45
66	990.476	RHS	Outer	INTERIOR	1131.3	11.811	80.0	17963.8	0.1585	0.1408	0.1237	0.0981	0.00624016	0.00554331	0.00487008	0.00386220	0.15	0.45
67	989.991	RHS	Outer	INTERIOR	1154.4	11.811	81.6	18330.6	0.1079	0.0953	0.0833	0.0721	0.00424803	0.00375197	0.00327953	0.00283858	0.15	0.45
68	989.976	RHS	Outer	CORNER	1139.8	11.811	80.6	18098.8	0.1025	0.0934	0.0856	0.0766	0.00403543	0.00367717	0.00337008	0.00301575	0.15	0.45

S. No.	Chinage	Side	Lane	Test Point Location	Pressure	Radius of Loading Plate (in)	Load	Load	Deflection in (mm)				Deflection in (inches)				Poisson ratio	
					N/mm2		(KN)	(Pound)	0	300	600	900	0	300	600	900	Concrete	Subgrade
69	989.487	RHS	Outer	INTERIOR	1149.7	11.811	81.3	18256.0	0.1132	0.0992	0.0879	0.0718	0.00445669	0.00390551	0.00346063	0.00282677	0.15	0.45
70	989.000	RHS	Outer	INTERIOR	1138.9	11.811	80.5	18084.5	0.1338	0.1241	0.1107	0.1055	0.00526772	0.00488583	0.00435827	0.00415354	0.15	0.45
71	988.984	RHS	Outer	CORNER	1111.0	11.811	78.6	17641.4	0.1636	0.1373	0.1158	0.0958	0.00644094	0.00540551	0.00455906	0.00377165	0.15	0.45
72	988.496	RHS	Outer	INTERIOR	1123.8	11.811	79.5	17844.7	0.1616	0.1468	0.1324	0.1161	0.00636220	0.00577953	0.00521260	0.00457087	0.15	0.45
73	987.983	RHS	Outer	INTERIOR	1133.7	11.811	80.2	18001.9	0.1492	0.1366	0.1144	0.1055	0.00587402	0.00537795	0.00450394	0.00415354	0.15	0.45
74	987.968	RHS	Outer	CORNER	1132.2	11.811	80.1	17978.1	0.1387	0.1272	0.1144	0.1012	0.00546063	0.00500787	0.00450394	0.00398425	0.15	0.45
75	987.533	RHS	Outer	INTERIOR	1129.4	11.811	79.9	17933.6	0.2071	0.1929	0.1766	0.1668	0.00815354	0.00759449	0.00695276	0.00656693	0.15	0.45
76	986.993	RHS	Outer	INTERIOR	1158.2	11.811	81.9	18390.9	0.1549	0.1311	0.1093	0.0900	0.00609843	0.00516142	0.00430315	0.00354331	0.15	0.45
77	986.978	RHS	Outer	CORNER	1121.2	11.811	79.3	17803.4	0.1376	0.1202	0.1018	0.0935	0.00541732	0.00473228	0.00400787	0.00368110	0.15	0.45
78	986.493	RHS	Outer	INTERIOR	1139.3	11.811	80.6	18090.8	0.1625	0.1498	0.1356	0.1252	0.00639764	0.00589764	0.00533858	0.00492913	0.15	0.45
79	985.997	RHS	Outer	INTERIOR	1121.9	11.811	79.3	17814.5	0.1719	0.1542	0.1371	0.1153	0.00676772	0.00607087	0.00539764	0.00453937	0.15	0.45
80	985.983	RHS	Outer	CORNER	1137.9	11.811	80.5	18068.6	0.1730	0.1641	0.1451	0.1264	0.00681102	0.00646063	0.00571260	0.00497638	0.15	0.45
81	985.494	RHS	Outer	INTERIOR	1140.3	11.811	80.6	18106.7	0.1802	0.1629	0.1439	0.1191	0.00709449	0.00641339	0.00566535	0.00468898	0.15	0.45
82	985.003	RHS	Outer	INTERIOR	1134.1	11.811	80.2	18008.3	0.1277	0.1167	0.1041	0.0904	0.00502756	0.00459449	0.00409843	0.00355906	0.15	0.45
83	984.986	RHS	Outer	CORNER	1125.6	11.811	79.6	17873.3	0.1153	0.1052	0.0966	0.0857	0.00453937	0.00414173	0.00380315	0.00337402	0.15	0.45
84	984.479	RHS	Outer	INTERIOR	1137.9	11.811	80.5	18068.6	0.1296	0.1176	0.1048	0.0920	0.00510236	0.00462992	0.00412598	0.00362205	0.15	0.45
85	984.001	RHS	Outer	INTERIOR	1153.0	11.811	81.5	18308.4	0.1042	0.0931	0.0844	0.0726	0.00410236	0.00366535	0.00332283	0.00285827	0.15	0.45
86	983.990	RHS	Outer	CORNER	1138.4	11.811	80.5	18076.5	0.1042	0.0946	0.0839	0.0738	0.00410236	0.00372441	0.00330315	0.00290551	0.15	0.45
87	983.510	RHS	Outer	INTERIOR	1136.0	11.811	80.3	18038.4	0.1219	0.1063	0.0936	0.0848	0.00479921	0.00418504	0.00368504	0.00333858	0.15	0.45
88	982.992	RHS	Outer	INTERIOR	1138.9	11.811	80.5	18084.5	0.1816	0.1748	0.1677	0.1542	0.00714961	0.00688189	0.00660236	0.00607087	0.15	0.45
89	982.980	RHS	Outer	CORNER	1135.1	11.811	80.3	18024.1	0.1239	0.1098	0.0959	0.0820	0.00487795	0.00432283	0.00377559	0.00322835	0.15	0.45
90	982.497	RHS	Outer	INTERIOR	1139.8	11.811	80.6	18098.8	0.1558	0.1439	0.1289	0.1157	0.00613386	0.00566535	0.00507480	0.00455512	0.15	0.45
91	981.997	RHS	Outer	INTERIOR	1125.2	11.811	79.6	17866.9	0.1197	0.1035	0.0904	0.0780	0.00471260	0.00407480	0.00355906	0.00307087	0.15	0.45
92	981.986	RHS	Outer	CORNER	1142.2	11.811	80.8	18136.9	0.1186	0.1051	0.0914	0.0784	0.00466929	0.00413780	0.00359843	0.00308661	0.15	0.45
93	981.504	RHS	Outer	INTERIOR	1129.9	11.811	79.9	17941.6	0.1165	0.1023	0.0903	0.0768	0.00458661	0.00402756	0.00355512	0.00302362	0.15	0.45
94	980.988	RHS	Outer	INTERIOR	1118.6	11.811	79.1	17762.1	0.1265	0.1125	0.1014	0.0896	0.00498031	0.00442913	0.00399213	0.00352756	0.15	0.45
95	980.974	RHS	Outer	CORNER	1136.5	11.811	80.4	18046.4	0.1157	0.1071	0.0973	0.0861	0.00455512	0.00421654	0.00383071	0.00338976	0.15	0.45
96	980.484	RHS	Outer	INTERIOR	1158.2	11.811	81.9	18390.9	0.1538	0.1413	0.1292	0.1077	0.00605512	0.00556299	0.00508661	0.00424016	0.15	0.45
97	980.001	RHS	Outer	INTERIOR	1119.1	11.811	79.1	17770.1	0.1715	0.1607	0.1482	0.1306	0.00675197	0.00632677	0.00583465	0.00514173	0.15	0.45
98	979.987	RHS	Outer	CORNER	1162.4	11.811	82.2	18457.6	0.1886	0.1709	0.1514	0.1364	0.00742520	0.00672835	0.00596063	0.00537008	0.15	0.45
99	979.500	RHS	Outer	INTERIOR	1154.9	11.811	81.7	18338.5	0.1453	0.1262	0.1088	0.0907	0.00572047	0.00496850	0.00428346	0.00357087	0.15	0.45
100	979.002	RHS	Outer	INTERIOR	1136.5	11.811	80.4	18046.4	0.1324	0.1176	0.1061	0.0931	0.00521260	0.00462992	0.00417717	0.00366535	0.15	0.45
101	978.989	RHS	Outer	CORNER	1123.7	11.811	79.5	17843.1	0.1224	0.1072	0.0960	0.0840	0.00481890	0.00422047	0.00377953	0.00330709	0.15	0.45

S. No.	Chinage	Side	Lane	Test Point Location	Pressure	Radius of Loading Plate (in)	Load	Load	Deflection in (mm)				Deflection in (inches)				Poisson ratio	
					N/mm2		(KN)	(Pound)	0	300	600	900	0	300	600	900	Concrete	Subgrade
102	978.497	RHS	Outer	INTERIOR	1135.5	11.811	80.3	18030.5	0.1483	0.1316	0.1188	0.1016	0.00583858	0.00518110	0.00467717	0.00400000	0.15	0.45
103	977.993	RHS	Outer	INTERIOR	1126.1	11.811	79.6	17881.2	0.1628	0.1428	0.1248	0.1079	0.00640945	0.00562205	0.00491339	0.00424803	0.15	0.45
104	977.977	RHS	Outer	CORNER	1128.5	11.811	79.8	17919.3	0.1335	0.1227	0.1074	0.0932	0.00525591	0.00483071	0.00422835	0.00366929	0.15	0.45
105	977.492	RHS	Outer	INTERIOR	1166.7	11.811	82.5	18525.9	0.1264	0.1179	0.0996	0.0878	0.00497638	0.00464173	0.00392126	0.00345669	0.15	0.45
106	976.910	RHS	Outer	INTERIOR	1131.8	11.811	80.0	17971.7	0.1443	0.1307	0.1225	0.0962	0.00568110	0.00514567	0.00482283	0.00378740	0.15	0.45
107	976.898	RHS	Outer	CORNER	1148.8	11.811	81.2	18241.7	0.1385	0.1225	0.1066	0.0903	0.00545276	0.00482283	0.00419685	0.00355512	0.15	0.45
108	976.466	RHS	Outer	INTERIOR	1144.5	11.811	80.9	18173.4	0.1588	0.1476	0.1327	0.1152	0.00625197	0.00581102	0.00522441	0.00453543	0.15	0.45
109	975.994	RHS	Outer	INTERIOR	1135.1	11.811	80.3	18024.1	0.1503	0.1377	0.1238	0.1064	0.00591732	0.00542126	0.00487402	0.00418898	0.15	0.45
110	975.982	RHS	Outer	CORNER	1137.9	11.811	80.5	18068.6	0.1490	0.1361	0.1210	0.1043	0.00586614	0.00535827	0.00476378	0.00410630	0.15	0.45
111	975.482	RHS	Outer	INTERIOR	1138.9	11.811	80.5	18084.5	0.1171	0.1058	0.0923	0.0823	0.00461024	0.00416535	0.00363386	0.00324016	0.15	0.45
112	974.997	RHS	Outer	INTERIOR	1133.7	11.811	80.2	18001.9	0.2108	0.1991	0.1745	0.1539	0.00829921	0.00783858	0.00687008	0.00605906	0.15	0.45
113	974.981	RHS	Outer	CORNER	1139.3	11.811	80.6	18090.8	0.1520	0.1381	0.1222	0.1070	0.00598425	0.00543701	0.00481102	0.00421260	0.15	0.45
114	974.494	RHS	Outer	INTERIOR	1121.0	11.811	79.3	17800.2	0.1147	0.1014	0.0897	0.0770	0.00451575	0.00399213	0.00353150	0.00303150	0.15	0.45
115	973.955	RHS	Outer	INTERIOR	1129.9	11.811	79.9	17941.6	0.1576	0.1408	0.1288	0.1109	0.00620472	0.00554331	0.00507087	0.00436614	0.15	0.45
116	973.943	RHS	Outer	CORNER	1122.3	11.811	79.4	17820.9	0.1241	0.1079	0.0913	0.0766	0.00488583	0.00424803	0.00359449	0.00301575	0.15	0.45
117	973.508	RHS	Outer	INTERIOR	1145.9	11.811	81.0	18195.6	0.1105	0.1010	0.0882	0.0757	0.00435039	0.00397638	0.00347244	0.00298031	0.15	0.45
118	973.000	RHS	Outer	INTERIOR	1138.9	11.811	80.5	18084.5	0.1768	0.1628	0.1495	0.1359	0.00696063	0.00640945	0.00588583	0.00535039	0.15	0.45
119	972.989	RHS	Outer	CORNER	1135.1	11.811	80.3	18024.1	0.1348	0.1232	0.1100	0.0974	0.00530709	0.00485039	0.00433071	0.00383465	0.15	0.45
120	972.474	RHS	Outer	INTERIOR	1118.1	11.811	79.1	17754.2	0.1356	0.1201	0.1068	0.0975	0.00533858	0.00472835	0.00420472	0.00383858	0.15	0.45
121	972.003	RHS	Outer	INTERIOR	1122.8	11.811	79.4	17828.8	0.1767	0.1633	0.1463	0.1274	0.00695669	0.00642913	0.00575984	0.00501575	0.15	0.45
122	971.990	RHS	Outer	CORNER	1130.8	11.811	80.0	17955.9	0.1775	0.1553	0.1337	0.1176	0.00698819	0.00611417	0.00526378	0.00462992	0.15	0.45
123	971.445	RHS	Outer	INTERIOR	1158.2	11.811	81.9	18390.9	0.1615	0.1523	0.1327	0.1149	0.00635827	0.00599606	0.00522441	0.00452362	0.15	0.45
124	971.002	RHS	Outer	INTERIOR	1132.7	11.811	80.1	17986.0	0.1229	0.1102	0.1019	0.0912	0.00483858	0.00433858	0.00401181	0.00359055	0.15	0.45
125	970.988	RHS	Outer	CORNER	1138.4	11.811	80.5	18076.5	0.1923	0.1702	0.1447	0.1222	0.00757087	0.00670079	0.00569685	0.00481102	0.15	0.45
126	970.487	RHS	Outer	INTERIOR	1104.9	11.811	78.1	17544.6	0.3125	0.3084	0.2946	0.2678	0.01230315	0.01214173	0.01159843	0.01054331	0.15	0.45
127	965.000	RHS	Outer	INTERIOR	1156.8	11.811	81.8	18368.7	0.2433	0.2315	0.2203	0.1790	0.00957874	0.00911417	0.00867323	0.00704724	0.15	0.45
128	964.983	RHS	Outer	CORNER	1124.3	11.811	79.5	17852.6	0.2343	0.2234	0.2074	0.1861	0.00922441	0.00879528	0.00816535	0.00732677	0.15	0.45
129	964.552	RHS	Outer	INTERIOR	1130.8	11.811	80.0	17955.9	0.1787	0.1628	0.1398	0.1179	0.00703543	0.00640945	0.00550394	0.00464173	0.15	0.45
130	963.542	RHS	Outer	INTERIOR	1125.7	11.811	79.6	17874.9	0.1704	0.1568	0.1415	0.1280	0.00670866	0.00617323	0.00557087	0.00503937	0.15	0.45
131	963.001	RHS	Outer	INTERIOR	1135.6	11.811	80.3	18032.1	0.1582	0.1471	0.1305	0.1185	0.00622835	0.00579134	0.00513780	0.00466535	0.15	0.45
132	962.987	RHS	Outer	CORNER	1120.9	11.811	79.3	17798.7	0.1221	0.1149	0.0952	0.0860	0.00480709	0.00452362	0.00374803	0.00338583	0.15	0.45
133	962.551	RHS	Outer	INTERIOR	1143.6	11.811	80.9	18159.1	0.1460	0.1279	0.1108	0.0950	0.00574803	0.00503543	0.00436220	0.00374016	0.15	0.45
134	962.100	RHS	Outer	INTERIOR	1124.2	11.811	79.5	17851.1	0.1567	0.1436	0.1303	0.1243	0.00616929	0.00565354	0.00512992	0.00489370	0.15	0.45
135	962.086	RHS	Outer	CORNER	1125.7	11.811	79.6	17874.9	0.1497	0.1325	0.1213	0.1002	0.00589370	0.00521654	0.00477559	0.00394488	0.15	0.45
136	961.547	RHS	Outer	INTERIOR	1170.0	11.811	82.7	18578.3	0.1390	0.1281	0.1176	0.1042	0.00547244	0.00504331	0.00462992	0.00410236	0.15	0.45

					Modulus of Subgrade Reaction & Elastic Modulus of Concrete Analysis: NH-27 Rakhaldubi - Kalijhar : RHS										
S. No.	Chinage	Side	Lane	Test Point Location	PQC Thickness	Area of defelection basin (inch)	Radius of relative stiffness, l (inch)	Normalised defelction, (inches)				Modulus of subgrade reaction k (MPa/m)	Elastic modulus of concrete Ec (MPa)	Strenght of concrete fc (MPa)	Flexural Strenght of concrete f_{mr} (MPa)
					mm			0	300	600	900				
1	1013.000	RHS	Outer	INTERIOR	300	32.239	46.857	0.122	0.118	0.107	0.093	37.22	32,483	42.20	4.55
2	1012.990	RHS	Outer	CORNER	300	31.660	42.202	0.121	0.117	0.104	0.088	50.47	28,988	33.61	4.06
3	1012.495	RHS	Outer	INTERIOR	300	31.214	39.144	0.120	0.116	0.102	0.085	33.27	14,142	8.00	1.98
4	1011.999	RHS	Outer	INTERIOR	300	30.977	37.680	0.120	0.115	0.100	0.083	79.09	28,864	33.33	4.04
5	1011.986	RHS	Outer	CORNER	300	31.445	40.678	0.121	0.116	0.103	0.087	65.79	32,615	42.55	4.57
6	1011.489	RHS	Outer	INTERIOR	300	28.886	28.195	0.117	0.110	0.089	0.067	75.44	8,632	2.98	1.21
7	1011.001	RHS	Outer	INTERIOR	300	31.610	41.836	0.121	0.117	0.104	0.088	40.10	22,242	19.79	3.11
8	1010.987	RHS	Outer	CORNER	300	31.234	39.269	0.120	0.116	0.102	0.085	67.66	29,131	33.94	4.08
9	1010.498	RHS	Outer	INTERIOR	300	31.768	43.010	0.121	0.117	0.104	0.089	47.10	29,184	34.07	4.09
10	1009.987	RHS	Outer	INTERIOR	300	32.566	49.886	0.122	0.119	0.108	0.096	26.31	29,502	34.81	4.13
11	1009.975	RHS	Outer	CORNER	300	30.809	36.697	0.120	0.115	0.099	0.081	85.38	28,037	31.44	3.93
12	1009.494	RHS	Outer	INTERIOR	300	30.523	35.135	0.119	0.114	0.098	0.079	99.01	27,320	29.86	3.82
13	1008.998	RHS	Outer	INTERIOR	300	30.176	33.402	0.119	0.113	0.096	0.076	102.24	23,042	21.24	3.23
14	1008.983	RHS	Outer	CORNER	300	31.363	40.119	0.121	0.116	0.102	0.086	69.34	32,526	42.32	4.55
15	1008.503	RHS	Outer	INTERIOR	300	31.338	39.953	0.121	0.116	0.102	0.086	83.72	38,622	59.67	5.41
16	1007.992	RHS	Outer	INTERIOR	300	32.400	48.308	0.122	0.118	0.108	0.095	31.70	31,255	39.07	4.38
17	1007.973	RHS	Outer	CORNER	300	30.178	33.412	0.119	0.113	0.096	0.076	76.82	17,334	12.02	2.43
18	1007.504	RHS	Outer	INTERIOR	300	33.523	60.937	0.123	0.120	0.113	0.103	12.24	30,553	37.34	4.28
19	1006.983	RHS	Outer	INTERIOR	300	32.195	46.467	0.121	0.118	0.107	0.093	31.28	26,408	27.90	3.70
20	1006.970	RHS	Outer	CORNER	300	30.797	36.629	0.120	0.115	0.099	0.081	73.21	23,862	22.78	3.34
21	1006.502	RHS	Outer	INTERIOR	300	31.093	38.382	0.120	0.116	0.101	0.084	67.87	26,671	28.45	3.73
22	1005.997	RHS	Outer	INTERIOR	300	29.616	30.927	0.118	0.112	0.093	0.072	101.92	16,881	11.40	2.36
23	1005.982	RHS	Outer	CORNER	300	29.948	32.348	0.119	0.113	0.095	0.075	92.22	18,285	13.37	2.56
24	1005.484	RHS	Outer	INTERIOR	300	30.947	37.498	0.120	0.115	0.100	0.083	85.79	30,713	37.73	4.30
25	1005.001	RHS	Outer	INTERIOR	300	29.108	28.976	0.118	0.110	0.090	0.068	123.57	15,772	9.95	2.21
26	1004.988	RHS	Outer	CORNER	300	30.118	33.127	0.119	0.113	0.096	0.076	101.65	22,164	19.65	3.10
27	1004.506	RHS	Outer	INTERIOR	300	31.736	42.767	0.121	0.117	0.104	0.089	50.51	30,598	37.45	4.28
28	1003.990	RHS	Outer	INTERIOR	300	31.288	39.621	0.120	0.116	0.102	0.085	67.33	30,045	36.11	4.21
29	1003.976	RHS	Outer	CORNER	300	31.347	40.011	0.121	0.116	0.102	0.086	68.91	31,977	40.90	4.48
30	1003.504	RHS	Outer	INTERIOR	300	31.175	38.895	0.120	0.116	0.101	0.084	75.49	31,281	39.14	4.38
31	1002.987	RHS	Outer	INTERIOR	300	30.103	33.057	0.119	0.113	0.096	0.076	102.32	22,124	19.58	3.10
32	1002.975	RHS	Outer	CORNER	300	31.646	42.100	0.121	0.117	0.104	0.088	44.87	25,520	26.05	3.57
33	1002.493	RHS	Outer	INTERIOR	300	28.715	27.623	0.117	0.109	0.088	0.065	143.11	15,086	9.10	2.11

S. No.	Chinage	Side	Lane	Test Point Location	PQC Thickness	Area of defelection basin (inch)	Radius of relative stiffness, l (inch)	Normalised defelction, (inches)				Modulus of subgrade reaction k (MPa/m)	Elastic modulus of concrete Ec (MPa)	Strenght of concrete fc (MPa)	Flexural Strenght of concrete f_{mr} (MPa)
					mm			0	300	600	900				
34	1001.987	RHS	Outer	INTERIOR	300	29.651	31.072	0.118	0.112	0.093	0.072	93.82	15,835	10.03	2.22
35	1001.974	RHS	Outer	CORNER	300	29.950	32.358	0.119	0.113	0.095	0.075	109.93	21,819	19.04	3.05
36	1000.501	RHS	Outer	INTERIOR	300	30.311	34.058	0.119	0.114	0.097	0.077	76.30	18,590	13.82	2.60
37	999.996	RHS	Outer	INTERIOR	300	31.013	37.893	0.120	0.115	0.101	0.083	78.70	29,380	34.53	4.11
38	999.981	RHS	Outer	CORNER	300	30.777	36.520	0.120	0.115	0.099	0.081	75.32	24,256	23.53	3.40
39	999.501	RHS	Outer	INTERIOR	300	31.505	41.089	0.121	0.117	0.103	0.087	56.38	29,097	33.87	4.07
40	998.963	RHS	Outer	INTERIOR	300	31.450	40.707	0.121	0.116	0.103	0.087	60.25	29,954	35.89	4.19
41	998.950	RHS	Outer	CORNER	300	30.669	35.916	0.120	0.114	0.099	0.080	69.84	21,042	17.71	2.95
42	998.496	RHS	Outer	INTERIOR	300	30.911	37.285	0.120	0.115	0.100	0.082	86.88	30,402	36.97	4.26
43	998.005	RHS	Outer	INTERIOR	300	30.148	33.270	0.119	0.113	0.096	0.076	105.19	23,337	21.79	3.27
44	997.993	RHS	Outer	CORNER	300	30.528	35.165	0.119	0.114	0.098	0.079	89.51	24,781	24.56	3.47
45	997.499	RHS	Outer	INTERIOR	300	30.880	37.109	0.120	0.115	0.100	0.082	64.06	21,995	19.35	3.08
46	996.990	RHS	Outer	INTERIOR	300	30.287	33.938	0.119	0.113	0.097	0.077	92.60	22,243	19.79	3.11
47	996.973	RHS	Outer	CORNER	300	30.107	33.075	0.119	0.113	0.096	0.076	91.56	19,840	15.74	2.78
48	996.477	RHS	Outer	INTERIOR	300	30.375	34.377	0.119	0.114	0.097	0.078	98.95	25,023	25.05	3.50
49	995.963	RHS	Outer	INTERIOR	300	30.760	36.421	0.120	0.115	0.099	0.081	74.75	23,815	22.69	3.33
50	995.950	RHS	Outer	CORNER	300	31.512	41.141	0.121	0.117	0.103	0.087	56.01	29,055	33.77	4.07
51	995.495	RHS	Outer	INTERIOR	300	29.850	31.915	0.119	0.112	0.094	0.074	110.59	20,775	17.26	2.91
52	994.998	RHS	Outer	INTERIOR	300	31.453	40.732	0.121	0.116	0.103	0.087	67.52	33,652	45.30	4.71
53	994.982	RHS	Outer	CORNER	300	31.387	40.281	0.121	0.116	0.102	0.086	71.08	33,880	45.91	4.74
54	994.474	RHS	Outer	INTERIOR	300	30.801	36.651	0.120	0.115	0.099	0.081	67.93	22,195	19.70	3.11
55	993.881	RHS	Outer	INTERIOR	300	30.352	34.263	0.119	0.114	0.097	0.078	88.98	22,203	19.72	3.11
56	993.869	RHS	Outer	CORNER	300	31.287	39.615	0.120	0.116	0.102	0.085	50.41	22,481	20.22	3.15
57	993.490	RHS	Outer	INTERIOR	300	31.886	43.915	0.121	0.117	0.105	0.090	43.75	29,458	34.71	4.12
58	992.980	RHS	Outer	INTERIOR	300	31.918	44.167	0.121	0.117	0.105	0.091	52.61	36,245	52.55	5.07
59	992.966	RHS	Outer	CORNER	300	30.838	36.865	0.120	0.115	0.100	0.082	77.14	25,798	26.62	3.61
60	992.502	RHS	Outer	INTERIOR	300	30.704	36.110	0.120	0.115	0.099	0.081	72.52	22,326	19.94	3.13
61	991.984	RHS	Outer	INTERIOR	300	31.943	44.369	0.121	0.118	0.105	0.091	51.56	36,178	52.35	5.06
62	991.966	RHS	Outer	CORNER	300	31.219	39.177	0.120	0.116	0.102	0.085	52.38	22,342	19.97	3.13
63	991.496	RHS	Outer	INTERIOR	300	30.558	35.322	0.120	0.114	0.098	0.079	79.27	22,342	19.97	3.13
64	990.979	RHS	Outer	INTERIOR	300	30.705	36.116	0.120	0.115	0.099	0.081	82.34	25,364	25.73	3.55
65	990.967	RHS	Outer	CORNER	300	31.306	39.743	0.120	0.116	0.102	0.086	67.46	30,473	37.14	4.27
66	990.476	RHS	Outer	INTERIOR	300	29.739	31.439	0.118	0.112	0.094	0.073	95.34	16,863	11.37	2.36
67	989.991	RHS	Outer	INTERIOR	300	29.872	32.013	0.119	0.112	0.094	0.074	136.79	26,013	27.07	3.64
68	989.976	RHS	Outer	CORNER	300	31.440	40.641	0.121	0.116	0.103	0.087	89.74	44,328	78.60	6.21

S. No.	Chinage	Side	Lane	Test Point Location	PQC Thickness	Area of defelection basin (inch)	Radius of relative stiffness, l (inch)	Normalised defelction, (inches)				Modulus of subgrade reaction k (MPa/m)	Elastic modulus of concrete Ec (MPa)	Strenght of concrete fc (MPa)	Flexural Strenght of concrete f_{mr} (MPa)
					mm			0	300	600	900				
69	989.487	RHS	Outer	INTERIOR	300	29.640	31.024	0.118	0.112	0.093	0.072	138.49	23,229	21.58	3.25
70	989.000	RHS	Outer	INTERIOR	300	31.789	43.167	0.121	0.117	0.105	0.090	60.88	38,278	58.61	5.36
71	988.984	RHS	Outer	CORNER	300	28.078	25.685	0.116	0.107	0.085	0.061	131.81	10,388	4.32	1.45
72	988.496	RHS	Outer	INTERIOR	300	31.043	38.077	0.120	0.115	0.101	0.083	63.78	24,276	23.57	3.40
73	987.983	RHS	Outer	INTERIOR	300	30.430	34.656	0.119	0.114	0.097	0.078	83.36	21,773	18.96	3.05
74	987.968	RHS	Outer	CORNER	300	31.280	39.573	0.120	0.116	0.102	0.085	69.50	30,860	38.09	4.32
75	987.533	RHS	Outer	INTERIOR	300	32.242	46.884	0.122	0.118	0.107	0.093	33.21	29,058	33.77	4.07
76	986.993	RHS	Outer	INTERIOR	300	28.110	25.775	0.116	0.108	0.085	0.061	144.39	11,538	5.33	1.62
77	986.978	RHS	Outer	CORNER	300	29.438	30.212	0.118	0.111	0.092	0.071	115.73	17,458	12.19	2.44
78	986.493	RHS	Outer	INTERIOR	300	31.698	42.484	0.121	0.117	0.104	0.089	51.82	30,570	37.38	4.28
79	985.997	RHS	Outer	INTERIOR	300	30.360	34.298	0.119	0.114	0.097	0.078	73.42	18,396	13.54	2.58
80	985.983	RHS	Outer	CORNER	300	31.831	43.490	0.121	0.117	0.105	0.090	46.86	30,351	36.85	4.25
81	985.494	RHS	Outer	INTERIOR	300	30.396	34.483	0.119	0.114	0.097	0.078	70.63	18,082	13.08	2.53
82	985.003	RHS	Outer	INTERIOR	300	30.996	37.792	0.120	0.115	0.100	0.083	82.78	30,574	37.39	4.28
83	984.986	RHS	Outer	CORNER	300	31.462	40.794	0.121	0.116	0.103	0.087	78.28	39,253	61.63	5.50
84	984.479	RHS	Outer	INTERIOR	300	30.852	36.943	0.120	0.115	0.100	0.082	85.36	28,790	33.15	4.03
85	984.001	RHS	Outer	INTERIOR	300	30.622	35.662	0.120	0.114	0.098	0.080	115.17	33,727	45.50	4.72
86	983.990	RHS	Outer	CORNER	300	30.806	36.682	0.120	0.115	0.099	0.081	107.67	35,297	49.84	4.94
87	983.510	RHS	Outer	INTERIOR	300	29.852	31.927	0.119	0.112	0.094	0.074	119.17	22,418	20.10	3.14
88	982.992	RHS	Outer	INTERIOR	300	33.727	63.812	0.123	0.121	0.114	0.105	20.85	62,591	156.71	8.76
89	982.980	RHS	Outer	CORNER	300	29.893	32.107	0.119	0.112	0.095	0.074	116.65	22,444	20.15	3.14
90	982.497	RHS	Outer	INTERIOR	300	31.467	40.829	0.121	0.116	0.103	0.087	58.59	29,478	34.76	4.13
91	981.997	RHS	Outer	INTERIOR	300	29.348	29.867	0.118	0.111	0.092	0.070	136.95	19,731	15.57	2.76
92	981.986	RHS	Outer	CORNER	300	29.848	31.909	0.119	0.112	0.094	0.074	124.05	23,285	21.69	3.26
93	981.504	RHS	Outer	INTERIOR	300	29.794	31.674	0.118	0.112	0.094	0.073	126.66	23,083	21.31	3.23
94	980.988	RHS	Outer	INTERIOR	300	30.541	35.229	0.120	0.114	0.098	0.079	93.96	26,205	27.47	3.67
95	980.974	RHS	Outer	CORNER	300	31.665	42.235	0.121	0.117	0.104	0.088	73.75	42,491	72.22	5.95
96	980.484	RHS	Outer	INTERIOR	300	31.307	39.747	0.120	0.116	0.102	0.086	63.95	28,897	33.40	4.05
97	980.001	RHS	Outer	INTERIOR	300	32.183	46.367	0.121	0.118	0.106	0.093	40.89	34,221	46.84	4.79
98	979.987	RHS	Outer	CORNER	300	30.846	36.911	0.120	0.115	0.100	0.082	59.88	20,125	16.20	2.82
99	979.500	RHS	Outer	INTERIOR	300	29.153	29.139	0.118	0.110	0.091	0.069	121.81	15,900	10.11	2.23
100	979.002	RHS	Outer	INTERIOR	300	30.494	34.984	0.119	0.114	0.098	0.079	92.49	25,084	25.17	3.51
101	978.989	RHS	Outer	CORNER	300	30.039	32.763	0.119	0.113	0.095	0.075	112.07	23,380	21.86	3.27

S. No.	Chinage	Side	Lane	Test Point Location	PQC Thickness	Area of defelection basin (inch)	Radius of relative stiffness, l (inch)	Normalised defelction, (inches)				Modulus of subgrade reaction k (MPa/m)	Elastic modulus of concrete Ec (MPa)	Strenght of concrete fc (MPa)	Flexural Strenght of concrete f_{mr} (MPa)
					mm			0	300	600	900				
102	978.497	RHS	Outer	INTERIOR	300	30.372	34.362	0.119	0.114	0.097	0.078	85.58	21,603	18.67	3.02
103	977.993	RHS	Outer	INTERIOR	300	29.701	31.281	0.118	0.112	0.094	0.073	92.38	16,016	10.26	2.24
104	977.977	RHS	Outer	CORNER	300	30.872	37.059	0.120	0.115	0.100	0.082	81.91	27,973	31.30	3.92
105	977.492	RHS	Outer	INTERIOR	300	30.816	36.740	0.120	0.115	0.099	0.082	91.02	30,029	36.07	4.20
106	976.910	RHS	Outer	INTERIOR	300	31.056	38.155	0.120	0.115	0.101	0.083	72.43	27,797	30.91	3.89
107	976.898	RHS	Outer	CORNER	300	29.762	31.536	0.118	0.112	0.094	0.073	109.37	19,587	15.35	2.74
108	976.466	RHS	Outer	INTERIOR	300	31.534	41.295	0.121	0.117	0.103	0.087	56.67	29,839	35.61	4.18
109	975.994	RHS	Outer	INTERIOR	300	31.126	38.585	0.120	0.116	0.101	0.084	67.70	27,172	29.53	3.80
110	975.982	RHS	Outer	CORNER	300	30.906	37.258	0.120	0.115	0.100	0.082	73.22	25,546	26.10	3.58
111	975.482	RHS	Outer	INTERIOR	300	30.518	35.107	0.119	0.114	0.098	0.079	104.15	28,648	32.83	4.01
112	974.997	RHS	Outer	INTERIOR	300	31.648	42.113	0.121	0.117	0.104	0.088	40.73	23,196	21.52	3.25
113	974.981	RHS	Outer	CORNER	300	30.774	36.498	0.120	0.115	0.099	0.081	74.63	23,979	23.00	3.36
114	974.494	RHS	Outer	INTERIOR	300	30.021	32.679	0.119	0.113	0.095	0.075	120.21	24,823	24.65	3.48
115	973.955	RHS	Outer	INTERIOR	300	30.750	36.365	0.120	0.115	0.099	0.081	71.85	22,753	20.71	3.19
116	973.943	RHS	Outer	CORNER	300	28.965	28.469	0.117	0.110	0.090	0.067	144.82	17,225	11.87	2.41
117	973.508	RHS	Outer	INTERIOR	300	30.657	35.852	0.120	0.114	0.099	0.080	107.16	32,057	41.11	4.49
118	973.000	RHS	Outer	INTERIOR	300	31.809	43.317	0.121	0.117	0.105	0.090	45.90	29,261	34.25	4.10
119	972.989	RHS	Outer	CORNER	300	31.095	38.394	0.120	0.116	0.101	0.084	75.99	29,898	35.76	4.19
120	972.474	RHS	Outer	INTERIOR	300	30.394	34.471	0.119	0.114	0.097	0.078	91.09	23,287	21.69	3.26
121	972.003	RHS	Outer	INTERIOR	300	31.351	40.042	0.121	0.116	0.102	0.086	53.00	24,670	24.34	3.45
122	971.990	RHS	Outer	CORNER	300	29.513	30.511	0.118	0.111	0.093	0.071	89.09	13,980	7.82	1.96
123	971.445	RHS	Outer	INTERIOR	300	31.445	40.677	0.121	0.116	0.103	0.087	58.21	28,853	33.30	4.04
124	971.002	RHS	Outer	INTERIOR	300	31.162	38.812	0.120	0.116	0.101	0.084	81.20	33,362	44.52	4.67
125	970.988	RHS	Outer	CORNER	300	29.463	30.313	0.118	0.111	0.092	0.071	84.24	12,879	6.63	1.80
126	970.487	RHS	Outer	INTERIOR	300	34.297	73.054	0.123	0.121	0.116	0.109	8.99	46,362	85.98	6.49
127	965.000	RHS	Outer	INTERIOR	300	32.698	51.208	0.122	0.119	0.109	0.097	24.77	30,834	38.03	4.32
128	964.983	RHS	Outer	CORNER	300	32.830	52.586	0.122	0.119	0.110	0.098	23.47	32,500	42.25	4.55
129	964.552	RHS	Outer	INTERIOR	300	30.279	33.898	0.119	0.113	0.097	0.077	72.95	17,440	12.17	2.44
130	963.542	RHS	Outer	INTERIOR	300	31.514	41.155	0.121	0.117	0.103	0.087	52.03	27,027	29.22	3.78
131	963.001	RHS	Outer	INTERIOR	300	31.551	41.416	0.121	0.117	0.103	0.088	55.90	29,780	35.47	4.17
132	962.987	RHS	Outer	CORNER	300	30.875	37.075	0.120	0.115	0.100	0.082	88.88	30,408	36.99	4.26
133	962.551	RHS	Outer	INTERIOR	300	29.523	30.551	0.118	0.111	0.093	0.071	109.51	17,274	11.94	2.42
134	962.100	RHS	Outer	INTERIOR	300	31.735	42.754	0.121	0.117	0.104	0.089	52.22	31,589	39.91	4.42
135	962.086	RHS	Outer	CORNER	300	30.361	34.304	0.119	0.114	0.097	0.078	84.57	21,205	17.99	2.97
136	961.547	RHS	Outer	INTERIOR	300	31.709	42.565	0.121	0.117	0.104	0.089	62.21	36,974	54.68	5.18

Load Transfer Efficiency Analysis: NH-27 Rakhaldubi - Kaljhar : RHS									
S.No.	Chainage	Side	Lane	Test Point Location	Pressure	Load	0	300	LTE %
					N/mm2	KN	Loaded Slab	Unloaded Slab	
1	1012.997	RHS	Outer	DOWEL	1177.5	83.3	0.1026	0.0912	88.9%
2	1011.997	RHS	Outer	DOWEL	1129.9	79.9	0.1635	0.1226	75.0%
3	1010.999	RHS	Outer	DOWEL	1162.4	82.2	0.1761	0.1622	92.1%
4	1009.984	RHS	Outer	DOWEL	1168.6	82.6	0.2169	0.2030	93.6%
5	1008.994	RHS	Outer	DOWEL	1134.1	80.2	0.1312	0.1166	88.9%
6	1007.984	RHS	Outer	DOWEL	1123.8	79.5	0.1587	0.1470	92.6%
7	1006.980	RHS	Outer	DOWEL	1122.8	79.4	0.2004	0.1852	92.4%
8	1005.991	RHS	Outer	DOWEL	1127.6	79.7	0.1518	0.1322	87.1%
9	1004.998	RHS	Outer	DOWEL	1137.4	80.4	0.1252	0.1093	87.3%
10	1003.987	RHS	Outer	DOWEL	1111.5	78.6	0.1338	0.1189	88.9%
11	1002.984	RHS	Outer	DOWEL	1137.9	80.5	0.1416	0.1243	87.8%
12	1001.984	RHS	Outer	DOWEL	1136.0	80.3	0.1783	0.1584	88.8%
13	999.992	RHS	Outer	DOWEL	1140.7	80.7	0.1470	0.1280	87.1%
14	998.959	RHS	Outer	DOWEL	1155.3	81.7	0.1397	0.1282	91.8%
15	998.002	RHS	Outer	DOWEL	1145.9	81.0	0.1751	0.1366	78.0%
16	996.984	RHS	Outer	DOWEL	1111.5	78.6	0.1530	0.1358	88.8%
17	995.961	RHS	Outer	DOWEL	1132.2	80.1	0.2081	0.1500	72.1%
18	994.993	RHS	Outer	DOWEL	1145.0	81.0	0.1251	0.1124	89.8%
19	993.878	RHS	Outer	DOWEL	1137.9	80.5	0.1495	0.1103	73.8%
20	992.974	RHS	Outer	DOWEL	1138.9	80.5	0.1693	0.1518	89.7%
21	991.976	RHS	Outer	DOWEL	1121.9	79.3	0.1500	0.1376	91.7%
22	990.976	RHS	Outer	DOWEL	1126.6	79.7	0.1567	0.1483	94.6%
23	989.987	RHS	Outer	DOWEL	1139.8	80.6	0.1053	0.1010	95.9%
24	988.995	RHS	Outer	DOWEL	1141.2	80.7	0.1189	0.1127	94.8%
25	987.978	RHS	Outer	DOWEL	1146.4	81.1	0.1465	0.1409	96.2%
26	986.990	RHS	Outer	DOWEL	1143.6	80.9	0.1203	0.1092	90.8%
27	985.993	RHS	Outer	DOWEL	1139.8	80.6	0.1767	0.1493	84.5%
28	984.996	RHS	Outer	DOWEL	1157.3	81.8	0.1192	0.1094	91.8%
29	983.998	RHS	Outer	DOWEL	1113.4	78.7	0.1144	0.0901	78.8%
30	982.989	RHS	Outer	DOWEL	1134.1	80.2	0.1722	0.1459	84.7%
31	981.994	RHS	Outer	DOWEL	1162.4	82.2	0.1299	0.1193	91.8%
32	980.984	RHS	Outer	DOWEL	1155.3	81.7	0.1282	0.1183	92.3%
33	979.997	RHS	Outer	DOWEL	1103.5	78.0	0.2089	0.1775	85.0%
34	978.998	RHS	Outer	DOWEL	1145.0	81.0	0.1399	0.1259	90.0%
35	977.989	RHS	Outer	DOWEL	1144.5	80.9	0.1367	0.1246	91.1%
36	976.907	RHS	Outer	DOWEL	1129.0	79.8	0.1399	0.1271	90.9%
37	975.991	RHS	Outer	DOWEL	1132.3	80.1	0.1347	0.1284	95.3%
38	974.992	RHS	Outer	DOWEL	1142.2	80.8	0.1616	0.1511	93.5%
39	973.951	RHS	Outer	DOWEL	1145.0	81.0	0.1188	0.1099	92.5%
40	972.997	RHS	Outer	DOWEL	1126.1	79.6	0.1197	0.1139	95.2%
41	972.000	RHS	Outer	DOWEL	1141.7	80.7	0.1768	0.1632	92.3%
42	970.998	RHS	Outer	DOWEL	1133.7	80.2	0.1673	0.1599	95.6%
43	964.993	RHS	Outer	DOWEL	1151.1	81.4	0.2195	0.1705	77.7%
44	962.997	RHS	Outer	DOWEL	1156.8	81.8	0.1331	0.1169	87.8%
45	962.097	RHS	Outer	DOWEL	1140.7	80.7	0.1855	0.1571	84.7%

Load Transfer Efficiency Analysis: NH-27 Rakhaldubi - Kaljhar : RHS									
S.No.	Chainage	Side	Lane	Test Point Location	Pressure	Load	0	300	LTE %
					N/mm2	KN	Loaded Slab	Unloaded Slab	
1	1012.983	RHS	Outer	TIE	1157.7	81.9	0.0802	0.0682	85.0%
2	1011.980	RHS	Outer	TIE	1117.6	79.0	0.1679	0.1285	76.5%
3	1010.981	RHS	Outer	TIE	1132.2	80.1	0.1681	0.1511	89.9%
4	1009.968	RHS	Outer	TIE	1120.0	79.2	0.1281	0.1135	88.6%
5	1008.978	RHS	Outer	TIE	1128.5	79.8	0.1605	0.1388	86.5%
6	1007.967	RHS	Outer	TIE	1128.5	79.8	0.1345	0.1220	90.7%
7	1006.964	RHS	Outer	TIE	1142.6	80.8	0.2175	0.1918	88.2%
8	1005.976	RHS	Outer	TIE	1142.2	80.8	0.1400	0.1262	90.1%
9	1004.983	RHS	Outer	TIE	1129.0	79.8	0.1110	0.1013	91.3%
10	1003.970	RHS	Outer	TIE	1142.1	80.8	0.1284	0.1135	88.4%
11	1002.970	RHS	Outer	TIE	1174.7	83.1	0.1926	0.1670	86.7%
12	1001.967	RHS	Outer	TIE	1166.7	82.5	0.1302	0.1159	89.0%
13	999.974	RHS	Outer	TIE	1156.8	81.8	0.1533	0.1405	91.7%
14	998.942	RHS	Outer	TIE	1150.6	81.4	0.1643	0.1481	90.1%
15	997.986	RHS	Outer	TIE	1129.9	79.9	0.1535	0.1378	89.8%
16	996.966	RHS	Outer	TIE	1112.0	78.6	0.1430	0.1270	88.8%
17	995.944	RHS	Outer	TIE	1137.9	80.5	0.1928	0.1276	66.2%
18	994.977	RHS	Outer	TIE	1128.5	79.8	0.1453	0.1314	90.4%
19	993.863	RHS	Outer	TIE	1146.4	81.1	0.2226	0.1789	80.4%
20	992.961	RHS	Outer	TIE	1162.0	82.2	0.1504	0.1355	90.1%
21	991.959	RHS	Outer	TIE	1157.2	81.8	0.1444	0.1331	92.2%
22	990.959	RHS	Outer	TIE	1135.1	80.3	0.1505	0.1390	92.4%
23	989.971	RHS	Outer	TIE	1113.4	78.7	0.2091	0.1513	72.4%
24	988.978	RHS	Outer	TIE	1165.7	82.4	0.1275	0.1184	92.9%
25	987.961	RHS	Outer	TIE	1160.1	82.0	0.1126	0.1059	94.0%
26	986.973	RHS	Outer	TIE	1121.4	79.3	0.1157	0.1073	92.7%
27	985.977	RHS	Outer	TIE	1132.3	80.1	0.1554	0.1376	88.5%
28	984.979	RHS	Outer	TIE	1130.8	80.0	0.1476	0.1421	96.3%
29	983.984	RHS	Outer	TIE	1130.8	80.0	0.1162	0.1011	87.0%
30	982.972	RHS	Outer	TIE	1138.9	80.5	0.1350	0.1268	93.9%
31	981.979	RHS	Outer	TIE	1142.2	80.8	0.1270	0.1120	88.2%
32	980.965	RHS	Outer	TIE	1135.1	80.3	0.1416	0.1293	91.3%
33	979.980	RHS	Outer	TIE	1085.1	76.7	0.1394	0.1282	92.0%
34	978.983	RHS	Outer	TIE	1145.5	81.0	0.1260	0.1091	86.6%
35	977.969	RHS	Outer	TIE	1123.3	79.4	0.1414	0.1301	92.0%
36	976.889	RHS	Outer	TIE	1138.4	80.5	0.1711	0.1547	90.4%
37	975.976	RHS	Outer	TIE	1123.3	79.4	0.1671	0.1314	78.6%
38	974.974	RHS	Outer	TIE	1140.3	80.6	0.1328	0.1245	93.8%
39	973.935	RHS	Outer	TIE	1138.4	80.5	0.1620	0.1606	99.1%
40	972.983	RHS	Outer	TIE	1137.0	80.4	0.1300	0.1188	91.4%
41	971.983	RHS	Outer	TIE	1147.4	81.1	0.1396	0.1264	90.5%
42	970.982	RHS	Outer	TIE	1137.4	80.4	0.1525	0.1503	98.6%
43	964.976	RHS	Outer	TIE	1146.9	81.1	0.2381	0.2079	87.3%
44	962.984	RHS	Outer	TIE	1146.9	81.1	0.1278	0.1118	87.5%
45	962.081	RHS	Outer	TIE	1113.4	78.7	0.1419	0.1311	92.4%

Annexure – 4.8

Mobile Bridge Inspection Unit (MBIU)

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Kochugaon- Rakhaldubi
5	Location Chainage	34084
6	Structure Number	35/1
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Data not avalible
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Kochugaon
12	Year of Construction	Data not avalible
13	Overall Bridge Length	156.80 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	No
31	Overall Deck Width in m	8.00 m
32	Approach Roadway Width including Shoulders in m	7.40 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	4.50 m (Above water)
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	4
40	Maximum Span	39.20 m
41	Type of Superstructure	RCC Deck slab + PSC Girder
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	POT cum PTFE
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
49	Type of Railing	RCC Crash barrier + Cast In-Situ
50	Corrosion Protection	No
51	Bank Protection Type	No
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	Growth of vegetation
60	Distress and Repairs in Substructure	Leaching is observed on piers
61	Distress and Repairs in Superstructure	Cracking, spalling and Exposed reinforcement.
62	Any other Observation/Data	No

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: KOCHUGAON-RAKHALDUBI**

CHAINAGE : KM 34+084 (RHS) **DATE OF INSPECTION: 06-12-2022**

TYPE OF STRUCTURE: MAJOR BRIDGE

STRUCTURE NO: 35/1

LATITUDE: 26.541398° **LONGITUDE: 90.105433°**

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Major bridge
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.40 m
1.6	Overall Deck width (m)	8.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	Yes
1.9	Span Arrangement (Nos. x Length in m)	04 x 39.20 m
1.10	Total length of the bridge (m)	156.80 m
1.11	Vertical Clearance (m)	4.00 m
1.12	Whether meadian, if yes its width (m)	8.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	3.50 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Hand rails & Length - 172.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	No spans

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	Cracks are observed
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No damages
2.8	Approach slab (Check settlement, cracks,movement etc.)	No settlement and cracks
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall & Height-7.00 m
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Retaining wall is in fair condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	Not present
2.12	Approach Geometry (Check whether it satisfies the standard in force)	Satisfied
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	Stone pitching
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitching, Growth of vegetation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	Not present
	b) For Piers	Not present
3.4	Bank Protection & Type	Not present
3.5	Floor Protection & Type	Not visible
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	No obstruction in waterway
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	No meandering of inflow

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Information is not with the respective Department	
4.5	Check the adequacy of waterway	Not present	
4.6	Check the errosion of bank	Not present	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Well foundation	
5.2	Material	RCC	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall	Wall
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good Condition	Good Condition
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No weepholes are observed	No weepholes are observed
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.1.9	Check damage of protective coating of painting.	Not relevant	

6.2	Pier	03 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Leaching is observed	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not applicable	
6.2.6	Check damage of protective coating of painting.	Not visible	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not applicable	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not applicable	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 3 Nos.	02 x 3 Nos.
8.2	No. per Pier	03 x 6 Nos.	03 x 6 Nos.
8.3	Type and allowable movements	Rocker roller	Rectangular
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Corrosion observed,cleanliness and greassing reqiured	Fair condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Proper functioning	Proper functioning
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	04 Nos. & 4 x 39.20 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab + PSC Girders	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC + PSC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No spalling and honey combing
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	No cracks
9.7	Check exposed reinforcement, if any	Reinforcement is exposed
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	Leaching is observed
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	NA
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No leakage
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	Not relevant
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	Not present
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Not present
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not relevant
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not relevant as this is not a box girder
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not relevant as this is not a submersible structure
9.22	Check peeling off of protective coat or paint	Protective coat is applied
9.23	Check steel members	Not relevant
9.24	Check condition of protective system	Not relevat as this is not an steel structure
9.25	Check corrosion, if any	Not relevat as this is not an steel structure
9.26	Check excessive vibrations, if any	Not relevat as this is not an steel structure
9.27	Check alignment of members	Not relevat as this is not an steel structure
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not relevat as this is not an steel structure
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not relevat as this is not an steel structure
9.30	Check buckling, kinking, warping and waviness	Not relevat as this is not an steel structure

9.31	Check apparent fracture if any	Not relevat as this is not an steel structure
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not relevat as this is not an steel structure
9.33	Check conditions inside the closed members	Not relevat as this is not an steel structure
9.34	Check masonry arches	Not relevat as this is not an arch structure
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not relevat as this is not an arch structure
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not relevat as this is not an arch structure
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not relevat as this is not an arch structure
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not relevat as this is not an arch structure
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not relevant as this is a concrete structure
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not relevant as this is a concrete structure
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not relevant as this is not an masonry structure
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	Misalignment of joints and debris are accmulated.
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Fair condition

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	Neoprene sealing material is damaged
10.5	Check secureness of the joints	No
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	No
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	NA
10.8	Check for debris in joints	Debris is accumulated in the joints
10.9	Report rattling, if any	No
10.10	Check drainage from expansion joint	Yes
10.11	Check alignment and clearance	good
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Horizontal cracksin the Wearing course are observed at the starting point of bridge
11.3	Details of water proofing system, if any	Data not available

12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Drainage spouts are partially clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Protection of spouts are provided being observed and strutural memebers are not being affected
12.3	Check adequacy thereof	Adequate
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not relevant as this is not a subway
12.5	For submersible bridges, report on functioning	Not relevant as this is not a submersible type of bridge
12.6	Report absence of Drainage Spouts	Not relevant
12.7	Check choking of drainage holes provided in the bottom booms	No bottom booms
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Crash barrier
13.2	Material	RCC
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	No
14.2	Material	Not relevant
14.3	Condition	Not relevant
14.4	Check missing footpath slab	Not relevant
14.5	Cleanless of ducts along with footpath	Not relevant
15.UTILITIES		

15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cable
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes	Remove of vegetation and cleaning is required
2	Pier	Provide the water proof paint
3	Expansion joints	Sealing material to be replaced and cleaning is required, Misalignment of joints
4	Drainage spouts	Cleaning is required
5	Superstructure	Cracks and spalling are observed, Reinforcement is exposed
6	Bearings	Provide the corrosion protection and cleaning & gressing is required

17.PHOTOGRAPHS

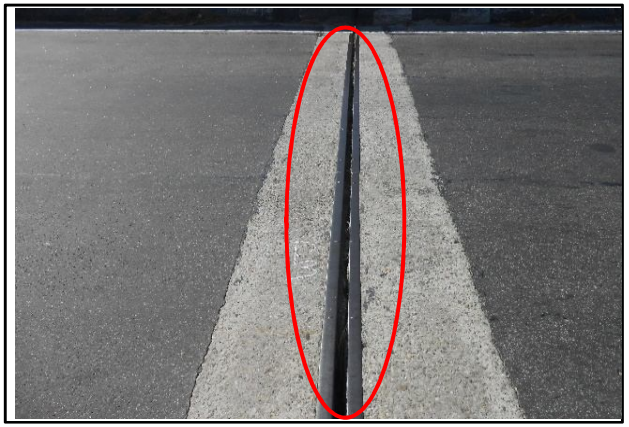
17.1 Mobile Bridge Inspection Unit Picture (if required)

View of pavement approach

View of Mobile Bridge Inspection Unit

17.2 Expansion Joints (If any)

View of strip seal expansion joint



Neoprene sealing material damaged

17.3 Spout (If any)

View of drainage spouts

View of drainage spouts

17.4 Bearings (if any)

View of POT cum PTFE bearings

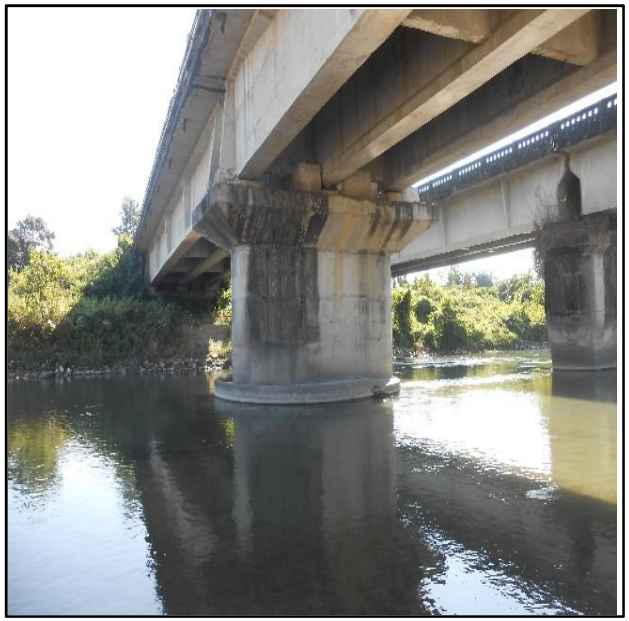
View of Seismic Arrester bearings

17.5 Abutment

Viwe of abutment

Viwe of abutment

17.6 Piers



View of pier

leaching is observed at pier

17.7 Superstructure

View of superstructure

View of superstructure

17.8 Overall Bridge

View of Overall bridge

View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Kochugaon- Rakhaldubi
5	Location Chainage	34084
6	Structure Number	35/1
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Data not avalible
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Kochugaon
12	Year of Construction	Data not avalible
13	Overall Bridge Length	156.80 m
14	No of Lanes	2Lane of Class A
15	Load Rating	70 R
16	Design Loading	70 R
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	No
31	Overall Deck Width in m	8.00 m
32	Approach Roadway Width including Shoulders in m	7.40 m
33	Average Skew	No
34	Conditions of Exposure	Nil
35	Whether Navigable	Yes
36	Vertical and Horizantal Clearence	4.50 m (Above water)
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	4
40	Maximum Span	39.20 m
41	Type of Superstructure	RCC Deck slab + PSC Girder
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	Rocke Roller
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
49	Type of Railing	RCC Hand railing
50	Corrosion Protection	No
51	Bank Protection Type	No
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	Growth of vegetation
60	Distress and Repairs in Substructure	Leaching is observed on piers
61	Distress and Repairs in Superstructure	Cracks, spalling and reinforcement is exposed
62	Any other Observation/Data	No

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: KOCHUGAON-RAKHALDUBI**

CHAINAGE : KM 34+084 (RHS) **DATE OF INSPECTION: 06-12-2022**

TYPE OF STRUCTURE: MAJOR BRIDGE

STRUCTURE NO: 35/1

LATITUDE: 26.541323° **LONGITUDE: 90.105370°**

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Major bridge
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.40 m
1.6	Overall Deck width (m)	8.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	Yes
1.9	Span Arrangement (Nos. x Length in m)	04 x 39.20 m
1.10	Total length of the bridge (m)	156.80 m
1.11	Vertical Clearance (m)	4.00 m
1.12	Whether meadian, if yes its width (m)	8.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	3.50 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Hand rails & Length - 172.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	No spans

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	Pavement surface is in fair condition
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No damages
2.8	Approach slab (Check settlement, cracks,movement etc.)	Not visible
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall & Height-7.00 m
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Retaining wall is in fair condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	No
2.12	Approach Geometry (Check whether it satisfies the standard in force)	No
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	Stone pitching, Growth of vegetation on side slopes
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitching, Growth of vegetation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	No
	b) For Piers	No
3.4	Bank Protection & Type	No
3.5	Floor Protection & Type	Not visible
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	No
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	Uniform. No change in flow, erosion of banks

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Not visible	
4.5	Check the adequacy of waterway	Not visible	
4.6	Check the errosion of bank	Not visible	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Data not available	
5.2	Material	Data not available	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall	Wall
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No cracks, settlement, sour, exposed steel	No cracks, settlement, sour, exposed steel
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No	No
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not applicable	
6.1.9	Check damage of protective coating of painting.	Not visible	

6.2	Pier	03 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Leaching is observed	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not applicable	
6.2.6	Check damage of protective coating of painting.	Not visible	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not applicable	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not applicable	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 3 Nos.	02 x 3 Nos.
8.2	No. per Pier	03 x 6 Nos.	03 x 6 Nos.
8.3	Type and allowable movements	Rocker roller	Rectangular
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Corrosion and cleanliness is observed	Fair condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Proper functioning	Proper functioning
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	04 Nos. & 4 x 39.20 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab + PSC Girders	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC + PSC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	Spalling is observed
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	Cracks are observed
9.7	Check exposed reinforcement, if any	Reinforcement is exposed
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	Not applicable
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	No
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Major cracks are observed S1/P1/G2
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not applicable
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not applicable
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not applicable
9.22	Check peeling off of protective coat or paint	Not applicable
9.23	Check steel members	Not applicable
9.24	Check condition of protective system	Not applicable
9.25	Check corrosion, if any	Not applicable
9.26	Check excessive vibrations, if any	Not applicable
9.27	Check alignment of members	Not applicable
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not applicable
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not applicable
9.30	Check buckling, kinking, warping and waviness	Not applicable

9.31	Check apparent fracture if any	Not applicable
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not applicable
9.33	Check conditions inside the closed members	Not applicable
9.34	Check masonry arches	Not applicable
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not applicable
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not applicable
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not applicable
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not applicable
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not applicable
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not applicable
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not applicable
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	Misalignment of joints and debris are accmulated.
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Fair condition

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	Neoprene sealing is damaged
10.5	Check secureness of the joints	No
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	No
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	No
10.8	Check for debris in joints	Yes
10.9	Report rattling, if any	No
10.10	Check drainage from expansion joint	No
10.11	Check alignment and clearance	Yes
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Fair condition
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Drainage spouts are clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Drain pipes are provided, no structural members are affected
12.3	Check adequacy thereof	Adeqated
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not applicable
12.5	For submersible bridges, report on functioning	Not applicable
12.6	Report absence of Drainage Spouts	Drainage spouts are provided

12.7	Check choking of drainage holes provided in the bottom booms	Not applicable
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Hand rail
13.2	Material	RCC
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	No
14.2	Material	Not applicable
14.3	Condition	Not applicable
14.4	Check missing footpath slab	Not applicable
14.5	Cleanless of ducts along with footpath	Not applicable
15.UTILITIES		
15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cable
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes	Remove of vegetation and cleaning is required
2	Pier	Provide the water proof paint

3	Expansion joints	Sealing material to be replaced and cleaning is required, Misalignment of joints
4	Drainage spouts	Cleaning is required
5	substructure	Leaching is observed
6	Superstructure	Cracks and spalling are observed, Reinforcement is exposed
7	Bearings	Provide the corrosion protection and cleaning is required

17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit

View of Mobile Bridge Inspection Unit

17.2 Expansion Joints (If any)

View of strip seal expansion joint

View of Neoprene sealing material damaged

17.3 Spout (If any)

View of drainage spouts

Drainage spouts clogged

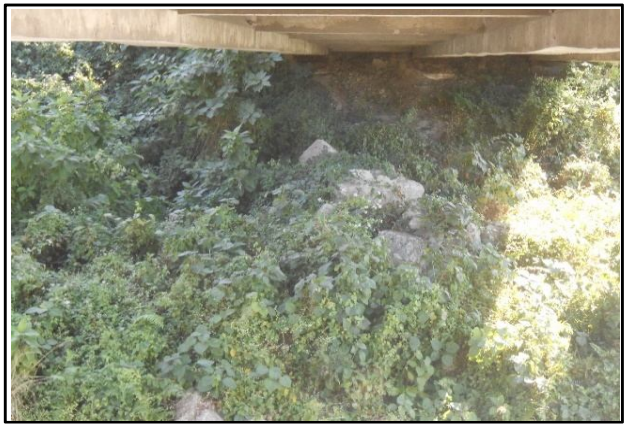
17.4 Bearings (if any)

View of Rocker Roller bearing

Corrosion of bearings

17.5 Abutment

Viwe of abutment



Growth of vegetation

17.6 Piers

View of pier

Leaching is observed at pier

17.7 Superstructure

View of superstructure

Reinforcement is exposed

17.8 Retaining wall (if any)

View of retaining wall

View of water flow

17.9 Overall Bridge

View of Overall bridge

View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Kochugaon- Rakhaldubi
5	Location Chainage	41294
6	Structure Number	42/2
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Data not avalible
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Kochugaon
12	Year of Construction	Data not avalible
13	Overall Bridge Length	78.00 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	No
31	Overall Deck Width in m	8.00 m
32	Approach Roadway Width including Shoulders in m	7.40 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	2.50 m and 23.50 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	3
40	Maximum Span	26.00 m
41	Type of Superstructure	Box Girder
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	Rocke Roller
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
49	Type of Railing	RCC Cast In-Situ
50	Corrosion Protection	No
51	Bank Protection Type	No
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	Growth of vegetation
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	Cracks and minor honeycombing is observed
62	Any other Observation/Data	No

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: KOCHUGAON-RAKHALDUBI**

CHAINAGE : KM 41+294 (LHS) **DATE OF INSPECTION: 06-12-2022**

TYPE OF STRUCTURE: MAJOR BRIDGE

STRUCTURE NO: 42/2

LATITUDE: 26.551180° **LONGITUDE: 90.163516°**

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Major bridge
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.40 m
1.6	Overall Deck width (m)	8.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	03 x 26.00 m
1.10	Total length of the bridge (m)	78.00 m
1.11	Vertical Clearance (m)	2.50 m
1.12	Whether meadian, if yes its width (m)	6.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	2.50 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Cast In-Situ & Length - 84.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	No spans

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	Cracks are observed
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No damages
2.8	Approach slab (Check settlement, cracks,movement etc.)	Not visible
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Retaining wall is in fair condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	Not present
2.12	Approach Geometry (Check whether it satisfies the standard in force)	Satisfied
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	Stone pitching
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitching, Growth of vegetation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	Not present
	b) For Piers	Not present
3.4	Bank Protection & Type	Not present
3.5	Floor Protection & Type	Not visible
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	Obstruction due to vegetation growth and island formation
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	No meandering of inflow

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Information is not with the respective Department	
4.5	Check the adequacy of waterway	Adequate	
4.6	Check the errosion of bank	Not present	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Well	
5.2	Material	RCC	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall	Wall
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	No cracks, settlement, sour, exposed steel
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No weep holes are being observed	No weep holes are being observed
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	Not visible as it is covered by growth of vegetation	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.1.9	Check damage of protective coating of painting.	Not visible	

6.2	Pier	02 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Strains observed	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.2.6	Check damage of protective coating of painting.	No damages	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not relevant	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not relevant	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 3 Nos.	02 x 3 Nos.
8.2	No. per Pier	03 x 6 Nos.	03 x 6 Nos.
8.3	Type and allowable movements	Rocker roller bearings	Rectangular
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Not visible as it is covered with iron plates	Fair condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Not visible as it is covered with iron plates	Fair condition
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	03 Nos. & x 26.00 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	Box Girder	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	Minor Honeycombing & Expopsed steel observed
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	Hair line shear crackers are observed on second girder G2 of span1
9.7	Check exposed reinforcement, if any	No
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No leakage
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	Not relevant
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	Not present
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Cracks are observed
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not relevant
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Hairline cracks are observed at the outer faces of girder in the second span
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not relevant as this is not a submersible structure
9.22	Check peeling off of protective coat or paint	Protective coat is applied
9.23	Check steel members	Not relevant
9.24	Check condition of protective system	Not relevat as this is not an steel structure
9.25	Check corrosion, if any	Not relevat as this is not an steel structure
9.26	Check excessive vibrations, if any	Not relevat as this is not an steel structure
9.27	Check alignment of members	Not relevat as this is not an steel structure
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not relevat as this is not an steel structure
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not relevat as this is not an steel structure
9.30	Check buckling, kinking, warping and waviness	Not relevat as this is not an steel structure

9.31	Check apparent fracture if any	Not relevat as this is not an steel structure
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not relevat as this is not an steel structure
9.33	Check conditions inside the closed members	Not relevat as this is not an steel structure
9.34	Check masonry arches	Not relevat as this is not an arch structure
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not relevat as this is not an arch structure
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not relevat as this is not an arch structure
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not relevat as this is not an arch structure
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not relevat as this is not an arch structure
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not relevant as this is a concrete structure
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not relevant as this is a concrete structure
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not relevant as this is not an masonry structure
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	Fair condition, No misalignment of joints, debris are accmulated.
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Existance of normal gap

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	Not visible
10.5	Check secureness of the joints	Secured
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	Not present
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	Not relevant as this is not a finger type of expansion joint
10.8	Check for debris in joints	Debris is accumulated in the joints
10.9	Report rattling, if any	Not present
10.10	Check drainage from expansion joint	Not relevant as this is not a finger type of expansion joint
10.11	Check alignment and clearance	In aligned
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Pot holes and cracks are observed in the wearing course
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Drainage spouts are partially clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Drainage spouts projections are observed and not affecting the structural memebers
12.3	Check adequacy thereof	Adequate
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not relevant
12.5	For submersible bridges, report on functioning	Not relevant
12.6	Report absence of Drainage Spouts	Drainage spouts are provided

12.7	Check choking of drainage holes provided in the bottom booms	No bottom booms
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Cast In-Situ
13.2	Material	RCC
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	No
14.2	Material	Not relevant
14.3	Condition	Not relevant
14.4	Check missing footpath slab	Not relevant
14.5	Cleanless of ducts along with footpath	Not relevant
15.UTILITIES		
15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cable
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes and waterway	Slope protection around Abutment required ,Remove of vegetation and cleaning is required
2	Drainage spouts	Cleaning is required
3	Expansion joints	Cleaning is required

4	Superstructure	Cracks & minor honeycomning are observed.
5	Bearings	Provide the corrosion protection and cleaning is required

17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit

View of Mobile Bridge Inspection Unit

17.2 Expansion Joints (If any)

View of strip seal expansion joint

View of strip seal expansion joint

17.3 Spout (If any)

View of drainage spouts

View of drainage spouts

17.4 Bearings (if any)

View of Rocker Roller bearing

View of Rocker Roller bearing

17.5 Abutment

Viwe of abutment

Viwe of abutment

17.6 Piers

View of pier

View of leaching is observed at pier

17.7 Superstructure

Cracks are observed

View of superstructure

17.8 Retaining wall (if any)

View of reataining wall

Stone pitching damaged

17.9 Overall Bridge

View of Overall bridge

View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Kochugaon- Rakhaldubi
5	Location Chainage	41294
6	Structure Number	42/2
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Data not avalible
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Kochugaon
12	Year of Construction	Data not avalible
13	Overall Bridge Length	78.00 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	No
31	Overall Deck Width in m	8.00 m
32	Approach Roadway Width including Shoulders in m	7.40 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	2.50 m and 23.50 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	3
40	Maximum Span	26.00 m
41	Type of Superstructure	Girder
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	POT cum PTFE
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
49	Type of Railing	RCC Cast In-Situ
50	Corrosion Protection	No
51	Bank Protection Type	No
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	Removal of vegetation and cleaning
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	Cracks, spalling and honey combing and reinforcement is exposed
62	Any other Observation/Data	No

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: KOCHUGAON-RAKHALDUBI**

CHAINAGE : KM 41+294 (RHS) **DATE OF INSPECTION: 06-12-2022**

TYPE OF STRUCTURE: MAJOR BRIDGE

STRUCTURE NO: 42/2

LATITUDE: 26.551014° **LONGITUDE: 90.163502°**

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Major bridge
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.50 m
1.6	Overall Deck width (m)	10.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	03 x 26.00 m
1.10	Total length of the bridge (m)	78.00 m
1.11	Vertical Clearance (m)	2.50 m
1.12	Whether meadian, if yes its width (m)	6.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	2.50 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Cast In-Situ & Length - 84.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	No spans

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	Pavement surface is in fair condition
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No damages
2.8	Approach slab (Check settlement, cracks,movement etc.)	Not visible
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Retaining wall is in fair condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	Not present
2.12	Approach Geometry (Check whether it satisfies the standard in force)	Satisfied
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	Stone pitching
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitching, Growth of vegetation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	Not present
	b) For Piers	Not present
3.4	Bank Protection & Type	Not present
3.5	Floor Protection & Type	Not visible
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	Growth of vegetation in vent way and island formation
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	Uniform. No change in flow, erosion of banks

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Information is not with the respective Department	
4.5	Check the adequacy of waterway	Adequate	
4.6	Check the errosion of bank	Not present	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Well	
5.2	Material	RCC	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good Condition	Good Condition
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No weep holes are being observed	No weep holes are being observed
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	Not visible as it is covered by growth of vegetation	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.1.9	Check damage of protective coating of painting.	Not visible	

6.2	Pier	02 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Hairline cracks are observed at pier 1	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.2.6	Check damage of protective coating of painting.	No damages	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not relevant	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not applicable	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 4 Nos. + 1 seismic arrester	02 x 3 Nos. + 1
8.2	No. per Pier	02 x 8 Nos. + 1	02 x 8 Nos. + 1
8.3	Type and allowable movements	POT cum PTFE	Square
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Corrosion and cleanliness is observed	Good Condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Proper functioning	-
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	03 Nos. & x 26.00 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab + PSC Girder	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	Exposed steel at span 2, S2/G4 and honey combing is observed
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	Hairline shear Cracks are observed near supporting end.
9.7	Check exposed reinforcement, if any	Reinforcement is exposed near bearing S2/G4
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No leaching
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	Corrosion of exposed reinforcement is observed
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No leakage
9.14	Check damages if any due to moving vehicle	No damages
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	Not relevant
9.16	Check excessive vibrations, if any	Not present

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	No
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Not present
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not relevant
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not relevant as this is not a box girder
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not relevant as this is not a submersible structure
9.22	Check peeling off of protective coat or paint	Protective coat is applied
9.23	Check steel members	Not relevant
9.24	Check condition of protective system	Not relevat as this is not an steel structure
9.25	Check corrosion, if any	Not relevat as this is not an steel structure
9.26	Check excessive vibrations, if any	Not relevat as this is not an steel structure
9.27	Check alignment of members	Not relevat as this is not an steel structure
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not relevat as this is not an steel structure
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not relevat as this is not an steel structure
9.30	Check buckling, kinking, warping and waviness	Not relevat as this is not an steel structure

9.31	Check apparent fracture if any	Not relevat as this is not an steel structure
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not relevat as this is not an steel structure
9.33	Check conditions inside the closed members	Not relevat as this is not an steel structure
9.34	Check masonry arches	Not relevat as this is not an arch structure
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not relevat as this is not an arch structure
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not relevat as this is not an arch structure
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not relevat as this is not an arch structure
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not relevat as this is not an arch structure
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not relevant as this is a concrete structure
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not relevant as this is a concrete structure
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not relevant as this is not an masonry structure
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	No misalignment of joints and debris are accmulated.
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Good condition but cracks are observed at several locations

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	Sealing material is damaged at pier P2
10.5	Check secureness of the joints	Secured
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	No damages
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	Not relevant as this is not a finger type of expansion joint
10.8	Check for debris in joints	Debris is accumulated in the joints
10.9	Report rattling, if any	Not present
10.10	Check drainage from expansion joint	Not relevant as this is not a finger type of expansion joint
10.11	Check alignment and clearance	Aligned
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Cracks are observed at several locations
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Drainage spouts are clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Drain pipes are provided, no structural members are affected
12.3	Check adequacy thereof	Adequate
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not relevant
12.5	For submersible bridges, report on functioning	Not relevant
12.6	Report absence of Drainage Spouts	Drainage spouts are provided

12.7	Check choking of drainage holes provided in the bottom booms	No bottom booms
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Cast In-Situ and crash barrier
13.2	Material	RCC
13.3	Condition	Fair condition, observed damage of cast In-Situ upto1 m
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	Yes
14.2	Material	RCC
14.3	Condition	Good Condition
14.4	Check missing footpath slab	No
14.5	Cleanless of ducts along with footpath	Yes
15.UTILITIES		
15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cable
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes and waterway	Remove of vegetation and cleaning is required
2	Drainage spouts	Cleaning is required
3	Expansion joints	Sealing material to be replaced at pier P1 and Cleaning is required
4	Superstructure	Spalling, honey combing and cracks are observed, Reinforcement is exposed
5	Bearings	Provide the corrosion protection and cleaning is required

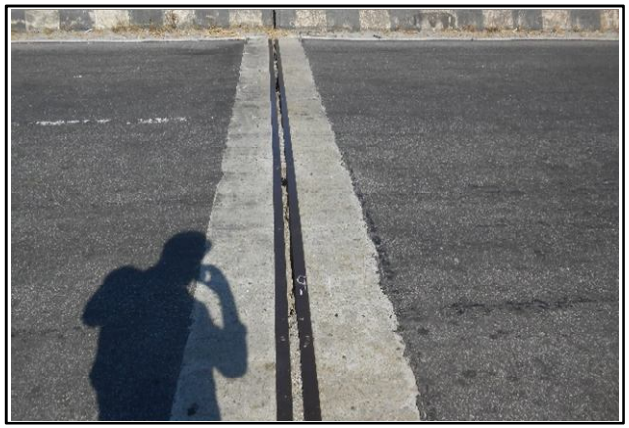
17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

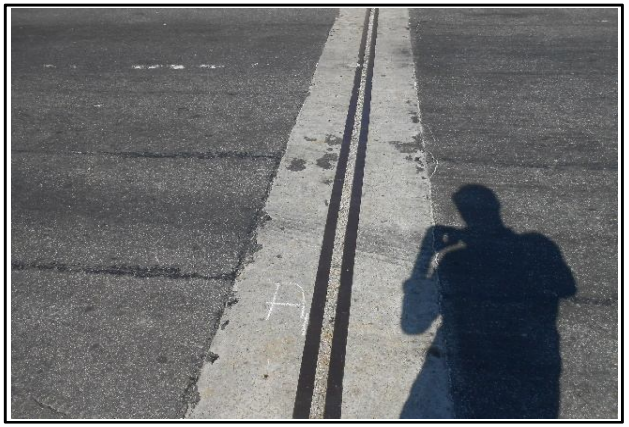
View of Mobile Bridge Inspection Unit

View of Mobile Bridge Inspection Unit

17.2 Expansion Joints (If any)



View of strip seal expansion joint



View of strip seal expansion joint

17.3 Spout (If any)

View of drainage spouts

View of drainage spouts

17.4 Bearings (if any)

View of POT cum PTFE bearing

View of sesmic arrester bearing

17.5 Abutment

View of abutment

Viwe of abutment

17.6 Piers

View of pier

View of pier

17.7 Superstructure

View of superstructure Exposed Steel

Cracks are observed

17.8 Overall Bridge

View of Overall bridge

View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Kochugaon- Rakhaldubi
5	Location Chainage	45177
6	Structure Number	46/1
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Data not avalible
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Kochugaon
12	Year of Construction	Data not avalible
13	Overall Bridge Length	69.00 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	No
31	Overall Deck Width in m	10.00 m
32	Approach Roadway Width including Shoulders in m	7.40 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	3.00 m and 20.00 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	3
40	Maximum Span	26.00 m
41	Type of Superstructure	Girder
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	POT cum PTFE
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
49	Type of Railing	RCC Cast In-Situ + RCC Crash barrier
50	Corrosion Protection	No
51	Bank Protection Type	No
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	No
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	Cracks are observed
62	Any other Observation/Data	No

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: KOCHUGAON-RAKHALDUBI**

CHAINAGE : KM 45+177 (LHS) **DATE OF INSPECTION: 06-12-2022**

TYPE OF STRUCTURE: MAJOR BRIDGE

STRUCTURE NO: 46/1

LATITUDE: 26.569092° **LONGITUDE: 90.195397°**

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Major bridge
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.50 m
1.6	Overall Deck width (m)	10.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	3 x 23.00 m
1.10	Total length of the bridge (m)	69.00 m
1.11	Vertical Clearance (m)	3.00 m
1.12	Whether meadian, if yes its width (m)	8.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	1.50 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Crash barrier + Cast In-Situ & Length - 75.00 m
	2.APPROACHES	
2.1	Type of Terrain	Curved, Super elevator
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	No spans

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	No cracks, settlement
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	Erosion of embankment
2.8	Approach slab (Check settlement, cracks,movement etc.)	Not visible
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Retaining wall is in fair condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	Not present
2.12	Approach Geometry (Check whether it satisfies the standard in force)	Satisfied
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	Not present
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitching, growth of vegetation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	Not present
	b) For Piers	Not present
3.4	Bank Protection & Type	Not present
3.5	Floor Protection & Type	Not visible
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	Obstruction due to growth of vegetation in vent way and island formation
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	No meandering of inflow

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Information is not with the respective Department	
4.5	Check the adequacy of waterway	Not Present	
4.6	Check the errosion of bank	Not Present	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Data not available	
5.2	Material	Data not available	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No cracks, settlement, sour, exposed steel	No cracks, settlement, sour, exposed steel
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No weepholes being observed	No weepholes being observed
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.1.9	Check damage of protective coating of painting.	Not Present	
6.2	Pier	02 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	

6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No cracks, settlement, sour, exposed steel	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.2.6	Check damage of protective coating of painting.	Not Present	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not applicable	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not applicable	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 4 Nos. + 1	02 x 4 Nos. + 1
8.2	No. per Pier	2 x 8 Nos. + 2	2 x 8 Nos. + 2
8.3	Type and allowable movements	POT cum PTFE	Rectangular
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Good condition	Good condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Proper functioning	Proper functioning
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	03 Nos. & 3 x 23.00 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab + Girders	
9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported	
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC	
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No Spalling and Honeycombing observed	

9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	Cracks are observed
9.7	Check exposed reinforcement, if any	No exposed reinforcement being observed
9.8	Check wear of deck surface	No wear of deck surface observed
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No surface stains stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No leaching observed
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No corrosion of reinforcement being observed
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No leakage
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	No cracks and exposed reinforcement being observed
9.16	Check excessive vibrations, if any	No
9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	Not present
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	No cracks being observed
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not relevant

9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not relevant as this is not a box girder.
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not relevant as this is not a submersible structure
9.22	Check peeling off of protective coat or paint	Protective coat is not applied
9.23	Check steel members	No
9.24	Check condition of protective system	Not relevant as this not an steel structure
9.25	Check corrosion, if any	Not relevant as this not an steel structure
9.26	Check excessive vibrations, if any	Not relevant as this not an steel structure
9.27	Check alignment of members	Not relevant as this not an steel structure
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not relevant as this not an steel structure
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not relevant as this not an steel structure
9.30	Check buckling, kinking, warping and waviness	Not relevant as this not an steel structure
9.31	Check apparent fracture if any	Not relevant as this not an steel structure
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not relevant as this not an steel structure
9.33	Check conditions inside the closed members	Not relevant as this not an steel structure

9.34	Check masonry arches	Not relevant as this not an Arch structure
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not relevant as this not an Arch structure
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not relevant as this not an Arch structure
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not relevant as this not an Arch structure
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not relevant as this not an Arch structure
9.39	Check growth of vegetation	Not relevant as this not an Arch structure
9.40	Check all cast iron/wrought iron components	Not relevant as this a Concrete structure
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not relevant as this a Concrete structure
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not relevant as this a Concrete structure
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	No misalignment of joints being observed
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	No cracks in wearing coarse
10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	Not visible
10.5	Check secureness of the joints	Secured
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	No corrosion and damage

10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	Not relevant as this is not a finger type expansion joint
10.8	Check for debris in joints	Cleaned
10.9	Report rattling, if any	No rattling
10.10	Check drainage from expansion joint	Not relevant as this is not a finger type expansion joint
10.11	Check alignment and clearance	In aligned
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Cracks and potholes are observed
11.3	Details of water proofing system, if any	Not present
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Drainage spouts are clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Drain pipes are provided, no structural members are affected
12.3	Check adequacy thereof	Adeqated
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not relevant as this not a subway structure
12.5	For submersible bridges, report on functioning	Not relevant as this not a submersible bridge
12.6	Report absence of Drainage Spouts	Not relevant
12.7	Check choking of drainage holes provided in the bottom booms	No Bottom booms
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes
13.2	Material	RCC Crash barrier + Railling Cast In-Situ

13.3	Condition	Good condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	Yes
14.2	Material	RCC
14.3	Condition	Good condition
14.4	Check missing footpath slab	No
14.5	Cleanless of ducts along with footpath	No
15.UTILITIES		
15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cable
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes and waterway	Remove of vegetation and cleaning is required
2	Expansion joints	Cleaning is required
3	Drainage spouts	Cleaning is required
4	Superstructure	Cracks are observed

17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit

View of Mobile Bridge Inspection Unit

17.2 Expansion Joints (If any)

View of strip seal expansion joint

Debris is accmulated

17.3 Bearings (if any)

View of POT cum PTFE

Corrosion of bearings

17.4 Abutment

Viwe of abutment

Viwe of abutment

17.5 Piers

View of pier

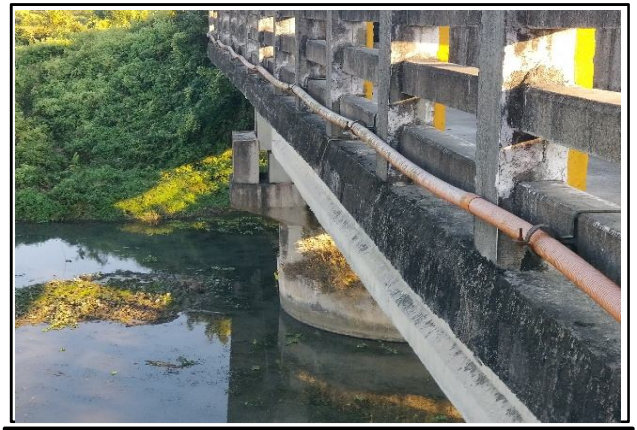
View of pier

17.6 Superstructure

View of superstructure

View of superstructure

17.7 Retaining wall (if any)



View of retaining wall

View of retaining wall

17.8 Overall Bridge

View of Overall bridge

View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Kochugaon- Rakhaldubi
5	Location Chainage	45177
6	Structure Number	46/1
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Data not avalible
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Kochugaon
12	Year of Construction	Data not avalible
13	Overall Bridge Length	66.00 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	No
31	Overall Deck Width in m	8.00 m
32	Approach Roadway Width including Shoulders in m	7.40 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	3.00 m and 19.00 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	3
40	Maximum Span	26.00 m
41	Type of Superstructure	T-Beam
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	Rocker Roller
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
49	Type of Railing	RCC Cast In-Situ
50	Corrosion Protection	No
51	Bank Protection Type	No
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	No
60	Distress and Repairs in Substructure	Reinforcement is exposed
61	Distress and Repairs in Superstructure	Cracks and spalling is observed, Reinforcement is exposed
62	Any other Observation/Data	Expansion joint sealing material has to be replaced.

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: KOCHUGAON-RAKHALDUBI**

CHAINAGE : KM 45+177 (RHS) **DATE OF INSPECTION: 06-12-2022**

TYPE OF STRUCTURE: MAJOR BRIDGE

STRUCTURE NO: 46/1

LATITUDE:26.568935° **LONGITUDE: 90.195338°**

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Major bridge
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.50 m
1.6	Overall Deck width (m)	8.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	3 x 22.00 m
1.10	Total length of the bridge (m)	66.00 m
1.11	Vertical Clearance (m)	3.00 m
1.12	Whether meadian, if yes its width (m)	8.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	2.50 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Railling+ Cast In-Situ & Length - 72.00 m
	2.APPROACHES	
2.1	Type of Terrain	Curved, Super elevator
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	No spans

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	No cracks are observed
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	Erosion of embankment
2.8	Approach slab (Check settlement, cracks,movement etc.)	No Settlement
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Retaining wall is in fair condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	Not present
2.12	Approach Geometry (Check whether it satisfies the standard in force)	Satisfy
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	Not present
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitching, growth of vegetation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	Not present
	b) For Piers	Not present
3.4	Bank Protection & Type	Not present
3.5	Floor Protection & Type	Not visible
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	Growth of vegetation and island formation
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	Uniform. No change in flow, erosion of banks

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	No	
4.5	Check the adequacy of waterway	No	
4.6	Check the errosion of bank	Not visible	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Information is not with the respective Department	
5.2	Material	Information is not with the respective Department	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No settlement and tilting	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	Good condition
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No	No
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No cracking and seepage	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant as this not a flyover or viaduct	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not relevant as this not a flyover or viaduct	
6.1.9	Check damage of protective coating of painting.	Not visible	

6.2	Pier	02 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant as this not a flyover or viaduct	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not relevant as this not a flyover or viaduct	
6.2.6	Check damage of protective coating of painting.	Not visible	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not relevant	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not relevant	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 3 Nos.	02 x 3 Nos.
8.2	No. per Pier	02 x 6 Nos.	02 x 6 Nos.
8.3	Type and allowable movements	Elastomeric	Rectangular
8.4	Material	Rubber and steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Good condition (Cleaning required)	Good condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Proper functioning	-
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	03 Nos. & 3 x 22.00 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab + T-Beam	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	Hairline cracks , Honeycombing ,exposed steel and Spalling is observed S1/G1 & S2/G3
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	Cracks are observed
9.7	Check exposed reinforcement, if any	Reinforcement is exposed
9.8	Check wear of deck surface	No wear of deck surface observed
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No surface stains stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No leaching observed
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No corrosion of reinforcement being observed
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No leakage
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	No cracks and exposed reinforcement being observed
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	Not present
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	No cracks being observed
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not relevant
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not relevant as this is not a box girder.
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not relevant as this is not a submersible structure
9.22	Check peeling off of protective coat or paint	Protective coat is not applied
9.23	Check steel members	No
9.24	Check condition of protective system	Not relevant as this not an steel structure
9.25	Check corrosion, if any	Not relevant as this not an steel structure
9.26	Check excessive vibrations, if any	Not relevant as this not an steel structure
9.27	Check alignment of members	Not relevant as this not an steel structure
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not relevant as this not an steel structure
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not relevant as this not an steel structure
9.30	Check buckling, kinking, warping and waviness	Not relevant as this not an steel structure

9.31	Check apparent fracture if any	Not relevant as this not an steel structure
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not relevant as this not an steel structure
9.33	Check conditions inside the closed members	Not relevant as this not an steel structure
9.34	Check masonry arches	Not relevant as this not an Arch structure
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not relevant as this not an Arch structure
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not relevant as this not an Arch structure
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not relevant as this not an Arch structure
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not relevant as this not an Arch structure
9.39	Check growth of vegetation	Not relevant as this not an Arch structure
9.40	Check all cast iron/wrought iron components	Not relevant as this a Concrete structure
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not relevant as this a Concrete structure
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not relevant as this a Concrete structure
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	No misalignment of joints being observed
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	No cracks in wearing coarse

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	Neoprene sealing material damaged
10.5	Check secureness of the joints	Secured
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	No corrosion and damage
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	Not relevant as this is not a finger type expansion joint
10.8	Check for debris in joints	Cleaned
10.9	Report rattling, if any	No rattling
10.10	Check drainage from expansion joint	Not relevant as this is not a finger type expansion joint
10.11	Check alignment and clearance	In aligned
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Good condition
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Drainage spouts are clear
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Drain pipes are not provided, structural members are affected
12.3	Check adequacy thereof	Adeqated
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not relevant as this not a subway structure
12.5	For submersible bridges, report on functioning	Not relevant as this not a submersible bridge
12.6	Report absence of Drainage Spouts	Not relevant

12.7	Check choking of drainage holes provided in the bottom booms	No Bottom booms
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes
13.2	Material	RCC Railling Cast In-Situ
13.3	Condition	poor condition (12mt damaged A2 side)
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	No
14.2	Material	Not relevant
14.3	Condition	Not relevant
14.4	Check missing footpath slab	Not relevant
14.5	Cleanless of ducts along with footpath	Not relevant
15.UTILITIES		
15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cable
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes and waterway	Remove of vegetation and cleaning is required
2	Expansion joints	Sealing material to be replaed and Cleaning is required
3	Pier	Leaching ,Stains on piers and cracks on abutment A1 wall leakage observed.
4	Superstructure	Cracks, Honeycombing, Spalling ,Reinforcement is exposed observed
5	Bearings	corrosion protection and Cleanling Required.

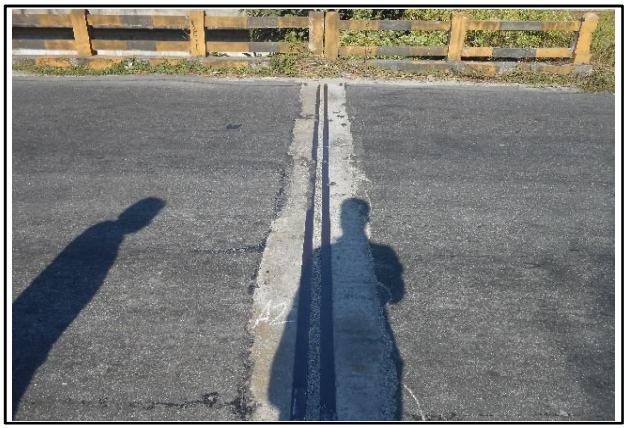
17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit

View of Mobile Bridge Inspection Unit

17.2 Expansion Joints (If any)



View of strip seal expansion joint

View of strip seal expansion joint

17.3 Spout (If any)

View of drainage spouts

View of drainage spouts

17.3 Bearings (if any)

View of Elastomeric bearing

Cleaning of bearings

17.4 Abutment

Viwe of abutment

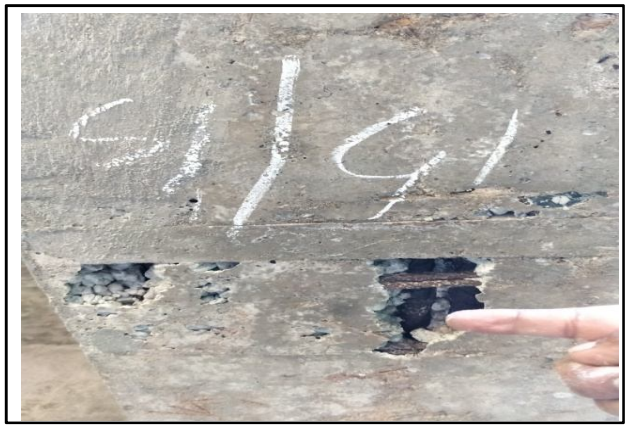
Viwe of abutment

17.5 Piers

View of pier

Reinforcment exposed and damages of pier

17.6 Superstructure



Reinforcment exposed

View of superstructure

17.8 Overall Bridge

View of Overall bridge

View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Kochugaon- Rakhaldubi
5	Location Chainage	45522
6	Structure Number	46/3
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Data not avalible
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Kochugaon
12	Year of Construction	Data not avalible
13	Overall Bridge Length	72.00 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	No
31	Overall Deck Width in m	10.00 m
32	Approach Roadway Width including Shoulders in m	7.50 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	3.00 m and 21.00 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	3
40	Maximum Span	24.00 m
41	Type of Superstructure	PSC Girder
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	POT cum PTFE
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
49	Type of Railing	RCC Crash barrier + Cast In-Situ
50	Corrosion Protection	No
51	Bank Protection Type	Yes
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	No
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	Data not avalible
62	Any other Observation/Data	Expansion joint sealing material has to be replaced.

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: KOCHUGAON-RAKHALDUBI**

CHAINAGE : KM 45+522 (LHS) **DATE OF INSPECTION: 06-12-2022**

TYPE OF STRUCTURE: MAJOR BRIDGE

STRUCTURE NO: 46/3

LATTITUDE:- 26.567465° **LONGITUDE:- 90.198358°**

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Major bridge
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.50 m
1.6	Overall Deck width (m)	10.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	03 x 24.00 m
1.10	Total length of the bridge (m)	72.00 m
1.11	Vertical Clearance (m)	4.00 m
1.12	Whether meadian, if yes its width (m)	8.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	3.50 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Crash barrier + Cast In-Situ & Length - 79.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	No spans

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	Cracks,uneveness, bulging are observed
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Stone pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No damages
2.8	Approach slab (Check settlement, cracks,movement etc.)	Minor Settlement observed towards A1 side
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Retaining wall is in fair condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	Not present
2.12	Approach Geometry (Check whether it satisfies the standard in force)	Satisfied
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	Stone pitched, growth of vegitation
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitched, growth of vegitation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	Not present
	b) For Piers	Not present
3.4	Bank Protection & Type	Not present
3.5	Floor Protection & Type	Not visible
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	Obstruction due to growth of vegetation in vent way and island formation
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	No meandering of inflow

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Information is not with the respective Department	
4.5	Check the adequacy of waterway	Not Present	
4.6	Check the errosion of bank	Not Present	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Well foundation	
5.2	Material	RCC	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No cracks, settlement, sour, exposed steel	No cracks, settlement, sour, exposed steel
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No weepholes being observed	No weepholes being observed
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.1.9	Check damage of protective coating of painting.	Not Present	

6.2	Pier	02 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No cracks, settlement, sour, exposed steel	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.2.6	Check damage of protective coating of painting.	Not Present	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not applicable	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not applicable	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 4 Nos. + 1	02 x 4 Nos. + 1
8.2	No. per Pier	02 x 8 Nos.	02 x 8 Nos.
8.3	Type and allowable movements	POT cum PTFE	Rectangular
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Corrosion is observed	Good condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Proper functioning	-
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	03 Nos. & 3 x 24.00 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab + PSC Girder	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported (End diaphrams honeycombing observed)
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC + PSC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	Honeycombing observed near bearing locations.
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	No cracks
9.7	Check exposed reinforcement, if any	No exposed reinforcement being observed
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No leaching observed
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No corrosion of reinforcement being observed
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No Leakage
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	No cracks and exposed reinforcement being observed.
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	Not present
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Not relevant as this is not a prestressed concrete members
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not relevant
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not relevant as this is not a box girder
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not relevant as this is not a submersible structure
9.22	Check peeling off of protective coat or paint	Protective coat is not applied
9.23	Check steel members	No
9.24	Check condition of protective system	Not relevant as this not an steel structure
9.25	Check corrosion, if any	Not relevant as this not an steel structure
9.26	Check excessive vibrations, if any	Not relevant as this not an steel structure
9.27	Check alignment of members	Not relevant as this not an steel structure
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not relevant as this not an steel structure
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not relevant as this not an steel structure
9.30	Check buckling, kinking, warping and waviness	Not relevant as this not an steel structure

9.31	Check apparent fracture if any	Not relevant as this not an steel structure
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not relevant as this not an steel structure
9.33	Check conditions inside the closed members	Not relevant as this not an steel structure
9.34	Check masonry arches	Not relevant as this not an arch structure
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not relevant as this not an arch structure
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not relevant as this not an arch structure
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not relevant as this not an arch structure
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not relevant as this not an arch structure
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not relevant as this is a concrete structure
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not relevant as this is a concrete structure
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not relevant as this is not masonry structure
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	Fair condition, No misalignment of joints, debris are accmulated.
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Fair condition

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	Neoprene sealing material is damged and excessive gap observed.
10.5	Check secureness of the joints	Secured
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	No corrosion and damage
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	Not relevant as this is not a finger type expansion joint
10.8	Check for debris in joints	Debris is accmulated in joints
10.9	Report rattling, if any	No rattling
10.10	Check drainage from expansion joint	Not relevant as this is not a finger type expansion joint
10.11	Check alignment and clearance	In aligned
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Bulging and cracks observed
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Projection of spouts are provided being observed and structural members are not being affected
12.3	Check adequacy thereof	Adequate
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not relevant as this not a subway
12.5	For submersible bridges, report on functioning	Not relevant as this not a submersible type of bridge
12.6	Report absence of Drainage Spouts	Not relevant

12.7	Check choking of drainage holes provided in the bottom booms	No bottom booms
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Crash barrier + Cast In-Situ
13.2	Material	RCC
13.3	Condition	Good condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	Yes
14.2	Material	RCC
14.3	Condition	Good condition
14.4	Check missing footpath slab	No
14.5	Cleanless of ducts along with footpath	Yes
15.UTILITIES		
15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cable
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes and waterway	Remove of vegetation and cleaning is required
2	Drainage spouts	Cleaning is required
3	Expansion joints	Sealing materials to be replace and excessive gap observed.
4	Pavement surface	Cracks and bulging observed
5	Bearings	Provide the corrosion protection and cleaning is required

17.PHOTOGRAPHS

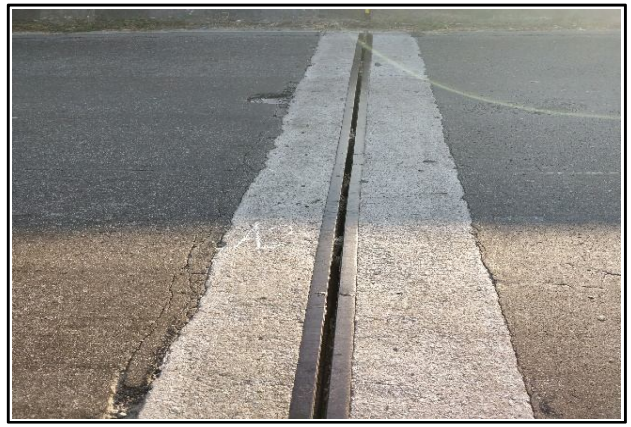
17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit

View of Mobile Bridge Inspection Unit

17.2 Expansion Joints (If any)

View of strip seal expansion joint



View of strip seal expansion joint

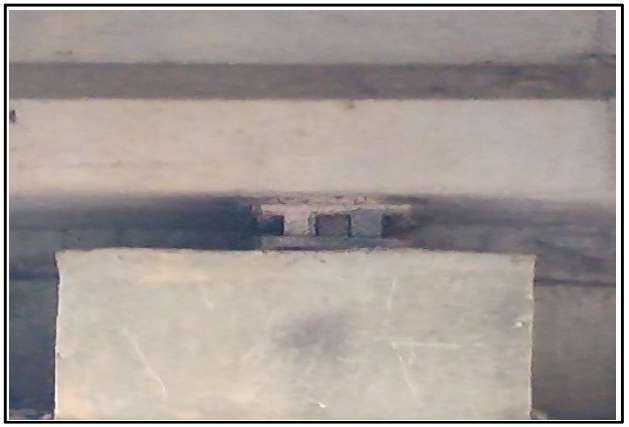
17.3 Spout (If any)

View of drainage spouts

View of drainage spouts

17.4 Bearings (if any)

View of Rocker Roller bearing



View of Seismic Arrester bearing

17.5 Abutment

View of abutment

View of abutment

17.6 Piers

View of pier cap

View of pier

17.7 Superstructure

View of superstructure

View of superstructure

17.9 Overall Bridge

View of Overall bridge

View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Kochugaon- Rakhaldubi
5	Location Chainage	45522
6	Structure Number	46/3
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Data not avalible
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Kochugaon
12	Year of Construction	Data not avalible
13	Overall Bridge Length	73.20 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	No
31	Overall Deck Width in m	8.00 m
32	Approach Roadway Width including Shoulders in m	7.50 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	3.50 m and 21.00 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	3
40	Maximum Span	24.40 m
41	Type of Superstructure	PSC Box Girder
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	Roller
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
49	Type of Railing	RCC Crash barrier + Cast In-Situ
50	Corrosion Protection	No
51	Bank Protection Type	Yes
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	No
60	Distress and Repairs in Substructure	Pier2 is damaged.
61	Distress and Repairs in Superstructure	Box girder at pier 2 is damaged.
62	Any other Observation/Data	Missing of roller bearing.

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: KOCHUGAON-RAKHALDUBI**

CHAINAGE : KM 45+522 (RHS) **DATE OF INSPECTION: 06-12-2022**

TYPE OF STRUCTURE: MAJOR BRIDGE

STRUCTURE NO: 46/3

LATTITUDE:- 26.567569° **LONGITUDE:- 90.198484°**

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Major bridge
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.40 m
1.6	Overall Deck width (m)	8.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	03 x 24.40 m
1.10	Total length of the bridge (m)	73.20 m
1.11	Vertical Clearance (m)	3.50 m
1.12	Whether meadian, if yes its width (m)	6.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	2.00 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Railling Cast In-Situ & Length - 80.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	No spans

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	Pavement surface is in fair condition
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No damages
2.8	Approach slab (Check settlement, cracks,movement etc.)	No settlement
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Retaining wall is in fair condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	No
2.12	Approach Geometry (Check whether it satisfies the standard in force)	No
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	No
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	No
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	Not present
	b) For Piers	Not present
3.4	Bank Protection & Type	Not present
3.5	Floor Protection & Type	Not visible
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	Obstruction due to growth of vegetation is observed
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	No meandering of inflow

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Information is not with the respective Department	
4.5	Check the adequacy of waterway	Not Present	
4.6	Check the errosion of bank	Not Present	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Not visible	
5.2	Material	Not visible	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Cracks are observed	cracks observed And no settlement, sour, exposed steel
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No weepholes being observed	No weepholes being observed
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.1.9	Check damage of protective coating of painting.	Not Present	

6.2	Pier	02 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Pier 2 is damaged completely and reinforcement is exposed	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.2.6	Check damage of protective coating of painting.	Not visible	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not relevant	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not relevant	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 3 Nos.	02 x 3 Nos.
8.2	No. per Pier	03 x 6 Nos.	03 x 6 Nos.
8.3	Type and allowable movements	Roller	Rectangular
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Roller bearing on pier 2 is totally damaged	Pedestal is damaged completely at pier 2
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	No functioning	POOR Condtion
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	03 Nos. & x 26.00 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	Box Girder	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	Spalling and honey combing is observed at pier 2
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	Major cracks are observed due to damage of pier 2
9.7	Check exposed reinforcement, if any	Exposed reinforcement is observed at pier 2
9.8	Check wear of deck surface	Bottom of deck slab is damaged completely at the end diaphragam
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No leaching observed
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No corrosion of reinforcement being observed
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No Leakage
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	No cracks and exposed reinforcement being observed.
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	Not present
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Not relevant as this is not a prestressed concrete members
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not relevant
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	**Span2 and 3 on Pier2 box girder bottom totally damaged and major cracks on outer faces of flanges. Immediate reconstruction required.**
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not relevant as this is not a submersible structure
9.22	Check peeling off of protective coat or paint	Protective coat is not applied
9.23	Check steel members	No
9.24	Check condition of protective system	Not relevant as this not an steel structure
9.25	Check corrosion, if any	Not relevant as this not an steel structure
9.26	Check excessive vibrations, if any	Not relevant as this not an steel structure
9.27	Check alignment of members	Not relevant as this not an steel structure
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not relevant as this not an steel structure
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not relevant as this not an steel structure
9.30	Check buckling, kinking, warping and waviness	Not relevant as this not an steel structure

9.31	Check apparent fracture if any	Not relevant as this not an steel structure
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not relevant as this not an steel structure
9.33	Check conditions inside the closed members	Not relevant as this not an steel structure
9.34	Check masonry arches	Not relevant as this not an arch structure
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not relevant as this not an arch structure
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not relevant as this not an arch structure
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not relevant as this not an arch structure
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not relevant as this not an arch structure
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not relevant as this is a concrete structure
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not relevant as this is a concrete structure
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not relevant as this is not masonry structure
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	Fair condition, No misalignment of joints, debris are accmulated.
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Bulges and cracks are observed in wearing course

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	Sealing materials totally damaged and excessive gap observed.
10.5	Check secureness of the joints	Secured
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	No corrosion and damage
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	Not relevant as this is not a finger type expansion joint
10.8	Check for debris in joints	Debris is accmulated in joints
10.9	Report rattling, if any	No rattling
10.10	Check drainage from expansion joint	Not relevant as this is not a finger type expansion joint
10.11	Check alignment and clearance	In aligned
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Fair condition
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Projection of spouts are provided being observed and structural members are not being affected
12.3	Check adequacy thereof	Adequate
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not relevant as this not a subway
12.5	For submersible bridges, report on functioning	Not relevant as this not a submersible type of bridge
12.6	Report absence of Drainage Spouts	Not relevant

12.7	Check choking of drainage holes provided in the bottom booms	No bottom booms
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Cast In-Situ
13.2	Material	RCC
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	No
14.2	Material	Not applicable
14.3	Condition	Not applicable
14.4	Check missing footpath slab	Not applicable
14.5	Cleanless of ducts along with footpath	Not applicable
15.UTILITIES		
15.1	Present (Yes/No)	No
15.2	Type of Utility	No
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes and waterway	Remove of vegetation and cleaning is required
2	Drainage spouts	Cleaning is required
3	Expansion joints	Cleaning is required
4	Substructure	PIER2 Totally damaged ,steel exposed
5	Superstructure	Span2 and 3 on Pier2 box girder bottom totally damaged and major cracks on outter
6	Bearings	Missing of roller bearing and no functioning ,rusting Replacment with superstructure

SPECIAL OBSERVATION : REPLACEMNET OF SUPERSTRUCTURE AND MAJOR REPAIR TO SUBSTRUCTURE AND REPLACMENT OF BEARING.

17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit

View of Mobile Bridge Inspection Unit

17.2 Expansion Joints (If any)

View of strip seal expansion joint

View of strip seal expansion joint

17.3 Spout (If any)

View of drainage spouts

View of drainage spouts

17.4 Bearings (if any)

View of Roller Bearing displacment

View of Roller bearing

17.5 Abutment

View of abutment

View of Pier1

17.6 Piers

View of pier 2

View of pier

17.7 Superstructure

View of superstructure

Reinforcement is Exposed

17.8 Retaining wall (if any)

Growth of Vegetation

Growth of Vegetation

17.9 Overall Bridge

View of Overall bridge

View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Kochugaon- Rakhaldubi
5	Location Chainage	46950
6	Structure Number	47/2
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Data not avalible
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Kochugaon
12	Year of Construction	Data not avalible
13	Overall Bridge Length	174.00 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	1.00 m
31	Overall Deck Width in m	10.00 m
32	Approach Roadway Width including Shoulders in m	7.50 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	4.50 m and 40.50 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	4
40	Maximum Span	43.50 m
41	Type of Superstructure	PSC Box Girder
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	POT cum PTFE
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
49	Type of Railing	RCC Crash barrier + Cast In-Situ
50	Corrosion Protection	No
51	Bank Protection Type	Yes
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	No
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	Data not avalible
62	Any other Observation/Data	All Expansion Joints sealing material has to be replaced.

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: KOCHUGAON-RAKHALDUBI**

CHAINAGE : KM 46+950 (LHS) **DATE OF INSPECTION: 07-12-2022**

TYPE OF STRUCTURE: MAJOR BRIDGE

STRUCTURE NO: 47/2

LATTITUDE:- 26.568636° **LONGITUDE:- 90.210940°**

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Major bridge
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.50 m
1.6	Overall Deck width (m)	10.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	04 x 43.50 m
1.10	Total length of the bridge (m)	174.00 m
1.11	Vertical Clearance (m)	4.50 m
1.12	Whether meadian, if yes its width (m)	6.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	3.50 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Crash barrier + Cast In-Situ & Length - 184.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	Not Present

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	No cracks, potholes and uneven settlement surface
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No Erosion of embankment is observed
2.8	Approach slab (Check settlement, cracks,movement etc.)	No settlement and cracks
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Not accessible due to extensive growth of vegetation
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	Not Present
2.12	Approach Geometry (Check whether it satisfies the standard in force)	Satisfied
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	Stone pitched
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitching, growth of vegetation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	Not Present
	b) For Piers	Not Present
3.4	Bank Protection & Type	Not Present
3.5	Floor Protection & Type	Not visible
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	No obstruction in waterway
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	No meandering of inflow

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Information is not with the respective Department	
4.5	Check the adequacy of waterway	Not Present	
4.6	Check the errosion of bank	Not Present	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Well foundation	
5.2	Material	RCC	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	Good condition
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No weepholes being observed	No weepholes being observed
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.1.9	Check damage of protective coating of painting.	Not Present	

6.2	Pier	03 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.2.6	Check damage of protective coating of painting.	Not Present	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not relevant	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not relevant	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 3 Nos.	02 x 3 Nos.
8.2	No. per Pier	03 x 6 Nos.	03 x 6 Nos.
8.3	Type and allowable movements	POT cum PTFE	Square
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Good condition	Good condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Proper functioning	-
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	04 Nos. & 4 x 43.50 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	Deck slab + Box Girder	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	PSC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No spalling and honeycombing observed
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	No cracks
9.7	Check exposed reinforcement, if any	No exposed reinforcement being observed
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	Leaching is observed at the expansion joints
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No corrosion of reinforcement being observed
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No Leakage
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	No cracks and exposed reinforcement being observed.
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	Not present
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	No cracks
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not relevant
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Internal flanges and webs are easily accessible and no signs of distress is observed
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not relevant as this is not a submersible structure
9.22	Check peeling off of protective coat or paint	Protective coat is not applied
9.23	Check steel members	No
9.24	Check condition of protective system	Not relevant as this not an steel structure
9.25	Check corrosion, if any	Not relevant as this not an steel structure
9.26	Check excessive vibrations, if any	Not relevant as this not an steel structure
9.27	Check alignment of members	Not relevant as this not an steel structure
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not relevant as this not an steel structure
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not relevant as this not an steel structure
9.30	Check buckling, kinking, warping and waviness	Not relevant as this not an steel structure

9.31	Check apparent fracture if any	Not relevant as this not an steel structure
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not relevant as this not an steel structure
9.33	Check conditions inside the closed members	Not relevant as this not an steel structure
9.34	Check masonry arches	Not relevant as this not an arch structure
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not relevant as this not an arch structure
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not relevant as this not an arch structure
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not relevant as this not an arch structure
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not relevant as this not an arch structure
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not relevant as this is a concrete structure
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not relevant as this is a concrete structure
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not relevant as this is not masonry structure
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	No misalignment of joints and debris are accmulated.
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Cracks are observed in wearing course

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	Sealing material in all the expansion joints is damaged
10.5	Check secureness of the joints	Secured
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	No corrosion and damage
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	Not relevant as this is not a finger type expansion joint
10.8	Check for debris in joints	Debris is accmulated in joints
10.9	Report rattling, if any	No rattling
10.10	Check drainage from expansion joint	Not relevant as this is not a finger type expansion joint
10.11	Check alignment and clearance	In aligned
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Minor cracks are observed
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Projection of spouts are provided being observed and structural members are not being affected
12.3	Check adequacy thereof	Adequate
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not relevant as this not a subway
12.5	For submersible bridges, report on functioning	Not relevant as this not a submersible type of bridge
12.6	Report absence of Drainage Spouts	Not relevant

12.7	Check choking of drainage holes provided in the bottom booms	No bottom booms
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Crash barrier + Cast In-Situ
13.2	Material	RCC
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	Yes
14.2	Material	RCC
14.3	Condition	Fair condition
14.4	Check missing footpath slab	No
14.5	Cleanless of ducts along with footpath	No
15.UTILITIES		
15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cable
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes	Remove of vegetation and cleaning is required
2	Drainage spouts	Cleaning is required
3	Expansion joints	All expansion joints sealing material to be replaced and Cleaning is required

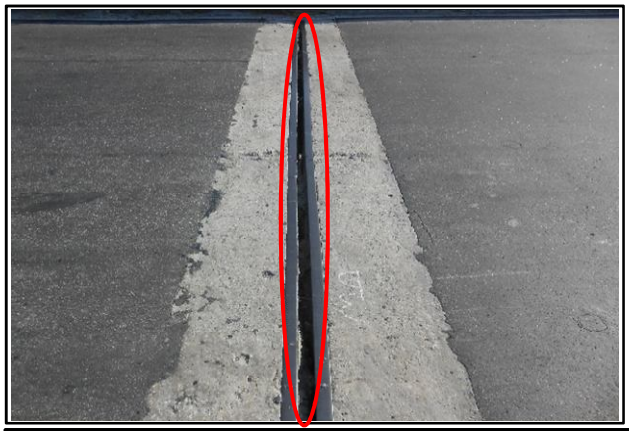
17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

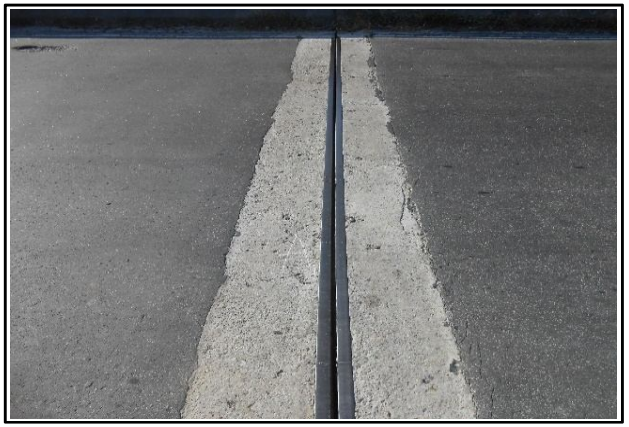
View of Mobile Bridge Inspection Unit

View of Mobile Bridge Inspection Unit

17.2 Expansion Joints (If any)



View of strip seal expansion joint



View of strip seal expansion joint

17.3 Spout (If any)

View of drainage spouts

View of drainage spouts

17.4 Bearings (if any)

View of Rocker Roller bearing

View of Seismic Arrester bearing

17.5 Abutment

View of abutment

View of abutment

17.6 Piers

View of pier

View of pier

17.7 Superstructure

View of Box Girder inside

View of superstructure

17.8 Overall Bridge

View of Overall bridge

View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Kochugaon- Rakhaldubi
5	Location Chainage	46950
6	Structure Number	47/2
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Data not avalible
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Kochugaon
12	Year of Construction	Data not avalible
13	Overall Bridge Length	174.00 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	No
31	Overall Deck Width in m	8.00 m
32	Approach Roadway Width including Shoulders in m	7.40 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	4.50 m and 40.50 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	4
40	Maximum Span	43.50 m
41	Type of Superstructure	PSC Girder
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	Rocker roller
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
49	Type of Railing	RCC Hand rail
50	Corrosion Protection	No
51	Bank Protection Type	Yes
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	No
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	Data not avalible
62	Any other Observation/Data	Corrosion protection for bearings is required.

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: KOCHUGAON-RAKHALDUBI**

CHAINAGE : KM 46+950 (RHS) **DATE OF INSPECTION: 07-12-2022**

TYPE OF STRUCTURE: MAJOR BRIDGE

STRUCTURE NO: 47/2

LATTITUDE:- 26.568506° **LONGITUDE:- 90.210877°**

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Major bridge
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.40 m
1.6	Overall Deck width (m)	8.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	04 x 43.50 m
1.10	Total length of the bridge (m)	174.00 m
1.11	Vertical Clearance (m)	4.50 m
1.12	Whether meadian, if yes its width (m)	6.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	4.50 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Hand rail & Length - 184.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	Not Present

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	No cracks, potholes and uneven settlement surface
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No Erosion of embankment is observed
2.8	Approach slab (Check settlement, cracks,movement etc.)	No settlement and cracks
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Not accessible due to extensive growth of vegetation
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	Not Present
2.12	Approach Geometry (Check whether it satisfies the standard in force)	Satisfied
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	Stone pitching
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitching, growth of vegetation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	Not Present
	b) For Piers	Not Present
3.4	Bank Protection & Type	Front protection observed
3.5	Floor Protection & Type	Not Present
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	No obstruction in waterway
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	No meandering of inflow

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Information is not with the respective Department	
4.5	Check the adequacy of waterway	Not Present	
4.6	Check the errosion of bank	Not Present	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Well foundation	
5.2	Material	RCC	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	Good condition
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No weepholes being observed	No weepholes being observed
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.1.9	Check damage of protective coating of painting.	Not Present	

6.2	Pier	03 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Scaling upto 1 m is observed on piers	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.2.6	Check damage of protective coating of painting.	Not Present	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not applicable	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not applicable	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 3 Nos.	02 x 3 Nos.
8.2	No. per Pier	03 x 6 Nos.	03 x 6 Nos.
8.3	Type and allowable movements	Rocker	Rectangular
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Rusting in bearings is observed	Good condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Good functioning	-
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	04 Nos. & 4 x 43.50 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab + Girder	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	PSC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No spalling and honeycombing observed
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	No cracks
9.7	Check exposed reinforcement, if any	No exposed reinforcement being observed
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	Leaching is onserved at expansion joints
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No corrosion of reinforcement being observed
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No Leakage
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	No cracks and exposed reinforcement being observed.
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	Not present
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Not relevant as this is not a prestressed concrete members
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not applicable
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not relevant as this is not a box girder
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not relevant as this is not a submersible structure
9.22	Check peeling off of protective coat or paint	Protective coat is not applied
9.23	Check steel members	No
9.24	Check condition of protective system	Not relevant as this not an steel structure
9.25	Check corrosion, if any	Not relevant as this not an steel structure
9.26	Check excessive vibrations, if any	Not relevant as this not an steel structure
9.27	Check alignment of members	Not relevant as this not an steel structure
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not relevant as this not an steel structure
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not relevant as this not an steel structure
9.30	Check buckling, kinking, warping and waviness	Not relevant as this not an steel structure

9.31	Check apparent fracture if any	Not relevant as this not an steel structure
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not relevant as this not an steel structure
9.33	Check conditions inside the closed members	Not relevant as this not an steel structure
9.34	Check masonry arches	Not relevant as this not an arch structure
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not relevant as this not an arch structure
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not relevant as this not an arch structure
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not relevant as this not an arch structure
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not relevant as this not an arch structure
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not relevant as this is a concrete structure
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not relevant as this is a concrete structure
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not relevant as this is not masonry structure
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	Misalignment of joints, debris are accmulated.
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Expansion joint edge beam damaged at pier 1

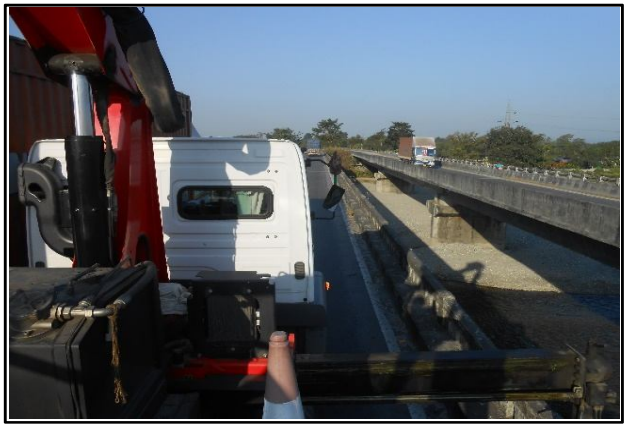
10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	All expansion joints sealing material is damaged
10.5	Check secureness of the joints	Secured
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	No corrosion and damage
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	Not relevant as this is not a finger type expansion joint
10.8	Check for debris in joints	Debris is accmulated in joints
10.9	Report rattling, if any	No rattling
10.10	Check drainage from expansion joint	Not relevant as this is not a finger type expansion joint
10.11	Check alignment and clearance	In aligned
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Bulges and potholes are observed
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Projection of spouts are provided being observed and structural members are not being affected
12.3	Check adequacy thereof	Adequate
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not relevant as this not a subway
12.5	For submersible bridges, report on functioning	Not relevant as this not a submersible type of bridge
12.6	Report absence of Drainage Spouts	Not relevant

12.7	Check choking of drainage holes provided in the bottom booms	No bottom booms
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Hand rail
13.2	Material	RCC
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	No
14.2	Material	Not applicable
14.3	Condition	Not applicable
14.4	Check missing footpath slab	Not applicable
14.5	Cleanless of ducts along with footpath	Not applicable
15.UTILITIES		
15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cable
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes	Remove of vegetation and cleaning is required
2	Drainage spouts	Cleaning is required
3	Expansion joints	All expansion joints sealing material to be replaced and Cleaning is required
4	Bearings	Provide the corrosion protection and cleaning is required

17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit



View of Mobile Bridge Inspection Unit

17.2 Expansion Joints (If any)

View of strip seal expansion joint

View of strip seal expansion joint

17.3 Spout (If any)

View of drainage spouts

View of drainage spouts

17.4 Bearings (if any)

View of Rocker Roller bearing

View of Rocker Roller bearing

17.5 Abutment

Viwe of abutment

Viwe of abutment

17.6 Piers

View of pier

View of pier

17.7 Superstructure

View of superstructure

View of superstructure

17.8 Retaining wall (if any)

Growth of Vegetation

Growth of Vegetation

17.9 Overall Bridge

View of Overall bridge

View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Kochugaon- Rakhaldubi
5	Location Chainage	46950
6	Structure Number	Data not avalible
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Data not avalible
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Kochugaon
12	Year of Construction	Data not avalible
13	Overall Bridge Length	174.80 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	No
31	Overall Deck Width in m	8.00 m
32	Approach Roadway Width including Shoulders in m	7.40 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	8.00 m and 41.00 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	4
40	Maximum Span	43.70 m
41	Type of Superstructure	PSC Girder
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	Rocker roller
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
49	Type of Railing	RCC Hand rail
50	Corrosion Protection	No
51	Bank Protection Type	Yes
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	Removal of vegetation and cleaning is required.
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	Cracks and honeycombing is observed
62	Any other Observation/Data	No

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: KOCHUGAON-RAKHALDUBI**

CHAINAGE : KM 62+830 (LHS) **DATE OF INSPECTION: 05-12-2022**

TYPE OF STRUCTURE: MAJOR BRIDGE

STRUCTURE NO:

LATTITUDE:- 26.546920° **LONGITUDE:- 90.363749°**

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Champa Revier/Major bridge
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.40 m
1.6	Overall Deck width (m)	8.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	04 x 43.70 m
1.10	Total length of the bridge (m)	174.80 m
1.11	Vertical Clearance (m)	8.00 m
1.12	Whether meadian, if yes its width (m)	8.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	5.50 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Hand rail & Length - 180.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	Not Present

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	No cracks, potholes and uneven settlement surface
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No Erosion of embankment is observed
2.8	Approach slab (Check settlement, cracks,movement etc.)	No settlement and cracks
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Not accessible due to extensive growth of vegetation
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	Not Present
2.12	Approach Geometry (Check whether it satisfies the standard in force)	Satisfied
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	Stone pitching
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitching, growth of vegetation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	Not Present
	b) For Piers	Not Present
3.4	Bank Protection & Type	Front protection observed
3.5	Floor Protection & Type	Not Present
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	No obstruction in waterway
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	No meandering of inflow

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Information is not with the respective Department	
4.5	Check the adequacy of waterway	Not Present	
4.6	Check the errosion of bank	Not Present	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Well foundation	
5.2	Material	RCC	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	Good condition
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No weepholes being observed	No weepholes being observed
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.1.9	Check damage of protective coating of painting.	Not Present	

6.2	Pier	03 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.2.6	Check damage of protective coating of painting.	Not Present	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not relevant	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not relevant	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 3 Nos.	02 x 3 Nos.
8.2	No. per Pier	03 x 6 Nos.	03 x 6 Nos.
8.3	Type and allowable movements	Rocker roller	Rectangular
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Covered with iron plates	Good condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Covered with iron plates	-
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	04 Nos. & 4 x 43.70 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab + Girder	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC + PSC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No spalling and honeycombing observed
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	Cracks and honeycombing is observed
9.7	Check exposed reinforcement, if any	No exposed reinforcement being observed
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No leaching observed
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No corrosion of reinforcement being observed
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No Leakage
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	No cracks and exposed reinforcement being observed.
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	Not present
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Cracks are observed at the anchorage zone on pier 2, on the both sides
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not relevant
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not relevant as this is not a box girder
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not relevant as this is not a submersible structure
9.22	Check peeling off of protective coat or paint	Protective coat is not applied
9.23	Check steel members	No
9.24	Check condition of protective system	Not relevant as this not an steel structure
9.25	Check corrosion, if any	Not relevant as this not an steel structure
9.26	Check excessive vibrations, if any	Not relevant as this not an steel structure
9.27	Check alignment of members	Not relevant as this not an steel structure
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not relevant as this not an steel structure
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not relevant as this not an steel structure
9.30	Check buckling, kinking, warping and waviness	Not relevant as this not an steel structure

9.31	Check apparent fracture if any	Not relevant as this not an steel structure
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not relevant as this not an steel structure
9.33	Check conditions inside the closed members	Not relevant as this not an steel structure
9.34	Check masonry arches	Not relevant as this not an arch structure
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not relevant as this not an arch structure
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not relevant as this not an arch structure
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not relevant as this not an arch structure
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not relevant as this not an arch structure
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not relevant as this is a concrete structure
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not relevant as this is a concrete structure
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not relevant as this is not masonry structure
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	Misalignment of joints, debris are accmulated.
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Cracks are observed

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	All expansion joints sealing material is damaged
10.5	Check secureness of the joints	Secured
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	No corrosion and damage
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	Not relevant as this is not a finger type expansion joint
10.8	Check for debris in joints	Debris is accmulated in joints
10.9	Report rattling, if any	No rattling
10.10	Check drainage from expansion joint	Not relevant as this is not a finger type expansion joint
10.11	Check alignment and clearance	In aligned
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Cracks and potholes are observed
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Projection of spouts are provided being observed and structural members are not being affected
12.3	Check adequacy thereof	Adequate
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not relevant as this not a subway
12.5	For submersible bridges, report on functioning	Not relevant as this not a submersible type of bridge
12.6	Report absence of Drainage Spouts	Not relevant

12.7	Check choking of drainage holes provided in the bottom booms	No bottom booms
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Hand rail
13.2	Material	RCC
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	No
14.2	Material	Not applicable
14.3	Condition	Not applicable
14.4	Check missing footpath slab	Not applicable
14.5	Cleanless of ducts along with footpath	Not applicable
15.UTILITIES		
15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cable
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes	Remove of vegetation and cleaning is required
2	Drainage spouts	Cleaning is required
3	Expansion joints	All expansion joints sealing material to be replaced and Cleaning is required
4	Superstructure	Cracks and honeycombing is observed
5	Bearings	Covered with iron plates
6	Pavement surface	Cracks and potholes are observed

17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit

View of Mobile Bridge Inspection Unit

17.2 Expansion Joints (If any)

View of strip seal expansion joint

View of strip seal expansion joint

17.3 Spout (If any)

View of drainage spouts

View of drainage spouts

17.4 Bearings (if any)

View of Rocker Roller bearing

View of Rocker Roller bearing

17.5 Abutment

View of abutment

View of abutment

17.6 Piers

View of pier

View of pier

17.7 Superstructure

Cracks are observed

Reinforcement is Exposed

17.8 Overall Bridge

View of Overall bridge

View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Kochugaon- Rakhaldubi
5	Location Chainage	46950
6	Structure Number	Data not avalible
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Data not avalible
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Kochugaon
12	Year of Construction	Data not avalible
13	Overall Bridge Length	174.80 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	No
31	Overall Deck Width in m	8.00 m
32	Approach Roadway Width including Shoulders in m	7.40 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	8.00 m and 41.00 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	4
40	Maximum Span	43.70 m
41	Type of Superstructure	PSC Girder
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	Rocker roller
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
49	Type of Railing	RCC Hand rail
50	Corrosion Protection	No
51	Bank Protection Type	Yes
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	No
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	No
62	Any other Observation/Data	Expansion Joints sealing material is to be replaced.

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27		**DIRECTION: KOCHUGAON-RAKHALDUBI**
CHAINAGE : KM 62+830 (RHS)		**DATE OF INSPECTION: 05-12-2022**
TYPE OF STRUCTURE: MAJOR BRIDGE		
STRUCTURE NO:		
LATTITUDE:- 26.546815°		**LONGITUDE:- 90.363857°**
S.NO	**DESCRIPTION**	**OBSERVATIONS**
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Champa Revier/Major bridge
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.50 m
1.6	Overall Deck width (m)	10.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	04 x 43.70 m
1.10	Total length of the bridge (m)	174.80 m
1.11	Vertical Clearance (m)	8.00 m
1.12	Whether meadian, if yes its width (m)	8.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	5.50 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Crash barrier + Cast In-Situ & Length - 180.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	Not Present

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	No cracks, potholes and uneven settlement surface
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No Erosion of embankment is observed
2.8	Approach slab (Check settlement, cracks,movement etc.)	Settlement is observed at abutment A1
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Not accessible due to extensive growth of vegetation
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	Not Present
2.12	Approach Geometry (Check whether it satisfies the standard in force)	Not Present
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	No
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitched, growth of vegitation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	Not Present
	b) For Piers	Not Present
3.4	Bank Protection & Type	Not Present
3.5	Floor Protection & Type	Not visible
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	No obstruction in waterway
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	No meandering of inflow

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Information is not with the respective Department	
4.5	Check the adequacy of waterway	Not Present	
4.6	Check the errosion of bank	Not Present	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Well foundation	
5.2	Material	RCC	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	Good condition
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No weepholes being observed	No weepholes being observed
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.1.9	Check damage of protective coating of painting.	Not Present	

6.2	Pier	03 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.2.6	Check damage of protective coating of painting.	Not Present	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not relevant	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not relevant	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 3 Nos. + 1	02 x 3 Nos. + 1
8.2	No. per Pier	03 x 6 Nos.	03 x 6 Nos.
8.3	Type and allowable movements	POT cum PTFE	Square
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Rusting of bearings is observed	Exposed reinforcement is observed at the top
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Proper functioning	Proper functioning
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	04 Nos. & 4 x 43.70 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	Box Girder	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	PSC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No spalling and honeycombing observed
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	No cracks
9.7	Check exposed reinforcement, if any	No exposed reinforcement being observed
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No leaching observed
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No corrosion of reinforcement being observed
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No Leakage
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	No cracks and exposed reinforcement being observed.
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	Not present
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Not relevant as this is not a prestressed concrete members
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not relevant
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not relevant as this is not a box girder
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not relevant as this is not a submersible structure
9.22	Check peeling off of protective coat or paint	Protective coat is not applied
9.23	Check steel members	No
9.24	Check condition of protective system	Not relevant as this not an steel structure
9.25	Check corrosion, if any	Not relevant as this not an steel structure
9.26	Check excessive vibrations, if any	Not relevant as this not an steel structure
9.27	Check alignment of members	Not relevant as this not an steel structure
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not relevant as this not an steel structure
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not relevant as this not an steel structure
9.30	Check buckling, kinking, warping and waviness	Not relevant as this not an steel structure

9.31	Check apparent fracture if any	Not relevant as this not an steel structure
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not relevant as this not an steel structure
9.33	Check conditions inside the closed members	Not relevant as this not an steel structure
9.34	Check masonry arches	Not relevant as this not an arch structure
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not relevant as this not an arch structure
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not relevant as this not an arch structure
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not relevant as this not an arch structure
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not relevant as this not an arch structure
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not relevant as this is a concrete structure
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not relevant as this is a concrete structure
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not relevant as this is not masonry structure
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	Edge beam is damaged and sealing material is damaged
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Cracks and pot holes are observed

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	Not visible as it is filled with bituminous
10.5	Check secureness of the joints	Secured
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	No corrosion and damage
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	Not relevant as this is not a finger type expansion joint
10.8	Check for debris in joints	Debris is accmulated in joints
10.9	Report rattling, if any	No rattling
10.10	Check drainage from expansion joint	Not relevant as this is not a finger type expansion joint
10.11	Check alignment and clearance	In aligned
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Cracks and pot holes are observed
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Projection of spouts are provided being observed and structural members are not being affected
12.3	Check adequacy thereof	Adequate
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not relevant as this not a subway
12.5	For submersible bridges, report on functioning	Not relevant as this not a submersible type of bridge
12.6	Report absence of Drainage Spouts	Not relevant

12.7	Check choking of drainage holes provided in the bottom booms	No bottom booms
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Crash barrier + Cast In-Situ
13.2	Material	RCC
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	Yes
14.2	Material	RCC
14.3	Condition	Fair condition
14.4	Check missing footpath slab	No
14.5	Cleanless of ducts along with footpath	No
15.UTILITIES		
15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cable
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes	Settlement is observed at abutment A1, repair to be done
2	Drainage spouts	Cleaning is required
3	Expansion joints	All expansion joints sealing material to be replaced and Cleaning is required

17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit

View of Mobile Bridge Inspection Unit

17.2 Expansion Joints (If any)

View of strip seal expansion joint

View of strip seal expansion joint

17.3 Spout (If any)

View of drainage spouts

View of drainage spouts

17.4 Bearings (if any)

View of POT cum PTFE bearing

View of Seismic arrester bearing

17.5 Abutment

View of abutment

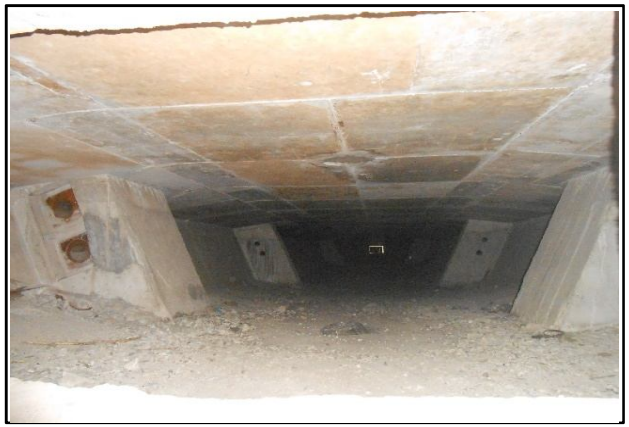
View of abutment

17.6 Piers

View of pier

View of pier

17.7 Superstructure



View of Box Girder inside

View of superstructure

17.8 Overall Bridge

View of Overall bridge

View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Kochugaon- Rakhaldubi
5	Location Chainage	46950
6	Structure Number	Data not avalible
7	Features Intersected	Train Crossing
8	Type of Structure	Road Over Bridge
9	Popular/Official Name	Data not avalible
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Kochugaon
12	Year of Construction	Data not avalible
13	Overall Bridge Length	61.00 m
14	No of Lanes	3 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 3Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	1.20 m
31	Overall Deck Width in m	13.80 m
32	Approach Roadway Width including Shoulders in m	11.40 m
33	Average Skew	60°
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	6.00 m and 38.00 + 16.50 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	2
40	Maximum Span	42.00 m
41	Type of Superstructure	PSC Girder
42	Peir Type	Trestle
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	POT cum PTFE
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
49	Type of Railing	RCC Crash barrier
50	Corrosion Protection	No
51	Bank Protection Type	Not applicable
52	Floor Protection Type	Not applicable
53	Suspension of Traffic	Not applicable
54	Erosion of Banks/Bunds	Not applicable
55	Abnormal Scour Level Around Peirs	Not applicable
56	Abnormal Scour Level Around Abutments	Not applicable
57	Abnormal Floor Level in m	Not applicable
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	Not applicable
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	Data not avalible
62	Any other Observation/Data	No

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: KOCHUGAON-RAKHALDUBI**

CHAINAGE : KM 87+840 (LHS) **DATE OF INSPECTION: 05-12-2022**

TYPE OF STRUCTURE: ROAD OVER BRIDGE

STRUCTURE NO:

LATTITUDE:- 26.488545° **LONGITUDE:- 90.597124°**

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Road Over Bridge
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	Data not available
	(c) Erosion of Banks as evident	Data not available
1.5	Clear Carriageway width(m)	11.40 m
1.6	Overall Deck width (m)	13.80 m
1.7	Average skew angle	60°
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	1 x 42.00 + 1 x 19.00 m
1.10	Total length of the bridge (m)	61.00 m
1.11	Vertical Clearance (m)	6.00 m
1.12	Whether meadian, if yes its width (m)	4.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	7.50 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Crash barrier & Length - 70.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	1 x 19.00 m

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	Cracks in wearing course are observed at the starting point of bridge
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Not relevant
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No damages
2.8	Approach slab (Check settlement, cracks,movement etc.)	No settlement and cracks
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Retaining wall is in fair condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	Not Present
2.12	Approach Geometry (Check whether it satisfies the standard in force)	Satisfied
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	Not relevant
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Not relevant
3.3	Scour (Check any abnormal scour noticed.)	Not relevant
	a) For Abutments	Not relevant
	b) For Piers	Not relevant
3.4	Bank Protection & Type	Not relevant
3.5	Floor Protection & Type	Not relevant
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	Not relevant
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	Not relevant

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Not relevant	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Not relevant	
4.5	Check the adequacy of waterway	Not relevant	
4.6	Check the errosion of bank	Not relevant	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Data not available	
5.2	Material	Data not available	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	Good condition
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No weepholes being observed	No weepholes being observed
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.1.9	Check damage of protective coating of painting.	Not Present	

6.2	Pier	01 Nos.	
6.2.1	Type	Trestle type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.2.6	Check damage of protective coating of painting.	Not Present	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not relevant	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not relevant	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 5 Nos.	02 x 5 Nos.
8.2	No. per Pier	01 x 10 Nos.	01 x 10 Nos.
8.3	Type and allowable movements	POT cum PTFE	Square
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Rusting of bearings is observed	Fair condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Proper functioning	-
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	02 Nos. & 1 x 42.00 + 1 x 19.00 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab + Girder	
9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported	

9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC + PSC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No spalling and honeycombing observed
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	Cracks observed
9.7	Check exposed reinforcement, if any	No exposed reinforcement being observed
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No leaching observed
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No corrosion of reinforcement being observed
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No Leakage
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	No cracks and exposed reinforcement being observed.
9.16	Check excessive vibrations, if any	No
9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	Not present

9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Not relevant as this is not a prestressed concrete members
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not relevant
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not relevant as this is not a box girder
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not relevant as this is not a submersible structure
9.22	Check peeling off of protective coat or paint	Protective coat is not applied
9.23	Check steel members	No
9.24	Check condition of protective system	Not relevant as this not an steel structure
9.25	Check corrosion, if any	Not relevant as this not an steel structure
9.26	Check excessive vibrations, if any	Not relevant as this not an steel structure
9.27	Check alignment of members	Not relevant as this not an steel structure
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not relevant as this not an steel structure
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not relevant as this not an steel structure
9.30	Check buckling, kinking, warping and waviness	Not relevant as this not an steel structure
9.31	Check apparent fracture if any	Not relevant as this not an steel structure

9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not relevant as this not an steel structure
9.33	Check conditions inside the closed members	Not relevant as this not an steel structure
9.34	Check masonry arches	Not relevant as this not an arch structure
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not relevant as this not an arch structure
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not relevant as this not an arch structure
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not relevant as this not an arch structure
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not relevant as this not an arch structure
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not relevant as this is a concrete structure
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not relevant as this is a concrete structure
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not relevant as this is not masonry structure
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	No misalignment of joints being observed
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	No cracks in wearing course

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	No spliting and oxidation
10.5	Check secureness of the joints	Secured
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	No corrosion and damage
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	Not relevant as this is not a finger type expansion joint
10.8	Check for debris in joints	Debris is accmulated in joints
10.9	Report rattling, if any	No rattling
10.10	Check drainage from expansion joint	Not relevant as this is not a finger type expansion joint
10.11	Check alignment and clearance	In aligned
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	fair condition
11.3	Details of water proofing system, if any	Not present
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Projection of spouts are provided being observed and structural members are not being affected
12.3	Check adequacy thereof	Adequate
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not relevant as this not a subway
12.5	For submersible bridges, report on functioning	Not relevant as this not a submersible type of bridge
12.6	Report absence of Drainage Spouts	Not relevant

12.7	Check choking of drainage holes provided in the bottom booms	No bottom booms
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Crash barrier + Cast In-Situ
13.2	Material	RCC
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	Yes
14.2	Material	RCC
14.3	Condition	Fair condition
14.4	Check missing footpath slab	Not visible
14.5	Cleanless of ducts along with footpath	No
15.UTILITIES		
15.1	Present (Yes/No)	No
15.2	Type of Utility	Not relevant
15.3	Report damage due to Utility if any	Not relevant
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Drainage spouts	Cleaning is required
2	Expansion joints	Cleaning is required
3	Bearings	corrosion protection and cleaning is required
4	wearing coat	Cracks observed

17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit

View of Mobile Bridge Inspection Unit

17.2 Expansion Joints (If any)

View of strip seal expansion joint

View of strip seal expansion joint

17.3 Spout (If any)

View of bottom booms

View of drainage spouts

17.4 Bearings (if any)

View of POT cum PTFE bearing

View of POT cum PTFE bearing

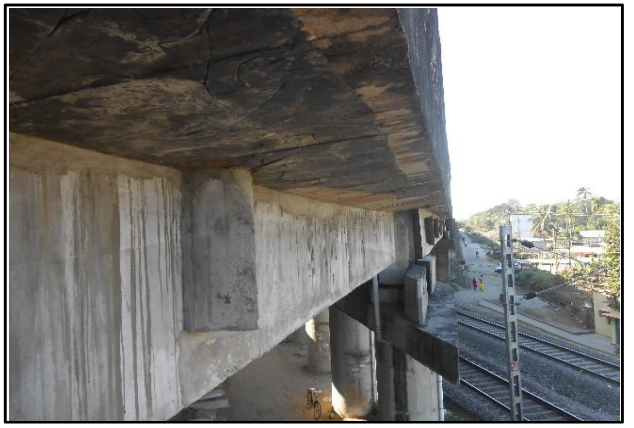
17.5 Piers

View of pier

View of pier

17.6 Superstructure

View of superstructure



View of superstructure

17.7 Overall Bridge

View of Overall bridge

View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Kochugaon- Rakhaldubi
5	Location Chainage	46950
6	Structure Number	Data not avalible
7	Features Intersected	Train Crossing
8	Type of Structure	Road Over Bridge
9	Popular/Official Name	Data not avalible
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Kochugaon
12	Year of Construction	Data not avalible
13	Overall Bridge Length	61.00 m
14	No of Lanes	3 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 3Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	1.20 m
31	Overall Deck Width in m	13.80 m
32	Approach Roadway Width including Shoulders in m	11.40 m
33	Average Skew	60°
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	6.00 m and 38.00 + 16.50 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	2
40	Maximum Span	42.00 m
41	Type of Superstructure	PSC Girder
42	Peir Type	Trestle
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	POT cum PTFE
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Kochugaon- Rakhaldubi Section
49	Type of Railing	RCC Crash barrier
50	Corrosion Protection	No
51	Bank Protection Type	Not applicable
52	Floor Protection Type	Not applicable
53	Suspension of Traffic	Not applicable
54	Erosion of Banks/Bunds	Not applicable
55	Abnormal Scour Level Around Peirs	Not applicable
56	Abnormal Scour Level Around Abutments	Not applicable
57	Abnormal Floor Level in m	Not applicable
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	Not applicable
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	Cracks are observed
62	Any other Observation/Data	No

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: KOCHUGAON-RAKHALDUBI**

CHAINAGE : KM 87+840 (RHS) **DATE OF INSPECTION: 05-12-2022**

TYPE OF STRUCTURE: ROAD OVER BRIDGE

STRUCTURE NO:

LATTITUDE:- 26.488435° **LONGITUDE:- 90.597049°**

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Road Over Bridge
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	Data not available
	(c) Erosion of Banks as evident	Data not available
1.5	Clear Carriageway width(m)	11.40 m
1.6	Overall Deck width (m)	13.80 m
1.7	Average skew angle	60°
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	1 x 42.00 + 1 x 19.00 m
1.10	Total length of the bridge (m)	61.00 m
1.11	Vertical Clearance (m)	6.00 m
1.12	Whether meadian, if yes its width (m)	4.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	7.50 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Crash barrier & Length - 70.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	1 x 19.00 m

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	Pavement surface is in fair condition
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Not relavant
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No damages
2.8	Approach slab (Check settlement, cracks,movement etc.)	Not visible
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Retaining wall is in fair condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	Not present
2.12	Approach Geometry (Check whether it satisfies the standard in force)	Satisfied
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	Not relevant
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Not relevant
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	Not relevant
	b) For Piers	Not relevant
3.4	Bank Protection & Type	Not relevant
3.5	Floor Protection & Type	Not relevant
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	Not relevant
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	Not relevant

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Not relevant	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Not relevant	
4.5	Check the adequacy of waterway	Not relevant	
4.6	Check the errosion of bank	Not relevant	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Not visible	
5.2	Material	Data not available	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	Good condition
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No weepholes being observed	No weepholes being observed
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.1.9	Check damage of protective coating of painting.	Not Present	

6.2	Pier	01 Nos.	
6.2.1	Type	Trestle type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.2.6	Check damage of protective coating of painting.	Not Present	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not relevant	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not relevant	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 5 Nos.	02 x 5 Nos.
8.2	No. per Pier	01 x 10 Nos.	01 x 10 Nos.
8.3	Type and allowable movements	POT cum PTFE	Square
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Good condition	Good condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Proper functioning	-
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	02 Nos. & 1 x 42.00 + 1 x 19.00 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab + Girder	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC + PSC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No spalling and honeycombing observed
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	Hairline cracks are observed at girder
9.7	Check exposed reinforcement, if any	No exposed reinforcement being observed
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No leaching observed
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No corrosion of reinforcement being observed
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No Leakage
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	No cracks and exposed reinforcement being observed.
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	Not present
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Not relevant as this is not a prestressed concrete members
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not relevant
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not relevant
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not relevant as this is not a submersible structure
9.22	Check peeling off of protective coat or paint	Protective coat is not applied
9.23	Check steel members	No
9.24	Check condition of protective system	Not relevant as this not an steel structure
9.25	Check corrosion, if any	Not relevant as this not an steel structure
9.26	Check excessive vibrations, if any	Not relevant as this not an steel structure
9.27	Check alignment of members	Not relevant as this not an steel structure
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not relevant as this not an steel structure
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not relevant as this not an steel structure
9.30	Check buckling, kinking, warping and waviness	Not relevant as this not an steel structure

9.31	Check apparent fracture if any	Not relevant as this not an steel structure
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not relevant as this not an steel structure
9.33	Check conditions inside the closed members	Not relevant as this not an steel structure
9.34	Check masonry arches	Not relevant as this not an arch structure
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not relevant as this not an arch structure
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not relevant as this not an arch structure
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not relevant as this not an arch structure
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not relevant as this not an arch structure
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not relevant as this is a concrete structure
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not relevant as this is a concrete structure
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not relevant as this is not masonry structure
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	Fair condition, No misalignment of joints, debris are accmulated.
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	No cracks in wearing course

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	No spliting and oxidation
10.5	Check secureness of the joints	Secured
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	No corrosion and damage
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	Not relevant as this is not a finger type expansion joint
10.8	Check for debris in joints	Debris is accmulated in joints
10.9	Report rattling, if any	No rattling
10.10	Check drainage from expansion joint	Not relevant as this is not a finger type expansion joint
10.11	Check alignment and clearance	In aligned
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Cracks are observed
11.3	Details of water proofing system, if any	Not present
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Drainage spouts are clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Projection of spouts are provided being observed and structural members are not being affected
12.3	Check adequacy thereof	Not relevant
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not relevant
12.5	For submersible bridges, report on functioning	Not relevant
12.6	Report absence of Drainage Spouts	Drainage spouts are provided
12.7	Check choking of drainage holes provided in the bottom booms	Yes

13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Crash barrier
13.2	Material	RCC
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	Yes
14.2	Material	RCC
14.3	Condition	Fair condition
14.4	Check missing footpath slab	Not visible
14.5	Cleanless of ducts along with footpath	No
15.UTILITIES		
15.1	Present (Yes/No)	No
15.2	Type of Utility	Not relevant
15.3	Report damage due to Utility if any	Not relevant
15.4	Any type of Encroachment under the bridge	High tension line railways
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Drainage spouts	Cleaning is required
2	Expansion joints	Cleaning is required
3	Superstructure	Cracks are observed
1	wearing coat	Cracks are observed

17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit

View of Mobile Bridge Inspection Unit

17.2 Expansion Joints (If any)

View of strip seal expansion joint

View of strip seal expansion joint

17.3 Spout (If any)

View of drainage spouts

Projection pipe is damage

17.4 Bearings (if any)

View of POT cum PTFE bearing

View of POT cum PTFE bearing

17.5 Piers

View of pier

View of pier

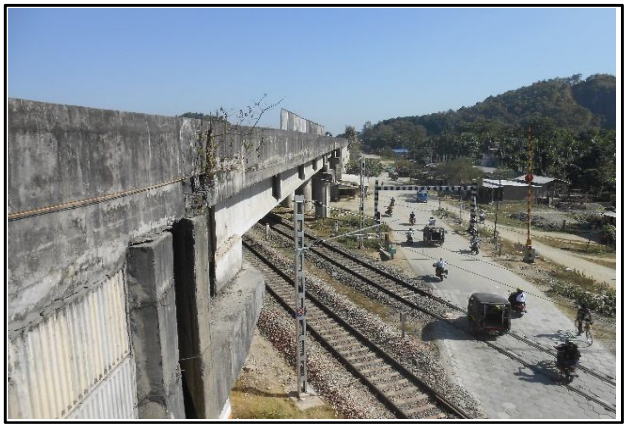
17.6 Superstructure

View of superstructure

View of superstructure

17.7 Overall Bridge

View of Overall bridge



View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Rakhaldubi-Kaljhar Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Rakhaldubi-Kaljhar
5	Location Chainage	963868
6	Structure Number	Data not avalible
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Aie Bridge/Major bridge/ Manas Revier
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Rakhaldubi
12	Year of Construction	Data not avalible
13	Overall Bridge Length	332.80 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	No
31	Overall Deck Width in m	10.00 m
32	Approach Roadway Width including Shoulders in m	7.50 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	5.00 m and 39.50 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	8
40	Maximum Span	41.60 m
41	Type of Superstructure	Girder
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	Rocker roller
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Rakhaldubi-Kaljhar Section
49	Type of Railing	RCC Hand rail
50	Corrosion Protection	No
51	Bank Protection Type	No
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	No
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	Cracks are observed and bearings are covered with box.
62	Any other Observation/Data	No

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27		**DIRECTION: RAKHALDUBI-KALJHAR**
CHAINAGE : KM 963+868 (LHS)		**DATE OF INSPECTION: 05-12-2022**
TYPE OF STRUCTURE: MAJOR BRIDGE		
STRUCTURE NO:		
LATTITUDE:- 26.497225°		**LONGITUDE:- 90.653080°**
S.NO	**DESCRIPTION**	**OBSERVATIONS**
1.STRUCTURE DATA		
1.1	Name of Bridge/No.of Bridge/Name of River	Aie Bridge/Major bridge/ Manas Revier
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.50 m
1.6	Overall Deck width (m)	10.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	08 x 41.60 m
1.10	Total length of the bridge (m)	332.80 m
1.11	Vertical Clearance (m)	5.00 m
1.12	Whether meadian, if yes its width (m)	20.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	3.00 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Hand rail & Length - 440.00 m
2.APPROACHES		
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	Not Present

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	Cracks are observed
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No Erosion of embankment is observed
2.8	Approach slab (Check settlement, cracks,movement etc.)	No settlement and cracks
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Not accessible due to extensive growth of vegetation
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	Not Present
2.12	Approach Geometry (Check whether it satisfies the standard in force)	Satisfied
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	Not Present
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitching, growth of vegetation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	Not Present
	b) For Piers	Not Present
3.4	Bank Protection & Type	Not Present
3.5	Floor Protection & Type	Not visible
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	No obstruction in waterway
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	No meandering of inflow

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Information is not with the respective Department	
4.5	Check the adequacy of waterway	Not Present	
4.6	Check the errosion of bank	Not Present	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Well foundation	
5.2	Material	RCC	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	Good condition
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No	No
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.1.9	Check damage of protective coating of painting.	Not Present	

6.2	Pier	07 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.2.6	Check damage of protective coating of painting.	Not Present	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not relevant	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not relevant	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 3 Nos.	02 x 3 Nos.
8.2	No. per Pier	07 x 6 Nos.	07 x 6 Nos.
8.3	0	Rocker Roller	Rectangular
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Fair condition	Fair condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Not visible as it is covered with box	Good functioning
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	08 Nos. & 8 x 41.60 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab + Girder	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC + PSC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No spalling and honeycombing observed
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	Cracks are observed
9.7	Check exposed reinforcement, if any	No exposed reinforcement being observed
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No leaching observed
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No corrosion of reinforcement being observed
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No Leakage
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	Not relevant
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	Not Present
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Yes
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not relevant
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not relevant as this is not a box girder
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not relevant as this is not a submersible structure
9.22	Check peeling off of protective coat or paint	Protective coat is not applied
9.23	Check steel members	Not relevant
9.24	Check condition of protective system	Not relevant as this not an steel structure
9.25	Check corrosion, if any	Not relevant as this not an steel structure
9.26	Check excessive vibrations, if any	Not relevant as this not an steel structure
9.27	Check alignment of members	Not relevant as this not an steel structure
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not relevant as this not an steel structure
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not relevant as this not an steel structure
9.30	Check buckling, kinking, warping and waviness	Not relevant as this not an steel structure

9.31	Check apparent fracture if any	Not relevant as this not an steel structure
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not relevant as this not an steel structure
9.33	Check conditions inside the closed members	Not relevant as this not an steel structure
9.34	Check masonry arches	Not relevant as this not an arch structure
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not relevant as this not an arch structure
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not relevant as this not an arch structure
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not relevant as this not an arch structure
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not relevant as this not an arch structure
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not relevant as this is a concrete structure
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not relevant as this is a concrete structure
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not relevant as this is not masonry structure
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	Misalignment of joints and debris are accmulated.
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Cracks are observed on expansion joint edge beam

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	Not visible
10.5	Check secureness of the joints	No
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	No corrosion and damage
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	Not relevant as this is not a finger type expansion joint
10.8	Check for debris in joints	Debris is accmulated in joints
10.9	Report rattling, if any	Yes
10.10	Check drainage from expansion joint	Not relevant as this is not a finger type expansion joint
10.11	Check alignment and clearance	Yes
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Surface condition is good
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Projection of spouts are provided being observed and structural members are not being affected
12.3	Check adequacy thereof	Adequate
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not relevant as this not a subway
12.5	For submersible bridges, report on functioning	Not relevant as this not a submersible type of bridge
12.6	Report absence of Drainage Spouts	Not relevant

12.7	Check choking of drainage holes provided in the bottom booms	No bottom booms
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes
13.2	Material	RCC
13.3	Condition	Good condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	No
14.2	Material	Not relevant
14.3	Condition	Not relevant
14.4	Check missing footpath slab	Not relevant
14.5	Cleanless of ducts along with footpath	Not relevant
15.UTILITIES		
15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cable
15.3	Report damage due to Utility if any	Good condition
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes	Remove of vegetation and cleaning is required
2	Drainage spouts	Cleaning is required
3	Expansion joints	Misalignment of joints and Cleaning is required
4	Superstructure	Cracks are observed
5	Bearings	Not visible as it is covered with box
6	Pavement surface	Cracks are observed

17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit

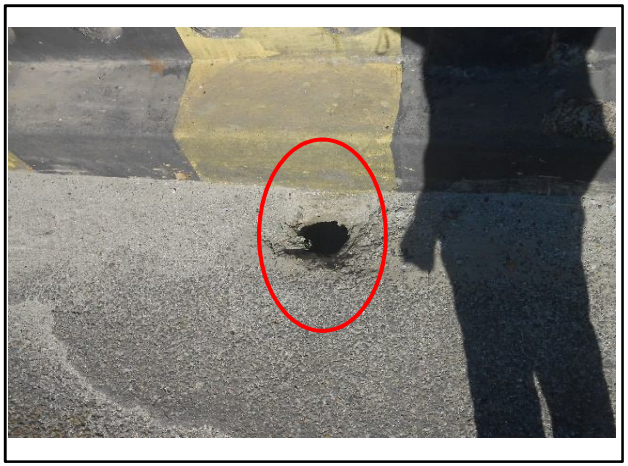
Pavement surface cracks

17.2 Expansion Joints (If any)

View of strip seal expansion joint

Rattling of expansion joint

17.3 Spout (If any)



View of drainage spouts

View of drainage spouts

17.4 Bearings (if any)

View of Rocker Roller bearing

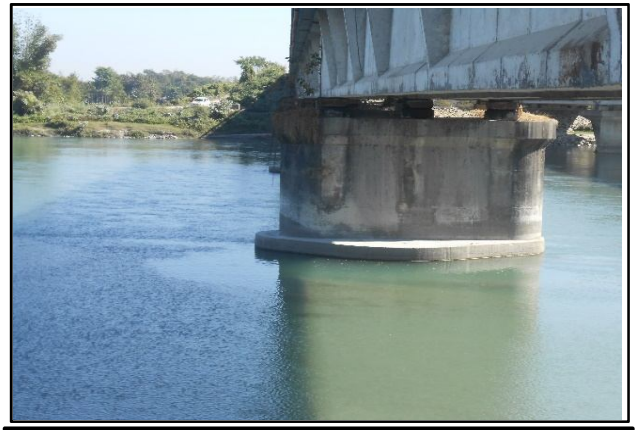
View of Rocker Roller bearing

17.5 Abutment

View of abutment

View of abutment

17.6 Piers



View of pier

View of pier

17.7 Superstructure

View of Superstructure

View of Superstructure

17.8 Overall Bridge

View of overall bridge

View of overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Rakhaldubi-Kaljhar Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Rakhaldubi-Kaljhar
5	Location Chainage	963868
6	Structure Number	Data not avalible
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Aie Bridge/Major bridge/ Manas Revier
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Rakhaldubi
12	Year of Construction	Data not avalible
13	Overall Bridge Length	332.80 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	1.20 m
31	Overall Deck Width in m	10.00 m
32	Approach Roadway Width including Shoulders in m	7.50 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	4.00 and 39.50 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	8
40	Maximum Span	41.60 m
41	Type of Superstructure	Girder
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	POT cum PTFE
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Rakhaldubi-Kaljhar Section
49	Type of Railing	RCC Hand rail
50	Corrosion Protection	No
51	Bank Protection Type	No
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	No
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	Cracks are observed and seismic arrester pedestal is damaged.
62	Any other Observation/Data	No

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27		**DIRECTION: RAKHALDUBI-KALJHAR**
CHAINAGE : KM 963+868 (RHS)		**DATE OF INSPECTION: 05-12-2022**
TYPE OF STRUCTURE: MAJOR BRIDGE		
STRUCTURE NO:		
LATTITUDE:- 26.497007°		**LONGITUDE:- 90.653046°**
S.NO	**DESCRIPTION**	**OBSERVATIONS**
1.STRUCTURE DATA		
1.1	Name of Bridge/No.of Bridge/Name of River	Aie Bridge/Major bridge/ Manas Revier
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.50 m
1.6	Overall Deck width (m)	10.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	08 x 41.60 m
1.10	Total length of the bridge (m)	332.80 m
1.11	Vertical Clearance (m)	4.00 m
1.12	Whether meadian, if yes its width (m)	20.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	3.00 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Crash barrier + Cast In-Situ & Length - 440.00 m
2.APPROACHES		
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	No spans

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	Pavement surface is in fair condition
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No damages
2.8	Approach slab (Check settlement, cracks,movement etc.)	Not visible
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Retaining wall is in fair condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	No
2.12	Approach Geometry (Check whether it satisfies the standard in force)	No
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	No
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitching, growth of vegetation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	No
	b) For Piers	No
3.4	Bank Protection & Type	No
3.5	Floor Protection & Type	Not visible
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	No
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	Uniform. No change in flow, erosion of banks

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Not visible	
4.5	Check the adequacy of waterway	Not visible	
4.6	Check the errosion of bank	Not visible	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Well foundation	
5.2	Material	RCC	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No cracks, settlement, sour, exposed steel	No cracks, settlement, sour, exposed steel
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No	No
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not applicable	
6.1.9	Check damage of protective coating of painting.	Not visible	

6.2	Pier	07 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No cracks, settlement, sour, exposed steel	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not applicable	
6.2.6	Check damage of protective coating of painting.	Not visible	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not applicable	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not applicable	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 3 Nos. + 2	02 x 3 Nos. + 2
8.2	No. per Pier	07 x 6 Nos. + 2	07 x 6 Nos. + 2
8.3	0	POT cum PTFE	Rectangular
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Fair condition	Sesmic arrester pedestal damaged at abutment A2
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Proper functioning	Proper functioning
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	08 Nos. & 8 x 41.60 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab + Girder	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC + PSC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	Cracks are observed
9.7	Check exposed reinforcement, if any	No
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	Not applicable
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	No
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Yes
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not applicable
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not applicable
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not applicable
9.22	Check peeling off of protective coat or paint	Not applicable
9.23	Check steel members	Not applicable
9.24	Check condition of protective system	Not applicable
9.25	Check corrosion, if any	Not applicable
9.26	Check excessive vibrations, if any	Not applicable
9.27	Check alignment of members	Not applicable
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not applicable
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not applicable
9.30	Check buckling, kinking, warping and waviness	Not applicable

9.31	Check apparent fracture if any	Not applicable
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not applicable
9.33	Check conditions inside the closed members	Not applicable
9.34	Check masonry arches	Not applicable
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not applicable
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not applicable
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not applicable
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not applicable
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not applicable
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not applicable
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not applicable
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	No Misalignment of joints and debris are accmulated.
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Cracks are observed on expansion joint edge beam

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	Not visible as it is covered with bituminous
10.5	Check secureness of the joints	No
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	No
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	No
10.8	Check for debris in joints	Yes
10.9	Report rattling, if any	No
10.10	Check drainage from expansion joint	No
10.11	Check alignment and clearance	Yes
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Fair condition
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Drainage spouts are clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Drain pipes are provided, no structural members are affected
12.3	Check adequacy thereof	Adequated
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not applicable
12.5	For submersible bridges, report on functioning	Not applicable
12.6	Report absence of Drainage Spouts	Drainage spouts are provided

12.7	Check choking of drainage holes provided in the bottom booms	No
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Crash barrier + Cast In-Situ
13.2	Material	RCC
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	Yes
14.2	Material	RCC
14.3	Condition	Fair condition
14.4	Check missing footpath slab	No
14.5	Cleanless of ducts along with footpath	No
15.UTILITIES		
15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cable
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes	Remove of vegetation and cleaning is required
2	Drainage spouts	Cleaning is required
3	Expansion joints	Crcaks are observed and Cleaning is required
4	Superstructure	Cracks are observed
5	Bearings	Sesmic arrester pedestal damaged

17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit

View of Mobile Bridge Inspection Unit

17.2 Expansion Joints (If any)

View of strip seal expansion joint

View of strip seal expansion joint

17.3 Spout (If any)

View of drainage spouts

View of drainage spouts

17.4 Bearings (if any)

View of Rocker Roller bearing

View of Seismic arrester bearing

17.5 Abutment

no pics

no pics

17.6 Piers

View of pier

View of leaching is observed at pier

17.7 Superstructure

View of Superstructure

Cracks Observed

17.8 Overall Bridge

View of Overall bridge

View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Rakhaldubi-Kaljhar Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Rakhaldubi-Kaljhar
5	Location Chainage	975251
6	Structure Number	Data not avalible
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Major bridge/ Manas Revier
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Rakhaldubi
12	Year of Construction	Data not avalible
13	Overall Bridge Length	175.00 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	No
31	Overall Deck Width in m	8.20 m
32	Approach Roadway Width including Shoulders in m	7.40 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	4.00 and 38.00 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	8
40	Maximum Span	41.50 m
41	Type of Superstructure	Girder
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	Rocker roller
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Rakhaldubi-Kaljhar Section
49	Type of Railing	RCC Hand rail
50	Corrosion Protection	No
51	Bank Protection Type	No
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	No
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	Cracks are observed.
62	Any other Observation/Data	No

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: RAKHALDUBI-KALJHAR**

CHAINAGE : KM 975+251 (LHS) **DATE OF INSPECTION: 04-12-2022**

TYPE OF STRUCTURE: MAJOR BRIDGE

STRUCTURE NO:

LATTITUDE:- 26.465936° **LONGITUDE:- 90.749927°**

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Major bridge/ Manas Revier
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.40 m
1.6	Overall Deck width (m)	8.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	02 x 26.00 + 3 x 41.00 m
1.10	Total length of the bridge (m)	175.00 m
1.11	Vertical Clearance (m)	4.00 m
1.12	Whether meadian, if yes its width (m)	8.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	5.50 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Hand rail & Length - 181.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	No spans

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	Cracks are observed
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No damages
2.8	Approach slab (Check settlement, cracks,movement etc.)	Not visible
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Retaining wall is in fair condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	No
2.12	Approach Geometry (Check whether it satisfies the standard in force)	No
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	No
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitched, growth of vegitation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	No
	b) For Piers	No
3.4	Bank Protection & Type	No
3.5	Floor Protection & Type	Not visible
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	No
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	Uniform. No change in flow, erosion of banks

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Not visible	
4.5	Check the adequacy of waterway	Not visible	
4.6	Check the errosion of bank	Not visible	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Well foundation	
5.2	Material	RCC	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No cracks, settlement, sour, exposed steel	No cracks, settlement, sour, exposed steel
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No	No
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not applicable	
6.1.9	Check damage of protective coating of painting.	Not visible	

6.2	Pier	04 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No cracks, settlement, sour, exposed steel	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not applicable	
6.2.6	Check damage of protective coating of painting.	Not visible	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not applicable	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not applicable	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 3 Nos.	02 x 3 Nos.
8.2	No. per Pier	04 x 6 Nos.	04 x 6 Nos.
8.3	Type and allowable movements	Rocker roller	Rectangular
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Not visible as it is covered with box	Fair condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Proper functioning	Proper functioning
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	05 Nos. & 2 x 41.50 + 3 x 41.00 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab + Girder	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC + PSC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	No
9.7	Check exposed reinforcement, if any	No
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	Not applicable
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	No
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Not applicable
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not applicable
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not applicable
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not applicable
9.22	Check peeling off of protective coat or paint	Not applicable
9.23	Check steel members	Not applicable
9.24	Check condition of protective system	Not applicable
9.25	Check corrosion, if any	Not applicable
9.26	Check excessive vibrations, if any	Not applicable
9.27	Check alignment of members	Not applicable
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not applicable
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not applicable
9.30	Check buckling, kinking, warping and waviness	Not applicable

9.31	Check apparent fracture if any	Not applicable
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not applicable
9.33	Check conditions inside the closed members	Not applicable
9.34	Check masonry arches	Not applicable
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not applicable
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not applicable
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not applicable
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not applicable
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not applicable
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not applicable
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not applicable
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	Misalignment of joints and debris are accmulated.
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Cracks and reinforcement is exposed on expansion joint edge beam

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	Sealing material is damaged
10.5	Check secureness of the joints	No
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	Top sliding plate is damaged
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	No
10.8	Check for debris in joints	Yes
10.9	Report rattling, if any	Rattling is observed
10.10	Check drainage from expansion joint	No
10.11	Check alignment and clearance	In aligned
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Fair condition
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Drainage spouts are clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Drain pipes are provided, no structural members are affected
12.3	Check adequacy thereof	Adequated
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not applicable
12.5	For submersible bridges, report on functioning	Not applicable
12.6	Report absence of Drainage Spouts	Drainage spouts are provided

12.7	Check choking of drainage holes provided in the bottom booms	No
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Hand rail
13.2	Material	RCC
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	No
14.2	Material	Not applicable
14.3	Condition	Not applicable
14.4	Check missing footpath slab	Not applicable
14.5	Cleanless of ducts along with footpath	Not applicable
15.UTILITIES		
15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cable
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes	Remove of vegetation and cleaning is required
2	Drainage spouts	Cleaning is required
3	Expansion joints	Misalignment of joints and debris are accmulated, steel plate damaged.
4	Bearings	Not visible as it is covered with box

17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit

View of Mobile Bridge Inspection Unit

17.2 Expansion Joints (If any)

Damage of expansion joint

View of strip seal expansion joint

17.3 Spout (If any)

View of drainage spouts

View of drainage spouts

17.4 Bearings (if any)

View of Rocker roller bearing

View of Rocker roller bearing

17.5 Abutment

View of abutment

View of abutment

17.6 Piers

View of pier

View of leaching is observed at pier

17.7 Superstructure

View of Superstructure

View of Superstructure

17.8 Overall Bridge

View of Overall bridge

View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Rakhaldubi-Kaljhar Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Rakhaldubi-Kaljhar
5	Location Chainage	975251
6	Structure Number	Data not avalible
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Major bridge/ Manas Revier
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Rakhaldubi
12	Year of Construction	Data not avalible
13	Overall Bridge Length	175.00 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	1.20 m
31	Overall Deck Width in m	10.00 m
32	Approach Roadway Width including Shoulders in m	7.50 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	4.00 and 38.00 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	5
40	Maximum Span	41.40 m
41	Type of Superstructure	Girder
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	Rocker roller
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Rakhaldubi-Kaljhar Section
49	Type of Railing	RCC Crash barrier + Cast In-Situ
50	Corrosion Protection	No
51	Bank Protection Type	No
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	No
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	Cracks are observed
62	Any other Observation/Data	No

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: RAKHALDUBI-KALJHAR**

CHAINAGE : KM 975+251 (RHS) **DATE OF INSPECTION: 04-12-2022**

TYPE OF STRUCTURE: MAJOR BRIDGE

STRUCTURE NO:

LATTITUDE: 26.465756° **LONGITUDE: 90.749973°**

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Major bridge/ Manas Revier
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.50 m
1.6	Overall Deck width (m)	10.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	02 x 26.00 + 3 x 41.00 m
1.10	Total length of the bridge (m)	175.00 m
1.11	Vertical Clearance (m)	4.00 m
1.12	Whether meadian, if yes its width (m)	8.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	2.00 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Crash barrier + Cast In-Situ & Length - 181.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	No spans

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	No cracks, potholes and uneven settlement surface
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No Erosion of embankment is observed
2.8	Approach slab (Check settlement, cracks,movement etc.)	Cracks are observed and settlement at A1 side.
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Retaining wall is in good condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	Not Present
2.12	Approach Geometry (Check whether it satisfies the standard in force)	Satisfied
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	No
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitched, growth of vegitation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	Not Present
	b) For Piers	Not Present
3.4	Bank Protection & Type	No
3.5	Floor Protection & Type	No
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	No obstruction in waterway
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	No meandering of inflow

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Information is not with the respective Department	
4.5	Check the adequacy of waterway	Not Present	
4.6	Check the errosion of bank	Not Present	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Well foundation	
5.2	Material	RCC	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No settlement and tilting	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	Not visible	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	Good condition
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No weepholes being observed	No weepholes being observed
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.1.9	Check damage of protective coating of painting.	Not Present	

6.2	Pier	04 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.2.6	Check damage of protective coating of painting.	Not present	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not relevant	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not relevant	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 4 Nos. + 2	02 x 4 Nos. + 2
8.2	No. per Pier	04 x 8 Nos. + 2	04 x 8 Nos. + 2
8.3	Type and allowable movements	POT cum PTFE	Rectangular
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Good condition	Good condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Good functioning	-
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	05 Nos. & 2 x 41.50 + 3 x 41.00 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab + Girder	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC + PSC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No spalling and honeycombing observed
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	Cracks are observed at end diaphragam.
9.7	Check exposed reinforcement, if any	No exposed reinforcement being observed
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No leaching observed
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No corrosion of reinforcement being observed
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No Leakage
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	Not relevant
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	Not relevant as this is not a prestressed concrete members
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Horizantal hairline cracks are observed at span2
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not relevant
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not relevant as this is not a box girder
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not relevant as this is not a submersible structure
9.22	Check peeling off of protective coat or paint	Not relevant
9.23	Check steel members	Not relevant as this not an steel structure
9.24	Check condition of protective system	Not relevant as this not an steel structure
9.25	Check corrosion, if any	Not relevant as this not an steel structure
9.26	Check excessive vibrations, if any	Not relevant as this not an steel structure
9.27	Check alignment of members	Not relevant as this not an steel structure
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not relevant as this not an steel structure
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not relevant as this not an steel structure
9.30	Check buckling, kinking, warping and waviness	Not relevant as this not an steel structure

9.31	Check apparent fracture if any	Not relevant as this not an steel structure
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not relevant as this not an steel structure
9.33	Check conditions inside the closed members	Not relevant as this not an steel structure
9.34	Check masonry arches	Not relevant as this not an arch structure
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not relevant as this not an arch structure
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not relevant as this not an arch structure
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not relevant as this not an arch structure
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not relevant as this not an arch structure
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not relevant as this is a concrete structure
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not relevant as this is a concrete structure
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not relevant as this is not masonry structure
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	Good condition, No Misalignment of joints and debris are accmulated.
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	No cracks in wearing course

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	No spliting and oxidation
10.5	Check secureness of the joints	No
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	No corrosion and damage
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	Not relevant as this is not a finger type expansion joint
10.8	Check for debris in joints	Debris is accmulated in joints
10.9	Report rattling, if any	No rattling
10.10	Check drainage from expansion joint	Not relevant as this is not a finger type expansion joint
10.11	Check alignment and clearance	In aligned
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Cracks, Potholes and bulges are observed.
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Drainage spouts are clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Projection of spouts are provided being observed and structural members are not being affected
12.3	Check adequacy thereof	Adequate
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not relevant as this not a subway
12.5	For submersible bridges, report on functioning	Not relevant as this not a submersible type of bridge
12.6	Report absence of Drainage Spouts	Not relevant

12.7	Check choking of drainage holes provided in the bottom booms	No bottom booms
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Crash barrier + Cast In-Situ
13.2	Material	RCC
13.3	Condition	Good condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	Yes
14.2	Material	RCC
14.3	Condition	Good condition
14.4	Check missing footpath slab	No
14.5	Cleanless of ducts along with footpath	No
15.UTILITIES		
15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cable
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes	Remove of vegetation and cleaning is required
2	Drainage spouts	Cleaning is required
3	Expansion joints	Cleaning is required
4	Superstructure	Cracks are observed
5	Pavement surface	Cracks and potholes are observed

17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit

View of Mobile Bridge Inspection Unit

17.2 Expansion Joints (If any)

View of strip seal expansion joint

View of strip seal expansion joint

17.3 Spout (If any)

View of drainage spouts

View of drainage spouts

17.4 Bearings (if any)

View of POT cum PTFE bearing

View of POT cum PTFE bearing

17.5 Abutment

View of abutment

View of abutment

17.6 Piers

View of pier

View of pier

17.7 Superstructure

View of Superstructure

View of Superstructure

17.8 Floor Protection

View of potholes on wearing coat

View of Cracks at End Diaphragam

17.09 Overall Bridge

View of Overall bridge

View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Rakhaldubi-Kaljhar Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Rakhaldubi-Kaljhar
5	Location Chainage	986300
6	Structure Number	Data not avalible
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Major bridge/ Pokalage Revier
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Rakhaldubi
12	Year of Construction	1966
13	Overall Bridge Length	206.50 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	No
31	Overall Deck Width in m	8.20 m
32	Approach Roadway Width including Shoulders in m	7.40 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	6.00 and 37.50 m + 38.50 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	5
40	Maximum Span	41.70 m
41	Type of Superstructure	Girder
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	Rocker roller
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Rakhaldubi-Kaljhar Section
49	Type of Railing	RCC Hand rail
50	Corrosion Protection	No
51	Bank Protection Type	No
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	No
60	Distress and Repairs in Substructure	Scouring is observed
61	Distress and Repairs in Superstructure	Excesive moment is observed at Pier P4 and pedestal damaged and reinforcement exposed at bottom of deck slab.
62	Any other Observation/Data	No

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: RAKHALDUBI-KALJHAR**

CHAINAGE : KM 986+300 (LHS) **DATE OF INSPECTION: 04-12-2022**

TYPE OF STRUCTURE: MAJOR BRIDGE

STRUCTURE NO:

LATTITUDE:- 26.482790° **LONGITUDE:- 90.838464°**

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Major bridge/ Pokalage Revier
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.40 m
1.6	Overall Deck width (m)	8.20 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	02 x 40.70 + 3 x 41.70 m
1.10	Total length of the bridge (m)	206.50 m
1.11	Vertical Clearance (m)	6.00 m
1.12	Whether meadian, if yes its width (m)	10.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	3.50 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Hand rail & Length - 212.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	Not Present

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	No cracks, potholes and uneven settlement surface
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No Erosion of embankment is observed
2.8	Approach slab (Check settlement, cracks,movement etc.)	No settlement and cracks
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Retaining wall is in fair condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	Not Present
2.12	Approach Geometry (Check whether it satisfies the standard in force)	Satisfiesd
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	No
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitched, growth of vegitation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	Not Present
	b) For Piers	Not Present
3.4	Bank Protection & Type	No
3.5	Floor Protection & Type	Not Present
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	Island formation
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	No meandering of inflow

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Information is not with the respective Department	
4.5	Check the adequacy of waterway	Not Present	
4.6	Check the errosion of bank	Not Present	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Well foundation	
5.2	Material	RCC	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No settlement and tilting	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	Not visible	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	Good condition
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No weepholes being observed	No weepholes being observed
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.1.9	Check damage of protective coating of painting.	Not present	

6.2	Pier	04 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.2.6	Check damage of protective coating of painting.	Not Present	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not relevant	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not relevant	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 2 Nos.	02 x 2 Nos.
8.2	No. per Pier	04 x 4 Nos.	04 x 4 Nos.
8.3	Type and allowable movements	Rocker roller	Rectangular
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Bearings are covered with iron box.	Poor condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Excesive moment is observed at Pier P4	Pedestals damaged at Pier P4
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	05 Nos. & 2 x 40.70 + 3 x 41.70 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab + Girder	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC + PSC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No spalling and honeycombing observed
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	No cracks
9.7	Check exposed reinforcement, if any	No exposed reinforcement being observed
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No leaching observed
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No corrosion of reinforcement being observed
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No Leakage
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	Reinforcement is exposed at several locations
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	Not present
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Not relevant as this is not a prestressed concrete members
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not relevant
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not relevant as this is not a box girder
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not relevant as this is not a submersible structure
9.22	Check peeling off of protective coat or paint	Protective coat is not applied
9.23	Check steel members	No
9.24	Check condition of protective system	Not relevant as this not an steel structure
9.25	Check corrosion, if any	Not relevant as this not an steel structure
9.26	Check excessive vibrations, if any	Not relevant as this not an steel structure
9.27	Check alignment of members	Not relevant as this not an steel structure
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not relevant as this not an steel structure
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not relevant as this not an steel structure
9.30	Check buckling, kinking, warping and waviness	Not relevant as this not an steel structure

9.31	Check apparent fracture if any	Not relevant as this not an steel structure
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not relevant as this not an steel structure
9.33	Check conditions inside the closed members	Not relevant as this not an steel structure
9.34	Check masonry arches	Not relevant as this not an arch structure
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not relevant as this not an arch structure
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not relevant as this not an arch structure
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not relevant as this not an arch structure
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not relevant as this not an arch structure
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not relevant as this is a concrete structure
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not relevant as this is a concrete structure
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not relevant as this is not masonry structure
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	Edge beam is damaged,Misalignment of joints and debris is accmulated.
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Cracks are observed on expansion joint edge beam

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	Sealing material is damaged and completely covered by Bituminous layer.
10.5	Check secureness of the joints	No
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	No corrosion and damage
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	Not relevant as this is not a finger type expansion joint
10.8	Check for debris in joints	Debris is accmulated in joints
10.9	Report rattling, if any	Rattling is observed
10.10	Check drainage from expansion joint	No
10.11	Check alignment and clearance	In aligned
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Surface condition is good
11.3	Details of water proofing system, if any	Not present
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Projection of spouts are provided being observed and structural members are not being affected
12.3	Check adequacy thereof	Adequate
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not relevant as this not a subway
12.5	For submersible bridges, report on functioning	Not relevant as this not a submersible type of bridge
12.6	Report absence of Drainage Spouts	Not relevant

12.7	Check choking of drainage holes provided in the bottom booms	No bottom booms
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Hand rail
13.2	Material	RCC
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	No
14.2	Material	Not relevant
14.3	Condition	Not relevant
14.4	Check missing footpath slab	Not relevant
14.5	Cleanless of ducts along with footpath	Not relevant
15.UTILITIES		
15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cable
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes and waterway	Remove of vegetation and cleaning is required
2	Drainage spouts	Cleaning is required
3	Expansion joints	Misalignment of joints and sealing material to be replaced, cleaning is required.
4	Bearings	Excesive moment is observed at Pier P4 and pedestal damaged
5	Pier	Scouing is observed
6	Superstructure	Reinforcement is exposed at the bottom of deck slab.

17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Bridge

View of pavement surface

17.2 Expansion Joints (If any)

View of strip seal expansion joint

View of strip seal expansion joint

17.3 Spout (If any)

View of drainage spouts

View of drainage spouts

17.4 Bearings (if any)

View of Rocker roller bearing

Pedestal damaged

17.5 Abutment

View of abutment

View of abutment

17.6 Piers

View of pier

View of pier

17.7 Superstructure

View of Exposed reinforcement in superstructure

View of superstructure

17.8 Overall Bridge

View of Overall bridge

View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Rakhaldubi-Kaljhar Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Rakhaldubi-Kaljhar
5	Location Chainage	986300
6	Structure Number	Data not avalible
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Major bridge/ Pokalage Revier
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Rakhaldubi
12	Year of Construction	Data not avalible
13	Overall Bridge Length	206.50 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	1.20 m
31	Overall Deck Width in m	10.00 m
32	Approach Roadway Width including Shoulders in m	7.50 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	6.00 and 37.50 m + 38.50 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	5
40	Maximum Span	41.70 m
41	Type of Superstructure	Girder
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	POT cum PTFE
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Rakhaldubi-Kaljhar Section
49	Type of Railing	RCC Crash barreir + Cast In-Situ
50	Corrosion Protection	No
51	Bank Protection Type	No
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	No
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	No
62	Any other Observation/Data	No

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27		**DIRECTION: RAKHALDUBI-KALJHAR**
CHAINAGE : KM 986+300 (RHS)		**DATE OF INSPECTION: 04-12-2022**
TYPE OF STRUCTURE: MAJOR BRIDGE		
STRUCTURE NO:		
LATTITUDE:- 26.482617°		**LONGITUDE:- 90.838482°**
S.NO	**DESCRIPTION**	**OBSERVATIONS**
1.STRUCTURE DATA		
1.1	Name of Bridge/No.of Bridge/Name of River	Major bridge/ Pokalage Revier
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.50 m
1.6	Overall Deck width (m)	10.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	02 x 40.70 + 3 x 41.70 m
1.10	Total length of the bridge (m)	206.50 m
1.11	Vertical Clearance (m)	6.00 m
1.12	Whether meadian, if yes its width (m)	10.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	3.50 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Crash barrier + Cast In-Situ & Length - 212.00 m
2.APPROACHES		
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	Not Present

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	No cracks, potholes and uneven settlement surface
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No Erosion of embankment is observed
2.8	Approach slab (Check settlement, cracks,movement etc.)	Settlemet is observed at Abutment A2 side
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Retaining wall is in good condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	Not Present
2.12	Approach Geometry (Check whether it satisfies the standard in force)	Satisfiesd
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	No
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitched, growth of vegitation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	Not Present
	b) For Piers	Not Present
3.4	Bank Protection & Type	No
3.5	Floor Protection & Type	Not Present
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	No obstruction in waterway
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	No meandering of inflow

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Not visible	
4.5	Check the adequacy of waterway	Not visible	
4.6	Check the errosion of bank	Not visible	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Well foundation	
5.2	Material	RCC	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No settlement and tilting	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	Good condition
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No weepholes being observed	No weepholes being observed
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.1.9	Check damage of protective coating of painting.	Not visible	

6.2	Pier	04 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Cracks are observed at piers p2,p3,p4&p5	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.2.6	Check damage of protective coating of painting.	Not visible	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not relevant	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not relevant	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 4 Nos.	02 x 4 Nos.
8.2	No. per Pier	04 x 8 Nos.	04 x 8 Nos.
8.3	Type and allowable movements	POT cum PTFE	Rectangular
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Good condition	Good condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Good functioning	-
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	05 Nos. & 2 x 40.70 + 3 x 41.70 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab + Girder	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC + PSC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No spalling and honeycombing observed
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	Cracks are observed
9.7	Check exposed reinforcement, if any	No exposed reinforcement being observed
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No leaching observed
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No corrosion of reinforcement being observed
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No Leakage
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	No cracks and exposed reinforcement being observed.
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	Notpresent
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Not relevant as this is not a prestressed concrete members
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not relevant
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not relevant as this is not a box girder
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not relevant as this is not a submersible structure
9.22	Check peeling off of protective coat or paint	Not relevant
9.23	Check steel members	Not relevant as this not an steel structure
9.24	Check condition of protective system	Not relevant as this not an steel structure
9.25	Check corrosion, if any	Not relevant as this not an steel structure
9.26	Check excessive vibrations, if any	Not relevant as this not an steel structure
9.27	Check alignment of members	Not relevant as this not an steel structure
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not relevant as this not an steel structure
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not relevant as this not an steel structure
9.30	Check buckling, kinking, warping and waviness	Not relevant as this not an steel structure

9.31	Check apparent fracture if any	Not relevant as this not an steel structure
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not relevant as this not an steel structure
9.33	Check conditions inside the closed members	Not relevant as this not an steel structure
9.34	Check masonry arches	Not relevant as this not an arch structure
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not relevant as this not an arch structure
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not relevant as this not an arch structure
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not relevant as this not an arch structure
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not relevant as this not an arch structure
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not relevant as this is a concrete structure
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not relevant as this is a concrete structure
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not relevant as this not an arch structure
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	Good condition, No Misalignment of joints and debris are accmulated.
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	No cracks in wearing course

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	No spliting and oxidation
10.5	Check secureness of the joints	Secured
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	No corrosion and damage
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	Not relevant as this is not a finger type expansion joint
10.8	Check for debris in joints	Debris is accmulated in joints
10.9	Report rattling, if any	No rattling
10.10	Check drainage from expansion joint	Not relevant as this is not a finger type expansion joint
10.11	Check alignment and clearance	In aligned
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Surface condition is good
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Drainage spouts are clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Projection of spouts are provided being observed and structural members are not being affected
12.3	Check adequacy thereof	Adequate
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not relevant as this not a subway
12.5	For submersible bridges, report on functioning	Not relevant as this not a submersible type of bridge
12.6	Report absence of Drainage Spouts	Drainage spouts are provided

12.7	Check choking of drainage holes provided in the bottom booms	No bottom booms
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Crash barrier + Cast In-Situ
13.2	Material	RCC
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	Yes
14.2	Material	RCC
14.3	Condition	Fair condition
14.4	Check missing footpath slab	No
14.5	Cleanless of ducts along with footpath	No
15.UTILITIES		
15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cable
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes	Remove of vegetation and cleaning is required
2	Drainage spouts	Cleaning is required
3	Expansion joints	Cleaning is required
4	Approachs slab	Settlemet is observed at Abutment A2 side

17.PHOTOGRAPHS

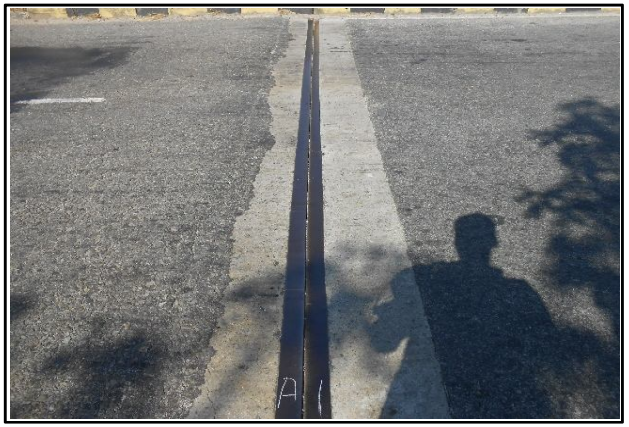
17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit

View of pavement surface

17.2 Expansion Joints (If any)

View of strip seal expansion joint



View of strip seal expansion joint

17.3 Spout (If any)

View of drainage spouts

View of drainage spouts

17.4 Bearings (if any)

View of POT cum PTFE bearing

View of Sesmic arrerster bearing

17.5 Abutment

View of abutment

View of abutment

17.6 Piers

View of pier

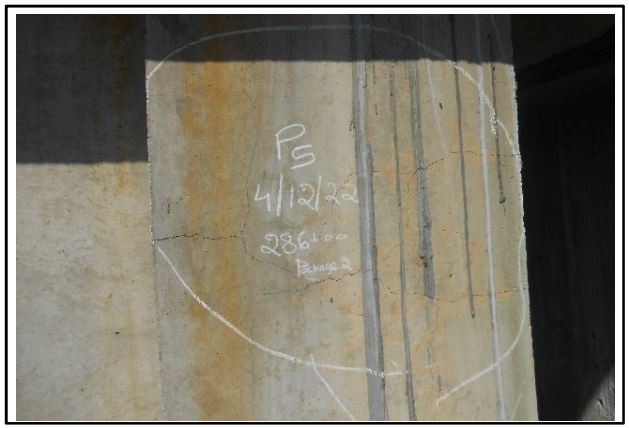
View of pier

17.7 Superstructure

Cracks are observed

View of superstructure

17.8 Floor Protection



View of cracks at P5

View of cracks at P2-P3

17.9 Overall Bridge

View of Overall bridge

View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Rakhaldubi-Kaljhar Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Rakhaldubi-Kaljhar
5	Location Chainage	996120
6	Structure Number	Data not avalible
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Major bridge/ Beki Revier
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Rakhaldubi
12	Year of Construction	Data not avalible
13	Overall Bridge Length	393.30 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	No
31	Overall Deck Width in m	8.20 m
32	Approach Roadway Width including Shoulders in m	7.40 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	6.00 and 41.00 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	9
40	Maximum Span	41.70 m
41	Type of Superstructure	Girder
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	Rocker roller
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Rakhaldubi-Kaljhar Section
49	Type of Railing	RCC Hand rail
50	Corrosion Protection	No
51	Bank Protection Type	No
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	No
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	Cracks and Exposed reinforcement is observed
62	Any other Observation/Data	Sealing material of expansion joints has to be replaced.

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: RAKHALDUBI-KALJHAR**

CHAINAGE : KM 996+120 (LHS) **DATE OF INSPECTION: 04-12-2022**

TYPE OF STRUCTURE: MAJOR BRIDGE

LATTITUDE:- 26.494950° **LONGITUDE:- 90.917866°**

STRUCTURE NO:

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Major bridge/ Beki Revier
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.40 m
1.6	Overall Deck width (m)	8.20 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	09 x 43.70 m
1.10	Total length of the bridge (m)	393.30 m
1.11	Vertical Clearance (m)	6.00 m
1.12	Whether meadian, if yes its width (m)	10.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	3.50 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Hand rail & Length - 400.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	No spans

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	No cracks, potholes and uneven settlement surface
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No Erosion of embankment is observed
2.8	Approach slab (Check settlement, cracks,movement etc.)	Minor settlemet is observed at Abutment A2 side
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Retaining wall is in fair condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	Not Present
2.12	Approach Geometry (Check whether it satisfies the standard in force)	Satisfied
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	No
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitched, growth of vegitation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	Not Present
	b) For Piers	Not Present
3.4	Bank Protection & Type	No
3.5	Floor Protection & Type	Not visible
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	No obstruction in waterway
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	No meandering of inflow

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Not visible	
4.5	Check the adequacy of waterway	Not visible	
4.6	Check the errosion of bank	Not visible	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Well foundation	
5.2	Material	RCC	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	Good condition
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No weepholes being observed	No weepholes being observed
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.1.9	Check damage of protective coating of painting.	Not visible	

6.2	Pier	08 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Exosed reinforcement is observed at the diaphragam of abutment A1 side.	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.2.6	Check damage of protective coating of painting.	Not visible	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not relevant	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not relevant	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 3 Nos.	02 x 3 Nos.
8.2	No. per Pier	08 x 6 Nos.	08 x 6 Nos.
8.3	Type and allowable movements	Rocker roller	Rectangular
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Good condition	Good condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Bearing movement is observed at span 2 and span 8	-
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	09 Nos. & 9 x 43.70 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab + Girder	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC + PSC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No spalling and honeycombing observed
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	Shear cracks are observed on the outer faces.
9.7	Check exposed reinforcement, if any	Exposed reinforcemet is observed at the bottom.
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No leaching observed
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No corrosion of reinforcement being observed
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No Leakage
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	Not relevant
9.16	Check excessive vibrations, if any	Vibrations are observed while the vehicles are moving

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	No
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Cracks are observed at span-3, G1&G3 and at span-5, G1
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not relevant as this is not a prestressed concrete members
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not relevant as this is not a box girder
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not relevant as this is not a submersible structure
9.22	Check peeling off of protective coat or paint	Not applicable
9.23	Check steel members	Not relevant as this not an steel structure
9.24	Check condition of protective system	Not relevant as this not an steel structure
9.25	Check corrosion, if any	Not relevant as this not an steel structure
9.26	Check excessive vibrations, if any	Not relevant as this not an steel structure
9.27	Check alignment of members	Not relevant as this not an steel structure
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not relevant as this not an steel structure
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not relevant as this not an steel structure
9.30	Check buckling, kinking, warping and waviness	Not relevant as this not an steel structure

9.31	Check apparent fracture if any	Not relevant as this not an steel structure
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not relevant as this not an steel structure
9.33	Check conditions inside the closed members	Not relevant as this not an steel structure
9.34	Check masonry arches	Not relevant as this not an arch structure
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not relevant as this not an arch structure
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not relevant as this not an arch structure
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not relevant as this not an arch structure
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not relevant as this not an arch structure
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not relevant as this is a concrete structure
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not relevant as this is a concrete structure
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not relevant as this not an arch structure
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	Misalignment of joints and debris are accmulated.
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Cracks are observed on expansion joint edge beam

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	Sealing material is damaged
10.5	Check secureness of the joints	No
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	No corrosion and damage
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	Not relevant as this is not a finger type expansion joint
10.8	Check for debris in joints	Debris is accmulated in joints
10.9	Report rattling, if any	No rattling
10.10	Check drainage from expansion joint	Not relevant as this is not a finger type expansion joint
10.11	Check alignment and clearance	In aligned
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Cracks, potholes, bulges and spalling are observed
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Drainage spouts are clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Projection of spouts are provided being observed and structural members are not being affected
12.3	Check adequacy thereof	Adequate
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not relevant as this not a subway
12.5	For submersible bridges, report on functioning	Not relevant as this not a submersible type of bridge
12.6	Report absence of Drainage Spouts	Not relevant

12.7	Check choking of drainage holes provided in the bottom booms	No bottom booms
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Hand rail
13.2	Material	RCC
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	No
14.2	Material	Not relevant
14.3	Condition	Not relevant
14.4	Check missing footpath slab	Not relevant
14.5	Cleanless of ducts along with footpath	Not relevant
15.UTILITIES		
15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cable
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes	Remove of vegetation and cleaning is required
2	Drainage spouts	Cleaning is required
3	Expansion joints	Sealing material to be replaced
4	Superstructure	Cracks and exposed reinforcement is observed
5	Pavement surface	Wearing course has to be layed

17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit

View of Mobile Bridge Inspection Unit

17.2 Expansion Joints (If any)

View of strip seal expansion joint

View of strip seal expansion joint

17.3 Spout (If any)

View of drainage spouts

View of drainage spouts

17.4 Bearings (if any)

View of Rocker Roller bearing

View of POT cum PTFE bearing

17.5 Abutment

View of abutment

View of abutment

17.6 Piers

View of pier

View of pier

17.7 Superstructure

Cracks Observed

View of superstructure

17.8 Floor Protection

View of exposed reinforcement

View of exposed reinforcement

17.9 Overall Bridge

View of Overall bridge

View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Rakhaldubi-Kaljhar Section
1	State	AS
2	Category of Road	NH
3	Road No	NH-27
4	Section	Rakhaldubi-Kaljhar
5	Location Chainage	996120
6	Structure Number	Data not avalible
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Major bridge/ Beki Revier
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Rakhaldubi
12	Year of Construction	Data not avalible
13	Overall Bridge Length	393.30 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	1.20 m
31	Overall Deck Width in m	10.00 m
32	Approach Roadway Width including Shoulders in m	7.50 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	6.00 and 41.00 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	9
40	Maximum Span	41.70 m
41	Type of Superstructure	Girder
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	POT cum PTFE
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Rakhaldubi-Kaljhar Section
49	Type of Railing	RCC Crash barrier + Cast In-Situ
50	Corrosion Protection	No
51	Bank Protection Type	No
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	No
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	Data not avalible
62	Any other Observation/Data	No

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: RAKHALDUBI-KALJHAR**

CHAINAGE : KM 996+120 (RHS) **DATE OF INSPECTION: 04-12-2022**

TYPE OF STRUCTURE: MAJOR BRIDGE

STRUCTURE NO:

LATTITUDE:- 26.494669° **LONGITUDE:- 90.917905°**

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Major bridge/ Beki Revier
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.50 m
1.6	Overall Deck width (m)	10.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	09 x 43.70 m
1.10	Total length of the bridge (m)	393.30 m
1.11	Vertical Clearance (m)	6.00 m
1.12	Whether meadian, if yes its width (m)	10.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	3.50 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Crash barrier + Cast In-Situ & Length - 400.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	No spans

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	Pavememnt surface is in fair condition
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No Erosion of embankment is observed
2.8	Approach slab (Check settlement, cracks,movement etc.)	Settlemet is observed at Abutment A1 side
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Retaining wall is in fair condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	No
2.12	Approach Geometry (Check whether it satisfies the standard in force)	Satisfied
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	No
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitched, growth of vegitation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	Not Present
	b) For Piers	Not Present
3.4	Bank Protection & Type	No
3.5	Floor Protection & Type	Not visible
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	No obstruction in waterway
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	No meandering of inflow

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Not visible	
4.5	Check the adequacy of waterway	Not visible	
4.6	Check the errosion of bank	Not visible	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Well foundation	
5.2	Material	RCC	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	Good condition
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No weepholes being observed	No weepholes being observed
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	Not relevant	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.1.9	Check damage of protective coating of painting.	Not visible	

6.2	Pier	08 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Good condition	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not relevant	
6.2.6	Check damage of protective coating of painting.	Not visible	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not relevant	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not relevant	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 4 Nos. + 3	02 x 4 Nos. + 3
8.2	No. per Pier	08 x 4 Nos. + 3	08 x 4 Nos. + 3
8.3	Type and allowable movements	POT cum PTFE	Rectangular
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Good condition	Good condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Good functioning	-
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	09 Nos. & 9 x 43.70 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab + Girder	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC + PSC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No spalling and honeycombing observed
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	No cracks
9.7	Check exposed reinforcement, if any	No exposed reinforcement being observed
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No leaching observed
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No corrosion of reinforcement being observed
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No Leakage
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	No cracks and exposed reinforcement being observed.
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	Not present
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Not relevant as this is not a prestressed concrete members
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not relevant
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not relevant as this is not a box girder
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not relevant as this is not a submersible structure
9.22	Check peeling off of protective coat or paint	Protective coat is not applied
9.23	Check steel members	No
9.24	Check condition of protective system	Not relevant as this not an steel structure
9.25	Check corrosion, if any	Not relevant as this not an steel structure
9.26	Check excessive vibrations, if any	Not relevant as this not an steel structure
9.27	Check alignment of members	Not relevant as this not an steel structure
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not relevant as this not an steel structure
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not relevant as this not an steel structure
9.30	Check buckling, kinking, warping and waviness	Not relevant as this not an steel structure

9.31	Check apparent fracture if any	Not relevant as this not an steel structure
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not relevant as this not an steel structure
9.33	Check conditions inside the closed members	Not relevant as this not an steel structure
9.34	Check masonry arches	Not relevant as this not an arch structure
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not relevant as this not an arch structure
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not relevant as this not an arch structure
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not relevant as this not an arch structure
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not relevant as this not an arch structure
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not relevant as this is a concrete structure
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not relevant as this is a concrete structure
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not relevant as this not an arch structure
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	No Misalignment of joints and debris are accmulated.
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Fair condition

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	Sealing material is damaged at pier P8
10.5	Check secureness of the joints	Secured
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	No corrosion and damage
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	Not relevant as this is not a finger type expansion joint
10.8	Check for debris in joints	Debris is accmulated in joints
10.9	Report rattling, if any	No rattling
10.10	Check drainage from expansion joint	Not relevant as this is not a finger type expansion joint
10.11	Check alignment and clearance	In aligned
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Surface condition is good
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Drainage spouts are clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Projection of spouts are provided being observed and structural members are not being affected
12.3	Check adequacy thereof	Adequate
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not relevant as this not a subway
12.5	For submersible bridges, report on functioning	Not relevant as this not a submersible type of bridge
12.6	Report absence of Drainage Spouts	Drainage spouts are provided

12.7	Check choking of drainage holes provided in the bottom booms	No bottom booms
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Crash barrier + Cast In-Situ
13.2	Material	RCC
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	Yes
14.2	Material	RCC
14.3	Condition	Fair condition
14.4	Check missing footpath slab	No
14.5	Cleanless of ducts along with footpath	No
15.UTILITIES		
15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cable
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes	Remove of vegetation and cleaning is required
2	Drainage spouts	Cleaning is required
3	Expansion joints	Sealing material to replaced at pier P8 and Cleaning is required
4	Approachs slab	Settlemet is observed at Abutment A1 side

17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit

View of Mobile Bridge Inspection Unit

17.2 Expansion Joints (If any)

View of strip seal expansion joint

View of strip seal expansion joint

17.3 Spout (If any)

View of drainage spouts

View of drainage spouts

17.4 Bearings (if any)

View of POT cum PTFE bearing

View of POT cum PTFE bearing

17.5 Abutment

View of abutment

View of abutment

17.6 Piers

View of pier

View of pier

17.7 Superstructure

View of Superstructure

View of Superstructure

17.8 Retaining wall (if any)

View of retaining wall

View of retaining wall

17.9 Overall Bridge

View of Overall bridge

View of Overall bridge

Annexure – 4.9

Lab Test Results

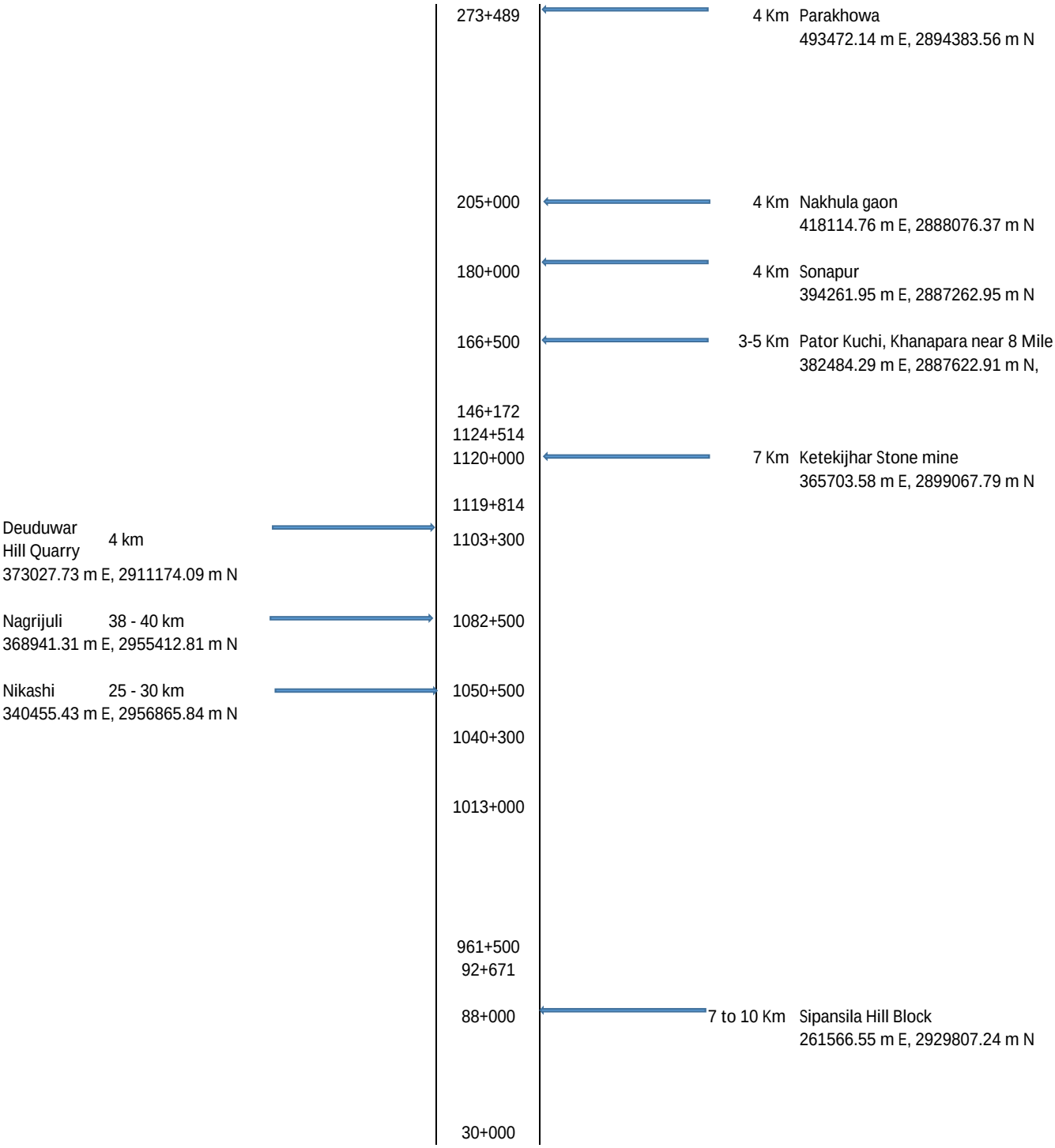
Test Results Summary: NH-27_Kochugoan to Rakhaldubi Section_Km 30.000 to Km 92.671																			
S:No	Existing road	Location (Km.)	Side (LHS/RHS)	Type of Pit	Soil Classification as per IS: 1498	Gradation: Percent by weight passing through the Sieve (IS:2720-IV)			Clay & silt content %	Atterberg Limits [IS :2720-Pt-V]			Modified Proctor Test (IS:2720-Pt-VIII)		In-situ Density		4-Days Soaked CBR (%)	Free Swell Index (%)	Degree of Compaction (%)
						Gravel (%)	Sand (%)	Clay & silt content %		Liquid Limit (LL) %	Plastic Limit (PL) %	Plasticity Index (PI)	Max. dry density gm/cc.	OMC (%)	FDD (gm/cc)	FMC (%)			
1	NH-27	30+000	LHS	Subgrade	SM	18.0	74.0	8.0	8.0	22	NP	NP	1.86	8.8	1.69	6.0	8.2	0.0	90.9
2	NH-27	35+000	RHS	Subgrade	SM	7.2	51.8	41.0	41.0	23	NP	NP	1.73	8.2	1.67	6.0	8.0	0.0	96.4
3	NH-27	40+000	LHS	Subgrade	SM	10.0	60.4	29.6	29.6	21	NP	NP	1.79	7.8	1.71	5.0	7.6	0.0	95.6
4	NH-27	45+000	RHS	Subgrade	ML	0.0	30.2	69.8	69.8	24	NP	NP	1.75	10.2	1.67	5.0	7.8	0.0	95.2
5	NH-27	50+000	LHS	Subgrade	ML	0.0	35.6	64.4	64.4	25	NP	NP	1.76	10.3	1.71	6.0	7.5	0.0	97.4
6	NH-27	55+000	RHS	Subgrade	SM	8.7	47.9	43.4	43.4	22	NP	NP	1.85	9.8	1.71	6.0	8.1	0.0	92.6
7	NH-27	60+200	LHS	Subgrade	SM	8.7	50.6	40.7	40.7	20	NP	NP	1.78	8.9	1.71	6.0	7.6	0.0	95.9
8	NH-27	65+000	RHS	Subgrade	SM	9.4	58.1	32.5	32.5	22	NP	NP	1.81	8.7	1.70	7.0	8.2	0.0	93.9
9	NH-27	71+000	LHS	Subgrade	SM	7.8	83.8	8.4	8.4	26	NP	NP	1.84	8.8	1.73	5.0	8.4	0.0	94.3
10	NH-27	75+000	RHS	Subgrade	SM	5.4	49.0	45.6	45.6	25	NP	NP	1.78	9.2	1.68	5.0	7.2	0.0	94.6
11	NH-27	81+700	LHS	Subgrade	SM	1.7	91.1	7.2	7.2	24	NP	NP	1.86	8.9	1.84	7.0	7.6	0.0	98.9
12	NH-27	85+000	RHS	Subgrade	SM-SC	14.6	66.0	19.4	19.4	32	26	6	1.75	10.2	1.70	6.0	7.6	10.0	97.2
13	NH-27	90+000	LHS	Subgrade	SM-SC	10.5	68.6	20.9	20.9	30	23	7	1.82	9.8	1.79	6.0	7.2	15.0	98.5

Test Results Summary: NH-27_Rakhaldubi to Kaljhar section_961+500 to 1013+000																			
S:No	Existing road	Location (Km.)	Side (LHS/RHS)	Type of Pit	Soil Classification as per IS: 1498	Gradation: Percent by weight passing through the Sieve (IS:2720-IV)			Clay & silt content %	Atterberg Limits [IS :2720-Pt-V]			Modified Proctor Test (IS:2720-Pt-VIII)		In-situ Density		4-Days Soaked CBR (%)	Free Swell Index (%)	Degree of Compaction (%)
						Gravel (%)	Sand (%)	Clay & silt content %		Liquid Limit (LL) %	Plastic Limit (PL) %	Plasticity Index (PI)	Max. dry density gm/cc.	OMC (%)	FDD (gm/cc)	FMC (%)			
1	NH-27	962+500	LHS	Subgrade	SM	15.0	51.6	33.4	33.4	26	NP	NP	1.82	8.5	1.73	7.0	7.3	0.0	94.8
2	NH-27	967+000	RHS	Subgrade	SM-SC	13.4	44.5	42.1	42.1	27	20	7	1.85	9.0	1.78	5.0	7.6	10.0	96.1
3	NH-27	972+000	LHS	Subgrade	SC	17.3	55.8	26.9	26.9	32	22	10	1.81	8.2	1.74	6.0	6.9	0.0	96.2
4	NH-27	979+000	RHS	Subgrade	SC	11.3	60.7	28.0	28.0	32	24	8	1.87	8.2	1.71	6.0	7.5	0.0	91.3
5	NH-27	982+000	LHS	Subgrade	ML	19.5	55.0	25.5	25.5	28	NP	NP	1.87	8.0	1.78	7.0	6.8	5.3	95.1
6	NH-27	987+000	RHS	Subgrade	SM	5.9	55.2	38.9	38.9	24	NP	NP	1.76	10.8	1.63	6.0	6.5	0.0	92.6
7	NH-27	991+500	LHS	Subgrade	ML	17.5	45.4	37.1	37.1	27	NP	NP	1.76	8.2	1.66	5.0	7.0	0.0	94.6
8	NH-27	997+000	RHS	Subgrade	SM	5.0	59.6	35.4	35.4	25	NP	NP	1.75	9.1	1.67	8.0	7.3	25.0	95.5
9	NH-27	1003+000	LHS	Subgrade	SM	5.6	42.6	51.8	51.8	33	NP	NP	1.78	8.9	1.72	6.0	7.9	0.0	96.9
10	NH-27	1007+000	RHS	Subgrade	ML	2.3	42.6	55.1	55.1	25	NP	NP	1.74	8.5	1.70	6.0	6.7	0.0	98.0
11	NH-27	1012+000	LHS	Subgrade	CL	10.4	38.9	50.7	50.7	28	18	10	1.75	9.2	1.71	6.0	7.1	15.0	97.9

Annexure – 5.1

Lead Chart

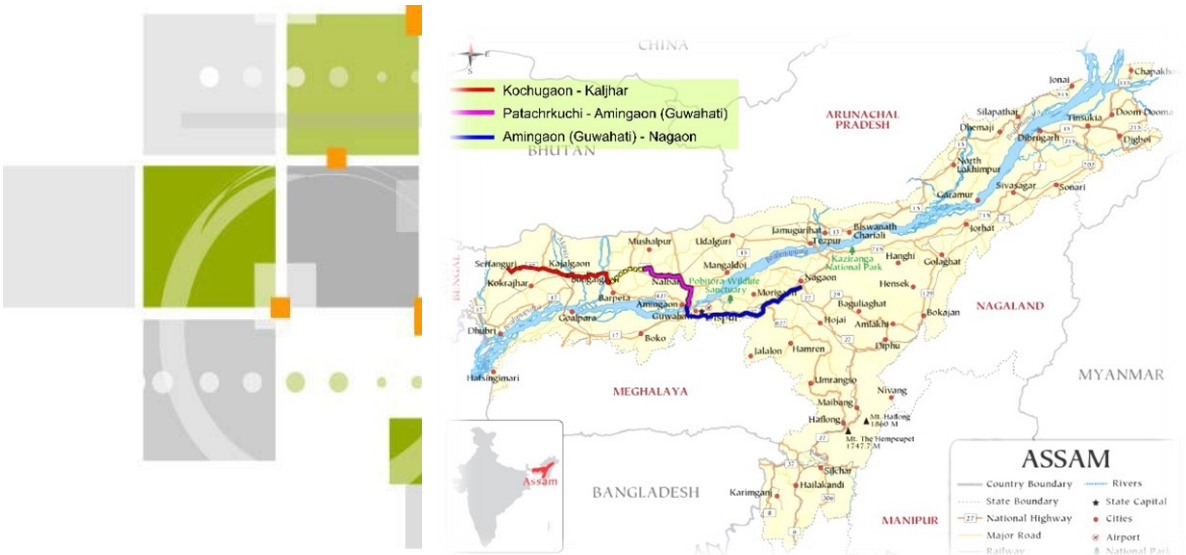
LEAD CHART


273+489
4 Km Parakhowa
493472.14 m E, 2894383.56 m N
205+000
4 Km Nakhula gaon
418114.76 m E, 2888076.37 m N
180+000
4 Km Sonapur
394261.95 m E, 2887262.95 m N
166+500
3-5 Km Pator Kuchi, Khanapara near 8 Mile
382484.29 m E, 2887622.91 m N,
146+172
1124+514
1120+000
7 Km Ketekijhar Stone mine
365703.58 m E, 2899067.79 m N
1119+814
Deuduwar Hill Quarry 4 km
373027.73 m E, 2911174.09 m N
1103+300
Nagrijuli 38 - 40 km
368941.31 m E, 2955412.81 m N
1082+500
Nikashi 25 - 30 km
340455.43 m E, 2956865.84 m N
1050+500
1040+300
1013+000
961+500
92+671
88+000
7 to 10 Km Sipansila Hill Block
261566.55 m E, 2929807.24 m N
30+000

SUPPLEMENTARY REPORT OF THE FINAL TECHNICAL DUE-DILIGENCE REPORT

Technical Consultant Services for National Highways Infra Trust

Kochugaon to Rakhaldubi and Rakhaldubi to Kaljhar Section of NH-27 in the State of Assam



February 2024

egis India
Consulting engineers pvt. ltd.

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1.2 Strategy for Toll Operation 3
1.3 Updated O&M Cost 3

Section 1: Supplementary Report

1.1 Background

Technical Consultant submitted the Final TDD Report for Kochugaon – Rakhaldubi and Rakhaldubi - Kaljahr sections of NH-27 in the state of Assam in October – 2023. Later a strategy is formed to optimise the cost of toll collection operation which has impact on the operation cost presented in the final TDD report. This Supplementary Report is submitted with respect to updated operation cost and shall be read in conjunction with the Final TDD Report submitted in October – 2023.

1.2 Strategy for Toll Operation

It is understood that requirement of man-powers for toll operation shall reduce with time. Revised strategy in this regard is presented below:

S. No.	Financial Year	Toll Collector	Lane Assitant	Traffic Marshal
1	Appointed Date (First year)	Each per Lane per shift + No. of Lanes x 3/6	Each per Two Lanes per shift	Each per Two Lanes per shift
2	2nd Year	Each per Lane per shift + No. of Lanes x 3/6	Each per Two Lanes per shift	Each per Two Lanes per shift
3	3rd Year	Two per Three Lane per shift + No. of Lanes x 2/3 x 3/6	Each per Three Lanes per shift	Each per Three Lanes per shift
4	4th Year	Two per Three Lane per shift + No. of Lanes x 2/3 x 3/6	Each per Three Lanes per shift	Each per Three Lanes per shift
5	5th Year to 20th year	Two per Four Lane per shift + No. of Lanes x 1/2 x 3/6	Each per Four Lanes per shift	Each per Four Lanes per shift

1.3 Updated O&M Cost

As per the strategy explained in above section, O&M cost for the entire concession period (excluding escalation) is updated which is presented below:

Kochugaon – Rakhaldubi; Updated Estimate - CapEx and O&M ***(excluding escalation, Figures in INR Crore)***

Year of Concession	O & M Year	Capex							Major Maintenance			Operation & Maintenance					Admin Expenses	Insurance	Estimated O&M Cost (Rs.)
		New Construction (Sch B)	Electrical work	ATMS	TCMS	Immediate Maintenance			Structure & Roadwork	Equipment replacement cost for Tolling	Equipment replacement cost for ATMS	Operations			Maintenance				
						Road works-Flex	Road works-Rigid	Structure works				Tolling Operations	Incident Management	Routine Maintenance	Repairs	ATMS			
1	2024-25	6.77	19.71	0	1.91							3.24	2.23	3.28	1.98		3.38	1.43	43.94
2	2025-26	10.16										3.24	2.23	3.28	1.98		3.38	1.43	25.70
3	2026-27											2.83	2.23	3.28	14.33		3.38	1.43	27.48
4	2027-28											2.83	2.23	3.28	1.98		3.38	1.43	15.13
5	2028-29											2.67	2.23	3.28	1.98		3.38	1.43	14.97
6	**2029-30**								**86.58**			2.67	2.23	3.28	1.98		3.38	1.43	101.54
7	2030-31									0.95		2.67	2.23	3.28	1.98		3.38	1.43	15.92
8	2031-32											2.67	2.23	3.28	1.98		3.38	1.43	14.97
9	2032-33											2.67	2.23	3.28	1.98		3.38	1.43	14.97
10	2033-34											2.67	2.23	3.28	1.98		3.38	1.43	14.97
11	2034-35											2.67	2.23	3.28	1.98		3.38	1.43	14.97
12	**2035-36**								**56.04**			2.67	2.23	3.28	1.98		3.38	1.43	71.00
13	2036-37											2.67	2.23	3.28	1.98		3.38	1.43	14.97
14	2037-38									1.91		2.67	2.23	3.28	1.98		3.38	1.43	16.87
15	2038-39											2.67	2.23	3.28	1.98		3.38	1.43	14.97
16	2039-40											2.67	2.23	3.28	1.98		3.38	1.43	14.97
17	2040-41											2.67	2.23	3.28	1.98		3.38	1.43	14.97
18	**2041-42**								**57.57**			2.67	2.23	3.28	1.98		3.38	1.43	72.54
19	2042-43											2.67	2.23	3.28	1.98		3.38	1.43	14.97
20	2043-44											2.67	2.23	3.28	1.98		3.38	1.43	14.97
Total		**16.93**	**19.71**	**0**	**1.91**	**0**	**0**	**0**	**200.19**	**2.86**	**0**	**54.86**	**44.6**	**65.6**	**51.95**	**0**	**67.60**	**28.60**	**554.79**

Rakhaldubi – Kaljhar: Updated Estimate -CapEx and O&M ***(excluding escalation, Figures in INR Crore)***

Year of Concession	O & M Year	Capex							Major Maintenance			Operation & Maintenance					Admin Expenses	Insurance	Estimated O&M Cost (Rs.)
		New Construction (Sch B)	Electrical work	ATMS	TCMS	Immediate Maintenance			Structure & Roadwork	Equipment replacement cost for Tolling	Equipment replacement cost for ATMS	Operations		Maintenance					
						Road works-Flex	Road works-Rigid	Structure works				Tolling Operations	Incident Management	Routine Maintenance	Repairs	ATMS			
1	2024-25	5.48	21.64		3.18							4.21	2.21	3.14	1.67		3.38	1.05	45.95
2	2025-26	8.22										4.21	2.21	3.14	1.67		3.38	1.05	23.88
3	2026-27											3.47	2.21	3.14	11.82		3.38	1.05	25.07
4	2027-28											3.47	2.21	3.14	1.67		3.38	1.05	14.92
5	2028-29											3.19	2.21	3.14	1.67		3.38	1.05	14.63
6	**2029-30**								**86.90**			3.19	2.21	3.14	1.67		3.38	1.05	101.54
7	2030-31									1.59		3.19	2.21	3.14	1.67		3.38	1.05	16.22
8	2031-32											3.19	2.21	3.14	1.67		3.38	1.05	14.63
9	2032-33											3.19	2.21	3.14	1.67		3.38	1.05	14.63
10	2033-34											3.19	2.21	3.14	1.67		3.38	1.05	14.63
11	2034-35											3.19	2.21	3.14	1.67		3.38	1.05	14.63
12	**2035-36**								**49.47**			3.19	2.21	3.14	1.67		3.38	1.05	64.10
13	2036-37											3.19	2.21	3.14	1.67		3.38	1.05	14.63
14	2037-38									3.18		3.19	2.21	3.14	1.67		3.38	1.05	17.81
15	2038-39											3.19	2.21	3.14	1.67		3.38	1.05	14.63
16	2039-40											3.19	2.21	3.14	1.67		3.38	1.05	14.63
17	2040-41											3.19	2.21	3.14	1.67		3.38	1.05	14.63
18	**2041-42**								**53.37**			3.19	2.21	3.14	1.67		3.38	1.05	68.01
19	2042-43											3.19	2.21	3.14	1.67		3.38	1.05	14.63
20	2043-44											3.19	2.21	3.14	1.67		3.38	1.05	14.63
Total		**13.70**	**21.64**	**0**	**3.18**	**0**	**0**	**0**	**189.74**	**4.77**	**0**	**66.40**	**44.20**	**62.80**	**43.55**	**0**	**67.60**	**21.00**	**538.43**

FINAL TECHNICAL DUE-DILIGENCE REPORT

Technical Consultant Services for National Highways Infra Trust

Kaljhar to Patacharkuchi Section of NH-27 in the State of Assam

February 2024

egis India
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Acronyms and Abbreviations

BC	Bituminous Concrete
BOQ	Bill of Quantities
C/W	Carriageway
CA	Concession Agreement
COD	Commercial Operation Date
CVPD	Commercial Vehicles Per Day
DLP	Digital Laser Profile
EGIS	Egis India Consulting Engineers Pvt. Ltd.
EPC	Engineering Procurement and Construction
FWD	Falling Weight Deflectometer
IM	Investment Manager
InvIT	National Highways Infra Trust
IRC	Indian Road Congress
Km	Kilometer (Chainage)
km	Kilometer (Length)
LHS	Left Hand Side
MBIU	Mobile Bridge Inspection Unit
MJB	Major Bridge
MNB	Minor Bridge
MPD	Mean Profile Depth
MSA	Million Standard Axles
NH	National Highway
NHAI	National Highways Authority of India
NHIIMPL	National Highways Infra Investment Managers Private Limited
NSV	Network Survey Vehicle
O&M	Operation and Maintenance
RCC	Reinforced Cement Concrete
RHS	Right Hand Side
ROB	Road over Bridge
SH	Stage Highway
SMTD	Sensor Measured Texture Depth
SPV	Special Purpose Vehicle
VDF	Vehicle Damage Factor
VUP	Vehicular Underpass

Section 1: Executive Summary

1.1 Introduction

1.1.1 Background

NHAI has set up an Infrastructure Investment Trust namely National Highways Infra Trust ("InvIT") and is acting as its Sponsor to the said InvIT. National Highways Infra Investment Managers Private Limited ("NHIIMPL") has been appointed as the Investment Manager to the InvIT.

Further, InvIT would be evaluating acquisition opportunities going forward. In this context, NHIIMPL (on behalf of InvIT & NHIPPL) has created a panel of Technical Consultants for undertaking technical due diligence of its assets and acquisition opportunities.

NHIIMPL appointed M/s Egis India Consulting Engineers Private Limited, as Technical Consultant to conduct the due diligence on the proposed Assets. The Letter of Empanelment (LOE) was received on 3rd November 2022 and Letter of Award (LoA) dated 11th October 2023 for the subject Project was received on 17th October 2023 by Egis India and the services commenced immediately thereafter.

The project stretch detail is listed below.

Table 1.1: Detail of Project Stretches

Sr. No.	Stretches	Toll Plaza	NH No.	Length (km)
1	Kaljhar to Patacharkuchi	Galia	NH-27	27.300

1.1.2 Objectives

The main objectives of the present assignment is to

1. review project documents and understanding schedule B requirements for improvement works for the assessment of Capex and Opex during the concession period.
2. conduct field investigations to assess the existing asset condition and future deterioration.
3. validate executed works with respect to schedule A and assessment of improvement Works
4. review quality of construction based on available data, design and drawings.
5. undertake designs for rehabilitation requirements of different assets based on field investigation data and available documents.
6. assess operation and maintenance cost including major maintenance expected to be incurred during the concession period.

1.2 Site Visit

The Technical Consultant visited site from 25th October 2023 to 28th October 2023. The important aspects of the project road were noted in the detailed site reconnaissance along with various field investigations. These included general description about the project road, site features, structures, junctions, pavement characteristics, road safety. Field investigation consists of NSV, FWD test, axle load survey, trail pits and drone videography survey were conducted by Technical Consultant to assess the present condition of the project road.

1.2.1 Salient Features

Details of Assets:

S. No.	Description		Unit	Kaljhar to Patacharkuchi Section
1	Total Project length		Km	27.300
2	Service Roads/ Slip Roads	Existing	Km	4.375
		Construction in progress	Km	1.880
3	Access Road (Construction in Progress)		Km	1.880
4	Bus Shelters		No.	5
5	Bus bays with Shelters		No.	5
6	Truck Lay-bays		No.	2
7	Toll Plaza		No.	1
8	Major Bridge		No.	1
9	Minor Bridge		No.	23
10	ROB		No.	1
11	Slab Culverts		No.	24
12	At grade Intersections (Major/Minor)		No.	4/57
13	Underpasses (VUP)		No.	1
14	Flyover (under construction by NHAI)		No.	1

Details of 4-laning construction

Chainage (Km)		Mode of Construction	Contractor During 4 Lanning	Date of Commencement	Date of Completion
From	To				
1013+000	1040+300	Item Rate	M/s KMC Constructions Limited	21.10.2005	25.11.2022

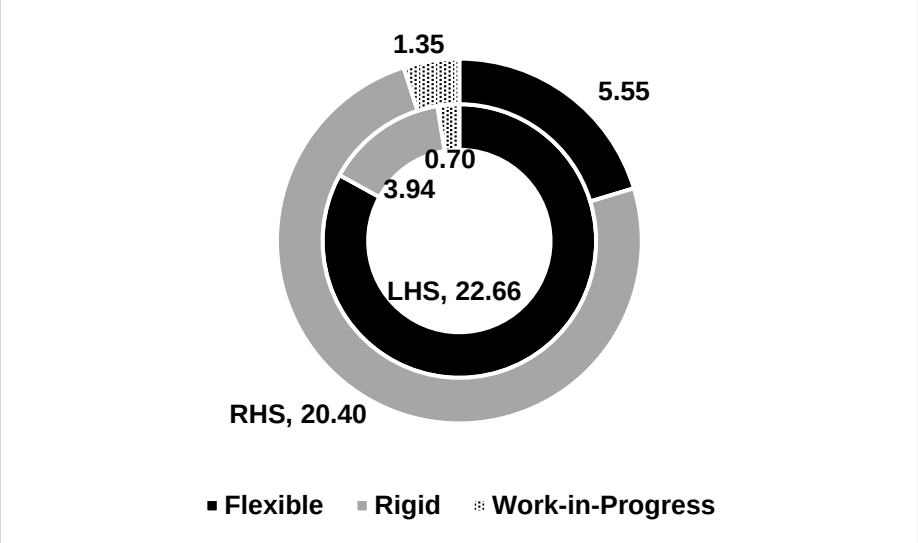
1.3 Surveys and Investigations

1.3.1 Network Survey Vehicle (NSV)

The Network Survey Vehicle, which is the latest survey technique which utilizes Lasers, Global Positioning System and Video image processing tools, is used for automatic data collection pertains to pavement condition and road inventory data. The NSV survey has been carried out along the project corridor on 06/11/2023 for collection of field data pertains to pavement condition and road inventory. Summary of findings of NSV survey is given in preceding sections.

1.3.1.1 Pavement Type

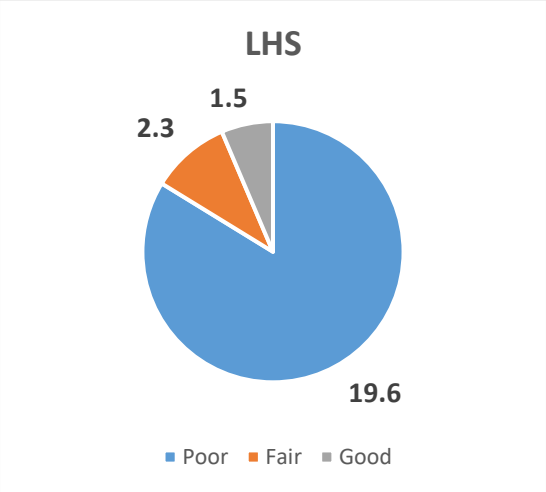
Summary of pavement types in terms of length in km are given below:

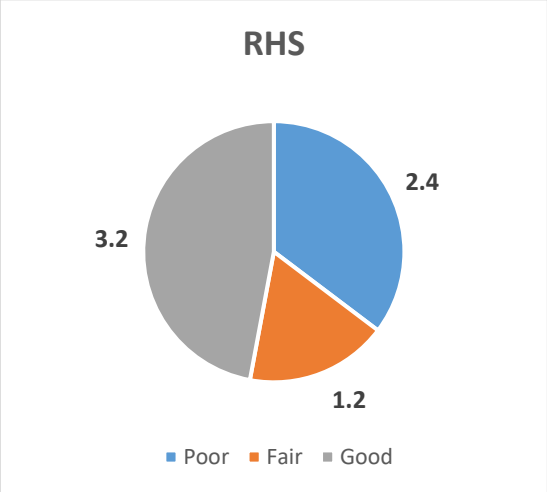


1.3.1.2 Pavement Distresses

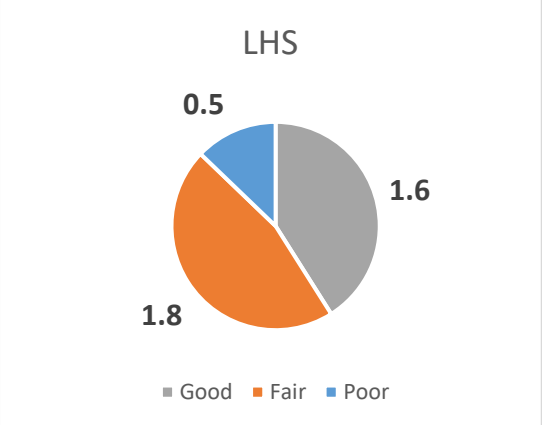
The summary of pavement distresses in terms of length in km for both flexible and rigid pavement are presented below.

Flexible Pavement (length in km)





Rigid Pavement (length in km)



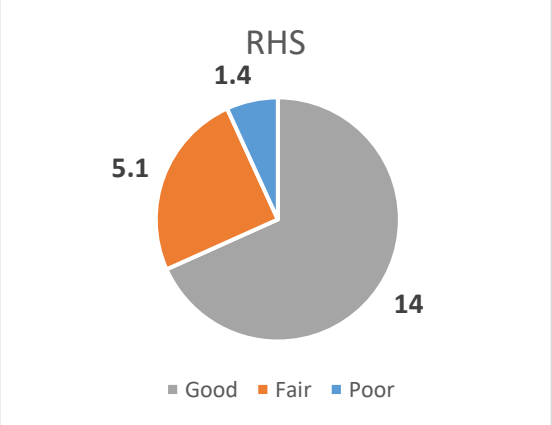


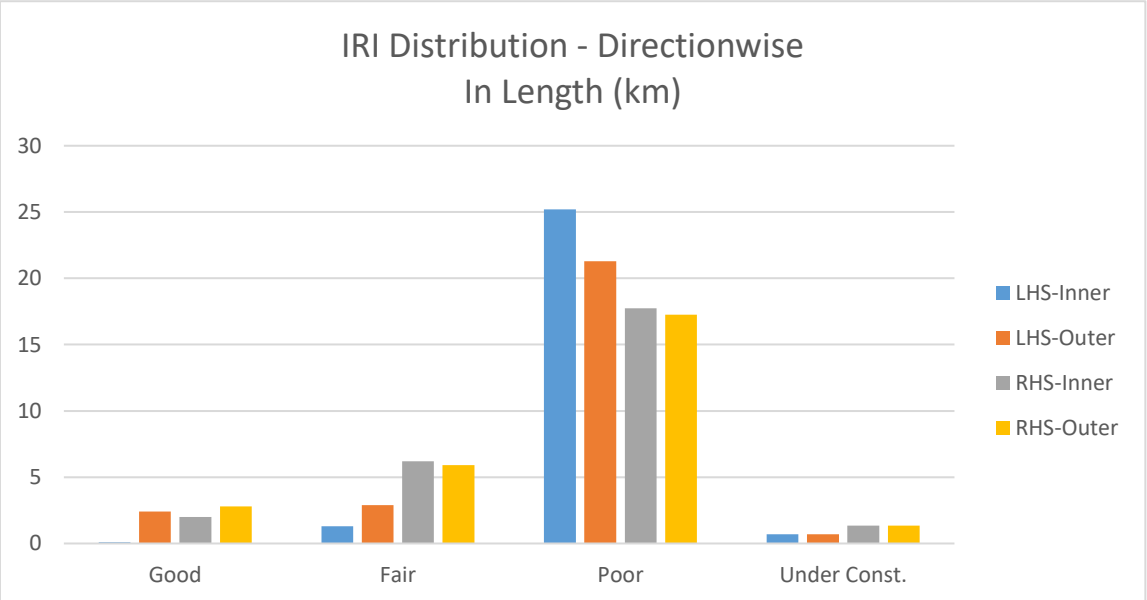
Figure 1.1: Summary of Pavement Distress

1.3.1.3 *Pavement Roughness*

The summary of Roughness values are presented in table below.

Table 1.2: Summary of Pavement Roughness

Condition	BI (mm/km)	LHS				RHS			
		Inner		Outer		Inner		Outer	
		Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)
Flexible Pavement									
Good	<1800	0.10	0%	2.4	10%	1.40	25%	2.10	38%
Fair	1800-2400	1.30	6%	2.2	9%	1.60	29%	1.30	23%
Poor	>2400	21.26	91%	18.06	77%	2.55	46%	2.15	39%
Under Construction		0.70	3%	0.7	3%	0.00	0%	0.00	0%
Length (km)		23.36	100%	23.36	100%	5.55	100%	5.55	100%
Rigid Pavement									
Good	<2000	0	0%	0	0%	0.60	3%	0.70	3%
Fair	2000-2400	0	0%	0.7	18%	4.60	21%	4.60	21%
Poor	>2400	3.94	100%	3.24	82%	15.20	70%	15.10	69%
Under Construction		0	0%	0	0%	1.35	6%	1.35	6%
Length (Km)		3.94	100%	3.94	100%	21.75	100%	21.75	100%



1.3.1.4 *Rutting*

Rutting in pavement as captured during NSV survey are given below:

Table 1.3: Summary of Pavement Rutting

Condition	Rutting, mm	LHS				RHS			
		Inner		Outer		Inner		Outer	
		Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)
Good	< 5	19	69.6%	9.34	34.2%	21.05	77.1%	26.5	97.1%
Fair	5 to 10	4.1	15.0%	9.46	34.7%	5.05	18.5%	0.5	1.8%
Poor	> 10	4.2	15.4%	8.5	31.1%	1.2	4.4%	0.3	1.1%

Observations:

The condition of pavement in respect of pavement rutting is fair to poor mostly on LHS carriageway, and there will be further increase of rut depth if any delay in rectifying these defects through timely periodic maintenance and hence the areas showing these higher order rut depth needs to be rectified immediately.

1.3.2 Test Pit Investigations

The subgrade soils are generally consistent throughout the project road and is predominantly Gravels and clayey sands. Because of this soil type, Liquid Limit (LL) is ranging between 23-28 %, and these values are within the limit as per MoRTH specifications (<50%). The obtained maximum Plasticity Index of the subgrade soils is NP-11 % and the degree of free swell is 10.0 %. All the measured PI and FSI values are also within the acceptable limits as per MoRTH guidelines, of 25% and 50% respectively.

Further, the MDD values is ranging between 91.97 % - 95.48 %. The 4-days soaked CBR and is ranging from 6.5% to 7.2 % with an average value of 6.3 %, which is in line with design CBR adopted during 4-lane construction.

1.3.3 Axle Load Survey

Axle load survey has been conducted in compliance with IRC 37 2018 for 24 hours in both directions at the existing toll plaza locations. Obtained VDF values comparing the values adopted at the time of pavement design during construction summarized in table below.

Table 1.4: Vehicle Damage Factors (VDF)

Toll Plaza	Direction	Vehicle Damage factors				
		Bus	LCV	2-Axle	3-Axle	MAV
Galia	LHS	0.53	0.62	1.85	5.37	8.30
	RHS	0.66	0.39	1.33	6.82	7.19

1.3.4 Falling Weight Deflectometer

Remaining Life Estimation for Flexible Pavement

The detailed remaining life analysis is done using 90 percent reliability equation of IRC: 115-2014 is presented in tables below for LHS and RHS carriageway.

Table 1.5: Remaining Life Analysis of Existing Pavement

S. No	Existing Chainage		15th Percentile E Value (Mpa)			Obtained Strains (through IITPAVE)		Remaining Life of Exisitng Pavement (msa)		
	From	To	Bituminous Layer	Granular Layer	Subgrade	Fatigue Strain	Rutting Strain	Fatigue Residual Life	Rutting Residual Life	Remaining life
Kaljhar - Patrakuchi Section (LHS)										
1	1013.028	1014.11	823.4	195.6	81.6	0.0002219	0.0002136	37.6	616.2	37.6
2	1014.11	1015.108	734.4	231	86.3	0.000215	0.0002029	46.9	777.8	46.9
3	1015.108	1016.108	822.4	134.8	71.4	0.0002629	0.0002491	19.5	306.9	19.5
4	1016.108	1017.097	859.1	138.5	69.7	0.0002538	0.0002487	21.5	309.1	21.5
5	1017.097	1018.094	762.8	164.8	93.6	0.0002498	0.0002082	25.3	692	25.3
6	1018.094	1019.088	776.1	140.9	95.5	0.000265	0.00021	19.8	665.5	19.8
7	1019.088	1020.123	736.2	181.9	87	0.000243	0.0002146	29.1	603.3	29.1
8	1020.123	1021.09	635.9	191.2	79.4	0.0002544	0.0002296	27.6	444.1	27.6
9	1021.09	1022.122	721.2	113.4	81.7	0.000303	0.0002425	12.5	346.6	12.5
10	1022.122	1023.095	787.7	120.5	81.3	0.0002811	0.0002386	15.6	373.1	15.6
11	1023.095	1024.142	830	145.8	89.1	0.0002523	0.0002277	22.7	461.2	22.7
12	1025.522	1025.632	868.1	225.5	69.1	0.0002024	0.0002358	51.4	393.6	51.4
13	1026.541	1027.607	1229	194.5	94.3	0.0001794	0.0001907	61.1	1030.4	61.1
14	1027.607	1028.089	776.5	163	102.5	0.0002487	0.0002087	25.4	684.5	25.4
15	1029.021	1030.01	1022.5	165.9	83.4	0.0002131	0.0002204	36.6	534.6	36.6
16	1030.01	1031.035	1158	188.3	75.3	0.0001892	0.0002206	52.3	532.4	52.3
17	1031.035	1031.982	1225.4	175.2	82.6	0.0001881	0.0002095	50.9	672.8	50.9
18	1031.982	1033.005	885	143.4	72.9	0.0002463	0.0002533	23.6	284.5	23.6
19	1033.005	1033.991	952.6	130.2	86.1	0.0002438	0.0002277	23	461.2	23
20	1033.991	1034.999	683	204	99.1	0.0002075	0.0002033	57.3	770.9	57.3
21	1034.999	1036.001	801.9	159.6	105	0.0002036	0.0001929	53.8	978.2	53.8
22	1036.001	1037.459	574.1	133	101.3	0.0002647	0.0002196	25.8	543.5	25.8
23	1038.261	1039.236	790	109.6	56.9	0.0002424	0.0002905	27.6	152.8	27.6
Patrakuchi - Kaljhar Section (RHS)										
1	1040.086	1039.015	848.9	85.3	108.7	0.000231	0.0001882	31.3	1093.9	31.3
2	1039.015	1037.559	575.2	146.1	84.6	0.0002439	0.0002506	35.4	298.6	35.4
3	1025.563	1024.49	532.2	144.3	105.9	0.000254	0.0002226	32.3	511	32.3

FWD data Analysis for Rigid Pavement

The range of Elastic Modulus, other PQC parameters and their percentage of length and Load Transfer Efficiency (LTE) is presented in table below.

Table 1.6: Summary of Flexural Strength and Elastic Modulus

Pavement layer	Range	Percentage of Project Road	
		LHS	RHS
Elastic Modulus of PQC Layer (Mpa)	> 30000	10.00%	34.91%
	30000 - 10000	90.00%	65.09%
Flexural Strength of PQC Layer (Mpa)	> 4.5	10.00%	30.66%
	4.5 - 3.0	12.50%	25.47%
	<3.0	77.50%	43.87%

1.3.5 Structure Inventory and Condition Survey

There are deficiencies noted in the structures and relevant repair-rehabilitation measures are suggested. There are requirements of minor maintenance for structures except for the only major bridge in the project which requires major remedial measures to increase the waterway/vertical clearance.

1.3.6 Key Technical Issues

The major findings from visual assessment, available documents, from the discussion with maintenance and operation team at site and other local enquiries are listed below. The advisor will explore these further and same shall be presented in the Draft Due Diligence Report.

1.3.6.1 Under Construction Flyover at Km 1032+840 (Pathsala)

A flyover and its approaches is being constructed by NHAI on EPC mode at Patshala from km 1032+530 to km 1033+470, a total length of 940m with 3 span viaduct of 100m length. As on 27th October 2023, substructures, i.e. up to pier caps, were almost completed for both the carriageways except for 2 nos of pier caps on LHS carriageway. Girders are to be pre-cast and around 13 nos out of 30 nos were already casted near the construction site. RE wall construction at Bongegaon side approach were in progress whereas embankment construction was in progress towards Guwahati side approach. Construction is expected to be completed by June 2024 and there is 10 years maintenance period post construction.

1.3.6.2 Major Bridge at Km 1025+540 LHS

LHS is the new constructed bridge at the time of 4-laning. It has 4 girders system whereas old bridge has 6 girders, thus more depth of superstructure of new bridge. As FRL of both side of the bridges are kept same, soffit level of the LHS bridge is below the RHS bridge (approx. 600mm). From the local enquiry, it came to our notice that water reaches up to 1 ft from the girder bottom during the monsoon. This is not only resulting damage for the bearing, debris flowing with the flood water may damage the superstructure also. Moreover, local people told that due to obstruction in waterway, there are water logging around the area during flooding.

Figure 1.2: Soffit level of Major Bridge @ 1025+540

1.3.6.3 Minor Bridge at Km 1023+180 RHS

Return wall for the minor bridge @ 1023+180 RHS towards Bongegaon side is failed and require reconstruction.

Figure 1.3: Retaining Wall Damaged at Minor Bridge @ 1023+180 RHS

1.3.6.4 Pavement and Road Condition

There is no major maintenance activity carried out so far in the project corridor resulting significant deterioration of pavement where it has been observed with various distress like ravelling, alligator cracks, potholes etc. for flexible pavement and wide longitudinal/transverse cracks, sealant damage, widening of joints were noted for the rigid pavement from the site reconnaissance.

A considerable number of rigid panels are having high severity cracks, which perhaps may requires full depth replacement.

Immediate Repair and Rehabilitation of pavement for both flexible and rigid is required as part of initial improvement works by adopting suitable rehabilitation strategies based on the outcome of present engineering surveys and investigations so that service life of the pavement structure can be increased. However, as per the technical schedule B, the initial repair and rehabilitation of pavement and structures shall be done by Authority.

1.3.6.5 Minor Bridge

During the development of the project old minor bridges were retained. These structures are with mostly RCC/PSC solid slab/girder type with 2 lane configuration without paved shoulder. All new minor bridges are RCC/PSC solid slab/girder with 2 lane configuration and footpath.

At few locations porous concrete surface observed in substructure of bridges particularly in old structures.

Expansion joints are found damage in some of the bridges.

Wearing course needs to be replaced for almost all minor bridges.

Some Minor Bridges are currently with RCC handrails. These are to be replaced with concrete crash barrier.

1.3.6.6 *Toll Plaza/Toll Management System*

Existing TMS is not as per the codal requirements or as per industry norms.

1.4 Capital Expenditure (CapEx) Requirement

1.4.1 New Construction

Schedule B of each stretch specifies the requirements of new construction which the concessionaire has to construct after the appointment date.

New construction Scope specified for each stretch is tabulated below:

Table 1.7: New Construction Requirements

S. No.	Description	Unit	Quantum
1	Improvement of existing service/slip road, junction and median opening		
i)	Hazard marker sign	No.	15
ii)	Pass either sign	No.	2
iii)	Merge sign	No.	5
iv)	Chevron marking	No.	7
v)	Stop sign	No.	32
vi)	Advance direction sign	No.	6
vii)	Stop sign	No.	32
viii)	Rumble strip sign	No.	32
ix)	Junction sign	No.	32
x)	Flag sign	No.	32
xi)	Median opening sign	No.	6
2	Entry /Exit arrangements of service road	No.	4
3	Redesign of junction	No.	3
4	Acceleration/Deceleration of junction& New Minor junction	No.	9
5	New Median opening	No.	4
6	Close median opening	No.	7
7	Storage lane on existing median opening	No.	7
8	Truck lay bye sign board	No.	4
9	Admin Building at toll plaza	No.	1
10	Toilet block near toll plaza	No.	2
11	Traffic aid post	Sqm	25
12	Transverse Bar Marking	Job	Median opening/toll plaza/ grade separated
13	Metal Beam crash barrier	Lm.	5380
14	Solar Blinker cantilever type	No.	46
14	Pedestrian guard rail	Lm.	3580
16	Police assistant jeep	No.	1
17	Highway lighting	Km	7.78

S. No.	Description	Unit	Quantum
18	High mast	No.	5
19	TMS equipment	LS	1

Time to complete above construction works is 6 months from the Appointed Date.

1.4.2 Immediate Maintenance Requirements

Immediate maintenance requirements as assessed by the Consultant is presented below for reference.

Table 1.8: Quantum of Pavement Rehabilitation

Immediate Maintenance	Unit	Requirements	
		LHS	RHS
Rigid Pavement			
Replacement of Joint Sealant	Km	Entire Length	Entire Length
Diamond grooving after Diamond grinding	Km	Entire Length	Entire Length
Crack sealing with epoxy	Lm	140	1440
Partial depth repair	Nos	42	113
Panel Replacement	Nos.	82	168
Flexible Pavement			
50mm Milling and 50mm BC Overlay	Km	Entire Length	Entire Length

Replacement of wearing coat and expansion joint are considered as immediate maintenance requirements for almost all existing structures, Besides this, the remedial measures for damaged component of minor bridges are also considered.

1.5 O&M Cost Estimation

1.5.1 Recommended MM Cycles for Pavement

Considering the initial pavement design period and crust, remaining life data, anticipated traffic loading during the concession period, and in compliance to the provisions of schedule B, the following cycles of Major maintenance is proposed for satisfactory performance of the pavement during operation period for both functionally and structurally.

Table 1.9: Proposed Major Maintenance Cycles for Balance Concession period

S. No	Year	Description	Recommended improvements	
			MCW	Service/Slip Roads
1	2024/25	Initial repair and rehabilitation of pavement	**Flexible pavement**: Milling to a depth of 50mm and provide 50mm BC overlay for entire length **Rigid Pavement**: Panel replacement: 250 Nos, Partial Depth Repair: 155 Nos of panel, Seal with Epoxy: 1580 m whereas joint sealing, diamond grinding is required for full length.	30mm BC for the entire length
2	2031/32	Periodic Maintenance to	**Flexible Pavement:**	30mm BC for the entire

S. No	Year	Description	Recommended improvements	
			MCW	Service/Slip Roads
		improve the roughness as per the provisions of Concession Agreement	40mm BC overlay for entire length **Rigid Pavement:** Sealant replacement for 100% length, 1% for pothole filling and 0.5% for panel replacement and repair of corner breaks for 0.5%.	length
3	2037/38	Periodic Maintenance to improve the roughness and structural integrity to extent the pavement life per the provisions of Concession Agreement	**Flexible Pavement:** Milling to a depth of 50mm and provide a 50mm BC overlay using RAP for entire length **Rigid Pavement:** Sealant replacement for 100% length, 0.5% for pothole filling and 0.5% for panel replacement and diamond grooving for 100% length to restore the skid resistance	30mm BC for the entire length
4	2043/44	Periodic Maintenance to improve the roughness as per the provisions of Concession Agreement	**Flexible Pavement:** 40mm BC overlay for entire length **Rigid Pavement:** Sealant replacement for 100% and 0.5% for panel replacement and repair of corner breaks for 0.5%.	30mm BC for the entire length

1.5.2 Structures

As no NDT reports are available and neither design documents stating design life are available it's not feasible to assess life expectancy of existing structures. However, based on the past experiences regarding working life of different structure elements, replacement cycles and major maintenance cost of structures is analysed based on the following:

- Wearing coat replacement every 6th years
- Expansion joint replacement every 6th years
- Elastomeric bearing replacement every 6th years
- POT PTFE Bearing every 20th years

1.5.3 Estimate (CapEx and O&M)

1.5.3.1 Capital Expenditure (CapEx) Requirement

Cost of capital expenditure (CapEx) are presented below.

Table 1.10: Cost of Capital Expenditure (CapEx)

Particulars	Amount in INR Crore
New Construction	
Improvement Works (Schedule - B)	**11.90**
Improvement of existing service/slip road	0.01
Entry /exit arrangements of service road	1.48

Redesign of junction	0.83
Acceleration/Deceleration of junction& New Minor junction	1.91
Improvement of junction (safety)	0.23
New Median opening	1.08
Close median opening	0.14
Storage lane on existing median opening	1.14
Improvement of median opening (safety)	0.01
Truck lay bye sign board	0.001
Admin Building	0.6
Toilet block	0.15
Traffic aid post	0.06
Transverse Bar marking	0.59
Metal Beam crash barrier	1.97
Solar Blinker cantilever type	0.27
Pedestrian guard rail	1.18
Police assistant jeep	0.18
Toll plaza construction cost	0.06
Immediate repair works for Flexible pavement	**24.58**
Immediate repair works for Rigid pavement	**10.04**
Immediate repair works for Structure	**4.95**
Electrical work	**8.76**
ATMS	**9.52**
TCMS	**2.81**
Total including GST (18%)	**72.55**

1.5.3.2 *Cost of Operation & Maintenance*

Cost of Operation & Maintenance per annum are presented below.

Table 1.11: Cost of Operation & Maintenance (per annum)

Description	Amount in INR Crores
Tolling Operations	3.71
Incident Management	3.32
Routine Maintenance	1.22
Repairs	0.99
ATMS	1.44
Admin Expenses	3.18
Insurance	0.56
Total	**14.42**

1.5.3.3 *Periodic Maintenance*

Cost of Periodic Maintenance (Base year 2025) including GST, but excluding escalation are presented below.

Table 1.12: Cost of Periodic Maintenance

Year	Periodic Maintenance (INR in Crores)				
	Functional +Structural overlay MCW+ S/R	Major Maintenance of Rigid Pavement	Replacement of ATMS	Replacement of TMS	Structure specified repairs
2031-2032	19.70	11.41	3.81	1.19	15.31
2037-2038	27.16	10.71			1.12
2038-2039			5.90	2.38	
2043-2044	22.05	11.06			
Total	**68.91**	**33.18**	**9.71**	**3.57**	**16.43**
Grand Total					**131.80**

1.5.3.4 O&M Cost during Entire Concession Period

O&M cost for the entire concession period as assessed above is presented below

Table 1.13: Estimate (CapEx and O&M)

Year of Concession	O & M Year	Capex							Major Maintenance			Operation & Maintenance					Admin Expenses	Insurance	Estimated O&M Cost (Rs.)
		New Construction (Sch B)	Electrical work	ATMS	TCMS	Immediate Maintenance			Structure & Roadwork	Equipment replacement cost for Tolling	Equipment replacement cost for ATMS	Operations			Maintenance				
						Road works-Flex	Road works-Rigid	Structure works				Tolling Operations	Incident Management	Routine Maintenance	Repairs	ATMS			
1	2024-25	11.90	8.76	9.52	2.81	24.58	10.04	4.95				3.71	3.32	1.22	0.99	1.44	3.18	0.56	86.97
2	2025-26											3.71	3.32	1.22	0.99	1.44	3.18	0.56	14.42
3	2026-27											3.17	3.32	1.22	0.99	1.44	3.18	0.56	13.88
4	2027-28											3.17	3.32	1.22	0.99	1.44	3.18	0.56	13.88
5	2028-29											2.88	3.32	1.22	0.99	1.44	3.18	0.56	13.59
6	2029-30											2.88	3.32	1.22	0.99	1.44	3.18	0.56	13.59
7	2030-31											2.88	3.32	1.22	0.99	1.44	3.18	0.56	13.59
8	2031-32								46.43	1.19	3.81	2.88	3.32	1.22	0.99	1.44	3.18	0.56	65.01
9	2032-33											2.88	3.32	1.22	0.99	1.44	3.18	0.56	13.59
10	2033-34											2.88	3.32	1.22	0.99	1.44	3.18	0.56	13.59
11	2034-35											2.88	3.32	1.22	0.99	1.44	3.18	0.56	13.59
12	2035-36											2.88	3.32	1.22	0.99	1.44	3.18	0.56	13.59
13	2036-37											2.88	3.32	1.22	0.99	1.44	3.18	0.56	13.59
14	2037-38								39.00			2.88	3.32	1.22	0.99	1.44	3.18	0.56	52.59
15	2038-39									2.38	5.90	2.88	3.32	1.22	0.99	1.44	3.18	0.56	21.87
16	2039-40											2.88	3.32	1.22	0.99	1.44	3.18	0.56	13.59
17	2040-41											2.88	3.32	1.22	0.99	1.44	3.18	0.56	13.59
18	2041-42											2.88	3.32	1.22	0.99	1.44	3.18	0.56	13.59
19	2042-43											2.88	3.32	1.22	0.99	1.44	3.18	0.56	13.59
20	2043-44								33.12			2.88	3.32	1.22	0.99	1.44	3.18	0.56	46.71
Total		**11.90**	**8.76**	**9.52**	**2.81**	**24.58**	**10.04**	**4.95**	**118.55**	**3.57**	**9.71**	**59.84**	**66.40**	**24.40**	**19.80**	**28.80**	**63.60**	**11.20**	**478.41**

1.6 Conclusion

The 4-lane construction of project highway has been completed on EPC basis and at present toll is being collected by Toll Collection Agency appointed by NHAI. Tthere is no major maintenance works carried out neither for pavement nor structure/other element of the highway even after several years of traffic opening and thus there is a drop in asset quality to a poor condition. it appears that some of the heavily distressed are being repaired manually by applying thin bituminous overlays in the form of patch works. As part of present study, various physical testing and visual site inspections were conducted to evaluate the asset condition and to establish the required maintenance and rehabilitation measures/decisions. Based on the site reconnaissance, it is appraised that majority of the locations on both of the carriageway is distressed in the form of cracks and potholes for flexible pavement and wide cracks of longitudinal, transverse, joint failures, loss of texture has been observed. Based on the results of physical testing, condition assessment, review of available reports/data, analysis of remaining life data, the project stretch would require immediate repairs and rehabilitation to improve the asset condition. The subsequent period maintenance by functional/structural overlays are required at every 6th year would be sufficient to keep the project stretch in good condition and hence the suitable measures of major maintenance for periodic renewals as required during the concession period has also been suggested based on the present asset condition.

Based upon the site visit for assessment of condition of CD structures including MJB, MNBs, ROB, VUPs and Culverts in the project corridor and observations submitted in various chapters of this report, it is concluded that there are requirements of major repairs in major bridge in terms of inadequate waterway. It is understood that Authority will address this issue before it is handed over to the incoming Concessionaire for maintenance.

Section 2: Introduction

2.1 Background

NHAI has set up an Infrastructure Investment Trust namely National Highways Infra Trust ("InvIT") and is acting as its Sponsor to the said InvIT. National Highways Infra Investment Managers Private Limited ("NHIIMPL") has been appointed as the Investment Manager to the InvIT.

Further, InvIT would be evaluating acquisition opportunities going forward. In this context, NHIIMPL (on behalf of InvIT & NHIPPL) has created a panel of Technical Consultants for undertaking technical due diligence of its assets and acquisition opportunities.

NHIIMPL appointed M/s Egis India Consulting Engineers Private Limited, as Technical Consultant to conduct the due diligence on the proposed Assets. The Letter of Empanelment (LOE) was received on 3rd November 2022 and Letter of Award (LoA) dated 11th October 2023 for the subject Project was received on 17th October 2023 by Egis India and the services commenced immediately thereafter.

The project stretch detail as per LoA is listed below.

Table 2.1: Detail of Project Stretches

Sr. No.	Stretches	Toll Plaza	NH No.	Length (km)
1	Kaljhar to Patacharkuchi	Galia	NH-27	27.3

2.2 Objectives

The main objectives of the present assignment is to

review project documents and understanding schedule B requirements for improvement works for the assessment of Capex and Opex during the concession period.

- conduct field investigations to assess the existing asset condition and future deterioration.
- validate executed works with respect to schedule A and assessment of improvement works
- review quality of construction based on available data, design and drawings.
- undertake designs for rehabilitation requirements of different assets based on field investigation data and available documents.
- assess operation and maintenance cost including major maintenance expected to be incurred during the concession period.

2.3 Technical Consultant Team

The Technical Consultant commenced its services from 18th October 2023 and the team comprising of Highway, Pavement & Structure Engineers have conducted site visit from 25th October 2023 to 28th October 2023 to appreciate the project corridor characteristics. This report highlights the

findings from visual assessment, available documents shared with the consultant, discussion with NHAI officials involved with the maintenance and operation of project road at site and other local enquiries. Analysis of data as obtained from various survey and investigations conducted at site are present in this report.

Date-wise various field activities at site are shown below in bar chart form in **Figure 2.1.**

Name of Survey	24-Oct-2023	25-Oct-2023	26-Oct-2023	27-Oct-2023	28-Oct-2023	06-Nov-2023
Network Survey Vehicle (NSV) Survey						
FWD Test						
Axle Load Survey						
Test Pit Investigations Pits						
Video-graphy						

Figure 2.1: Project ActivitiesSchedule

2.4 Disclaimer

The information and documents received from the Client are being reviewed by the Consultant and have been used for preparing this report. Due care has been taken while reproduction of the information where required to avoid typographical or other errors.

2.5 Structure of the Report

The report has been structured into nine sections as follows:

Section 1: Executive Summary
Section 2: Introduction
Section 3: Inventory and Condition Assessment
Section 4: Surveys and Investigations
Section 5: Review of Documents
Section 6: Capital Expenditure (CapEx) Requirement
Section 7: Operation & Maintenance
Section 8: Analysis & Comparisons with Seller Data
Section 9: Conclusions

Section 3: Inventory and Condition Assessment

3.1 General

The Technical Consultant visited site from 25th October 2023 to 28th October 2023. The important aspects of the project road were noted in the detailed site reconnaissance along with various field investigations. These included general description about the project road, site features, structures, junctions, pavement characteristics, road safety. Field investigation for NSV, FWD test, axle load survey, trail pits, MBIU and drone videography survey were also conducted by Technical Consultant to assess the present condition of the project road. This chapter elaborates various findings of these surveys and studies conducted by the Technical Consultant team in different sections.

3.2 Project Corridor

The project stretches details are listed below:

Table 3.1: Detail of Project Stretches

Sr. No.	Stretches	Toll Plaza	NH No.	Length (km)
1	Kaljhar to Patacharkuchi	Galia	NH-27	27.3

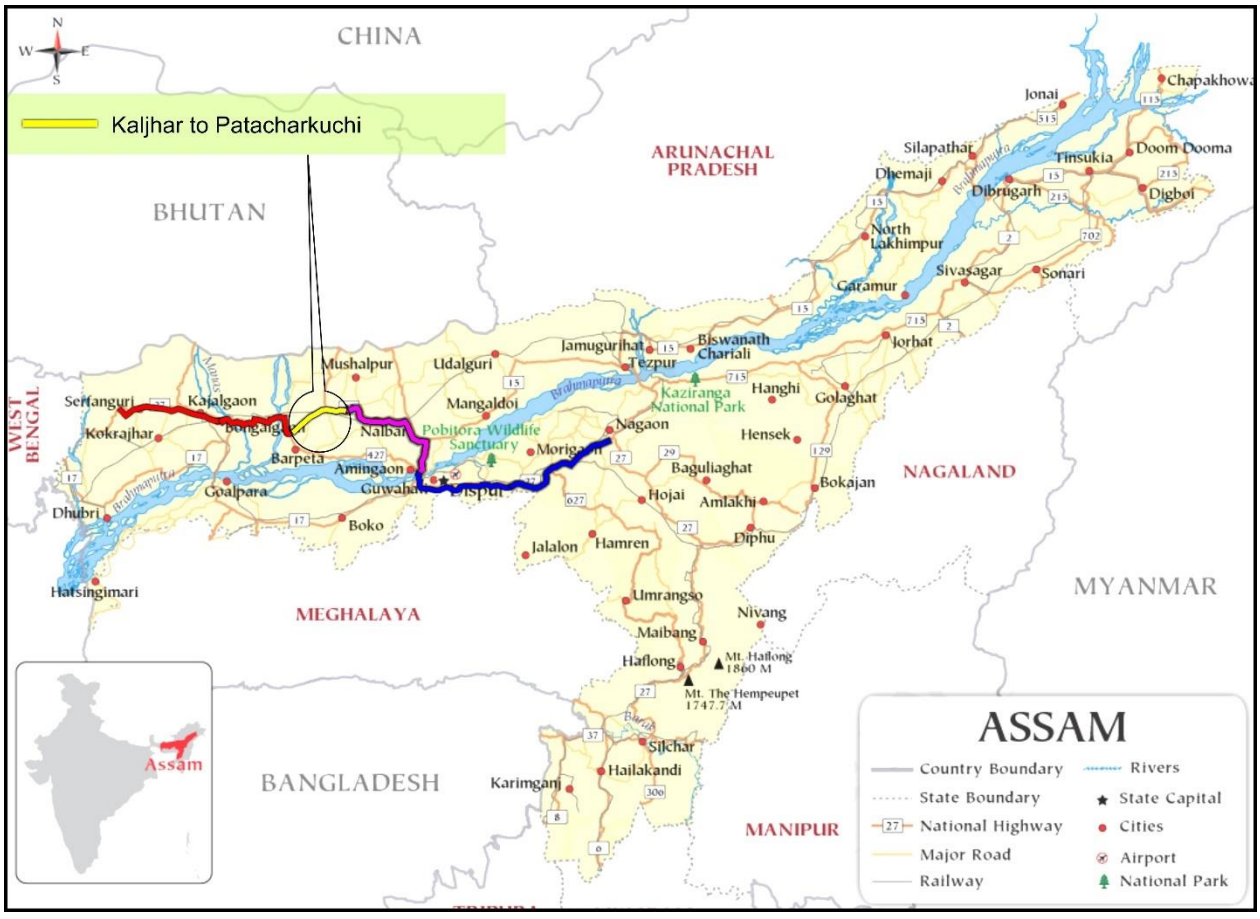


Figure 3.1: Project Location Map

3.3 Project Brief

3.3.1 Salient Features

Details of Assets:

S. No.	Description		Unit	Kaljhar to Patacharkuchi Section
1	Total Project length		Km	27.300
2	Service Roads/ Slip Roads	Completed	Km	4.375
		Construction in progress	Km	1.880
3	Access Road (Construction in Progress)		Km	1.880
4	Bus Shelters		No.	5
5	Bus bays with Shelters		No.	5
6	Truck Lay-bays		No.	2
7	Toll Plaza		No.	1
8	Major Bridge		No.	1
9	Minor Bridge		No.	22
10	ROB		No.	1
11	Slab Culverts		No.	25
12	At grade Intersections (Major/Minor)		No.	4/57
13	Underpasses (VUP)		No.	1
14	Flyover (under construction by NHAI)		No.	1

Details at Construction Stage:

Chainage (Km)		Mode	Contractor During 4 Lanning	Date of Commencement	Date of Completion
From	To				
1013+000	1040+300	Item Rate	M/s KMC Constructions Limited	21.10.2005	25.11.2022

3.4 Road Inventory and Condition Survey

3.4.1 Road Inventory

The Road Inventory is conducted to assess and list out the existing features of the project corridor and to validate that project road is conforming to the requirements of CA. It covers all the existing physical features such as terrain, land use, carriageway surfacing type, shoulder width, junctions, water bodies, roadside arboriculture, general drainage conditions, etc. It was carried out in accordance with the guidelines given in IRC: SP 19-2001, generally by visual means, and supplemented by simple tape measurement.

The road inventory data collected for the project highway is presented in the **Annexure - 3.1.**

3.4.2 Terrain

The project highway falls in plain terrain.

3.4.3 Land Use

The land along the project highway is predominantly built up residential and commercial areas followed by agricultural lands. Details of land use are given in the **Table 3.2**.

Table 3.2: Land Use

Description	Length (km)		%age	
	LHS	RHS	LHS	RHS
Agriculture	9.795	7.965	35.88%	29.18%
Built-Up Area (Residential/Commercial/ Industrial)	11.76	16.32	43.08%	59.78%
Others (Water Bodies/Mix etc.)	5.745	3.015	21.04%	11.04%
Total	27.300	27.300	100%	100%

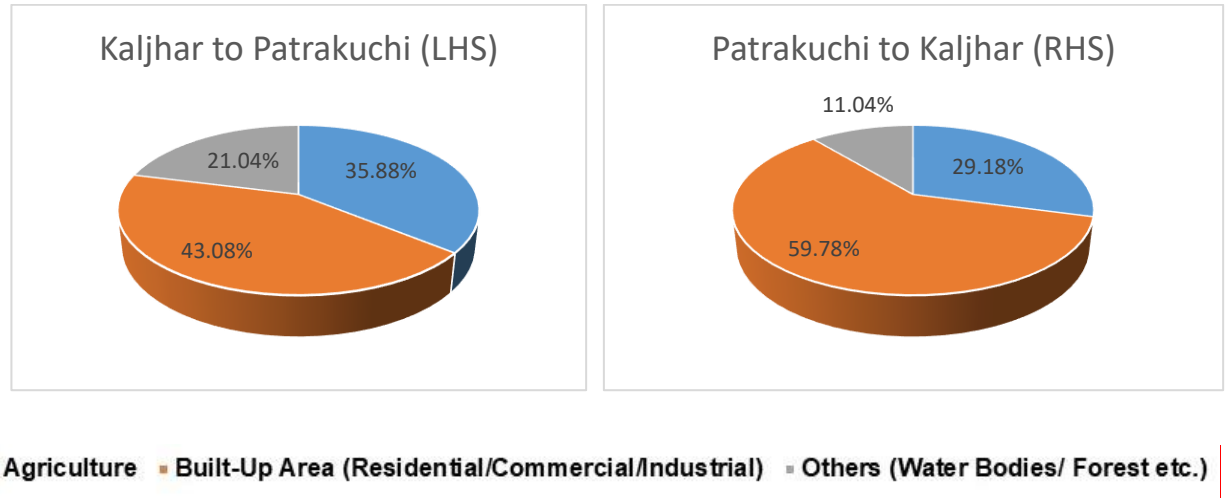


Figure 3.2: Land Use

3.4.4 Main Carriageway

The project highway is a four lane divided carriageway with paved shoulder. The carriageway width is 7.25m with kerb shyness and 1.5 m wide paved shoulder all along the project corridor except at toll plaza, retained structures and approaches to ROB. Pavement of both the nature (rigid and flexible) is being observed in this stretch. Median width is predominantly 4.5m (excluding shyness). However, variation in median width is found at major bridge location and median openings.

4 lane Carriageway

4 lane Carriageway at Bridge

Median Opening

Median Opening

Wide Median Opening at Major Bridge

Rigid and Flexible Pavement at Toll Plaza

Figure 3.3: Main Carriageway

3.4.5 Service Road

Detail of service road are given below.

Table 3.3: Service Road

S. No.	Chainage (kms)		Side	Length (kms)	Width (m)	Remarks
	From	To				
1	1020+025	1020+850	LHS	0.825	5.5	
2	1027+935	1028+500	LHS	0.565	7.0	
3	1032+530	1033+470	LHS	0.940	7.0	Construction Work is in Progress at Pathsala
4	1038+190	1038+830	LHS	0.640	5.5	
5	1039+050	1038+190	RHS	0.860	5.5	
6	1033+470	1032+530	RHS	0.940	7.0	Construction Work is in Progress at Pathsala
7	1032+530	1031+620	RHS	0.910	5.5	
8	1028+250	1027+965	RHS	0.285	3.5	
9	1020+785	1020+495	RHS	0.290	5.0	
			Total	**6.255**		

Service Road at Km 1020+020 LHS

Service Road at Km 1038+700 LHS

Figure 3.4: Service Road Carriageway

3.4.6 Towns and Built-Up-Areas

Major settlement along the project road is Pathsala. Chainage-wise detail of towns and built-up areas are given below:

Table 3.4: Built Up Areas

Sr. No.	Chainage (km)		Length (m)	Side	Name of Settlement
	From	To			
1	1014+190	1015+775	1585	LHS	Barpeta
2	1014+360	1015+775	1415	RHS	Barpeta
3	1019+850	1021+000	1150	LHS	Bhawanipur
4	1019+850	1021+200	1350	RHS	Bhawanipur
5	1027+617	1028+210	593	RHS	Rajghat
6	1027+970	1028+330	360	LHS	Rajghat
7	1031+000	1031+355	355	LHS	Dumuria
8	1031+000	1036+670	5670	RHS	Pathsala
9	1031+740	1036+670	4930	LHS	Pathsala
10	1037+320	1037+660	340	LHS	Pattacharkuchi
11	1038+000	1039+400	1400	RHS	Pattacharkuchi
12	1038+100	1039+400	1300	LHS	Pattacharkuchi

3.4.7 Major and Minor Junctions

3.4.7.1 Major Junction

There are 4 nos. of Major Jjunctions are with the channelizer Islands. Details of the major junction are given in the **Table 3.6** below:

Table 3.5: List of Major Junction

Sr. No.	Chainage (Km)	Type of Junction (T, X, Y)	Side	Cross Road leads to	
				LHS	RHS
1	1031+290	Y Junction	RHS	-	Pathsala
2	1032+840	X Junction	BHS	NH-127A	Pathsala
3	1034+710	Y Junction	RHS	-	Pathsala
4	1038+815	X Junction	BHS	Patacharkuchi- Anchai road	Patacharkuchi Khola

3.4.7.2 Minor Junction

There are minor junctions all along the project road at a very frequent interval. Summary of the minor junctions are given in the **Table 3.7** below:

Table 3.6: Summary of Minor Junction

Junction Type	Numbers
T - Junction	45
Y - Junction	9
X - Junction	1
Total	**55**

3.4.7.3 Median

Median width is 4.5m (excluding kerb shyness) throughout project stretch except at major bridge approaches and at median openings where it varies.

3.4.8 Earthen / Hard Shoulder

Earthen shoulders are provided on the outer side of the main carriageway. The width of these shoulders is 1.5m.

3.4.9 Drainage

Cover Drain is provided at built-up-area, flyovers and underpasses. Longitudinal lined drains are provided in median at super-elevated stretches. Median cut drains are provided at super-elevated portion for efficiently draining out rainwater.

General observation of drainage conditions during the site reconnaissance are:

- Cleaning and maintenance of roadside drainage needs improvement.
- Provision of chute drain at high embankment location is observed.
- Median cut drains at super-elevated section is observed. Longitudinal median drain is provided to trap water from higher carriageway and discharge the same through pits.
- No overtopping of road was observed at any location during reconnaissance survey.

Covered Drain at Service Road

Typical Drainage at Median

Median Cut Drain

Chute Drain at High Embankment

Figure 3.5: Drainage System

3.4.10 Road Furniture

3.4.10.1 W-Beam Crash Barrier, Concrete Crash Barrier and Pedestrian Guardrail

W-Beam Crash Barrier

W-beam Crash Barrier is provided at high embankment location, Median, near major structures and at outer side of sharp curves. Length of metal beam crash barrier are 10800 m and 11230m on LHS and RHS respectively. Out of this length, MBCB was found damaged for 420m on LHS and 407m on RHS during the survey work.

Concrete Crash Barrier

Concrete Crash Barrier is provided at approaches of ROBs, Flyovers and Underpasses. Length of CC barrier is 4305m on either side and 10m on either side was found damaged at the time of survey.

Pedestrian Guardrails

There is no pedestrian guardrail observed along the project section.

3.4.10.2 Sign Boards and Gantry

The project have good number of signages and are in good condition. Full width gantry signs on were observed on both the sides of the carriageway at chainage 1016+150 and at 1040+280.

3.4.10.3 5 km / Km / Hectometer Stones

Km & Hectometer stones are observed at shoulder.

Figure 3.6: Kilometer Stones

3.4.11 Project Facilities

3.4.11.1 Bus Bays and Shelters

There are bus bay with shelters and only shelters without bays. Number of these facilities are given in **Table 3.13** and shown in **Figure 3.10** below.

Table 3.7: Bus Bays and Shelters

Type of bus bay	LHS	RHS
Bus Shelter	3	3
Bus Bay with Shelter	2	2
Total	**5**	**5**

Bus Bay with Shelter

Bus Shelter

Figure 3.7: Bus Bay and Shelters

3.4.11.2 Truck Lay bye

There are two nos of truck Lay byes along the project road, one is at km 1031+060 on LHS and other one is at km 1034+050 on RHS. There is no toilet block at any of the truck lay bye.

3.4.11.3 Street Light

Double arm streetlights are there at the median at Galia toll plaza for a length of around 200m.

3.4.11.4 High Mast Light

High mast lights are observed at Ch 1033+775, RHS on the crossroad at T-junction and at Ch 1034+650, RHS on the service road at Y-junction.

3.5 Toll Plaza

The purpose of the Toll Plaza is to collect toll from road users of the Project highway with transparency in the system.

There is one toll plaza along the project road at Galia at Km 1017+350. It has 4+4 toll lanes wth basic TMS which are being managed with the help of only 3 toll booths. Pota cabins is being used as building at the Toll Plaza Location.

The Concession Agreement (CA) Sl no 6 of deviation table given in schedule C specifies that existing toll plaza shall be retained with same nos. of toll lanes as present at site. Appropriate technology is recommended so that not more than 6 vehicles/lane queue up during peak hours.

Figure 3.8: Toll Plaza

3.5.1 Toll Collection Equipment Status

Sr. No.	Particulars	Details
1	Toll Plaza Chainage	1017+350
2	No. of Toll lane	8
3	No. of ETC lane	8
4	No. of Toll Booths	3
5	Toll Plaza control room building is not available	Pota cabin is being used as control room Permanent Building is not available for Toll Plaza
6	Static weigh bridge	Not available
7	High Mast	Not available
8	Tunnel	Not available, Lane equipment is installed in Toll booth
9	Medium Speed Weigh in Motion (MSWIM)	Not available
10	Canopy	Available

Figure 3.9: Toll Plaza Infrastructure

Condition:

1. Toll lane equipment is installed in every lane but not in good condition, Maximum equipment found were not functioning properly.
2. There is no medium speed weigh in motion (MSWIM) found at any lane.
3. There is no High mast for lighting up plaza area.
4. The Static Weigh Bridge (SWB) is not installed.
5. Some essential equipment such as Master intercom at plaza control room, slave intercom at every lane for communication, AVC controller for vehicle classification, Loop with detector, Customize key board (presently normal key board available), Manual booth controller, Traffic lights, Fog light, User Fare Display (UFD) Violation light with alarm, Incident capture camera, PTZ camera for surveillance of plaza area, Overhead lane sign (OHLS) etc are either missing or not in working order.

3.5.2 Toll Plaza Administration Building

The Plaza administration building serves as the support structure for the operation and maintenance of the toll plaza. It is from here that utilities are distributed and controlled, employee amenities are maintained, the toll collection process overseen, revenues are processed & audited. Sale of local passes and recharge is done at Plaza building. Transfer of funds from toll booth to plaza building and from plaza building to bank are being facilitated/managed by administration and financial management functions are also conducted in the building.

Pota cabin is being used as Toll plaza control room. Toll Plaza Building available at site does not meet the standard design being opted if properly planned wherein usually a supervisor room cum control room is kept on the first floor in line of sight of toll booths for visual monitoring. The lane activities here in these plazas are monitored through CCTV Cameras installed in booths, lanes, and plaza level.

3.5.3 TMS Requirements

The Concession Agreement (CA) Sl no 6 of deviation table given in schedule C specifies that existing toll plaza shall be retained with same nos. of toll lanes as present at site. Appropriate technology shall be used so that service time should not take more than 10 second per vehicle at peak flow. Waiting time of the users should not exceed three minutes.

The purpose of Toll Management System is to collect smooth, fast processing of vehicle from toll plaza and maintain records of all the transactions at the lane level, auditing the lane collectors

through AVC systems to prevent collection malfunctioning . All the statistical, configuration and financial / MIS reports being generated through the TMS.

Toll lane shall have lane equipment to regulate traffic movement form the Toll Plaza area. CCTV Cameras shall be installed for monitoring the traffic and lane activities. Automatic Vehicle Classification System along with incident capture camera that triggers and captures the image of outgoing vehicle when the AVC found a mismatch with the vehicle class assigned by the toll collector and the vehicle class classified by the automatic vehicle classification system. Lane computers shall be installed in the Booth for issuing the electronic tickets. RFID Transceiver shall be installed to process FASTAG vehicle.

The outermost lane in each direction is for extra wide vehicular traffic and is bifurcated by temporary barriers to allow for non-fee paying traffic (two /three wheelers etc.) to pass through without disturbing the other lanes.

3.6 Structure Inventory and Condition Survey

This section mainly presents the Site Inventory and Condition Survey of all existing Structures likes Culverts, Minor bridges & Major bridges, Flyovers/ Viaducts, VUP, LVUP, PUP, RUB and ROBs along the project road. The aim of the section is to present the details of existing structures, condition of existing structures and functioning of structures. The structure inventory has been done on the basis of visual assessment of each structure. Drone camera has been used to access the structure components where it was not feasible to monitor the condition physically.

A summary table of existing structures along the Project road are given below. Detailed inventory and condition data is presented in **Annexures – 3.2**.

Table 3.8: Summary of Structures

S. No.	Type of Structure	Nos.	Remarks
1	ROB	1	RCC Girder with Deck Slab and Steel Truss
2	Major Bridge	1	PSC Girder with Deck Slab
3	Minor Bridge	22	3 nos RCC Solid Slab in LHS & RCC Girder in RHS, 14 nos RCC Solid Slab, 4 nos RCC Girder & Slab and 3 nos PSC Girder & Deck Slab
4	Vehicular Underpasses	1	RCC Slab
5	Flyover	1	Under Construction at Pathsala by NHAI
6	Culverts	25	25 Slab

Section 4: Surveys and Investigations

4.1 Visual Pavement Condition Assessment

- In general, the pavement condition is fair to poor. At many locations, surface condition as observed is poor with all wider cracks, particularly in rigid pavement locations.
- It is observed that there is a drop in quality of pavement surface due to absence of timely routine/periodic maintenance activities. Upon enquiry with local PIU teams, there is no maintenance history is available.
- Most of the structure approaches has got damaged extensively with higher order settlements leading to sudden bumps/discomfort to road users.
- Significant number of rigid pavement panels have got cracked longitudinally in majority of the locations in each of the contract package. The cracking may be rated as high severity based on the visual observations and these panels may require for full depth replacement.
- The flexible pavement is experiencing the distress like hairline cracks, raveling, potholes and hungry surface with poor riding quality.
- The pavement performance for both functional and structural has been evaluated using various Engineering Surveys and Investigations and details are presented in subsequent sections of this report.
- Some of the photos showing condition of existing pavement are presented as under.

Flexible Pavement Condition (Alligator cracks and pot-holes)

Rigid Pavement Condition (Longitudinal Cracks)

Flexible Pavement Condition (Patch works)

Rigid Pavement Condition (Transverse Cracks)

Figure 4.1: Condition of Existing Pavement

4.2 Network Survey Vehicle (NSV)

The Network Survey Vehicle is the latest survey technique which utilizes Lasers, Global Positioning System and Video image processing tools. The survey vehicle is used for automatic data collection pertains to pavement condition and road inventory data, required for preparation of pavement maintenance and management proposals. It allows all the data to be collected in a single pass consequently minimising the time needed to complete the data collection. The measurement of surface distresses like cracking, ravelling, patching and pot holes etc. is done using the calibrated image processing methods. The description of NSV and the methodology adopted is provided in **Annexure-4.1.**

The NSV survey has been carried out along the project corridor on 06/12/2023 for collection of field data pertains to pavement condition and road inventory. The data has been collected separately for each lane of the Carriageway.

Figure 4.2: NSV survey

The collected data has been processed, analysed and the summary of such analysis findings for each of the performance parameter is presented below.

4.2.1 Evaluation of Pavement Condition

NSV survey has been conducted for assessment of pavement condition and its distresses. The pavement surface images captured by NSV were processed in Survey board and all the images are geotagged with corresponding co-ordinates and chainage. By manual intervention with Survey Board, it was mapped/ identified various distresses showing distress type, location, magnitude and severity.

Flexible Pavement Distresses

The following Pavement distresses are considered for assessing the flexible pavement condition as per IRC: 82-2015 “Code of Practice for Maintenance of Bituminous Road Surfaces”.

- Cracking
  - Longitudinal cracks
  - Transverse cracks
  - Alligator cracks/ Crocodile cracks

- Multiple cracks

➢ Raveling
➢ Shoving
➢ Bleeding
➢ Slippage/ Delamination
➢ Potholes
  - Area: Surface Area of the Pothole;
  - Numbers
➢ Edge break
➢ Patching
➢ Settlements, Depressions

Strip chart showing the observed pavement distresses is provided in **Annexure 4.2** separately for LHS and RHS directions along with rating of the pavement surface in terms of Good, Fair and Poor. Based on the pavement condition, suitable repair and rehabilitation strategies have been suggested and same shall be presented under the section of Major Maintenance of this report.

The summary of distress is presented in below Table.

Table 4.1: Summary of Flexible Pavement Distresses (LHS)

From	To	Cracking %	Patching	Patching %	Rutting
1013.000	1014.000	32.3	16.80	4.8	7.40
1014.000	1015.000	11.1	8.30	2.4	5.90
1015.000	1016.000	16.2	10.80	3.1	6.80
1016.000	1017.000	45.2	20.80	5.9	6.30
1017.000	1018.000	31.9	15.80	4.5	8.30
1018.000	1019.000	23.2	26.50	7.6	7.60
1019.000	1020.000	18	11.00	3.1	6.50
1020.000	1021.000	23.4	19.70	5.6	6.30
1021.000	1022.000	21.1	20.60	5.9	9.30
1022.000	1023.000	29.2	41.60	11.9	7.10
1023.000	1024.000	31.8	48.30	13.8	8.40
1024.000	1025.000	7.6	8.30	2.4	5.20
1025.000	1026.000	0.1	2.20	0.6	3.70
1026.000	1027.000	0.1	0.00	0	5.00
1027.000	1028.000	5.8	5.80	1.7	7.20
1028.000	1029.000	19.5	16.50	4.7	14.80
1029.000	1030.000	10.7	2.90	0.8	4.50
1030.000	1031.000	16.3	4.40	1.2	5.30
1031.000	1032.000	36.8	13.40	3.8	7.40
1032.000	1033.000	10.9	5.10	1.4	6.40
1033.000	1034.000	24.3	0.00	0	7.90
1034.000	1035.000	20.4	2.20	0.6	6.50
1035.000	1036.000	9.9	6.30	1.8	5.90
1036.000	1037.000	14.5	0.00	0	10.10
1037.000	1038.000	11	0.00	0	3.70
1038.000	1039.000	4.2	0.00	0	6.00
1039.000	1040.000	8	0.00	0	6.00
1040.000	1040.300	3	0.00	0	3.50

Table 4.2: Summary of Flexible Pavement Distresses (RHS)

From	To	Cracking %	Patching	Patching %	Rutting
1040.3	1040	11.9	0	0	3.6
1040	1039	17.3	0	0	4.5
1039	1038	3.4	0	0	4.1
1038	1037	6	0	0	3.6
1037	1036	32.6	0	0	2.1
1036	1035	12	0	0	2.0
1035	1034	2.8	0	0	2.6
1034	1033	0.2	0	0	2.4
1033	1032	0.1	0	0	2.8
1032	1031	0.7	0	0	3.3
1031	1030	1.8	0.2	0	4.1
1030	1029	0.6	0	0	3.5
1029	1028	14.7	12.6	3.6	9.2
1028	1027	1.9	0	0	3.6
1027	1026	2.1	0	0	2.8
1026	1025	3.2	0	0	3.5
1025	1024	6.8	0	0	4.0
1024	1023	0.7	0	0	2.5
1023	1022	0.3	0	0	2.3
1022	1021	0.6	0	0	2.8
1021	1020	0.3	0	0	2.3
1020	1019	0.1	0	0	2.1
1019	1018	0.2	0	0	1.8
1018	1017	0.9	0	0	3.2
1017	1016	0.8	0.4	0.1	2.9
1016	1015	0.6	0	0	3.7
1015	1014	0.2	0	0	2.7
1014	1013	0	0.2	0.1	2.7

Table 4.3: Summary of Rigid Pavement Distresses

Severity	Longitudinal Cracks	Transverse/ Diagonal Cracks	Multiple Cracks	Corner Cracks/ Breaking	Joint Spalling/ Joint Damage	Joint Seal defects	Joint Separation	Faulting/ Stepping	Blow Up/ Buckling	Ravelling	Scaling	Pothole/ Popout
LHS-Inner Lane												
0	2.100	3.900	3.900	3.100	3.900	3.800	3.900	3.900	3.900	3.200	2.800	3.900
1	1.800	0.000	0.000	0.600	0.000	0.100	0.000	0.000	0.000	0.200	0.900	0.000
2	0.000	0.000	0.000	0.200	0.000	0.000	0.000	0.000	0.000	0.500	0.200	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Length (Km)	**3.900**	**3.900**	**3.900**	**3.900**	**3.900**	**3.900**	**3.900**	**3.900**	**3.900**	**3.900**	**3.900**	**3.900**
LHS-Outer Lane												
0	2.100	3.900	3.800	3.500	3.900	3.900	3.900	3.900	3.900	2.900	3.200	3.900
1	1.500	0.000	0.000	0.400	0.000	0.000	0.000	0.000	0.000	0.800	0.600	0.000
2	0.300	0.000	0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.200	0.050	0.000

Severity	Longitudinal Cracks	Transverse/ Diagonal Cracks	Multiple Cracks	Corner Cracks/ Breaking	Joint Spalling/ Joint Damage	Joint Seal defects	Joint Separation	Faulting/ Stepping	Blow Up/ Buckling	Ravelling	Scaling	Pothole/ Popout
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.050	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Length (Km)	**3.900**	**3.900**	**3.900**	**3.900**	**3.900**	**3.900**	**3.900**	**3.900**	**3.900**	**3.900**	**3.900**	**3.900**
RHS-Inner Lane												
0	14.600	18.000	19.850	20.050	20.450	20.500	20.500	20.500	20.500	18.300	18.000	20.500
1	5.100	2.300	0.650	0.050	0.050	0.000	0.000	0.000	0.000	2.200	2.100	0.000
2	0.800	0.200	0.050	0.400	0.000	0.000	0.000	0.000	0.000	0.000	0.400	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Length (Km)	**20.500**	**20.500**	**20.500**	**20.500**	**20.500**	**20.500**	**20.500**	**20.500**	**20.500**	**20.500**	**20.500**	**20.500**
RHS-Outer Lane												
0	16.400	19.200	19.650	19.500	20.500	20.500	20.500	20.500	20.500	16.850	18.200	20.500
1	2.700	1.300	0.750	0.350	0.000	0.000	0.000	0.000	0.000	3.600	1.850	0.000
2	1.400	0.000	0.150	0.650	0.000	0.000	0.000	0.000	0.000	0.050	0.400	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.050	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Length (Km)	**20.500**	**20.500**	**20.500**	**20.500**	**20.500**	**20.500**	**20.500**	**20.500**	**20.500**	**20.500**	**20.500**	**20.500**

4.2.2 Pavement Roughness

The roughness data was collected at 100m interval using NSV on each lane in-terms of IRI (International Roughness Index) value. In Indian context, the IRI values were converted to BI as per IRC: SP:16-2019 “Guidelines on Measuring Road Roughness and Norms” with the following equation;

$BI = 630*(IRI)^{\wedge 1.12}$

Where

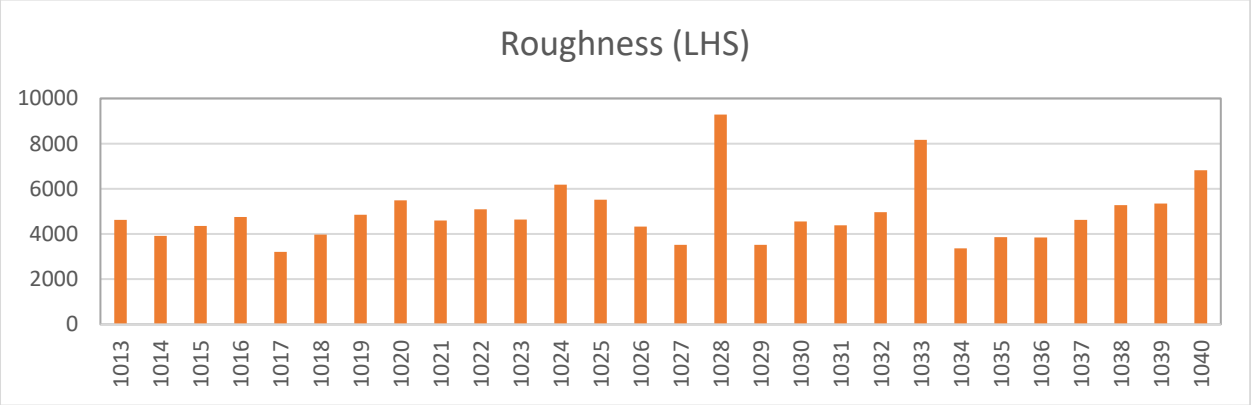
BI = Bump Integrator Roughness in mm/km

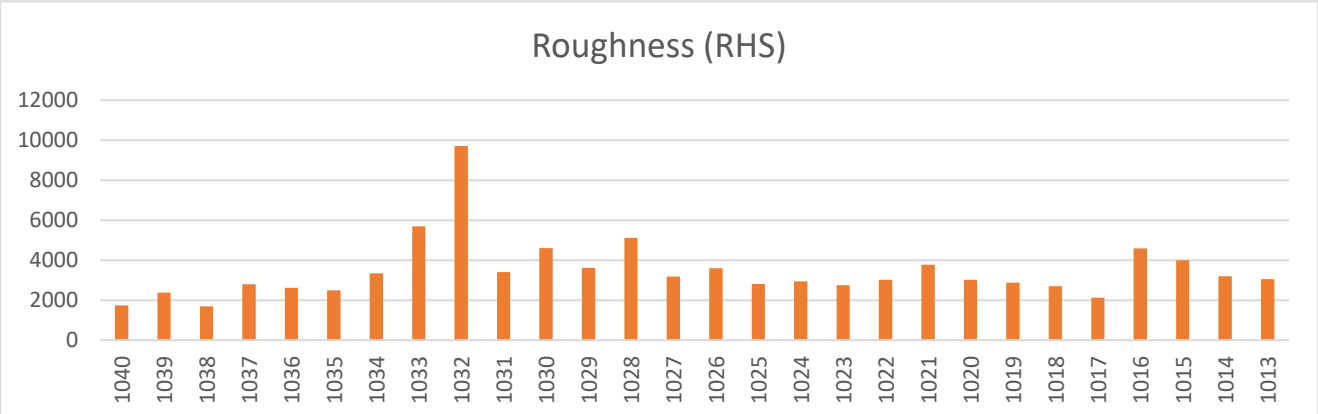
IRI = International Roughness Index.

Roughness data of Flexible & Rigid Pavement was collected through Digital Laser Profilers System (DLP) and the same is presented in **Annexure 4.3**. The summary of Roughness values is presented in tables below

Table 4.4: Summary of Pavement Roughness

Condition	BI (mm/km)	LHS				RHS			
		Inner		Outer		Inner		Outer	
		Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)	Length (km)	Length (%)
Flexible Pavement									
Good	<1800	0.10	0%	2.4	10%	1.40	25%	2.10	38%
Fair	1800-2400	1.30	6%	2.2	9%	1.60	29%	1.30	23%
Poor	>2400	21.26	91%	18.06	77%	2.55	46%	2.15	39%
Under Construction		0.70	3%	0.7	3%	0.00	0%	0.00	0%
Length (km)		23.36	100%	23.36	100%	5.55	100%	5.55	100%
Rigid Pavement									
Good	<2000	0	0%	0	0%	0.60	3%	0.70	3%
Fair	2000-2400	0	0%	0.7	18%	4.60	21%	4.60	21%
Poor	>2400	3.94	100%	3.24	82%	15.20	70%	15.10	69%
Under Construction		0	0%	0	0%	1.35	6%	1.35	6%
Length (Km)		3.94	100%	3.94	100%	21.75	100%	21.75	100%





4.2.3 Test Pit Investigations

Test pit investigations have been carried out at every 5km in a staggered manner ascertain the existing pavement composition (pavement course, material type, and thickness). The summary of

existing pavement crust thickness is presented in table and some of the photographs showing the pavement crust thickness are shown as below.

Table 4.5: Summary of Existing Pavement Crust Thickness

S. No	Existing Road	Location (Km.)	Side (LHS/RHS)	Existing Crust details					
				Bituminous Layer	Pavement Quality Concrete (PQC)	Dry Lean Concrete (DLC)	Granular Layer-I (/WMM)	Granular Layer-II (GSB)	Total Thickness (mm)
1	NH-27	1013+000	LHS	240			250	250	740
2	NH-27	1018+000	RHS		310	180		180	670
3	NH-27	1023+000	LHS	240			250	220	710
4	NH-27	1027+000	RHS		300	160		240	700
5	NH-27	1034+000	LHS	280			230	200	710
6	NH-27	1038+000	RHS	290			200	200	690

Figure 4.3: Pavement Composition & Thickness Measurement

Observations and Conclusions:

i) The existing pavement of the project highway is a combination of both flexible and rigid type. The pavement composition comprises of bituminous layer, granular base/sub-base on subgrade for flexible pavement whereas PQC, DLC and granular layer for rigid pavement.

ii) Throughout the project road, it is found that the consistent bituminous/ granular layer thickness with an average thickness of more than of 250mm in each of the project package over an average granular thickness of more than 400mm, whereas for rigid pavement average thickness of PQC is 300mm. The thickness and composition is almost matching with as-built crust of 4-lane highway.

During the above investigations, the existing subgrade soils samples were collected and tested in the laboratory to understand the properties of these foundation soils. The test results are presented in **Annexure 4.9.** The observations from test results are given below for each of the package.

The subgrade soils are generally consistent throughout the project road and is predominantly Gravels and clayey sands. Because of this soil type, Liquid Limit (LL) is ranging between 23-28 %, and these values are within the limit as per MoRTH specifications (<50%). The obtained maximum Plasticity Index of the subgrade soils is NP-11 % and the degree of free swell is 10.0 %. All the measured PI and FSI values are also within the acceptable limits as per MoRTH guidelines, of 25% and 50% respectively.

Further, the MDD values is ranging between 91.97 % - 95.48 %. The 4-days soaked CBR and is ranging from 6.5% to 7.2 % with an average value of 6.3 %, which is in line with design CBR adopted during 4-lane construction.

4.3 Axle Load Survey

Vehicle axle loading has a significant impact on pavement performance and design. Thus, an axle load survey has been conducted from 24th Nov-2022 to 01st Dec-2022 in compliance with IRC 37 2018 and such survey was conducted for 48 hours (2 normal days) in both directions at the existing toll plaza locations in each of the 5 project packages.

The type of vehicle considered for axle load survey along with its axle configurations are presented in below. Few of the survey photographs were shown in Photos as below:

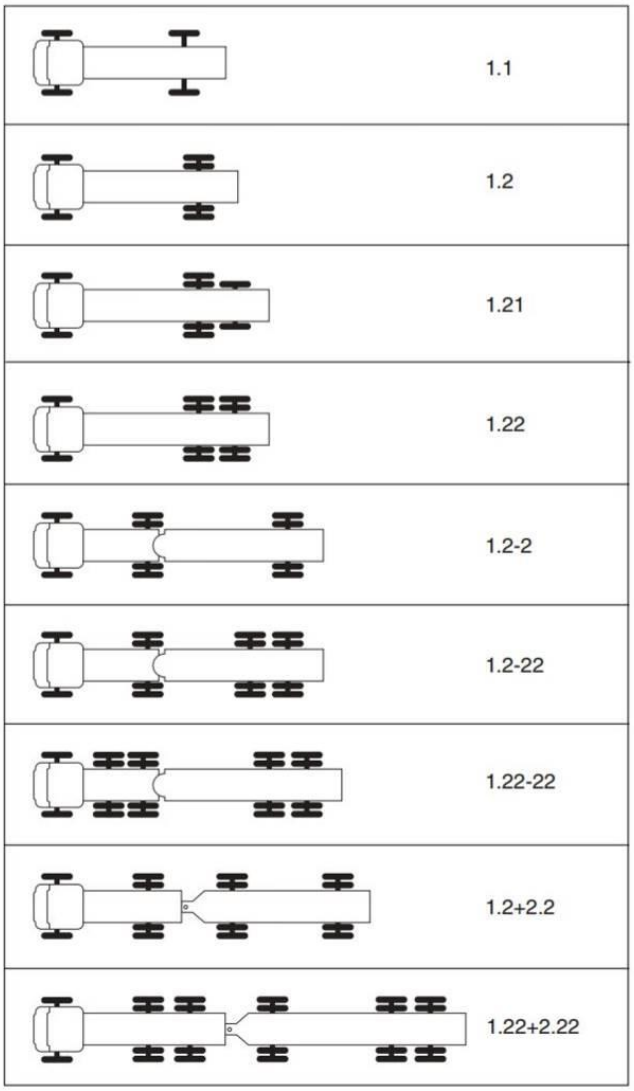


Figure 4.4: Axle Load Survey

The VDF analysis was carried out in line with section 4.4 of IRC: 37-2018 based on the axle load data. The equations for computing equivalency factor for single, tandem and tridem axles given below is used as directed in the IRC:37-2018 for converting different axle load repetitions into equivalent standard axle load repetitions;

- ✓ Single axle with single wheel on either side = {axle load in kN / 65}4
- ✓ Single axle with dual wheel on either side = {axle load in kN / 80}4
- ✓ Tandem axle with single wheel on either side = {axle load in kN /148}4
- ✓ Tridem axle with dual wheel on either side = {axle load in kN /224}4

With the stated above procedure, the Vehicle Damage Factor for each class of commercial vehicle on both the directions were calculated separately for empty and loaded vehicles. The Axle load data format and VDF analysis are presented in **Annexure 4.5** and obtained VDF values comparing the values adopted at the time of pavement design during construction summarized in table below.

Table 4.6: Vehicle Damage Factors (VDF)

Toll Plaza	Direction	Vehicle Damage factors				
		Bus	LCV	2-Axle	3-Axle	MAV
Galia	LHS	0.53	0.62	1.85	5.37	8.30
	RHS	0.66	0.39	1.33	6.82	7.19

4.4 Falling Weight Deflectometer (FWD)

The structural evaluation of pavement has been carried out in accordance with IRC: 115-2014, “Guidelines for Structural Evaluation and Strengthening of Flexible Road Pavements Using Falling Weight Deflectometer (FWD) Technique” to determine the remaining life of the pavement structure.

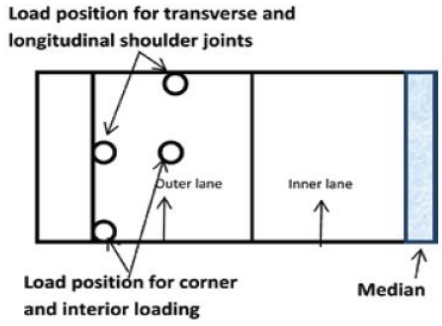
The principle and description of FWD and its methodology is provided in **Annexure 4.6.**

FWD deflection measurement has been carried out for each direction and the measurement has been carried out at a test point along outer wheel path of each direction which is at an offset of 1m from the outer edge of outer lane as specified in section 5.4.5 of IRC: 115-2014. At every measurement location, four drops were made, such that the first drop was the ‘**seating drop’** and with the remaining three drops deflections were recorded. Field survey photographs is shown below.

Figure 4.5: FWD Survey at Project Site

The deflection testing has been carried out on the existing pavement as per IRC Codes at the rate of 5 points per km as stipulated in TOR of the Consultant.

Adopted deflection measurement scheme is as under.

Adopted Measurement Scheme	Maximum Spacing(m) for test points along selected wheel path (Flexible Pavement)	Rigid Pavement
(i) measurement along outer wheel paths of outer lanes (3 points)	200	
(ii) measurement along the outer wheel path of inner lane (2 points)	400	

4.4.1 Back-calculation of Layer Moduli for Flexible Pavement

Layer moduli have been back-calculated using KGPBACK program. The pavement has been modelled as a three-layer system with bituminous layer, granular layer and subgrade. The following inputs have been provided for back analysis.

1. Single wheel load 40 kN and contact pressure 0.56 MPa
2. No. of deflection sensors: 9
3. Radial Distances of the Geophones i.e., 0,200, 300,450, 600, 900 and 1500mm
4. Measured Surface Deflections normalized to 40kN in mm
5. Pavement Layer Thicknesses (as measured from Trial Pits)
6. Poisson's ratio for different layers i.e., 0.35 for bituminous, granular and subgrade
7. Range of Possible modulus value (Min.- Max.) of bituminous layer, granular layer and subgrade.

Ranges of different layer moduli have been given as input to KGPBACK for back-calculation. These ranges have been selected judiciously by experienced pavement engineering taking into considerations the approximate age of pavement, visual assessment of the condition of bituminous

layer, climatic conditions prevailing at the time of deflection measurements and information available from test pits, and laboratory tests conducted as detailed below:

Range of modulus value of existing subgrade:

The range of moduli of existing subgrade is taken based on the subgrade CBR values for the analysis.

Range of modulus value of existing granular layers i.e., base and sub base:

The range of moduli of existing granular layers is based on Appendix III.8.4 of IRC 115-2014.The range for combined (base and sub-base) is taken as 100-500 MPa.

Range of modulus value of existing thick bituminous layers:

The range of moduli of existing thick bituminous layer has been determined on the basis of condition data. If the road condition is good the range is considered as 750 MPa to 3000 MPa, for sections with pavement condition is Fair- Poor, the range specified for thick bituminous layer 400 MPa to 1500 MPa as stipulated in Appendix III.8.4 of IRC: 115-2014 has been taken into consideration.

4.4.1.1 Correction for Temperature

Back-calculated moduli values of the bituminous layers evaluated by FWD survey are influenced by the pavement temperature. The standard pavement temperature for India is recommended as 35°C, hence the back-calculated moduli obtained at temperatures other than the identified standard temperature will have to be corrected using a suitable correction factor using equations 4 and 5 of IRC:115-2014 and the same is extracted below for ready reference.

$$\boldsymbol{E_{T1} = \lambda E_{T2}} \text{..... (4)}$$

Where,

λ temperature correction factor, is given as

$$\boldsymbol{\lambda = \frac{(1-0.238 \ln T_1)}{(1-0.238 \ln T_1)}} \text{..... (5)}$$

Where,

E_{T1} = Back-calculated modulus (MPa) at temperature $T_1^0\ C$

E_{T2} = Back-calculated modulus (MPa) at temperature $T_2^0\ C$

However, in few sections, after applying the temperature correction the E value of bituminous layers are coming more than 3000MPa. As the project road was constructed with VG-30/VG-40 grade bitumen, it is restricted to keep the maximum E value of 3000MPa, wherever it is exceeding. In these locations, the temperature correction factor was applied as 1.

4.4.1.2 Correction for Seasonal Variation

Moisture content affects the strength of subgrade and granular sub base/base layers. Therefore, the back-calculated moduli of subgrade and granular layers should be taken from field moduli using

seasonal corrections. Seasonal correction equations 7 and 8 of IRC: 115-2014 has been extracted below for ready reference.

$$E_{sub\_mon=}\ 3.351 * \left(E_{sub\_win}\right)^{0.7688} - 28.9 \ldots (6)$$

$$E_{sub\_mon} = 0.8554 * (E_{sub\_sum}) - 8.461 \ldots (7)$$

where,

E_{sub_mon} = subgrade modulus in monsoon (MPa)

E_{sub_sum} = subgrade modulus in Summer (MPa)

E_{sub_win} = subgrade modulus in Winter (MPa)

$$E_{gran\_mon=}\ -0.0003 * \left(E_{gran\_sum}\right)^2 + 0.9584 * \left(E_{gran\_sum}\right) - 32.989 \ldots (8)$$

$$E_{gran\_mon=}\ 10.5523 * \left(E_{gran\_win}\right)^{0.624} - 113.857 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

where,

E_{gran_mon} = granular layer modulus in monsoon (MPa)

E_{gran_sum} = granular layer modulus in Summer (MPa)

E_{gran_win} = granular layer modulus in Winter (MPa)

Since the deflection measurements have been carried out in the month of December hence seasonal correction factor is applicable.

The 15th percentile value (as the same has been recommended by IRC: 115-2014 for purpose of design) of back-calculated & corrected layer moduli of each identified homogeneous sub-sections of both directions separately are presented next.

4.4.1.3 Results of Back Calculated Modulii (E) of Pavement Layer

The summary of back calculated E values is presented in **Annexure 4.7**.

4.4.1.4 Remaining Life Estimation for Flexible Pavement

The in-service three-layer pavement system has been analysed with the back-calculated corrected layer moduli and layer thicknesses. The critical strains have been calculated by IITPAVE program. From the performance criteria equations, the residual/remaining rutting and fatigue life have been estimated.

Performance Criteria

The layer moduli of in-service pavement back calculated from FWD deflection data are used to analyse the pavement for critical strains which are indicators of pavement performance in terms of rutting and fatigue cracking. The following approach is proposed for design of bituminous overlays for existing flexible pavements. The mechanistic criteria (fatigue and rutting) adopted in the IRC:37-2018 “Guidelines for the Design of Flexible Pavements”, forms the basis for the overlay design method. Performance models adopted in these guidelines are given below.

a) Fatigue in Bituminous layer:

As it specified in IRC: 115-2014, the fatigue model for 90 percent reliability was used as below

$$N_f = 0.711 * 10^{-04} \times [1/\varepsilon_t]^{3.89} * [1/M_R]^{0.854}$$

As it specified in IRC: 37-2012, the fatigue model for 80 percent reliability was used as below

$$N_f = 2.21 * 10^{-04} \times [1/\varepsilon_t]^{3.89} * [1/M_R]^{0.854}$$

Where,

N_f = fatigue life in number of standard axles,

ε_t = Maximum Tensile strain at the bottom of the bituminous layer

M_R= resilient modulus of the bituminous layer.

b) Rutting in Subgrade:

Rutting model for 90 percent reliability level as specified in IRC: 115-2014 was used as below;

$$N = 1.41 \times 10^{-08} [1/\varepsilon_v]^{4.5337}$$

As it specified in IRC: 37-2012, the rutting model for 80 percent reliability was used as below

$$N = 4.1656 \times 10^{-08} [1/\varepsilon_v]^{4.5337}$$

Where,

N= Number of cumulative standard axles, and

ε_v= Vertical strain in the subgrade

The detailed remaining life analysis is done using 90 percent reliability equation of IRC: 115-2014 is presented in tables below for LHS and RHS carriageway.

Table 4.7: LHS Carriageway

S. No	Existing Chainage		Total Length(Km)	Average Crust Thickness (mm)		15th Percentile E Value (Mpa)			Obtained Strains (through IITPAVE)		Remaining Life of Exisitng Pavement (msa)		
	From	To		Bituminous Layer	Granular Layer	Bituminous Layer	Granular Layer	Subgrade	Fatigue Strain	Rutting Strain	Fatigue Residual Life	Rutting Residual Life	Remaining life
1	1013.028	1014.110	1.081	240	500	823.4	195.6	81.6	0.0002219	0.0002136	37.6	616.2	37.6
2	1014.110	1015.108	0.998	240	500	734.4	231.0	86.3	0.0002150	0.0002029	46.9	777.8	46.9
3	1015.108	1016.108	1.000	240	500	822.4	134.8	71.4	0.0002629	0.0002491	19.5	306.9	19.5
4	1016.108	1017.097	0.989	240	500	859.1	138.5	69.7	0.0002538	0.0002487	21.5	309.1	21.5
5	1017.097	1018.094	0.998	240	500	762.8	164.8	93.6	0.0002498	0.0002082	25.3	692.0	25.3
6	1018.094	1019.088	0.994	240	500	776.1	140.9	95.5	0.0002650	0.0002100	19.8	665.5	19.8
7	1019.088	1020.123	1.035	240	500	736.2	181.9	87.0	0.0002430	0.0002146	29.1	603.3	29.1
8	1020.123	1021.090	0.967	240	500	635.9	191.2	79.4	0.0002544	0.0002296	27.6	444.1	27.6
9	1021.090	1022.122	1.032	240	500	721.2	113.4	81.7	0.0003030	0.0002425	12.5	346.6	12.5
10	1022.122	1023.095	0.974	240	495	787.7	120.5	81.3	0.0002811	0.0002386	15.6	373.1	15.6
11	1023.095	1024.142	1.046	240	470	830.0	145.8	89.1	0.0002523	0.0002277	22.7	461.2	22.7
12	1025.522	1025.632	0.111	240	470	868.1	225.5	69.1	0.0002024	0.0002358	51.4	393.6	51.4
13	1026.541	1027.607	1.066	240	470	1229.0	194.5	94.3	0.0001794	0.0001907	61.1	1030.4	61.1
14	1027.607	1028.089	0.483	240	470	776.5	163.0	102.5	0.0002487	0.0002087	25.4	684.5	25.4
15	1029.021	1030.010	0.989	240	470	1022.5	165.9	83.4	0.0002131	0.0002204	36.6	534.6	36.6
16	1030.010	1031.035	1.024	240	470	1158.0	188.3	75.3	0.0001892	0.0002206	52.3	532.4	52.3
17	1031.035	1031.982	0.948	240	470	1225.4	175.2	82.6	0.0001881	0.0002095	50.9	672.8	50.9
18	1031.982	1033.005	1.023	240	470	885.0	143.4	72.9	0.0002463	0.0002533	23.6	284.5	23.6
19	1033.005	1033.991	0.986	240	470	952.6	130.2	86.1	0.0002438	0.0002277	23.0	461.2	23.0
20	1033.991	1034.999	1.008	270	440	683.0	204.0	99.1	0.0002075	0.0002033	57.3	770.9	57.3
21	1034.999	1036.001	1.002	280	430	801.9	159.6	105.0	0.0002036	0.0001929	53.8	978.2	53.8
22	1036.001	1037.459	1.458	280	430	574.1	133.0	101.3	0.0002647	0.0002196	25.8	543.5	25.8
23	1038.261	1039.236	0.975	280	430	790.0	109.6	56.9	0.0002424	0.0002905	27.6	152.8	27.6

Table 4.8: RHS Carriageway

S. No	Existing Chainage		Total Length(Km)	Average Crust Thickness (mm)		15th Percentile E Value (Mpa)			Obtained Strains (through IITPAVE)		Remaining Life of Exisitng Pavement (msa)		
	From	To		Bituminous Layer	Granular Layer	Bituminous Layer	Granular Layer	Subgrade	Fatigue Strain	Rutting Strain	Fatigue Residual Life	Rutting Residual Life	Remaining life
1	1040.086	1039.015	1.070	290	400	848.9	85.3	108.7	0.0002310	0.0001882	31.3	1093.9	31.3
2	1039.015	1037.559	1.456	290	400	575.2	146.1	84.6	0.0002439	0.0002506	35.4	298.6	35.4
3	1025.563	1024.490	1.073	290	400	532.2	144.3	105.9	0.0002540	0.0002226	32.3	511.0	32.3

From the above, it can be revealed that existing pavement has as life to cater for the above mentioned traffic levels. Since the calculated design traffic is higher than the existing life, thus initial strengthening is required to improve the structural and functional adequacy. Further, major maintenance has to be carried out at every 6th year to improve the riding quality and life of the pavement during the concession period.

4.4.1.5 FWD data Analysis for Rigid Pavement

As per IRC: 117-2015, the collected FWD data for the rigid pavement has been analysed to determine the following parameters.

- Modulus of subgrade reaction k (MPa/m)
- Elastic modulus of concrete E_c (MPa)
- Flexural Strength of concrete f_{mr} (MPa)
- Load Transfer Efficiency (LTE) of Joints (%)

The range of Elastic Modulus, strength and Load Transfer Efficiency (LTE) for both Dowels and Tie bars is presented in table below.

Table 4.9:Summary of Flexural Strength and Elastic Modulus

S. No.	Chainage	PQC Thickness (mm)	Area of defelection basin (inch)	Radius of relative stiffness, l (inch)	Modulus of subgrade reaction k (MPa/m)	Elastic modulus of concrete Ec (MPa)	Strength of concrete fc (MPa)	Flexural Strength of concrete f_{mr} (MPa)
Kaljhar – Patrakuchi Section (LHS)								
1	1024.4985	310	26.255	21.371	476.43	16,308	10.64	2.28
2	1024.5102	310	27.746	24.778	370.17	22,897	20.97	3.21
3	1024.5423	310	27.711	24.686	289.18	17,624	12.42	2.47
4	1024.554	310	27.251	23.537	331.97	16,720	11.18	2.34
5	1024.8387	310	28.656	27.431	188.51	17,515	12.27	2.45
6	1024.8503	310	28.430	26.722	192.31	16,090	10.36	2.25
7	1025.0096	310	28.631	27.351	157.47	14,461	8.36	2.02
8	1025.0212	310	28.635	27.364	159.89	14,711	8.66	2.06
9	1025.1108	310	28.291	26.301	462.62	36,326	52.78	5.09
10	1025.1224	310	27.923	25.252	227.07	15,153	9.18	2.12
11	1025.8533	310	29.792	31.665	140.95	23,253	21.63	3.26
12	1025.865	310	28.750	27.739	165.38	16,068	10.33	2.25
13	1025.9744	310	28.808	27.930	285.52	28,514	32.52	3.99
14	1025.9861	310	31.212	39.130	88.00	33,858	45.86	4.74
15	1026.0991	310	28.639	27.378	165.44	15,253	9.31	2.14
16	1026.1108	310	27.300	23.654	380.84	19,565	15.31	2.74
17	1026.4075	310	28.154	25.902	254.62	18,807	14.15	2.63
18	1026.4192	310	27.870	25.108	252.70	16,481	10.87	2.31
19	1037.4843	300	30.437	34.688	63.00	16,517	10.91	2.31
20	1037.496	300	28.521	27.002	177.36	17,071	11.66	2.39
21	1037.6123	300	28.070	25.662	223.51	17,549	12.32	2.46
22	1037.624	300	27.989	25.434	193.87	14,689	8.63	2.06
23	1037.8591	300	29.455	30.279	213.23	32,451	42.12	4.54
24	1037.8708	300	29.199	29.307	148.74	19,868	15.79	2.78
25	1038.0067	300	27.031	23.024	353.85	18,004	12.97	2.52
26	1038.0183	300	29.295	29.665	123.33	17,292	11.96	2.42
27	1038.1079	300	28.654	27.427	140.61	14,407	8.30	2.02
28	1038.1196	300	26.260	21.381	394.54	14,930	8.92	2.09
29	1038.6578	300	28.037	25.570	240.50	18,615	13.86	2.61
30	1038.6695	300	30.725	36.228	84.09	26,229	27.52	3.67

S. No.	Chainage	PQC Thickness (mm)	Area of defelection basin (inch)	Radius of relative stiffness, l (inch)	Modulus of subgrade reaction k (MPa/m)	Elastic modulus of concrete Ec (MPa)	Strength of concrete fc (MPa)	Flexural Strength of concrete f_{mr} (MPa)
31	1039.5012	300	28.603	27.262	184.42	18,444	13.61	2.58
32	1039.5129	300	29.949	32.352	107.11	21,245	18.05	2.97
33	1039.5993	300	28.131	25.837	215.59	17,394	12.10	2.44
34	1039.6109	300	27.347	23.767	304.86	17,614	12.41	2.47
35	1039.8155	300	30.227	33.644	174.69	40,527	65.70	5.67
36	1039.8272	300	27.199	23.415	271.17	14,759	8.71	2.07
37	1039.98	300	26.758	22.418	372.50	17,034	11.61	2.38
38	1039.9916	300	28.624	27.329	232.01	23,433	21.97	3.28
39	1040.1725	300	28.481	26.879	193.14	18,254	13.33	2.56
40	1040.1841	300	25.121	19.291	580.81	14,564	8.48	2.04
Patrakuchi -Kaljhar Section (RHS)								
1	1037.500	300	29.774	31.590	82.31	14,842	8.81	2.08
2	1037.477	300	27.734	24.746	250.14	16,983	11.54	2.38
3	1037.127	300	29.553	30.669	171.97	27,549	30.36	3.86
4	1037.108	300	29.141	29.094	115.99	15,047	9.06	2.11
5	1037.006	300	29.948	32.348	75.18	14,905	8.89	2.09
6	1036.983	300	27.499	24.144	356.35	21,927	19.23	3.07
7	1036.852	300	29.687	31.219	86.91	14,948	8.94	2.09
8	1036.832	300	29.640	31.026	91.68	15,383	9.47	2.15
9	1036.577	300	31.360	40.101	98.83	46,275	85.65	6.48
10	1036.558	300	29.361	29.915	109.27	15,845	10.04	2.22
11	1036.5	300	31.505	41.088	57.54	29,691	35.26	4.16
12	1036.477	300	30.637	35.742	135.02	39,897	63.67	5.59
13	1036.146	300	31.452	40.720	84.91	42,270	71.47	5.92
14	1036.127	300	28.980	28.521	124.60	14,928	8.91	2.09
15	1036.003	300	31.398	40.355	58.27	27,981	31.32	3.92
16	1035.981	300	31.378	40.220	90.81	43,028	74.06	6.02
17	1035.825	300	31.276	39.547	95.69	42,379	71.84	5.93
18	1035.806	300	26.183	21.227	411.34	15,122	9.15	2.12
19	1035.602	300	30.867	37.030	112.87	38,424	59.06	5.38
20	1035.583	300	27.995	25.451	244.55	18,580	13.81	2.60
21	1035.498	300	31.330	39.900	56.11	25,747	26.52	3.60
22	1035.476	300	31.378	40.220	90.81	43,028	74.06	6.02
23	1035.164	300	31.620	41.906	82.86	46,265	85.62	6.48
24	1035.145	300	28.318	26.382	231.43	20,300	16.48	2.84
25	1035.015	300	29.768	31.564	86.53	15,552	9.67	2.18
26	1034.992	300	29.029	28.693	133.57	16,392	10.75	2.29
27	1034.872	300	31.456	40.754	98.67	49,285	97.16	6.90
28	1034.853	300	28.854	28.087	204.70	23,066	21.28	3.23
29	1034.59	300	32.688	51.106	48.41	59,797	143.03	8.37
30	1034.571	300	28.685	27.524	180.22	18,729	14.03	2.62
31	1034.512	300	32.357	47.915	47.93	45,746	83.71	6.40
32	1034.489	300	29.780	31.615	83.11	15,033	9.04	2.10

S. No.	Chainage	PQC Thickness (mm)	Area of defelection basin (inch)	Radius of relative stiffness, l (inch)	Modulus of subgrade reaction k (MPa/m)	Elastic modulus of concrete Ec (MPa)	Strength of concrete fc (MPa)	Flexural Strength of concrete f_{mr} (MPa)
33	1034.123	300	31.249	39.367	82.80	36,007	51.86	5.04
34	1034.104	300	31.011	37.880	71.47	26,645	28.40	3.73
35	1034.063	300	29.732	31.410	98.80	17,413	12.13	2.44
36	1034.04	300	29.033	28.705	236.95	29,128	33.94	4.08
37	1033.818	300	31.686	42.390	74.52	43,571	75.94	6.10
38	1033.798	300	29.625	30.963	102.21	17,009	11.57	2.38
39	1031.767	300	31.207	39.097	77.20	32,661	42.67	4.57
40	1031.748	300	29.276	29.591	103.27	14,336	8.22	2.01
41	1031.634	300	29.448	30.254	126.32	19,161	14.69	2.68
42	1031.615	300	27.522	24.201	290.10	18,017	12.98	2.52
43	1031.512	300	31.161	38.804	71.78	29,468	34.73	4.13
44	1031.489	300	31.645	42.090	103.18	58,635	137.52	8.21
45	1031.123	300	31.746	42.840	80.82	49,287	97.17	6.90
46	1031.104	300	29.690	31.231	90.39	15,570	9.70	2.18
47	1030.997	300	29.603	30.872	105.14	17,293	11.96	2.42
48	1030.975	300	31.557	41.455	105.57	56,456	127.49	7.90
49	1030.871	300	30.443	34.720	104.61	27,525	30.30	3.85
50	1030.852	300	27.492	24.125	262.39	16,095	10.36	2.25
51	1030.613	300	32.255	46.998	58.88	52,019	108.24	7.28
52	1030.594	300	29.261	29.536	171.57	23,642	22.36	3.31
53	1030.514	300	22.927	15.931	1277.39	14,898	8.88	2.09
54	1030.491	300	29.589	30.817	198.50	32,414	42.03	4.54
55	1030.071	300	29.688	31.223	123.65	21,279	18.11	2.98
56	1030.052	300	29.745	31.466	148.17	26,301	27.67	3.68
57	1030.001	300	33.264	57.588	34.03	67,758	183.65	9.49
58	1029.979	300	27.533	24.228	306.51	19,124	14.63	2.68
59	1029.828	300	30.074	32.925	117.23	24,944	24.89	3.49
60	1029.808	300	29.473	30.351	155.55	23,900	22.85	3.35
61	1029.588	300	30.469	34.855	112.40	30,038	36.09	4.21
62	1029.569	300	28.576	27.176	184.18	18,189	13.23	2.55
63	1029.503	300	30.030	32.720	103.85	21,553	18.58	3.02
64	1029.48	300	31.805	43.285	83.98	53,375	113.96	7.47
65	1029.096	300	31.211	39.124	80.50	34,151	46.65	4.78
66	1029.077	300	30.254	33.776	132.69	31,267	39.10	4.38
67	1028.492	300	32.982	54.255	49.58	77,782	242.00	10.89
68	1028.469	300	31.769	43.017	69.18	42,893	73.59	6.01
69	1028.119	300	29.467	30.326	181.41	27,780	30.87	3.89
70	1028.1	300	27.469	24.068	369.88	22,473	20.20	3.15
71	1028.008	300	31.769	43.012	55.82	34,595	47.87	4.84
72	1027.985	300	29.620	30.943	142.70	23,686	22.44	3.32
73	1027.84	300	30.432	34.663	104.85	27,407	30.05	3.84
74	1027.821	300	27.946	25.316	198.48	14,762	8.72	2.07
75	1027.575	300	31.237	39.289	76.13	32,846	43.15	4.60

S. No.	Chainage	PQC Thickness (mm)	Area of defelection basin (inch)	Radius of relative stiffness, l (inch)	Modulus of subgrade reaction k (MPa/m)	Elastic modulus of concrete Ec (MPa)	Strength of concrete fc (MPa)	Flexural Strength of concrete f_{mr} (MPa)
76	1027.555	300	31.379	40.229	93.26	44,227	78.24	6.19
77	1027.504	300	33.434	59.753	29.56	68,221	186.17	9.55
78	1027.482	300	31.084	38.327	98.98	38,671	59.82	5.41
79	1027.134	300	29.388	30.018	138.95	20,429	16.69	2.86
80	1027.115	300	28.483	26.885	210.01	19,865	15.79	2.78
81	1026.994	300	30.551	35.283	77.32	21,696	18.83	3.04
82	1026.972	300	28.359	26.507	196.89	17,598	12.39	2.46
83	1026.832	300	32.624	50.465	60.86	71,465	204.29	10.01
84	1026.813	300	27.163	23.330	291.06	15,612	9.75	2.19
85	1026.624	300	30.012	32.638	129.38	26,584	28.27	3.72
86	1026.605	300	28.660	27.445	177.74	18,259	13.34	2.56
87	1026.512	300	31.677	42.327	52.38	30,438	37.06	4.26
88	1026.489	300	29.196	29.293	113.82	15,175	9.21	2.12
89	1026.129	300	31.960	44.504	69.30	49,228	96.93	6.89
90	1026.109	300	27.845	25.041	427.14	30,409	36.99	4.26
91	1026.015	300	31.482	40.932	64.85	32,958	43.45	4.61
92	1025.992	300	29.109	28.976	150.93	19,265	14.85	2.70
93	1025.854	300	29.829	31.824	148.63	27,603	30.48	3.86
94	1025.835	300	29.664	31.125	109.62	18,626	13.88	2.61
95	1025.58	300	27.312	23.685	318.87	18,168	13.20	2.54
96	1025.561	300	27.881	25.140	203.87	14,745	8.70	2.06
97	1025.455	300	31.170	38.864	72.01	29,744	35.39	4.16
98	1025.432	300	28.273	26.248	238.95	20,538	16.87	2.88
99	1024.083	300	28.599	27.248	169.65	16,934	11.47	2.37
100	1024.064	300	29.692	31.242	95.85	16,534	10.94	2.31
101	1024.008	300	31.076	38.280	54.61	21,231	18.03	2.97
102	1023.985	300	31.360	40.102	145.12	67,952	184.70	9.51
103	1023.874	300	31.497	41.036	60.95	31,298	39.18	4.38
104	1023.855	300	31.395	40.332	65.24	31,259	39.09	4.38
105	1023.597	300	30.357	34.286	115.15	28,811	33.20	4.03
106	1023.578	300	28.836	28.026	160.08	17,882	12.79	2.50
107	1023.501	300	29.802	31.707	84.22	15,413	9.50	2.16
108	1023.479	300	32.176	46.309	44.47	37,035	54.86	5.18
109	1023.118	300	31.341	39.971	76.90	35,544	50.53	4.98
110	1023.099	300	28.205	26.048	176.36	14,701	8.64	2.06
111	1023.008	300	32.432	48.608	43.96	44,437	78.99	6.22
112	1022.985	300	30.379	34.396	108.52	27,504	30.26	3.85
113	1022.876	300	28.997	28.578	154.80	18,695	13.98	2.62
114	1022.857	300	30.299	33.996	103.31	24,985	24.97	3.50
115	1022.643	300	31.831	43.487	72.25	46,786	87.56	6.55
116	1022.624	300	29.381	29.993	127.16	18,633	13.89	2.61
117	1022.505	300	29.205	29.327	126.29	16,916	11.45	2.37
118	1022.483	300	31.786	43.144	63.38	39,758	63.23	5.57

S. No.	Chainage	PQC Thickness (mm)	Area of defelection basin (inch)	Radius of relative stiffness, l (inch)	Modulus of subgrade reaction k (MPa/m)	Elastic modulus of concrete Ec (MPa)	Strength of concrete fc (MPa)	Flexural Strength of concrete f_{mr} (MPa)
119	1022.148	300	29.752	31.494	138.28	24,630	24.27	3.45
120	1022.128	300	28.462	26.820	159.49	14,942	8.93	2.09
121	1022.006	300	32.669	50.916	38.25	46,552	86.68	6.52
122	1021.984	300	31.330	39.899	119.26	54,728	119.80	7.66
123	1021.882	300	29.464	30.316	121.99	18,658	13.92	2.61
124	1021.863	300	27.783	24.877	296.35	20,551	16.89	2.88
125	1021.632	300	29.763	31.541	211.31	37,865	57.35	5.30
126	1021.613	300	26.048	20.966	429.34	15,020	9.02	2.10
127	1021.507	300	31.870	43.789	52.83	35,169	49.47	4.92
128	1021.484	300	28.345	26.463	237.30	21,072	17.76	2.95
129	1021.14	300	29.632	30.994	120.55	20,143	16.23	2.82
130	1021.121	300	29.000	28.590	133.35	16,131	10.41	2.26
131	1021.008	300	30.795	36.619	66.64	21,697	18.83	3.04
132	1020.986	300	30.603	35.561	153.74	44,516	79.27	6.23
133	1020.818	300	30.193	33.482	94.90	21,594	18.65	3.02
134	1020.799	300	28.319	26.386	181.37	15,918	10.14	2.23
135	1020.572	300	29.773	31.585	102.77	18,518	13.72	2.59
136	1020.553	300	28.163	25.927	196.64	16,089	10.35	2.25
137	1020.507	300	30.541	35.228	70.20	19,577	15.33	2.74
138	1020.485	300	30.941	37.463	93.24	33,252	44.23	4.66
139	1020.132	300	30.603	35.558	118.12	34,191	46.76	4.79
140	1020.113	300	29.473	30.349	207.86	31,931	40.78	4.47
141	1019.994	300	30.952	37.526	80.57	28,929	33.47	4.05
142	1019.972	300	30.597	35.529	164.29	47,400	89.87	6.64
143	1019.884	300	29.852	31.923	144.60	27,192	29.58	3.81
144	1019.865	300	29.305	29.700	133.42	18,798	14.13	2.63
145	1019.651	300	29.226	29.406	124.88	16,908	11.43	2.37
146	1019.632	300	30.497	35.002	93.20	25,331	25.67	3.55
147	1019.52	300	29.758	31.520	107.83	19,272	14.86	2.70
148	1019.497	300	27.386	23.864	251.26	14,754	8.71	2.07
149	1019.105	300	32.094	45.607	50.74	39,747	63.19	5.56
150	1019.086	300	30.522	35.132	108.30	29,871	35.69	4.18
151	1018.995	300	31.571	41.559	64.76	34,978	48.94	4.90
152	1018.972	300	29.193	29.284	135.40	18,029	13.00	2.52
153	1018.862	300	31.695	42.459	78.65	46,284	85.69	6.48
154	1018.843	300	27.312	23.683	282.24	16,077	10.34	2.25
155	1018.624	300	31.361	40.105	83.59	39,155	61.33	5.48
156	1018.605	300	30.585	35.462	97.09	27,802	30.92	3.89
157	1018.505	300	31.946	44.396	55.22	38,839	60.34	5.44
158	1018.482	300	29.074	28.851	201.73	25,307	25.62	3.54
159	1018.118	300	30.258	33.794	124.33	29,363	34.49	4.11
160	1018.099	300	29.516	30.523	121.99	19,173	14.70	2.68
161	1017.99	300	31.784	43.126	56.00	35,072	49.20	4.91

S. No.	Chainage	PQC Thickness (mm)	Area of defelection basin (inch)	Radius of relative stiffness, l (inch)	Modulus of subgrade reaction k (MPa/m)	Elastic modulus of concrete Ec (MPa)	Strength of concrete fc (MPa)	Flexural Strength of concrete f_{mr} (MPa)
162	1017.968	300	26.991	22.934	290.12	14,533	8.45	2.03
163	1017.86	310	32.526	49.503	50.11	49,385	97.56	6.91
164	1017.841	310	29.159	29.158	133.84	15,875	10.08	2.22
165	1017.58	310	32.273	47.151	65.73	53,311	113.68	7.46
166	1017.561	310	29.580	30.780	113.30	16,689	11.14	2.34
167	1017.539	310	30.578	35.425	68.28	17,646	12.46	2.47
168	1017.517	310	27.189	23.390	315.06	15,476	9.58	2.17
169	1017.092	310	31.943	44.370	51.08	32,488	42.22	4.55
170	1017.073	310	28.653	27.423	157.82	14,648	8.58	2.05
171	1017.006	310	31.415	40.469	63.72	28,046	31.46	3.93
172	1016.983	310	28.223	26.101	199.09	15,164	9.20	2.12
173	1016.883	310	32.593	50.150	55.32	57,419	131.88	8.04
174	1016.864	310	29.447	30.247	152.57	20,958	17.57	2.93
175	1016.648	310	30.687	36.017	113.85	31,438	39.53	4.40
176	1016.629	310	29.456	30.283	168.35	23,236	21.60	3.25
177	1016.51	310	30.641	35.765	75.76	20,341	16.55	2.85
178	1016.487	310	30.111	33.096	116.00	22,839	20.86	3.20
179	1016.159	310	31.474	40.873	70.65	32,358	41.88	4.53
180	1016.14	310	28.338	26.441	218.62	17,535	12.30	2.45
181	1015.997	310	28.333	26.426	194.51	15,566	9.69	2.18
182	1015.974	310	27.156	23.314	369.60	17,919	12.84	2.51
183	1015.825	310	31.567	41.528	70.11	34,217	46.83	4.79
184	1015.806	310	30.034	32.740	161.07	30,372	36.90	4.25
185	1015.574	310	32.471	48.976	61.88	58,428	136.55	8.18
186	1015.555	310	27.103	23.191	405.46	19,246	14.82	2.69
187	1015.512	310	29.709	31.311	125.31	19,765	15.63	2.77
188	1015.49	310	30.055	32.834	109.83	20,945	17.55	2.93
189	1015.121	310	30.929	37.391	68.50	21,973	19.31	3.08
190	1015.102	310	28.310	26.359	193.94	15,364	9.44	2.15
191	1014.996	310	31.614	41.869	65.24	32,901	43.30	4.61
192	1014.974	310	30.183	33.436	118.06	24,212	23.45	3.39
193	1014.837	310	31.496	41.026	84.96	39,495	62.40	5.53
194	1014.817	310	28.934	28.361	185.89	19,735	15.58	2.76
195	1014.596	310	30.139	33.226	125.49	25,096	25.19	3.51
196	1014.577	310	27.497	24.139	275.87	15,370	9.45	2.15
197	1014.53	310	30.624	35.675	66.92	17,787	12.65	2.49
198	1014.508	310	30.048	32.801	119.98	22,793	20.78	3.19
199	1014.093	310	31.883	43.896	70.32	42,845	73.43	6.00
200	1014.074	310	28.268	26.234	217.69	16,920	11.45	2.37
201	1013.998	310	30.307	34.038	119.39	26,301	27.67	3.68
202	1013.976	310	29.170	29.200	164.96	19,679	15.49	2.76
203	1013.862	310	31.764	42.979	64.03	35,852	51.42	5.02
204	1013.843	310	28.735	27.690	190.51	18,379	13.51	2.57

S. No.	Chainage	PQC Thickness (mm)	Area of defelection basin (inch)	Radius of relative stiffness, l (inch)	Modulus of subgrade reaction k (MPa/m)	Elastic modulus of concrete Ec (MPa)	Strength of concrete fc (MPa)	Flexural Strength of concrete f_{mr} (MPa)
205	1013.585	310	29.493	30.430	138.44	19,480	15.18	2.73
206	1013.566	310	29.383	30.001	165.45	21,994	19.35	3.08
207	1013.507	310	31.383	40.252	82.13	35,382	50.08	4.95
208	1013.485	310	27.936	25.288	217.94	14,626	8.56	2.05
209	1013.115	310	32.599	50.217	54.75	57,132	130.56	8.00
210	1013.096	310	28.343	26.457	200.09	16,088	10.35	2.25
211	1013.009	310	29.784	31.632	112.87	18,545	13.76	2.60
212	1012.987	310	28.484	26.889	180.05	15,445	9.54	2.16

Table 4.10: Load Transfer Efficiency of Dowel Bars

S. No.	Chainage	Side	Lane	Test Point Location	Pressure	Load	0	300	LTE %
					N/mm2	KN	Loaded Slab	Unloaded Slab	
Kaljhar – Patrakuchi Section (LHS)									
1	1024.516	LHS	INNER	Transverse Joint	836.0	59.1	0.123	0.115	92.9%
2	1024.56	LHS	OUTER	Transverse Joint	852.0	60.3	0.123	0.112	91.4%
3	1024.856	LHS	INNER	Transverse Joint	858.2	60.7	0.123	0.111	90.6%
4	1025.027	LHS	OUTER	Transverse Joint	874.3	61.8	0.123	0.113	91.5%
5	1025.128	LHS	INNER	Transverse Joint	839.9	59.4	0.123	0.113	92.1%
6	1025.871	LHS	OUTER	Transverse Joint	858.0	60.7	0.123	0.111	90.3%
7	1025.992	LHS	INNER	Transverse Joint	835.1	59.1	0.123	0.115	92.9%
8	1026.117	LHS	OUTER	Transverse Joint	837.9	59.3	0.123	0.113	92.1%
9	1026.425	LHS	INNER	Transverse Joint	851.4	60.2	0.123	0.112	91.3%
10	1037.502	LHS	OUTER	Transverse Joint	863.7	61.1	0.122	0.109	89.3%
11	1037.63	LHS	INNER	Transverse Joint	846.7	59.9	0.124	0.117	94.5%
12	1037.877	LHS	OUTER	Transverse Joint	852.3	60.3	0.124	0.116	93.8%
13	1038.024	LHS	INNER	Transverse Joint	867.7	61.4	0.124	0.117	94.4%
14	1038.125	LHS	OUTER	Transverse Joint	858.9	60.7	0.123	0.114	92.6%
15	1038.675	LHS	INNER	Transverse Joint	866.5	61.3	0.124	0.116	94.0%
16	1039.519	LHS	OUTER	Transverse Joint	841.6	59.5	0.124	0.117	94.7%
17	1039.617	LHS	INNER	Transverse Joint	858.9	60.7	0.123	0.114	92.3%
18	1039.833	LHS	OUTER	Transverse Joint	865.4	61.2	0.123	0.114	92.3%
19	1039.997	LHS	INNER	Transverse Joint	823.7	58.2	0.124	0.117	94.6%
20	1040.19	LHS	OUTER	Transverse Joint	849.7	60.1	0.123	0.112	91.2%
Patrakuchi -Kaljhar Section (RHS)									

S. No.	Chainage	Side	Lane	Test Point Location	Pressure	Load	0	300	LTE %
					N/mm2	KN	Loaded Slab	Unloaded Slab	
1	1037.466	RHS	INNER	Transverse Joint	864.8	61.2	0.122	0.110	89.5%
2	1037.095	RHS	OUTER	Transverse Joint	838.0	59.3	0.123	0.111	90.8%
3	1036.972	RHS	INNER	Transverse Joint	834.5	59.0	0.124	0.117	94.2%
4	1036.819	RHS	OUTER	Transverse Joint	849.4	60.1	0.122	0.108	88.5%
5	1036.545	RHS	OUTER	Transverse Joint	842.6	59.6	0.122	0.110	89.6%
6	1036.466	RHS	INNER	Transverse Joint	851.8	60.2	0.122	0.109	89.2%
7	1036.114	RHS	OUTER	Transverse Joint	838.6	59.3	0.123	0.112	91.5%
8	1035.969	RHS	INNER	Transverse Joint	855.1	60.5	0.123	0.112	91.1%
9	1035.793	RHS	OUTER	Transverse Joint	839.6	59.4	0.123	0.111	90.6%
10	1035.570	RHS	OUTER	Transverse Joint	842.9	59.6	0.122	0.105	86.6%
11	1035.464	RHS	INNER	Transverse Joint	851.8	60.2	0.122	0.109	89.3%
12	1035.132	RHS	OUTER	Transverse Joint	834.7	59.0	0.122	0.110	89.5%
13	1034.981	RHS	INNER	Transverse Joint	860.4	60.8	0.124	0.116	93.9%
14	1034.840	RHS	OUTER	Transverse Joint	839.4	59.4	0.122	0.109	89.3%
15	1034.558	RHS	OUTER	Transverse Joint	853.7	60.4	0.123	0.112	90.8%
16	1034.478	RHS	INNER	Transverse Joint	871.4	61.6	0.122	0.106	87.2%
17	1034.090	RHS	OUTER	Transverse Joint	844.4	59.7	0.123	0.113	92.0%
18	1034.029	RHS	INNER	Transverse Joint	845.9	59.8	0.123	0.114	92.8%
19	1033.785	RHS	OUTER	Transverse Joint	839.7	59.4	0.123	0.114	92.3%
20	1031.735	RHS	OUTER	Transverse Joint	839.4	59.4	0.123	0.114	92.4%
21	1031.602	RHS	OUTER	Transverse Joint	835.8	59.1	0.122	0.109	89.3%
22	1031.478	RHS	INNER	Transverse Joint	846.1	59.8	0.124	0.117	94.8%
23	1031.090	RHS	OUTER	Transverse Joint	841.5	59.5	0.120	0.099	82.3%
24	1030.963	RHS	INNER	Transverse Joint	852.2	60.3	0.124	0.117	94.5%
25	1030.838	RHS	OUTER	Transverse Joint	850.0	60.1	0.122	0.108	88.5%
26	1030.581	RHS	OUTER	Transverse Joint	846.5	59.9	0.123	0.110	89.8%
27	1030.480	RHS	INNER	Transverse Joint	854.1	60.4	0.122	0.106	86.8%
28	1030.039	RHS	OUTER	Transverse Joint	842.1	59.5	0.122	0.106	87.0%
29	1029.968	RHS	INNER	Transverse Joint	833.6	58.9	0.122	0.109	88.8%
30	1029.795	RHS	OUTER	Transverse Joint	840.1	59.4	0.123	0.114	92.2%
31	1029.556	RHS	OUTER	Transverse Joint	848.8	60.0	0.122	0.107	87.7%

S. No.	Chainage	Side	Lane	Test Point Location	Pressure	Load	0	300	LTE %
					N/mm2	KN	Loaded Slab	Unloaded Slab	
32	1029.469	RHS	INNER	Transverse Joint	841.5	59.5	0.124	0.119	95.6%
33	1029.063	RHS	OUTER	Transverse Joint	835.3	59.1	0.122	0.110	89.5%
34	1028.458	RHS	INNER	Transverse Joint	864.0	61.1	0.122	0.106	87.0%
35	1028.087	RHS	OUTER	Transverse Joint	841.9	59.5	0.123	0.110	90.0%
36	1027.974	RHS	INNER	Transverse Joint	853.6	60.4	0.123	0.115	92.9%
37	1027.808	RHS	OUTER	Transverse Joint	833.9	59.0	0.124	0.117	94.8%
38	1027.542	RHS	OUTER	Transverse Joint	840.9	59.5	0.124	0.118	95.2%
39	1027.470	RHS	INNER	Transverse Joint	876.9	62.0	0.123	0.115	93.0%
40	1027.102	RHS	OUTER	Transverse Joint	829.0	58.6	0.123	0.115	93.5%
41	1026.960	RHS	INNER	Transverse Joint	824.9	58.3	0.122	0.108	88.1%
42	1026.800	RHS	OUTER	Transverse Joint	828.6	58.6	0.123	0.114	92.6%
43	1026.592	RHS	OUTER	Transverse Joint	835.4	59.1	0.123	0.112	91.2%
44	1026.478	RHS	INNER	Transverse Joint	873.1	61.7	0.123	0.114	92.6%
45	1026.096	RHS	OUTER	Transverse Joint	839.3	59.3	0.123	0.111	90.6%
46	1025.981	RHS	INNER	Transverse Joint	851.2	60.2	0.124	0.120	96.4%
47	1025.822	RHS	OUTER	Transverse Joint	838.7	59.3	0.122	0.108	88.7%
48	1025.548	RHS	OUTER	Transverse Joint	836.2	59.1	0.123	0.111	90.6%
49	1025.421	RHS	INNER	Transverse Joint	843.0	59.6	0.124	0.117	94.9%
50	1024.051	RHS	OUTER	Transverse Joint	845.1	59.8	0.122	0.108	88.7%
51	1023.974	RHS	INNER	Transverse Joint	862.9	61.0	0.124	0.117	94.6%
52	1023.842	RHS	OUTER	Transverse Joint	832.6	58.9	0.121	0.102	84.3%
53	1023.565	RHS	OUTER	Transverse Joint	845.0	59.8	0.123	0.111	90.3%
54	1023.467	RHS	INNER	Transverse Joint	824.8	58.3	0.123	0.112	90.8%
55	1023.086	RHS	OUTER	Transverse Joint	841.5	59.5	0.121	0.102	84.4%
56	1022.974	RHS	INNER	Transverse Joint	865.3	61.2	0.122	0.109	89.3%
57	1022.844	RHS	OUTER	Transverse Joint	839.1	59.3	0.123	0.112	91.1%
58	1022.611	RHS	OUTER	Transverse Joint	837.6	59.2	0.123	0.110	89.9%
59	1022.471	RHS	INNER	Transverse Joint	858.9	60.7	0.124	0.116	94.2%
60	1022.115	RHS	OUTER	Transverse Joint	850.7	60.2	0.123	0.111	90.2%
61	1021.972	RHS	INNER	Transverse Joint	851.4	60.2	0.123	0.114	92.8%
62	1021.850	RHS	OUTER	Transverse Joint	842.3	59.6	0.122	0.110	89.7%

S. No.	Chainage	Side	Lane	Test Point Location	Pressure	Load	0	300	LTE %
					N/mm2	KN	Loaded Slab	Unloaded Slab	
63	1021.599	RHS	OUTER	Transverse Joint	845.3	59.8	0.122	0.106	87.1%
64	1021.473	RHS	INNER	Transverse Joint	831.1	58.8	0.124	0.116	94.1%
65	1021.107	RHS	OUTER	Transverse Joint	825.3	58.4	0.122	0.110	89.6%
66	1020.974	RHS	INNER	Transverse Joint	846.4	59.9	0.124	0.118	95.1%
67	1020.786	RHS	OUTER	Transverse Joint	854.1	60.4	0.122	0.107	87.5%
68	1020.540	RHS	OUTER	Transverse Joint	840.1	59.4	0.123	0.112	91.4%
69	1020.473	RHS	INNER	Transverse Joint	855.8	60.5	0.123	0.112	91.4%
70	1020.100	RHS	OUTER	Transverse Joint	840.9	59.5	0.122	0.106	86.8%
71	1019.960	RHS	INNER	Transverse Joint	843.6	59.7	0.123	0.111	90.4%
72	1019.852	RHS	OUTER	Transverse Joint	840.0	59.4	0.121	0.102	84.3%
73	1019.619	RHS	OUTER	Transverse Joint	854.9	60.5	0.122	0.106	87.1%
74	1019.486	RHS	INNER	Transverse Joint	844.8	59.7	0.121	0.103	84.9%
75	1019.073	RHS	OUTER	Transverse Joint	842.6	59.6	0.121	0.104	86.0%
76	1018.961	RHS	INNER	Transverse Joint	846.8	59.9	0.122	0.110	89.5%
77	1018.830	RHS	OUTER	Transverse Joint	841.0	59.5	0.123	0.112	91.1%
78	1018.592	RHS	OUTER	Transverse Joint	836.4	59.1	0.122	0.107	87.5%
79	1018.471	RHS	INNER	Transverse Joint	840.0	59.4	0.122	0.109	89.3%
80	1018.085	RHS	OUTER	Transverse Joint	838.2	59.3	0.121	0.105	86.2%
81	1017.956	RHS	INNER	Transverse Joint	845.7	59.8	0.122	0.108	88.2%
82	1017.828	RHS	OUTER	Transverse Joint	843.3	59.6	0.123	0.112	91.0%
83	1017.548	RHS	OUTER	Transverse Joint	846.1	59.8	0.123	0.113	92.2%
84	1017.505	RHS	INNER	Transverse Joint	845.6	59.8	0.123	0.113	91.9%
85	1017.060	RHS	OUTER	Transverse Joint	843.3	59.6	0.123	0.112	91.0%
86	1016.972	RHS	INNER	Transverse Joint	844.2	59.7	0.122	0.105	86.5%
87	1016.850	RHS	OUTER	Transverse Joint	848.1	60.0	0.122	0.106	86.9%
88	1016.616	RHS	OUTER	Transverse Joint	848.9	60.0	0.123	0.112	91.2%
89	1016.476	RHS	INNER	Transverse Joint	842.4	59.6	0.123	0.110	89.9%
90	1016.127	RHS	OUTER	Transverse Joint	823.4	58.2	0.122	0.108	88.4%
91	1015.963	RHS	INNER	Transverse Joint	850.4	60.1	0.121	0.104	85.7%
92	1015.793	RHS	OUTER	Transverse Joint	848.8	60.0	0.121	0.105	86.1%
93	1015.542	RHS	OUTER	Transverse Joint	846.4	59.9	0.123	0.114	92.3%

S. No.	Chainage	Side	Lane	Test Point Location	Pressure	Load	0	300	LTE %
					N/mm2	KN	Loaded Slab	Unloaded Slab	
94	1015.478	RHS	INNER	Transverse Joint	843.8	59.7	0.122	0.106	86.8%
95	1015.089	RHS	OUTER	Transverse Joint	841.6	59.5	0.123	0.110	90.1%
96	1014.962	RHS	INNER	Transverse Joint	848.0	60.0	0.121	0.101	84.0%
97	1014.804	RHS	OUTER	Transverse Joint	827.4	58.5	0.122	0.109	89.5%
98	1014.564	RHS	OUTER	Transverse Joint	839.6	59.4	0.123	0.113	92.2%
99	1014.496	RHS	INNER	Transverse Joint	822.9	58.2	0.122	0.110	89.5%
100	1014.061	RHS	OUTER	Transverse Joint	846.3	59.8	0.122	0.105	86.3%
101	1013.964	RHS	INNER	Transverse Joint	840.8	59.5	0.122	0.106	87.3%
102	1013.830	RHS	OUTER	Transverse Joint	846.1	59.8	0.121	0.101	84.0%
103	1013.553	RHS	OUTER	Transverse Joint	837.5	59.2	0.122	0.110	89.7%
104	1013.473	RHS	INNER	Transverse Joint	832.2	58.8	0.122	0.108	88.6%
105	1013.083	RHS	OUTER	Transverse Joint	842.4	59.6	0.123	0.111	90.8%
106	1012.975	RHS	INNER	Transverse Joint	840.1	59.4	0.122	0.109	89.2%

Table 4.11: Load Transfer Efficiency of Tie Bars

S. No.	Chainage	Side	Lane	Test Point Location	Pressure	Load	0	300	LTE %
					N/mm2	KN	Loaded Slab	Unloaded Slab	
Kaljhar – Patrakuchi Section (LHS)									
1	1024.504	LHS	INNER	Longitudinal Joint	838.2	59.3	0.121	0.102	84.3%
2	1024.548	LHS	OUTER	Longitudinal Joint	829.0	58.6	0.123	0.112	91.2%
3	1024.844	LHS	INNER	Longitudinal Joint	845.0	59.8	0.122	0.108	88.5%
4	1025.015	LHS	OUTER	Longitudinal Joint	868.9	61.4	0.123	0.111	90.6%
5	1025.116	LHS	INNER	Longitudinal Joint	854.0	60.4	0.122	0.108	88.2%
6	1025.859	LHS	OUTER	Longitudinal Joint	849.7	60.1	0.122	0.109	89.0%
7	1025.98	LHS	INNER	Longitudinal Joint	846.1	59.8	0.122	0.106	86.9%
8	1026.105	LHS	OUTER	Longitudinal Joint	854.3	60.4	0.121	0.104	85.5%
9	1026.413	LHS	INNER	Longitudinal Joint	840.1	59.4	0.122	0.106	87.3%
10	1037.49	LHS	OUTER	Longitudinal Joint	860.2	60.8	0.122	0.109	88.9%
11	1037.618	LHS	INNER	Longitudinal Joint	857.9	60.7	0.123	0.113	91.8%
12	1037.865	LHS	OUTER	Longitudinal Joint	852.6	60.3	0.123	0.112	91.3%
13	1038.012	LHS	INNER	Longitudinal Joint	848.5	60.0	0.121	0.104	85.9%
14	1038.113	LHS	OUTER	Longitudinal Joint	863.5	61.1	0.123	0.113	91.8%

S. No.	Chainage	Side	Lane	Test Point Location	Pressure	Load	0	300	LTE %
					N/mm2	KN	Loaded Slab	Unloaded Slab	
15	1038.663	LHS	INNER	Longitudinal Joint	847.6	59.9	0.122	0.110	89.6%
16	1039.507	LHS	OUTER	Longitudinal Joint	846.0	59.8	0.123	0.112	90.9%
17	1039.605	LHS	INNER	Longitudinal Joint	867.8	61.4	0.122	0.108	88.1%
18	1039.821	LHS	OUTER	Longitudinal Joint	852.1	60.3	0.123	0.110	90.1%
19	1039.985	LHS	INNER	Longitudinal Joint	861.5	60.9	0.122	0.107	87.8%
20	1040.178	LHS	OUTER	Longitudinal Joint	842.3	59.6	0.122	0.109	88.9%
Patrakuchi -Kaljhar Section (RHS)									
1	1037.492	RHS	INNER	Longitudinal Joint	804.1	56.9	0.123	0.112	90.9%
2	1037.116	RHS	OUTER	Longitudinal Joint	834.5	59.0	0.123	0.113	91.8%
3	1036.997	RHS	INNER	Longitudinal Joint	847.3	59.9	0.123	0.111	90.6%
4	1036.84	RHS	OUTER	Longitudinal Joint	839.5	59.4	0.122	0.109	89.3%
5	1036.566	RHS	OUTER	Longitudinal Joint	839.7	59.4	0.123	0.112	91.4%
6	1036.491	RHS	INNER	Longitudinal Joint	851.1	60.2	0.123	0.116	93.6%
7	1036.135	RHS	OUTER	Longitudinal Joint	833.5	58.9	0.123	0.112	90.9%
8	1035.995	RHS	INNER	Longitudinal Joint	851.3	60.2	0.122	0.108	88.4%
9	1035.814	RHS	OUTER	Longitudinal Joint	829.7	58.7	0.122	0.109	89.1%
10	1035.591	RHS	OUTER	Longitudinal Joint	841.5	59.5	0.123	0.114	92.5%
11	1035.49	RHS	INNER	Longitudinal Joint	843.6	59.7	0.124	0.118	95.2%
12	1035.153	RHS	OUTER	Longitudinal Joint	838.7	59.3	0.122	0.109	89.2%
13	1035.006	RHS	INNER	Longitudinal Joint	869.7	61.5	0.122	0.109	89.0%
14	1034.861	RHS	OUTER	Longitudinal Joint	845.2	59.8	0.122	0.107	87.8%
15	1034.579	RHS	OUTER	Longitudinal Joint	840.8	59.5	0.123	0.114	92.5%
16	1034.504	RHS	INNER	Longitudinal Joint	836.4	59.1	0.122	0.108	88.5%
17	1034.112	RHS	OUTER	Longitudinal Joint	842.8	59.6	0.123	0.115	92.9%
18	1034.054	RHS	INNER	Longitudinal Joint	845.7	59.8	0.122	0.107	87.7%
19	1033.806	RHS	OUTER	Longitudinal Joint	828.0	58.5	0.123	0.112	91.5%
20	1031.756	RHS	OUTER	Longitudinal Joint	839.4	59.4	0.123	0.114	92.2%
21	1031.623	RHS	OUTER	Longitudinal Joint	851.6	60.2	0.123	0.110	89.9%
22	1031.503	RHS	INNER	Longitudinal Joint	862.9	61.0	0.122	0.106	87.1%
23	1031.112	RHS	OUTER	Longitudinal Joint	840.5	59.4	0.122	0.107	88.0%
24	1030.989	RHS	INNER	Longitudinal Joint	857.4	60.6	0.122	0.106	87.1%

S. No.	Chainage	Side	Lane	Test Point Location	Pressure	Load	0	300	LTE %
					N/mm2	KN	Loaded Slab	Unloaded Slab	
25	1030.86	RHS	OUTER	Longitudinal Joint	831.0	58.8	0.123	0.110	90.0%
26	1030.602	RHS	OUTER	Longitudinal Joint	849.4	60.1	0.122	0.106	87.3%
27	1030.505	RHS	INNER	Longitudinal Joint	850.7	60.2	0.122	0.108	88.8%
28	1030.06	RHS	OUTER	Longitudinal Joint	845.9	59.8	0.122	0.107	87.8%
29	1029.993	RHS	INNER	Longitudinal Joint	823.6	58.2	0.123	0.113	91.6%
30	1029.816	RHS	OUTER	Longitudinal Joint	841.1	59.5	0.122	0.108	88.5%
31	1029.577	RHS	OUTER	Longitudinal Joint	844.6	59.7	0.122	0.107	88.1%
32	1029.494	RHS	INNER	Longitudinal Joint	825.7	58.4	0.124	0.117	94.4%
33	1029.085	RHS	OUTER	Longitudinal Joint	847.9	60.0	0.122	0.109	89.3%
34	1028.483	RHS	INNER	Longitudinal Joint	837.7	59.2	0.124	0.117	94.4%
35	1028.108	RHS	OUTER	Longitudinal Joint	840.4	59.4	0.123	0.111	90.3%
36	1027.999	RHS	INNER	Longitudinal Joint	858.0	60.7	0.123	0.113	91.7%
37	1027.829	RHS	OUTER	Longitudinal Joint	839.9	59.4	0.122	0.108	88.6%
38	1027.563	RHS	OUTER	Longitudinal Joint	831.4	58.8	0.122	0.109	89.4%
39	1027.496	RHS	INNER	Longitudinal Joint	843.2	59.6	0.124	0.117	94.4%
40	1027.123	RHS	OUTER	Longitudinal Joint	846.7	59.9	0.122	0.106	86.8%
41	1026.986	RHS	INNER	Longitudinal Joint	853.4	60.3	0.124	0.117	94.9%
42	1026.821	RHS	OUTER	Longitudinal Joint	849.3	60.1	0.122	0.106	87.0%
43	1026.613	RHS	OUTER	Longitudinal Joint	838.0	59.3	0.124	0.118	95.2%
44	1026.503	RHS	INNER	Longitudinal Joint	845.7	59.8	0.122	0.107	87.7%
45	1026.118	RHS	OUTER	Longitudinal Joint	837.9	59.3	0.123	0.113	91.9%
46	1026.006	RHS	INNER	Longitudinal Joint	877.5	62.1	0.123	0.114	92.5%
47	1025.843	RHS	OUTER	Longitudinal Joint	824.6	58.3	0.123	0.112	91.4%
48	1025.569	RHS	OUTER	Longitudinal Joint	836.5	59.2	0.122	0.109	89.1%
49	1025.446	RHS	INNER	Longitudinal Joint	847.9	60.0	0.123	0.112	91.2%
50	1024.072	RHS	OUTER	Longitudinal Joint	846.7	59.9	0.122	0.108	88.7%
51	1023.999	RHS	INNER	Longitudinal Joint	838.5	59.3	0.124	0.116	93.9%
52	1023.863	RHS	OUTER	Longitudinal Joint	847.1	59.9	0.123	0.115	93.0%
53	1023.586	RHS	OUTER	Longitudinal Joint	843.5	59.6	0.122	0.107	88.1%
54	1023.493	RHS	INNER	Longitudinal Joint	867.7	61.4	0.122	0.108	88.2%
55	1023.107	RHS	OUTER	Longitudinal Joint	847.9	60.0	0.122	0.107	87.5%

S. No.	Chainage	Side	Lane	Test Point Location	Pressure	Load	0	300	LTE %
					N/mm2	KN	Loaded Slab	Unloaded Slab	
56	1022.999	RHS	INNER	Longitudinal Joint	829.6	58.7	0.123	0.111	90.7%
57	1022.865	RHS	OUTER	Longitudinal Joint	832.7	58.9	0.122	0.107	87.5%
58	1022.632	RHS	OUTER	Longitudinal Joint	844.6	59.7	0.122	0.108	88.4%
59	1022.497	RHS	INNER	Longitudinal Joint	858.0	60.7	0.124	0.117	94.7%
60	1022.136	RHS	OUTER	Longitudinal Joint	843.8	59.7	0.123	0.112	90.9%
61	1021.998	RHS	INNER	Longitudinal Joint	855.3	60.5	0.124	0.118	95.6%
62	1021.871	RHS	OUTER	Longitudinal Joint	850.5	60.1	0.121	0.102	84.4%
63	1021.621	RHS	OUTER	Longitudinal Joint	839.5	59.4	0.123	0.111	90.5%
64	1021.498	RHS	INNER	Longitudinal Joint	866.4	61.3	0.123	0.114	92.2%
65	1021.129	RHS	OUTER	Longitudinal Joint	852.0	60.2	0.119	0.093	78.3%
66	1021	RHS	INNER	Longitudinal Joint	873.5	61.8	0.123	0.114	92.3%
67	1020.807	RHS	OUTER	Longitudinal Joint	842.6	59.6	0.122	0.110	89.6%
68	1020.561	RHS	OUTER	Longitudinal Joint	835.3	59.1	0.121	0.103	85.1%
69	1020.499	RHS	INNER	Longitudinal Joint	851.5	60.2	0.122	0.109	88.8%
70	1020.121	RHS	OUTER	Longitudinal Joint	830.3	58.7	0.122	0.107	87.9%
71	1019.986	RHS	INNER	Longitudinal Joint	845.3	59.8	0.123	0.112	91.3%
72	1019.873	RHS	OUTER	Longitudinal Joint	841.7	59.5	0.124	0.116	93.8%
73	1019.64	RHS	OUTER	Longitudinal Joint	842.2	59.6	0.123	0.111	90.3%
74	1019.511	RHS	INNER	Longitudinal Joint	832.8	58.9	0.123	0.110	89.9%
75	1019.094	RHS	OUTER	Longitudinal Joint	835.1	59.1	0.122	0.106	87.0%
76	1018.986	RHS	INNER	Longitudinal Joint	831.0	58.8	0.121	0.104	86.1%
77	1018.851	RHS	OUTER	Longitudinal Joint	850.6	60.1	0.123	0.111	90.3%
78	1018.613	RHS	OUTER	Longitudinal Joint	846.0	59.8	0.123	0.111	90.3%
79	1018.497	RHS	INNER	Longitudinal Joint	836.1	59.1	0.122	0.107	88.0%
80	1018.107	RHS	OUTER	Longitudinal Joint	833.4	58.9	0.122	0.108	88.6%
81	1017.982	RHS	INNER	Longitudinal Joint	844.1	59.7	0.122	0.110	89.6%
82	1017.849	RHS	OUTER	Longitudinal Joint	840.0	59.4	0.123	0.110	89.8%
83	1017.569	RHS	OUTER	Longitudinal Joint	840.1	59.4	0.122	0.107	87.7%
84	1017.531	RHS	INNER	Longitudinal Joint	842.8	59.6	0.122	0.109	88.9%
85	1017.081	RHS	OUTER	Longitudinal Joint	846.8	59.9	0.123	0.115	93.0%
86	1016.997	RHS	INNER	Longitudinal Joint	856.9	60.6	0.122	0.107	87.8%

S. No.	Chainage	Side	Lane	Test Point Location	Pressure	Load	0	300	LTE %
					N/mm2	KN	Loaded Slab	Unloaded Slab	
87	1016.872	RHS	OUTER	Longitudinal Joint	838.2	59.3	0.123	0.114	92.2%
88	1016.637	RHS	OUTER	Longitudinal Joint	839.7	59.4	0.122	0.108	88.5%
89	1016.501	RHS	INNER	Longitudinal Joint	830.7	58.7	0.124	0.117	94.4%
90	1016.148	RHS	OUTER	Longitudinal Joint	833.9	59.0	0.123	0.111	90.1%
91	1015.988	RHS	INNER	Longitudinal Joint	844.7	59.7	0.122	0.107	88.0%
92	1015.814	RHS	OUTER	Longitudinal Joint	843.4	59.6	0.122	0.109	89.2%
93	1015.563	RHS	OUTER	Longitudinal Joint	845.1	59.8	0.123	0.111	90.2%
94	1015.504	RHS	INNER	Longitudinal Joint	841.3	59.5	0.123	0.111	90.2%
95	1015.11	RHS	OUTER	Longitudinal Joint	840.7	59.5	0.123	0.113	91.5%
96	1014.988	RHS	INNER	Longitudinal Joint	851.4	60.2	0.123	0.112	91.2%
97	1014.826	RHS	OUTER	Longitudinal Joint	841.4	59.5	0.122	0.108	88.7%
98	1014.585	RHS	OUTER	Longitudinal Joint	836.5	59.2	0.123	0.110	89.9%
99	1014.522	RHS	INNER	Longitudinal Joint	857.9	60.7	0.123	0.111	90.2%
100	1014.082	RHS	OUTER	Longitudinal Joint	835.2	59.1	0.121	0.104	85.9%
101	1013.99	RHS	INNER	Longitudinal Joint	852.7	60.3	0.123	0.111	90.6%
102	1013.851	RHS	OUTER	Longitudinal Joint	849.3	60.1	0.123	0.111	90.1%
103	1013.574	RHS	OUTER	Longitudinal Joint	830.0	58.7	0.122	0.109	89.2%
104	1013.499	RHS	INNER	Longitudinal Joint	838.9	59.3	0.123	0.110	89.8%
105	1013.104	RHS	OUTER	Longitudinal Joint	828.5	58.6	0.121	0.102	84.6%
106	1013.001	RHS	INNER	Longitudinal Joint	854.7	60.4	0.121	0.104	86.0%

- Due to the presence of longitudinal cracks. Corner breaks, multiple cracks, there is loss of flexural strength of PQC slab. Considering the same, suitable repair and rehabilitation measures recommended as per the present performance of the pavement in the form of panel replacement, joint sealing and other suitable repairs to improve the life of the pavement..
- Load Transfer Efficiency (LTE) for Transverse joints is more than 50% for both LHS & RHS direction except few locations on LHS.
- Load Transfer Efficiency (LTE) for Longitudinal joints is more than 90% for both LHS & RHS direction so, the joint system is adequate in load transfer.

4.5 Drone Videography of Entire Stretch

Videography of entire Project Stretch is captured through Drone cameras flown at about 40m above ground at a speed of 35 km/hr. This is useful for observing various features of Project Stretch from bird's eye level.

Section 5: Review of Documents

5.1 General

Technical Consultant (TC), since the start of technical due diligence study, has requested for various documents from the Client. A list of documents required were shared with the Client before TC team started the study which was appended with few more queries after the conclusion of the site visit once the project site is appraised. Most of the queries were also discussed with the Client in many meetings. This section of the report deals with the documents requested by TC and its review along with highlighting major issues found during this review.

5.2 Documents Collected and Reviewed

List of documents requested, received and reviewed are given below:

S. No.	List of Documents	Status of Documents	Remarks on Review
DOCUMENTS RELATED TO CURRENT ACQUISITION			
1.	Concession Agreement	Not Available	Though CA for round 4 roads are not available, CA available for round 3 roads are referred for this technical due diligence study.
2.	Schedules	Technical Schedule Available	Technical schedules were shared with TC on 15th Dec – 2023. Later revised technical schedule were shared on 2nd Jan – 2024. These schedules are modified from the standard provisions given in manual as below: Sch A: Existing features Sch B: Scope of Work including facilities to be provided Sch C: Specifications and Standards Sch F: Maintenance Requirements Table 1 of Sch F provides maintenance criteria for pavements which has performance parameter, desirable and acceptable level of service, frequency of inspection and time limit for rectification/repair. Sch F specifies roughness value as 2000 mm/km desirable and 2400mm/km acceptable for flexible pavement. These values are 2200mm/km and 2400 mm/km respectively for rigid pavement. Updated schedule stipulates that "*The Initial Repair and Rehabilitation of Pavement and Structure shall be done Authority by December 2024 and after initial improvement, InvIT Concessionaire shall maintain the project Stretch as per Schedule B and Schedule F requirements*". Thus, it is understood that initial maintenance cost is not in the scope of the Invit Concessionaire.
3.	Final Feasibility Report	Not Available	
4.	FWD data	Not Available	

S. No.	List of Documents	Status of Documents	Remarks on Review
5.	Latest MPRs	Not available	
6.	Maintenance History	Not available	There is no maintenance history of the project road post completion of 4-laining. It is also understood that no major maintenance has been done on the project after the completion of 4-laning.
7.	O&M Agreement	Not available	NHAI is doing the maintenance and toll collection. No maintenance agreement was made available,
8.	NSV data	Not Available	
9.	AADT for each section and Growth rate	Available	AADT along with traffic projections for the project roads have been provided by Client.
10.	Details of flyover proposed by NHAI which is under implementation stage and its construction and maintenance schedule.	Available	TC during the site visit collected the document pertaining to the ongoing construction undertaken by EPC contractor of NHAI. it reflects that construction of the flyover shall be completed by July 2024. EPC CA indicates DLP cum maintenance period of 10 years.
11.	Concession Period	Not available	TC has adopted 20 years concession period with reference to round 3 CA.
12.	Projected Escalation factor	Not available	In absence of projected escalation factor, all cost are given at the present rate as per direction of the Client.

5.3 Key Technical Issues

The major findings from visual assessment, available documents, from the discussion with maintenance and operation team at site and other local enquiries are listed below. The advisor will explore these further and same shall be presented in the Draft Due Diligence Report.

5.3.1 Under Construction Flyover at Km 1032+840 (Pathsala)

A flyover and its approaches is being constructed by NHAI on EPC mode at Patshala from km 1032+530 to km 1033+470, a total length of 940m with 3 span viaduct of 100m length. As on 27th October 2023, substructures, i.e. up to pier caps, were almost completed for both the carriageways except for 2 nos of pier caps on LHS carriageway. Girders are to be pre-cast and around 13 nos out of 30 nos were already casted near the construction site. RE wall construction at Bongegaon side approach were in progress whereas embankment construction was in progress towards Guwahati side approach. Construction is expected to be completed by June 2024 and there is 10 years maintenance period post construction.

5.3.2 Major Bridge at Km 1025+540 LHS

LHS is the new constructed bridge at the time of 4-laning. It has 4 girders system whereas old bridge has 6 girders, thus more depth of superstructure of new bridge. As FRL of both side of the bridges are kept same, soffit level of the LHS bridge is below the RHS bridge (approx. 600mm). From the local enquiry, it came to our notice that water reaches up to 1 ft from the girder bottom during the monsoon. This is not only resulting damage for the bearing, debris flowing with the flood water may damage the superstructure also. Moreover, local people told that due to obstruction in waterway, there are water logging around the area during flooding.

Figure 5.1: Soffit level of Major Bridge @ 1025+540

5.3.3 Minor Bridge at Km 1023+180 RHS

Return wall for the minor bridge @ 1023+180 RHS towards Bongegaon side is failed and require reconstruction.

Figure 5.2: Retaining Wall Damaged at Minor Bridge @ 1023+180 RHS

5.3.4 Pavement and Road Condition

There is no major maintenance activity carried out so far in the project corridor resulting significant deterioration of pavement where it has been observed with various distress like ravelling, alligator cracks, potholes etc. for flexible pavement and wide longitudinal/transverse cracks, sealant damage, widening of joints were noted for the rigid pavement from the site reconnaissance.

A considerable number of rigid panels are having high severity cracks, which perhaps may requires full depth replacement.

Immediate Repair and Rehabilitation of pavement for both flexible and rigid is required as part of initial improvement works by adopting suitable rehabilitation strategies based on the outcome of present engineering surveys and investigations so that service life of the pavement structure can be increased. However, as per the technical schedule B, the initial repair and rehabilitation of pavement and structures shall be done by Authority.

5.3.5 Minor Bridge

During the development of the project old minor bridges were retained. These structures are with mostly RCC/PSC solid slab/girder type with 2 lane configuration without paved shoulder. All new minor bridges are RCC/PSC solid slab/girder with 2 lane configuration and footpath.

At few locations porous concrete surface observed in substructure of bridges particularly in old structures.

Expansion joints are found damage in some of the bridges.

Wearing course needs to be replaced for almost all minor bridges.

Some Minor Bridges are currently with RCC handrails. These are to be replaced with concrete crash barrier.

5.3.6 Toll Plaza/Toll Management System

Existing TMS is not as per the codal requirements or as per industry norms.

Section 6: Capital Expenditure (CapEx) Requirement

6.1 New Construction

Schedule B of each stretch specifies the requirements of new construction which the concessionaire has to construct after the appointment date. Major works and reference used to quantify these construction requirements are listed below:

1. Improvement of existing service/slip road (signboard and marking)
2. Entry /exit arrangements of service road
3. Redesign of junction
4. Acceleration/Deceleration of junction & New Minor junction
5. Improvement of junction (signboard and marking)
6. New Median opening
7. Close existing median opening
8. Storage lane on existing median opening
9. Improvement of median opening (signboard and marking)
10. Truck lay bye sign board
11. Admin Building
12. Toilet block near toll plaza
13. Traffic aid post
14. Transverse Bar Marking
15. Metal Beam crash barrier
16. Solar Blinker
17. Pedestrian guard rail
18. Police assistant jeep
19. Toll plaza management system
20. Highway lighting

New construction Scope specified for each stretch is tabulated below:

Table 6.1: New Construction Requirements

S. No.	Description	Unit	Quantum
1	Improvement of existing service/slip road, junction and median opening		
i)	Hazard marker sign	No.	15
ii)	Pass either sign	No.	2
iii)	Merge sign	No.	5
iv)	Chevron marking	No.	7

S. No.	Description	Unit	Quantum
v)	Stop sign	No.	32
vi)	Advance direction sign	No.	6
vii)	Stop sign	No.	32
viii)	Rumble strip sign	No.	32
ix)	Junction sign	No.	32
x)	Flag sign	No.	32
xi)	Median opening sign	No.	6
2	Entry /Exit arrangements of service road	No.	4
3	Redesign of junction	No.	3
4	Acceleration/Deceleration of junction& New Minor junction	No.	9
5	New Median opening	No.	4
6	Close median opening	No.	7
7	Storage lane on existing median opening	No.	7
8	Truck lay bye sign board	No.	4
9	Admin Building at toll plaza	No.	1
10	Toilet block near toll plaza	No.	2
11	Traffic aid post	Sqm	25
12	Transverse Bar Marking	Job	Median opening/toll plaza/ grade separated
13	Metal Beam crash barrier	Lm.	5380
14	Solar Blinker cantilever type	No.	46
14	Pedestrian guard rail	Lm.	3580
16	Police assistant jeep	No.	1
17	Highway lighting	Km	7.78
18	High mast	No.	5
19	TMS equipment	LS	1

Time to complete above construction works is 6 months from the Appointed Date.

6.2 Immediate Maintenance Requirements

Based on the pavement condition and distress identification as explained in above sections of this report, immediate maintenance is required for repair and rehabilitation of existing pavement. Quantum of pavement rehabilitation for the entire project length for both flexible and rigid pavements in terms of length in km are presented below:

Table 6.2: Quantum of Pavement Rehabilitation

Immediate Maintenance	Unit	LHS	RHS
Rigid Pavement			
Replacement of Joint Sealant	Km	Entire Length	Entire Length
Diamond grooving after Diamond grinding	Km	Entire Length	Entire Length
Crack sealing with epoxy	Lm	140	1440
Partial depth repair	Nos	42	113
Panel Replacement	Nos.	82	168

Immediate Maintenance	Unit	LHS	RHS
Flexible Pavement			
50mm Milling and 50mm BC Overlay	Km	Entire Length	Entire Length

Replacement of wearing coat and expansion joint are the major items considered for the immediate maintenance requirements of structures. Construction of retaining wall for the minor bridge @ km 1023+180 (RHS) is also considered under immediate maintenance.

6.3 Capital Expenditure (CapEx)

Cost of new construction as per the requirements of Schedule B and immediate maintenance as assessed by the Consultant are considered for capital expenditure. Cost of capital expenditure (CapEx) are presented below.

Table 6.3: Cost of Capital Expenditure (CapEx)

Particulars	Amount in INR Crore
New Construction	
Improvement Works (Schedule - B)	**11.90**
Improvement of existing service/slip road	0.01
Entry /exit arrangements of service road	1.48
Redesign of junction	0.83
Acceleration/Deceleration of junction& New Minor junction	1.91
Improvement of junction (safety)	0.23
New Median opening	1.08
Close median opening	0.14
Storage lane on existing median opening	1.14
Improvement of median opening (safety)	0.01
Truck lay bye sign board	0.001
Admin Building	0.6
Toilet block	0.15
Traffic aid post	0.06
Transverse Bar marking	0.59
Metal Beam crash barrier	1.97
Solar Blinker cantilever type	0.27
Pedestrian guard rail	1.18
Police assistant jeep	0.18
Toll plaza construction cost	0.06
Immediate repair works for Flexible pavement	24.58
Immediate repair works for Rigid pavement	10.04
Immediate repair works for Structure	4.95
Electrical work	8.76
ATMS	9.52
TCMS	2.81
Total including GST (18%)	**72.55**

Section 7: Operation & Maintenance

7.1 General

The O & M requirements for the project facilities are specified in the Concession Agreement (CA) mainly under following Articles/ Schedules:

- Article 15 - Operation and Maintenance
- Article 16 - Monitoring and supervising during Operations
- Article 17 – Traffic Regulation
- Article 18 and Schedule H – Safety Requirements
- Schedule F- Maintenance Requirements

7.2 Requirement as per Concession Agreement

Schedule F of the Concession Agreement sets out the Operation and Maintenance requirements for the Project. As per this schedule, scope for Operation and Maintenance includes but not limited to following obligations:

1. **Improvement** – This includes improvement of the existing assets as per requirement of this Agreement and safety audit.
2. **Maintenance of Civil Works and Assets** – this includes maintenance of civil works and all assets as per requirement of this agreement.
3. **Road Maintenance** – This includes routine maintenance, preventive maintenance, periodic maintenance as per IRC:82-2015, Design overlay as per Manual of 4- laning/6-laning, disaster maintenance, exigencies, and inspections.
4. **Traffic Management** – This includes enforcement of regulations together with the relevant authorities. This also includes hazard response, information gathering and dissemination, Road patrols and ATMS surveillance etc.
5. **Safety** – This includes accident prevention, after care, user education, enforcement, data collection and analysis.
6. **Facility Management** – This includes periodic inspections, routine maintenance, Rehabilitation, and expansion planning.
7. **Road property management** – This includes management of access, encroachment, and ribbon development.
8. **General responsibilities** – This includes budgeting, compliance with legal and accounting requirements, and public relations.
9. Maintaining public relations unit to interface with and attend to suggestions from users of the highway, the media, Govt. agencies and other external agencies.

Routine Maintenance: These are maintenance needs required on daily, weekly, monthly and annual basis for the smooth and efficient running of traffic and includes the activities of minor repairs of all project elements, cleaning of road furnitures, replacement of consumables, horticulture

maintenance, keeping the project site /project facilities clean, tidy and orderly condition free of litters and debris, preventing unauthorized entry and exit including any encroachment etc.

Preventive Maintenance: Preventive maintenance shall include the activities related to each element and the system as a whole of the Project Highway to ensure that during the Concession Period and at its end is in sound, durable and functional condition. In other words Preventive maintenance are a planned strategy of cost-effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system (without significantly increasing the structural capacity).

Periodic Maintenance: These are maintenance needs required on periodic annual basis. The periodic maintenance can be further divided into two sub heads namely (i) functional overlay to improve the riding quality and (ii) structural overlay to improve the structural strength of the pavement.

Factor influencing periodic maintenance: performance parameter for flexible pavement in terms of roughness as given in Schedule F is 2000 mm/km as desirable and 2400 mm/km as acceptable. Clause 4 (III) of Schedule B states that periodic maintenance shall be carried out in full length of the project stretch including main carriageway, service/slip road and at facilities etc. either in every six years or in the year in which roughness index exceeds the limit given in schedule F, whichever comes earlier.

7.3 O&M Cost Estimation

7.3.1 Routine maintenance

This is a ‘day to day’ work that is necessary to preserve and keep a pavement as close to as constructed condition and to ensure smooth and functional conditions all the times. The item in this subhead include maintenance of earthen shoulder, restoration of rain cuts, maintenance of slope protection works, cleaning of road side drains, cleaning of carriageway, maintenance of structures, repairs of road surface such as filling of potholes, repairing of cracks and patch works, carrying out of Road roughness survey, FWD test etc.

7.3.2 Repair/Maintenance

Repair/maintenance covers the minor repair which are required on day to day maintenance to maintain the assets in good condition. This is sub-divided in two categories as below:

a) **Preventive Maintenance:** The preventive maintenance is required to be done for further improve or extend the functional life of pavement surface whist in fair to good condition. Any of the treatment under preventive maintenance does not significantly increasing the structural capacity of pavement rather which decreases rate of surface deterioration, which may result in saving of pavement from leading to poor condition where major maintenance could be inevitable.

   Future preventive maintenance on the project road depends largely on routine inspection of the pavement with careful observation of specific distress and to take a decision at that time and suitable type of preventive maintenance treatment and its timing. All the narrow and wide surface cracks must be arrested immediately after identification with fog/slurry

seals as the most recommend preventive type maintenance measure for the in-service flexible pavement.

Based on the condition and distress identification survey as explained above paragraph, preventive maintenance treatments have to be taken up immediately to reduce rate of further damage to the surface and for enhance the pavement performance to the condition similar to non-distressed surface condition.

b) **Road Property Maintenance:** The items in this subhead covers the plantation/ maintenance of shrubs, turfing, replacement/ repair of damaged railing, crash barrier, kerbs, road delineators, signage, Road marking and painting etc.

7.3.3 Toll Management System

Toll operations cost includes manpower, power, TCMS operation and spares cost etc. Cost estimate for Toll Management System was worked out by TC. Same was presented and discussed in detail with the IM before adopting the rationalised cost finalized by IM.

The requirement of manpower is worked out to function all activity at project road for compliance of CA requirement, toll collection and security of asset. Requirement of manpower is classified into following broad division:

1) Toll collection, Security & Traffic Management: in-house manpower

2) Power and internet connectivity

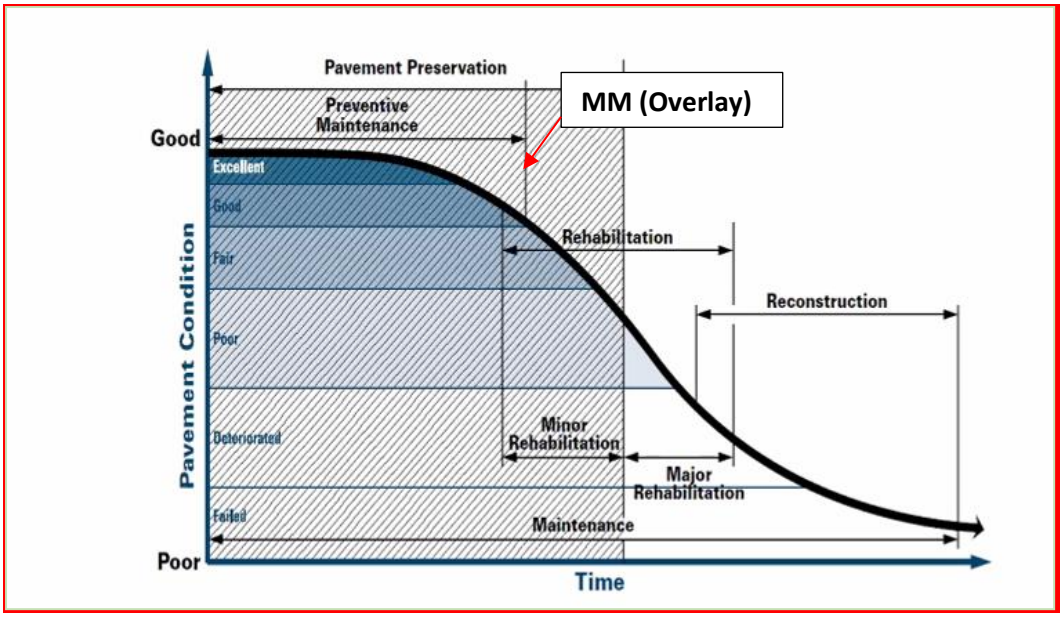
3) Operation Manpower: outsource for providing 24-hour uninterrupted traffic flow at toll plaza and collection of toll.

7.3.4 Corridor Management

Incident Management: The items in this subhead include minimize the effects of incident and restore normal capacity and safety levels to all affected road facilities as efficiently as possible and. repair/ replacement of removing the dead animals & broken-down vehicles etc.

7.4 Major Maintenance

The pavement deteriorates with time caused by traffic movement and weather conditions. The rate of deterioration depends on the original design, type of maintenance being done/undertaken and time of application. Therefore, timely and appropriate maintenance of bituminous surface using suitable materials is essential to increase the pavement service life to a greater extent. Any delay in maintenance of the pavement substantially increase severity of the distresses, which results into a poor condition as depicted in figure below and thereby increase in maintenance costs to bring the surface to a good condition/serviceable level.



Therefore, timely maintenance of the pavement is required for its satisfactory performance both in terms of functionally and structurally during the pavement service life.

Schedule F of the Concession Agreement set out the maintenance requirements in the Project. The performance parameters are indicated in schedule F descripting the nature of defect/deficiency along with time limits for repair/rectification for roads and bridges.

Schedule F, Pavement Roughness Value (Functional Overlay): The Periodic maintenance is required to be provided as and when performance parameters in terms of cracking, roughness and rutting etc. exceeded the limits as indicated in the schedule F anytime during the service life of the pavement. As per the provisions of Concession agreement, Surface roughness value is the major governing factor for selection of an appropriate pavement maintenance treatment required to bring the roughness value below the prescribed limit of 2000mm/km.

Pavement Strengthening (Structural Overlay): When the pavement is structurally deficient having high severity alligator/fatigue cracks, rutting and other associated distresses, then the structural overlay is required to be provided for strengthening of the pavement to cater for the anticipated design traffic. The pavement strengthening may be required when the

i) Remaining life of the in-service pavement as evaluated using Falling Weight Deflectometer (FWD) is less than the calculated design traffic for the design life as intended to consider for strengthening during the concession period.

ii) Before expiry of initial design traffic as adopted at the time of asset construction.

7.4.1.1 *Review of Pavement Design (4-lane Construction)*

The Pavement design for Main Carriageway (combination of flexible and rigid type adopted along the project length) has been designed as per IRC-37-2001 for flexible pavement and IRC:58-2002 for rigid pavement. The flexible type pavement was adopted for service roads.

There are no records made available to pavement design report of 4-lane construction neither in As-built drawings nor other information shared by NHIIPL. However, the based on the information available from the source of IE documents at the time of 4-lane construction, the following composition and thickness was adopted for 4-lane construction.

Main Carriageway (MCW): Flexible Pavement

BC:50mm, DBM:125mm, BM:75mm, WMM:250mm, GSB:250mm and subgrade:500mm, designed for 150MSA with a design CBR of 7%

Service Roads (SR): Flexible Pavement

BC:25mm, BM:75mm, WMM:200mm, GSB:230mm and subgrade:500mm, designed for 2 MSA traffic.

Toll Plaza Rigid pavement

PQC: 300mm M40, DLC 150mm M15 and GSB 200mm with a subgrade of 500mm.

7.4.1.2 Review of Major Maintenance History

There is no detail available regarding type of maintenance/rehabilitation that has been carried out so far in the project after completion of construction.

As per the discussion with local site teams of Authority, there is no major maintenance work that has been carried out so far in the project from the date of traffic opening neither the pavement nor structure/other element of the highway. From the site reconnaissance of the Technical Consultant, it appears that some of the heavily distressed are being repaired manually by applying thin bituminous overlays in the form of patch works. As the project asset has not been maintained to the desired level of serviceability, there is a drop in asset quality in general.

7.4.1.3 Design Traffic during the Concession Period

The design traffic in terms of MSA during the concession period has been calculated based on the current traffic pattern and data shared by the NHIIPL. The Vehicle Damage Factors (VDF) has been adopted as obtained from the present survey. The summary of design traffic during the concession period is as under.

Table 7.1: Summary of Design Traffic during Concession Period

Project Stretch	Direction	Design Traffic in MSA	
		10 years (FY34)	10 years (FY44)
Kaljhar - Pattacharkuchi Section	LHS	42	105
	RHS	39	97

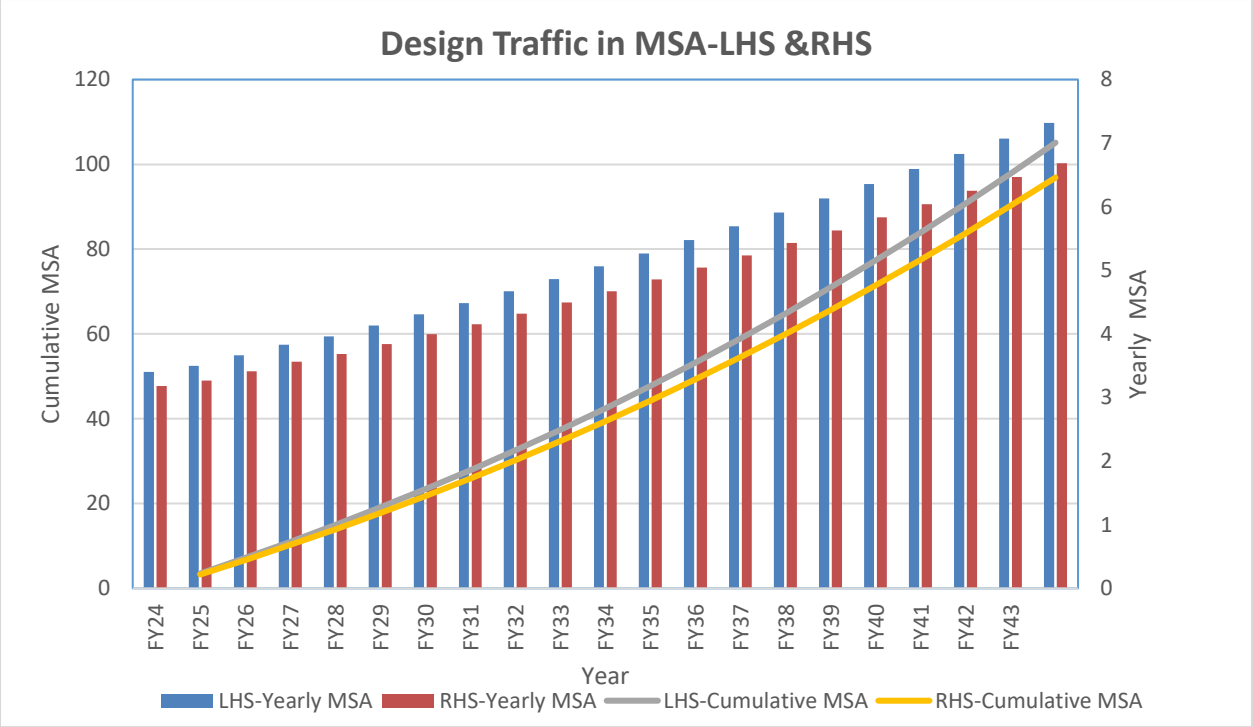


Figure 7.1: Design Traffic in MSA

Based on the above calculated design traffic and remaining life of the existing pavement, the TOT concessionaire is required to carry out the initial and major maintenance works in the form of repair and rehabilitation. However, as per the schedule B, initial repair of pavement will be done by Authority and hence no such initial repairs works are considered in this report. However, major maintenance by Bituminous overlays/PQC repairs is required to be done at every 6th year to bring the pavement surface to the desired level of serviceability.

7.4.1.4 Future Major Maintenance Requirement

Major maintenance is required in order to comply with provisions of concession agreement and to maintain performance levels as defined in schedule F throughout the operation and maintenance period.

As per schedule B, the TOT concessionaire shall carryout the periodic maintenance in full length of the project stretch including main carriageway, service roads and facilities in every 6th year or the year in which roughness index exceeds the limits given in schedule F, whichever comes earlier.

Therefore, considering the initial pavement design period and crust, remaining life data, anticipated traffic loading during the concession period, and in compliance to the provisions of schedule B, the following cycles of Major maintenance is proposed for satisfactory performance of the pavement during operation period for both functionally and structurally.

Table 7.2: Proposed Major Maintenance Cycles for Balance Concession period

S. No.	Year	Description	Recommended improvements MCW	Service/Slip Roads
1	2024/25	Initial repair and rehabilitation of pavement	**Flexible pavement**: Milling to a depth of 50mm and provide 50mm BC overlay for entire length **Rigid Pavement**: Panel replacement: 250 Nos, Partial Depth Repair: 155 Nos of panel, Seal with Epoxy: 1580 m whereas joint sealing, diamond grinding is required for full length.	30mm BC for the entire length
2	2031/32	Periodic Maintenance to improve the roughness as per the provisions of Concession Agreement	**Flexible Pavement:** 40mm BC overlay for entire length **Rigid Pavement:** Sealant replacement for 100% length, 1% for pothole filling and 0.5% for panel replacement and repair of corner breaks for 0.5%.	30mm BC for the entire length
3	2037/38	Periodic Maintenance to improve the roughness and structural integrity to extent the pavement life per the provisions of Concession Agreement	**Flexible Pavement:** Milling to a depth of 50mm and provide a 50mm BC overlay using RAP for entire length **Rigid Pavement:** Sealant replacement for 100% length, 0.5% for pothole filling and 0.5% for panel replacement and diamond grooving for 100% length to restore the skid resistance	30mm BC for the entire length
4	2043/44	Periodic Maintenance to improve the roughness as per the provisions of Concession Agreement	**Flexible Pavement:** 40mm BC overlay for entire length **Rigid Pavement:** Sealant replacement for 100% and 0.5% for panel replacement and repair of corner breaks for 0.5%.	30mm BC for the entire length

7.4.1.5 Structures

As no NDT reports are available and neither design documents stating design life are available it's not feasible to assess life expectancy of existing structures. However, based on the past experiences regarding working life of different structure elements, replacement cycles and major maintenance cost of structures is analysed based on the following:

- Wearing coat replacement every 12th years
- Expansion joint replacement every 12th years
- Elastomeric bearing replacement every 12th years
- POT PTFE Bearing every 20th years.

7.4.1.6 Cost of Operation & Maintenance

Cost of Operation & Maintenance per annum are presented below.

Table 7.3: Cost of Operation & Maintenance (per annum)

Description	INR in Crores
Tolling Operations	3.71
Incident Management	3.32
Routine Maintenance	1.22
Repairs	0.99
ATMS	1.44
Admin Expenses	3.18
Insurance	0.56
Total	**14.42**

7.4.1.7 Periodic Maintenance

Cost of Periodic Maintenance (Base year 2025) including GST, but excluding escalation are presented below.

Table 7.4: Cost of Periodic Maintenance

Year	Periodic Maintenance (INR in Crores)				
	Functional +Structural overlay MCW+ S/R	Major Maintenance of Rigid Pavement	Replacement of ATMS	Replacement of TMS	Structure specified repairs
2031-2032	19.70	11.41	3.81	1.19	15.31
2037-2038	27.16	10.71			1.12
2038-2039			5.90	2.38	
2043-2044	22.05	11.06			
Total	**68.91**	**33.18**	**9.71**	**3.57**	**16.43**
Grand Total					**131.80**

Section 8: Conclusions

The 4-lane construction of project highway has been completed on EPC basis and at present toll is being collected by Toll Collection Agency appointed by NHAI. Tthere is no major maintenance works carried out neither for pavement nor structure/other element of the highway even after several years of traffic opening and thus there is a drop in asset quality to a poor condition. it appears that some of the heavily distressed are being repaired manually by applying thin bituminous overlays in the form of patch works. As part of present study, various physical testing and visual site inspections were conducted to evaluate the asset condition and to establish the required maintenance and rehabilitation measures/decisions. Based on the site reconnaissance, it is appraised that majority of the locations on both of the carriageway is distressed in the form of cracks and potholes for flexible pavement and wide cracks of longitudinal, transverse, joint failures, loss of texture has been observed. Based on the results of physical testing, condition assessment, review of available reports/data, analysis of remaining life data, the project stretch would require immediate repairs and rehabilitation to improve the asset condition. The subsequent period maintenance by functional/structural overlays are required at every 6th year would be sufficient to keep the project stretch in good condition and hence the suitable measures of major maintenance for periodic renewals as required during the concession period has also been suggested based on the present asset condition.

Based upon the site visit for assessment of condition of CD structures including MJB, MNBs, ROB, VUPs and Culverts in the project corridor and observations submitted in various chapters of this report, it is concluded that there are requirements of major repairs in major bridge in terms of inadequate waterway. It is understood that Authority will address this issue before it is handed over to the incoming Concessionaire for maintenance.

NATIONAL HIGHWAYS INFRA INVESTMENT MANAGERS PRIVATE LIMITED

FINAL REPORT

Technical Diligence for Tolling, Operation, Maintenance & Transfer of Lakhnadon to Khawasa (from Km 547+400 to Km 653+770) of NH-44 (old NH-7) in the State of Madhya Pradesh

SAMARTH INFRAENGG Technocrats Private Limited

FEBRUARY 2024

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LIST OF ABBREVIATIONS AND SYMBOLS

AADT	-Average Annual Daily Traffic
AE	-Authority Engineer
AMC	-Annual Maintenance Contract
ATMS	-Advanced Traffic Management System
BC	-Bituminous Concrete
BOQ	-Bill of Quantities
BOT	-Build, Operate & Transfer
CA	-Concession Agreement
CBR	-California Bearing Ratio
CCB	-Concrete Crash Barrier
CCR	-Cement Concrete Railing
COD	-Commercial Operation Date
COS	-Change of scope
CPI	-Consumer Price Index
CUP	-Cattle Underpass
CVC	-Classified Volume Count
CVPD	-Commercial Vehicles per Day
DBM	-Dense Bituminous Concrete

DPR	-Detailed Project Report
ECB	-Emergency Call Box
EPC	-Engineering, Procurement and Construction
ESI	- Employees' State Insurance
FDD	-Filed Dry Density
FOB	-Foot Over Bridge
FRL	-Finished Road Level
FSI	-Free Swell Index
FWD	-Falling Weight Deflectometer
FY	-Financial Year
GOI	- Government of India
GR	-Growth Rates
GS	-Grade Separated
GSB	-Granular Sub Base
GST	-Goods and Services Tax
HCPT	-Half cell Potential Test
HPC	-Hume Pipe Culvert
HR	- Human Resources
HTMS	-Highway Traffic Management Systems
IE	-Independent Engineer
IRC	- Indian Roads Congress
IRC SP	- Indian Roads Congress Special Publications
IRI	-International Roughness Index
Km	-kilometer
LHS	-Left Hand Side
LL	-Liquid Limit
LS	-Lumpsum
m	-Meter
MBIU	-Mobile Bridge Inspection Unit
MCB	-Metal Beam Crash Barrier
MCS	-Micro Surfacing
MCW	-Main Carriageway
MDD	-Maximum Dry Density
MHR	-Metallic Hand Rail
MJB	-Major Bridge
mm	-Millimeter
MM	-Major Maintenance
MNB	-Minor Bridge
MoRT&H	- Ministry of Road Transport & Highways
MPa	-Mega Pascal
MR	-Resilient Modulus

MSA	-Million Standard Axle
NDT	-Non-Destructive Testing
NHAI	- National Highways Authority of India
NSV	-Network survey Vehicle
O&M	- Operation and Maintenance
OL	-Overlay
PF	-Provident Fund
PGR	-Pedestrian Guard Rail
PI	-Plasticity Index
PL	-Plastic Limit
PM	-Periodic Maintenance
PUP	-Pedestrian Underpass
R&R	-Repair and Rehabilitation
RCC	-Reinforced Cement Concrete
RE Wall	-Reinforced Earth Wall
RHS	-Right Hand Side
RHT	-Rebound Hammer Test
RM	-Routine Maintenance
ROB	-Road Over Bridge
RPO	-Route Patrol Officer
RUB	-Road Under Bridge
SDBC	-Semi-Dense Bituminous Concrete
SPV	-Special Purpose Vehicle
SR	-Service Road
SWB	-Static Weigh Bridge
TCS	-Typical cross Section
TDRT	-Transient Dynamic Response test
TMS	-Toll Management System
UI	-Unevenness Index
UPVT	-Ultra Pulse Velocity test
VDF	-Vehicle Damage Factor
VG	-Viscosity Grade
VUP	-Vehicular Underpass
WBM	-Water Bound Macadam
WMM	-Wet Mix Macadam
WPI	-Wholesale Price Index

CHAPTER 1. INTRODUCTION

1.1 INTRODUCTION

National Highways Authority of India ("NHAI"/ "Authority") is an autonomous body of the Government of India ("GoI") under the Ministry of Road Transport and Highways ("MoRTH") and was constituted on June 15, 1989 by an Act of Parliament titled - The National Highways Authority of India Act, 1988 ("NHAI Act"). NHAI was operationalized in February 1995 with the appointment of full time Chairman and other Members. The functioning of NHAI is governed by NHAI Act and rules, and regulations framed thereunder.

NHAI has set up an Infrastructure Investment Trust Namely National Highways Infra Trust ("InvIT") and is acting as its Sponsor to the said InvIT.

National Highways Infra Investment Managers Private Limited ("NHIIMPL") has been appointed as the Investment Manager to the InvIT

National Highways Infra Projects Private Limited ("NHIPPL"), a wholly owned subsidiary of InvIT is planning to enter into concession agreements with NHAI for "Tolling, Operation, Maintenance & Transfer of Lakhnadon Khawasa (Km 547+400 to Km 653+770 of NH-44) in the State of Madhya Pradesh (MP).

M/s National Highways Infra Projects Private Limited ("NHIPPL") has engaged M/s SAMARTH INFRAENGG Technocrats Pvt Ltd as their Technical Consultants for undertaking technical due diligence study for the said project to estimate initial improvement cost (EPC) including immediate requirements for repair & rehabilitation of various elements and make an assessment of Operation & Maintenance costs for entire concession period.

1.2 PROJECT AT A GLANCE

The site of the four-lane divided Project Highway comprises the section of National Highway NH-44 (Old NH-7) commencing from Km 547+400 to Km 653+770 (at NH-44) in the state of Madhya Pradesh. – Maharashtra Border. The total length of road is 106.370 km. Toll is being collected at 2 locations at Km 549+200 (Madai) & Km 651+718 (Khawasa). The given chainage in schedule are from 546.420 to 653.770 is of length 107.350 Kms whereas as per the site the chainage starts from Km 547.400 to 653.770 is of length 106.370. The 0.98 Km is added in the RKJL project.

The project stretch is currently under O&M phase under BOT (Annuity) and will be handed over to the TOT concessionaire from the date of appointment for Toll Collection and Operation of TMS and works mentioned in Schedule-B. Overall Concession period for the TOT- Concessionaire is 20 years from the Appointed Date.

The entire project stretch has been divided in to Four parts as it was executed under different contracts as given below.

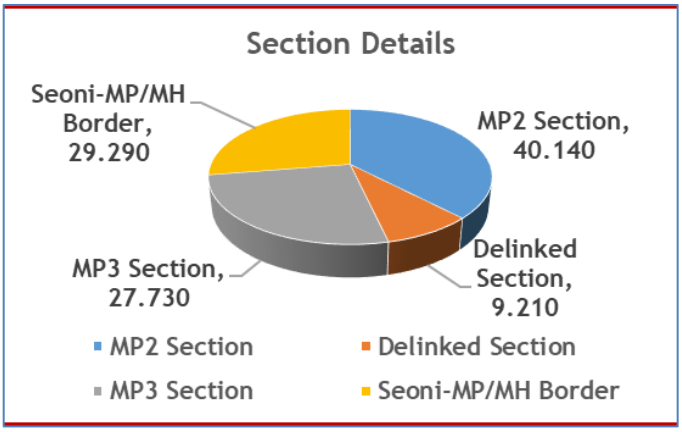
Package	Stretch of NH-44	Concessionaire/Contractor	Date of COD	End of Concession
MP-02 Under Annuity Mode	Km 547+400 to Km 596+750 except Delinked Section	M/s Malaxmi Highway Pvt. Ltd.	28 Sept 2009	27 Mar 2027
Delinked Section	Km 551+600 to Km 553+100 Km 557+400 to Km 557+800 Km558+930 to Km 562+450 Km 563+760 to Km 567+550	Authority shall carryout pavement rehabilitation and slope protection work within six months with DLP of three years. Delinked section shall be handed over on Appointed Date.		
MP-03 under Annuity Mode	Km 596+750 to Km 624+480	M/s Nagpur-Seoni Expressway Limited	25 May 2010	28 Nov 2027
MP- 04 under EPC mode	Km 624+480 to Km 653+770 (Seoni-MP/MH Border)	M/s. Dilip Buildcon Ltd	04 Mar 2021	DLP period: 06 Feb 2025

Note: After completion of the Concession period of existing BOT Annuity concessionaire/DLP of EPC Contractor, subject section of NH –44 shall be handed over to the TOT Concessionaire to operate and maintain the Project Highway.

Section Details along the Project corridor is as below:

S.No	From	To	Length	Remarks	Pavement Type
1	547.40	551.60	4.200	MP2 Section	Flexible
2	551.60	553.10	1.500	Delinked Section	Flexible
3	553.10	557.40	4.300	MP2 Section	Flexible
4	557.40	557.80	0.400	Delinked Section	Flexible
5	557.80	558.93	1.130	MP2 Section	Flexible
6	558.93	562.45	3.520	Delinked Section	Flexible
7	562.45	563.76	1.310	MP2 Section	Flexible
8	563.76	567.55	3.790	Delinked Section	Flexible
9	567.55	596.75	29.200	MP2 Section	Flexible
10	596.75	624.48	27.730	MP3 Section	Flexible
11	624.48	653.77	29.290	Seoni-MP/MH Border	Rigid

The project road operated by different concessionaires and its lengths are as listed below.



Map Showing the Project Corridor

Table 1: Project Corridor Chainage System

Referencing system	Project Corridor Start Point (km)	Project Corridor End Point (km)	Length (km)
As per CA Chainage	546.420 (NH-44)	653.770 (NH-44)	107.350
As per Site	547.400 (NH-44)	653.770 (NH-44)	106.370

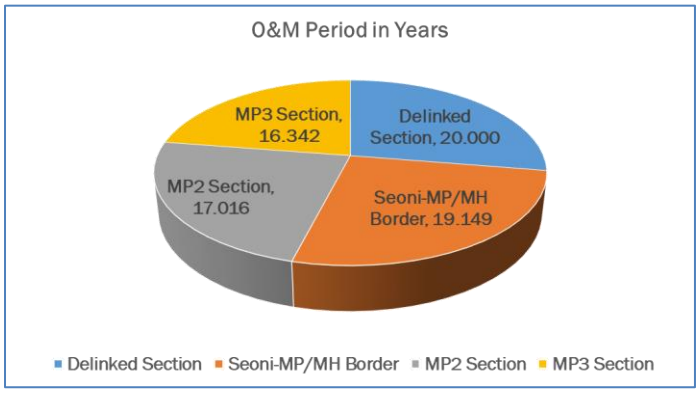
Photograph showing the start and end point of the project road are presented below

A view of the Start Point of Project Road at km 547.400

A view of the End Point of Project Road at km 653.770

1.3 O&M HAND OVER DATES AND OPERATION PERIODS

Details	Delinked Section	Seoni-MP/MH Border	MP2 Section	MP3 Section
	Appointed Date	O&M Hand Over Date	O&M Hand Over Date	O&M Hand Over Date
	01-04-2024 (Assumed)	06-02-2025	27-03-2027	28-11-2027
DLP/Existing Concession in Years		0.851	2.984	3.658
O&M Period in Years	20.000	19.149	17.016	16.342



1.4 OBJECTIVE AND SCOPE OF SERVICES

The main objective of the study is to review the current status of project corridor including details pertaining to its construction and maintenance and to provide requisite technical information for processing the acquisition of said project by client. Objective of the study can be broadly defined with following tasks:

- Study CA requirements for construction/maintenance requirements
- Undertake Detailed Reconnaissance to appreciate the project corridor characteristics

- Collection of relevant records and documents and review of same
- Undertake Engineering Studies to Establish:
    - Present Condition of Existing Road Assets
    - Quality of Executed Works/Quantity of Reutilization
    - Requirement of Immediate improvement costs as per Sch B (1st Year Capex)
    - Major Maintenance Strategies Over Concession Period
    - Routine Maintenance & Operations Requirements Over Concession Period
    - Prepare BOQ
    - Prepare Rate Analysis and finalize unit rates
    - EPC and O&M Cost

End Result is the finalization of:

- Initial improvement Works
- Major Maintenance Schedules/Cost
- Routine Maintenance Cost
- Operations Cost

The elaborate scope of services as defined in the "terms of reference" for consultants is as below:

i) Detailed reconnaissance.

ii) Video graphic survey of the entire Project corridor.

iii) Carrying out inventory and condition surveys for Project Road.

iv) Carrying out Inventory and detailed condition surveys for bridges & cross drainage structures (along with Photographs thereof) including recommendation for either strengthening/rehabilitation or reconstruction.

v) 24 hrs. Axle load survey along with axle load spectrum analysis for rigid pavement of the project corridor at one location, wherever applicable (7-day traffic count to be provided by client)

vi) Test pits required @ every 10 km interval along the Project corridor.

vii) Carrying out necessary laboratory tests to determine the CBR value of the subgrade materials to be obtained from potential borrow pits and the quality of the aggregates from potential quarries for the pavement layers, concrete etc. The existing ground which will support the embankment and pavement must be tested for its adequacy, particularly in silty or clayey water-logged areas.

viii) Carrying out deflection test by Falling Weight Deflect meter (FWD) for existing pavement as per relevant IRC code at the rate of 5 points in km in each direction making it 10 points for both directions in the damaged stretches as well as fair stretches.

ix) Availability of construction materials as per required specification to be confirmed. Detailed Logistic plan showing the locations of the potential Borrow pits, Quarries, etc.

x) Report on existing condition of Toll Plazas and its associated facilities and proposal for their improvement.

xi) Preparation of Maintenance (Routine, Periodic and Major) costs to be incurred over the period of the concession keeping in mind the requirements of the draft Concession Agreement like adequate resources, maintenance of Cranes, Ambulance, ATMS, etc.,

xii) Independently develop a bottom-up forecast of Operating expenses for each project, with detailed break-up of each type of operating expense, along with underlying assumptions

1.5 DATA COLLECTION AND REVIEW

In brief, following were covered

- ✓Review of Concession Agreement & Schedules,
- ✓Review of Detailed Project Report prepared by NHAI
- ✓ Review of As-built drawings, Plan and profiles, Structural drawings & Detailed Project Reports and Designs where available
- ✓Review of O&M costs as presented in DPR reports
- ✓Review of MPR provided by NHAI
- ✓Review of Latest NSV, FWD, MBIU etc data provided by PIU, NHAI

1.6 O&M REQUIREMENTS OF EXISTING CONCESSIONNAIRES/EPC

Following table depicts the maintenance requirements of existing concessionaires for MP2/Mp3 packages and for EPC contractor in Seoni-MP/MH border section:

S.NO	Description	MP2	MP3	Seoni-MP/MH Border
1	Maximum Roughness allowable (mm/Km)	3000	3000	2200
2	Scheduled Overlay	Every 5 Years or when Roughness exceeds 3000 mm/Km whichever is earlier Sep 2014,2019,2024	Every 5 Years or when Roughness exceeds 3000 mm/Km whichever is earlier May 2015,2020.2025	
3	Maximum allowable Deflection (mm)	1.2	1.2	
4	Frequency of Roughness	2 Times in a Year	2 Times in a Year	
5	Frequency of FWD Test-	Once in a Year	Once in a Year	
6	Handing Over Requirements (Roughness allowable)	2500 mm/Km 27-03-2027	2500 mm/Km 28-11-2027	

1.7 O&M REQUIREMENTS FOR TOT (INVIT) CONCESSIONNAIRE

- Applicable Manual----------IRC:SP:84-2019
- Applicable Schedule for O&M-------Schedule-F and Manual
- Maximum Roughness Allowed ------2400 mm/Km
- Mandatory Overlay—----------NA
- Frequency of Roughness Test----------2 Times in a Year
- Frequency of FWD Test----------Once in a Year only for Flexible Pavement
- No specific Handing Over (Divestment) requirements are mentioned under CA. It shall be same as Schedule-F

CHAPTER 2. SURVEYS AND INVESTIGATIONS

2.1 INTRODUCTION

The main objective of undertaking Surveys and Investigations is to appreciate the existing engineering features along the project corridor and to understand the present condition of the various elements of the project road and to prepare required inputs for various rehabilitation and maintenance strategies.

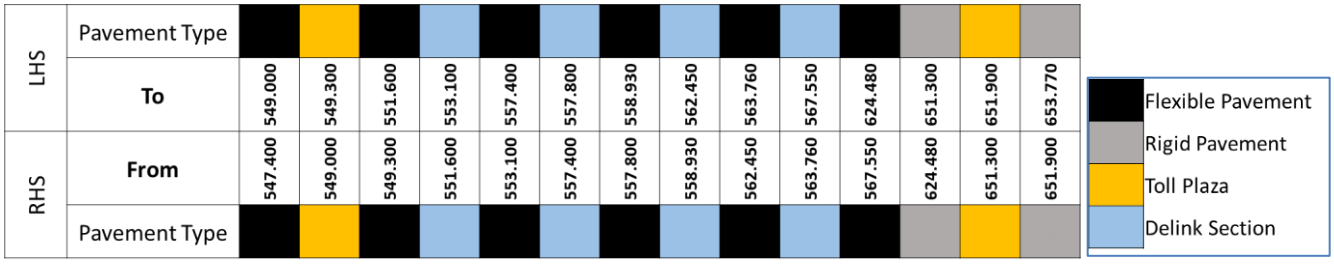
Following Survey and Investigations have been undertaken as a part of study with an objective to understand the present condition of the road and there by access the quality of construction and as well to prepare requisite rehabilitation/corrective designs where necessary.

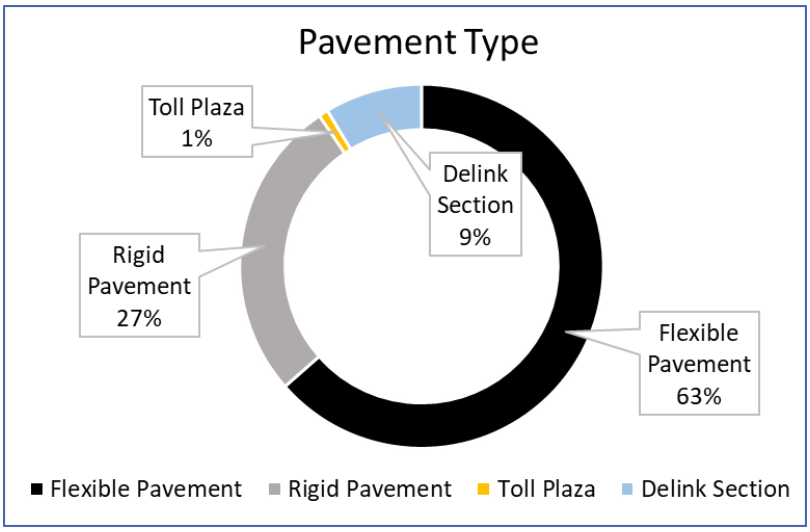
- ***Road Inventory Surveys***
- ***Pavement Condition using NSV***
- ***FWD Surveys***
- ***Roughness Surveys using NSV***
- ***Pavement Composition surveys (Test Pits)***
- ***Subgrade Investigations & Laboratory testing***
- ***Material Investigations***
- ***Core Cutting Investigation***
- ***Axle Load Survey***
- ***Structure Inventory and Condition Surveys***

2.2 ROAD INVENTORY

The project corridor has combination of both Flexible and Rigid pavement, with 7.5m wide carriageway including shyness flanked by 1.5m paved shoulder plus 1.0 m to 2.0 m earthen shoulder on each side expect at Structure Approach locations. The length of Rigid and flexible pavement is presented below.

Description	LHS (km)	RHS (km)
Rigid Pavement	24.130	23.810
Flexible Pavement	82.240	82.560
Project Length	106.370	106.370





In general, majority of project road has 4.5m wide median and in built-up sections it is narrowed down to 1.5m. Narrow median is also observed at delinked portions at forest areas.

The project corridor generally runs in plain/rolling terrain and in Hilly terrain also. Hilly sections are mainly observed in Mp2 section and Seoni-Khawasa section. The land use along the project road is mostly Agricultural and Forest area. It passes through urban settlements like, Mandai, Ganeshganj, Devgaon, Chhapara, Gokalpur, Seoni, Mohgaon, Khawasa.

In general, in plain terrain, the road embankments are in the range of 0.5-3.0m height. Embankments higher than 3.0m are observed mainly in the approaches of CD-Structures and Underpass locations.

Typical View of Project Road is shown below:

A view of the Project Corridor at Km 553.500

A view of the Project Road at km 585.000 RHS

A view of the Project Road at km 605.000 LHS	A view of the Project Road at km 608.000
A view of the Project Road at km 615.820	A view of the Project Road at km 650.000

The Project Road has 12 Nos. of major junctions and 75 Nos. of minor junctions. Photographs showing the Major Junctions and minor junctions are presented below:

Major Junction at km 596.915 LHS

Major Junction at km 572.630 RHS

Minor Junction at km 554.100 BHS

Minor Junction at km 648.625 RHS

Minor Junction at km 594.050 RHS

Minor Junction at km 648.625 RHS

6 Nos of High mast and 14 No of Low mast were observed near major Junctions and Toll Plaza locations, whereas, Highway lighting is observed in 8.270 kms length along the project road near urban locations. Few photos showing High masts & lighting are presented below:

A view of Low Mast Lighting at km 586.500 RHS

A view of Single Arm lighting at km 612.500 in Truck Lay Bay

A view of Double Arm lighting at km 629.400 Median

A view of High Mast Lighting at km 651.800

Project Road has provided with 8 Nos. of Bus Bay with shelter & 14 Nos. of Bus Shelters along the project road. Few photos taken at the Bus Bays and Bus Shelters are presented below:

Bus shelter @ Km 629.400 LHS

Bus Bay with Bus shelter @ 575.000 BHS

The Project Road has 4 Nos. of Truck lay-byes at 2 locations on either side. These truck lay-byes have been provided with Flexible and the condition appears to be fair. Toilet blocks also available at these

locations and are in fair in condition. Separator is provided between main carriageway and Truck lay bye portion. Lighting in the form of single arm poles have been provided on the shoulder side of the truck lay bye. Lighting provided in one location with 56 nos. of single-arm lights on either side and all are found to be in good condition.

Few photos depicting the truck lay bye portion are presented below:

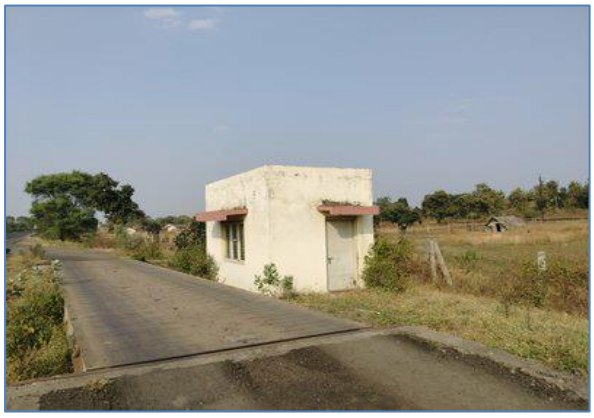
A view of Truck Lay Bye at Km 612.500-RHS

A view of Truck Lay Bye at Km 612.500 - LHS

The Project Road has 2 Nos. of Toll Plazas at Km 549.200 (Madai Toll Plaza) and Km 652.800 (Khawasa Toll Plaza). Rigid pavement exists at both the toll plaza locations. The condition of the toll plaza appears to be fair. It has 8 lanes in Toll Plaza-1 and 18 lanes in Toll Plaza-2 including reversible lanes. High mast lighting of 6 Nos. have been provided at both Toll Plazas approaches and double arm lighting has been provided on median.

A view of the Existing Toll Plaza near km 549.200 (Madai Toll Plaza)

A view of the Existing Toll Plaza near km 651.800 (Khawasa Toll Plaza)



Static Weigh Bridge @ km 549.200

Static Weigh Bridge @ km 651.600

The Summary of Service Road/slip roads are given below

Width of the Service Road	Flexible (km)	Rigid (km)	Total (km)
5.50	3.916	3.130	7.046
7.00	7.070	0	7.070
Total	**10.986**	**3.130**	**14.116**

Photos depicting the service/slip road pavement surface type, condition and the other associated features like drain. Few photos taken at service/slip road locations are presented below:

Service road at km 583.200 RHS

Service road at km 621.800 LHS

Service road at km 637.200 LHS

Service road at km 651.100 RHS

The collected Road Inventory Data is presented in **Appendix 1** of this Report

2.3 PAVEMENT CONDITION SURVEYS

The present Pavement condition data has been collected using **Network Survey Vehicle (NSV)**. The Pavement Condition report covering the data collection for each km length in each direction has been presented in **Appendix 2** of this Report.

The photographs showing the pavement condition of the Project Road is presented below.

Patching and raveling @ 559.900 RHS	Shoving @ Km 561.610 LHS	Paver Blocks Totally damaged @ Km 565.350 LHS
Pothole @ km 603.700 LHS	Rutting & Cracks @ Km 610.100 RHS	Wide Cracks @ km 631.300 LHS
Cracks @ Km 635.800 LHS	Longitudinal Cracks @ km 652.120 RHS	Panel Replacement works @ Km 633.300 LHS

2.4 FALLING WEIGHT DEFLECTOMETER (FWD) SURVEYS

2.4.1 Falling Weight Deflectometer Survey (Flexible Pavement)

In order to evaluate the structural strength of the existing pavement, Falling Weight Deflectometer (FWD) survey has been carried out along the project road as per IRC 115 guidelines. The collected FWD Data and Analysis is presented in **Appendix 3** of this Report.

Few photos taken during the progress of FWD Surveys are presented below:

Deflection Measurement in progress

Deflection Measurement in progress

The homogenous sections in each direction of traffic (i.e., LHS & RHS) for the project stretch have been identified and are given in the below table followed by graphical representation of the same.

Table 2: FWD Data - Summary of Homogenous Section of Main Carriageway - LHS

S. No	From	To	Length (m)	Remarks
1	547.400	549.000	1.600	
	549.000	549.300	0.300	Toll Plaza-1
	549.300	551.400	2.100	
2	551.400	553.100	1.700	Delink
3	553.100	557.204	4.104	
4	557.204	557.800	0.596	Delink
5	557.800	558.819	1.019	
6	558.819	562.450	3.631	Delink
7	562.450	563.591	1.141	
8	563.591	567.550	3.959	Delink
	567.550	570.730	3.180	
9	570.730	573.006	2.276	
10	573.006	577.003	3.997	
11	577.003	578.350	1.347	Overlay Work Under Progress
	578.350	582.250	3.900	
	582.250	585.013	2.763	
14	585.013	587.580	2.567	
15	587.580	590.401	2.821	
16	590.401	594.007	3.606	
17	594.007	596.750	2.743	
18	596.750	600.002	3.252	

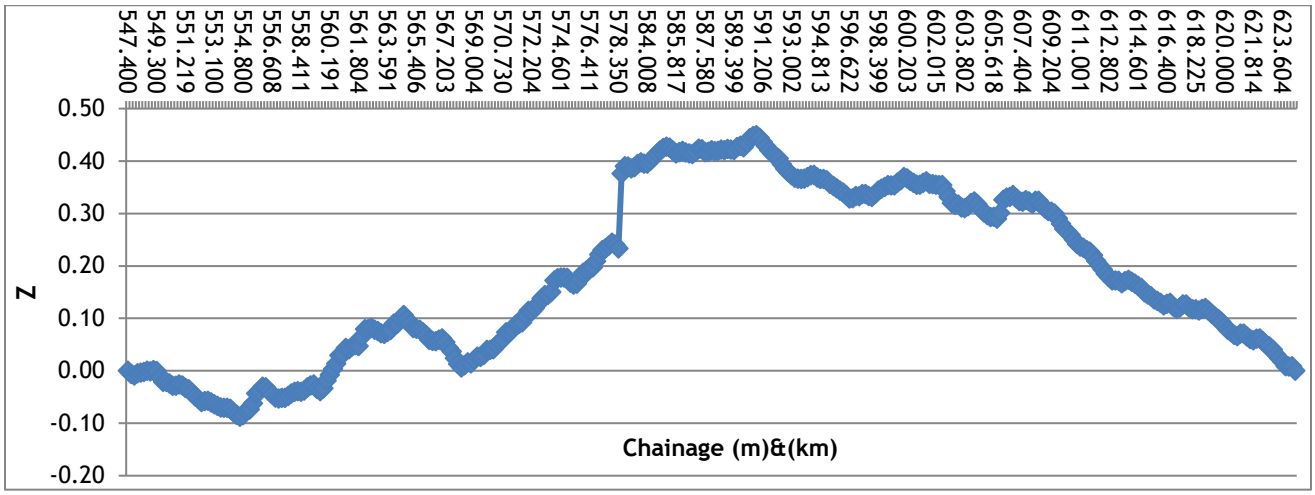
S. No	From	To	Length (m)	Remarks
19	600.002	603.230	3.228	
20	603.230	606.000	2.770	
21	606.000	608.400	2.400	
22	608.400	611.001	2.601	
23	611.001	613.620	2.619	
24	613.620	616.200	2.580	
25	616.200	618.611	2.411	
26	618.611	621.615	3.004	
27	621.615	624.480	2.865	
	Total Length		**77.080**	

Table 3: FWD Data – Summary of Homogenous Section of Main Carriageway – RHS

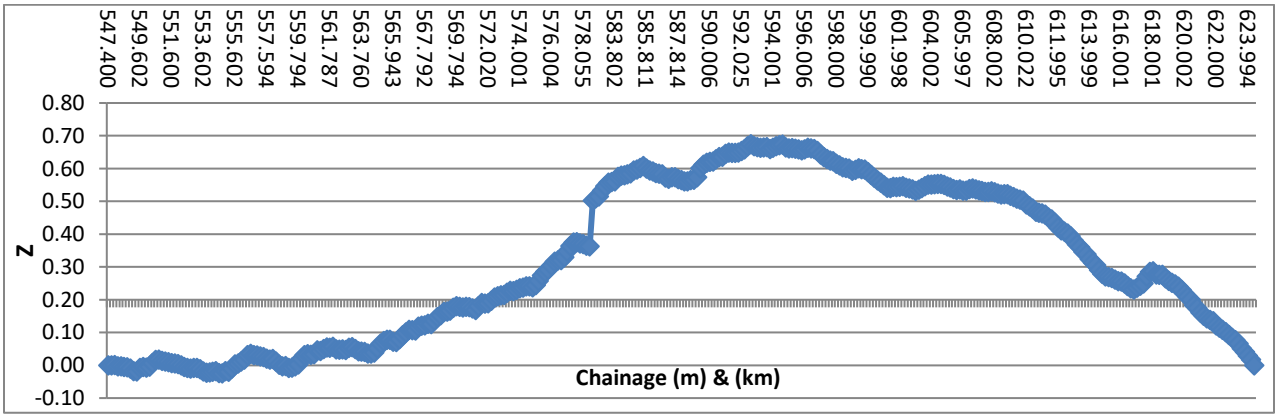
S. No	From	To	Length (m)	Remarks
1	547.400	549.000	1.60	
	549.000	549.300	0.30	Toll Plaza 1
	549.300	551.404	2.10	
2	551.404	553.100	1.70	Delink
3	553.100	557.202	4.10	
4	557.202	557.800	0.60	Delink
5	557.800	558.801	1.00	
6	558.801	562.450	3.65	Delink
7	562.450	563.602	1.15	
8	563.602	567.550	3.95	Delink
9	567.550	570.730	3.18	
10	570.730	574.386	3.66	
11	574.386	578.350	3.96	
12	578.350	582.250	3.90	Overlay Work Under Progress
13	582.250	585.401	3.15	
14	585.401	588.998	3.60	
15	588.998	592.399	3.40	
16	592.399	596.750	4.35	
17	596.750	599.194	2.44	
18	599.194	601.998	2.80	
19	601.998	606.000	4.00	
20	606.000	609.200	3.20	
21	609.200	612.794	3.59	
22	612.794	616.603	3.81	
23	616.603	619.573	2.97	
24	619.573	622.000	2.43	
25	622.000	624.480	2.48	
Total Length			**77.08**	

Cumulative Difference Approach (CDA) has been used for the identification of homogeneous sections on the basis of Surface Curvature Index (SCI). SCI is calculated as the difference between D_0 and D_{300}, where D_0 and D_{300} are the peak deflections (mm) measured at the center of loading plate and at a radial distance of 300mm

The homogenous sections in each direction of traffic (i.e., LHS & RHS) for the project stretch have been identified for Main carriageway and Slip Road are given in the below tables followed by graphical representation of the same.



Delineation of Homogeneous Section - LHS



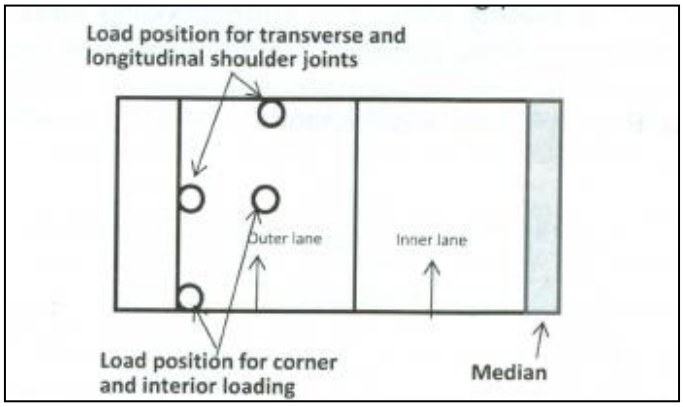
Delineation of Homogeneous Section - RHS

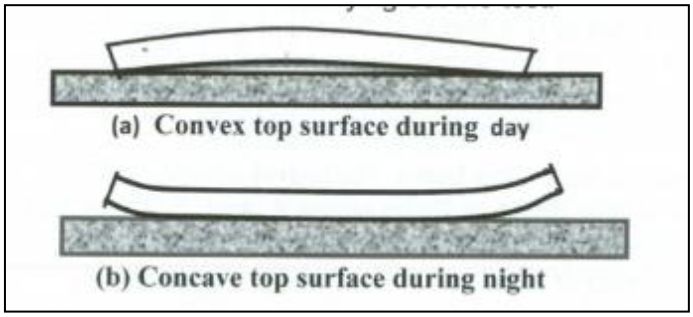
2.4.2 Pavement Evaluation Using FWD - Rigid Pavement

Structural condition of in-service rigid pavement can be evaluated using Falling Weight Deflectometer as per IRC 117 guidelines. FWD surveys are done at interior of panel to determine the Strength of Concrete and Subgrade Support and to detect voids for loss of support FWD has been done in Wheel path.

For Evaluation of Modulus of Subgrade reaction and Strength of Concrete i.e., "Interior" loading case is done when temp gradient is zero or Negative (Top Surface is Cooler than Bottom), i.e., in the Early Morning or night time has been done.

Corner loading has no indirect measure from the test, FWD test to be done when pavement is not in curled position and Deflections measured along wheel paths to get void locations. Load position for various cases has been presented below:





Among equipment available for structural evaluation of pavements, the Falling Weight Deflectometer (FWD) is extensively used world-wide because it simulates, to a large extent, the actual loading conditions of the pavement. When a moving wheel load passes over the pavement it produces load pulses. Normal stresses (vertical as well as horizontal) at a location in the pavement will increase in magnitude from zero to a peak value as the moving wheel load approaches the location. The time taken for the stress pulse to vary from zero to peak value is termed as 'rise time of the pulse'. As the wheel moves away from the location, magnitude of stress reduces from peak value to zero. The time period during which the magnitude of stress pulse varies from 'zero-to-peak-to-zero' is the pulse duration. Peak load and the corresponding pavement responses are of interest for pavement evaluation.

In present study, Falling Weight Deflectometer (FWD) Test system has been used to generate the requisite NDT load-deflection data which was analyzed and is presented in this report. Surface deflections were measured at the center of the 300mm diameter loading plate and at the radial distances shown in the below table:

Sl. No	Geophone Ref No	Radial distance measured from center of load plate (mm)
1	D0	0
2	D1	300
3	D2	600

Sl. No	Geophone Ref No	Radial distance measured from center of load plate (mm)
4	D3	900

Methodology adopted for carrying the survey

1. The FWD Surveys are carried out as per IRC:117-2014
2. The project road has two longitudinal joint one at center and other paved shoulder. Panel size is nearly 4.5x3.5m
3. Interior points at a distance of 2.25m from edge (1.5m paved shoulder+0.75m for wheel path). These points will also act as under wheel path for detection of voids. Testing was done at two interior points in outer lane at 200m and 600m. Three points @ 0, 400 and 800 in inner lane to know strength/subgrade support. (These have been taken at night)

The collected FWD Data and Analysis is presented in **Appendix 3** of this Report.

2.5 ROUGHNESS SURVEYS

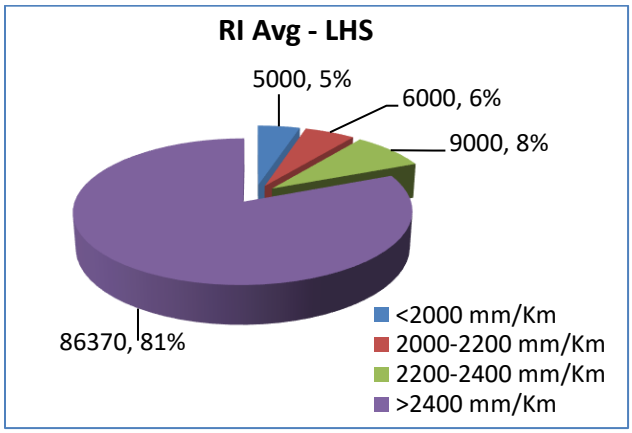
The Roughness data has been collected using **Network Survey Vehicle** and analyzed in terms of International Roughness Index (IRI), separately for each lane, for both direction of travel. Pavement Roughness report covering the data collection and methodology, computation of IRI for each km length in each direction is presented in **Appendix 4** of this Report.

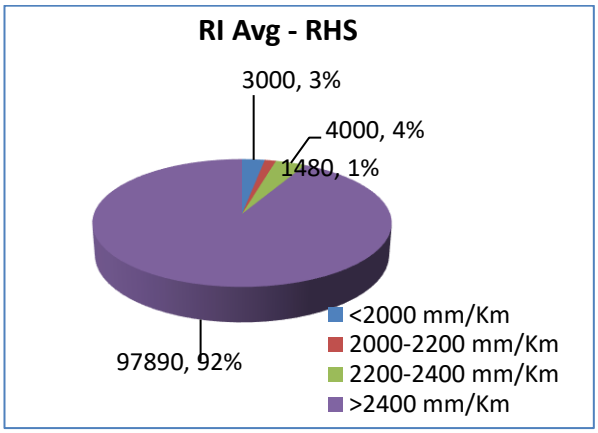
As per Schedule-F of TOT, the desirable level of service for Roughness values for bituminous pavement surface is considered to less than 2000 mm/Km and the acceptable limits are less than 2400mm/Km.

As per Schedule-F of TOT, the desirable level of service for Roughness values for rigid pavement surface is considered to less than 2200 mm/Km and the acceptable limits are less than 2400mm/Km.

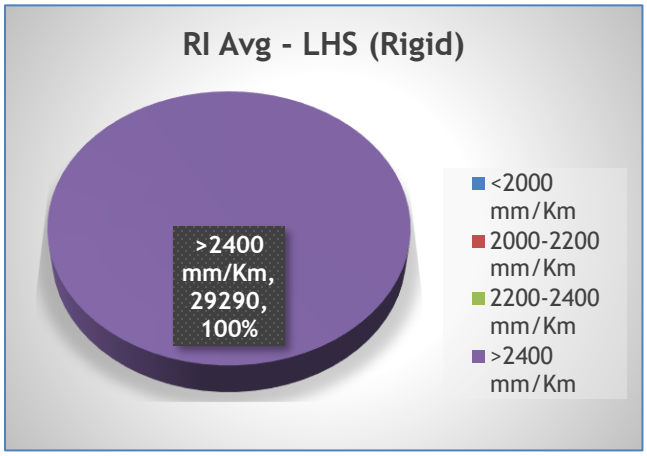
Average RI values along the corridor were grouped in to four categories, Pie chart showing the range of RI values in each carriageway of the project road have been presented below:

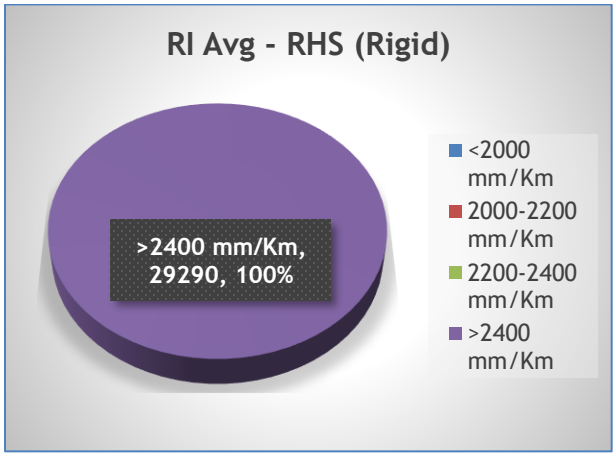
- ***Flexible Pavement Roughness:***





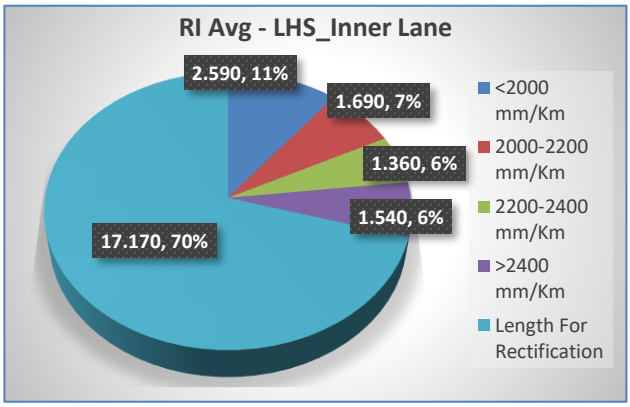
- ***Rigid Pavement Roughness (Simple Average Method):***

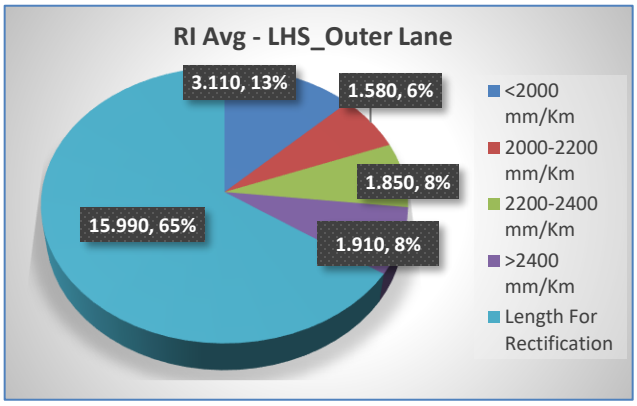


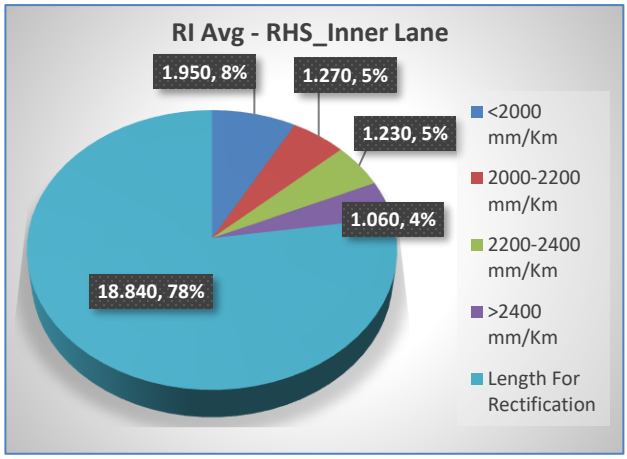


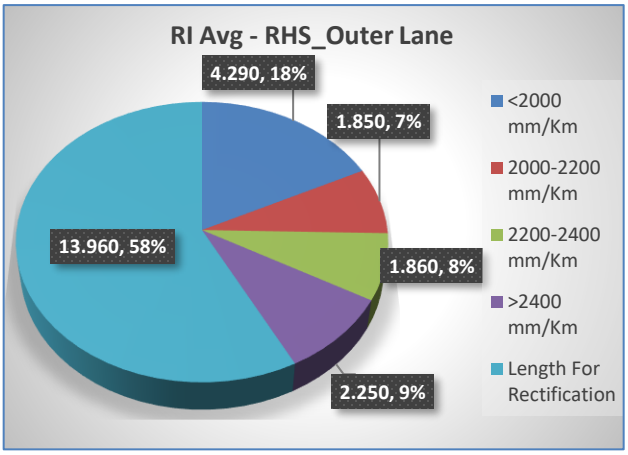
It can be noted that majority length of the project road has exceeded the roughness threshold limit (>2400 mm/km) and warranted for functional overlay. Section of flexible pavement is under operation and is scheduled to receive a overlay before handing over (2025/2026). In the case of rigid pavement it is required to get the roughness corrected before handing over. Moving average method has been adopted for rectification of the rigid panels as described below.

- ***Rigid Pavement Roughness (Moving Average Method):***









From the above graph, about 65% of the rigid pavement requires rectifications to be bring the roughness threshold limit (>2400 mm/km).

2.6 PAVEMENT COMPOSITION SURVEYS (TEST PITS)

The composition of the existing pavement crust has been noted from test pit surveys. Thus, a total of 22 Nos. of pits have been dug along the corridor and the data on composition of pavement has been noted. Photographs have been taken at all test pit locations depicting the crust thickness and nature of material in the pavement.

Results of the test pit survey showing average thickness of pavement layers are presented in the Table below.

Table 4: Pavement Composition of Existing Pavement along Project Road

S no	Sample No	Chainage	Side	BT, mm	WMM, mm	PQC, mm	DLC, mm	GSB, mm	Total, mm
1	LK-TP-1	606+800	LHS	300	250			200	750
2	LK-TP-2	617+250	LHS	270	250			300	820
3	LK-TP-3	626+200	LHS			310	160	180	650
4	LK-TP-4	636+650	LHS			300	150	180	630
5	LK-TP-5	648+200	LHS			310	150	200	660
6	LK-TP-6	650+200	RHS			320	200	150	670
7	LK-TP-7	642+600	RHS			280	160	200	640
8	LK-TP-8	629+700	RHS			290	150	200	640
9	LK-TP-9	622+550	RHS	260	200			200	660
10	LK-TP-10	612+150	RHS	270	200			150	620
11	LK-TP-11	601+750	RHS	260	200			150	610
12	LK-TP-12	592+600	RHS	230	180			250	660
13	LK-TP-13	582+800	RHS	230	200			200	630
14	LK-TP-14	572+900	RHS	220	200			250	670
15	LK-TP-15	562+600	RHS	200	250			250	700
16	LK-TP-16	552+200	RHS	180	280			350	810

S no	Sample No	Chainage	Side	BT, mm	WMM, mm	PQC, mm	DLC, mm	GSB, mm	Total, mm
17	LK-TP-17	547+900	LHS	190	200			180	570
18	LK-TP-18	557+350	LHS	200	210			180	590
19	LK-TP-19	567+900	LHS	200	200			200	600
20	LK-TP-20	577+500	LHS	280	250			150	680
21	LK-TP-21	587+600	LHS	200	220			250	670
22	LK-TP-22	597+600	LHS	240	200			200	640

The flexible pavement consists of BT (180mm to 300mm) + WMM (180mm to 280mm) + GSB (150mm to 350mm), with total thickness of 570mm to 820mm.

The Rigid pavement consists of PQC (280mm to 320mm) + DLC (150mm to 200mm) + GSB (150mm to 200mm), with total thickness of 630mm to 670mm.

2.7 SUBGRADE INVESTIGATIONS & LABORATORY TESTING

Sub-grade Investigations have been carried out to examine the subgrade soil characteristics along the project road. A total number of 22 test pits have been carefully dug from the pavement surface up to sub-grade level. Field density tests have been conducted for subgrade samples and a small quantity of sample has also been collected in airtight containers for determining the field moisture content. Upon completion of the field density test, representative sample of sub-grade soil has been collected in bulk, in gunny bags, from each test pit for laboratory testing.

The soil samples collected have been tested for the following properties to assess the existing sub-grade soil properties.

- *Sieve analysis*
- *Atterberg limits*
- *Heavy compaction*
- *Four (4) days soaked CBR as per IS standards at 97% of MDD as applicable for sub-grade (Heavy Compaction)*
- *Free swelling index*

LK-TP-1

LK-TP-2

LK-TP-3	LK-TP-4
LK-TP-5	LK-TP-6
LK-TP-7	LK-TP-8
LK-TP-9	LK-TP-10

LK-TP-11	LK-TP-12
LK-TP-13	LK-TP-14
LK-TP-15	LK-TP-16
LK-TP-17	LK-TP-18

LK-TP-19	LK-TP-20
LK-TP-21	LK-TP-22

2.8 BORROW AREAS

Potential borrows areas identified at 11 Nos. of locations within the vicinity of the project corridor for sub-grade/ embankment within economic haulage leads have been identified. The sources identified as potential borrow sources are shown in Table below and certain useful information such as distance from the project road, location, village name, etc., have also been presented in this table below.

Table 5: Borrow Area Samples Details

S.No	Borrow Area No	Chainage	Side	Offset	Village and contact person	Area	Rate	Remarks	Co-ordinate
1	LK-BP-1	639+400	RHS	1.5km	Village: Raiyarao Name: Dinesh Contact no: 7089493414 Name:Naresh pandey Contact no: 9425889057	5 Acre*6 feet	Rs 1250/Dumper (10Wheels)	Pvt.land	21.799999 79.489193
2	LK-BP-2	620+000	LHS	0.1km	Village: Kalbodi Name: naresh(Sarpanch) Contact no: 6260229554	5 Acre*5 feet	Only royalty	Govt.land	21.950597 79.528201

S.No	Borrow Area No	Chainage	Side	Offset	Village and contact person	Area	Rate	Remarks	Co-ordinate
3	LK-BP-3	610+900	RHS	1.2km	Village: Seoni Name: Gajendra(Sarpanch) Contact no: 8770144216	Hilly Area	Only royalty	Govt.land	22.036036 79.527144
4	LK-BP-4	606+300	LHS	4.5km	Village: Jantha nagar chouk Name: Thoshu sanodiya Contact no: 8871838834	8 Acre*6 feet	Rs 1800/Dumper (10Wheels)	Pvt.land	22.059747 79.5654436
5	LK-BP-5	594+000	LHS	0.2km	Village: Narela Name: Jagbandan Contact no: 7999217231	10 Acre*6 feet	Rate not told	Pvt.land	22.182475 79.531606
6	LK-BP-6	572+500	RHS	2.3km	Village: Chappara Name: Raj Kishore singh Tagore Contact no: 7000479052	8 Acre*5 feet	Rs 1800/Dumper (10Wheels)	Pvt.land	22.380961 79.825926
7	LK-BP-7	584+500	LHS	0.8km	Village: kuklah Name: Sunil Contact no: 9425174511	10Acre* 4 feet	Rs 1500/Dumper (10Wheels)	Pvt.land	22.257625 79.545767
8	LK-BP-8	557+300	RHS	Road side	Village: kuhiya Name: Mahesh Nayak Contact no: 9713902912	3Acre*10 feet	Rs 1000/Dumper (10Wheels)	Pvt.land	22.481978 79.577178
9	LK-BP-9	554+100	RHS	1.3km	Village: kuhiya Name: Mahesh Nayak Contact no: 9713902912	3Acre*10 feet	Rs 1000/Dumper (10Wheels)	Pvt.land	22.481978 79.577179
10	LK-BP-10	547+400	LHS	2.0km	Village: Bombodi Name: Mansukhalal irpache Contact no: 9111812649	5Acre*8 feet	Only royalty	Govt.land	22.559819 79.610722
11	LK-BP-11	648+400	LHS	0.1km	Village: Pachdhar Name: Jitendar Derhwal Contact no: 7000971343	25Acre* 5 feet	Rs 400/Dumper (400 Sqare feet)	Pvt.land	21.727125 79.453678

Soil samples from these borrow sources have been collected in bulk by excavating test pits down up to 1.0m depth from the existing ground surface. The top organic soil layer of approximately 150mm thickness was removed before sampling. The samples collected from these identified borrow pits/ gravel quarries have been tested for the suitability of utilizing them as embankment fill/ sub-grade. The sample photos of borrow area locations are as presented below.

LK-BP-1	LK-BP-2
LK-BP -3	LK-BP-4
LK-BP-5	LK-BP-6

LK-BP-7	LK-BP-8
LK-BP-9	LK-BP-10
LK-BP-11	

2.9 AGGREGATE SAMPLES

Aggregates samples from 5 Nos. of sources from crusher/quarry have identified for the use of sub-base, base, surface courses and concrete works have been collected. The locations, estimated quantity, basic cost of material and the approximate distance from each source to the nearest point on the project corridor are compiled in Tables below.

LK-AQ-1	LK-AQ-2
LK-AQ-3	LK-AQ-4
LK-AQ-5	

Table 6: Aggregate Samples Details

sample No.	Ex Chainage (Km.)	Left/ Right	Name of Village	Name of Source/ Crusher	Lead from Nearest Ex. Chainage (Km.)	Approximate Quantity (ton)	Basic cost of the material (Rs.)	Remarks	Co-ordinate
LK-AQ-1	588+100	RHS	Bandol	Farooq Stone Crusher Owner- Farooq Mahammed Contract no- 9425140198	6.3 km	Plenty	40mm-Rs 400/- per tonne 20mm-Rs 475/- per tonne 10mm-Rs 175/- per tonne 6mm-Rs 175/- per tonne 4 mm-Rs 200/- per tonne GSB-Rs 275/- per tonne Wmm-Rs 275/- per tonne Dust-Rs 200/- per tonne	Extra GST 5% and Royalty 160/Cubic. Meter	22.238599 79.511290
LK-AQ-2	588+100	RHS	Bandol	Vardhaman Stone Crusher Owner- Pranav malu Contract no- 8956275558	3.5 km	Plenty	40mm-Rs 350/- per tonne 20mm-Rs 400/- per tonne 10mm-Rs 65/- per tonne 6mm-Rs 60/- per tonne GSB-Rs 180/- per tonne Wmm-Rs 180/- per tonne Dust-Rs 75/- per tonne	Extra GST 5% and Royalty 160/Cubic. Meter	22.246858 79.515903
LK-AQ-3	572+500	RHS	Chappara	Tagore Stone Crusher Owner-Raj Kishore singh Tagore Contract no- 7000479052	2.3 km	Plenty	40mm-Rs 420/- per tonne 20mm-Rs 520/- per tonne 10mm-Rs 160/- per tonne 6mm-Rs 170/- per tonne GSB-Rs 380/- per tonne Wmm-Rs 400/- per tonne Dust-Rs 280/- per tonne	Extra GST 5% and Royalty 180/Cubic. Meter	22.380961 79.825926
LK-AQ-4	447+400	RHS	Chappara	Tagore Stone Crusher Owner-Raj Kishore singh Tagore Contract no- 7000479052	12.3 km	Plenty	40mm-Rs 17/- per c.f.t 20mm-Rs 22/- per c.f.t 10mm-Rs 8/- per c.f.t 6mm-Rs 7/- per c.f.t 4mm-Rs 10/- per c.f.t GSB-Rs 13/- per c.f.t Wmm-Rs 12/- per c.f.t Dust-Rs 10/- per c.f.t M-Sand-Rs 10/- per c.f.t	Extra GST 5% and Royalty 160/Cubic. Meter	22.628807 79.550738
LK-AQ-5	579+000	RHS	Chappara	Jain Stone Crusher Owner-Nithin Jain Contract no- 7000427412	0.3 km	Plenty	40mm-Rs 400/- per tonne 20mm-Rs 500/- per tonne 10mm-Rs 125/- per tonne 6mm-Rs 125/- per tonne Dust-Rs 150/- per tonne	Extra GST 5% and Royalty 200/Cubic. Meter	22.313178 79.543217

2.10 SAND SAMPLES

River Sand samples of 3 Nos. have been collected from the source and tested. The location of this sand quarry along with lead to the Project Road is presented in the following table.

Table 7: Sand Samples Details

sample No.	Ex. Chainage (Km.)	Left/ Right	Name of Village	Name of Source/ River	Lead from Nearest Ex.Chainage (Km.)	Approximate Quantity (ton)	Basic cost of the material (Rs.)	Remarks	Co-ordinate
LK-SQ-1	644+900	LHS	Bala Ghat	Bainganga River Supplier-Raju khan Seoni Contract no-7223999951 6263753909	100 km	Plenty	River Sand-Rs 32,000/- per Dumper(45 to 50tonne)		21.755241 80.176052
LK-SQ-2	644+900	LHS	Bala Ghat	Bainganga River Supplier-Sanjeev Sanodiya Seoni Contract no: 9340646465	100 km	Plenty	River Sand-Rs 35,000/- per Dumper(45 to 50tonne)		21.755241 80.176052
LK-SQ-3	641+000	LHS	Khair ghat	Bawanthadi River Supplier: Aklesh Daharwal Contract no: 9340646465	6.5 km	Plenty	Rate not told		21.741574 79.509884

The Photos dispatching the above are presented below

LK-SQ-1

LK-SQ-2

LK-SQ-3

2.11 CORE CUTTING INVESTIGATION

The objective of the core cutting is examining the engineering properties of the materials relevant to the project as per specification. As a first step, Details of sections are identified with good, fair and poor locations. The locations have been identified with the help of Visual observation of existing Road condition and Past condition. Thereafter the Location has been identified for core cutting as visual observation of the existing road condition of Rigid Pavement, 10 cores were cut in Main carriageway. After noting the condition such as location, cracks, depth of core etc. The core samples were properly packed and sent for laboratory testing for its properties:

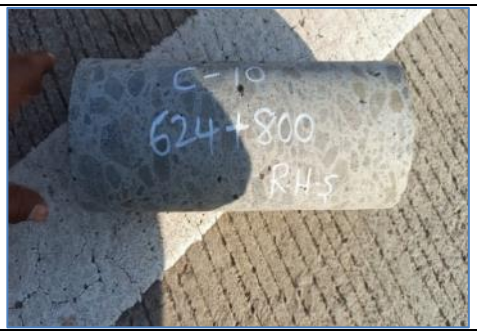
Table 8: Core Cutting Samples Details

Sr No.	Sample No.	Chainage	Direction	Carriage way	Distance from Kerb(m)	Pavement condition	Thickness (mm)	Crack Depth (mm)
1	LK-C-1	626+200	LHS	Outer Lane	7.0 m	Good	300	
2	LK-C-2	631+500	LHS	Inner lane	1.9m	Cracks	300	300 (Full depth Crack)
3	LK-C-3	636+650	LHS	Inner lane	1.4m	Fair	308	
4	LK-C-4	639+400	LHS	Outer Lane	5.2m	Cracks	310	80mm From Top
5	LK-C-5	648+200	LHS	Inner lane	3.2m	Good	330	
6	LK-C-6	650+200	RHS	Outer Lane	6.8m	Cracks	320	60mm From Top
7	LK-C-7	642+600	RHS	Inner lane	3.4m	Good	300	
8	LK-C-8	636+700	RHS	Outer Lane	6.8m	Cracks	300	300 (Full depth Crack)
9	LK-C-9	629+650	RHS	Inner lane	1.6m	Fair	300	
10	LK-C-10	624+800	RHS	Inner lane	2.9m	Good	280	

The Photos dispatching the above are presented below:

LK-C-1

LK-C-2

LK-C-3	LK-C-4
LK-C-5	LK-C-6
LK-C-7	LK-C-8
	
LK-C-9	LK-C-10

2.12 AXLE LOAD SURVEYS

Traffic loading has a significant impact on pavement performance and design. This is because the damage that vehicles create to a road depends very strongly on the axle loads of the vehicles. The

exact relationship is influenced by the type of road structure and the way the road deteriorates but a "fourth power" damage law gives a good approximation.

Axle load study has been conducted using portable axle load pads. The survey was conducted near two toll plazas at km 549.200 and km 651.600 on the dates of 30.10.2023 and 02.11.2023 for 24 hrs. duration respectively. The survey has been conducted in both the directions. The measurements have been made on random sampling basis. The collected axle load data and analysis is presented in **Appendix 5** of this Report.

The vehicle damage factors have been calculated using the standard axle loadings given in IRC: 37-2018. The standard axle loadings adopted have been presented in the following table

Table 9: Details of Standard Axles Used

Axle Configuration	Standard Axle load (Tonnes)*/ KN	Remarks
Single Wheel, Single Axle	6.60/65	As per IRC 37-2018
Dual Wheel, Single Axle	8.16/80	As per IRC 37-2018
Dual Wheel, Tandem Axle group	15.10/148	As per IRC 37-2018
Dual Wheel, Tridem Axle group	22.90/224	As per IRC 37-2018

Few photographs illustrating the survey locations and axle load measurements are presented below.

Survey in Progress

Survey in Progress

Direction wise VDF for each mode of commercial traffic has been estimated. Results of axle load surveys have been presented in the following table.

Table 10: VDF Values Estimated at the Toll Plaza Locations

Vehicle Type	Madai Toll plaza at Km 549.200		Khawasa Toll plaza at Km 651.600	
	UP	DN	UP	DN
BUS	0.83	0.11	0.50	1.58
2-Axle	1.80	1.54	1.95	1.54
3-Axle	3.23	3.00	5.01	4.72
M Axle	8.44	6.93	8.98	8.77
LCV	0.46	0.81	0.37	0.43

CHAPTER 3. VALIDATION OF EXECUTED WORKS

3.1 ROAD WORKS

The project road has been closely inspected to verify the executed works on ground. As a part of the validation, the available as-built drawings and the inventory data received from the Concessionaire were also referred. Each structure has been inspected to note down its structural configuration and condition. The following table highlights the scope comparison of the executed works on ground.

Table 11: Scope Comparison of Executed works

S. No.	Particulars	Length/ Nos.	Total for O&M Estimation	As per Schedule-A	As per Schedule-A/B	As per Site	Remarks
1	Start Chainage (Km)	Km	547.400	547.400	-	547.400	
2	End chainage (Km)	Km	653.770	653.770	-	653.770	
3	Length of the Project Corridor	Kms	106.370	106.370	-	106.370	
4	Service Road / Slip Road	Kms	14.116	12.716	3.526	14.116	The 3.526 Km new service roads shall be constructed Authority as mentioned in SCH-A
5	Bypass	Kms	-	23.186	-	-	
6	Toll Plaza	Nos.	2	2	-	2	
7	No. of Lanes (Both side)	Nos.	26	8+18	-	8+18	Includes reversible lanes
8	ROBs	Nos.	1	1	-	1	
9	Flyovers	Nos.	1	1	-	1	
10	VUPs	Nos.	10	10	-	10	
11	PUP's/CUP's	Nos.	8	8	-	8	
12	AUP	Nos.	14	14	-	14	
13	Major Bridges	Nos.	3	3	-	3	
14	Minor Bridges	Nos.	31	31	-	31	
15	Culverts (Pipe)	Nos.	109	111	-	109	
16	Culvert (Slab/Box)	Nos.	5/51	5/51	-	5/51	
17	Major Junctions	Nos.	12	12	-	12	
18	Minor junctions	Nos.	75	69	-	75	
19	Embankment	Kms	0.690	-	-	0.690	
20	Stone Pitching	Kms	39.960	-	-	39.960	
21	RCC Wall	Kms	0.360	-	-	0.360	
22	RE wall with Stone Pitching	Kms	0.790	-	-	0.790	
23	Bus Bays with Shelter	Nos.	8	-	-	8	
24	Bus Shelters	Nos.	14	14	-	14	
25	Bus Bays	Nos.	0	5	-	0	
26	Truck Laybye	Nos.	4	4	-	4	At 2 locations

S. No.	Particulars	Length/ Nos.	Total for O&M Estimation	As per Schedule-A	As per Schedule-A/B	As per Site	Remarks
27	High Mast Lights	Nos.	6	-	-	6	
28	Low Mast Lights	Nos.	14	-	-	14	
29	Highway Lighting (length only)	Kms	16.207	-	12.669	8.270	
30	Single Arm Lightnings	Nos.	877	-	697	180	
31	Double Arm Lightnings	Nos.	450	-	367	83	
32	Solar Blinkers	Nos.	197	-	70	127	
33	RCC Cover Drain	Kms	13.880	14.037	1.470	12.410	
34	RCC Open Line Drain	Kms	1.35	-	1.350	-	
35	Median drain	Kms	3.800	2.073	-	3.800	
36	Median Cuts	Nos.	2501	-	-	2501	
37	Chutes	Nos.	1956.5	-	-	1956.5	
38	Median Opening	Nos.	62	62	47	62	
39	Median Kerb Damages	Kms	435.000	-	-	435.000	
40	Median Plantation Functional	Kms	93.752	-	-	93.752	
41	Median Plantation_ Non-Functional	Kms	1.518	-	-	1.518	
42	Road Markings	Kms	106.370	-	-	106.370	
43	W-Beam Safety Barriers	Kms	76.179	-	26.109	50.070	
44	Rigid Concrete Barriers	Kms	60.880	-	-	60.880	
45	Hand Railing on Crash Barriers	Kms	0.920	-	-	0.920	
46	Pedestrian Guard Rails	Kms	14.950	-	8.190	6.760	
47	Delineators	Nos.	186	-	-	186	
48	Kilometer Stones	Nos.	212	-	-	212	
49	Hectometer Stones	Nos.	852	-	-	852	
50	Road Signs	Nos.	4861	-	3000	1861	
51	Gantry Sign Boards	Nos.	8	-	2	6	
52	Cantilever Sign Boards	Nos.	30	-	8	22	
53	Varying Message Signs (VMS)	Nos.	4	-	2	2	
54	Edge Kerb in High embankment locations	Kms	37.160	-	-	37.160	
55	Noise Barriers	Kms	43.700	-	-	43.700	
56	ECB	Nos.	108	4	108	-	

In the project stretch, the Service Roads/Slip Roads with an overall length of km 14.116 km have been observed. The service roads having the width of 5.5m and 7.0m with flexible and cc pavements. The summary of service roads and slip roads are presented in the table below and the location details are presented in the **Appendix-6** of this report.

Table 12: Details of Service Roads/Slip Roads along Project Road

Summary	Schedule-A (Km)	As Per Site	Remarks
MP-2 Section	6.598	5.080	

Delinked Section	-	-	
MP-3 Section	2.58	2.640	
Seoni MP-MH Border Section	3.538	6.396	
Total	12.716	14.116	

RCC Lined Covered drains are exist along the project road. Covered slab was missing & damage observed above the lined drain locations, cleaning need to be required. The summary of **RCC Covered Drains** is presented in the table below and the location details are presented in the **Appendix-6** of this report.

Table 13: RCC Covered Drains

Summary	RCC Drain As per Sch-A (Km)	RCC Drain As per Site (Km)
MP-2 Section	5.868	4.130
Delinked Section	-	-
MP-3 Section	2.075	2.290
Seoni MP-MH Border Section	6.094	5.990
Damage	-	0.010

Partial RCC walls, Partial RE walls and Full Height RE walls are found in approaches of some of the underpass, High embankment, Minor Bridges along the Project Corridor. The summary of the slope protection table was presented below and the location details are presented in the **Appendix-6** of this report.

Table 14: Summary of Slope Protection along Project Road

Summary	RE Wall with Stone Pitching	Embankment	Stone Pitching	RCC Wall
MP-2 Section	0.790	0.150	18.835	0.050
Delinked Section	-	0.540	0.150	-
MP-3 Section	-	-	20.975	-
Seoni MP-MH Border Section	-	-	-	0.310

In general, the median width is 4.5m. As per site 62 No of Median openings are observed in that 36 Nos. of Normal Lane & 26 No's of Reserved Lane Median Openings are Observed. For the reserve lane locations, the width of the reserved lane is 4.0m. The summary of Median Openings is presented in the table below and the location details are presented in the **Appendix-6** of this report.

Table 15: Details of Median Openings along Project Road

Summary	As Per Schedule-A	Normal Lane As per Site	Reserve Lane As per Site
MP-2 Section	21	18	4
Delinked Section	4	2	1
MP-3 Section	19	6	14
Seoni MP-MH Border Section	18	10	7
Total	62	36	26

The Project Road has 12 Nos. of Major Junctions and 75 Nos. of Minor Junctions. The summary of Major Junctions and Minor Junctions is presented in the table below and the location details are presented in the **Appendix-6** of this report.

Table 16: List of Major Junctions

Summary	Schedule-A	As Per Site
MP-2 Section	6	6
Delinked Section	-	-
MP-3 Section	5	5
Seoni MP-MH Border Section	1	1
Total	12	12

Table 17: List of Minor Junctions

Summary	Schedule-A	As Per Site
MP-2 Section	30	32
Delinked Section	4	4
MP-3 Section	17	18
Seoni MP-MH Border Section	18	21
Total	69	75

Safety Barriers are provided at Minor Bridges, Culverts and Underpasses (VUP, PUP and LVUP), approach Locations and Built-Up Areas. The table below shows the summary of Safety Barriers provided along the project corridor and the summary is presented in the table below. The location details is presented in the **Appendix-6** of this report:

Table 18: Summary of Safety Barriers

S. No.	Description	Length (Kms)
1	W-Beam Safety Barriers	50.070
2	Concrete Crash Barriers	60.880
3	Pedestrian Guard Railings	6.760
4	Concrete Crash Railing	0.920
5	Noise Barrier	43.700

Table 19: W-Beam Safety Barriers

Summary	As Per Schedule-A	MCB as per site (Km)
MP-2 Section	-	19.930
Delinked Section	-	1.340
MP-3 Section	-	26.140
MP-3 Section (Loops & Ramps)		2.050
Seoni MP-MH Border Section	-	0.610
Total	-	50.070
Damage	-	3.250

Table 20: Concrete Crash Barriers along Project Road

Summary	As Per Schedule-A	CCB as per site (Kms)
MP-2 Section	-	3.540
Delinked Section	-	0.280
MP-3 Section	-	1.800

Seoni MP-MH Border Section	-	55.260
Total	-	60.880
Damage	-	0.070

Pedestrian Guard Railing (PGR) were observed on the separator between the Carriageway and Service Road. Along the project corridor, the summary is presented in the table below. The location details is presented in the **Appendix-6** of this report:

Table 21: List of Pedestrian Guard Rails

Summary	As Per Schedule-A	PGR as per site (Kms)
MP-2 Section	-	-
Delinked Section	-	
MP-3 Section	-	-
Seoni MP-MH Border Section	-	6.760
Total	-	6.760
Damage	-	0.230

Table 22: List of Concrete Crash Railing

Summary	As Per Schedule-A	CCR as per Site (Kms)
MP-2 Section	-	0.120
Delinked Section	-	
MP-3 Section	-	0.600
Seoni MP-MH Border Section	-	0.200
Total	-	0.920
Damage	-	0.120

Table 23: List of Noise Barrier

Summary	As Per Schedule-A	Noise Barrier as per site (Km)
MP-2 Section	-	-
Delinked Section	-	
MP-3 Section	-	-
Seoni MP-MH Border Section	-	**43.700**
Total	-	**43.700**
Damage	-	**0.020**

Road furniture in the form of High masts, Highway Lighting and Sign boards have been provided along the project road. The list of all road items has been furnished in **Appendix-6** of this report.

The tables below depict the summary of few Road Furniture items and the location wise details are provided.

Table 24: Locations of Highway Lighting

Summary	High mast (No's)	Low mast (No's)	Single Arm (No's)	Double Arm (No's)
MP-2 Section	2	3	-	-
Delinked Section	-	-	-	-
MP-3 Section	-	-	56	-
Seoni MP-MH Border Section	4	-	124	83
Damage	-	-	4	-

Table 25: Details of Road Signs along Project Road

Summary	As per Site LHS	As per Site RHS	AS per Site Toll Boards
MP-2 Section	186	189	5
Delinked Section	71	61	-
MP-3 Section	145	116	-
Seoni MP-MH Border Section	553	472	16
MP-2 Section	-	-	-
Damage	20	21	-

The project road has total 22 Nos. of Bus Bays & Bus shelters on Highway. In that 8 Nos. are Bus Bay with shelters & 14 Nos. are Bus Shelters. Flexible pavement is provided at Bus Bay locations.The summary is presented in the table below:

Table 26: Details of Bus Bays with Shelters

Summary	As per Sch-A (No's)	Bus Bay with Shelters as per Site	Bus Shelters as per site
MP-2 Section	**4**	**4**	**-**
Delinked Section	**-**	**-**	**-**
MP-3 Section	**5**	**4**	**2**
Seoni MP-MH Border Section	**13**	**-**	**12**

The Project Road has 4 Nos. Truck lay byes in two locations on either side of Highway. The Truck lay bye has been provided with rigid pavement and the condition appears to be fair to poor. Separator is provided between main carriageway and truck lay bye portion and the summary is presented in the table below. The location details is presented in the **Appendix-6** of this report:

Table 27: Details of Truck lay byes

Summary	As per Sch-A (No's)	As per Site (No's)
MP-2 Section	2	2
Delink Section	-	-
MP-3 Section	2	2
MP-MH Section	-	-

3.2. STRUCTURES

List of Structures found during the inventory surveys along the corridor are as follows:

Table 28: Summary of Structures as per CA & Site

S.No	Type of Str	No.of Structure Locations								Total No.of Str Locations		Remarks
		MP-2 Package (Km 547.400 to Km 596.750)		MP-2 Package (Delink section)		MP-3 Package (Km 596.750 to Km 624.500)		MP-MH Border (Km 624.500 to Km 653+770)				
		CA	Site	CA	Site	CA	Site	CA	Site	CA	Site	
1	ROB	-	-	-	-	1	1	-	-	1	1	-
2	MJB	2	2	-	-	-	-	1	1	3	3	-
3	MNB	8	8	4	4	9	9	10	10	31	31	-
4	AUP	-	-	-	-	-	-	14	14	14	14	-
5	Flyover	-	-	-	-	1	1	-	-	1	1	-
6	VUP	4	4	-	-	6	6	-	-	10	10	-
7	CUP	3	3	-	-	5	5	-	-	8	8	-
8	BC	16	16	-	-	1	1	34	34	51	51	-
9	SC	5	5	-	-	-	-	-	-	5	5	-
10	PC	41	41	24	24	19	17	27	27	111	109	-
Total No's		79	79	28	28	40	40	86	86	233	233	

Table 29: Age of Structures

S.No	Type of Str	MP-2 Package		MP-2 Package (Delink section)		MP-3 Package		MP-MH Border		Total No's of Str's	
		Old	New	Old	New	Old	New	Old	New	Old	New
1	ROB	-	-	-	-	-	2	-	-	-	2
2	MJB	-	4	-	-	-	-	-	2	-	6
3	MNB	7	9	-	8	3	15	1	19	11	51
4	AUP	-	-	-	-	-	-	-	28	-	28
5	Flyover	-	-	-	-	-	2	-	-	-	2
6	VUP	-	8	-	-	-	12	-	-	-	22
7	CUP	-	6	-	-	-	10	-	-	-	14
Total No's		**7**	**27**	**0**	**8**	**3**	**41**	**1**	**49**	**11**	**125**
		34		8		44		50		136	

Table 30: Summary of Bearings

S.No	Type of Str	MP-2 Package			MP-2 Package Delink section		MP-3 Package		MP-MH Border		Total No's
		Pot PTFE	Elastomeric	Rocker Roller	Pot PTFE	Elastomeric	Pot PTFE	Elastomeric	Pot PTFE	Elastomeric	
1	ROB	-	-	-	-	-	16	-	-	-	16
2	MJB	-	208	-	-	-	-	-	40	-	248
3	MNB	-	30	8	-	-	-	-	-	-	38
4	AUP	-	-	-	-	-	-	-	40	2212	2252
Total No's		**0**	**238**	**8**	**0**	**0**	**16**	**0**	**80**	**2212**	**2554**
		246			**0**		**16**		**2292**		

Table 31: Summary of Expansion Joints

S.No	Type of Str	MP-2		MP-2 Delink section		MP-3		MP-MH Border		Total No's
		Old	New	Old	New	Old	New	Old	New	
1	ROB	-	-	-	-	-	4	-	-	4
2	MJB	-	30	-	-	-	-	-	6	36
3	MNB	4	6	-	-	-	-	-	-	10
4	AUP	-	-	-	-	-	-	-	258	258
Total No's		**4**	**36**	**0**	**0**	**0**	**4**	**0**	**264**	**308**

List of Bridges and Structures for **MP-2 Package (Km 547.400 to Km 596.750)**

Table 32: Details of Major Bridges

S. No.	Site Chainage (Km)	Type of Str	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Skew (Y/N)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
1	554+946	MJB	LHS	MCW	New	3x29.6	12	No	Not Visible	RCC Wall Type	Single Circular Column Type	PSC Girder	Elastomeric
2	554+946	MJB	RHS	MCW	New	3x29.6	12	No	Not Visible	RCC Wall Type	Single Circular Column Type	PSC Girder	Elastomeric
3	570+880	MJB	LHS	MCW	New	10x29.6	12	No	Not Visible	RCC Wall Type	Single Circular Column Type	PSC Girder	Elastomeric
4	570+880	MJB	RHS	MCW	New	10x29.6	12	No	Not Visible	RCC Wall Type	Single Circular Column Type	PSC Girder	Elastomeric

Table 33: Details of Minor Bridges

S. No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Skew (Y/N)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
1	556+872	MNB	LHS	MCW	New	5x6.8	12	Yes	Open	RCC Wall Type	RCC Wall Type	RCC Slab	-
2	556+872	MNB	RHS	MCW	Old	5x6.8	12.6	Yes	Open	RCC Wall Type	RCC Wall Type	RCC Slab	-

S. No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Skew (Y/N)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
3	567+872	MNB	LHS	MCW	New	1x11.82	12	No	Open	RCC Wall Type	-	RCC Slab	-
4	567+872	MNB	RHS	MCW	New	1x11.82	12	No	Open	RCC Wall Type	-	RCC Slab	-
5	574+671	MNB	LHS	MCW	New	1x19.82	12	No	Open	RCC Wall Type	-	RCC Girder	Elastomeric
6	574+671	MNB	RHS	MCW	Old	1x19.82	8.4	No	Open	RCC Wall Type	-	RCC Girder	Elastomeric
7	576+642	MNB	LHS	MCW	New	1x22.24	12	No	Not Visible	RCC Wall Type	-	RCC Girder	Elastomeric
8	576+642	MNB	RHS	MCW	Old	2x11.5	12	No	Not Visible	RCC Wall Type	RCC Wall Type	RCC Slab	-
9	579+109	MNB	LHS	MCW	Old	1x15.24	12	No	Open	RCC Wall Type	-	RCC Girder	Rocker Roller
10	579+109	MNB	RHS	MCW	New	1x15.24	12	No	Open	RCC Wall Type	-	RCC Girder	Elastomeric
11	592+151	MNB	LHS	MCW	New	3x8.8	12	No	Open	RCC Wall Type	-	RCC Slab	-
12	592+151	MNB	RHS	MCW	Old	3x8.8	12	No	Open	RCC Wall Type	-	RCC Slab	-
13	596+040	MNB	LHS	MCW	New	1x11.42	12	No	Open	RCC Wall Type	-	RCC Slab	-
14	596+040	MNB	RHS	MCW	Old	1x11.42	12	No	Open	RCC Wall Type	-	RCC Slab	-
15	596+436	MNB	LHS	MCW	New	3x10.8	12	No	Open	RCC Wall Type	RCC Wall Type	RCC Slab	-
16	596+436	MNB	RHS	MCW	Old	3x10.8	12	No	Open	RCC Wall Type	RCC Wall Type	RCC Slab	-

Table 34: Details of VUP's

S. No.	Site Chainage (Km)	Type of Str	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure
									Abutment	Pier	
1	555+105	VUP	LHS	MCW	New	1x12	12	Open	RCC Wall Type	-	RCC Slab
2	555+105	VUP	RHS	MCW	New	1x12	12	Open	RCC Wall Type	-	RCC Slab
3	568+895	VUP	LHS	MCW	New	1x12	12	Open	RCC Wall Type	-	RCC Slab
4	568+895	VUP	RHS	MCW	New	1x12	12	Open	RCC Wall Type	-	RCC Slab
5	570+074	VUP	LHS	MCW	New	1x12	12	Open	RCC Wall Type	-	RCC Slab
6	570+074	VUP	RHS	MCW	New	1x12	12	Open	RCC Wall Type	-	RCC Slab
7	572+085	VUP	LHS	MCW	New	1x12	12	Open	RCC Wall Type	-	RCC Slab
8	572+085	VUP	RHS	MCW	New	1x12	12	Open	RCC Wall Type	-	RCC Slab

Table 35: Details of CUP's

S. No.	Site Chainage (Km)	Type of Str	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure
									Abutment	Pier	
1	568+575	CUP	LHS	MCW	New	1x6	12	Raft	RCC Box		
2	568+575	CUP	RHS	MCW	New	1x6	12	Raft	RCC Box		
3	583+222	CUP	LHS	MCW	New	1x6	12	Raft	RCC Box		
4	583+222	CUP	RHS	MCW	New	1x6	12	Raft	RCC Box		
5	587+258	CUP	LHS	MCW	New	1x6	12	Raft	RCC Box		
6	587+258	CUP	RHS	MCW	New	1x6	12	Raft	RCC Box		

List of Bridges and Structures for **MP-3 Package (Km 596.750 to Km 624.500)**

Table 36: Details of Major Bridges

S. No.	Site Chainage (Km)	Type of Str	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Skew (Y/N)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
										Abutment	Pier		
1	649+000	MJB	LHS	MCW	New	2 x 35.0	16.00	No	Open	RCC Wall Type	RCC Wall Type	PSC Girder	Pot PTFE

2	649+000	MJB	RHS	MCW	New	2 x 35.0	16.00	No	Open	RCC Wall Type	RCC Wall Type	PSC Girder	Pot PTFE

Table 37: Details of Minor Bridges

S. No.	Site Chainage (Km)	Type of Str	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Skew (Y/N)	Type of Foundation	Type of Substructure		Type of Superstructure
										Abutment	Pier	
1	629+122	MNB	LHS	MCW	New	2 x 10.0	12.50	No	Raft	-	-	RCC Box
2	629+122	MNB	RHS	MCW	New	2 x 10.0	12.50	No	Raft	-	-	RCC Box
3	631+987	MNB	LHS	MCW	New	1 x 10.0	14.25	No	Raft	-	-	RCC Box
4	631+987	MNB	RHS	MCW	New	1 x 10.0	14.25	No	Raft	-	-	RCC Box
5	638+694	MNB	LHS	MCW	New	4 x 10.0	12.50	Yes	Raft	-	-	RCC Box
6	638+694	MNB	RHS	MCW	New	4 x 10.0	12.50	Yes	Raft	-	-	RCC Box
7	639+264	MNB	LHS	MCW	New	3 x 8.330	12.50	No	Raft	-	-	RCC Box
8	639+264	MNB	RHS	MCW	New	3 x 8.330	12.50	No	Raft	-	-	RCC Box
9	641+982	MNB	LHS	MCW	New	2 x 6.0	12.50	No	Raft	-	-	RCC Box
10	641+982	MNB	RHS	MCW	New	2 x 6.0	12.50	No	Raft	-	-	RCC Box
11	642+896	MNB	LHS	MCW	New	4 x 9.0	12.50	No	Raft	-	-	RCC Box
12	642+896	MNB	RHS	MCW	Old	3 x 12	12.50	No	Open	RCC Wall Type	RCC Wall Type	RCC Slab
13	646+109	MNB	LHS	MCW	New	2 x 6.0	12.50	No	Raft	-	-	RCC Box
14	646+109	MNB	RHS	MCW	New	2 x 6.0	12.50	No	Raft	-	-	RCC Box
15	648+059	MNB	LHS	MCW	New	2 x 5.0	12.50	No	Raft	-	-	RCC Box
16	648+059	MNB	RHS	MCW	New	2 x 5.0	12.50	No	Raft	-	-	RCC Box
17	653+037	MNB	LHS	MCW	New	3 x 7.4	12.50	No	Raft	-	-	RCC Box
18	653+037	MNB	RHS	MCW	New	3 x 7.4	12.50	No	Raft	-	-	RCC Box
19	653+220	MNB	LHS	MCW	New	6 x 8.3	12.50	No	Raft	-	-	RCC Box
20	653+220	MNB	RHS	MCW	New	6 x 8.3	12.50	No	Raft	-	-	RCC Box

Table 38: Details of AUP's

S. No.	Site Chainage (Km)	Type of Str	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
									Abutment	Pier		
1	626+915	AUP	LHS	MCW	New	1 x 25 + 12 x 30 + 1 x 25 + 3 x 30	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	RCC Girder & PSC Girder	Elastomeric
2	626+915	AUP	RHS	MCW	New	1 x 25 + 12 x 30 + 1 x 25 + 3 x 30	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	RCC Girder & PSC Girder	Elastomeric
3	630+727	AUP	LHS	MCW	New	1 x 25 + 45 x 30 + 1 x 25	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	RCC Girder & PSC Girder	Elastomeric
4	630+727	AUP	RHS	MCW	New	1 x 25 + 45 x 30 + 1 x 25	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	RCC Girder & PSC Girder	Elastomeric
5	632+050	AUP	LHS	MCW	New	2 x 35.0	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	PSC Girder	Pot PTFE
6	632+050	AUP	RHS	MCW	New	2 x 35.0	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	PSC Girder	Pot PTFE
7	632+356	AUP	LHS	MCW	New	3 x 30	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	PSC Girder	Elastomeric
8	632+356	AUP	RHS	MCW	New	3 x 30	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	PSC Girder	Elastomeric
9	632+634	AUP	LHS	MCW	New	3 x 30	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	PSC Girder	Elastomeric
10	632+634	AUP	RHS	MCW	New	3 x 30	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	PSC Girder	Elastomeric
11	632+790	AUP	LHS	MCW	New	2 x 30	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	PSC Voided Slab	Elastomeric
12	632+790	AUP	RHS	MCW	New	2 x 30	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	PSC Voided Slab	Elastomeric
13	633+510	AUP	LHS	MCW	New	2 x 30	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	PSC Voided Slab	Elastomeric
14	633+510	AUP	RHS	MCW	New	2 x 30	14.50	Open	RCC Rectangular Column Type	RCC Rectangular	PSC Voided Slab	Elastomeric

S. No.	Site Chainage (Km)	Type of Str	Side	Str on	Age of Str	Span Arrangement (m)	Deck Width (m)	Type of Foundation	Type of Substructure		Type of Superstructure	Type of Bearings
									Abutment	Pier		
										Column Type		
15	634+330	AUP	LHS	MCW	New	2 x 30	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	PSC Voided Slab	Elastomeric
16	634+330	AUP	RHS	MCW	New	2 x 30	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	PSC Voided Slab	Elastomeric
17	634+637	AUP	LHS	MCW	New	3 x 25	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	PSC Voided Slab	Elastomeric
18	634+637	AUP	RHS	MCW	New	3 x 25	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	PSC Voided Slab	Elastomeric
19	635+160	AUP	LHS	MCW	New	2 x 30	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	PSC Voided Slab	Elastomeric
20	635+160	AUP	RHS	MCW	New	2 x 30	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	PSC Voided Slab	Elastomeric
21	635+680	AUP	LHS	MCW	New	1 x 30	14.50	Open	RCC Rectangular Column Type	-	PSC Voided Slab	Elastomeric
22	635+680	AUP	RHS	MCW	New	1 x 30	14.50	Open	RCC Rectangular Column Type	-	PSC Voided Slab	Elastomeric
23	636+075	AUP	LHS	MCW	New	4 x 30	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	PSC Girder	Elastomeric
24	636+075	AUP	RHS	MCW	New	4 x 30	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	PSC Girder	Elastomeric
25	643+726	AUP	LHS	MCW	New	1 x 25 + 15 x 30 + 1 x 25	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	RCC Girder & PSC Girder	Elastomeric
26	643+726	AUP	RHS	MCW	New	1 x 25 + 15 x 30 + 1 x 25	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	RCC Girder & PSC Girder	Elastomeric
27	652+500	AUP	LHS	MCW	New	10 x 30	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	PSC Girder	Elastomeric
28	652+500	AUP	RHS	MCW	New	10 x 30	14.50	Open	RCC Rectangular Column Type	RCC Rectangular Column Type	PSC Girder	Elastomeric

Table 39: Summary of Culverts:

S.No.	Design Chainage (Km)	Type of Culvert	Side	Str. On	Span Arrangement (No x Length)	Deck Width (m)	Quadrant Stone Pitching (Yes/No)		Floor Protection (Yes/No)		Observations
							LHS	RHS	LHS	RHS	
1	624+674	BC	BHS	MCW	1 x 3.0	26.00	Yes	Yes	Yes	Yes	> No access to inspect culvert.
2	625+451	BC	BHS	MCW	1 x 3.0	26.00	Yes	Yes	Yes	Yes	> No access to inspect culvert.
3	625+686	BC	BHS	MCW	1 x 3.0	26.00	Yes	Yes	Yes	Yes	> No access to inspect culvert.
4	626+094	PC	BHS	MCW	2 x 1.2	23.75	No	No	Yes	Yes	> No access to inspect culvert.
5	626+439	PC	BHS	MCW	1 x 1.2	31.25	No	No	Yes	Yes	> No access to inspect culvert.
6	626+525	PC	BHS	MCW	1 x 1.2	30.00	No	No	No	No	> No access to inspect culvert.
7	626+880	PC	BHS	MCW	1 x 1.2	30.00	No	No	Yes	No	> No access to inspect culvert.
8	627+011	PC	BHS	MCW	1 x 1.2	28.75	No	No	Yes	No	> No access to inspect culvert.
9	627+850	PC	BHS	MCW	1 x 1.2	26.25	No	No	Yes	Yes	> No access to inspect culvert.
10	628+548	PC	BHS	MCW	1 x 1.2	25.00	No	No	Yes	Yes	> No access to inspect culvert.
11	629+282	PC	BHS	MCW	1 x 1.2	28.75	No	No	Yes	Yes	> Vegetation growth observed on BHS.
12	631+519	PC	BHS	MCW	1 x 1.2	31.25	No	No	Yes	Yes	> No access to inspect culvert.
13	631+654	PC	BHS	MCW	1 x 1.2	31.27	No	No	Yes	Yes	> No access to inspect culvert.
14	632+183	BC	BHS	MCW	1 x 2.0	30.00	No	No	Yes	Yes	> No access to inspect culvert.
15	632+244	BC	BHS	MCW	1 x 2.0	30.80	No	No	Yes	Yes	> No access to inspect culvert.
16	632+436	PC	BHS	MCW	1 x 1.2	32.00	No	No	Yes	Yes	> No access to inspect culvert.
17	632+497	BC	BHS	MCW	1 x 2.0	32.55	No	No	Yes	Yes	> No access to inspect culvert.
18	632+532	BC	BHS	MCW	1 x 2.0	31.90	No	No	Yes	Yes	> No access to inspect culvert.
19	632+914	BC	BHS	MCW	1 x 2.0	30.95	No	No	Yes	Yes	> No access to inspect culvert.
20	632+988	BC	BHS	MCW	1 x 2.0	31.10	No	No	Yes	Yes	> No access to inspect culvert.
21	633+055	BC	BHS	MCW	1 x 2.0	29.50	No	No	Yes	Yes	> No access to inspect culvert.
22	633+185	BC	BHS	MCW	1 x 2.0	32.30	No	No	No	No	> No access to inspect culvert.
23	633+327	BC	BHS	MCW	1 x 2.0	32.40	No	No	No	No	> No access to inspect culvert.
24	633+582	BC	BHS	MCW	1 x 3.0	30.70	No	No	No	No	> No access to inspect culvert.
25	633+710	PC	BHS	MCW	1 x 1.2	30.00	No	No	Yes	Yes	> No access to inspect culvert.
26	633+821	BC	BHS	MCW	1 x 6.0	33.00	No	No	Yes	Yes	> No access to inspect culvert.
27	634+008	BC	BHS	MCW	1 x 3.0	30.00	No	No	No	No	> No access to inspect culvert.
28	634+108	BC	BHS	MCW	1 x 2.0	31.30	No	No	Yes	Yes	> No access to inspect culvert.
29	634+158	BC	BHS	MCW	1 x 2.0	31.30	No	No	Yes	Yes	> No access to inspect culvert.
30	634+519	PC	BHS	MCW	1 x 1.2	31.27	No	No	Yes	Yes	> No access to inspect culvert.
31	634+540	PC	BHS	MCW	1 x 1.2	30.00	No	No	Yes	Yes	> No access to inspect culvert.
32	634+695	BC	BHS	MCW	1 x 6.0	34.75	No	No	Yes	Yes	> No access to inspect culvert.
33	634+849	BC	BHS	MCW	1 x 3.0	32.21	No	No	No	No	> No access to inspect culvert.
34	635+110	BC	BHS	MCW	1 x 2.0	29.85	No	No	Yes	Yes	> No access to inspect culvert.
35	635+276	BC	BHS	MCW	1 x 3.0	30.00	No	No	No	No	> No access to inspect culvert.
36	635+300	BC	BHS	MCW	1 x 3.0	33.00	No	No	Yes	No	> No access to inspect culvert.
37	635+502	BC	BHS	MCW	1 x 6.0	30.65	No	No	Yes	Yes	> No access to inspect culvert.
38	635+760	BC	BHS	MCW	1 x 6.0	30.50	No	No	Yes	Yes	> No access to inspect culvert.
39	635+960	PC	BHS	MCW	1 x 1.2	31.25	No	No	Yes	Yes	> No access to inspect culvert.
40	636+310	PC	BHS	MCW	1 x 1.2	31.25	No	No	Yes	Yes	> No access to inspect culvert.
41	636+708	BC	BHS	MCW	1 x 3.0	26.00	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
42	637+299	BC	BHS	MCW	2 x 3.0	24.50	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
43	637+826	BC	BHS	MCW & SR	1 x 2.0	37.50	No	No	Yes	Yes	> Culvert is in fair condition.
44	639+562	PC	BHS	MCW	1 x 1.2	30.00	No	No	Yes	Yes	> Culvert is in fair condition. > Vegetation growth observed on BHS.
45	639+855	BC	BHS	MCW	1 x 6.0	26.00	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
46	641+037	BC	BHS	MCW	1 x 3.0	26.71	Yes	Yes	Yes	Yes	> Culvert is in fair condition.

S.No.	Design Chainage (Km)	Type of Culvert	Side	Str. On	Span Arrangement (No x Length)	Deck Width (m)	Quadrant Stone Pitching (Yes/No)		Floor Protection (Yes/No)		Observations
							LHS	RHS	LHS	RHS	
47	642+171	BC	BHS	MCW	1 x 3.0	26.00	Yes	Yes	Yes	Yes	> Culvert is in fair condition.
48	644+159	PC	BHS	MCW	2 x 1.2	31.25	No	No	Yes	Yes	> No access to inspect culvert.
49	644+252	PC	BHS	MCW	2 x 1.2	31.25	No	No	No	No	> No access to inspect culvert.
50	646+591	BC	BHS	MCW	1 x 5.0	26.00	No	Yes	Yes	Yes	> No access to inspect culvert.
51	647+122	PC	BHS	MCW	2 x 1.2	32.50	No	No	Yes	Yes	> No access to inspect culvert.
52	647+278	PC	BHS	MCW	2 x 1.2	35.00	No	No	Yes	Yes	> No access to inspect culvert.
53	647+456	PC	BHS	MCW	1 x 1.2	36.25	No	No	Yes	Yes	> No access to inspect culvert.
54	647+628	BC	BHS	MCW	1 x 5.0	26.00	Yes	Yes	Yes	Yes	> No access to inspect culvert.
55	648+265	PC	BHS	MCW	1 x 1.2	28.75	No	No	Yes	Yes	> Culvert is in fair condition.
56	650+350	PC	BHS	MCW	1 x 1.2	33.75	No	No	Yes	Yes	> Vegetation growth observed on BHS.
57	650+953	PC	BHS	MCW	2 x 1.2	33.75	No	No	Yes	Yes	> Culvert is in fair condition.
58	651+666	PC	BHS	MCW	1 x 1.2	80.00	No	No	No	Yes	> Culvert is in fair condition.
59	652+847	BC	BHS	MCW	1 x 2.0	29.85	No	No	No	No	> No access to inspect culvert.
60	653+555	BC	BHS	MCW	1 x 3.0	30.50	Yes	Yes	Yes	Yes	> No access to inspect culvert.
61	653+641	PC	BHS	MCW	1 x 1.2	28.75	No	No	Yes	Yes	> No access to inspect culvert.

4.1 EMBANKMENT & SUBGRADE

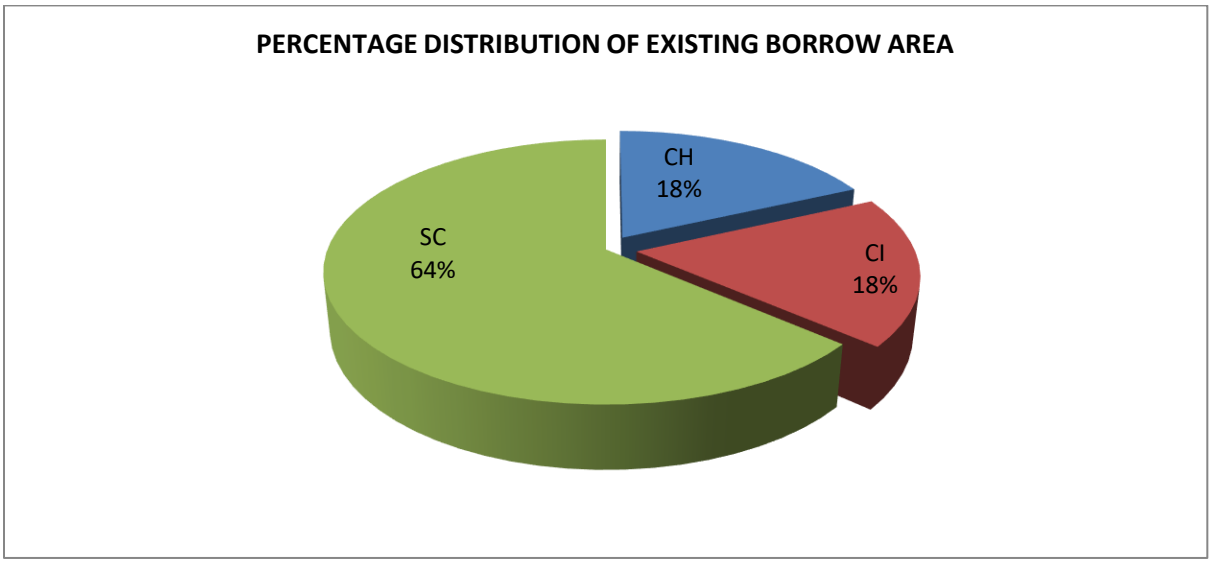
The embankment for project road has been constructed with available soils from nearby areas. No major settlements or depressions have been noted even at high embankment locations. There are no marshy/water logging areas along the length of project road.

Borrow pits sample reveal that the soil collected primarily belong to coarse grain soil type. Out of 11 samples 7 samples belongs to SC type of soil, 2 samples belong to CH type of soil and 2 samples belongs to CI type of soil. The test results of borrow area soils related to soil classification, Atterberg limits and other properties are as presented below.

Table 40: Test Results of Borrow area Samples Details

Lab Sample No	Site Identification		Grain Size Analysis					Atterberg Limits (%)			Soil Class	MDD (gm/cc)	OMC (%)	Dry Density at 97% MDD	Soaked CBR 97% MDD Average	Free Swelling Index (%)
	Location (km)	Up/Dn	Percentage passing from					LL	PL	PI						
			4.75 mm IS Sieve	425 mic IS Sieve	75 mic IS Sieve	Gravel %	Sand %									
LK-BP-1	639+400	RHS	92.99	33.29	21.38	7.01	71.61	33	20	13	SC	2.04	8.20	1.98	21.31	20
LK-BP-2	620+000	LHS	86.29	53.23	51.52	13.71	34.77	48	29	19	CI	1.86	16.40	1.80	4.71	45
LK-BP-3	610+900	RHS	98.65	82.17	72.22	1.35	26.43	58	35	23	CH	1.49	28.40	1.45	NA	52
LK-BP-4	606+300	LHS	79.9	36.46	35.05	20.10	44.85	49	27	22	SC	2.06	14.20	2.00	18.09	23
LK-BP-5	594+000	LHS	86.75	67.19	53.9	13.25	32.85	40	26	14	CI	1.86	16.40	1.80	9.14	23
LK-BP-6	572+500	RHS	80.52	48.19	36.73	19.48	43.79	33	23	10	SC	1.99	14.00	1.93	12.34	14
LK-BP-7	584+500	LHS	72.68	46.35	39.73	27.32	32.95	42	25	17	SC	1.85	13.60	1.79	12.24	15
LK-BP-8	557+300	RHS	90.08	58.47	42.21	9.92	47.87	46	30	16	SC	1.81	13.04	1.76	13.11	33
LK-BP-9	554+100	RHS	88.87	69.19	50.53	11.13	38.34	53	31	22	CH	1.70	19.00	1.65	NA	55
LK-BP-10	547+400	LHS	75.13	43.04	34.88	24.87	40.25	47	30	17	SC	1.76	16.60	1.71	8.59	30
LK-BP-11	648+400	LHS	96.24	54.91	41.08	3.76	55.16	43	23	20	SC	1.95	10.00	1.89	9.47	40

Pie Chart showing the percentage distribution of soil classification of Borrow area sample is presented below:

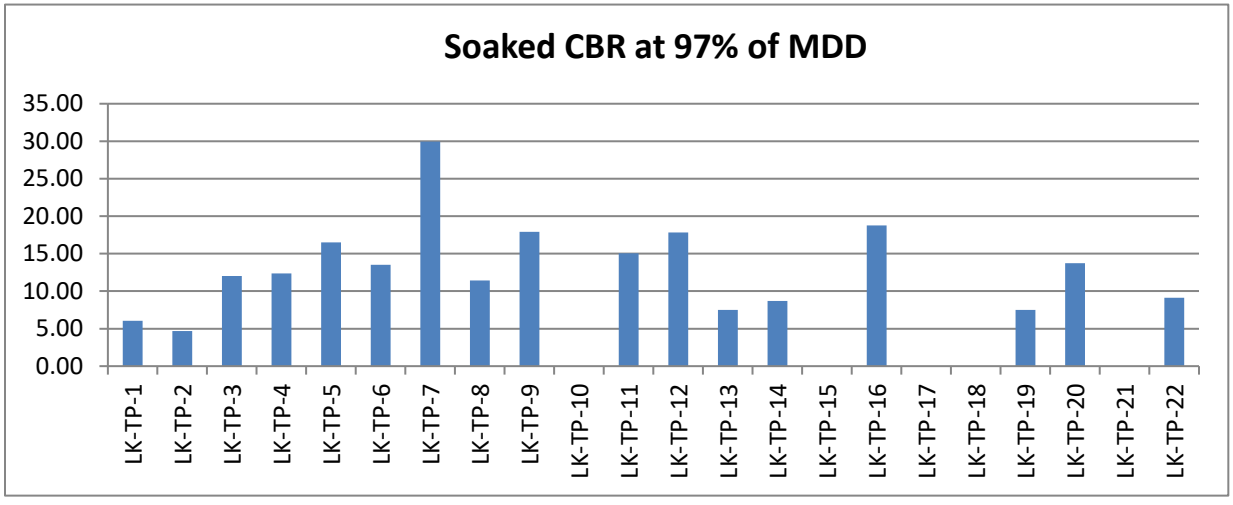


Laboratory test results indicate that all the Subgrade soil samples collected belongs to Coarse Grained Soil. Out of 22 samples, 13 samples belong to SC type of soil, 4 samples belongs to CI type of soil, 3 samples belongs to CH type of soil, 1 sample belongs to SM type of soil and 1 sample belongs to SM-SC type of soil.

The subgrade of the project road appears to be in good condition as revealed by test pit investigations. Soil classification has been done according to IS Classification of Soils (ISC) as detailed in IS 1498 - 1978.The percentage distribution of existing subgrade soil, soaked CBR values and other properties are presented below

Lab Sample No	Site Identification		Grain Size Analysis					Atterberg Limits (%)			Soil Class	MDD (gm/cc)	OMC (%)	FDD (gm/cc)	COMPACTION (%)	Dry Density at 97% MDD	Soaked CBR 97% MDD	Free Swelling Index (%)
	Location (km)	Up/Dn	Percentage passing from					LL	PL	PI								
			4.75 mm IS Sieve	425 mic IS Sieve	75 mic IS Sieve	Gravel %	Sand %											
LK-TP-1	606+800	LHS	92.99	81.28	78.37	7.01	14.62	49	27	22	CI	1.79	16.80	1.74	5.95	6.17	6.06	45
LK-TP-2	617+250	LHS	91.45	75.56	65.89	8.55	25.56	45	23	22	CI	1.86	15.50	1.80	5.12	4.29	4.71	38
LK-TP-3	626+200	LHS	88.53	43.25	41.79	11.47	46.74	42	25	17	SC	2.05	13.00	1.99	11.97	12.10	12.04	41
LK-TP-4	636+650	LHS	96.83	58.00	34.05	3.17	62.78	28	21	7	SC	2.08	10.90	2.02	11.50	13.19	12.35	20
LK-TP-5	648+200	LHS	98.27	74.80	45.52	1.73	52.75	26	17	9	SC	2.03	9.80	1.97	15.77	17.25	16.51	18
LK-TP-6	650+200	RHS	93.29	55.08	36.35	6.71	56.94	33	24	9	SC	1.99	11.40	1.93	12.85	14.21	13.53	24
LK-TP-7	642+600	RHS	93.8	44.77	28.98	6.20	64.82	32	25	7	SM-SC	2.03	8.80	1.97	28.91	31.02	29.97	18

Lab Sample No	Site Identification		Grain Size Analysis					Atterberg Limits (%)			Soil Class	MDD (gm/cc)	OMC (%)	FDD (gm/cc)	COMPACTION (%)	Dry Density at 97% MDD	Soaked CBR 97% MDD	Free Swelling Index (%)
			Percentage passing from															
	Location (km)	Up/Dn	4.75 mm IS Sieve	425 mic IS Sieve	75 mic IS Sieve	Gravel %	Sand %	LL	PL	PI								
LK-TP-8	629+700	RHS	93.15	59.2	31.75	6.85	61.40	-	NP	NP	SM	2.05	10.40	1.99	11.87	11.00	11.44	0
LK-TP-9	622+550	RHS	75.9	38.39	35.09	24.10	40.81	46	26	20	SC	2.07	10.00	2.01	17.25	18.60	17.93	26
LK-TP-10	612+150	RHS	96.34	85.92	82.22	3.66	14.12	68	39	29	CH	1.63	24.70	1.58	NA	NA	NA	57
LK-TP-11	601+750	RHS	69.40	33.10	27.23	30.60	42.17	37	23	14	SC	2.05	9.00	1.99	13.19	16.91	15.05	20
LK-TP-12	592+600	RHS	73.34	34.84	22.59	26.66	50.75	32	19	13	SC	2.09	12.02	2.03	17.52	18.10	17.81	14
LK-TP-13	582+800	RHS	68.75	37.57	33.09	31.25	35.66	44	28	16	SC	1.77	17.00	1.72	7.05	7.93	7.49	35
LK-TP-14	572+900	RHS	82.15	56.78	45.87	17.85	36.28	31	22	9	SC	2.06	11.00	2.00	8.79	8.61	8.70	15
LK-TP-15	562+600	RHS	89.25	66.54	62.08	10.75	27.17	47	30	17	CI	1.70	20.60	1.65	NA	NA	NA	23
LK-TP-16	552+200	RHS	63.06	20.75	14.94	36.94	48.12	37	26	11	SC	2.02	10.40	1.96	19.61	17.92	18.77	18
LK-TP-17	547+900	LHS	98.89	90.21	83.02	1.11	15.87	44	29	15	CI	1.72	19.00	1.67	NA	NA	NA	32
LK-TP-18	557+350	LHS	78.16	56.97	50.54	21.84	27.62	50	31	19	CH	1.67	20.00	1.62	NA	NA	NA	55
LK-TP-19	567+900	LHS	72.82	48.56	39.66	27.18	33.16	43	29	14	SC	1.76	17.70	1.71	7.05	7.93	7.49	19
LK-TP-20	577+500	LHS	75.21	34.92	29.28	24.79	45.93	43	28	15	SC	2.01	11.30	1.95	13.24	14.21	13.73	40
LK-TP-21	587+600	LHS	90.24	76.32	65.03	9.76	25.21	56	31	25	CH	1.66	23.70	1.61	NA	NA	NA	52
LK-TP-22	597+600	LHS	82.28	48.96	37.71	17.72	44.57	37	23	14	SC	1.88	16.80	1.82	8.37	9.91	9.14	14



Pie Chart showing the percentage distribution of soil classification of existing subgrade sample is presented below:

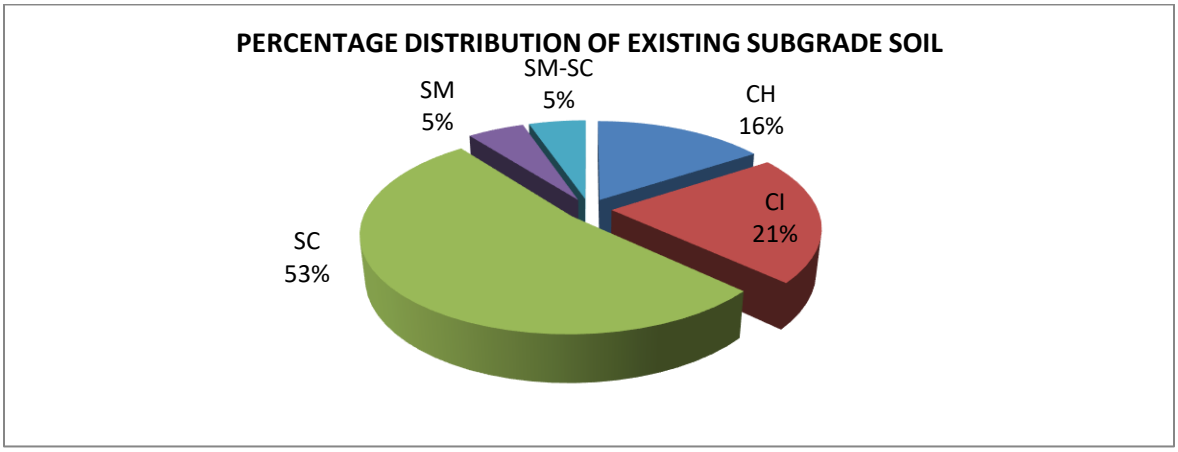


Table 41: Test results of Existing Subgrade Soils

The following observations can be made from the above test results conducted on of existing subgrade samples

- Liquid Limit: All the samples are within the limits (less than 50%). Minimum is 26 % and Maximum is 50 % Except 2 sample having Liquid Limit >50%.
- Plastic Index: All the samples are within the limits (less than 25%). Minimum is 7 % and Maximum is 25 % Except 1 sample having Liquid Limit >25%.
- Maximum Dry Density for all subgrade samples are above 1.75% (MDD>=1.75 gm/cc), except 5 samples (MDD<1.75 gm/cc).
- OMC for existing subgrade samples varies in between 9% to 25%.
- Free Swelling Index for existing subgrade samples varies in between 0% to 45%, satisfying FSI criterion (FSI<=50%) except 3 samples.
- CBR Values are varying from 5% to 30%.

Material related tests reports are provided in **Appendix-7** of this report.

Aggregates to be used for sub-base, base, surface courses and concrete works have been collected from the crushers under operation from the existing quarries. The Table below represents the test results of the Aggregate and Sand Samples

Table 42: Test Results of Aggregate Samples Details

S. No	Sample	Location (km)	Up/Dn	A.I.V (%)	Water Absorption (%)	Specific Gravity	Remark
1	LK-AQ-1	588+100	RHS	15.00	0.29	2.86	
2	LK-AQ-2	588+100	RHS	13.00	0.28	2.9	
3	LK-AQ-3	572+500	RHS	16.00	0.26	2.86	
4	LK-AQ-4	447+400	RHS	15.00	0.21	2.89	
5	LK-AQ-5	579+000	RHS	17.00	0.20	2.89	

Note: All samples meeting specification requirements AIV <24% and WA<2%,

Table 43: Test Results of Sand Samples Details

S. No	Sample No	CHAINAGE (KM)	SIDE	10 mm Passing %	4.75 mm Passing %	2.36 mm Passing %	1.18mm Passing %	600mm Passing %	300mm passing %	150mm Passing %	FM	ZONE
1	LK-SQ-1	644+900	LHS	100	99	90	68	40	9	3	2.91	ZONE -II
2	LK-SQ-2	644+900	LHS	100	93	86	72	43	10	1	2.95	ZONE -II
3	LK-SQ-3	641+000	LHS	100	96	91	69	32	9	7	2.96	ZONE -I

Note: Sand Samples meeting the requirement of Zone-1 & II criteria.

A total of 6 No's WMM samples have been collected from different Location of the project corridor. Selection of the Aggregate samples would depend upon engineering properties, lead and quantity available. The samples have been tested for sieve analysis as per requirement as per MORTH 5th revision.

4.2 CORE STRENGTH

The core strength of the samples is presented below.

Table 44: Test Results of Concrete core Details

Sl.No.	Chainage	SIDE	Core ID	Corrected Strength of core	Equivalent Cube Strength(N/mm^2)	F_{CK}	REMARK
				A	A = 1.25*F	0.7*SQRT(B)	
1	626+200	LHS	LK-C-1	43.4	54.2	5.52	Outer Lane
2	631+500	LHS	LK-C-2	Cracked			Inner lane
3	636+650	LHS	LK-C-3	27.9	34.9	4.43	Inner lane
4	639+400	LHS	LK-C-4	35.01	43.77	4.96	Outer Lane
5	648+200	LHS	LK-C-5	32.3	40.4	4.77	Inner lane
6	650+200	RHS	LK-C-6	35.41	44.27	4.99	Outer Lane
7	642+600	RHS	LK-C-7	33.9	42.3	4.88	Inner lane
8	636+700	RHS	LK-C-8	cracked			Outer Lane
9	629+650	RHS	LK-C-9	31.4	39.3	4.70	Inner lane
10	624+800	RHS	LK-C-10	43.3	54.2	5.52	Inner lane

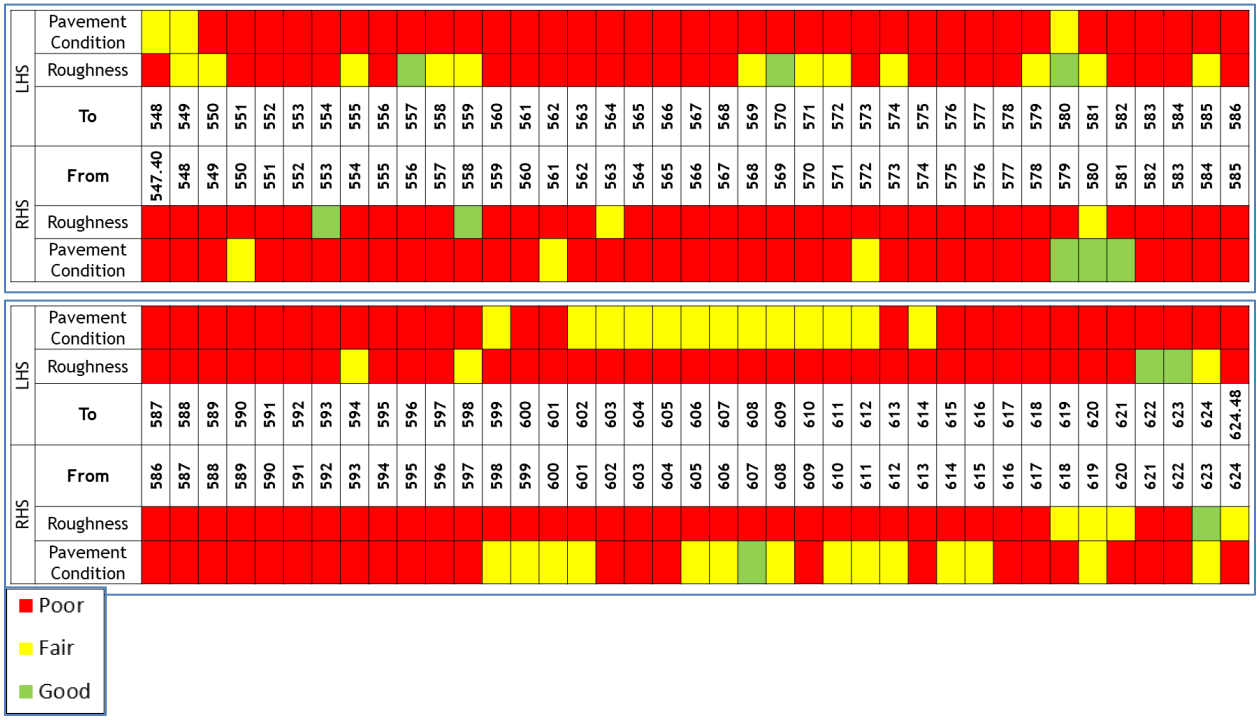
Note: core samples meeting the specifications as fck>4 MPa, except 3 samples

The above table indicates that concrete core strength is more than prescribed value of 4.5 Mpa.

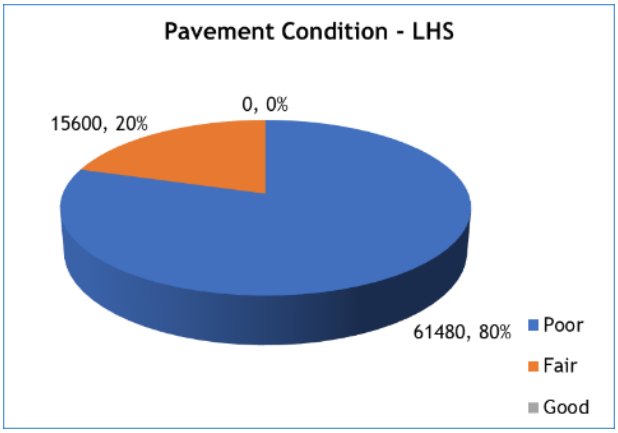
4.3 PAVEMENT CONDITION

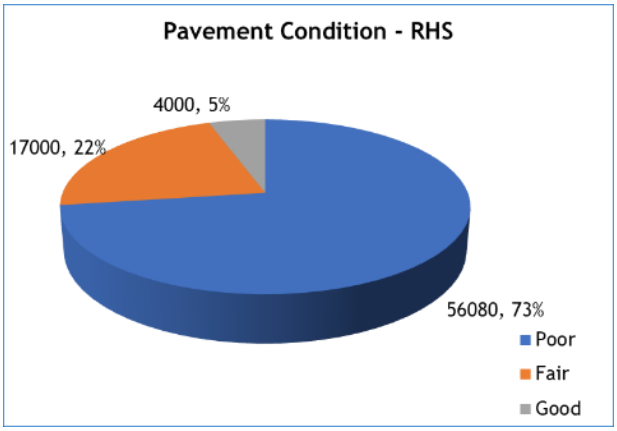
- **Flexible Pavement**

Majority length of the pavement is having severe distresses like cracking, associated with rutting, raveling and potholes. The distresses in bituminous surface have been captured on the project corridor for each lane separately by using the Network Survey Vehicle (NSV). Majority length of the project road is in poor condition. As mentioned before, flexible pavement is on the verge of getting overlay in coming 2 years and hence the condition captured below may not show a correct picture at handover.



The overall pavement condition of the project corridor is a presented below.





Pavement Condition report covering the data collection for each km length in each direction has been presented in the **Annexure-2** of this report.

➢ **Rigid Pavement**

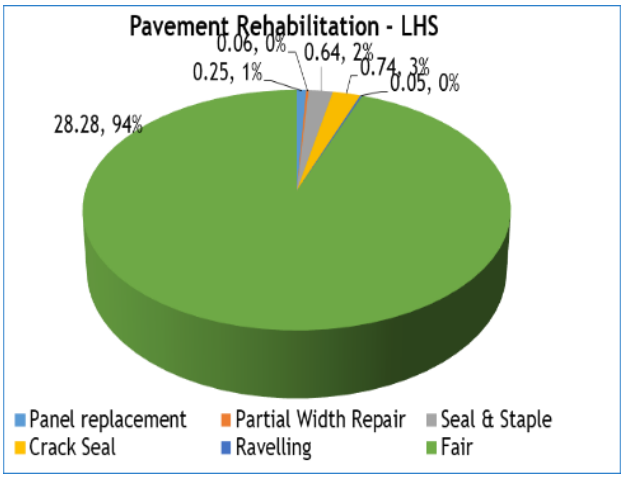
Based on IRC: SP: 83-2018 guidelines, for the identified distresses the rehabilitation measures suggested for rigid panels in terms of No. of panels based on visual pavement condition are as:

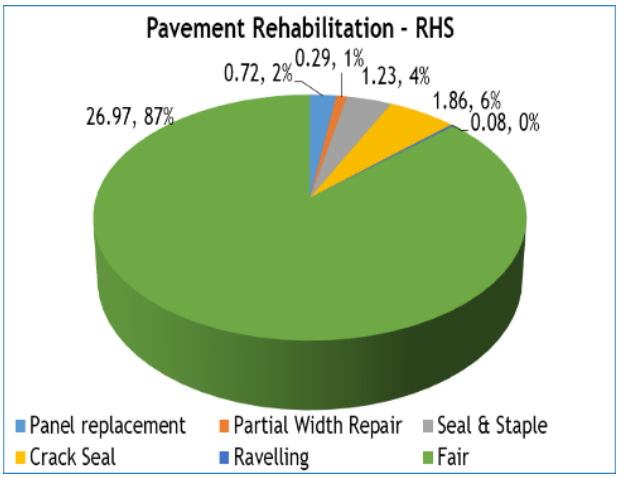
LHS	Roughness																													
	Overall Pavement Condition																													
	Ravelling	0	0	0	1	1	0	0	0	1	1	0	0	0	1	0	1	0	0	0	1	2	1	0	0	0	0	0	0	2	0
	Crack Seal	4	5	13	9	2	6	1	14	20	48	15	4	2	1	1	4	0	0	0	0	9	1	0	1	0	0	0	1	1	2
	Seal & Staple	0	5	43	8	0	8	3	26	2	8	1	5	0	4	2	3	1	0	0	2	1	1	0	0	1	0	1	1	14	3
	Partial Width Repair	0	0	3	0	0	1	0	4	2	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
	Panel replacement	0	12	17	1	0	0	1	3	5	10	0	1	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0
	To	**625**	**626**	**627**	**628**	**629**	**630**	**631**	**632**	**633**	**634**	**635**	**636**	**637**	**638**	**639**	**640**	**641**	**642**	**643**	**644**	**645**	**646**	**647**	**648**	**649**	**650**	**651**	**652**	**653**	**653.8**
RHS	**From**	**624.5**	**625**	**626**	**627**	**628**	**629**	**630**	**631**	**632**	**633**	**634**	**635**	**636**	**637**	**638**	**639**	**640**	**641**	**642**	**643**	**644**	**645**	**646**	**647**	**648**	**649**	**650**	**651**	**652**	**653**
	Panel replacement	0	0	6	0	0	1	0	0	3	9	13	14	0	0	0	5	17	0	0	3	14	20	6	6	5	17	8	12	0	0
	Partial Width Repair	0	0	0	0	0	0	0	0	0	0	2	8	0	0	4	0	2	0	0	8	6	4	1	0	5	2	8	0	14	0
	Seal & Staple	0	1	3	21	12	3	0	17	1	46	9	18	0	0	6	6	2	0	0	28	14	8	5	10	19	9	4	2	23	7
	Crack Seal	0	3	6	3	6	2	0	1	6	113	10	15	3	0	7	9	44	19	3	13	12	20	21	5	4	47	16	9	11	5
	Ravelling	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0	0	2	1	0	1	0	0	0	3	0	6	1
	Overall Pavement Condition																														
	Roughness																														

Roughness
Good - <2000 mm/Km
Fair - 2000 to 2400 mm/Km
Poor - >2400 mm/Km

Overall Pavement Condition
Good - Total no of distressed Panels <22
Fair - 22 > Total no of distressed Panels < 44
Poor - Total no of distressed Panels >44

The overall pavement condition of the project corridor is a presented below.





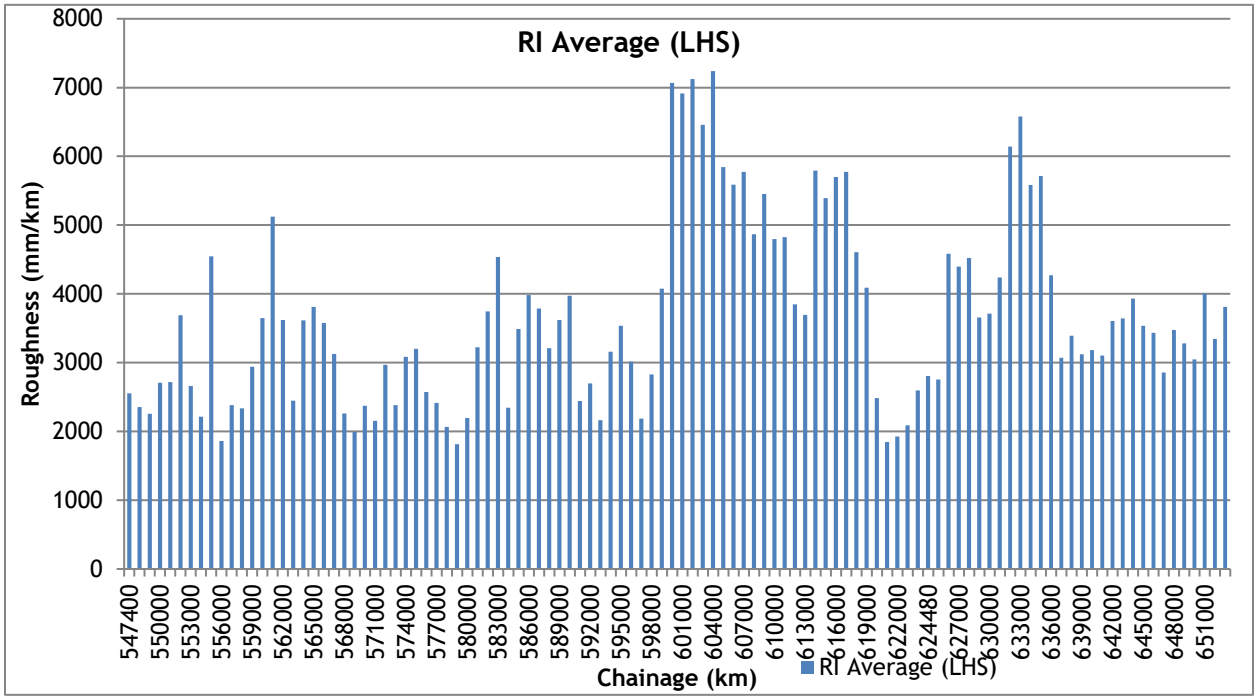
Following panel rectification measured are considered for the rigid pavement.

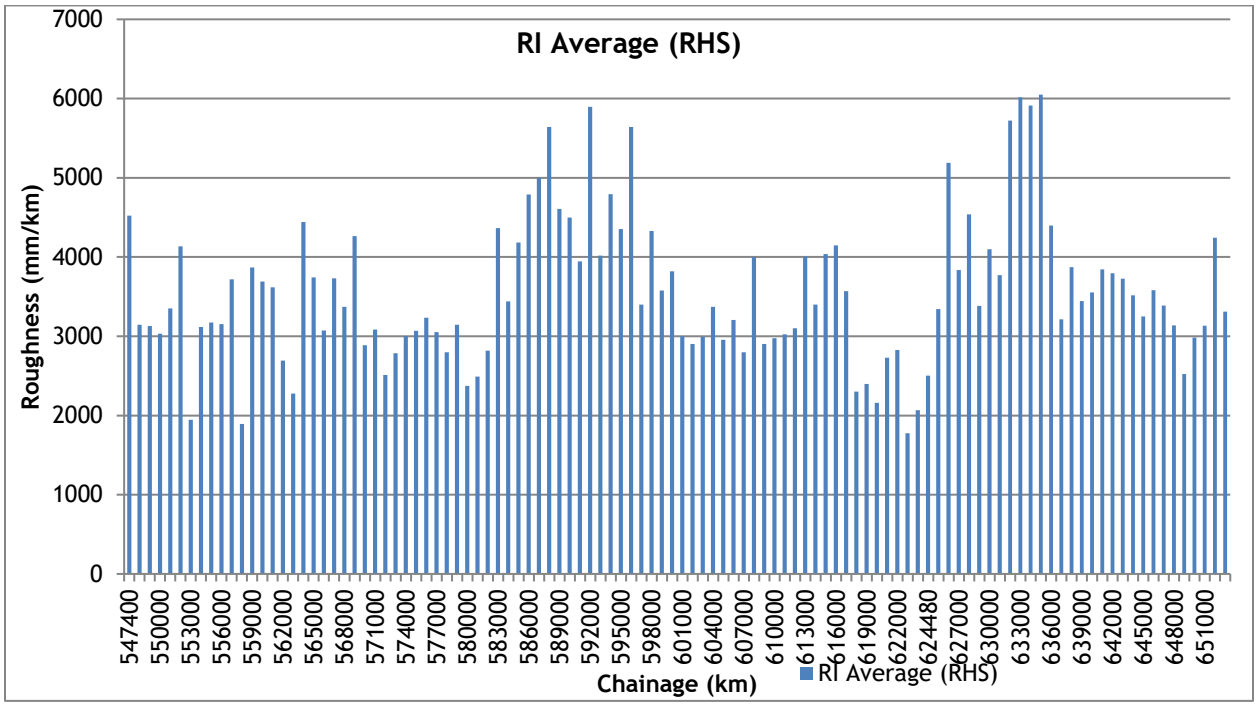
Total Number of Panels observed various Repairs						
S No	Side-Lane	Total Panels for replacement	Total Panels for Partial Width Repair	Seal & Staple (in Panels)	Crack Seal (in Panels)	Raveling in Number of Panels
1	LHS Inner Lane	38	3	84	53	10
2	LHS Outer Lane	18	11	59	111	2
3	RHS Inner Lane	16	5	67	262	7
4	RHS Outer Lane	143	59	207	151	11
Total		**215**	**78**	**417**	**577**	**30**

4.4 ROUGHNESS

- **Flexible Pavement**

The roughness surveys conducted along the corridor indicate poor riding quality in majority length of project corridor. Bar-graph showing the Kilometer-wise roughness along the project road are presented below:





Based on the above, considering the Km-stone reference system the summary of Lane-Km having varying roughness values are as presented below

RI (mm/Km)		Length (Km)			
>=	<	LHS Inner Lane	LHS Outer Lane	RHS Inner Lane	RHS Outer Lane
	2000	0	15480	2000	13480
2000	2200	2000	8600	1000	7000
2200	2400	5000	5000	0	10000
2400		70080	48000	74080	46600
Total Length		77080	77080	77080	77080

However, these lengths are not considered in the immediate cost considering the project is under operation of present concessionaire and is likely to receive overlays before handover.

- **Rigid Pavement**

An alternate exercise with moving average method has been adopted considering 10m point interval roughness data. With these criteria, considering roughness threshold limit (<2400mm/km), the combined lane-km lengths with varying roughness values are as presented below

RI (mm/Km)		Length (Km)			
>=	<	LHS Inner Lane	LHS Outer Lane	RHS Inner Lane	RHS Outer Lane
	2000	2.590	3.110	1.950	4.290
2000	2200	1.690	1.580	1.270	1.850
2200	2400	1.360	1.850	1.230	1.860
2400		1.540	1.910	1.060	2.250
Rigid Length for Rectification		17.170	15.990	18.840	13.960
Structure & Approaches		4.940	4.850	4.940	5.080
Total Length		29.290	29.290	29.290	29.290

By attending the rectification of 33.16 lane-km length in LHS, at identified locations, the roughness values can bring down to required threshold value(<2400m/km) by considering moving average method for roughness values in km-length. However, still there will be accumulated length of 3.45 lane-km at scattered points having roughness higher than threshold value (>2400m/km) and these values may have no impact and nullified while considering average in a km-length.

Similarly, in RHS, by attending the rectification of 32.8 lane-km length at identified locations, the roughness values can bring down to required threshold value(<2400m/km) by considering moving average method for roughness values in km-length. However, still there will be accumulated length of 3.31 lane-km at scattered points having roughness higher than threshold value (>2400m/km) and these values may have no impact and nullified while considering average in a km-length.

In addition to the above rigid pavement, rectification length for roughness correction at existing flexible pavement in-between in the rigid pavement at wearing coat at structure location. The details are as follows.

S No	Side	Inner lane (m)	Outer lane (m)	Total Length (m)
1	LHS	1180	1190	2370
2	RHS	1280	1290	2570

4.5 FWD ANALYSIS

4.5.1 Flexural strength of Concrete Rigid Pavement (Rigid)

FWD deflections shall be measured and recorded for radial distances at 0 mm, 300 mm, 600 mm and 900 mm from the Centre of loading point.

The area parameter of deflection basin should be calculated using the equation 2 of IRC 117-2014.

From area of deflection basin, Radius of relative stiffness (l) can be evaluated from the charts. The excel sheet provided with the guidelines used to get the value of Radius of relative stiffness (l).

After finding the Radius of relative stiffness, normalized deflections (d) are calculated using various equations formed from the charts. The excel sheet directly gives the values of the normalized deflections.

Subgrade modulus values can be found by using the equation 3 of IRC 117-2014 for different normalized deflections and average of all should be taken as subgrade modulus.

Elastic Modulus (MPa) of concrete can be found by using the equation 4 of IRC 117-2014.

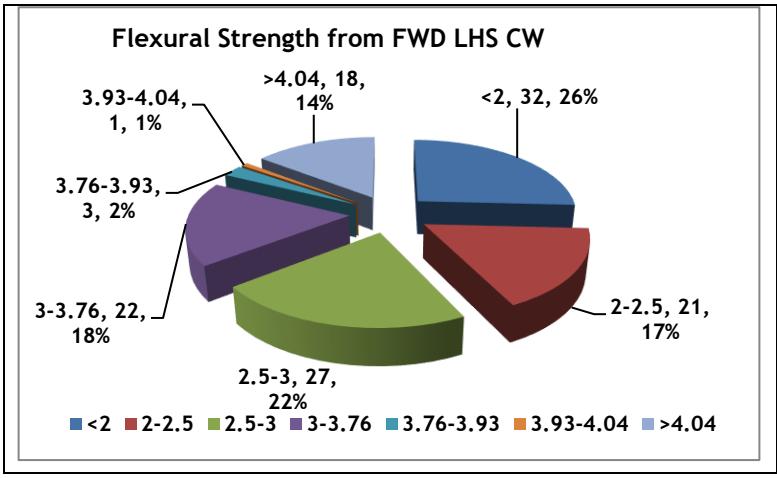
Strength of the concrete and Flexural strength can be determined from the value of Eco from the equation 5 & 6 of IRC 117-2014.

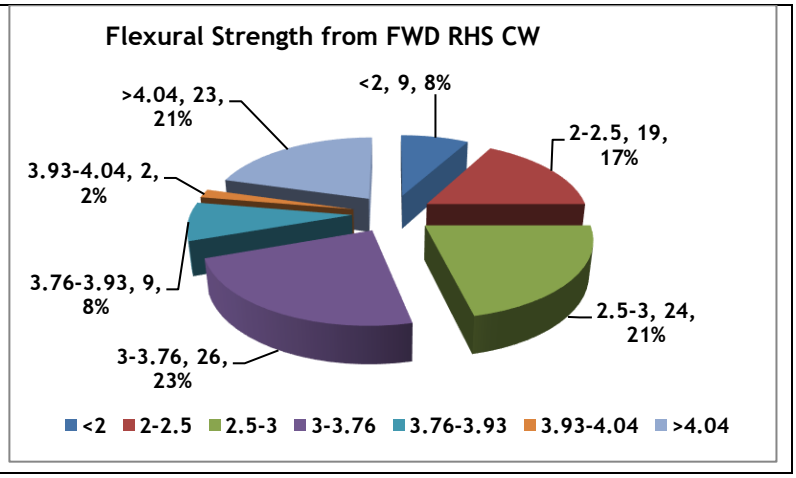
The fck values calculated for the rigid pavement are presented in **Appendix-3** of the report.

Pie charts showing the variation of the Flexural Strength estimated from FWD Surveys are presented below:

Table 45: FWD Data - Summary of Homogenous Section - LHS & RHS

No of points		
Flexural strength (Mpa) Range	**LHS**	**RHS**
<2.0	32	9
2.0-2.5	21	19
2.5-3.0	27	24
3.0-3.76	22	26
3.76-3.93	3	9
3.93-4.04	1	2
>4.04	18	23
Total	124	112



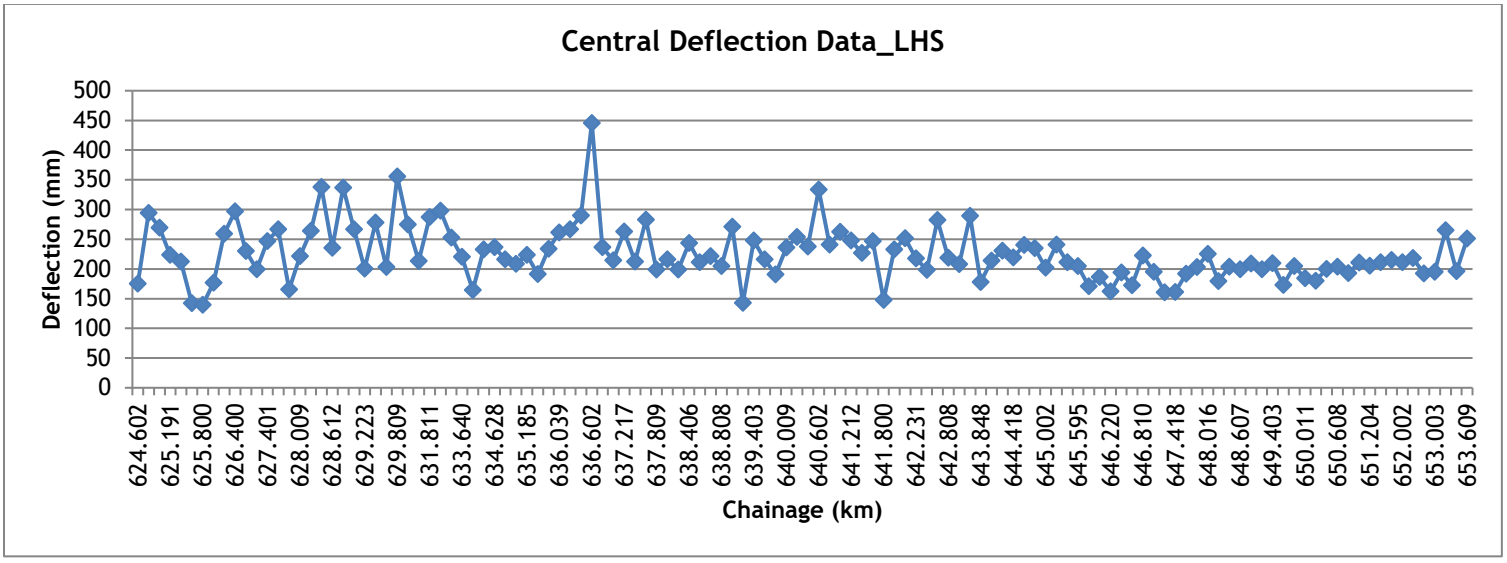


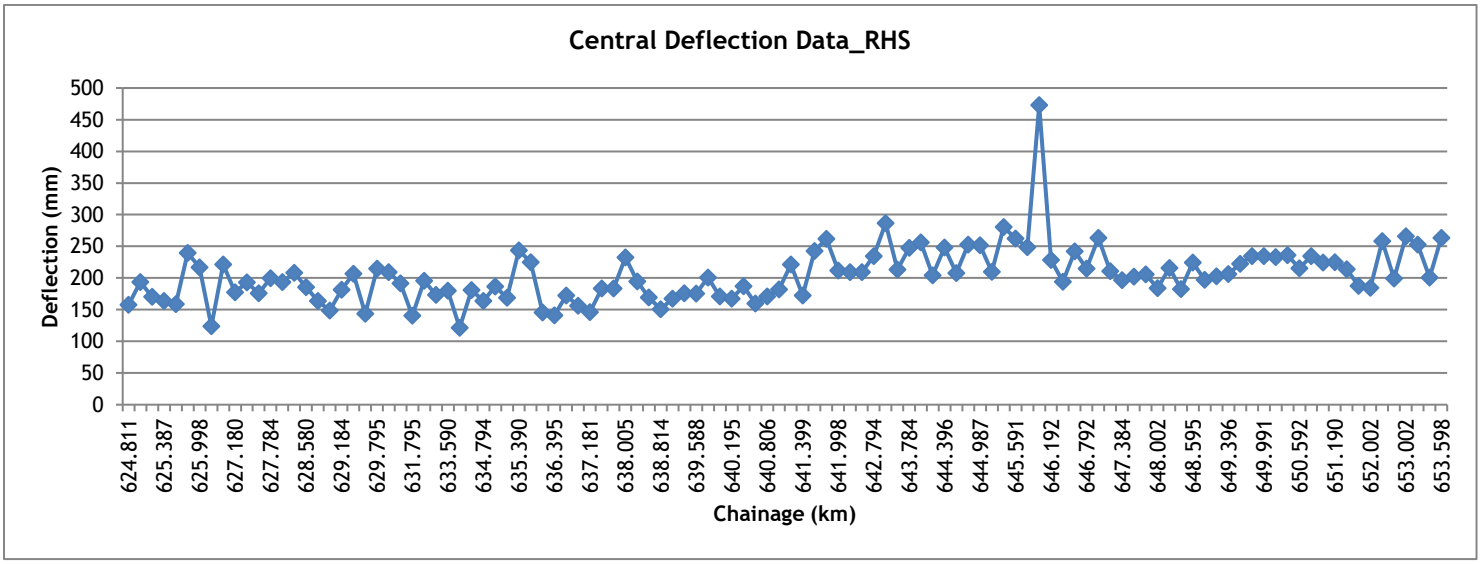
Flexural Strength of the PQC estimated from FWD Surveys indicates that:

a) *More than 14% of samples in LHS Carriageway and 21% of samples in RHS Carriageway are having values greater than 4.04 Mpa.*
b) *1% of samples in LHS Carriageway and 2% of samples in RHS Carriageway are having values between 3.93 - 4.04 MPa.*
c) *2% of samples in LHS Carriageway and 9% of samples in RHS Carriageway are having values between 3.76 - 3.93 Mpa.*
d) *18% of samples in LHS Carriageway and 23% of samples in RHS Carriageway are having values between 3 - 3.76 Mpa.*
e) *22% of samples in LHS Carriageway and 21% of samples in RHS Carriageway are having values between 2.5 - 3 Mpa.*
f) *17% of samples in LHS Carriageway and 17% of samples in RHS Carriageway are having values between 2 - 2.5 Mpa.*
g) *26% of samples in LHS Carriageway and 8% of samples in RHS Carriageway are having values Less than 2 Mpa.*

4.5.2 Detection of Voids underneath the Rigid Pavement

- Deflection of Voids below a pavement slab can be easily be done by a FWD. Deflections are measured along the wheel path and a plot of central deflections versus distance has to be made.
- The locations where the deflections are much higher than the normal may indicate presence of voids. Sample is shown in below





From the above graph, voids underneath the pavement are identified as 5 points in LHS, 1 point in RHS. For quantification, every point is considered for 150m length in lane width.

4.5.3 FWD Analysis and Assessment of Overlay Requirement (Flexible)

The FWD data collected has been analyzed as per IRC-115 guidelines with the suggested ranges for in-service pavements

- Subgrade Modulus---------- 5 CBR to 20 CBR
- Granular Layer Modulus---------- 100 Mpa to 500 MPa
- Bituminous Layers –Thick without distress------ 750 Mpa to 3000 MPa
- Bituminous Layers in distressed condition------ 400 Mpa to 1500 MPa

The above suggested ranges for guidance only and pavement engineer shall use his judgment based on available data while fixing the above ranges. By looking at the age and condition and performance of the pavement following different set of ranges have been used while finalizing the modulus values:

Layer	Bituminous Layers	Granular Layer Modulus	Subgrade
Modulus Value (MPa)	400-1500	100-500	50-75

Bituminous layer Moduli obtained from back calculations shall be corrected for a standard pavement temperature of 35ºC using given equations. Whereas, for back calculated moduli values obtained for granular and subgrade layer are corrected for seasonal variations (using winter and summer equations). As FWD tests, performed, during the winter seasonal correction factor winter is applied for granular and subgrade layer. The design moduli (15th percentile moduli) of in-service layers for each homogenous section are given in table below.

Table 46: Summary of Design Moduli of different layers – LHS CW

S.No	Side	From	To	Length (Km)	15th Percentile MR values		
					MR for BT (Mpa)	MR for Granular (Mpa)	MR for Subgrade (Mpa)
1	LHS	547.40	549.00	1.60	1240	392	64
2	LHS	549.00	549.30	0.30	Toll Plaza-1		
3	LHS	549.30	551.40	2.10	1240	392	64
4	LHS	551.60	553.10	1.50	1253	391	64
5	LHS	553.10	557.20	4.10	1242	390	64
6	LHS	557.40	557.80	0.40	1273	392	64
7	LHS	557.80	558.82	1.02	1306	389	64
8	LHS	558.93	562.45	3.52	1293	371	64
9	LHS	562.45	563.59	1.14	1314	387	64
10	LHS	563.76	567.55	3.79	1303	380	64
11	LHS	567.55	570.73	3.18	1310	354	64
12	LHS	570.73	573.01	2.28	1303	352	64
13	LHS	573.01	577.00	4.00	1323	388	64
14	LHS	577.00	578.35	1.35	1378	390	64
15	LHS	578.35	582.25	3.90	Work Under Progress		
16	LHS	582.25	585.01	2.76	1378	390	64
17	LHS	585.01	587.58	2.57	1380	387	64
18	LHS	587.58	590.40	2.82	1425	392	64
19	LHS	590.40	594.01	3.61	1417	390	64
20	LHS	594.01	596.75	2.74	1424	390	64
21	LHS	596.75	600.00	3.25	1271	389	64
22	LHS	600.00	603.23	3.23	1273	392	64
23	LHS	603.23	606.00	2.77	1264	383	64
24	LHS	606.00	608.40	2.40	1279	389	64
25	LHS	608.40	611.00	2.60	1262	394	64

S.No	Side	From	To	Length (Km)	15th Percentile MR values		
					MR for BT (Mpa)	MR for Granular (Mpa)	MR for Subgrade (Mpa)
26	LHS	611.00	613.62	2.62	1293	390	64
27	LHS	613.62	616.20	2.58	1309	391	64
28	LHS	616.20	618.61	2.41	1421	393	64
29	LHS	618.61	621.62	3.00	1447	393	64
30	LHS	621.62	624.48	2.87	1446	393	64

Table 47: Summary of Design Moduli of different layers – RHS CW

S.No	Side	From	To	Length (Km)	15th Percentile MR values		
					MR for BT (Mpa)	MR for Granular (Mpa)	MR for Subgrade (Mpa)
1	RHS	547.40	549.00	1.60	1409	391	64
2	RHS	549.00	549.30	0.30	Toll Plaza-1		
3	RHS	549.30	551.40	2.10	1409	391	64
4	RHS	551.60	553.10	1.50	1408	391	64
5	RHS	553.10	557.20	4.10	1297	375	64
6	RHS	557.40	557.80	0.40	1412	386	64
7	RHS	557.80	558.80	1.00	1414	385	64
8	RHS	558.93	562.45	3.52	1300	387	64
9	RHS	562.45	563.60	1.15	1264	389	64
10	RHS	563.76	567.55	3.79	1437	387	64
11	RHS	567.55	570.73	3.18	1394	376	64
12	RHS	570.73	574.39	3.66	1300	292	64
13	RHS	574.39	578.35	3.96	1477	251	64
14	RHS	578.35	582.25	3.90	Work Under Progress		
15	RHS	582.25	585.40	3.15	1542	315	64
16	RHS	585.40	589.00	3.60	1575	389	64
17	RHS	589.00	592.40	3.40	1564	383	64
18	RHS	592.40	596.75	4.35	1651	392	64
19	RHS	596.75	599.19	2.44	1485	392	64
20	RHS	599.19	602.00	2.80	1435	391	64
22	RHS	602.00	606.00	4.00	1293	390	64
23	RHS	606.00	609.20	3.20	1282	390	64
24	RHS	609.20	612.79	3.59	1293	389	64
25	RHS	612.79	616.60	3.81	1298	389	64
26	RHS	616.60	619.57	2.97	1288	391	64
27	RHS	619.57	622.00	2.43	1299	392	64
28	RHS	622.00	624.48	2.48	1290	392	64

Observations on FWD Results

It can be noticed from the above table that the layer moduli for the three layers are varying along the length and direction. The MR value for BT layer is 1240 MPa to 1447 MPa in LHS & 1264 MPa to 1651 MPa in RHS Carriageway. The MR value for Granular Layers is 352 MPa to 394 MPa in LHS & 251 MPa to 392 MPa in RHS Carriageway. Similarly, the MR value for Subgrade Layer is 64 MPa in LHS & 64 MPa in RHS Carriageway.

4.6 PAVEMENT COMPOSITION

a) *Main Carriageway Crust*

	BT (mm)	PQC (mm)	DLC (mm)	WMM (mm)	GSB (mm)	Total (mm)
Minimum	180	280	150	180	150	940
Maximum	300	320	200	280	350	1450
Average	240	300	175	230	250	1195

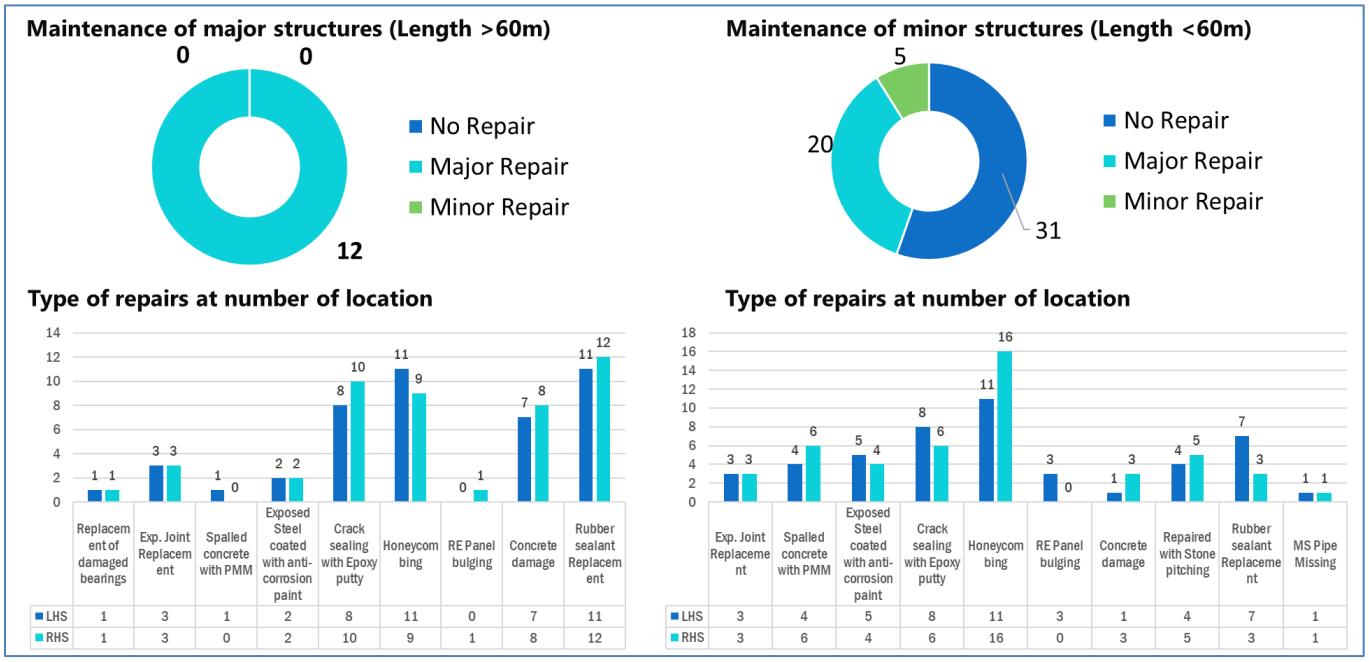
4.7 STRUCTURES

Inventory and asset condition of all the existing structures falling within project road have been verified as per IRC: SP-35 procedures and guidelines with following field surveys

- Inventory of existing highway bridges / structures
- MBIU/Visual condition survey of existing highway bridges / structures

Inventory of all the structures is presented in **Appendix 8** of this report.

Based on these surveys following structural rehabilitation measures have been considered.



Overall condition of few of the major structures are presented on sample basis of below. However, each and every structure details are presented in **Appendix-8** of this report

Chainage: **570+880**

General Description

RHS MCW (New)

- Type of Structure : MJB
- Span Arrangement : 10x29.6 m
- Total length of Structure : 296 m
- Total deck width of Structure : 12 m
- Type of Foundation : Not Visible
- Type of Substructure (Abutment & Pier) : RCC Wall Type & Single Circular Column Type
- Type of Superstructure : PSC Girder
- Type of Bearing : Elastomeric
- Type of Railing / Crash Barrier : Crash Barrier
- Method of Inspection : Visual

Observations

Visual Observations on condition of the structure are as below:

> Rubber sealant damaged at all expansion joints. > Expansion Joint damaged at EJ-1 & 10. > Honeycombing and reinforcement exposed on the intermediate cross girder in span-6 & 7. > Honeycombing observed on the intermediate cross girder in Span-2.

> Cracks observed on the Pier cap P3 in span-4.

> Cracks observed on Bearing B3 on P3 in span-4.

> Honeycombing observed on intermediate cross girder in span-8.

> Concrete damaged at the edge of the end cross girder at P9 in span-10.

Chainage: **554+946**

General Description

LHS MCW (New)

- Type of Structure : MJB
- Span Arrangement : 3x29.6 m
- Total length of Structure : 88.8 m
- Total deck width of Structure : 12 m
- Type of Foundation : Not Visible
- Type of Substructure (Abutment & Pier) : RCC Wall Type & Single Circular Column Type
- Type of Superstructure : PSC Girder
- Type of Bearing : Elastomeric
- Type of Railing / Crash Barrier : Crash Barrier
- Method of Inspection : Visual

Observations

Visual Observations on condition of the structure are as below:
> Rubber sealant damaged at expansion joint EJ-1, EJ-3 & EJ-4. > Expansion Joint damaged at EJ-2. > Honeycombing is observed on return wall at abutment A-1 side.

Chainage: **643+726**

General Description

LHS MCW (New)

- Type of Structure : AUP
- Span Arrangement : 1 x 25 + 15 x 30 + 1 x 25 m
- Total length of Structure : 500 m
- Total deck width of Structure : 14.5 m
- Type of Foundation : Open
- Type of Substructure (Abutment & Pier) : RCC Rectangular Column Type
- Type of Superstructure : RCC Girder & PSC Girder
- Type of Bearing : Elastomeric
- Type of Railing / Crash Barrier : Crash Barrier
- Method of Inspection : Visual

Observations

Visual Observations on condition of the structure are as below:

> Rubber sealant damaged at expansion joints EJ-5, EJ-8, EJ-10 & EJ-17.
> Cracks observed on soffit of the Girder G-1, G-3 & G-4 in span-1.
> Cracks observed on soffit of the Girder G-3, G-4 & G-5 in span-3.
> Cracks observed on soffit of the Girder G-3, G-4 & G-5 in span-4.
> Honeycombing observed on soffit of the deck slab in span-4.
> Honeycombing observed on Intermediate cross girder in span-4.
> Cracks observed on soffit of the Girder G-5 in span-5.
> Cracks observed on soffit of the Girder G-5 in span-6.
> Honeycombing observed on soffit of the deck slab and intermediate cross girder in span-6.
> Cracks observed on soffit of the Girder G-1 in span-7.
> Honeycombing observed on soffit of the deck slab in span-7.
> Cracks observed on soffit of the Girder G-4 in span-8.
> Honeycombing observed on intermediate cross girder in span-8.
> Cracks observed on soffit of the Girder G-5 in span-9.
> Cracks and Leaching observed on soffit of the deck slab in span-11.
> Honeycombing observed on soffit of the Girder G-1 in span-12.
> Cracks observed on soffit of the Girder G-2, G-3 & G-5 in span-13.
> Cracks observed on soffit of the Girder G-4 & G-5 in span-14.
> Cracks observed on soffit of the Girder G-4 in span-15.
> Cracks observed on soffit of the Girder G-5 in span-16.
> Honeycombing observed on intermediate cross girder in span-16
> RE panel Concrete damage observed at Abutment A-

Chainage: **643+726**

General Description

RHS MCW (New)

- Type of Structure : AUP
- Span Arrangement : 1 x 25 + 15 x 30 + 1 x 25 m
- Total length of Structure : 500 m
- Total deck width of Structure : 14.5 m
- Type of Foundation : Open
- Type of Substructure (Abutment & Pier) : RCC Rectangular Column Type
- Type of Superstructure : RCC Girder & PSC Girder
- Type of Bearing : Elastomeric
- Type of Railing / Crash Barrier : Crash Barrier
- Method of Inspection : Visual

Observations

Visual Observations on condition of the structure are as below:

> Rubber sealant damaged at expansion joints EJ-1, 2, 4, 6, 7, 8, 11, 14 & 16.
> Expansion Joint damaged at EJ-14.
> RE Panel bulging observed at Abutment A-1.
> Cracks and Leaching observed on top flange of the Girder G-5 in span-3.
> Honeycombing observed on soffit of the Girder G-4 & G-5 in span-4.
> Cracks and Leaching observed on top flange of all girders in span-4.
> Cracks observed on soffit of the Girder G-4 & G-5 in span-5.
> Honeycombing and Cracks observed on soffit of the Girder G-2 & G-3 in span-6.
> Leaching observed on top flange of the girder G-2 & G-3 in span-7.
> Honeycombing observed on soffit of the Girder G-1 in span-8.
> Concrete damage observed on soffit of the Girder G-1 in span-8.
> Honeycombing observed on soffit of the Girder G-3 & G-4 in span-9.
> Honeycombing observed on soffit of the deck slab in span-9.
> Leaching observed on top flange of the girder G-3 in span-9.
> Cracks and Leaching observed on Pier Cap P-9 in span-9.
> Cracks and Leaching observed on soffit of deck slab in span-10.
> Cracks observed on soffit of the Girder G-4 & G-5 in span-10.
> Cracks and Leaching observed on both pier caps in span-12.
> Cracks observed on soffit of the Girder G-4 & G-5 in span-13.
> Honeycombing observed on soffit of the Girder G-4 in span-15.
> Minor Honeycombing observed on soffit of the deck slab in span-16.
> Cracks observed on soffit of the Girder G-4 & G-5 in span-16.
> Honeycombing observed on soffit of the deck slab in span-17.
> Honeycombing and Cracks observed on soffit of the Girder G-3 in span-17.
> Cracks observed on soffit of the Girder G-5 in span-17.

Some of the major structure photos are presented below.

A view of MJB at Km 554+946	A view of MJB at Km 570+880
A view of MNB at Km 556+872	A view of MNB at Km 567+872
A view of MNB at Km 576+642	A view of MNB at Km 579+109

A view of VUP at Km 555+105	A view of VUP at Km 568+895
A view of CUP at Km 568+575	A view of CUP at Km 583+222

Animal Underpasses:

Few minute cracks are observed at the bottom flange of newly built animal underpass structures. These cracks require further investigation with NDT testing to assess the exact requirement of rehabilitation measures. Apart from cracks following distress were observed on AUP structures:

> Rubber sealant damaged at expansion joints EJ-2, EJ-10, EJ-11, EJ-13 & EJ-15.

> Cracks observed on soffit of the Girder G-3 & G-5 in span-2.

> Cracks observed on soffit of the Girder G-1, G-2, G-4 in span-4.

> Honeycombing observed on soffit of the Girder G-4 in span-4.

> Cracks observed on soffit of the Girder G-3 & G-4 in span-5.

> Cracks observed on soffit of the Girder G-5 in span-6.

> Honeycombing observed on soffit of the Girder G-5 in span-7.

> Cracks observed on soffit of the Girder G-2 in span-8.

> Soil erosion observed near Pier P-7 in span-8.

> Cracks observed on soffit of the Girder G-3 in span-9.

> Cracks observed on soffit of the Girder G-3 & G-4 in span-14.

> Cracks observed on soffit of the Girder G-1, G-3, G-4 & G-5 in span-15.

> Cracks observed on soffit of the Girder G-2 & G-3 in span-16.

> Cracks observed on soffit of the Girder G-3 & G-4 in span-17.

> Honeycombing observed on Coping beam in span-17

Following photographs depict the distress on AUP:

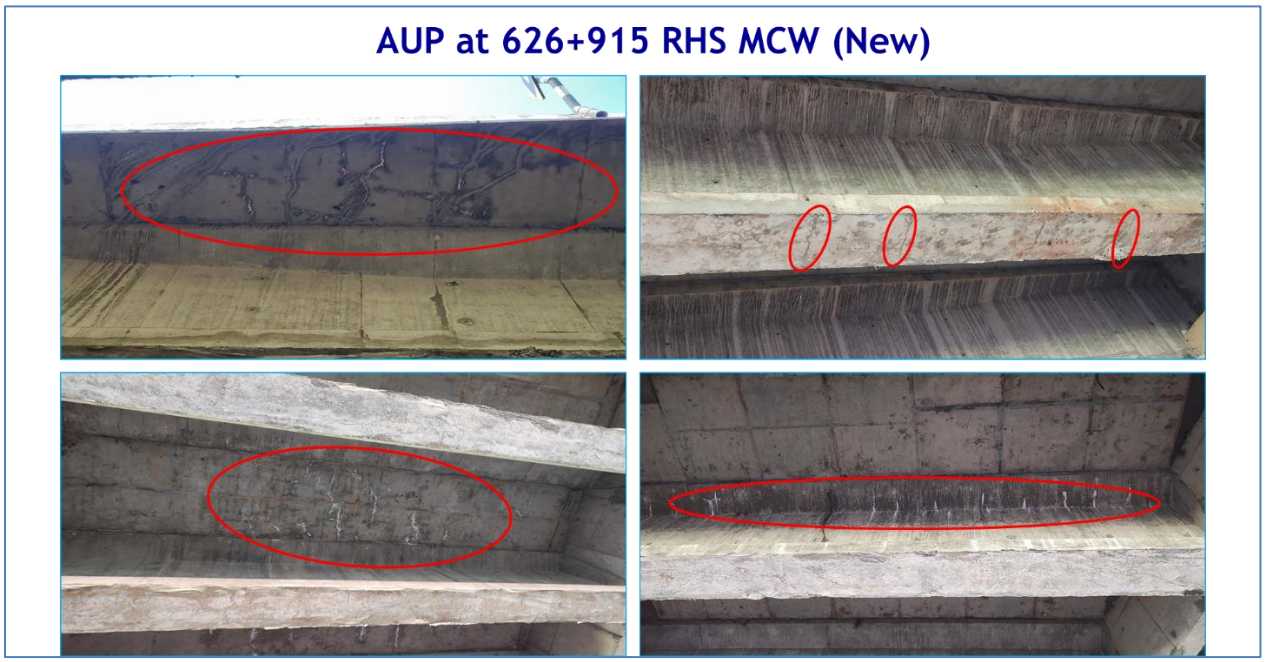


Table 48: AUP's having cracks on the soffit of the Girders

S.No.	Site Chainage (Km)	Type of Str	Side	Age of Str.	Span Arrangement (m)	Total No of Girders having cracks on the bottom flange	Area of bottom flange of Girder (m^2)
1	626+915	AUP	LHS	New	1 x 25 + 12 x 30 + 1 x 25 + 3 x 30	20	390
2	626+915	AUP	RHS	New	1 x 25 + 12 x 30 + 1 x 25 + 3 x 30	4	78
3	630+727	AUP	LHS	New	1 x 25 + 45 x 30 + 1 x 25	28	546
4	630+727	AUP	RHS	New	1 x 25 + 45 x 30 + 1 x 25	3	58.5
5	643+726	AUP	LHS	New	1 x 25 + 15 x 30 + 1 x 25	21	409.5
6	643+726	AUP	RHS	New	1 x 25 + 15 x 30 + 1 x 25	19	370.5
7	652+500	AUP	LHS	New	10 x 30	10	195
8	652+500	AUP	RHS	New	10 x 30	5	97.5
Total =						110 No's	2145 m^2

Table 49: AUP's having cracks on the soffit of the Deck slab

S.No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str.	Span Arrangement (m)	No of spans having cracks on soffit of deck slab	Area of Deck Slab having cracks (m^2)
1	626+915	AUP	RHS	MCW	New	1 x 25 + 12 x 30 + 1 x 25 + 3 x 30	4	1740
2	630+727	AUP	LHS	MCW	New	1 x 25 + 45 x 30 + 1 x 25	3	1305
3	630+727	AUP	RHS	MCW	New	1 x 25 + 45 x 30 + 1 x 25	14	6090
4	632+050	AUP	LHS	MCW	New	2 x 35.0	1	435
5	632+356	AUP	LHS	MCW	New	3 x 30	3	1305
6	632+356	AUP	RHS	MCW	New	3 x 30	2	870

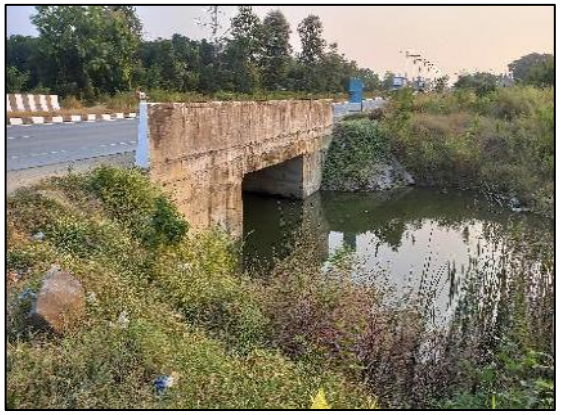
S.No.	Site Chainage (Km)	Type of Structure	Side	Str on	Age of Str.	Span Arrangement (m)	No of spans having cracks on soffit of deck slab	Area of Deck Slab having cracks (m^2)
7	632+634	AUP	RHS	MCW	New	3 x 30	1	435
8	634+637	AUP	RHS	MCW	New	3 x 25	1	435
9	636+075	AUP	RHS	MCW	New	4 x 30	1	435
10	643+726	AUP	LHS	MCW	New	1 x 25 + 15 x 30 + 1 x 25	4	1740
11	643+726	AUP	RHS	MCW	New	1 x 25 + 15 x 30 + 1 x 25	1	435
12	652+500	AUP	LHS	MCW	New	10 x 30	1	435
13	652+500	AUP	RHS	MCW	New	10 x 30	1	435
Total =							37 No's	16095 m^2

Remedial measures:

- ✓ It is observed during walkabout survey, the Animal Underpasses (AUP), at Km 626+915, Km 630+727, Km 632+356, Km 643+726 and Km 652+500 on BHS are having cracks on soffit of Girders and Cracks and leaching on the soffit of the deck slab at multiple locations. The distress shown in the PSC girders suggest durability makeup measures.
- ✓ As measure of abundant precaution and keeping in view the adverse deterioration predicted which may reduce the capacity of the girder effecting the performance both end shear and flexure.
- ✓ In order extend the service life it is felt prudent to provide Externally bonded reinforcement (EBR). This EBR can be by way of CFRP Laminates 3 lines over the full length of the soffit. As regards the cracks in the top flange sealing by epoxy material is proposed.
- ✓ These structures may require detailed investigation for assessing strength, integrity and durability parameters with NDT tests as follows
  - ➢ ***Crack mapping,***
  - ➢ ***Carbonation Depth Test***
  - ➢ ***Rebound hammer test,***
  - ➢ ***Profometer survey,***
  - ➢ ***Half-cell potential test,***
  - ➢ ***UPV Test by cross probing (Concrete quality assessment), UPV Test (Crack measurements)***
- ✓ Repair methodology and cost may be varied based on the interpretation of the NDT Test results

Sample photos of Culverts:

Box Culvert at 637+288



Box Culvert at 639+855

Box Culvert at 642+171

Pipe Culvert at 650+350

Pipe Culvert at 650+953

Pipe Culvert at 651+630

4.8 DRAINAGE AND SLOPE PROTECTION

- ✓ Lined Covered drains observed at urban locations and at service road Locations along the corridor.
- ✓ No major damages observed at covered drain locations.

4.9 TRAFFIC SAFETY AND ROAD FURNITURE

- ✓ Metal beam crash barriers provided along the project road appear to be intact over entire length except for few locations where it got damaged.
- ✓ Pedestrian guard rails installed on the Separator & appear to be intact and at few locations where it got damaged.
- ✓ Median Opening locations appear to be in good condition. The width of the existing standing lane median openings was observed for a width of 1.0m.
- ✓ Solar blinkers in Fair condition observed at median openings in the entire project corridor.
- ✓ Street lightings and High masts are observed at urban, Toll Plaza, Junction Locations, at few locations' street lightings are got damaged and not functioning well, and those items are addressed in the initial cost.

4.10 ROAD USER FACILITIES

- ✓ The Bus Bay with Shelters and Truck lay-byes were provided along the corridor.

CHAPTER 5.REHABILITATION PLANS AND DESIGNS

5.1 DESIGN TRAFFIC LOADING

Design Traffic loading has been estimated by considering the latest traffic (given) and VDFs as estimated from the latest axle load survey data and with min. 5% growth rates for 10 years, 15 years and 20 years design period as below:

Table 50: Traffic Volume (AADT)

Vehicle/Mode	Madai Toll Plaza		Khawasa Toll Plaza	
	Toll Plaza-1 (LHS)	Toll Plaza-1 (RHS)	Toll Plaza-2 (LHS)	Toll Plaza-2 (RHS)
BUS	132	132	125	125
2 Axle	910	910	816	816
3 Axle	669	669	638	638
M Axle	1296	1296	1218	1218
LCV	587	587	329	329

Table 51: Estimated Design traffic loading

Project Name	**Seoni - MSA Summary-Spectrum data**			
Design Period	**Madai Toll Plaza (549+200)**		**Khawasa Toll Plaza (651+600)**	
	LHS	**RHS**	**LHS**	**RHS**
10 years	57	48	60	57
15 years	99	84	104	100
20 years	153	130	161	154

The computation of traffic loadings is presented in **Appendix 9** of this Report. The traffic loading on LHS direction is high compared to RHS direction. Design traffic corresponding to 10 years period has been considered for overlay design.

5.2 PAVEMENT REHABILITATION AND STRENGTHENING

5.2.1 Rigid Pavement Strengthening

Based on the FWD survey and their results it appears that about 85% in LHS, 79% in RHS of the flexural strength values ranges less than 4.0 Mpa. The rigid pavement design period has been checked with various flexural strength values by considering the existing PQC & DLC thickness.

Number of axle load repetitions for each year of operation is estimated and cumulated for entire operation period of 20 years from now. Using IRC 58-2015 design charts, stress ratios corresponding each Flexural strength values ranging from 3.75MPa-4.5MPa have been estimated and number repetitions that existing pavement serves is also established.

The summary of the Design period satisfies for various flexural strength values as given below:

Flexural Strength (Mpa)	Existing Rigid Pavement Thickness satisfies to the design period in Years	
Side	LHS	RHS
3.76	10 Years	10 Years
3.93	20 Years	20 Years
4.04	30 Years	30 Years
3.75	9 Years	9 Years
4	26 Years	26 Years
4.5	30 Years	30 Years

From the FWD data analysis it is found that nearly 106 points in on LHS & 89 points in RHS were having flexural strength values less than 4Mpa. These locations may require major rehabilitation measures during operation period. However, comparison with core results at the same location of FWD, it is found that requisite strength of more than 4 Mpa is available from all cores that were extracted. Thus it is not essential to consider full length rehabilitation based on FWD. It is assumed that each point represents 20 panels. According replacement of panels is arrived after deducting certain panels which are considered in routine maintenance.

Thus, the same has been considered in cost estimates apart from routine and periodic maintenance of rigid pavement.

5.2.2 Flexible Pavement Strengthening

For Design the Overlay Thickness the following method as suggested in IRC: 115 has been used

- The existing pavement is considered as a 3-layer system consisting of subgrade, granular and bituminous layer. The remaining life of exiting pavement in terms of Fatigue and Rutting life (MSA) are estimated
- The remaining life is compared with design traffic loading. An overlay with assumed thickness is considered on exiting pavement where required.
- The Total system including the proposed Overlay (Trial thickness) is assumed as a four-layer system and considered the relevant MR values for all the four layers namely New BT layer, existing bituminous surface, total existing Granular layers and Subgrade layers.
- The MR value for the New BT is assumed as 3000 MPA (considering VG40 Bituminous grade) for Main Carriageway and for all the remaining three layers, the MR Values derived and finalized from the FWD Analysis are considered
- Critical Tensile strains and Vertical strains are found out by using the IIT PAVE Software at the bottom of existing bituminous layer and at the top of the subgrade layer respectively.
- The Fatigue and Rutting equations (equation given in the IRC: 115) applicable for 90% reliability has been used to estimate the Fatigue and Rutting Life of The Pavement system.
- The Obtained Fatigue and Rutting Life are compared with the required life for the assumed trial overlay thickness.

Remaining life of the existing pavement from the above analysis is presented in the following tables:

Table 52: Remaining life of the existing pavement on Both Carriageways

S.No	Side	From	To	Length (Km)	15th Percentile MR values			Average Existing Crust		Total Crust (mm)	Adopted MR for BT (Mpa)	Strains From IITPAVE		Nf- Fatigue life, mSA	Rutting life,mSA	Target MSA
					MR for BT (Mpa)	MR for Granular (Mpa)	MR for Subgrade (Mpa)	BT (mm)	Granular (mm)			Vertical strain at bottom, epZ	Tangential strain at top, epT			
LHS																
1	LHS	547.40	549.00	1.60	1240	392	64	190	380	570	1240	0.0003017	0.0001496	123	129	57
2	LHS	549.00	549.30	0.30								Toll Plaza				
3	LHS	549.30	551.40	2.10	1240	392	64					0.0003017	0.0001496	123	129	57
4	LHS	551.60	553.10	1.50	1253	391	64	193	383	575	1253	0.0002957	0.0001477	128	141	57
5	LHS	553.10	557.20	4.10	1242	390	64	200	390	590	1242	0.0002836	0.0001439	143	170	57
6	LHS	557.40	557.80	0.40	1273	392	64	200	390	590	1273	0.0002817	0.0001425	145	176	57
7	LHS	557.80	558.82	1.02	1306	389	64	200	390	590	1306	0.0002809	0.0001424	143	178	57
8	LHS	558.93	562.45	3.52	1293	371	64	200	390	590	1293	0.0002863	0.0001477	125	163	57
9	LHS	562.45	563.59	1.14	1314	387	64	200	398	598	1314	0.0002754	0.0001423	142	195	57
10	LHS	563.76	567.55	3.79	1303	380	64	200	400	600	1303	0.0002763	0.0001444	135	192	57
11	LHS	567.55	570.73	3.18	1310	354	64	200	400	600	1310	0.0002829	0.0001516	111	172	57
12	LHS	570.73	573.01	2.28	1303	352	64	212	400	612	1303	0.0002714	0.0001450	133	208	57
13	LHS	573.01	577.00	4.00	1323	388	64	280	400	680	1323	0.0002072	0.0001022	512	707	57
14	LHS	577.00	578.35	1.35	1378	390	64	228	446	674	1378	0.0002192	0.0001228	242	548	57
15	LHS	578.35	582.25	3.90								Work in progress				
16	LHS	582.25	585.01	2.76	1378	390	64					0.0002192	0.0001228	242	548	57
17	LHS	585.01	587.58	2.57	1380	387	64	200	470	670	1380	0.0002285	0.0001380	154	454	57
18	LHS	587.58	590.40	2.82	1425	392	64	200	470	670	1425	0.0002260	0.0001354	161	477	57
19	LHS	590.40	594.01	3.61	1417	390	64	218	439	657	1417	0.0002292	0.0001272	206	448	57
20	LHS	594.01	596.75	2.74	1424	390	64	240	400	640	1424	0.0002325	0.0001172	282	420	57
21	LHS	596.75	600.00	3.25	1271	389	64	240	400	640	1271	0.0002390	0.0001216	269	370	57
22	LHS	600.00	603.23	3.23	1273	392	64	263	419	681	1273	0.0002111	0.0001093	408	650	57
23	LHS	603.23	606.00	2.77	1264	383	64	300	450	750	1264	0.0001775	0.0000949	710	1426	57
24	LHS	606.00	608.40	2.40	1279	389	64	300	450	750	1279	0.0001761	0.0000936	742	1478	60
25	LHS	608.40	611.00	2.60	1262	394	64	300	450	750	1262	0.0001760	0.0000932	762	1482	60
26	LHS	611.00	613.62	2.62	1293	390	64	282	512	793	1293	0.0001628	0.0000986	601	2111	60
27	LHS	613.62	616.20	2.58	1309	391	64	270	550	820	1309	0.0001556	0.0001023	515	2591	60
28	LHS	616.20	618.61	2.41	1421	393	64	270	550	820	1421	0.0001526	0.0000991	542	2830	60
29	LHS	618.61	621.62	3.00	1447	393	64	270	550	820	1447	0.0001520	0.0000985	547	2881	60
30	LHS	621.62	624.48	2.87	1446	393	64	270	550	820	1446	0.0001520	0.0000985	547	2881	60

S.No	Side	From	To	Length (Km)	15th Percentile MR values			Average Existing Crust		Total Crust (mm)	Adopted MR for BT (Mpa)	Strains From IITPAVE		Nf- Fatigue life, mSA	Rutting life,mSA	Target MSA
					MR for BT (Mpa)	MR for Granular (Mpa)	MR for Subgrade (Mpa)	BT (mm)	Granular (mm)			Vertical strain at bottom, epZ	Tangential strain at top, epT			
RHS																
1	RHS	547.40	549.00	1.60	1409	391	64	180	630	810	1409	0.0001693	0.0001456	122	1767	48
2	RHS	549.00	549.30	0.30								Toll Plaza				
3	RHS	549.30	551.40	2.10	1409	391	64					0.0001693	0.0001456	122	1767	48
4	RHS	551.60	553.10	1.50	1408	391	64	180	630	810	1408	0.0001694	0.0001456	123	1763	48
5	RHS	553.10	557.20	4.10	1297	375	64	180	630	810	1297	0.0001745	0.0001537	106	1541	48
6	RHS	557.40	557.80	0.40	1412	386	64	193	543	737	1412	0.0001973	0.0001399	143	883	48

S.No	Side	From	To	Length (Km)	15th Percentile MR values			Average Existing Crust		Total Crust (mm)	Adopted MR for BT (Mpa)	Strains From IITPAVE		Nf- Fatigue life, mSA	Rutting life,mSA	Target MSA
					MR for BT (Mpa)	MR for Granular (Mpa)	MR for Subgrade (Mpa)	BT (mm)	Granular (mm)			Vertical strain at bottom, epZ	Tangential strain at top, epT			
7	RHS	557.80	558.80	1.00	1414	385	64	200	500	700	1414	0.0002126	0.0001368	156	629	48
8	RHS	558.93	562.45	3.52	1300	387	64	200	500	700	1300	0.0002154	0.0001397	154	593	48
9	RHS	562.45	563.60	1.15	1264	389	64	200	500	700	1264	0.0002160	0.0001402	156	586	48
10	RHS	563.76	567.55	3.79	1437	387	64	200	500	700	1437	0.0002115	0.0001356	159	644	48
11	RHS	567.55	570.73	3.18	1394	376	64	220	450	670	1394	0.0002555	0.0001296	194	274	48
12	RHS	570.73	574.39	3.66	1300	292	64	220	450	670	1300	0.0002492	0.0001561	100	306	48
13	RHS	574.39	578.35	3.96	1477	251	64	222	443	664	1477	0.0002552	0.0001606	80	275	48
14	RHS	578.35	582.25	3.90									Work in progress			
15	RHS	582.25	585.40	3.15	1542	315	64	230	400	630	1542	0.0002528	0.0001357	149	287	48
16	RHS	585.40	589.00	3.60	1575	389	64	230	411	641	1575	0.0002294	0.0001180	252	446	48
17	RHS	589.00	592.40	3.40	1564	383	64	230	430	660	1564	0.0002210	0.0001187	248	528	48
18	RHS	592.40	596.75	4.35	1651	392	64	230	430	660	1651	0.0002166	0.0001148	270	578	48
19	RHS	596.75	599.19	2.44	1485	392	64	258	357	614	1485	0.0002385	0.0001089	362	374	48
20	RHS	599.19	602.00	2.80	1435	391	64	260	350	610	1435	0.0002433	0.0001098	361	341	48
22	RHS	602.00	606.00	4.00	1293	390	64	260	350	610	1293	0.0002504	0.0001136	346	300	48
23	RHS	606.00	609.20	3.20	1282	390	64	268	350	618	1282	0.0002440	0.0001103	391	337	57
24	RHS	609.20	612.79	3.59	1293	389	64	270	350	620	1293	0.0002420	0.0001093	402	350	57
25	RHS	612.79	616.60	3.81	1298	389	64	270	350	620	1298	0.0002417	0.0001092	402	352	57
26	RHS	616.60	619.57	2.97	1288	391	64	262	390	652	1288	0.0002260	0.0001107	384	477	57
27	RHS	619.57	622.00	2.43	1299	392	64	260	400	660	1299	0.0002217	0.0001107	381	521	57
28	RHS	622.00	624.48	2.48	1290	392	64	260	400	660	1290	0.0002220	0.0001109	381	517	57

In both the directions (LHS& RHS) as the remaining life of the existing pavement is more than the required design life and thus no overlay is warranted.

Input data used and the output from the IIT Pave software has been presented as screen shots for ready reference in **Appendix 10** of this Report.

5.3 STRUCTURAL REHABILITATION

All the structure found to be in fair except minor treatment like crack repairs,repair of stone pitching, cleaning of drainage spouts, cleaning of vegetation etc. may be required. Detailed structural rehabilitation quantities have been worked out based on the prevailing condition of existing structures. This methodology describes in detail the procedure for the execution of each item of rehabilitation work of the Existing Bridges of the project.

The scope of this methodology covers the items mentioned below for rehabilitation work of all the existing Bridges.

- ***Repair/ Replacement of Existing Bearings***
- ***Repair / Replacement of Existing Expansion Joints***
- ***Repair / Replacement of Existing Wearing Coat***
- ***Profile Correction for Existing Deck Slab by Cement Concrete***
- ***Sealing of Cracks for Bridges by Epoxy Resin***
- ***Replacement of Spalled Concrete of ECW by Epoxy Mortar***
- ***Cement Grouting for Repair of Existing Bridges***

- ***Guniting / Shotcrete for Repair of Existing Bridges***
- ***Providing & Fixing of Drainage Spouts***
- ***Repair of Substructure Component***
- ***Repair / Replacement of Railing & Crash Barrier***
- ***Epoxy Bonding between New and Old Concrete.***

About 48 Nos. of locations, Structures are closely monitored by use of Mobile Bridge Inspection Unit (MBIU). Details of these structures where MBIU is used are presented in the following table

Table 53: Locations of MBIU survey

S. No.	Site Chainage (Km)	Type of Structure	Side
1	554+946	MJB	LHS
2	554+946	MJB	RHS
3	570+880	MJB	LHS
4	570+880	MJB	RHS
5	574+671	MNB	LHS
6	574+671	MNB	RHS
7	576+642	MNB	LHS
8	576+642	MNB	RHS
9	579+109	MNB	LHS
10	579+109	MNB	RHS
11	626+915	AUP	LHS
12	626+915	AUP	RHS
13	630+727	AUP	LHS
14	630+727	AUP	RHS
15	631+987	MNB	LHS
16	631+987	MNB	RHS
17	632+050	AUP	LHS
18	632+050	AUP	RHS
19	632+356	AUP	LHS
20	632+356	AUP	RHS
21	632+634	AUP	LHS
22	632+634	AUP	RHS
23	632+790	AUP	LHS
24	632+790	AUP	RHS
25	633+510	AUP	LHS
26	633+510	AUP	RHS
27	634+330	AUP	LHS
28	634+330	AUP	RHS
29	634+637	AUP	LHS
30	634+637	AUP	RHS
31	635+160	AUP	LHS
32	635+160	AUP	RHS
33	635+680	AUP	LHS
34	635+680	AUP	RHS
35	636+075	AUP	LHS
36	636+075	AUP	RHS
37	638+694	MNB	LHS
38	638+694	MNB	RHS
39	639+264	MNB	LHS
40	639+264	MNB	RHS
41	643+726	AUP	LHS
42	643+726	AUP	RHS
43	646+109	MNB	LHS
44	646+109	MNB	RHS

S. No.	Site Chainage (Km)	Type of Structure	Side
45	649+000	MJB	LHS
46	649+000	MJB	RHS
47	652+500	AUP	LHS
48	652+500	AUP	RHS

Based on the MBIU/Visual Inspection, following structures are identified to undertake NDT tests to evolve rehabilitation strategies.

S.No.	Chainage (Km)	Type of Structure	Side	
1	574+671	MNB	LHS	Standard NDT tests such as Crack mapping, Carbonation Depath test, Rebound hammer test, Half-cell potential test and UPV test (for depth of crack/ concrete quality) etc
2	574+671	MNB	RHS	
3	576+642	MNB	LHS	
4	579+109	MNB	LHS	
5	579+109	MNB	RHS	
6	626+915	AUP	LHS	
7	626+915	AUP	RHS	
8	630+727	AUP	LHS	
9	630+727	AUP	RHS	
10	643+726	AUP	LHS	
11	643+726	AUP	RHS	
12	652+500	AUP	LHS	
13	652+500	AUP	RHS	

5.4 DEVELOPMENT ZONES (Schedule-B PROVISIONS)

It Specifies

- ***Service Road/ Slip Road as per Cl. 1- nil***
- ***Improvement proposal in Main carriageway as per Cl.2- nil***
- ***Construction of New Structures/ Reconstruction of structures as per Cl.3- Nil***
- ***Maintenance works as per Cl.4***
- ***Junction improvements as per Cl. 5***
- ***Median openings as per Cl.6***
- ***Drain Locations as per Cl.7***
- ***Rain Water Harvesting Structures as per Cl.8***
- ***Project Facilities as per Cl.9***
- ***Traffic Control Devices/ Road Safety Devices/ Roadside Furniture Cl. 10***
- ***Completion Schedule for Improvement Proposals Cl. 11***

5.4.1 Service Roads/ Slip Road

➢ ***Construction of New Slip/Service Roads***

Slip/Service Roads as mentioned in Schedule-A shall be constructed by Authority at the locations indicated below:

S.No	Existing Kilometre (Km)		One Side Length (m)	Width (m)	Side	TCS Type	Remarks
	From	To					
1	577+650	578+000	350	5.5	LHS	TCS - 02	New Service Road
2	618+400	618+700	300	5.50	LHS	TCS - 02	New Service Road
3	636+900	637+310	410	5.5	LHS	TCS – 01	New Service Road
4	640+030	640+520	490	5.50	LHS	TCS - 03	New SR / Existing Drain and PGR
5	640+030	640+520	490	5.50	RHS	TCS - 03	New SR / Existing Drain and PGR
6	650+200	650+943	743	5.50	LHS	TCS - 03	New SR / Existing Drain and PGR
7	650+200	650+943	743	5.50	RHS	TCS - 03	New SR / Existing Drain and PGR
	Total Length		**3526**				

5.4.2 Maintenance Works

The Concessionaire shall be responsible for the improvement and Operation and Maintenance of the length of Project Highway stipulated by the Concession Agreement in accordance with scope defined in Concession Agreement (including but not limited to Schedule-B and Schedule – F) during the Concession Period. The Concessionaire shall carryout following maintenance works.

a) Repair and Rehabilitation of pavement
b) Repair and Rehabilitation of Embankment /Earthen Shoulders/ /Paved Shoulders/ Stone Pitching etc.
c) Repair and Rehabilitation of structures.

Repair and Rehabilitation of Pavement

The Concessionaire shall carry out Pavement condition survey (visual, deflection, roughness, Skid resistance, etc.) with NSV (Network Survey Vehicle) and assess the existing pavement condition and identify the pavement distresses/ type of defects (Structural distresses and Functional Distresses) and determine the root cause of pavement's distress and track the rate of progression of the distress leading to pavement deterioration.

As per the pavement distresses, the remedial measures shall be carried out as per IRC 82-2015 for Flexible Pavement and IRC: SP: 83-2018 for Rigid Pavement.

Concessionaire shall also carryout FWD survey for the entire project highway as per IRC 115-2014 (Flexible Pavement) and IRC 117-2015 (Rigid Pavement) for structural evaluation and accordingly carry out the periodic maintenance as per the concession agreement and applicable standards.

5.4.3 Junction Improvement

➢ ***Improvement of Major Junctions***

The Concessionaire shall improve the following junctions (below flyovers) as per details given below

and specifications & Standards given in IRC: SP: 84- 2019.

S. No.	Existing Kilometer (km)	Type	Improvement Proposal	Remarks
1	554+540	LHS	Development including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019 **(Ref: Appendix B-II)**	
2	555+695	LHS	Development including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019 **(Ref: Appendix B-II)**	
3	567+500	RHS	Development including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019 **(Ref: Appendix B-II)**	
4	572+725	RHS	Development including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019 **(Ref: Appendix B-II)**	
5	586+470	LHS	Development Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019 **(Ref: Appendix B-II)**	
6	589+213	LHS	Development including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019 **(Ref: Appendix B-II)**	
7	597+048	LHS	Development including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019 **(Ref: Appendix B-II)**	
8	606+350	BHS	Development including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019 **(Ref: Appendix B-III)**	Graded Separated Interchanges
9	610+338	LHS	Development including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019 **(Ref: Appendix B-II)**	
10	615+878	RHS	Development including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019 **(Ref: Appendix B-II)**	
11	617+796	RHS	Development Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019 **(Ref: Appendix B-II)**	
12	644+880	LHS	Development Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP:84-2019 (Ref: Appendix B-II)	

Note: The Concessionaire shall also maintain as per requirement of Schedule F for any new junction if constructed during Concession Period and NO COS shall be applicable.

- ***Improvement of Major Junctions***

The Concessionaire shall improve following minor junctions as per provisions of Section 3.2 of IRC: SP: 84- 2019. At – Grade Pedestrian crossing facility, Road Signage, Speed Breaker and Pavement marking shall be provided at all minor junctions in consultation with Independent Engineer.

S No.	Existing Kilometer (km)	Type	Improvement Proposal	Remarks
1	548+594	T	Development of Junction including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019. Refer Appendix **B- IV** for Signage at Junction	Shelter Lane to be added at Median Opening
2	554+200	+	Development of Junction including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019. Refer **Appendix B- IV** for Signage at Junction	Shelter Lane to be added at Median Opening
3	557+588	Y	Development of Junction including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019. Refer **Appendix B- IV** for Signage at Junction	Shelter Lane to be added at Median Opening
4	560+587	Y	Development of Junction including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019. Refer **Appendix B- V** for Signage at Junction	Narrow median
5	561+500	Y	Development of Junction including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019. Refer **Appendix B- V** for Signage at Junction	Narrow median
6	563+092	T	Development of Junction including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019. Refer **Appendix B- V** for Signage at Junction	Narrow median
7	569+720	T	Development of Junction including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019. Refer Appendix B- IV for Signage at Junction	Shelter Lane to be added at Median Opening
8	574+990	+	Development of Junction including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019. Refer **Appendix B- IV** for Signage at Junction	Shelter Lane to be added at Median Opening
9	578+500	Y	Development of Junction including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019. Refer **Appendix B- IV** for Signage at Junction	Shelter Lane to be added at Median Opening
10	580+650	+	Development of Junction including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019. Refer **Appendix B- IV** for Signage at Junction	Shelter Lane to be added at Median Opening
11	585+764	+	Development of Junction including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019. Refer **Appendix B- IV** for Signage at Junction	Shelter Lane to be added at Median Opening
12	592+794	T	Development of Junction including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019. Refer **Appendix B- IV** for Signage at Junction	Shelter Lane to be added at Median Opening
13	596+203	T	Development of Junction including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019. Refer **Appendix B- IV** for Signage at Junction	Shelter Lane to be added at Median Opening
14	610+862	T	Development of Junction including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC	Shelter Lane to be added at Median Opening

S No.	Existing Kilometer (km)	Type	Improvement Proposal	Remarks
			Codes and Standards as per IRC: SP: 84-2019. Refer **Appendix B- IV** for Signage at Junction	
15	613+500	T	Development of Junction including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019. Refer **Appendix B- IV** for Signage at Junction	Shelter Lane to be added at Median Opening
16	621+118	+	Development of Junction including Signages, marking, road studs, blinker, pedestrian crossing facility as per relevant IRC Codes and Standards as per IRC: SP: 84-2019. Refer **Appendix B- IV** for Signage at Junction	Shelter Lane to be added at Median Opening

For other Minor Junctions which are listed in Scheule A and not included in above table except minor Junctions at Km 640+950 shall also be developed with Road Signage, Marking, Road Studs, Pedestrian Crossing facility as per **Appendix B – V**.

Note: * Necessary modification as deemed required after completion of work shall also be considered scope of works and the same shall not constitute a Change of Scope.

- ***Entry/Exit arrangement***

The entry /exit arrangements shall be constructed/modified as per the 2.1A of IRC: SP: 84 - 2019, at the below mentioned locations:

S. No.	Existing Kilometer (Km)	LHS Exit	LHS Entry	RHS Exit	RHS Entry
1	550+374	Yes		Yes	
2	551+015		Yes		Yes
3	582+445	Yes		Yes	
4	583+668		Yes		Yes
5	589+410	Yes		Yes	
6	590+790		Yes		Yes
7	621+830	Yes		Yes	
8	622+325		Yes		Yes
9	623+375	Yes		Yes	
10	624+170	Yes		Yes	

Note: the existing structures if required to be widened for the construction of Entry / Exit arrangement shall also be widened and NO COS shall be considered for the widening of such structures. Pavement design at exit / entry shall be provided for design traffic of 50 MSA.

- ***Median Openings***

The following median openings shall be developed / closed developed as per IRC SP: 84 -2019.

A. **Existing Median Openings** at following locations shall be provided Shelter Lane as per Fig 3.7 of IRC SP: 84 - 2019

S No	Location of Median Opening	Proposal
1	548+594	Shelter Lane to be added at Median Opening
2	554+200	Shelter Lane to be added at Median Opening
3	557+588	Shelter Lane to be added at Median Opening

S No	Location of Median Opening	Proposal
4	569+720	Shelter Lane to be added at Median Opening
5	574+990	Shelter Lane to be added at Median Opening
6	578+500	Shelter Lane to be added at Median Opening
7	580+650	Shelter Lane to be added at Median Opening
8	585+764	Shelter Lane to be added at Median Opening
9	592+794	Shelter Lane to be added at Median Opening
10	596+203	Shelter Lane to be added at Median Opening
11	610+862	Shelter Lane to be added at Median Opening
12	613+500	Shelter Lane to be added at Median Opening
13	621+118	Shelter Lane to be added at Median Opening

B. **Existing Median Openings** without shelter lane / with shelter lane shall be provided with Road Signage, Marking, Road Studs and Blinkers as per IRC SP: 84 - 2019

S No	Location of Median Opening	Proposal
1	550+342	Existing Median opening without shelter lane is to be provided with Road Signage, Marking, Road Studs, Blinkers etc.
2	556+965	Existing Median opening without shelter lane is to be provided with Road Signage, Marking, Road Studs, Blinkers etc.
3	575+895	Existing Median opening with shelter lane is to be provided with Road Signage, Marking, Road Studs, Blinkers etc.
4	593+794	Existing Median opening without shelter lane is to be provided with Road Signage, Marking, Road Studs, Blinkers etc.
5	600+500	Existing Median opening with shelter lane is to be provided with Road Signage, Marking, Road Studs, Blinkers etc.
6	603+800	Existing Median opening with shelter lane is to be provided with Road Signage, Marking, Road Studs, Blinkers etc.
7	607+988	Existing Median opening with shelter lane is to be provided with Road Signage, Marking, Road Studs, Blinkers etc.
8	614+000	Existing Median opening with shelter lane is to be provided with Road Signage, Marking, Road Studs, Blinkers etc.
9	619+500	Existing Median opening with shelter lane is to be provided with Road Signage, Marking, Road Studs, Blinkers etc.
10	621+657	Existing Median opening with shelter lane is to be provided with Road Signage, Marking, Road Studs, Blinkers etc.
11	623+329	Existing Median opening with shelter lane is to be provided with Road Signage, Marking, Road Studs, Blinkers etc.

5.4.7 Rainwater Harvesting

Apart from existing Rainwater Harvesting Structures, if any additional is required as per MoRTH Circular ref: No. RW / NH-33044/14/2003 – S & R (R) Pt. II dated 3 Sep 2019 along the Project same shall be provided as per specifications & standards and relevant IRC Codes.

5.4.8 Project Facilities

Following Project Facilities shall be provided in accordance with provisions mentioned in Schedule-C of this agreement.

1. Toll plazas.
2. Truck Lay Bye.
3. Landscaping and tree plantation.

4. Rest areas / Wayside Amenities.
5. Others
   i. Highway Lighting
   ii. Highway Patrol
   iii. Ambulances
   iv. Cranes
   v. ATMS
   vi. Traffic Aid Post
   vii. Medical Aid Post

Truck Lay Bye

Truck Lay Bye shall be provided at the following locations as per IRC: SP:84- 2019 within the ROW.

S.No	Existing Kil (Km)		Side	Improvement Proposal
	From	To		
1	583+668	584+100	LHS and RHS	Existing Rest Area, Toilet block, Lighting shall be repair and maintain.
2	612+310	612+744	LHS and RHS	

Highway Lighting

The Concessionaire shall provide the lighting at the following locations as per the Manual for Four Laning IRC: SP: 84-2019.

Toll Plaza Approach: lighting at median shall be provided at following locations at approach of Toll Plaza.

S.No	Existing (LHS) km		Side	Length (km)
	From	To		
1	548+500	549+000	Median	0.5
2	549+320	549+820	Median	0.5
	Total Length			**1**

Lighting at Built Up-area: highway lighting shall be provided at following built up location.

S.No	Existing (LHS) Km		Side	Length (km)
	From	To		
1	550+374	551+015	MCW and Existing Service Road Both Side	0.641
2	582+445	583+668	MCW and Existing Service Road Both Side	1.223
3	589+300	590+790	MCW and Existing Service Road Both Side	1.49
4	621+830	622+325	MCW and Existing Service Road Both Side	0.495
5	623+375	624+170	MCW and Existing Service Road Both Side	0.795
6	636+900	637+310	MCW and Existing Service Road Both Side	0.41
	Total Length			**5.054**

Additional lighting of 150 m on MCW is to be provided after start / end of Service Road.

Grade Separated Structures: The Flyovers, ROB and service /slip roads shall have lighting with solar energy system, as per Manual. Lighting shall be provided at top & underside of the Grade Separated structures. The locations are given below:

S.No	Existing Kilometer (Km)		Length (km)	Remarks
	From	To		
1	Interchange 606		3.2	Single Arm for Ramp and Loop
2	606+000	607+000	1	MCW

Apart from above new lighting system as stated above, existing lighting system along the project road shall be repaired / replaced to achieve minimum Lux level as per IRC SP: 84 - 2019.

Truck Laybyes: Lighting shall be provided for existing Truck Laybyes at The Flyovers, ROB and service /slip roads shall have lighting with solar energy system, as per Manual. Lighting shall be provided at top & underside of the Grade Separated structures. The locations are given below:

S.No	Existing Kilometer (Km)		Length (km)	Remarks
	From	To		
1	583+668	584+200	0+532	Truck Laybys including MCW

Highway Patrol

Highway Patrol units (minimum three numbers i.e. one in MP 2, MP 3 and MP 4) in accordance with IRC SP-84-2019 and comply with Operational requirements as mentioned in Schedule-F shall be provided. The Patrol Vehicles shall be provided and maintained as per the specifications given in NHAI Policy No. 12.19, dated 20th March 2018. It shall be fitted with GPS based Vehicle Tracking System (VTS) to monitor movement on 24 hoursx7 days of a week basis.

Ambulances

Ambulance units (minimum three numbers i.e. one in MP 2, MP 3 and MP) shall be continuously available along the Project Highway in accordance with IRC SP-84-2019 and comply with Operational requirements as mentioned in Schedule-F. The Ambulances shall be provided and maintained as per the specifications given in NHAI Policy No. 12.19, dated 20th March 2018.

It shall be fitted with GPS based Vehicle Tracking System (VTS) to monitor movement on 24hours x 7 days of a week basis.

Cranes

Mobile cranes having the capacity to lift a truck with a Gross Vehicle Weight of 30,000 (thirty thousand) kilograms shall be provided and maintained round the clock for rescue operations.

Cranes (minimum three numbers i.e. one in MP 2, MP 3 and MP4) shall be continuously available along the Project Highway in accordance with the provision of IRC SP- 84-2019 and to comply with Operational requirements as mentioned in Schedule-F.

Traffic Aid Post

Traffic Aid Posts shall be repaired / maintained at the Toll Plaza / suitable locations with minimum one number in each package in accordance with Clause 17.3 of the DCA and the Manual of specifications & standards.

Medical Aid Post

Medical Aid Posts shall be repaired / maintained at the Toll Plaza / suitable locations with minimum one number in each package in accordance with Clause 18.2 of the DCA and the Manual of specifications & standards.

5.4.9 Traffic Control Devices/ Road Safety Devices/ Roadside Furniture

Traffic control devices/road safety devices/ roadside furniture shall be provided in accordance with Schedule C for the location where modification on carriageway and additional service / slip road is to be provided under this contract. The Concessionaire shall prepare detailed drawing showing traffic control devices (signage, marking, road studs, delineator, Kilometer / Hectometer/ Boundary Stone, blinkers, crash barrier etc.) incorporating existing features and additional devices to be provided as required to comply requirement of IRC SP: 84- 2019.

Traffic Signs, Road Marking, Road Studs, Road Delineators, Kilometer/Hectometer /Boundary Stones

- ***Traffic Signages:***
  - i. Road signages (cautionary, mandatory and informatory) along the project highway shall be provided wherever required, as per IRC:67-2022 & IRC: SP:84-2019.
  - ii. Overhead Gantry signs (Minimum 2 Nos) and Cantilever Gantry signs (Minimum 12 Nos) shall be provided suitably on the project highway as per IRC: SP:84-2019.
- ***The Concessionaire shall provide new Road marking at locations as mentioned main carriageway, Service/slip roads, Ramps etc. as per IRC:35-2015 & IRC: SP:84-2019. Excluding project road under Annuity Concession and DLP of EPC Contractor.***
- ***Road Studs including Solar Studs shall be provided as per IRC: SP:84-2019. Excluding project road under Annuity Concession and DLP of EPC Contractor.***
- ***Road Delineators shall be provided as per IRC: SP:84-2019 & IRC:79-2019. Excluding project road under Annuity Concession and DLP of EPC Contractor.***
- ***New KM / Hecto Stone shall be provided at locations excluding project road under Annuity Concession and DLP of EPC Contractor.***
- ***Boundary Stones shall be provided as per Schedule C.***

The requirement of the retired revenue officials or any other resources that may be required from Revenue Department / State Authorities as may be required to demarcate the already acquired land to provide Boundary Stone shall be incidental to the work and shall be considered to be in the scope of the Concessionaire.

RCC Median Barrier

The Concessionaire shall provide New Jersey Crash Barrier along Median as per Sub-clause 9.7.5.4 of IRC SP: 84 -2019 at following location after dismantling of existing raised median

S.N.	Existing Kilometer (LHS) km		Location	Length of MBCB (km)
	From	To		
1	551+600	553+100	Median	1.5
2	557+400	557+800	Median	0.4
3	558+930	562+450	Median	3.52
4	563+760	567+550	Median	3.79
	Total Length			**9.21**

RCC Median Barrier shall be provided as per Fig 26 of IRC 119-2015 and Antiglare shall be provided on top of RCC Median Barrier along entire length.

Traffic Impact Attenuator:

Traffic impact attenuator shall be provided at all exit gore location as per Sub-clause 9.6 of IRC SP: 84-2019 at following locations:

S. No.	Structure Location/ Existing Kilometer (Km)	LHS Exit	RHS Exit
1	Interchange at Km 606	1	1

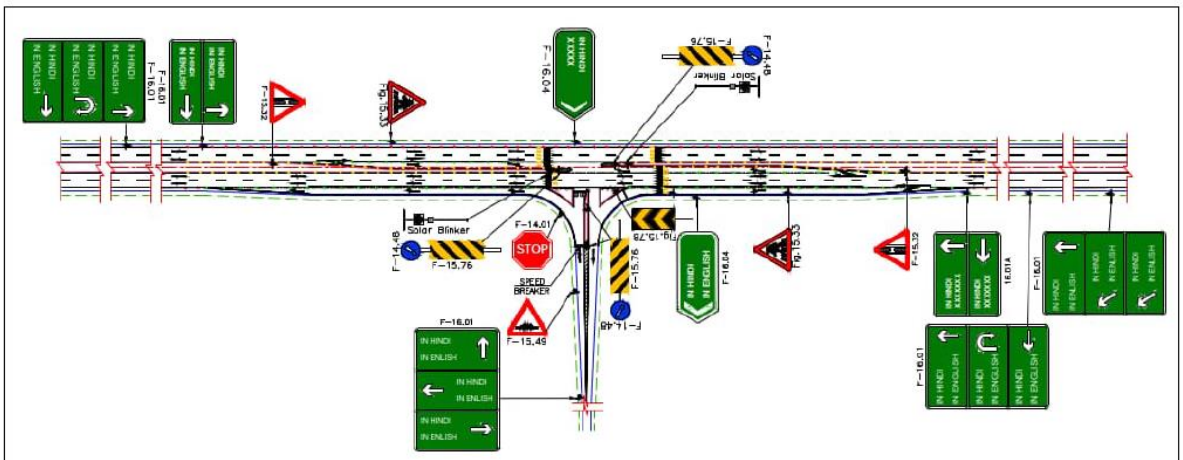
5.4.10 Completion Schedule for Improvement Proposals

Completion schedule for Scope mentioned in Schedule-B shall be as below.

S No	Description of Work	Date of Completion
1	Incident Management (9.7, 9.8 and 9.9)	From Appointed Date / O & M Handover Date, whichever is later
2	Installation / Rectification of road furniture related items (Section 10) Landscaping and Tree Plantation (Section 9.4)	9 months from Appointed Date
3	Maintenance and Rehabilitation (Section 4)	9 months from Appointed Date / O&M Handover Date, whichever is later
4	Toll Plaza and other facilities at Toll Plaza (Section 9.1, 9.11,9.12)	6 months from Appointed Date
5	ATMS (Section 9.10)	12 months form Appointed Date
6	Other Improvements (Section 1, 2, 3, 5, 6, 7, 8, 9.2, 9.3, 9.5, 9.6)	12 months from Appointed Date

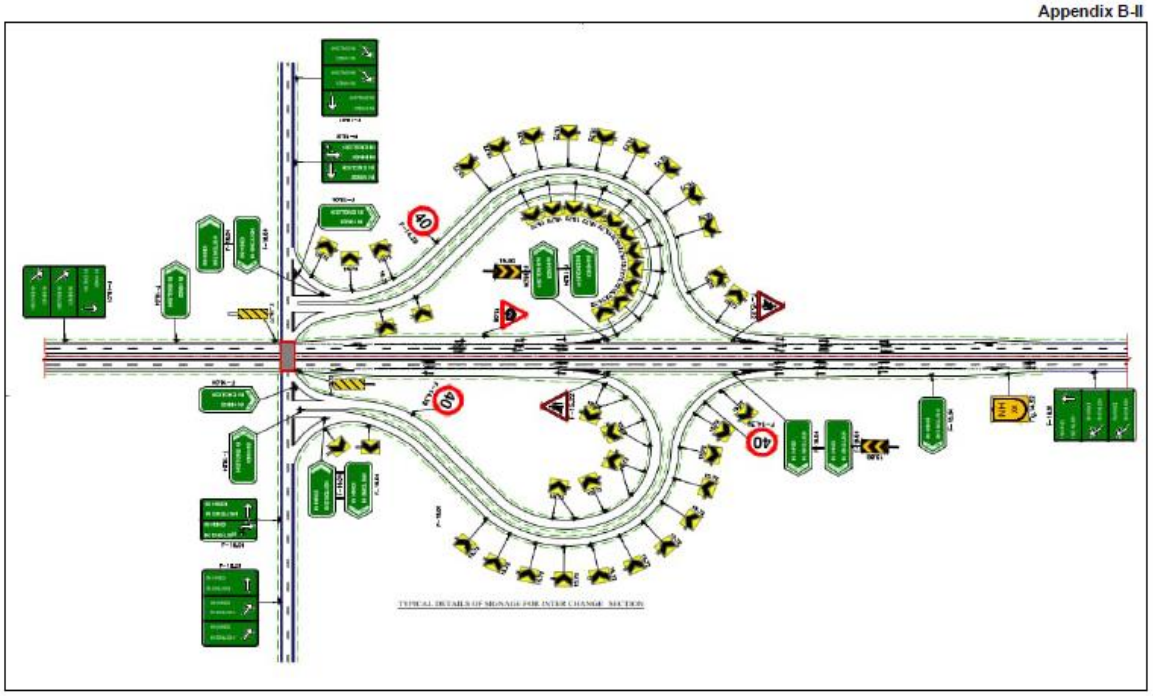
The following standard drawings are applicable for the project road.

Appendix B-I

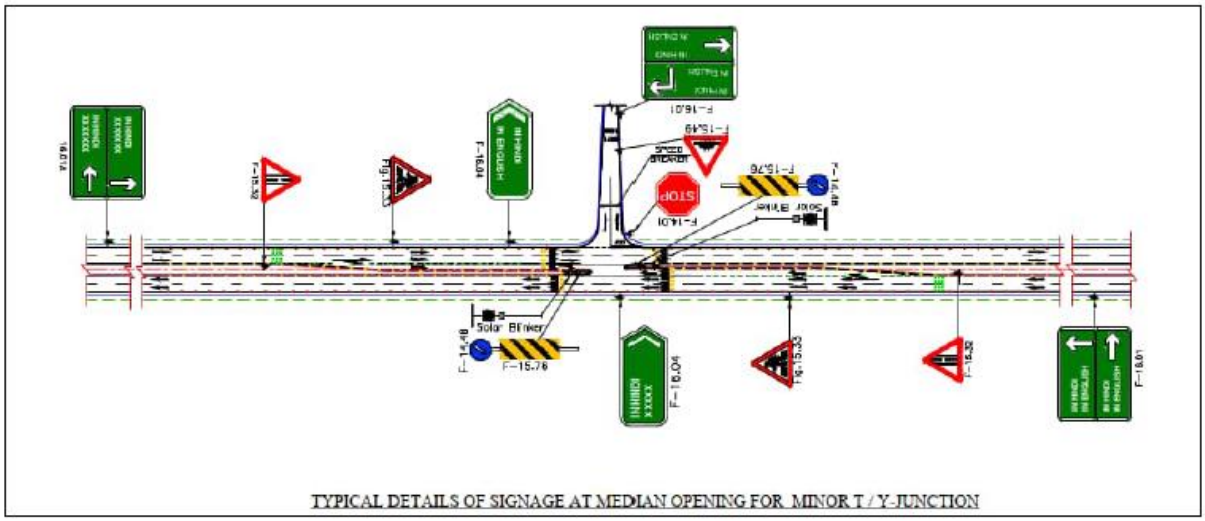


TYPICAL DETAILS OF SIGNAGE AT MEDIAN OPENING FOR T-JUNCTION / Y-JUNCTION

Appendix B-II

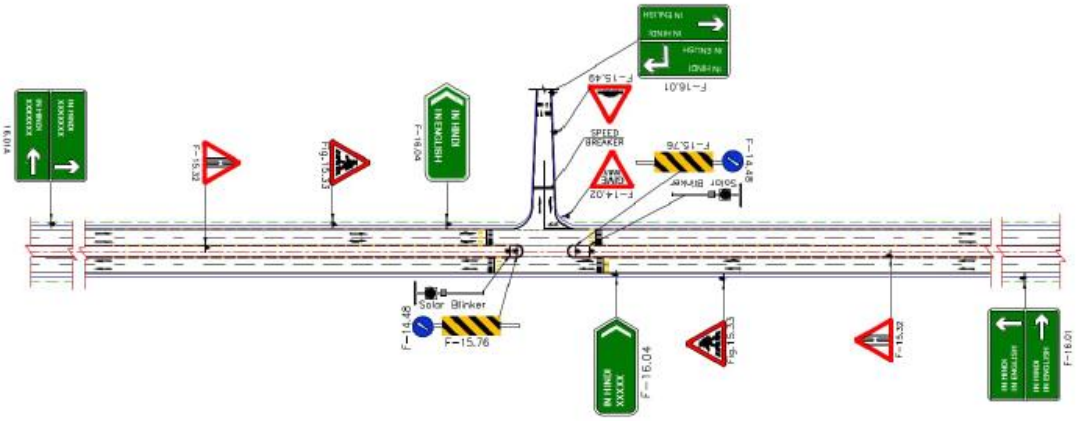


Appendix B-III



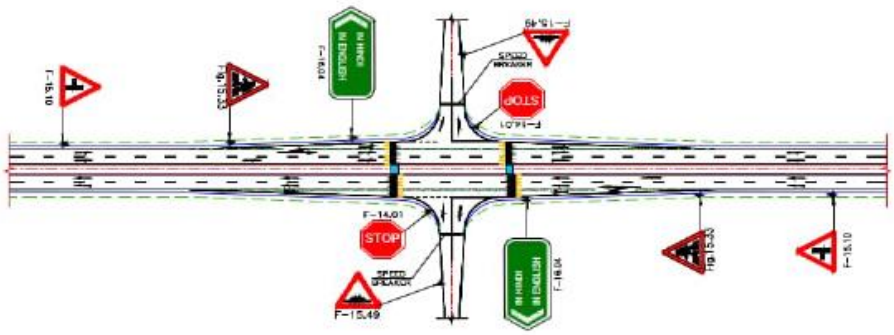
TYPICAL DETAILS OF SIGNAGE AT MEDIAN OPENING FOR MINOR T / Y-JUNCTION

Appendix B-IV

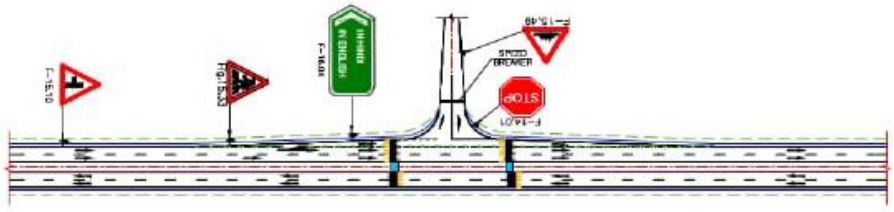


TYPICAL DETAILS OF SIGNAGE AT MEDIAN OPENING FOR T &Y-JUNCTION

Appendix B-V

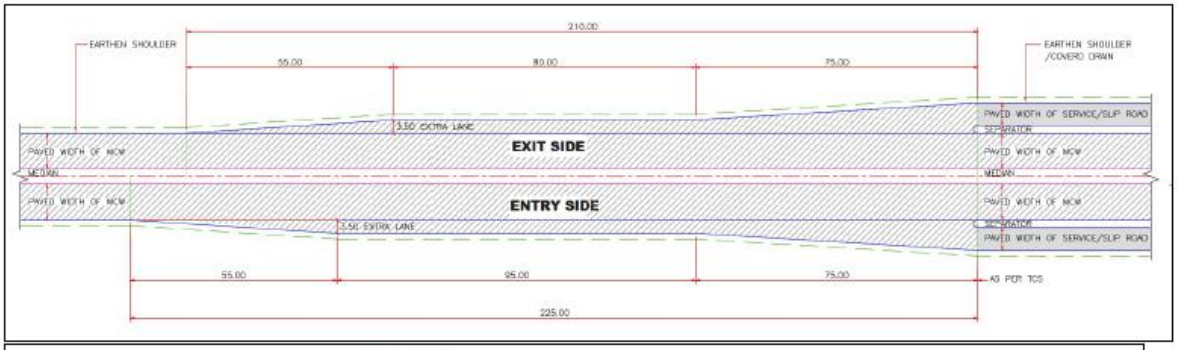


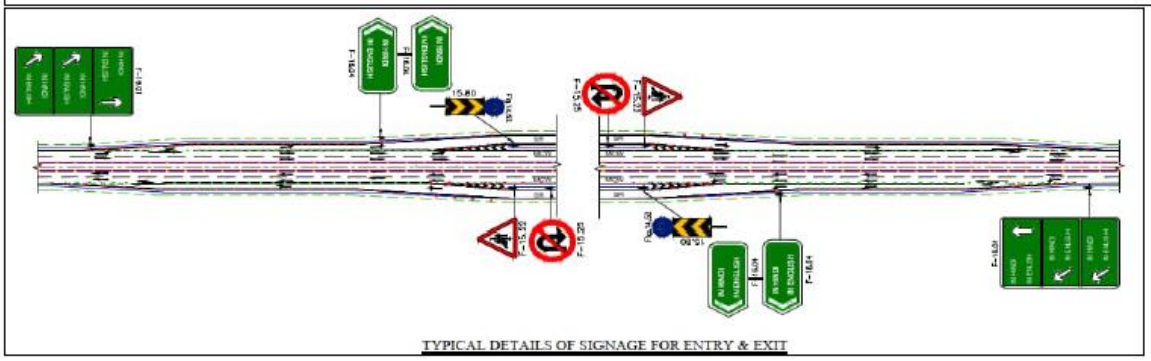
TYPICAL DETAILS OF SIGNAGE AT WITHOUT MEDIAN OPENING FOR X-JUNCTION



TYPICAL DETAILS OF SIGNAGE AT WITHOUT MEDIAN OPENING FOR T &Y-JUNCTION

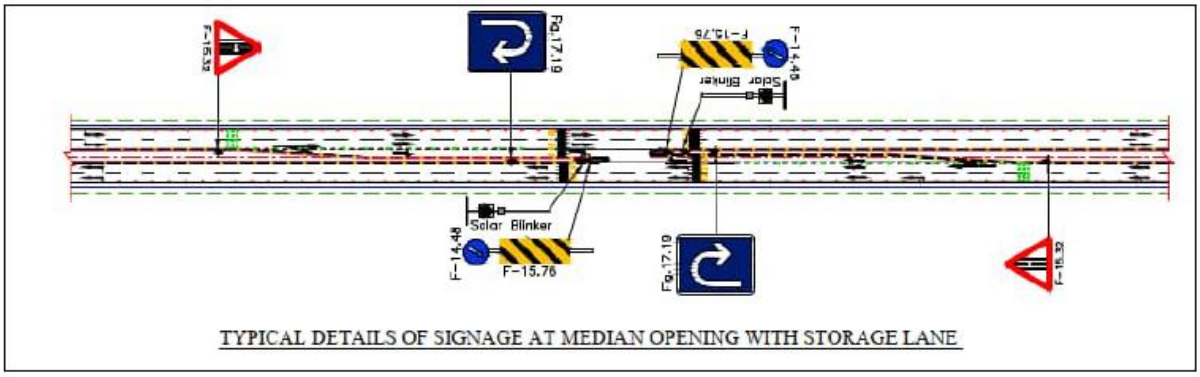
Appendix B-VI



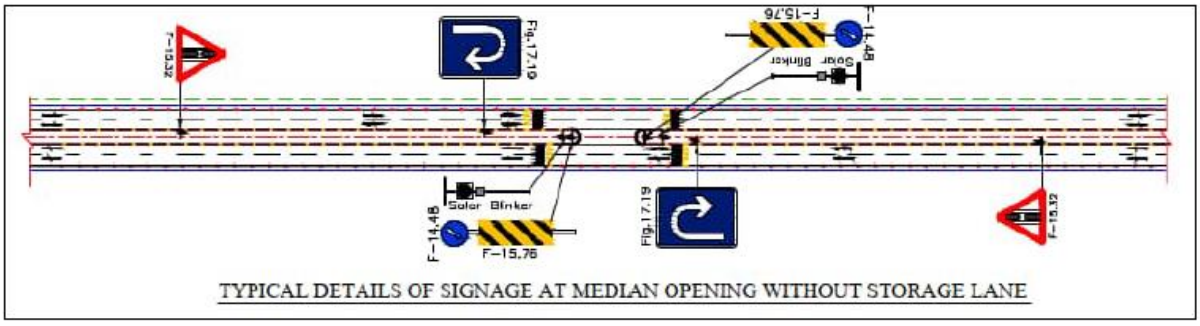


TYPICAL DETAILS OF SIGNAGE FOR ENTRY & EXIT

Appendix B-VII

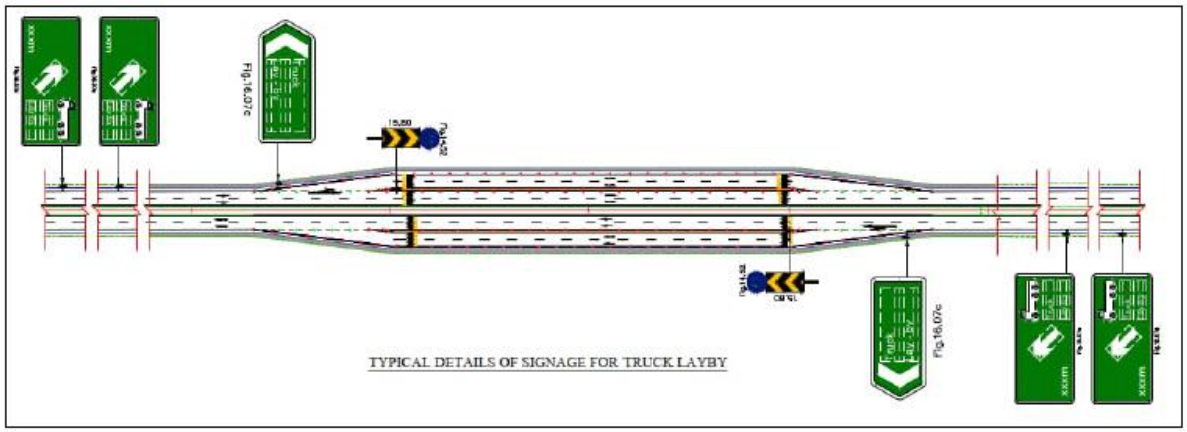


TYPICAL DETAILS OF SIGNAGE AT MEDIAN OPENING WITH STORAGE LANE



TYPICAL DETAILS OF SIGNAGE AT MEDIAN OPENING WITHOUT STORAGE LANE

Appendix B-VIII



TYPICAL DETAILS OF SIGNAGE FOR TRUCK LAYBY

CHAPTER 6.OPERATION AND MAINTENANCE

6.1 INTRODUCTION

Looking at the contractual requirements of maintaining project road under specified level of roughness it is felt that roughness is the most important criterion for finalizing the O&M schedule for the project. Accordingly, the methodology adopted by present consultants includes predicting the roughness year by year under the traffic using a well acknowledged HDM-4 model developed for developing countries like India after lot of research by World Bank. The said model is widely prescribed by MORTH and NHAI during the preparation of detailed project reports for several projects in doing economic analysis for the projects. The economic analysis mainly consists of two parts:

1. Predicting the road deterioration and estimating VOC
2. Estimating Benefits

Considering its importance and present use in India, consultants felt prudent to use the first part, i.e. estimating road deterioration and predicting roughness in HDM 4 model to finalize the O&M schedule for the project. This approach is more scientific as it does not assume hypothetical deflection values at 10th and 20th year and includes main criterion of maintaining roughness at 2400 mm/Km as per Schedule-F.

6.2 CA SPECIFICATIONS FOR MAJOR MAINTENANCE

- ***Schedule F of CA specifies that Roughness values exceeds 2400 mm/km in a length of KM, needs to be corrected within 180 days.***
- ***FWD test to perform every year***

6.3 RIGID PAVEMENT PERIODIC MAINTENANCE STRATEGY

Apart from the above requirements of Sch-F and maintaining the roughness and skid number for the rigid pavements, there are several other repair strategies included in Sch-K for rectification of defects in rigid pavement. These include following:

- ***Crack Seal***
- ***Seal & Stitch***
- ***Staple or Dowel Bar Retrofit***
- ***Partial Depth Repair with Stapling***
- ***Full Depth Repair: Dismantle and reconstruct affected Portion***
- ***Diamond Grinding***
- ***Joint Cleaning & Repair***

Looking at the above requirements, it is felt necessary to consider following activities as part of periodic maintenance cycle at every 7th year apart from routine maintenance activities:

Description	%	Unit	Rate	Quantity	Amount
Length of Rigid Pavement		Kms		11.905	
PQC Qty		Cum		159898	
Total Area		Sqm		494813	
No of Transverse Joints		no		11018	
No of Panels		no		29322	
Length of Transverse Joints		m		109958	
Longitudinal Joint		m		64287	233640
Repair of Transverse Joint @ 7 years	75.0%	m	88.50	82469	7298484
Repair of Longitudinal Joint @ 7 years	75.0%	m	88.50	48215	4267050
Replacement of Transverse Joint@ 7years	2.0%	m	751.00	2199	1651574
Replacement of Longitudinal Joint@ 7years	2.0%	m	751.00	1286	965591
Ravelling surface @7years	3.0%	Sqm	1030	14844	15289706
Crack sealing Surface @ 7years	2.0%	m	418	952	397722
Repair of Panels @ 7years	0.50%	No	9074	147	1333842
Removal of Panels @ 7years	1.50%	No	3463	440	1523519
Relaying of Panels @ 7years	1.50%	No	35986	440	15833789
Regrinding @ 7years	20%	Sqm	100	98963	9896250
Regrinding and Retexturing@ 7years	10%	Sqm	500	49481	24740625
Total Amount in Rs.					83198152
GST @ 18%					14975667
7th year periodic maintenance cost in Crores					9.817
Per Sqm per Cycle (Rs.)					**198**

The above are in addition to routine maintenance activities which include following for every year:

Longitudinal Cracks more than 1.5m	Li.m	0.50%
Longitudinal Cracks less than 1.5m	Li.m	0.50%
Transverse Cracks less than 1.5m	Li.m	0.50%
Transverse Cracks more than 1.5m	Li.m	0.50%
Longitudinal Crack full Depth	Cum	0.10%
Pothole	Sq.m	0.10%
Corner Cracks	cum	0.10%
Condition of Joints	Li.m	1.00%
Diagonal Cracking	Li.m	0.50%
Raveling of panel	Sq.m	0.15%

6.4 FLEXIBLE PAVEMENT PERIODIC MAINTENANCE

6.4.1 Project Sections

Based on traffic, Flexible pavement is divided into following two homogeneous sections have for the HDM analysis.

Section-1: km 547.400 to km 596.750 (49.35 km)- MP2
Section-2: km 596.750 to km 624.480 (27.73 km)- MP3

Since roughness is the main criterion for major maintenance, Project Corridor has been sub divided in to various Cases depending the present roughness values:

- ***Case 1: Roughness values (IRI) <2000 mm/Km***
- ***Case 2: >=2000 mm/Km Roughness values (IRI) <2200 mm/Km***
- ***Case 3: >=2200 mm/Km Roughness values (IRI) <2400 mm/Km***
- ***Case 4: Roughness values (IRI)>=2400 mm/Km***

6.4.2 Traffic (AADT)

The following traffic data has been used in the analysis is as below:

Vehicle/Mode	Madai Toll Plaza (549.200)		Khawasa Toll Plaza (651.800)	
	Toll Plaza-1 (LHS)	Toll Plaza-1 (RHS)	Toll Plaza-2 (LHS)	Toll Plaza-2 (RHS)
CAR	1336	1336	1481	1481
BUS	132	132	125	125
2 Axle	910	910	816	816
3 Axle	669	669	638	638
M Axle	1296	1296	1218	1218
LCV	587	587	329	329

6.4.3 Vehicle Damage Factors (VDF)

VDF values as obtained from axle load surveys are used for various sections are as given below:

Vehicle Type	Madai Toll Plaza (549.200)		Khawasa Toll Plaza (651.800)	
	LHS	RHS	LHS	RHS
BUS	0.83	0.11	o.50	1.58
2-Axle	1.80	1.54	1.95	1.54
3-Axle	3.23	3.00	5.01	4.72
M Axle	8.44	6.93	8.98	8.77
LCV	0.46	0.81	0.37	0.43

6.4.4 HDM Inputs

FWD and Roughness values are used as obtained from surveys and investigations as below:

Section - 1: km 547.400 to km 596.750 (49.35 km)- MP2

Section - 1 (LHS)	Case-1	Case-2	Case-3	Case-4
Criteria	<2000mm/km	2000-2200 mm/km	2200-2400 mm/km	>2400 mm/km
Length, m	5000	4000	7000	33350
Roughness, mm/km	1896	2149	2331	3341
IRI	2.67	2.99	3.22	4.43
Deflection, mm	0.38	0.36	0.38	0.36
Cracking, %	0.02	0.05	0.06	0.60
Ravelling %	0.01	0.02	0.00	0.16
Potholes %	0.00	0.00	0.00	0.00

Section - 1 (LHS)	Case-1	Case-2	Case-3	Case-4
Patching %	1.09	1.98	2.27	5.47
Rut Depth, mm	5.08	5.90	5.70	7.73
BT Crust, mm	200	230	209	210
Granular, mm	395	398	403	415

Section - 1 (RHS)	Case-1	Case-2	Case-3	Case-4
Criteria	<2000mm/km	2000-2200 mm/km	2200-2400 mm/km	>2400 mm/km
Length, m	5000	0	1000	43350
Roughness, mm/km	1913	0	2249	3802
IRI	2.70	0.00	3.11	4.97
Deflection, mm	0.34	0.00	0.31	0.41
Cracking, %	0.15	0.00	0.00	0.35
Ravelling %	0.52	0.00	0.00	0.17
Potholes %	0.00	0.00	0.00	0.00
Patching %	0.44	0.00	0.08	2.32
Rut Depth, mm	4.97	0.00	6.47	6.69
BT Crust, mm	190.0	0.0	200.0	211.3
Granular, mm	565.0	0.0	500.0	486.0

Section - 2: km 596.750 to km 624.480 (27.73 km)- MP3

Section - 2 (LHS)	Case-1	Case-2	Case-3	Case-4
Criteria	<2000mm/km	2000-2200 mm/km	2200-2400 mm/km	>2400 mm/km
Length, m	2000	2000	0	23730
Roughness, mm/km	1883	2141	0	5017
IRI	2.66	2.98	0.00	6.35
Deflection, mm	0.29	0.32	0.00	0.34
Cracking, %	0.01	2.63	0.00	0.18
Ravelling %	0.10	0.02	0.00	0.10
Potholes %	0.00	0.00	0.00	0.00
Patching %	1.37	3.04	0.00	5.73
Rut Depth, mm	3.66	3.60	0.00	4.82
BT Crust, mm	270	208	0	276
Granular, mm	550	475	0	479

Section - 2 (RHS)	Case-1	Case-2	Case-3	Case-4
Criteria	<2000mm/km	2000-2200 mm/km	2200-2400 mm/km	>2400 mm/km
Length, m	1480	1000	2000	23250
Roughness, mm/km	1898	2107	2353	3391
IRI	2.68	2.94	3.24	4.49
Deflection, mm	0.22	0.19	0.28	0.31
Cracking, %	0.32	0.01	0.01	0.16
Ravelling %	0.00	0.01	0.00	0.07
Potholes %	0.00	0.01	0.00	0.01
Patching %	1.68	1.34	1.87	2.96
Rut Depth, mm	3.01	3.80	4.76	5.14
BT Crust, mm	260.0	260.0	260.0	263.1
Granular, mm	400.0	400.0	400.0	358.8

6.4.5 Options for MM Schedules

Based on the requirements of CA, various options have been considered to be used as responsive overlays triggered at specified level of roughness of 2400 mm/km. Micro surfacing has also been considered to examine its feasibility for major maintenance.

In LHS & RHS directions following options were considered in the analysis:

- ✓ ***Base Case: MCS at Roughness of 2400mm/Km with regular maintenance***
- ✓ ***Opt-1: Responsive Mill & Overlay of 30mm BC whenever roughness is >2400mm/KM with regular maintenance***
- ✓ ***Opt-2: Responsive Mill & Overlay of 40mm BC whenever roughness is >2400mm/KM with regular maintenance***
- ✓ ***Opt-3: Responsive Mill & Overlay of 50mm BC whenever roughness is >2400mm/KM with regular maintenance***

6.4.6 ALTERNATIVES FOR HDM ANALYSIS

Following Two alternatives are considered for HDM Analysis:

- ***Alternative 1: Since the handing over requirements for present concessionaires is 2500mm/Km and that of TOT concessionaire is 2400mm/Km, it may be required to undertake an overlay immediately after handover in 2028 to bring the roughness lower than 2400mm/Km. Thus is scheduled overlay is introduced in FY 2028 in roughness model. For this Alt-1: with 50mm Overlay is considered in FY2025 & FY2028 (Considering Existing Concessionaire do OL in FY 25 and TOT- Concessionaire shall undertake OL in FY28 to maintain Roughness<2400mm/km)***
- ***Alternative 2: Since the overlay on the project road is being done by existing concessionaires who shall handover in 2028, it is assumed that the road will be handed over on good condition (below 2400mm/Km). Only condition specified option of maintaining roughness under 2400mm/Km is used in this alternative. No scheduled overlay is induced in year 2028 at handover. For this Alt-2: 50mm Overlay in FY2025 (Considering Existing Concessionaire do OL in FY 25 and handover to TOT-Concessionaire in FY 28 under roughness <2400mm/km without any overlay consideration):***

6.4.7 ROUGHNESS PROGRESSION

Roughness progression for each section under each alternative maintenance option has been done using the deterioration models in HDM-4. Following graphs represents the roughness progression for alternative 1:

Section - 1: km 547.400 to km 596.750 (49.35 km)- MP2

HDM-4
HIGHWAY DEVELOPMENT & MANAGEMENT

Average Roughness by Section (Graph)

Study Name: LK Sec-1 LHS FY_25&28
Run Date: 16-12-2023

Section Details:
ID: LK LHS 1 <2000 Road Class: Primary or Trunk Rise + Fall: 1.00m/km
Description: LK LHS 1 <2000 Length: 5.00km Curvature: 3.00deg/km
Width: 9.00m

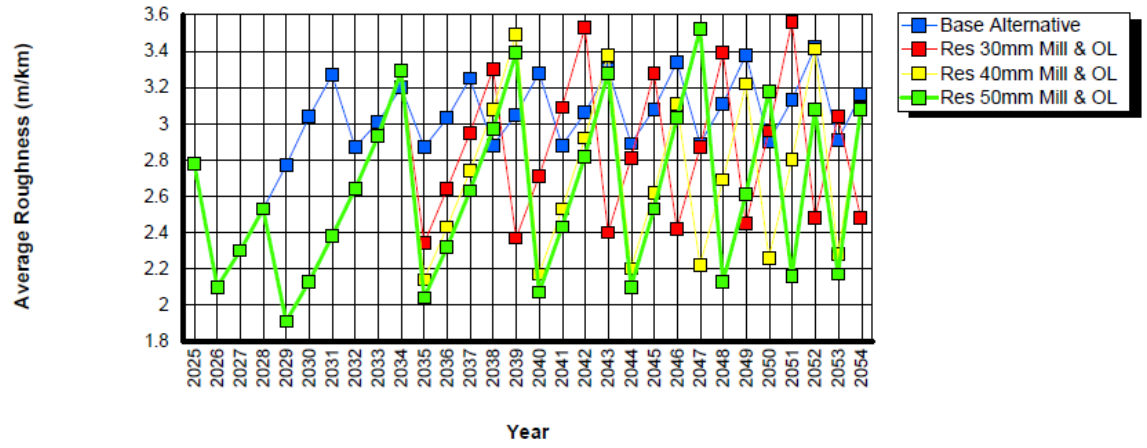


Figure 1: Average Roughness in LHS (UP) Carriageway (Sec-1) <2000 mm/km

HDM-4 Average Roughness by Section (Graph)

Section Details:
ID: LK LHS 1 <2200 Road Class: Primary or Trunk Rise + Fall: 1.00m/km
Description: LK LHS 1 <2200 Length: 4.00km Curvature: 3.00deg/km
Width: 9.00m

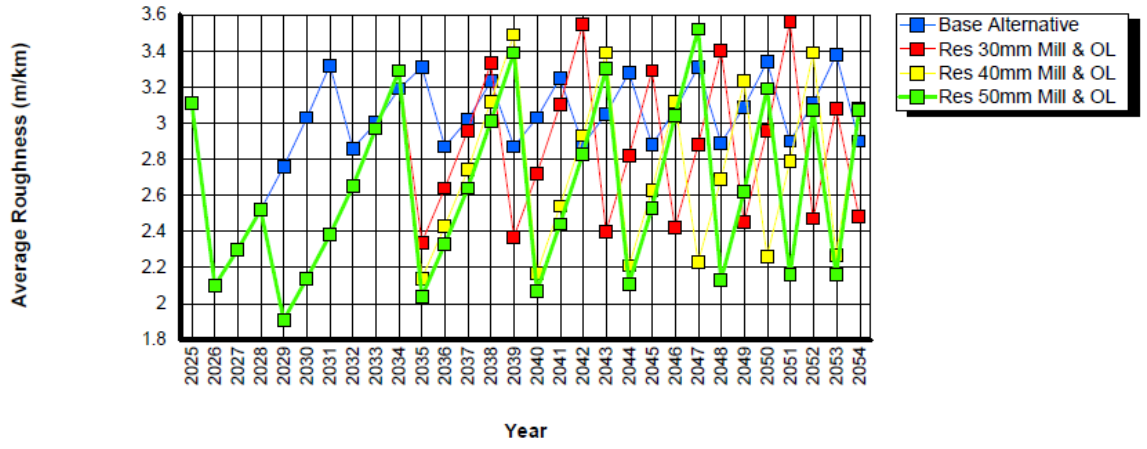


Figure 2: Average Roughness in LHS (UP) Carriageway (Sec-1) <2200 mm/km

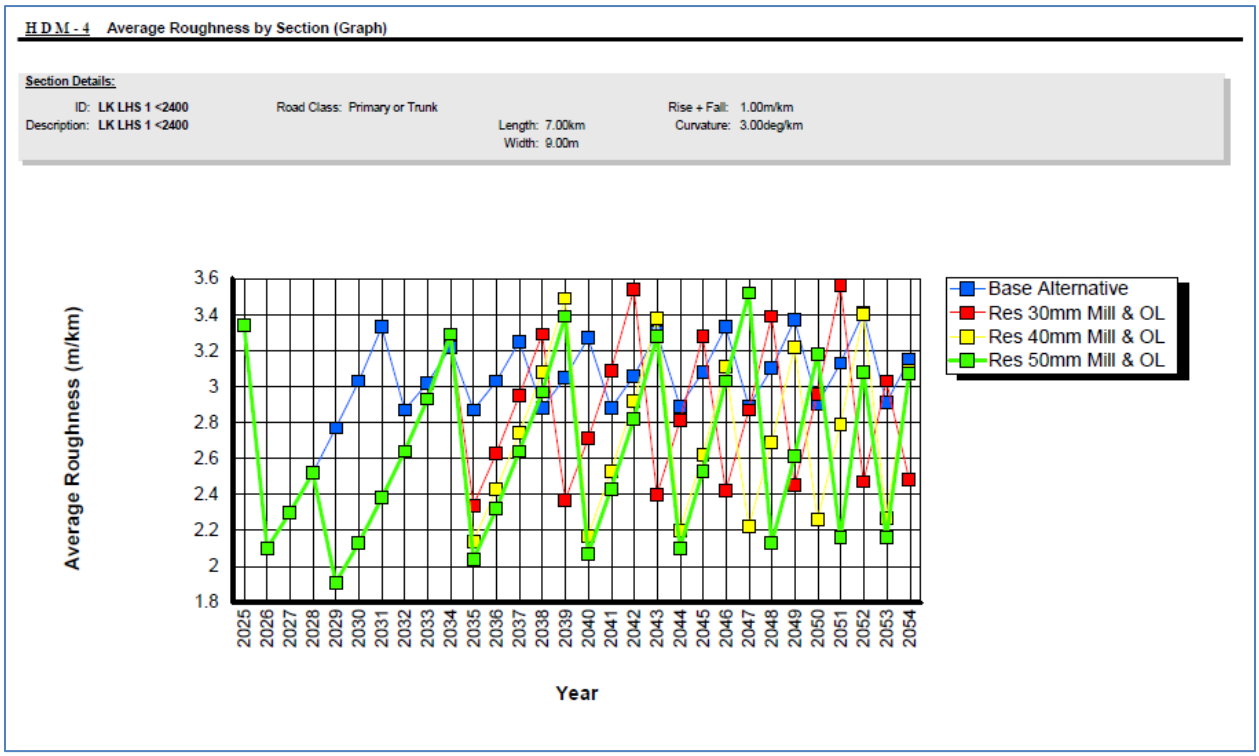


Figure 3: Average Roughness in LHS (UP) Carriageway (Sec-1) <2400 mm/km

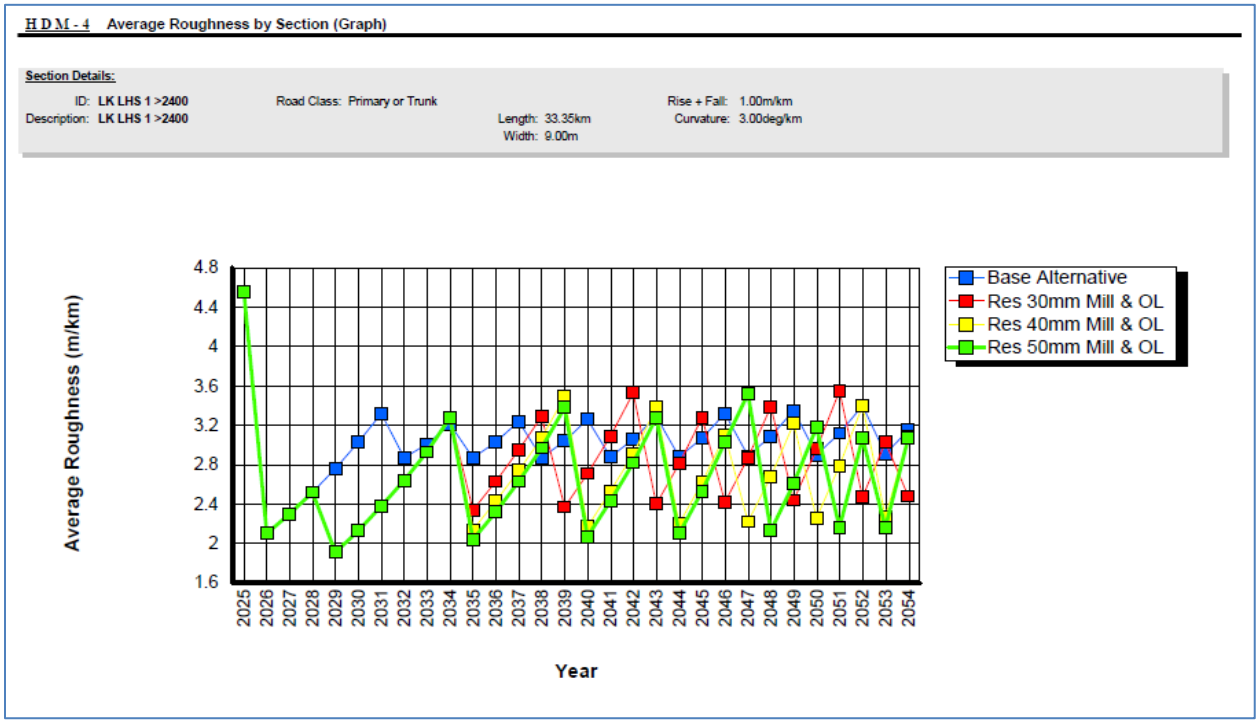


Figure 4: Average Roughness in LHS (UP) Carriageway (Sec-1) >2400 mm/km

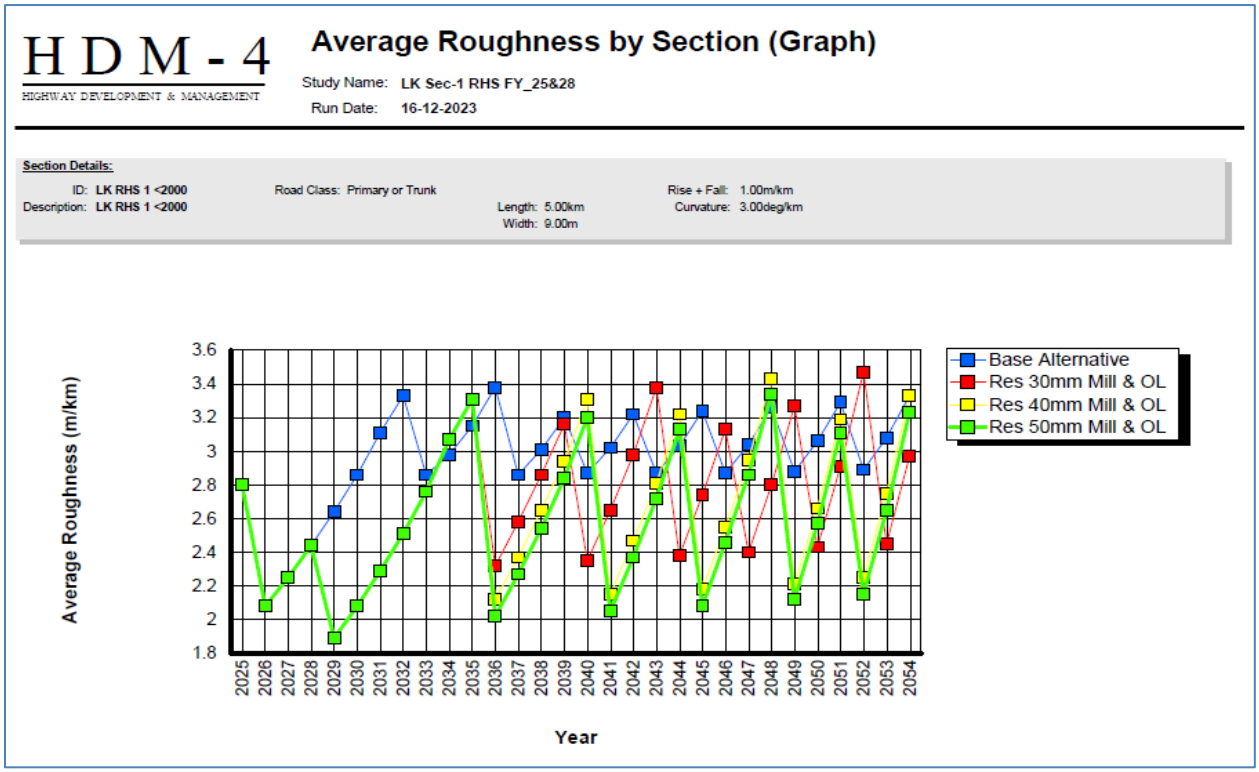


Figure 5: Average Roughness in RHS (DN) Carriageway (Sec-1) <2000 mm/km

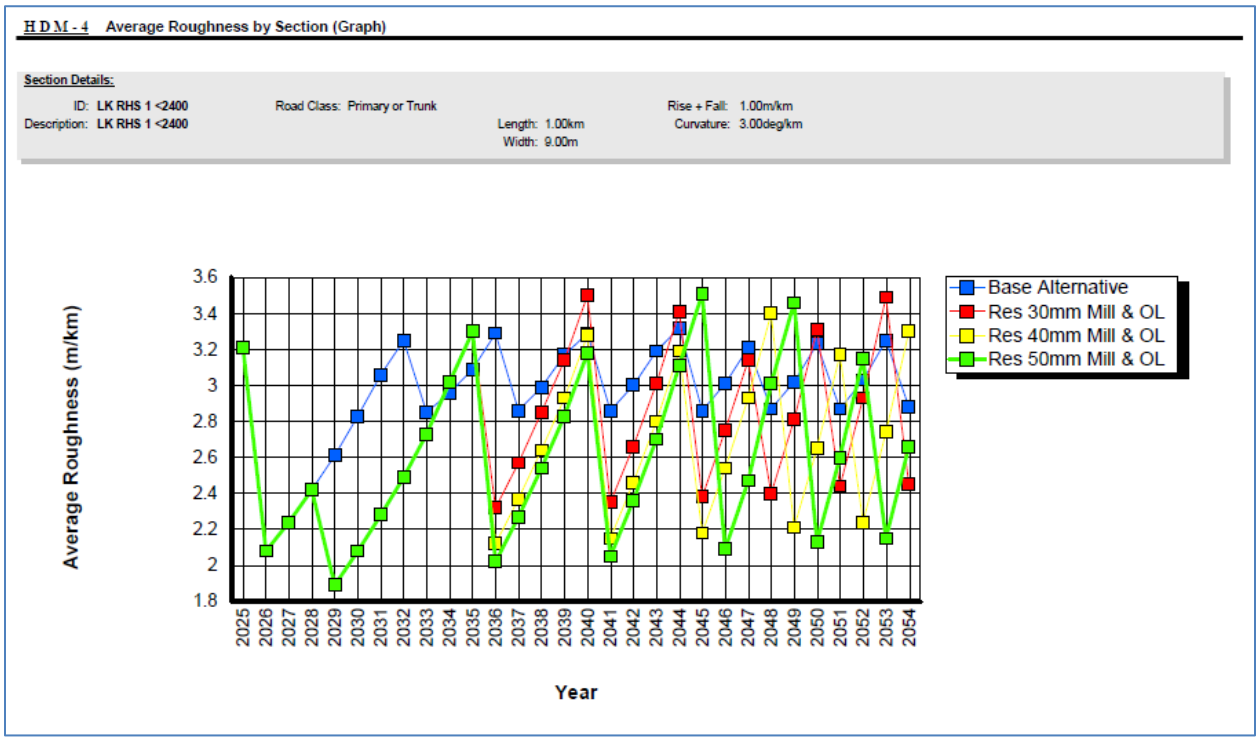


Figure 6: Average Roughness in RHS (DN) Carriageway (Sec-1) <2400 mm/km

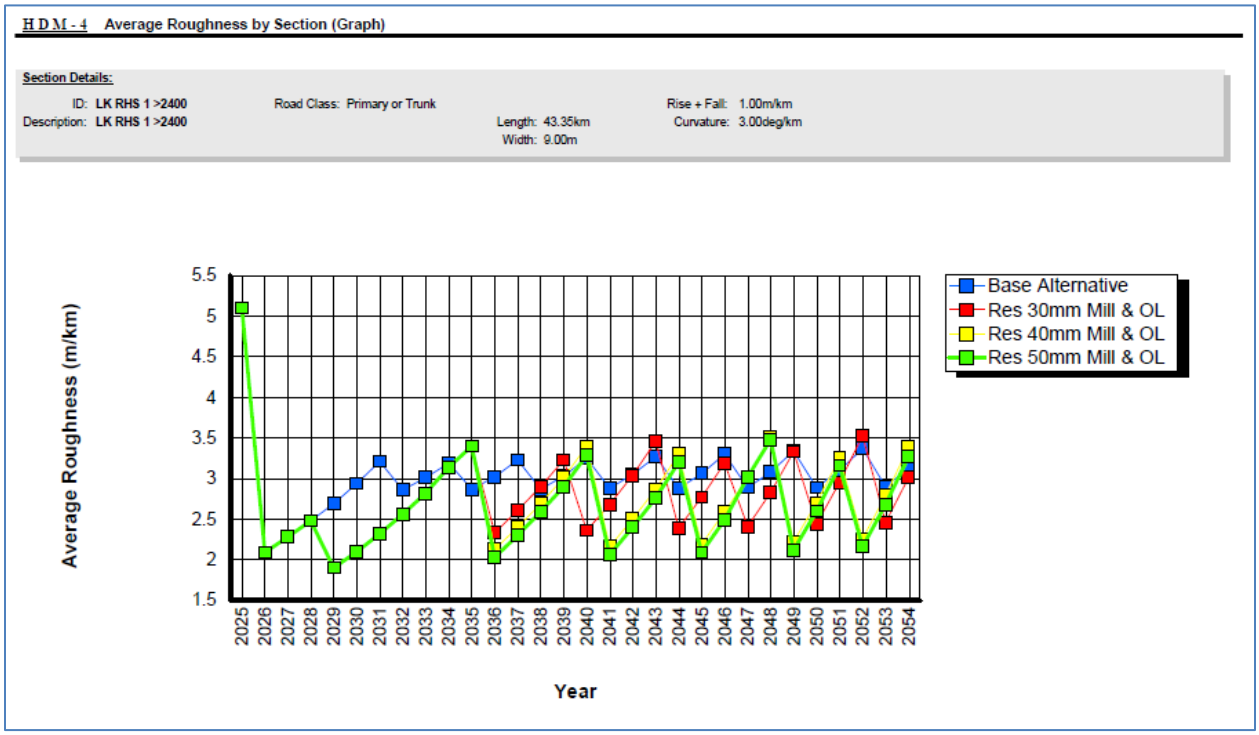


Figure 7: Average Roughness in RHS (DN) Carriageway (Sec-1) >2400 mm/km

Section – 2: km 596.750 to km 624.480 (27.73 km)- MP3

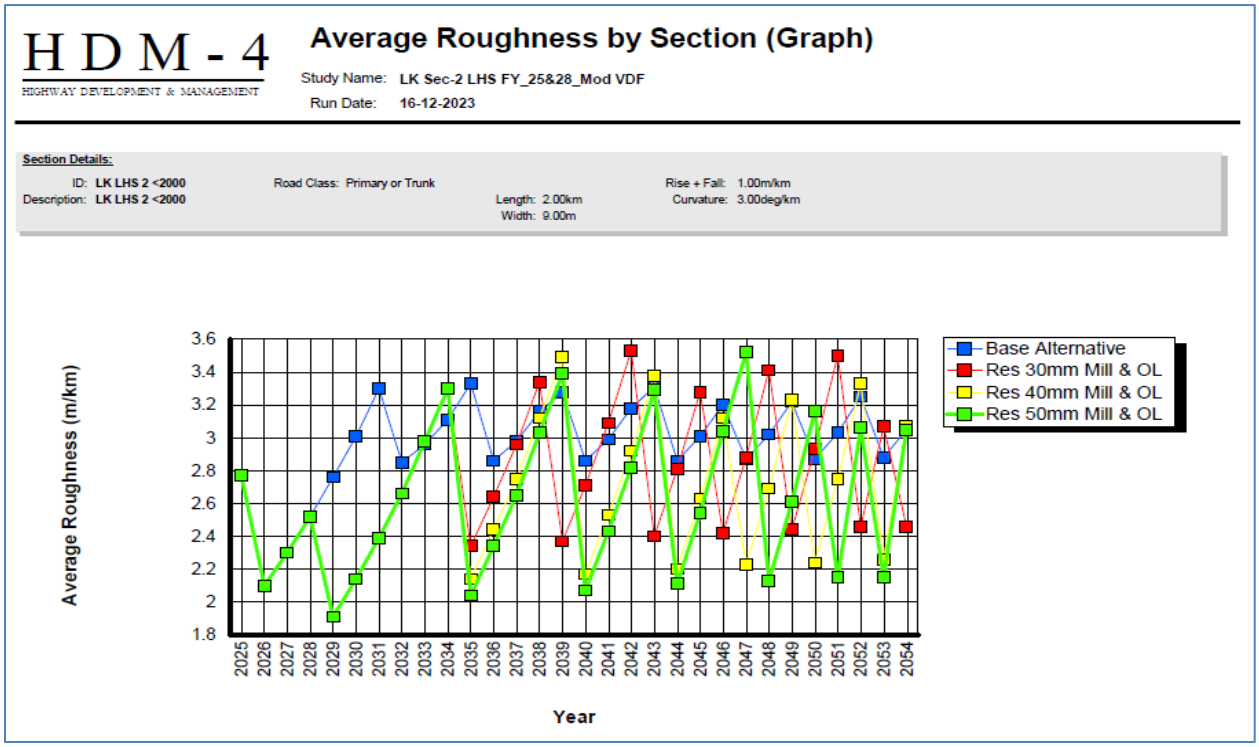


Figure 8: Average Roughness in LHS (UP) Carriageway (Sec-2) <2000 mm/km

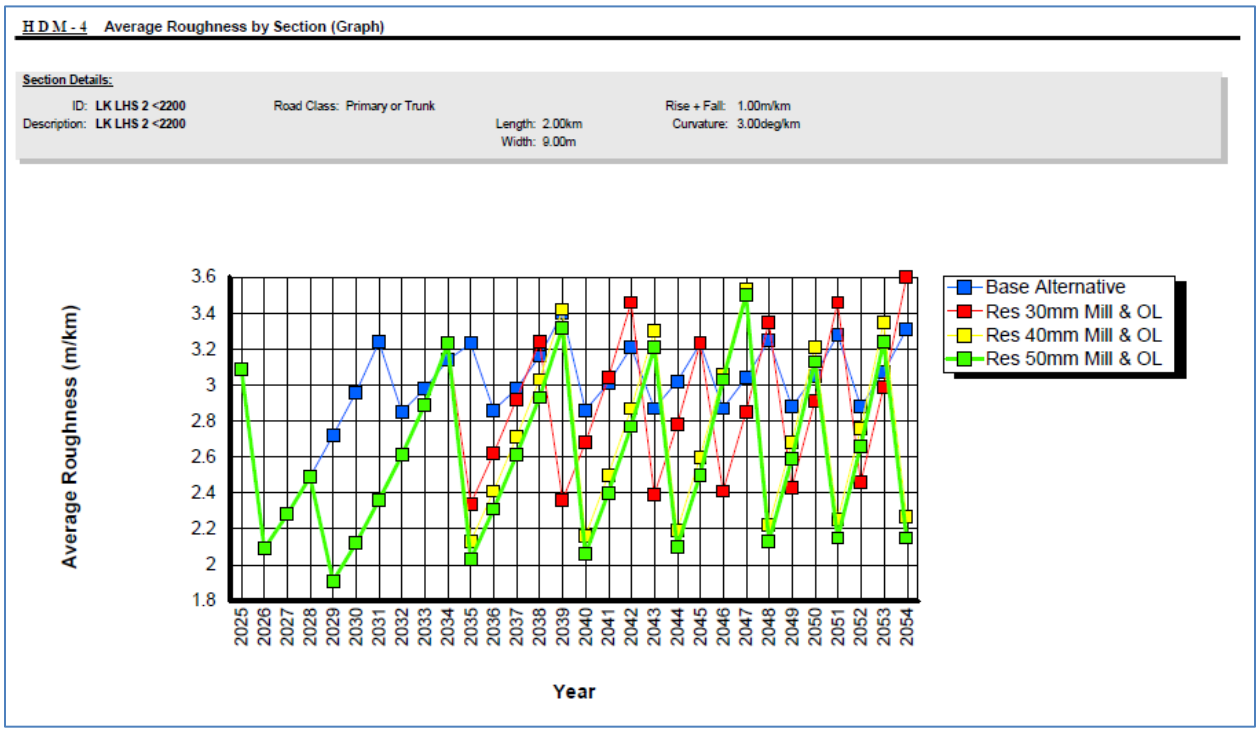


Figure 9: Average Roughness in LHS (UP) Carriageway (Sec-2) <2200 mm/km

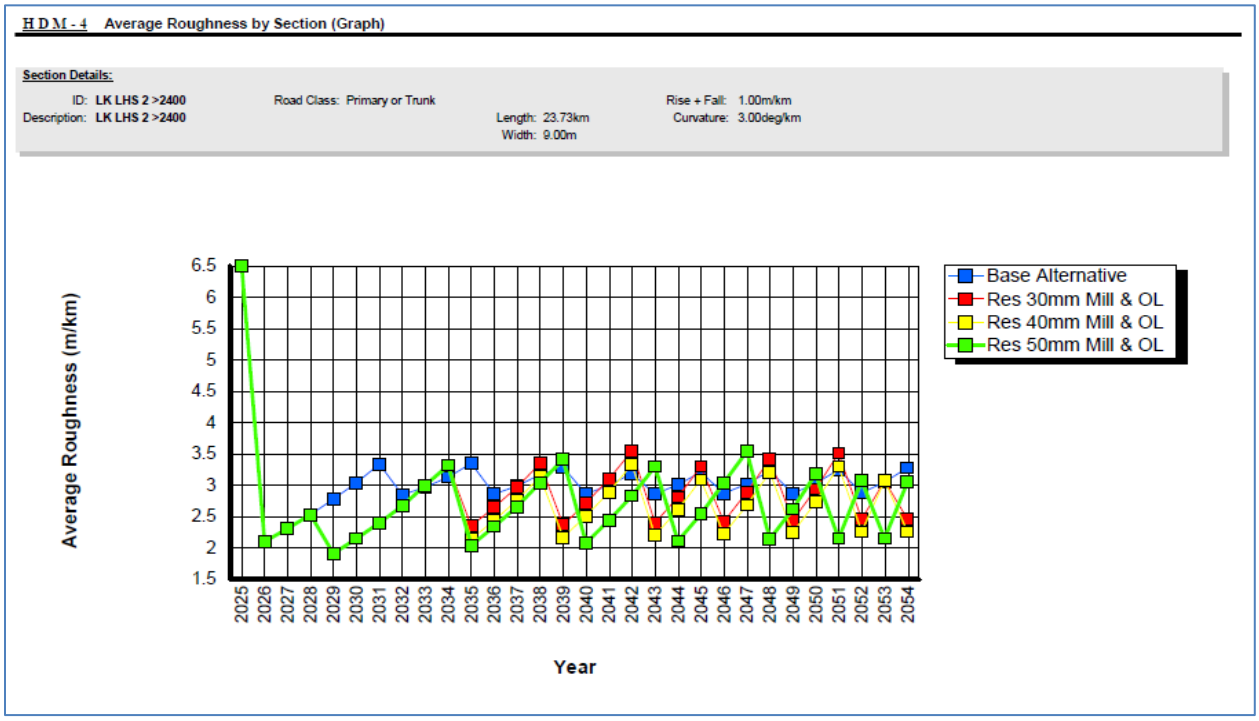


Figure 10: Average Roughness in LHS (UP) Carriageway (Sec-2) >2400 mm/km

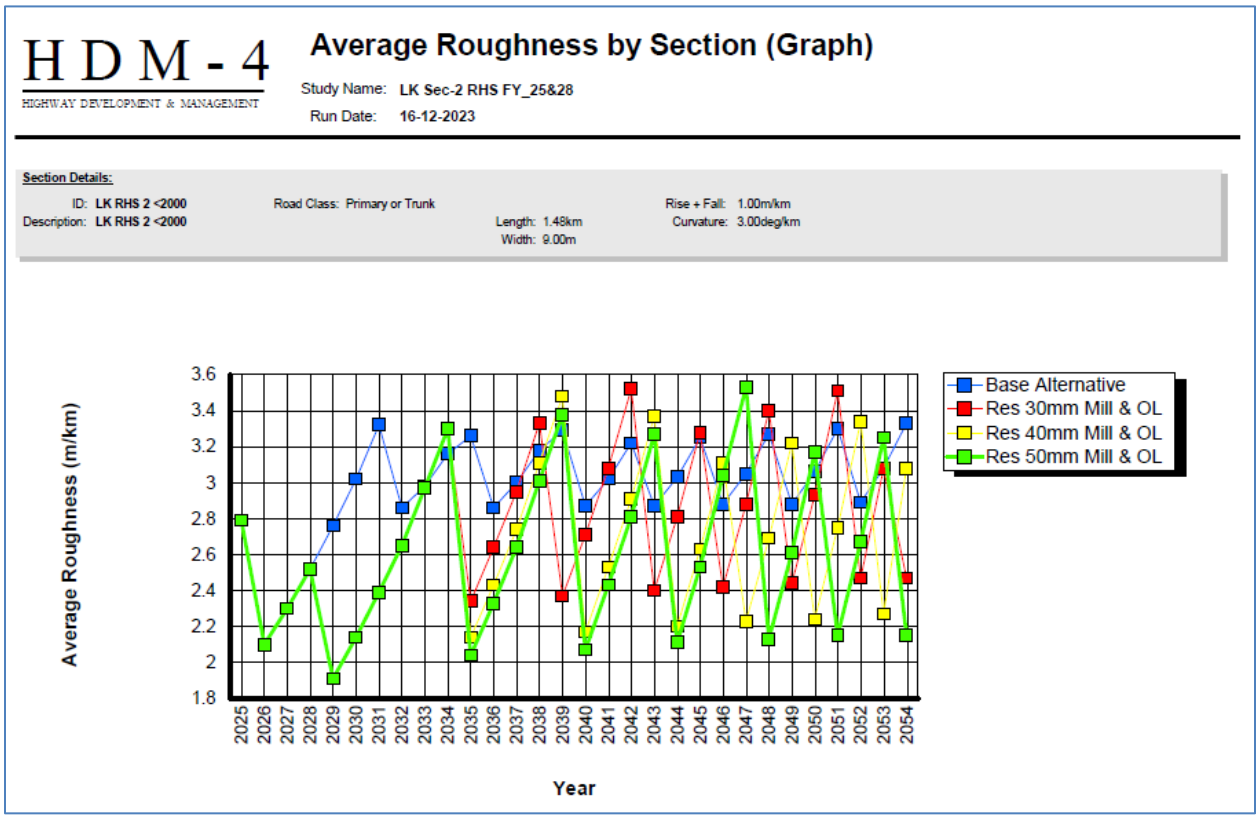


Figure 11: Average Roughness in RHS (DN) Carriageway (Sec-2) <2000 mm/km

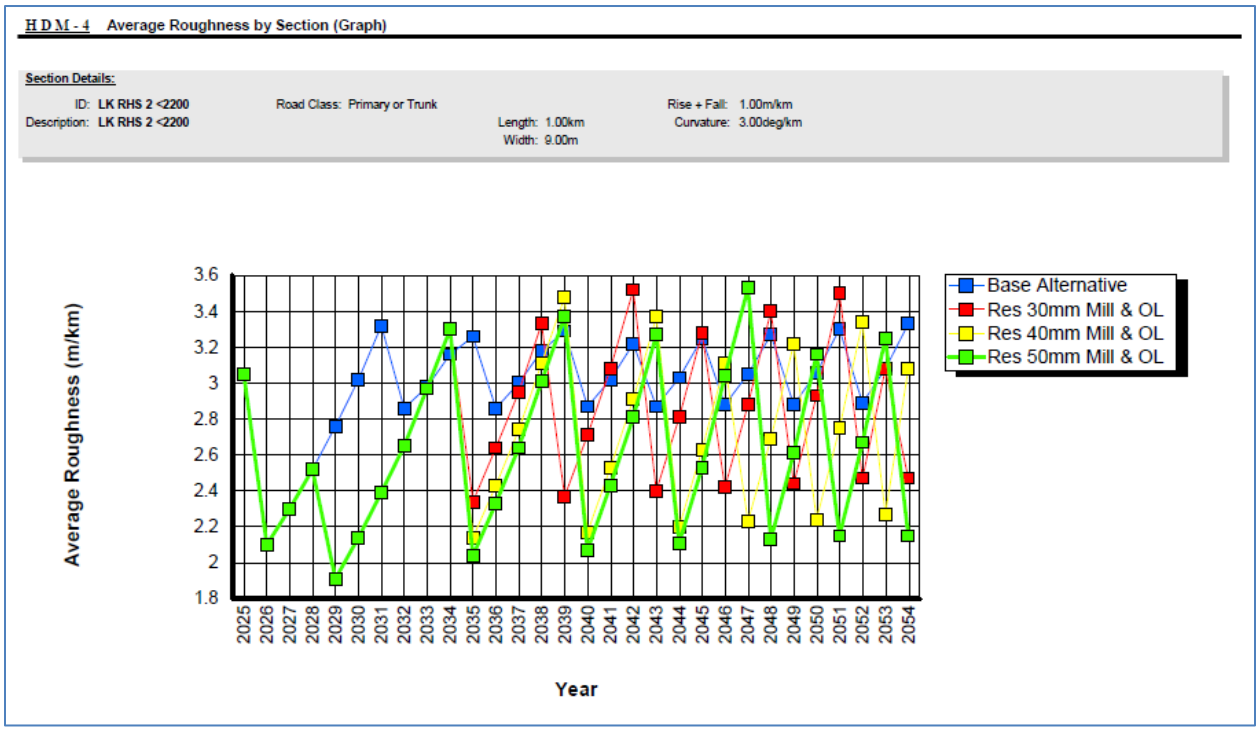


Figure 12: Average Roughness in RHS (DN) Carriageway (Sec-2) <2200 mm/km

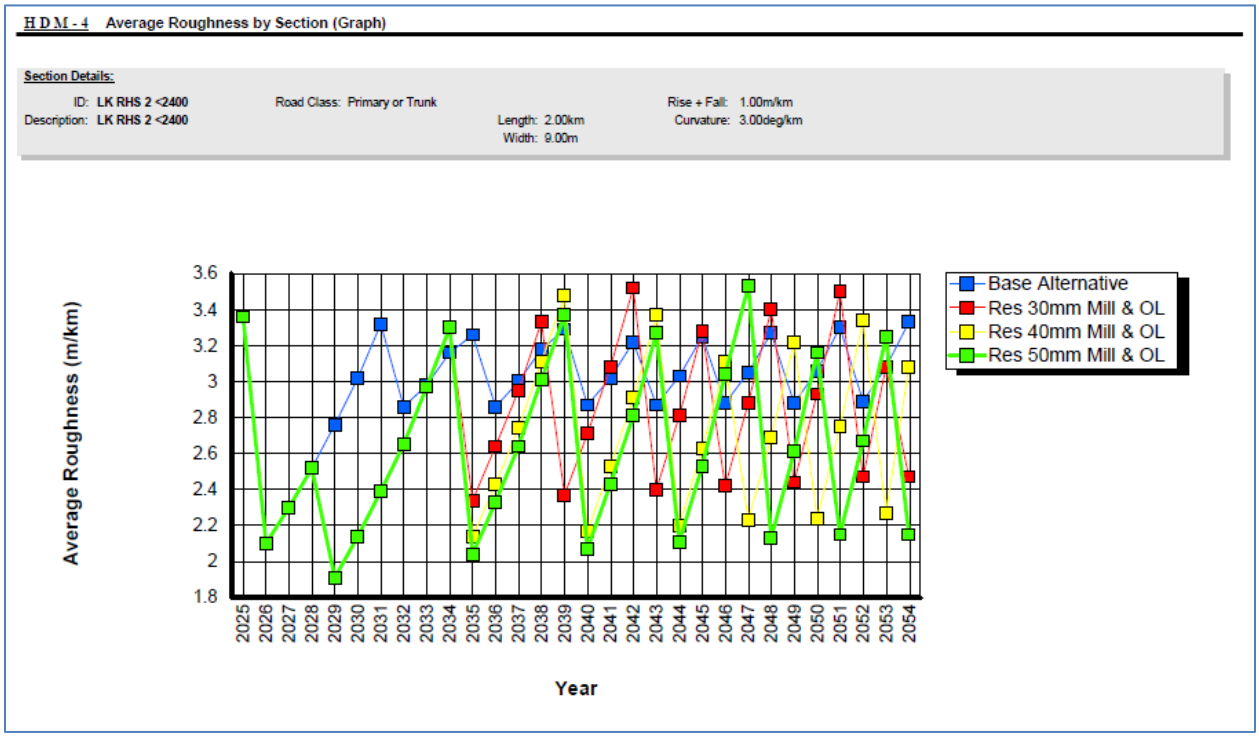


Figure 13: Average Roughness in RHS (DN) Carriageway (Sec-2) <2400 mm/km

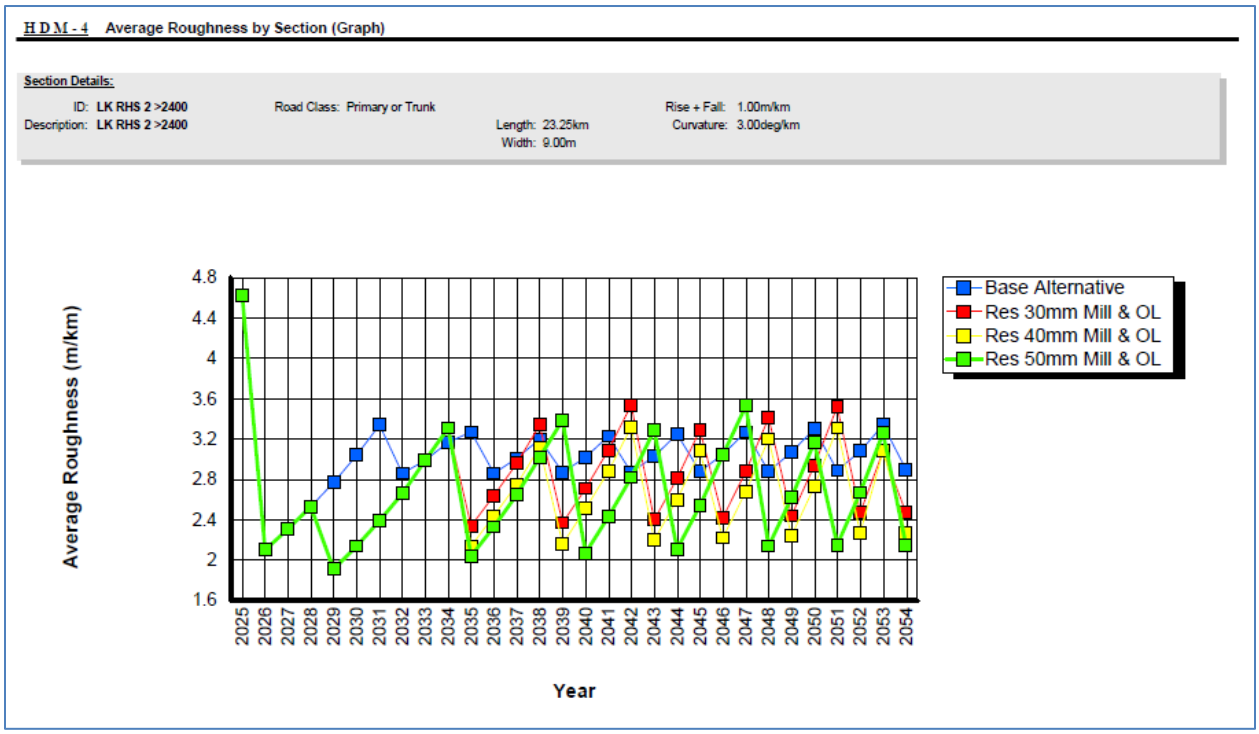


Figure 14: Average Roughness in RHS (DN) Carriageway (Sec-2) >2400 mm/km

Results of Roughness progressions indicate as below:

- For the Alternative-1: with 50mm Overlay in FY2025 & FY2028 (Considering Existing Concessionaire do OL in FY 25 and TOT- Concessionaire shall undertake OL in FY28 to maintain Roughness<2400mm/km): The suggested MMR cycles for option-1 as below:
    - **2028**
    - **2034**
    - **2039**
    - **2043**
- For the Alternative: with 50mm Overlay in FY2025 (Considering Existing Concessionaire do OL in FY 25 and handover to TOT-Concessionaire in FY 28 without any overlay consideration): The suggested MMR cycles for option-2 as below:
    - **2031**
    - **2036**
    - **2040**
    - **2044**

In both the options 4 MMR cycles are proposed but in different time-lines. Thus there is no differnce in number of cycles for overlay except for timing in different years of application.

6.5 M&M SCHEDULE

Based on the forgoing discussions and inputs, the O&M schedule for the project for Alternative 1 above for individual sections have been prepared for varying overlay thickness and Option with 50mm BC as overlay has been recommended for final application. Obtained & Adopted MM schedule for project is as below:

Table 54: MM schedule for project

Section – 1:

LHS Carriageway

	Section-1 Option-1								
	LHS-obtained					LHS-Adjusted			
	Option-1 (Responsive 50mm)					Option-1 (Responsive 50mm)			
Criteria:	IRI<2000	2000-2200	2200-2400	>=2400		IRI<2000	2000-2200	2200-2400	>=2400
Length:	5.000	4.000	7.000	33.350		5.000	4.000	7.000	33.350
Year	Case-1	Case-2	Case-3	Case-4		Case-1	Case-2	Case-3	Case-4
2025	40	40	40	40					
2026									
2027									
2028	50	50	50	50		50	50	50	50
2029									
2030									
2031									
2032									
2033									
2034	50	50	50	50		50	50	50	50
2035									
2036									
2037									
2038									
2039	50	50	50	50		50	50	50	50
2040									
2041									
2042									
2043	50	50	50	50		50	50	50	50
2044									

RHS Carriageway

	Section-1 Option-1								
	RHS-obtained					RHS-Adjusted			
	Option-1 (Responsive 50mm)					Option-1 (Responsive 50mm)			
Criteria:	IRI<2000	2000-2200	2200-2400	>=2400		IRI<2000	2000-2200	2200-2400	>=2400
Length:	5.000	0.000	1.000	43.350		5.000	0.000	1.000	43.350
Year	Case-1	Case-2	Case-3	Case-4		Case-1	Case-2	Case-3	Case-4
2025	40		40	40					
2026									
2027									
2028	50		50	50		50		50	50
2029									
2030									
2031									
2032									
2033									
2034						50		50	50
2035	50		50	50					
2036									
2037									
2038									
2039						50		50	50
2040	50		50	50					
2041									
2042									
2043						50		50	50
2044	50			50					

Section – 2:

LHS Carriageway

	Section-2 Option-1								
	LHS-obtained					LHS-Adjusted			
	Option-1 (Responsive 50mm)					Option-1 (Responsive 50mm)			
Criteria:	IRI<2000	2000-2200	2200-2400	>=2400		IRI<2000	2000-2200	2200-2400	>=2400
Length:	2.000	2.000	0.000	23.730		2.000	2.000	0.000	23.730
Year	Case-1	Case-2	Case-3	Case-4		Case-1	Case-2	Case-3	Case-4
2025	40	40		40					
2026									
2027									
2028	50	50		50		50	50		50
2029									
2030									
2031									
2032									
2033									
2034	50	50		50		50	50		50
2035									
2036									

	Section-2 Option-1								
	LHS-obtained					LHS-Adjusted			
	Option-1 (Responsive 50mm)					Option-1 (Responsive 50mm)			
Criteria:	IRI<2000	2000-2200	2200-2400	>=2400		IRI<2000	2000-2200	2200-2400	>=2400
Length:	2.000	2.000	0.000	23.730		2.000	2.000	0.000	23.730
Year	Case-1	Case-2	Case-3	Case-4		Case-1	Case-2	Case-3	Case-4
2037									
2038									
2039	50	50		50		50	50		50
2040									
2041									
2042									
2043	50	50		50		50	50		50
2044									

RHS Carriageway

	Section-2 Option-1								
	RHS-obtained					RHS-Adjusted			
	Option-1 (Responsive 50mm)					Option-1 (Responsive 50mm)			
Criteria:	IRI<2000	2000-2200	2200-2400	>=2400		IRI<2000	2000-2200	2200-2400	>=2400
Length:	1.480	1.000	2.000	23.250		1.480	1.000	2.000	23.250
Year	Case-1	Case-2	Case-3	Case-4		Case-1	Case-2	Case-3	Case-4
2025	40	40	40	40					
2026									
2027									
2028	50	50	50	50		50	50	50	50
2029									
2030									
2031									
2032									
2033									
2034	50	50	50	50		50	50	50	50
2035									
2036									
2037									
2038									
2039	50	50	50	50		50	50	50	50
2040									
2041									
2042									
2043	50	50	50	50		50	50	50	50
2044									

However, the project road is likely to have capacity augmentation in the year 2038-2039. Thus overlay cycles beyond 2038 are not necessary to be considered beyond 6 laning date.

6.6 STRUCTURAL PERIODIC MAINTENANCE STRATEGY

Expansion joints:

- Visual inspection is carried out to check for seal breakages, Armor angle, Weld failures, cracks between deck & Expansion joints concrete and Joints filled with debris. Such joints replaced immediately.
- Joint buried with debris shall be inspected for any distress, if any distress is shown it shall be replays immediately.
- During visual inspection it is seen that some Expansion joints are bad where as some are not showing any defects.
- Due to this it is considered provident to change the Expansion joints which are visibly damaged in initial stage.
- In the absence of records pertaining to Expansion joint replacements it is highly difficult to predict the date of replacement needed for compliance to IRC codal requirements. Balance joints which are not replaced initially will be replaced as on when defects are shown in the joints. This aspect is considered in BOQ.

Bearings:

- In order to identify the bearings requiring immediate replacement, the following strategy is adopted.
- Girder Bridges showing diagonal cracks at support, distress in the Pedestals and any form of distress in support location is regarded as a candidate for replacement. By visual inspection there are only a handful of such situations.
- Wherever pedestals are damaged either by cracking or spalling poisons confinement is proposed by Jacketing/MS plate bonding such procedure is very effective and common.
- All Metallic Bearings need to be taken up for servicing.

Wearing Coat:

It is necessary to replace the Wearing coat at every 15years interval, as wearing coat is a very weak component of the bridge structure which is subjected to severe deterioration due to Loading, Environment etc. As of now, we have considered sealing of cracks by Fog Seal and for which does not show any distress other than cracking by viz. Pot holes, abrading etc. Based on this aspect, this cost has been considered in highway O&M cost.

Periodic Maintenance strategy for Replacement of Bearings & Expansion joint:

Below strategy has been considered for periodic major maintenance of the structures.

S no	Description	Bridge components
1	Old structure	Structures retained at the time of 4-laning
2	New Structure	Structures newly constructed during 4-laning works

Age	Description	Item	structures-Assumption-MMR							
			% of Replacement of Major components							
			2028	2033	2038	2043	2043	2043	2043	2043
New	Super structure lifting with Pot bearings	Pot	10%	25%	40%	25%	0%	0%	0%	0%
New	Super structure lifting with Elastomeric bearings	Ela	10%	31%	50%	31%	0%	0%	0%	0%
New	Super structure lifting with Rocker bearings	Rocker	10%	10%	10%	10%	0%	0%	0%	0%
Old	Super structure lifting with Pot bearings	Pot	10%	25%	40%	25%	0%	0%	0%	0%
Old	Super structure lifting with Elastomeric bearings	Ela	10%	31%	50%	31%	0%	0%	0%	0%
Old	Super structure lifting with Rocker bearings	Rocker	10%	10%	10%	10%	0%	0%	0%	0%
New	Pot bearing cost	Pot	10%	25%	40%	25%	0%	0%	0%	0%
New	Elastomeric bearing cost	Ela	10%	31%	50%	31%	0%	0%	0%	0%
New	Rocker bearing cost	Rocker	10%	10%	10%	10%	0%	0%	0%	0%
Old	Pot bearing cost	Pot	10%	25%	40%	25%	0%	0%	0%	0%
Old	Elastomeric bearing cost	Ela	10%	31%	50%	31%	0%	0%	0%	0%
Old	Rocker bearing cost	Rocker	10%	10%	10%	10%	0%	0%	0%	0%
New	Expansion joint Replacement	EJ	13%	39%	62%	39%	0%	0%	0%	0%
Old	Expansion joint Replacement	EJ	0%	0%	0%	0%	0%	0%	0%	0%
New	Others (Filler joints, RE wall Major repairs etc)	-	13%	39%	62%	39%	0%	0%	0%	0%
Old	Others (Filler joints, RE wall Major repairs etc)	-	0%	0%	0%	0%	0%	0%	0%	0%

In addition to above, based on the NDT test results MMR for Structures shall be arrived in due course based on test inferences.

7.1 DATA COLLECTION AND REVIEW TMS Works

7.1.1 CA Provisions for TMS works

- ✓ ***Clause 11 of Schedule A***

S. No.	Particular	Details	
		Madai Toll Plaza	Khawasa Toll Plaza
1	Toll Plaza Chainage and name	Km 549+200 (NH-44) Madai Toll Plaza	Km 651+780 (NH-44) Khawasa Toll Plaza
2	Road Configuration	4 Lanes Divided Carriageway	4 Lanes Divided Carriageway
3	Number of Tolling lanes	4+4 Lanes (Normal-6, Extra-wide-2)	9+9 lanes (Normal-16, Extra wide-2)
4	Nos. of ETC lanes	4+4 in both plazas including reversible	9+9 in both plazas including reversible
5	Nos. of Toll Booth	7 Nos +1 Nos Double	17 Nos +1 Nos Double
6	Canopy	Yes	Yes
7	Administrative (Admin) building	Permanent Structure	Permanent Structure
8	Control Room	Yes	Yes
9	Server Room	Yes	Yes
10	Point of Sale Room	Yes	Yes
11	UPS Room & Battery Room	Yes	Yes
12	Plaza Manager Room	Yes	Yes
13	Cash UP Room	Yes	Yes
14	Room for Cashier	No	No
15	Cash Van Garage	No	No
16	Availability of tunnel or elevated walkway for movement between Fee lanes and administrative building	No	Yes
17	PRO Office	No	No
18	Meeting Room	Yes	Yes
19	Changing Room	Yes	Yes
20	Toilets (ladies and gents)	Yes	Yes
21	Type of Pavement at Toll Lanes	Rigid (Flexible in tapered Portion)	Rigid
22	Weigh-in-motion facility	No	Yes
23	Availability of Static Weigh Bridge	Yes	Yes
24	Availability of loading/unloading facility for overloaded Vehicles	Yes	Yes
25	Storage facility for overloaded material	No	No
26	Generator	Yes	Yes
27	High mast Light	2 Nos.	2 Nos.
28	Streetlight	Yes	Yes
29	Low mast Light	2 Nos.	2 Nos.
30	Highway Mini Nest	No	No

- ✓ ***Clause 9.1 of Schedule B***

Existing Toll Plaza at Km 549+200 (Madai Toll Plaza) and Km 651+780 (Khawasa) all toll booths are proposed to be retained. Any modification if required shall be done as per NHAI / Policy Guidelines / Management of Plaza / 2021 Policy Circular No. 17.5.82 Dated 25th May 2021. The Concessionaire shall modify / improve Toll Management System (TMS) as per latest Hybrid ETC system. Existing Toll Plaza Administration building shall be repaired/ rehabilitated as per the specifications and standards given in IRC: SP: 84-2019.

Concessionaire shall provide MSWIM at all lanes of Toll Plaza and PTZ Camera at Madai Toll Plaza Km 549+200.

Existing Toilet blocks and Water ATM (one in each direction) with adequate parking facility near Toll Plaza Area shall be provided / maintained as per the drawings and standards give in NHAI Circular dated 09-11-2017 (Ref. NHAI/GM(T)HO/Highway Nest (Mini)/2017/108290).

The Existing Toll Booths, Toll Plaza premises including all facilities, parking etc. shall be repaired, maintained, and upgraded for smooth toll operation as per IRC SP: 84-2019

The overall TMS cost estimated considering the 2 Toll Plazas is worked out to be Rs 1.31 Crores excluding GST.

7.2 DATA COLLECTION AND REVIEW ATMS Works

7.2.1 CA provisions for ATMS works

- ✓ ***Clause 15.1 – ATMS of Schedule A***

Following equipment are provided as part of ATMS along the project stretch:

MP-02 from Km 546+420 to Km 596+750 – Nil
MP-03 from Km 596+750 to Km 624+480 – Nil
MP- 04, Km 624+480 to Km 653+770 MP-MH Border

a) VMS 2 Nos
b) PTZ – 3 Nos
c) ECB – 4 Nos
d) ATCC – 2 Nos
e) VIDS -1 No
f) MET – At Toll Plaza

✓ ***Clause 9.10 – ATMS of Schedule B***

The ATMS system shall provide and maintain as per NHAI / Policy Guidelines / Standard Documents 2023, Policy Circular No. 11.53/2023 dated 10th October 2023, also implement the circular issued from time to time.

S No	ATMS Component	Unit	Minimum Qty.	Considered Qty
1	**Video Surveillance System** The system monitors vehicular and other road related activity along the highways stretch not more than interval of 1 km alternating side/median mounted on Poles. CCTV system is required to ensure effective surveillance of the target road section and related surrounding areas and generate a tamperproof record for post event analysis. The PTZ cameras shall be programmed such that they are able to cover 500m in each direction using presets. This will cover using the entire stretch and will be primary surveillance method. Which primary usage will be manual surveillance, TMCS cameras shall have basic intelligence for "Accident Detection" and "Stalled Vehicle Detection".	Km	107	122
	PTZ Camera	Nos.	107	118
2	Video Incident Detection and Enforcement System (VIDES) (At all Major Junctions) The VIDES, essentially consisting of fixed overview camera(s), ANPR camera(s) and an attached (co-locations or centralized) Video Image processing unit, shall perform real-time remote incident detection at designated spots on the highways section, record information on violators at ATMS software end for generation of eChallans and immediately provide local warning to nearby travellers / road – user on detection of relevant incidents. It shall also communicate such detections incidents to the ATMS Control Centre for storage, analysis & reporting	Nos	13	15
3	Vehicle Actuated Speed Display System The speed display shall provide textural or graphical warning to the vehicles exceeding the preset speed limits. The present limits can vary by lane. The positioning of this should be such that it is considerably separately from the VIDES Gantries as they are for enforcement while VASD are for warning only.	Nos	6	6
4	Emergency Call Box (ECB) at every 2Km on both sides Zones experiencing telecom blackspots along the Project Stretch shall be provided with Emergency Roadside Telephone (ERT). ERT shall be provided at every 2 km along the Project Stretch.	Nos	108	108
5	VMS Systems Displays (Full Gantry 4 Lane) at Blackspots, Major Junctions with NH. The VMS shall provide road users advance information of road conditions ahead and shall be controlled from the local ATMS Control centre. When drivers are to be warned of an incident, advised to opt for an alternate route, guided to reach a specific location or clear a lane as a response to an incident, the message posted should be appropriated and precise. The messages and the procedure for displaying them should be such that the information is grasped by a driver whose primary focus driving his vehicle while ensuring his and his co-passenger's safety	Nos	6	6
	VMS Portable type to provide local guidance to road users at of Vehicle Accidents / Incidents and road works	Nos	2	2
6	Automated Traffic Counter cum Classifier (ATCC) ATCC shall be installed (i) before the traffic diversion points where the traffic diverting from Project Stretch to other linked road and (ii) 1 km ahead of the toll plaza	Nos	4	-
7	Mobile Radio Communication System (For Ambulance, RPV, Cranes, Additional 2 nos for Maintenance Team) Mobile Rodio Communication System should be capable of providing wireless communication between ATMS Control Centre and Vehicle Mounted Units & Handheld units for Emergency responses as well as routine Operations & Maintenance activities for the highways. The Mobile Radio Communications system should have vehicle mounted units fitted on	Nos	11	11

S No	ATMS Component	Unit	Minimum Qty.	Considered Qty
	ambulances, Cranes and Patrolling Vehicles for Facilitating instant communication even when these are on the move across the highway. The vehicle mounted & handheld units shall communicate with the ATMS Control Centre as well as amongst themselves. The ATMS Control Centre besides having base/repeater Stations and Control equipment should have a provision for a voice logger to be attached with it for recording all communication.			
8	Network / Communication Infrastructure This system provides connectivity between ATMS Control Centre and outdoor equipment such as Emergency Roadside Phone,	km	107	107
	Variable Message Signs, Mobile and Fixed CCTV cameras, Speed Displays, VIDES, etc. It also provides the external data connectivity required between the ATMS control centre and the NHAI ATMS Cloud as well as between the ATMS control centre and the NHAI ATMS Master & relevant Regional Control Centres			
9	ATMS Control Centre One ATMS Control Centre including the equipment (hardware, software, and local networking) shall be developed on Project Stretch. ATMS Control Centre would be the facility from where all the activities of the ATMS would be controlled. ATMS Control Centre Would primarily comprise of the in-door portion of CCTV, VMS, and other support systems. All the aforementioned sub-systems shall preferably reside in a dedicated permanent structure with adequate floor area to house the required manpower and equipment.	Nos	1	1

Note: Number or locations of ATMS Equipment's shall be finalized as per site requirement in consultation with Authority / Independent Engineer.

The Concessionaire shall also integrate existing ATMS with new ATMS. Entire ATMS shall retain and maintain all component throughout the Concession Period.

The Concessionaire shall also maintain existing ATMS after O & M Handover Date.

✓ ***Schedule C states as below:***

Concessionaire shall provide the functional ATMS with all its components for continuous monitoring over the entire ROW without any blind spot. Minimum numbers of various components of ATMS shall be as specified in Schedule B. Technical Specification of ATMS shall be as per "Functional and Technical Specifications released by the NHAI vide Ref. No. NHAI/CO/ATMS/02-2021, February 2021". Command control center shall be established at Toll Plaza. Concessionaire shall also provide Portable VMS for Each Toll section.

The Cost estimated considering above all items is presented in the following table

Sl. No.	Activity	Capital cost of complete scope
1	**ATMS works of complete stretch**	**30,63,27,558**

Note: the above Cost is excluding GST.

CHAPTER 8. COST

Cost Component for various items and activities have been worked out by considering the Best Industry practice and most appropriate methods. Detailed quantities for work items have been estimated based on the details presented in previous chapters for various heads.

The List of the cost components considered are presented below:

- ***Immediate Repair's Cost***
- ***Routine Maintenance Cost***
- ***Incident Management Cost***
- ***Periodic Maintenance Cost***
- ***Operations Cost***
- ***Year by Year total O&M Costs***

8.1 RATE ANALYSIS

Detailed rate analysis has been carried out based on MORTH guidelines to arrive at the unit rates of various items. Material rates and their leads from the project corridor are considered as per the material investigations done on the project road. Summary of unit rates arrived at are presented in table below:

Table 55: Unit Rates of Basic material

Sl.no	Description	Units	Source	Basic rate excluding Transportation & GST	Lead in Kms
1	Good earth	Cum	BA	95	7.00
2	40 mm	Cum	Crusher	592	31.01
3	20 mm	Cum	Crusher	725	31.01
4	12 mm	Cum	Crusher	215	31.01
5	6 mm	Cum	Crusher	209	31.01
6	Dust	Cum	Crusher	283	31.01
7	M sand	Cum	Crusher	334	31.01
8	Flyash	Cum	Nearest Plant	0	82.44
9	Boulders	Cum	Querry	124	1.00
10	Sand source to Plant	Cum	River	1155	113.00
11	Sand source to working site	Cum	Stock yard	1155	70.00
12	Bitumen 60/70	MT	Mathura	42163	818.00
13	Bitumen 80/100	MT	Mathura	41772	818.00
14	VG-40	MT	Mathura	48000 (capex) 36000 (MMR)	818.00
15	CRMB-55	MT	Mathura	45382	818.00
16	PMB	MT	Mathura	56000	818.00
17	SS1	MT	Mathura	50000	818.00
18	Steel	MT	Lakhnadon	56050	72.00
19	HTS Strands	MT	Lakhnadon	75000	151.00
20	Cement	MT	Lakhnadon	6935	72.00
21	Structural Steel	MT	Lakhnadon	66000	72.00

Table 56: Major Material Cost

Sl.no	Item	Unit	Rate (INR) Excluding GST
1	BC - G1	Cum	10117
2	Tack coat on bituminous surface	Sqm	16
3	DBM G-1	Cum	8566
4	Tack coat on granular	Sqm	17
5	Prime Coat	Sqm	50
6	WMM	Cum	1658
7	GSB G-2	Cum	1534
8	CTSB	Cu.m	2157
9	CTB	Cu.m	2538
10	PQC	Cu.m	7616
11	DLC	Cu.m	3856
12	SG	Cum	383
13	Embankment - borrow	Cum	375
14	Embankment - Excavation	Cum	74
15	Select Fill	Cum	421
16	RE wall	Sqm	3757
17	Filter Media	Cum	1219
18	Road Marking	Sqm	630
19	M15	Cum	6510
20	M20	Cum	7131
21	M25	Cum	7746
22	M30	Cum	7762
23	M35	Cum	7962
24	M40	Cum	8101
25	PSC M45	Cum	9722
26	HYSD	MT	81526
27	HT strand	MT	153643

8.2 INITIAL COSTING

Costs associated with initial improvements are estimated based on the detailed asset inventory and condition assessment surveys, Pavement condition and structural condition assessment surveys. Items which are not executed as part of scope or in damaged condition have been considered for immediate costs as a part of 1-year Capex. Following items are mainly considered for Initial Improvement costs:

- ***Scope given in schedule-B***
- ***Scope which is not executed***
- ***Road work items***
- ***Bridge Work Items***
- ***Pavement Rehabilitation works***
- ***Structural Rehabilitation works***
- ***Drainage Works***
- ***Slope Protection works***
- ***Safety Works***

Summary of Initial Improvement Costs are included in table below:

Table 57: Initial Improvement Cost

S.no	Description	Unit	Quantity	Rate (Rs.)	Amount (Rs.)
1	Additional Repair works	LS	1	4,06,19,500	4,06,19,500
2	EPC (Highway & Str)	LS	1	28,82,57,780	28,82,57,780
3	TMS	LS	1	1,30,85,484	1,30,85,484
4	ATMS	LS	1	30,63,27,558	30,63,27,558
5	Revalidation surveys	LS	1	1,53,31,556	1,53,31,556
Total Cost excluding GST					66,36,21,878
GST at 18%					11,94,51,938
Total Cost including GST					78,30,73,816
Total Cost including GST IN Crores					**78.31**

Additional Cost for repair works is considered is as follows.

S.No	Description	Amount (Cr.)
1	Additional Median Drain at Super-elevated Section where the level difference exists in reverse order	1.445
2	Cost towards Protection against boulder fall at Hill Cut Locations	2.174
3	Slope protection at the above location	0.296
4	Median Plantation at the proposed median Closed locations	0.009
5	Antiglare with reflective stickers at Narrow Median Locations	0.138

8.3 ROUTINE MAINTENANCE & INCIDENT MANAGEMENT COSTS

Routine maintenance costs include general maintenance costs of road elements, bridge elements and road furniture and appurtenances. This can be mainly divided into two parts as:

- ✓ ***General Maintenance of Works***
- ✓ ***Repairs to Highway & Bridge Elements***

8.3.1 General Routine Maintenance

General Routine Maintenance of Roads generally include following items:

- ***Maintenance of noise barriers along AUP approach locations***
- ***Cleaning of Project facilities***
- ***Structures cleaning,***
- ***Cleaning of ROW***
- ***Cleaning and Maintenance of Toll Plaza***
- ***Unlined Drain Maintenance***
- ***Lined Drain Maintenance***
- ***Maintenance of Highway Lighting at Toll Plaza and other project locations***
- ***Median Plantation maintenance & Avenue plantation maintenance:***
- ***Maintenance of Road Furniture***
- ***Maintenance of Road Safety Items***

The above items are estimated by considering the detailed break-up of following items:

- ***Manpower including Managers/Labour etc.***
- ***Vehicles for Labour Transport/Water Tankers/Sweeping Machines etc.***
- ***Resources/Equipment's such as grass cutters, tools, jet sprayers, hydraulic trimmers etc.***

8.3.2 Repairs to Highway & Bridge Works

Repairs to highway and bridge works have been estimated based on the assumed quantities (Percentage basis) of execution for every year.

These items include the following:

1	Providing treatment for sealing of road surface / isolated cracks at scattered locations
	i) Covered with 6.7 mm size stone chipping @ 0.1 cum/ 10 sqm.
	ii) covered with dry coarse sand passing through 2.36 mm sieve and retained on 180-micron sieve @ 0.03 cum/10 sqm heated to 600 C
	iii) filling discrete cracks with slow curing bitumen emulsion as per Technical Specification Clause 3004.3.3
2	Providing treatment to bleeding bituminous surface at scattered locations
3	Providing localized repair to rutted portion and edge breaking of bituminous surface
4	Providing treatment and repair to pot-holes and patch work
5	Providing and laying dense bituminous macadam using bitumen grade VG 40 complete as per Technical Specification Clause 507
6	Proving and laying bituminous concrete (asphaltic concrete)
	(a) Using bitumen (VG-40) as per IRC: SP: 53
7	Road Roughness survey
8	Turfing on embankment slopes and at all other Project Facilities
9	Providing repair to stone pitching/apron at scattered locations
10	Rain Cuts Maintenance: Restoration of rain cuts soil, moorum, gravel or a mixture of these
11	Providing and laying apron/ stone pitching on slopes of guide bunds/ road embankment / other location
12	Providing and laying stone aggregate filter material (150 mm compacted thickness) underneath pitching
13	Unlined drain
14	Filling in median island with approved materials with all leads and lifts complete as per TS Clause No. 407
15	Replacing damaged / broken railing with new pre-cast / cast-in-situ, concrete railing to match with existing design and pattern.
24	Carrying out repair to road signs including strengthening resetting or otherwise repairing signs and delineators
	a) Road sign board mounted on single post
	b) Road sign board mounted on double post
	c) Overhead/ Gantry Sign boards
	d) Delineator
25	Supplying and fixing at site retro-reflectorized type **sign boards/signs**
	90cm Equilateral triangle
	60cm circular
	90 cm circular
	90cm high octagon
	80cm x 60cm rectangle
	Chevron signs 60cm x 45cm
	Place identification signs (Fig 15.7 of IRC 67)
	Providing and fixing Object Markers
	Providing and fixing of retro-reflectorized Route Marker signs (size 450mm x 600mm)

26	**Hazard Marker Sign:**
	a) size 90 x 30 cm
	b) size 30cm triangular side cluster of red reflectors (screen printed)
27	Cats Eyes/Raised pavement marker (NMC Nails Less)
28	Painting two coats on old surface after minor repairs to give an even and smooth surface and printing letters and figures with synthetic enamel paint
	a) Hectometer stones
	b) Kilometer Stone
	c) 5 Kilometer stone
	d) Boundary stone
	e) Guard stone
29	Providing painting lettering and fixing of distance measurement stones including dismantling of old damaged/ broken ones, confirming to TS Clause 804
	a) Hectometer stones
	b) Kilometer Stone
	c) 5 Kilometer stone
	d) Boundary stone
	e) Guard stone
30	Providing and fixing road delineators conforming to TS Clause No. 805 as directed by the Engineer.
31	Repainting the kerb stones and separation barrier with first quality synthetic enamel paint of approved brand
32	Painting all types of pavement markings including lines, dashes, arrows etc. on roads as per relevant IRC/MOST standards after cleaning the surface complete in all respects as directed by the Engineer.
	a) Hot applied Thermoplastic compound
	(i) Lane / Centre Line / Edge Line
	(ii) Direction Arrows
	(iii) Diagonal Chevrons Markings
33	Supplying and laying cast-in-situ cement concrete kerb without channel section
	a) by Manual/machine including formwork
34	Major repair / replacement of metal beam crash barrier (W profile guard rails)
35	Providing and fixing chain link/ welded mesh fencing / square bars fencing
36	Dismantling the old damaged chain link/welded mesh / square bars fencing and replacing it with new chain link/ welded mesh/square bars fencing
37	Provision of rumble strips
38	Shoulder Maintenance:
39	synthetic enamel paint of approved brand on metal pedestrian guard rail
40	Dismantling of wearing course
41	Repair and maintenance of noise barriers in forest area

B. Structures

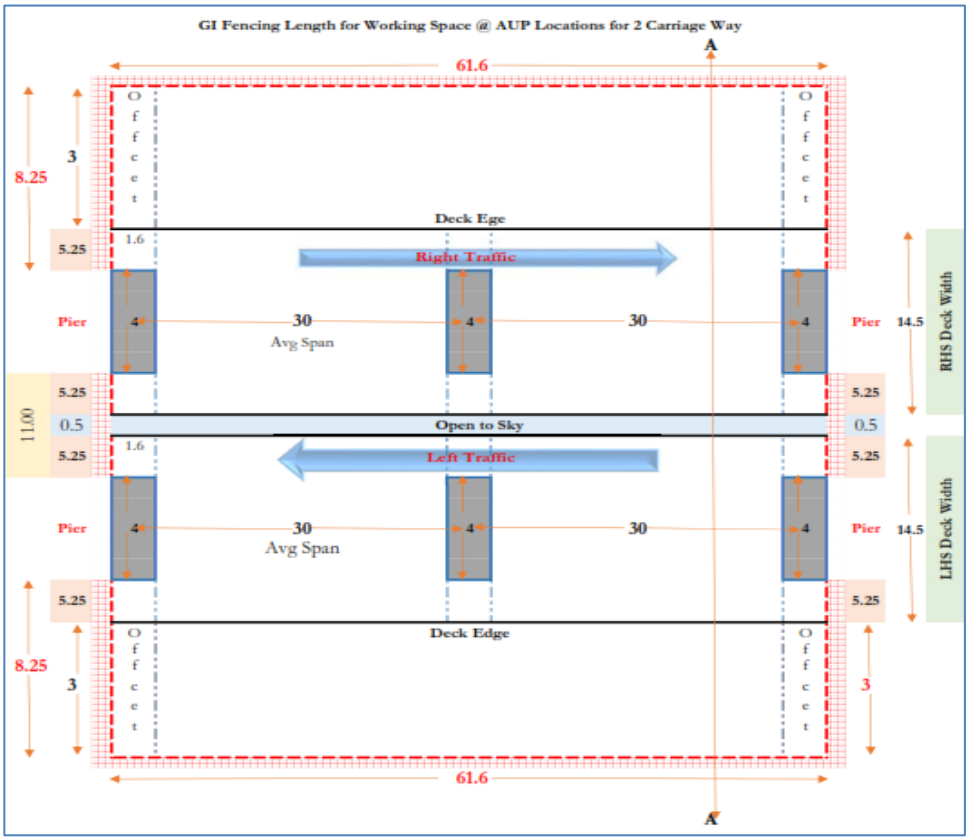
1. ***Wearing coat comprising of 50 mm thick BC.***
2. ***Cleaning and adding rubber sealant near expansion joints.***
3. ***Modular Expansion joints.***
4. ***Replacement of Damaged Concrete Railing all complete as per technical specifications and as directed by the Engineer***
5. ***Provision of an RCC crash barrier (0.35sqm cross sectional area) constructed with M-40 grade concrete including reinforcement***

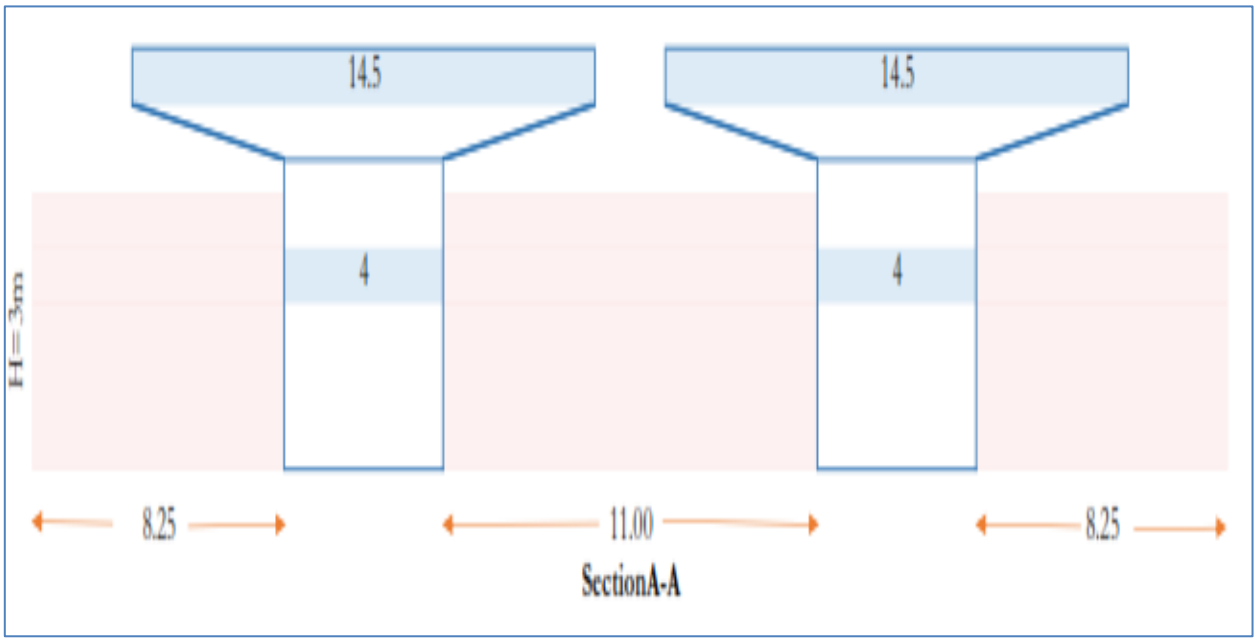
6. ***Cleaning of rocker & roller bearing using high pressure water jet, free from rust scales, re-setting & greasing the bearings using graphite grease including cost of materials, labour etc., complete.***
7. ***POT PTF Bearings greasing and maintaining (sand plastering).***
8. ***Elastomeric Bearings and maintaining.***
9. ***Cutting of groove of 15 mm x 15 mm along crack and sealing the same with epoxy putty including cost of material, labour etc.***
10. ***Carrying out 50mm to 60mm thick short sheeting using a mix proportion of 1:2:2 (cement: sand:6 mm down aggregate) added with Polypropylene fibers at a dosage rate of 125 gms/bag of cement including cost of labour, material, scaffolding, equipment etc complete.***
11. ***Repair of Floor Aprons, pitching and other protection works***
12. ***Cleaning of Drainage Spouts***
13. ***M-25 Concrete***

❖ ***Maintenance and Repairing Requirements for MP-MH Border Section:***

In addition to the above considering the dense forest location (Km 624+480 to Km 653+770, Khawasa section) additional precautionary measures.

Human risk is involved during Inspection, testing, repairing and maintenance activities. Effective safety measures are essential to complete the assignment safely and satisfactorily. The below scheme proposed to provide the safe access for repairing activities.





Cost towards above fencing arrangement in Pench Tiger Reserve is included as part of routine maintenance.

8.3.3 Incident Management Cost

Incident Management & Safety items include the following:

- ✓ ***ATMS control room operations,***
- ✓ ***Regular patrolling & reaching accident/incident site,***
- ✓ ***providing relief to injured persons including taking them to nearest hospital and attending to the safety requirements at the location (putting cones, safely guide & manage the traffic using signs, safety barricades, etc.),***
- ✓ ***removal of accident /breakdown vehicles, removing of dead animals/birds lying on the highway and loading, unloading, transportation & disposal of surplus material left over by accidental vehicle or otherwise lying on road (on carriageway) and***
- ✓ ***Encroachment prevention & removal with all lead & lifts complete with proper communication equipment,***
- ✓ ***consumables, materials, suitable Towing vehicles, Ambulance, patrolling vehicles and manpower like drivers, helpers, para-medical staff, labour including deployment of crane and all works shall be done as per requirement and as directed by Client representative and as per Relevant Specifications as applicable.***

8.4 OPERATIONS COSTS

Cost towards Operations include the following:

- ***Electricity Bill of lighting***
- ***Toll Plaza Operation cost***
- ***Operation and management costs of rest areas and lay byes***
- ***Operation and management costs of Traffic & medical aid posts***
- ***SPV Costs***
- ***Survey Costs***
- ***Insurance***
- ***IE Fee***
- ***Audit Charges***
- ***Administrative Cost***

Operation cost has been estimated depending on the handover dates for various sections along the project road. Following table depicts the estimated operation costs at various years.

Table 58: O&M Cost for various Years in Crores (including GST)

		FY25	FY26	FY27	FY28	FY29	FY39 & FY40	From FY41
	Road Length (Kms) ->	9.210	38.500	38.500	106.370	106.370	106.370	106.370
A	O&M	13.84	19.10	17.31	26.16	25.36	10.36	10.36
A1	Operations	9.86	12.66	10.87	13.67	12.88	7.28	7.28
A1.1	Tolling Operations	9.86	9.86	8.07	8.07	7.28	7.28	7.28
A1.2	Incident Management	-	2.80	2.80	5.60	5.60	-	-
A2	Maintenance	3.97	6.43	6.43	12.48	12.48	3.09	3.09
A2.1	Routine Maintenance	0.52	1.75	1.75	4.82	4.82	-	-
A2.2	Repairs	0.36	1.60	1.60	4.57	4.57	-	-
A2.3	ATMS	3.09	3.09	3.09	3.09	3.09	3.09	3.09
B	Admin Expenses	5.04	6.91	6.91	8.21	8.64	8.64	9.60
C	Power (Excluding Toll Plaza)	0.31	0.31	0.31	1.03	1.03	1.03	1.03
TA	Total Amount in Cr.	**19.19**	**26.31**	**24.52**	**35.39**	**35.03**	**20.04**	**20.99**

Note: Toll operations cost is mainly varying for the strategy of manpower adopted for same for initial 5 years. Year on year toll operations reduces based on man power considered.

8.5 PERIODIC MAINTENANCE COSTS

Cost towards major maintenance include following:

- ✓ ***Cost of Periodic maintenance of Pavement based on Finalized MM schedule***
- ✓ ***Cost of Periodic Maintenance of Structures***
- ✓ ***Cost of Periodic replacement of Toll Equipment's & Software***

capacity augmentation will be in FY 2039&40.

Table 59: Periodic Maintenance Cost

	Periodic Maintenance				
	Functional +Structural overlay MCW+ S/R	Major Maintenance of Rigid Pavement	Replacement of **ATMS**	Replacement of **TMS**	Structure specified repairs
2024-2025	-	-	-	-	-
2025-2026	-	23.88	-	-	9.50
2026-2027	-	-	-	-	-
2027-2028	106.65	-	-	-	9.95
2028-2029	-	-	-	-	-
2029-2030	-	15.40	-	-	-
2030-2031	2.63	-	14.46	3.32	-
2031-2032	-	-	-	-	-
2032-2033	-	0.87	-	-	17.97
2033-2034	99.77	-	-	-	-
2034-2035	-	-	-	-	-
2035-2036	-	29.49	-	-	-
2036-2037	2.63	-	-	-	15.89
2037-2038	-	-	22.41	3.32	-
2038-2039	-	-	-	-	-
2039-2040	-	-	-	-	-
2040-2041	-	-	-	-	-
2041-2042	-	-	-	-	-
2042-2043	-	-	2.71	-	-
2043-2044	-	-	2.71	3.98	-
Total	**211.69**	**69.64**	**42.29**	**10.62**	**53.31**

Note: All the Costs are in Crores, inclusive of GST, without escalation considering FY 2024 price

8.6 CAPACITY AUGMENTATION

The project is envisaged to have the capacity augmentation in 2039-2040 during concession period. The EPC contractor will be handed over the project road for construction of six laning with a DLP of 5 years for flexible and 10 years for rigid pavement. Thus, no maintenance costs are considered for the project beyond 2039.

Table 60: Cost Summary

Calendar Year	SUMMARY OF VARIOUS EXPENSES in Rs. Crs					
	Immediate Repair's Cost	Toll Collection Expenses and Patrolling expenses	Routine Maintenance Expenses	Periodic Maintenanace (Functional +Struc Overlay+ Toll collectio system)	Total Cost (Rs. Cr.)	Remarks
2024-2025	78.31	9.86	9.33	-	97.50	
2025-2026		9.86	16.45	33.38	59.69	
2026-2027		8.07	16.45	-	24.52	
2027-2028		8.07	27.32	116.60	151.99	
2028-2029		7.28	27.75	-	35.03	
2029-2030		7.28	27.75	15.40	50.43	
2030-2031		7.28	27.75	20.41	55.44	
2031-2032		7.28	27.75	-	35.03	
2032-2033		7.28	27.75	18.85	53.88	
2033-2034		7.28	27.75	99.77	134.81	
2034-2035		7.28	27.75	-	35.03	
2035-2036		7.28	27.75	29.49	64.52	
2036-2037		7.28	27.75	18.52	53.56	
2037-2038		7.28	27.75	25.73	60.76	
2038-2039		7.28	12.76	-	20.04	
2039-2040		7.28	12.76	-	20.04	
2040-2041		7.28	13.72	-	20.99	
2041-2042		7.28	13.72	-	20.99	
2042-2043		7.28	13.72	2.71	23.70	
2043-2044		7.28	13.72	6.69	27.69	
Total Cost:	***78.31***	***152.31***	***427.48***	***387.56***	**1,045.65**	

Note: All the Costs are in Crores, inclusive of GST, without escalation considering FY 2024 price

FINAL TECHNICAL DUE-DILIGENCE REPORT

Technical Consultant Services for National Highways Infra Trust

Orai to Barah Section of NH-27 in the State of Uttar Pradesh

October 2023

egis India
Consulting engineers pvt. ltd.

Document Name	Final Technical Due-Diligence Report
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	Name	Designation
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Approved by	Sanjay Kumar	Team Leader

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R0	22/05/2023	First Submission
R1	31/10/2023	Change in Cost due to changes in schedule issued by NHAI

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Acronyms and Abbreviations

BC	Bituminous Concrete
BOQ	Bill of Quantities
C/W	Carriageway
CA	Concession Agreement
COD	Commercial Operation Date
CVPD	Commercial Vehicles Per Day
DLP	Digital Laser Profile
EGIS	Egis India Consulting Engineers Pvt. Ltd.
EPC	Engineering Procurement and Construction
FWD	Falling Weight Deflectometer
IM	Investment Manager
InvIT	National Highways Infra Trust
IRC	Indian Road Congress
Km	Kilometer (Chainage)
km	Kilometer (Length)
LHS	Left Hand Side
MBIU	Mobile Bridge Inspection Unit
MJB	Major Bridge
MNB	Minor Bridge
MPD	Mean Profile Depth
MSA	Million Standard Axles
NH	National Highway
NHAI	National Highways Authority of India
NHIIMPL	National Highways Infra Investment Managers Private Limited
NSV	Network Survey Vehicle
O&M	Operation and Maintenance
RCC	Reinforced Cement Concrete
RHS	Right Hand Side
ROB	Road over Bridge
SH	Stage Highway
SMTD	Sensor Measured Texture Depth
SPV	Special Purpose Vehicle
VDF	Vehicle Damage Factor
VUP	Vehicular Underpass

Section 1: Executive Summary

1.1 Introduction

1.1.1 Background

NHAI has set up an Infrastructure Investment Trust namely National Highways Infra Trust ("InvIT") and is acting as its Sponsor to the said InvIT. National Highways Infra Investment Managers Private Limited ("NHIIMPL") has been appointed as the Investment Manager to the InvIT.

NHIIMPL appointed M/s Egis India Consulting Engineers Private Limited, as Technical Consultant to conduct the due diligence on the proposed Asset. The Letter of Empanelment (LOE) was received on 3rd November 2022 and Letter of Award (LoA) for the subject Project was received on 22nd November 2022 by Egis India and the services commenced immediately thereafter.

The project stretch detail as per LoA is listed below.

Table 1.1: Detail of Project Stretches

Sr. No.	Stretches	Toll Plaza	NH No.	Length (km)
1	Orai to Barah	Usaka	NH-27	67.810
Total				**67.810***

** Actual length of project stretch is 63.159 km on LHS & 62.647 km on RHS*

1.1.2 Objectives

The main objectives of the present assignment is to

1. review project documents and understanding schedule B requirements for improvement works for the assessment of Capex and Opex during the concession period.
2. conduct field investigations to assess the existing asset condition and future deterioration.
3. validate executed works with respect to schedule A and assessment of improvement Works
4. review quality of construction based on available data, design and drawings.
5. undertake designs for rehabilitation requirements of different assets based on field investigation data and available documents.
6. assess operation and maintenance cost including major maintenance expected to be incurred during the concession period.

1.2 Site Visit

The Technical Consultant visited site from 2nd December 2022 to 12th December 2022. The important aspects of the project road were noted in the detailed site reconnaissance along with various field investigations. These included general description about the project road, site features, structures, junctions, pavement characteristics, road safety and social issues. Field investigation

for NSV, FWD test, axle load survey, trail pits, MBIU and drone videography survey were also conducted by Technical Consultant to assess the present condition of the project road.

1.2.1 Salient Features

Client	:	National Highway Authority of India.
Existing Annuity Concessionaire	:	M/s O B Infrastructure Limited.
Concession Period	:	17.5 Years including construction period.
Date of Contract Appointment	:	24th October, 2006.
Construction Period	:	910 Days
Scheduled Date of Completion of Work	:	23rd April, 2009
Provisional COD	:	30.06.2009
Commercial Operation Date (COD)	:	31.08.2021
End of Concession Date	:	12.12.2024

1.2.2 Project Corridor

Project Stretch starts from Km 1515+713 (Orai) to Km 1578+872 (Barah) on LHS and from Km 1515+713 (Orai) to Km 1578+360 (Barah) on RHS in the state of Uttar Pradesh. The length of project stretch is 63.159 km on LHS & 62.647 km on RHS. Additional length of LHS carriageway is due to provision of unidirectional flyover towards the end point to provide connectivity of the project road with Auraiya – Kanpur road. The project highway falls in plain terrain and land use are 43.65% (LHS) & 56.62% (RHS) agricultural and 56.35% (LHS) & 43.38% (RHS) built up area.

The project highway is a four lane divided carriageway with paved shoulder. The carriageway width is 7.25m with kerb shyness and 1.5 m wide paved shoulder all along the project corridor except at toll plaza, retained structures and approaches of grade separated structure.

Details of assets are given below:

Table 1.2: Details of Assets

S. No.	Description			Orai to Barah
1	Total Project Length (km)			LHS-63.159
				RHS-62.647
2	Service Roads/ Slip Roads (km)			26.75
3	Pavement (km)	Flexible	LHS	63.094
			RHS	62.582
		Rigid	LHS	0.065
			RHS	0.065
4	Bus Shelters (no.)			4
	Bus bays with Shelters (no.)			20
5	Truck Lay-bays(no.)			4
6	Toll Plaza (no.)			1
7	Major Bridge (no.)			2
8	Minor Bridge (no.)			3

S. No.	Description		Orai to Barah
9	Culverts (no.)	Box	78
		Slab	-
		Pipe	7
10	At grade Intersections (no.)	Major	5
		Minor	121
11	Underpasses (no.)	VUP/ SVUP	2
		PUP	3
12	Flyover (no.)		5

1.3 Surveys and Investigations

1.3.1 Network Survey Vehicle (NSV)

The Network Survey Vehicle is the latest survey technique which utilizes Lasers, Global Positioning System and Video image processing tools. The survey vehicle is used for automatic data collection pertains to pavement condition and road inventory data. The NSV survey has been carried out separately for each lane of the Carriageway along the project corridor on 10/12/2022 for collection of pavement condition data.

1.3.1.1 Flexible Pavement Distresses

The summary of distress is presented in tables for LHS and RHS respectively.

Table 1.3: Summary of Flexible Pavement Distresses on LHS Carriageway

Distress	Rating	Severity (% of Area)	Inner Lane		Outer Lane	
			Length of the Road Effected (km)	% length	Length of the Road Effected (km)	% length
Cracks	Good	< 1%	42.5	66.41	35	54.69
	Fair	1% to 5%	16	25.00	15	23.44
	Poor	> 5%	5.5	8.59	14	21.88
Ravelling	Good	< 1%	49.5	77.34	46	71.88
	Fair	1% to 5%	13.5	21.09	17.5	27.34
	Poor	> 5%	1	1.56	0.5	0.78
Edge Break	Good	< 1%	64	100.00	64	100.00
	Fair	1% to 5%	0	0.00	0	0.00
	Poor	> 5%	0	0.00	0	0.00
Depression / Settlement	Good	< 1%	64	100.00	64	100.00
	Fair	1% to 5%	0	0.00	0	0.00
	Poor	> 5%	0	0.00	0	0.00
Bleeding	Good	< 1%	64	100.00	64	100.00
	Fair	1% to 5%	0	0.00	0	0.00
	Poor	> 5%	0	0.00	0	0.00

Table 1.4: Summary of Flexible Pavement Distresses on RHS Carriageway

Distress	Rating	Severity (% of Area)	Inner Lane		Outer Lane	
			Length of the Road Effected (km)	% length	Length of the Road Effected (km)	% length
Cracks	Good	< 1%	63	99.21	62.5	98.43
	Fair	1% to 5%	0.5	0.79	0.5	0.79
	Poor	> 5%	0	0.00	0.5	0.79
Ravelling	Good	< 1%	63.5	100.00	63	99.21
	Fair	1% to 5%	0	0.00	0.5	0.78
	Poor	> 5%	0	0.00	0	0.00
Edge Break	Good	< 1%	63.5	100.00	63.5	100.00
	Fair	1% to 5%	0	0.00	0	0.00
	Poor	> 5%	0	0.00	0	0.00
Depression / Settlement	Good	< 1%	63.5	100.00	63.5	100.00
	Fair	1% to 5%	0	0.00	0	0.00
	Poor	> 5%	0	0.00	0	0.00
Bleeding	Good	< 1%	63.5	100.00	63.5	100.00
	Fair	1% to 5%	0	0.00	0	0.00
	Poor	> 5%	0	0.00	0	0.00

1.3.1.2 Pavement Roughness

The summary of Roughness values is presented in table below and along with pictorial representation.

Table 1.5: Summary of Pavement Roughness

Pavement Type	Condition	Roughness	RI	Length (Km)			
		Range (m/km)	Range (mm/km)	LHS-Inner (L1)	RHS-Inner (R1)	LHS-Outer (L2)	RHS-Outer (R2)
Asphalt	Good	< 2.55	<1800	48.2	59	37.5	56.2
	Fair	2.55 – 3.30	1800-2400	10.6	2.3	18.1	4.7
	Poor	> 3.30	>2400	4.6	1.6	7.8	2
	Total			**63.4**	**62.9**	**63.4**	**62.9**

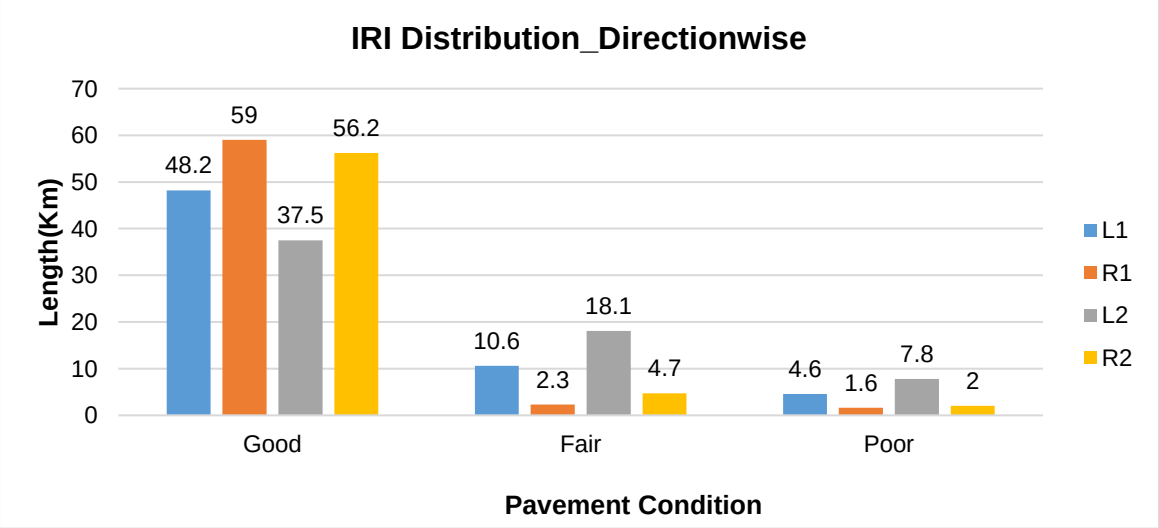


Figure 1.1: Pictorial Representation showing the Roughness Values in Project Section

1.3.1.3 Rutting

Extent of rutting along the project road is presented in tables below separately for LHS & RHS Carriageway.

Pavement Type	Condition	Rut Depth Range (mm)	Length (Km)			
			LHS-Inner (L1)	RHS-Inner (R1)	LHS-Outer (L2)	RHS-Outer (R2)
Asphalt	Good	< 5	21.5	57.2	12.4	38.4
	Fair	5 - 10	38.0	5.1	44.7	24.5
	Poor	> 10	3.9	0.6	6.3	0.0
	Total		**63.4**	**62.9**	**63.4**	**62.9**

1.3.2 Test Pit Investigations

The summary of existing pavement crust thickness is presented in table below**.**

Table 1.6: Summary of Existing Pavement Crust Thickness

S. No.	Location (Km)	Side (LHS/ RHS)	Co-ordinates		Existing Crust details			
			Latitude	Longitude	Bituminous Layer	Granular Layer-I (WMM)	Granular Layer-II (GSB)	Total Thickness (mm)
1	1516+000	LHS	26°1'25.21"N	79°32'31.42"E	260	250	200	710
2	1521+500	RHS	26°2'31.41"N	79°35'33.91"E	260	220	200	680
3	1525+050	LHS	26° 3'39.52"N	79°37'47.16"E	260	250	200	710
4	1530+000	RHS	26°4'46.69"N	79°40'4.00"E	270	250	200	720
5	1535+200	LHS	26° 6'17.90"N	79°42'47.85"E	250	240	200	690
6	1544+000	RHS	26° 9'42.85"N	79°46'38.54"E	270	260	200	730
7	1549+000	LHS	26°11'32.58"N	79°48'11.44"E	280	260	200	740
8	1556+000	RHS	26°14'13.16"N	79°51'2.42"E	300	250	200	750
9	1560+000	LHS	26°15'59.17"N	79°52'37.55"E	300	250	200	750
10	1565+000	RHS	26°17'48.04"N	79°54'48.12"E	290	250	200	740
11	1569+600	LHS	26°19'19.15"N	79°57'4.93"E	280	250	200	730
12	1575+350	RHS	26°22'3.13"N	79°59'27.23"E	300	250	200	750

Observations and Conclusions:

- The pavement composition comprises of bituminous layer, granular base/sub-base on subgrade.
- Throughout the project road, it is found that the consistent bituminous/ granular layer thickness with an average of 270mm bituminous layer over 450mm of granular layers.

The test results are presented in table below.

Table 1.7: Test Results

S. No.	Location (Km.)	Side (LHS/RHS)	Soil Classification as per IS: 1498	Gradation: Percent by weight passing through the Sieve (IS:2720-IV)			Clay & silt content %	Atterberg Limits [IS :2720-Pt-V]			Modified Proctor Test (IS:2720-Pt-VIII)		In-situ Density		4-Days Soaked CBR (%)	Free Swell Index (%)	Degree of Compaction (%)
				Gravel (%)	**Sand (%)**	**Clay & silt content %**		**Liquid Limit (LL) %**	**Plastic Limit (PL) %**	**Plasticity Index (PI)**	**Max. dry density gm/cc.**	**OMC (%)**	**FDD (gm/cc)**	**FMC (%)**			
1	1516+000	LHS	CL	3.5	33.8	62.7	62.7	32	21	11	1.82	9.2	1.8	8.0	7.5	20.0	98.2
2	1521+500	RHS	CL	5.2	29.8	65.0	65.0	35	23	12	1.91	10.0	1.9	9.0	7.7	22.5	99.1
3	1525+050	LHS	SC	10.2	56.2	33.6	33.6	29	17	12	2.01	10.2	2.0	9.0	7.9	20.0	98.1
4	1530+000	RHS	SC	11.5	57.9	30.6	30.6	27	14	13	2.00	9.6	2.0	10.0	8.2	15.0	98.5
5	1535+200	LHS	SC	8.7	53.8	37.5	37.5	30	15	15	1.82	10.2	1.7	9.0	8.5	16.7	94.0
6	1544+000	RHS	CL	9.2	33.8	57.0	57.0	32	20	12	1.88	9.2	1.9	10.0	7.6	20.0	99.2
7	1549+000	LHS	CL	10.9	36.7	52.4	52.4	33	17	16	1.82	11.0	1.7	11.0	7.8	33.3	95.2
8	1556+000	RHS	SC	15.5	50.7	33.8	33.8	29	20	9	1.75	8.8	1.7	10.0	8.2	15.0	94.6
9	1560+000	LHS	CL	13.0	32.6	54.4	54.4	32	14	18	1.77	10.5	1.7	11.0	7.4	33.3	96.6
10	1565+000	RHS	CL	6.0	36.8	57.2	57.2	33	15	18	1.89	10.8	1.8	12.0	7.8	35.0	97.7
11	1569+600	LHS	CL	8.5	29.8	61.7	61.7	30	20	10	1.75	9.9	1.6	9.0	8.1	20.0	94.2
12	1575+350	RHS	CL	9.7	32.5	57.8	57.8	35	16	19	1.90	9.5	1.9	12.0	7.8	35.0	97.9

Observations and Conclusions

- The subgrade soils are generally consistent throughout the project road and is predominantly Clays and Clayey sands, due to which, the Liquid Limit (LL) is ranging between 27-35 %, and these values are within the limit as per MoRTH specifications (<50%). The obtained maximum Plasticity Index of the subgrade soils is 9-19 % and the degree of free swell is 15-35 %. All the measured PI and FSI values are also within the acceptable limits as per MoRTH guidelines, of 25% and 50% respectively.

- Further, the MDD values is ranging between 94.0 % - 99.2 %. The 4-days soaked CBR and is ranging from 7.4 % to 8.5 % with an average value of 7.9 %. Average Subgrade CBR Value is 8.0 % which is in line with design CBR.

1.3.3 Axle Load Survey

Vehicle axle loading has a significant impact on pavement performance and design. Thus, an axle load survey has been conducted on 02nd Dec-2022 in compliance with IRC 37 2018 and such survey was conducted for 24 hours in both directions at the existing toll plaza location at km 1520+000 (Usaka Toll Plaza).

The VDF analysis was carried out in line with section 4.4 of IRC: 37-2018 based on the axle load data. Obtained VDF values comparing the values adopted at the time of pavement design during construction summarized in table below.

Table 1.8: Vehicle Damage Factors (VDF)

S. No.	Vehicle Type	Direction	
		Orai-Kanpur (LHS)	Kanpur-Orai (RHS)
1	Bus	1.45	1.21
2	LCV	2.57	1.69
3	2-Axle	3.01	1.13
4	3-Axle	5.66	2.59
5	MAV	14.58	8.87

1.3.4 Falling Weight Deflectometer

Remaining Life Estimation for Flexible Pavement

The detailed remaining life analysis is done using 90 percent reliability equation of IRC: 115-2014 is presented in tables below for LHS and RHS carriageway.

Table 1.9: Pavement Remaining life for LHS Carriageway

S. No	Existing Chainage		15th Percentile E Value (Mpa)			Obtained Strains (through IITPAVE)		Remaining Life of Existing Pavement (MSA)		
	From	To	Bituminous Layer	Granular Layer	Sub-grade	Fatigue Strain	Rutting Strain	Fatigue Residual Life	Rutting Residual Life	Remaining life
1	1515.750	1525.000	874.7	136.8	102.6	0.0002278	0.0002098	32.3	668.4	32.3
2	1525.000	1535.000	962.3	110.4	92.8	0.0002378	0.0002205	25.2	533.5	25.2
3	1535.000	1545.989	742.6	121.7	100.7	0.0002745	0.0002358	18.0	393.6	18.0
4	1545.989	1556.951	1077.7	220.2	101.8	0.0001555	0.0001746	119.2	1537.0	119.2
5	1556.951	1567.944	1352.9	147.1	101.7	0.0001472	0.0001607	121.5	2238.7	121.5
6	1567.944	1578.009	1051.5	119.5	91.6	0.0001988	0.0002011	46.8	809.9	46.8

Table 1.10: Pavement Remaining life for RHS Carriageway

S. No	Existing Chainage		15th Percentile E Value (Mpa)			Obtained Strains (through IITPAVE)		Remaining Life of Existing Pavement (MSA)		
	From	To	Bituminous Layer	Granular Layer	Subgrade	Fatigue Strain	Rutting Strain	Fatigue Residual Life	Rutting Residual Life	Remaining life
1	1578.250	1569.743	1197.7	207.4	121.6	0.0001387	0.0001510	169.9	2968.9	169.9
2	1569.743	1558.751	1190.1	138.3	120.7	0.0001610	0.0001518	95.7	2898.6	95.7
3	1558.751	1547.751	1383.9	180.2	122.0	0.0001431	0.0001496	133.0	3096.9	133.0
4	1547.751	1536.731	1260.5	238.3	98.8	0.0001396	0.0001771	158.6	1441.0	158.6
5	1536.731	1526.754	1466.4	278.1	103.1	0.0001362	0.0001678	153.4	1840.3	153.4
6	1526.754	1515.750	1407.2	219.8	95.1	0.0001452	0.0001957	123.9	916.3	123.9

1.3.5 Structure Inventory and Condition Survey

Details of existing structures along the project road are tabulated below.

Table 1.11: Details of Existing Structures

Sr. No.	Type of Structure		No. of Structure	Location	Span Arrangement	Deck width	Superstructure Type	Remark
1	Major Bridge		2	1540+800	7 x 85.00 + 2 x 80.80 + 2 x 5.00 LHS on Yamuna 8 x 85.00 + 2 x 52.00 m RHS on Yamuna	4 Lane	Box Girder/ Cantilever Box girder	Bridges found in sound condition except requirement of minor repair like cleaning of exp joint, drainage spouts, repair of minor honeycombing, removal of vegetation etc.
				1567+060	3 x 28.450 LHS 04 x 13.70 + 2 x 9.00 m - RHS	4Lane	PSC Girder/ Slab	
2	Minor Bridge		3	1517+510	3 x 14.6	4 Lane	RCC T-Girder + Slab	Expansion joints found damaged and need to be replaced.
				1539+255	3 x 6.8	4 Lane	RCC Box	Bridge is in sound condition except requirements of minor repairing like cleaning of exp joint, drainage spouts, repair of minor honeycombing, removal of vegetation etc.
				1574+655	1 x 6.0	4 Lane	RCC Slab	
3	Flyover/ Viaduct		5	1539+600	1 x 30	4 Lane	PSC Girder + Slab	All flyovers are in sound condition. Routine maintenance like cleaning of exp joint, drainage spouts etc. are required.
				1550+700	11 x 26.2	4 Lane	PSC Girder + Slab	
				1564+180	1 x 30.5	4 Lane	PSC Girder + Slab	
				1573+510	1 x 30.5	4 Lane	PSC Girder + Slab	
				1578+360	2 x 31	2-Lane (LHS)	PSC Girder + Slab	
4	SVUP		2	1551+000	1 x 7.0	4 Lane	RCC Box	Structures are in sound condition. Approx 15 nos of RE wall panels in approaches have minor cracks. Minor honeycombing is observed at crash barrier.
				1554+525	1 x 10.5	4 Lane	RCC Box	
5	PUP		3	1539+227	1 x 7.0	4 Lane	RCC Box	Structures are in sound condition.
				1539+730	1 x 7.0	4 Lane	RCC Box	
				1571+533	1 x 10.5	4 Lane	RCC Box	
6	Culverts	Box	78					Culverts are in sound condition. Minor routine repairs like repair of minor honeycombing, removal of vegetation etc. are required.
		Slab	Nil					
		Hume Pipe	7					

1.4 Key Technical Issues

1.4.1 Present Pavement Condition

The present (as on Dec-2022) pavement condition on LHS carriageway is very poor having high severity alligator cracks, lateral displacement of asphalt mix, rutting/settlements etc. even though renewal course of bituminous overlay on LHS carriageway has been completed in the year Nov-2021 as per the discussions with project site teams. This shows the structural deficiency in pavement layers, particularly asphalt layers, which results into cracks to progress and move upwards very fast with repeated application of heavier traffic loads.

The application of bituminous overlay works (2nd Renewal) on RHS carriageway has been commenced and completed these renewal works on 04.07.2022 and hence there were no major distresses as observed presently on the pavement surface. It was tried to explore the pavement condition before application of this renewal coat, but no information made available neither at site offices nor in available reports. Further, there is no historical data reports on pavement evaluation studies such as roughness and BBD survey. Discussions with site team's reveals that there are distresses such as alligator cracks and potholes of medium severity were also observed on non-renewal surface.

Structural distresses such as Alligator cracks and Rutting are the predominant mode of distress in the project highway as per the visual pavement condition assessment.

As per schedule B of TOT draft Concession Agreement, the entire section from Orai-Barah is under BOT (Annuity) up to 12/12/2024, so no immediate major rehabilitation/repairs are required. However, it is pertinent to mention that pavement has a structural deficiency and hence above structural failures of high severity needs to be rectified by the present Annuity Concessionaire before asset is handed over to the TOT Concessionaire.

1.4.2 Safety Issue at Kalpi Bakra Mandi

There is a market named "Kalpi Bakra mandi" at Ch 1544+300. At this location, there is unauthorised median opening and mountable kerbs. A number of vehicles use this unauthorised opening and even over the mountable kerbs to cross the road which is a safety concern.

1.5 Capital Expenditure (CapEx) Requirement

1.5.1 New Construction

Schedule B specifies the requirements of new construction which the concessionaire has to construct after the appointment date. Major works and reference used to quantify these construction requirements are listed below:

- Rainwater harvesting: Considered at 500m staggered interval
- Pedestrian Guard Rails: 13.18 km
- TMS.

1.5.2 Immediate Maintenance Requirements

The entire section is under BOT (Annuity) up to 12/12/2024. So no immediate major repair has been required.

1.6 O&M Cost Estimation

1.6.1 Recommended MM Cycles for Pavement

S. No.	Year	Description	MMR Proposal	
			MCW	Service/Slip Roads
1	2024	The project stretch is currently under BOT (Annuity) up to 12.12.2024, so no immediate major repair has been required as per clause 4.1.2, schedule B of CA. However, at present the pavement is having high severity distresses, which needs to be rectified by the existing concessionaire by suitable bituminous overlay of 40mm.		
2	2027-28	Structural overlay may be required since the initial 4-lane pavement was designed to cater operation period of the annuity which will be expired in 2024.	**Flexible Pavement:** 50mm BC for full length on LHS and 40mm on RHS side. **Rigid Pavement (Toll Plaza):** Nil	30mm BC overlay for full length
3	2032-33	Periodic Maintenance to improve the roughness	**Flexible Pavement:** 40mm BC overlay for 90% length and 50mm BC overlay for 10% length **Rigid Pavement (Toll Plaza):** Sealant replacement for 100% joint length and panel replacement for 0.5% of the total panels laid at Toll Plaza	30mm BC overlay for full length
4	2038-39	Periodic Maintenance to improve both pavement roughness and structural integrity	**Flexible Pavement:** 50mm BC overlay after milling to 50mm for entire length **Rigid Pavement (Toll Plaza):** Sealant replacement for 100% joint length	30mm BC for full length
5	2044-45	Periodic Maintenance to bring the roughness index below the prescribed limit (before handover)	**Flexible Pavement:** 40mm BC overlay for full length **Rigid Pavement (Toll Plaza):** Sealant replacement for 100% joint length and panel replacement for 0.5% of the total panels laid at Toll Plaza	30mm BC for full length

1.6.2 Estimate (CapEx and O&M)

1.6.2.1 Capital Expenditure (CapEx) Requirement

Cost of capital expenditure (CapEx) are presented below.

Table 1.12: Cost of Capital Expenditure (CapEx)

Description	EGIS Cost (INR in Crores)
Cost of Miscellaneous Road Furniture	4.24
Cost of Rain Water Harvesting	1.89
Cost of Repair & Rehabilitation of Existing Structures	0.86
Cost of Improvement to Toll Plaza	2.69
Police Assistance	0.15
Total Without GST	9.83
Total including GST (18%)	**11.61**

1.6.2.2 Cost of Operation & Maintenance

Cost of Operation & Maintenance per annum are presented below.

Table 1.13: Cost of Operation & Maintenance (per annum)

Description	EGIS Cost (INR in Crores)
Tolling Operations	5.05
Incident Management	2.23
Admin Expenses	4.34
Insurance	1.20
Routine Maintenance	2.33
Repairs	1.83
ATMS	-
Total	**16.98**

1.6.2.3 Periodic Maintenance

Cost of Periodic Maintenance (Base year 2024) including GST, but excluding escalation are presented below.

Table 1.14: Cost of Periodic Maintenance

Year	Periodic Maintenance (INR in Crores)				
	Functional +Structural overlay MCW+ S/R	Major Maintenance of Rigid Pavement	Replacement of ATMS	Replacement of TMS	Structure specified repairs
2023-2024					
2024-2025					
2025-2026					
2026-2027					
2027-2028	69.95				15.03
2028-2029					
2029-2030					
2030-2031				1.59	
2031-2032					
2032-2033	72.31				
2033-2034					
2034-2035					
2035-2036					
2036-2037					
2037-2038				3.18	
2038-2039					
2039-2040	81.05				
2040-2041					
2041-2042					
2042-2043					

Year	Periodic Maintenance (INR in Crores)				
	Functional +Structural overlay MCW+ S/R	Major Maintenance of Rigid Pavement	Replacement of ATMS	Replacement of TMS	Structure specified repairs
2043-2044					
2044-2045	89.44				
2045-2046					
2046-2047					
2047-2048					
2048-2049					
2049-2050					
2050-2051					
2051-2052					
2052-2053					
2053-2054					
Total	**312.75**	**–**		**4.77**	**15.03**
Grand Total					**332.55**

1.7 Conclusion

The entire section of the project highway is under BOT (Annuity) up to 12.12.2024. Two periodic renewals has undertaken by the exiting Annuity Concessionaire with significant delay and completed in the years 2017 and 2022 respectively for 1st and 2nd renewal. As per schedule L of annuity concession agreement, periodic overlay with Bituminous Concrete shall be laid every 5 years and accordingly 3rd renewal may be anticipated so as to improve the present condition of asset in respect of structural integrity and riding quality as per the CA provisions. As part of present study, various physical testing and visual site inspections was conducted to evaluate the asset condition and to take required maintenance decisions. Based on the site reconnaissance, it is appraised that majority of the locations, pavement on LHS carriageway is experiencing structural distresses like alligator/block cracking, rutting etc. for which requires immediate treatments to avoid further drop in pavement quality. Based on the results of physical testing and review of available reports/data, analysis of remaining life, the recommendations are made in proposing suitable the major maintenance strategy to be adopted during the concession period.

Based upon the site visit for assessment of condition of CD structures including MJB, MNBs, Flyovers, VUPs, Culverts and toll plaza buildings in the project corridor and observations submitted in various chapters of this report it is concluded that right now there is no major repairs involved in the structures other than what has been specified in this report which is of minor nature.

The assessment of estimated cost of anticipated future repair and rehabilitation cost are considered in the cost estimate of this report.

Section 2: Introduction

2.1 Background

NHAI has set up an Infrastructure Investment Trust namely National Highways Infra Trust ("InvIT") and is acting as its Sponsor to the said InvIT. National Highways Infra Investment Managers Private Limited ("NHIIMPL") has been appointed as the Investment Manager to the InvIT.

National Highways Infra Projects Private Limited ("NHIPPL"), a wholly owned subsidiary of InvIT has entered into concession agreements with NHAI for 5 road projects. Currently, NHIPPL is operating and managing these 5 road projects under the supervision of InvIT & NHIIMPL. In addition, InvIT is in the process of acquiring 3 additional road projects from NHAI subject to requisite approvals.

Further, InvIT would be evaluating acquisition opportunities going forward. NHAI has recently offered 5 additional road projects (with aggregate length of ~470 km) to InvIT for potential acquisition subject to requisite approvals. In this context, NHIIMPL (on behalf of InvIT & NHIPPL) has created a panel of Technical Consultants for undertaking technical due diligence of its assets and acquisition opportunities.

NHIIMPL appointed M/s Egis India Consulting Engineers Private Limited, as Technical Consultant to conduct the due diligence on the proposed Assets. The Letter of Empanelment (LOE) was received on 3rd November 2022 and Letter of Award (LoA) for the subject Project was received on 22nd November 2022 by Egis India and the services commenced immediately thereafter.

The project stretch detail as per LoA is listed below.

Table 2.1: Detail of Project Stretches

Sr. No.	Stretches	Toll Plaza	NH No.	Length (km)
1	Orai to Barah	Usaka	NH-27	67.810*
Total				**67.810***

** Actual length of project stretch is 63.159 km on LHS & 62.647 km on RHS*

2.2 Objectives

The main objectives of the present assignment is to

1. review project documents and understanding schedule B requirements for improvement works for the assessment of Capex and Opex during the concession period.
2. conduct field investigations to assess the existing asset condition and future deterioration.
3. validate executed works with respect to schedule A and assessment of improvement Works
4. review quality of construction based on available data, design and drawings.
5. undertake designs for rehabilitation requirements of different assets based on field investigation data and available documents.
6. assess operation and maintenance cost including major maintenance expected to be incurred during the concession period.

2.3 Technical Consultant Team

The Technical Consultant commenced its services from 14th November 2022 and the team comprising of Highway, Pavement & Structure Engineers and Experts have conducted site visit from 2nd December 2022 to 12th December 2022 to appreciate the project corridor characteristics. This report highlights the findings from visual assessment, available documents shared with the consultant, discussion with NHAI officials involved with the maintenance and operation of project road at site and other local enquiries. Analysis of data as obtained from various survey and investigations conducted at site are present in this report.

Date-wise various field activities at site are shown below in bar chart form in **Figure 2.1**

Name of Surveys	Days												
	02-Dec	03-Dec	04-Dec	05-Dec	06-Dec	07-Dec	08-Dec	09-Dec	10-Dec	11-Dec	12-Dec	13-Dec	20-Dec
FWD Survey													
NSV Survey													
Videogaphic Survey													
Axle Load Survey													
Test Pits													
MBIU for Major Structures (Length > 60m)													

Figure 2.1: Project ActivitiesSchedule

2.4 Disclaimer

The information and documents received from the Client are being reviewed by the Consultant and have been used for preparing this report. Due care has been taken while reproduction of the information where required to avoid typographical or other errors.

2.5 Structure of the Report

The report has been structured into nine sections as follows:

Section 1: Executive Summary
Section 2: Introduction
Section 3: Inventory and Condition Assessment
Section 4: Surveys and Investigations
Section 5: Review of Documents
Section 6: Capital Expenditure (CapEx) Requirement
Section 7: Operation & Maintenance
Section 8: Analysis & Comparisons with Seller Data
Section 9: Conclusions

Section 3: Inventory and Condition Assessment

3.1 General

The Technical Consultant visited site from 2nd December 2022 to 12th December 2022. The important aspects of the project road were noted in the detailed site reconnaissance along with various field investigations. These included general description about the project road, site features, structures, junctions, pavement characteristics, road safety, social and environment issues. Field investigation for NSV, FWD test, axle load survey, trail pits, MBIU and drone videography survey were also conducted by Technical Consultant to assess the present condition of the project road. This chapter elaborates various findings of these surveys and studies conducted by the Technical Consultant team in different sections.

3.2 Project Corridor

Project Stretch starts from Km 1515+713 (Orai) to Km 1578+872 (Baraha) on LHS and from Km 1515+713 (Orai) to Km 1578+360 (Barah) on RHS in the state of Uttar Pradesh. The length of project stretch is 63.159 km on LHS & 62.647 km on RHS. Additional length of LHS carriageway is due to provision of unidirectional flyover towards the end point to provide connectivity of the project road with Auraiya – Kanpur road.

The start and end points are shown in **Figure 3.1** below:

Start Point – Km 1515+713 of NH-27 at Orai

End Point – Km 1578+872 (LHS) & Km 1578+360 (RHS) of NH-27 at Barah

Figure 3.1: Start and End Points

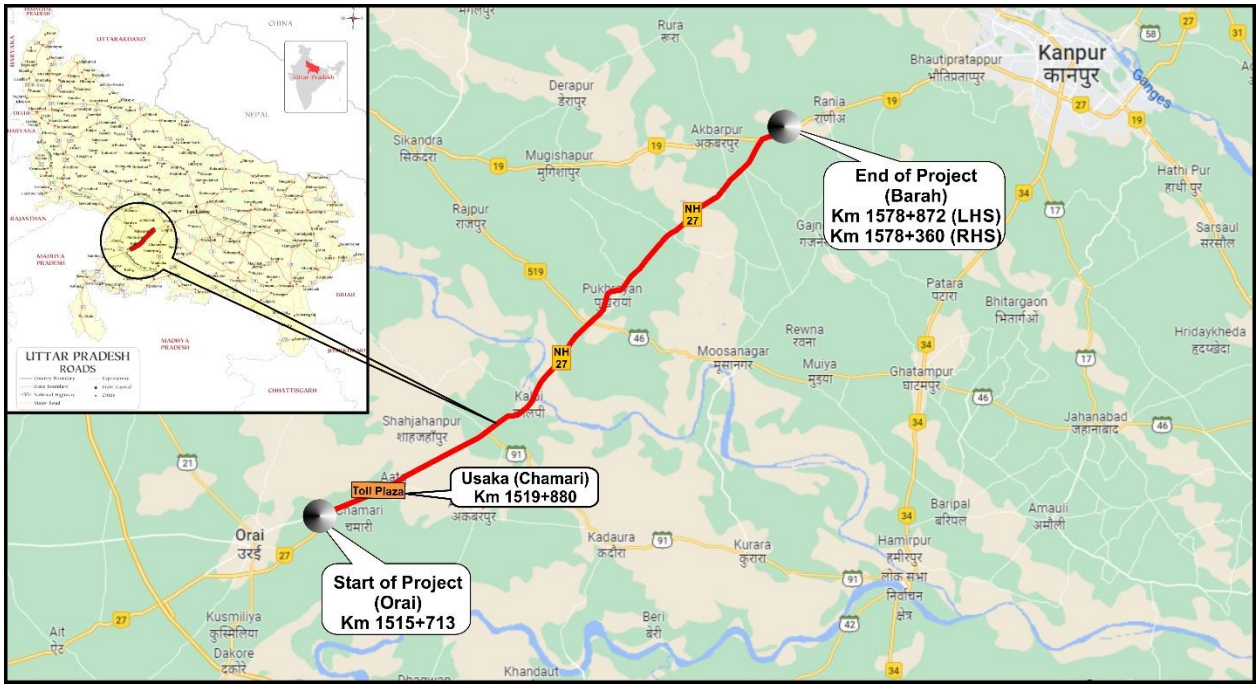


Figure 3.2: Location Map

3.3 Project Brief

3.3.1 Salient Features

Client	:	National Highway Authority of India.
Existing Annuity Concessionaire	:	M/s O B Infrastructure Limited.
Concession Period	:	17.5 Years including construction period.
Date of Contract Appointment	:	24th October, 2006.
Construction Period	:	910 Days
Scheduled Date of Completion of Work	:	23rd April, 2009
Provisional COD	:	30.06.2009
Commercial Operation Date (COD)	:	31.08.2021
End of Concession Date	:	12.12.2024

Details of Assets:

S. No.	Description			Orai to Barah
1	Total Project Length (km)			LHS-63.159
				RHS-62.647
2	Service Roads/ Slip Roads (km)			26.75
3	Pavement (km)	Flexible	LHS	63.094
			RHS	62.582
		Rigid	LHS	0.065
			RHS	0.065
4	Bus Shelters (no.)			4
	Bus bays with Shelters (no.)			20

S. No.	Description		Orai to Barah
5	Truck Lay-bays(no.)		4
6	Toll Plaza (no.)		1
7	Major Bridge (no.)		2
8	Minor Bridge (no.)		3
9	Culverts (no.)	Box	78
		Slab	-
		Pipe	7
10	At grade Intersections (no.)	Major	5
		Minor	121
11	Underpasses (no.)	VUP/ SVUP	2
		PUP	3
12	Flyover (no.)		5

3.4 Road Inventory and Condition Survey

3.4.1 Road Inventory

The Road Inventory is conducted to assess and list out the existing features of the project corridor and to validate that project road is conforming to the requirements of CA. It covers all the existing physical features such as terrain, land use, carriageway surfacing type, shoulder width, junctions, water bodies, roadside arboriculture, general drainage conditions, etc. It was carried out in accordance with the guidelines given in IRC: SP 19-2001, generally by visual means, and supplemented by simple tape measurement.

The road inventory data collected for the project highway is presented in the **Annexure 3.1.**

3.4.2 Terrain

The project highway falls in plain terrain.

3.4.3 Land Use

The land along the project highway is predominantly agricultural followed by built up, barren, residential and commercial areas. Details of land use are given in the **Table 3.1**.

Table 3.1: Land Use

Description	Length (km)		%age	
	LHS	RHS	LHS	RHS
Agriculture	27.57	35.473	43.65%	56.62%
Built-Up Area (Residential/Commercial/Industrial)	35.589	27.174	56.35%	43.38%
Total	63.159	62.647	100%	100%

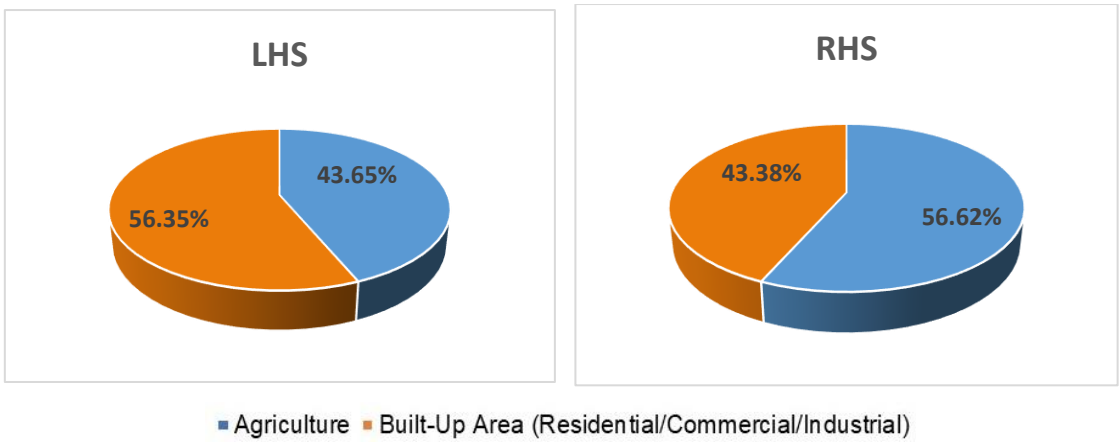


Figure 3.3: Land Use

3.4.4 Main Carriageway

The project highway is a four lane divided carriageway with paved shoulder. The carriageway width is 7.25m with kerb shyness and 1.5 m wide paved shoulder all along the project corridor except at toll plaza, retained structures and approaches of grade separated structure. There is flexible pavement all along except at toll plaza where rigid pavement is observed in the plaza area. Median width is predominantly 4.5m (excluding shyness).

4 lane Carriageway

Median Opening

Wide Median at Major Bridge

Rigid Pavement at Toll Plaza

Figure 3.4: Main Carriageway

3.4.5 Service Road

Detail of service road are given below.

Table 3.2: Service Road

S. No.	Chainage (Km)		Length (Km)	Side	Width in (m)
	From	To			
1	1537+883	1540+213	2330	LHS	5.0
2	1538+263	1540+243	1980	RHS	5.5
3	1550+150	1551+330	1180	LHS	7.5
4	1550+253	1551+343	1090	RHS	7.5
5	1551+550	1554+800	3250	LHS	5.5
6	1551+850	1554+800	2950	RHS	5.25
7	1556+250	1557+650	1400	LHS	5.5
8	1556+250	1557+100	850	RHS	5.5
9	1558+200	1559+250	1050	LHS	5.5
10	1557+470	1559+250	1780	RHS	5.5
11	1563+800	1564+600	800	LHS	7.25
12	1562+675	1562+925	250	RHS	7.25
13	1563+800	1564+600	800	RHS	7.25
14	1570+000	1570+750	750	LHS	5.5
15	1570+000	1571+950	1950	RHS	5.5
16	1571+220	1571+710	490	LHS	7.25
17	1572+650	1572+950	300	LHS	5.25
18	1572+650	1572+950	300	RHS	5.5
19	1573+200	1574+000	800	LHS	7.5
20	1573+200	1574+000	800	RHS	7.0
21	1575+600	1576+800	1200	LHS	5.25
22	1577+950	1578+400	450	LHS	7.0
Total Length =			**26750**		

Service Road at Km 1550+300 LHS

Service Road Entry ramp at Km 1551+220 RHS

Figure 3.5: Service/Slip Road Carriageway

3.4.6 Towns and Built-Up-Areas

Major town along the project road is Kalpi, Bhognipur and Mati. Chainage-wise detail of towns and built-up areas are given below:

Table 3.3: Built Up Areas

Sr. No.	Existing Chainage (km)		Length of Built-up area (in M.)		Name of Settlement
	From	To	LHS	RHS	
1	1522+000	1522+800	800	-	Ata
2	1522+150	1522+800	-	650	
3	1529+000	1529+200	200	-	Usergaon
4	1529+000	1529+500	-	500	
5	1532+500	1532+800	-	300	Choank
6	1534+200	1535+000	800	-	Jolhapur
7	1534+150	1535+000	-	850	
8	1537+900	1540+550	2650	-	Kalpi
9	1537+950	1540+410	-	2460	
10	1543+370	1545+700	2330	-	Chaura
11	1544+000	1545+700	-	1700	
12	1548+000	1548+250	250	-	Pipari
13	1548+000	1548+350	-	350	
14	1549+500	1552+350	2850	-	Bhognipur
15	1549+300	1552+400	-	3100	
16	1552+450	1556+100	3650	-	Pukhrayan
17	1552+450	1556+100	-	3650	
18	1557+250	1558+550	1300	-	Badoli
19	1557+350	1558+450	-	1100	
20	1558+800	1559+350	550	-	Hasenmau
21	1558+800	1559+400	-	600	
22	1561+000	1561+250	250	-	Chateni
23	1561+000	1561+400	-	400	
24	1562+800	1562+900	100	-	Digh
25	1562+700	1563+350	-	650	
26	1563+800	1564+500	700	-	Devipur
27	1563+800	1564+500	-	700	
28	1565+050	1565+250	-	200	Mohamodpur
29	1566+700	1566+900	200	-	Mavar
30	1570+000	1571+200	1200	-	Lalpur
31	1569+900	1571+200	-	1300	
32	1571+250	1572+350	1100	-	Muridpur
33	1571+250	1572+350	-	1100	
34	1572+450	1574+100	1650	-	Mati
35	1572+450	1574+100	-	1650	
36	1574+150	1575+750	1600	-	Navipur
37	1574+150	1575+650	-	1500	
38	1575+750	1577+800	2050	-	Jainpur
39	1575+700	1577+850	-	2150	
40	1578+000	1578+350	350	-	Bara Junction
41	1578+000	1578+500	-	500	
Total Length (m)=			**24580**	**25410**	

3.4.7 Major and Minor Junctions

3.4.7.1 Major Junction

There are 5 nos. of Major Junction. Details of the major junction are given in the **Table 3.4** below:

Table 3.4: List of Major Junction

Sr. No.	Chainage (Km)	Type of Junction (T, X, Y)	Side	Cross Road leads to	
				LHS	RHS
1	1534+150	T Junction	LHS	Sahrapur	-
2	1534+245	Y Junction	RHS	-	Jolhupur
3	1537+870	T Junction	LHS	Kalpi	-
4	1550+600	Y Junction	RHS	-	Bhognipur
5	1576+100	X Junction	BHS	Swarooppur	Jainpur

3.4.7.2 Minor Junction

There are minor junctions all along the project road at a very frequent interval. Summary of the minor junctions are given in the **Table 3.5** below:

Table 3.5: Summary of Minor Junction

Type of Junction	Y	T	X	Total
Nos.	33	59	29	121

3.4.8 Median

4.5 m wide median is there at most of project length except at few locations of Built-up Area, Flyovers and Underpasses where the median width is in the range of 1.0-2.5m. At location of few bridge approaches, median goes up to 60m. Summary of the median width are given in the **Table 3.6** below:

Table 3.6: Median Width

S. No.	Median Width (m)	Length (km)
1	< 4.5	14.672
2	4.5	45.687
3	> 4.5	2.800

3.4.9 Earthen / Hard Shoulder

Earthen shoulders are provided on the outer side of the main carriageway. The width of these shoulders is 1.5m.

3.4.10 Drainage

Cover Drain is provided at built-up-area, flyovers and underpasses. Longitudinal lined drains are provided in median at super-elevated stretches and split carriageway portions. Median cut drains are provided at super-elevated portion for efficiently draining out rain water. Details of Drainage are given in the **Table 3.7** and shown in **Figure 3.6.**

Table 3.7: Drainage System

Description	Total Linear Length (Km)
Covered lined Drain (km)	26.993
Median Drain (km)	0.785
Lined Drain between MCW and Service Road	0.428

General observation of drainage conditions during the site reconnaissance are:

- Cleaning and maintenance of roadside drainage needs improvement. Covered drain provided in urban area are encroached and clogged at many places.
- Provision of chute drain at high embankment location is observed. Stone pitching all through the slope at high embankment location is there for the protection from erosion.
- Median cut drains at super-elevated section is observed. It is found that provision of median cut drain is there to drain water from one carriageway to other whereas at super elevated portion with split level carriageway, longitudinal median drain is provided to trap water from higher carriageway and discharge the same through pits.
- There is no overtopping over road at any location.

Covered drain at Slip Road

Typical Drainage Arrangement at Service Road Location

Figure 3.6: Drainage System

3.4.11 Road Furniture

3.4.11.1 W-Beam Crash Barrier, Concrete Crash Barrier and Pedestrian Guardrail

W-Beam Crash Barrier

W-beam Crash Barrier is provided at high embankment location, Median, near major structures and at outer side of sharp curves. Package wise length of W-Beam Crash Barrier are given in the **Table 3.8** and shown in **Figure 3.7.**

Table 3.8: W-Beam Crash Barrier

Description	Total Linear Length (Km)
W-Beam Crash Barrier (km)	18.771

Figure 3.7: W-Beam Crash Barrier near High Embankment and Median

Concrete Crash Barrier

Concrete Crash Barrier is provided at the approaches of Flyovers and Underpasses. Length of CC barrier are given in the **Table 3.9** and shown in **Figure 3.8.**

Table 3.9: Concrete Crash Barrier and New Jersey Crash Barrier

Description	Total Length (Km)
Concrete Crash Barrier (km)	**12.834**

Figure 3.8: Concrete Crash Barrier

Pedestrian Guardrails

Pedestrian Guardrails are observed at few locations near median opening, grade separated junctions etc. Details are mentioned in the **Table 3.10** and shown in **Figure 3.9.**

Table 3.10: Pedestrian Guardrails

Description	Total Length (Km)
Pedestrian Guardrails (km)	0.200

Figure 3.9: Pedestrian Guardrail

In general, the conditions of these safety barriers are good.

3.4.11.2 Sign Boards and Gantry

The project have numbers of signages and are in good condition. There are many ooverhead and cantilever gantry signs as well. Location of gantry signs are shown in **Table 3.11** and **Figure 3.10** below.

Table 3.11: Cantilever & Overhead Gantry

S. No.	Chainage (km)	Side	Type
1	1518+955	LHS	Cantilever
2	1520+830	RHS	Cantilever
3	1533+725	LHS	Portal
4	1540+210	RHS	Portal
5	1540+240	LHS	Portal
6	1549+815	LHS	Portal
7	1551+595	RHS	Portal
8	1552+075	LHS	Cantilever
9	1553+985	LHS	Cantilever
10	1555+130	RHS	Cantilever
11	1556+760	RHS	Cantilever
12	1563+715	LHS	Cantilever
13	1572+640	LHS	Cantilever
14	1573+955	RHS	Cantilever
15	1575+145	RHS	Cantilever
16	1575+500	LHS	Cantilever
17	1577+125	LHS	Cantilever
18	1577+966	LHS	Portal
19	1578+168	RHS	Cantilever

Cantilever Gantry at Project Stretch

Portal Gantry at Project Stretch

Figure 3.10: Gantry & Signboards

3.4.11.3 5 km / Km / Hectometer Stones

5Km, Km & Hectometer stones are observed at shoulder & median. Most of stones are in good condition. Missing and damaged stone shall have to be restored as specified in Schedule B.

5 Km stone at Shoulder

Km Stone at Shoulder

Figure 3.11: Kilometer Stones

3.4.12 Project Facilities

3.4.12.1 Bus Bays and Shelters

There are two types of facilities for boarding the bus for the road users. There are bus bay with shelters and only shelters without bays. Number of these facilities are given in **Table 3.12** and shown in **Figure 3.12** below.

Table 3.12: Bus Bays and Shelters

Description	Unit	Total
Bus Shelter	Nos	4
Bus Bay with Shelter	Nos	20

Bus Shelter

Bus Bay with Shelter

Figure 3.12: Bus Bay and Shelters

3.4.12.2 Truck Lay bye

There are Truck lay bye at four locations along the project road. Their locations are give in **Table 3.13**.

Table 3.13: List of Truck Terminal

Sr. No.	Chainage (Km)	Side
1	1534+300	BHS
2	1549+800	RHS
3	1562+280	RHS
4	1568+950	RHS

3.4.12.3 Street Light

There are street lighting along the project roads at intermittent interval, mostly for small length except for the interchange. Number of street lighting is given in **Table 3.14** and few examples are shown in **Figure 3.13.**

Table 3.14: Highway Lighting

Description	Unit	Single Arm/ Double Arm
At Median & Shoulder	No	571

Figure 3.13: Street Light

3.4.12.4 High Mast Light

High mast lights are provided at toll plaza and few major junctions. Details are show in **Table 3.15** and **Figure 3.14** below.

Table 3.15: High Mast Light

S. No.	Chainage (Km)	Numbers	Location
1	1519+880	4	Toll Plaza
2	1534+150	1	Major Junction
3	1534+245	1	Major Junction
4	1550+600	1	Intersection
5	1550+700	1	Intersection
6	1552+500	1	Minor Junction
7	1578+360	1	Intersection

High Mast Light at Toll Plaza

High Mast Light at Junction

Figure 3.14: High Mast Light

3.5 Toll Plaza

The purpose of the Toll Plaza is to collect toll from road users of the Project highway with transparency in the system.

There is one toll plaza located at km 1519+880 called Usaka or Chamari which has 10 lanes. The toll plaza is with electronic toll collection system.

The Concession Agreement (CA) Sl no 11 of deviation table given in schedule C specifies that no toll lane augmentation is to be carried out.

Figure 3.15: Toll Plaza

3.5.1 Toll Plaza Administration Building

The Plaza administration building serves as the support structure for the operation and maintenance of the toll plaza. It is from here that utilities are distributed and controlled, employee amenities are maintained, the toll collection process overseen, revenues are processed & audited. Sale of local passes and recharge is done at Plaza building. Transfer of funds from toll booth to plaza building and from plaza building to bank are being facilitated/managed by administration and financial management functions are also conducted in the building.

The lane activities here in the plaza is monitored through CCTV Cameras installed in booths, lanes, and plaza level. Present condition of currently available toll plaza building, as appears from the visual inspection, is fair and does not warrant any major repair work in near future.

3.5.2 Toll Collection System

CA has the provision that no toll lanes augmentation is to be carried out. Appropriate technology shall be used so that service time should not take more than 10 second per vehicle at peak flow. Waiting time of the users should not exceed three minutes.

The purpose of Toll Management System is to collect smooth, fast processing of vehicle from toll plaza and maintain records of all the transactions at the lane level, auditing the lane collectors through AVC systems to prevent collection malfunctioning . All the statistical, configuration and financial / MIS reports being generated through the TMS.

Toll lane shall have lane equipment to regulate traffic movement form the Toll Plaza area. CCTV Cameras are to be installed for monitoring the traffic and lane activities. Automatic Vehicle Classification System along with incident capture camera that triggers and captures the image of outgoing vehicle when the AVC found a mismatch with the vehicle class assigned by the toll collector and the vehicle class classified by the automatic vehicle classification system. Lane computers shall be installed in the Booth for issuing the electronic tickets, RFID Transceiver installed to process FASTAG vehicle.

The Electronic Toll Collection System Deployed are electronically post classification system and comprises the following elements:

i) Automatic Vehicle Classification (AVC) and lane components.

ii) Toll Management System (TMS) software and computers in lanes and plaza buildings. The software has been developed by one of the group company of the existing Concessionaire.

Boom barrier

Camera, Traffic Light

The outermost lane in each direction is for extra wide vehicular traffic and is bifurcated by temporary barriers to allow for non-fee paying traffic (two /three wheelers etc.) to pass through without disturbing the other lanes.

3.5.3 TMS Requirements

Design of the Toll Plaza shall follow relevant MORTH standards which specify an open system of toll collection and should have equipment for registering of vehicle classification, ticket issuing, data processing and power supply. All the statistical, configuration and financial / MIS reports being generated through the TMS.

Toll lane shall have lane equipment to regulate traffic movement form the Toll Plaza area. CCTV Cameras shall be installed for monitoring the traffic and lane activities. Automatic Vehicle Classification System along with incident capture camera that triggers and captures the image of outgoing vehicle when the AVC found a mismatch with the vehicle class assigned by the toll collector and the vehicle class classified by the automatic vehicle classification system. Lane computers shall be installed in the Booth for issuing the electronic tickets, process FASTAG vehicles and controlling all the lane equipment.

Figure 3.16: Lane Equipment

3.6 Structure Inventory and Condition Survey

This section mainly presents the Site Inventory and Condition Survey of all existing Structures likes Culverts, Minor bridges, Major bridges, Flyovers, SVUP & PUP for the project road. The aim of the section is to present the details of existing structures, present condition of existing structure and functioning of structures. The structure inventory has been done on the basis of visual assessment of each structure. MBIU has been used for visual assessment inspection of major structures having length greater than 60m.

Details of existing structures along the Project road are tabulated below and Inventory and condition data is presented in **Annexure – 3.2** and **Annexure 3.3**.

Table 3.16: Details of Existing Structures

Sr. No.	Type of Structure		No. of Structure	Location	Span Arrangement	Deck width	Superstructure Type	Remark
1	Major Bridge		2	1540+800	7 x 85.00 + 2 x 80.80 + 2 x 5.00 LHS on Yamuna 8 x 85.00 + 2 x 52.00 m RHS on Yamuna	4 Lane	Box Girder/ Cantilever Box girder	Bridges are found in sound condition except requirement of minor repair like cleaning of exp joint, drainage spouts, repair of minor honeycombing, removal of vegetation etc.
				1567+060	3 x 28.450 LHS 04 x 13.70 + 2 x 9.00 m - RHS	4Lane	PSC Girder/ Slab	
2	Minor Bridge		3	1517+510	3 x 14.6	4 Lane	RCC T-Girder + Slab	Expansion joints found damaged and need to be replaced.
				1539+255	3 x 6.8	4 Lane	RCC Box	Bridges are in sound condition except requirements of minor repairing like cleaning of exp joint, drainage spouts, repair of minor honeycombing, removal of vegetation etc.
				1574+655	1 x 6.0	4 Lane	RCC Slab	
3	Flyover/ Viaduct		5	1539+600	1 x 30	4 Lane	PSC Girder + Slab	All flyovers are in sound condition. Routine maintenance like cleaning of exp joint, drainage spouts etc. are required.
				1550+700	11 x 26.2	4 Lane	PSC Girder + Slab	
				1564+180	1 x 30.5	4 Lane	PSC Girder + Slab	
				1573+510	1 x 30.5	4 Lane	PSC Girder + Slab	
				1578+360	2 x 31	2-Lane (LHS)	PSC Girder + Slab	
4	SVUP		2	1551+000	1 x 7.0	4 Lane	RCC Box	Structures are in sound condition. Approx 15 nos of RE wall panels in approaches have minor cracks. Minor honeycombing is observed at crash barrier.
				1554+525	1 x 10.5	4 Lane	RCC Box	
5	PUP		3	1539+227	1 x 7.0	4 Lane	RCC Box	Structures are in sound condition.
				1539+730	1 x 7.0	4 Lane	RCC Box	
				1571+533	1 x 10.5	4 Lane	RCC Box	
6	Culverts	Box	78					Culverts are in sound condition. Minor routine repairs like repair of minor honeycombing, removal of vegetation etc. are required.
		Slab	Nil					
		Hume Pipe	7					

Section 4: Surveys and Investigations

4.1 Visual Pavement Condition Assessment

i) The present (as on Nov-2022) pavement condition on LHS carriageway is very poor having high severity alligator cracks, lateral displacement of asphalt mix, rutting/settlements etc. Below are some of the photographs depicting the various types of distresses present on the pavement and its severity level, even though renewal course of bituminous overlay on LHS carriageway has been completed in the year Nov-2021 as per the discussions with project site teams. This shows the structural deficiency in pavement layers, particularly asphalt layers, which results into cracks to progress and move upwards very fast with repeated application of heavier traffic loads.

ii) The application of bituminous overlay works (2nd Renewal) on RHS carriageway has been commenced and completed these renewal works on 04.07.2022 and hence there were no major distresses as observed presently on the pavement surface. It was tried to explore the pavement condition before application of this renewal coat, but no information made available neither at site offices nor in available reports. Further, there is no historical data reports on pavement evaluation studies such as roughness and BBD survey. Discussions with site team's reveals that there are distresses such as alligator cracks and potholes of medium severity were also observed on non-renewal surface.

iii) Structural distresses such as Alligator cracks and Rutting are the predominant mode of distress in the project highway as per the visual pavement condition assessment.

iv) As per schedule B of TOT draft Concession Agreement, the entire section from Orai-Barah is under BOT (Annuity) up to 12/12/2024, so no immediate major rehabilitation/repairs are required. However, it is pertinent to mention that pavement has a structural deficiency and hence above structural failures of high severity needs to be rectified by the present Annuity Concessionaire before asset handing over to the TOT Concessionaire.

v) Some of the photos showing the existing pavement condition is as under.

High Severity Alligator Cracks at Ch 1515.840 LHS

Rutting and Alligator cracks at Ch 1516.080 LHS

High Severity Potholes, Alligator Cracks at Ch 1518.200 LHS

Block cracks at Ch 1518.250 LHS

Figure 4.1: Existing Pavement Condition

4.2 Network Survey Vehicle (NSV)

The Network Survey Vehicle is the latest survey technique which utilizes Lasers, Global Positioning System and Video image processing tools. The survey vehicle is used for automatic data collection pertains to pavement condition and road inventory data, required for preparation of pavement maintenance and management proposals. It allows all the data to be collected in a single pass consequently minimising the time needed to complete the data collection. The measurement of surface distresses like cracking, ravelling, patching and pot holes etc. is done using the calibrated image processing methods. The description of NSV and the methodology adopted is provided in **Annexure-4.1**

The NSV survey has been carried out along the project corridor on 10/12/2022 for collection of pavement condition data separately for each lane of the Carriageway. Some of the photographs of NSV testing is shown below.

Figure 4.2: NSV Survey

The collected data has been processed, analysed and the summary of such analysis findings for each of the performance parameter is presented as below;

4.2.1 Evaluation of Pavement Condition

NSV survey has been conducted for assessment of pavement condition and its distresses. The pavement surface images captured by NSV were processed in Survey board and all the images are geotagged with corresponding co-ordinates and chainage. By manual intervention with Survey Board, it was mapped/ identified various distresses showing distress type, location, magnitude and severity.

Flexible Pavement Distresses

The following Pavement distresses are considered for assessing the flexible pavement condition as per IRC: 82-2015 “Code of Practice for Maintenance of Bituminous Road Surfaces”.

- Cracking
  - Longitudinal cracks
  - Transverse cracks
  - Alligator cracks/ Crocodile cracks
  - Multiple cracks
- Raveling
- Shoving
- Bleeding
- Slippage/ Delamination
- Potholes
  - Area: Surface Area of the Pothole;
  - Numbers
- Edge break
- Patching
- Settlements, Depressions

Strip chart showing the pavement distresses as observed is provided in **Annexure 4.2** separately for LHS and RHS directions along with rating of the pavement surface in terms of Good, Fair and Poor.

The summary of distress is presented in tables for LHS and RHS respectively.

Table 4.1: Summary of Flexible Pavement Distresses on LHS Carriageway

Distress	Rating	Severity (% of Area)	Inner Lane		Outer Lane	
			Length of the Road Effected (km)	% length	Length of the Road Effected (km)	% length
Cracks	Good	< 1%	42.5	66.41	35	54.69
	Fair	1% to 5%	16	25.00	15	23.44
	Poor	> 5%	5.5	8.59	14	21.88
Ravelling	Good	< 1%	49.5	77.34	46	71.88
	Fair	1% to 5%	13.5	21.09	17.5	27.34
	Poor	> 5%	1	1.56	0.5	0.78

Distress	Rating	Severity (% of Area)	Inner Lane		Outer Lane	
			Length of the Road Effected (km)	% length	Length of the Road Effected (km)	% length
Edge Break	Good	< 1%	64	100.00	64	100.00
	Fair	1% to 5%	0	0.00	0	0.00
	Poor	> 5%	0	0.00	0	0.00
Depression / Settlement	Good	< 1%	64	100.00	64	100.00
	Fair	1% to 5%	0	0.00	0	0.00
	Poor	> 5%	0	0.00	0	0.00
Bleeding	Good	< 1%	64	100.00	64	100.00
	Fair	1% to 5%	0	0.00	0	0.00
	Poor	> 5%	0	0.00	0	0.00

Table 4.2: Summary of Flexible Pavement Distresses on RHS Carriageway

Distress	Rating	Severity (% of Area)	Inner Lane		Outer Lane	
			Length of the Road Effected (km)	% length	Length of the Road Effected (km)	% length
Cracks	Good	< 1%	63	99.21	62.5	98.43
	Fair	1% to 5%	0.5	0.79	0.5	0.79
	Poor	> 5%	0	0.00	0.5	0.79
Ravelling	Good	< 1%	63.5	100.00	63	99.21
	Fair	1% to 5%	0	0.00	0.5	0.78
	Poor	> 5%	0	0.00	0	0.00
Edge Break	Good	< 1%	63.5	100.00	63.5	100.00
	Fair	1% to 5%	0	0.00	0	0.00
	Poor	> 5%	0	0.00	0	0.00
Depression / Settlement	Good	< 1%	63.5	100.00	63.5	100.00
	Fair	1% to 5%	0	0.00	0	0.00
	Poor	> 5%	0	0.00	0	0.00
Bleeding	Good	< 1%	63.5	100.00	63.5	100.00
	Fair	1% to 5%	0	0.00	0	0.00
	Poor	> 5%	0	0.00	0	0.00

From the above table, it can be revealed that LHS carriageway is more distress experienced than RHS carriageway due to the overloading of commercial vehicles.

4.2.2 Pavement Roughness

The roughness data was collected at 100m interval using NSV on each lane in-terms of IRI (International Roughness Index) value. In Indian context, the IRI values were converted to BI as per IRC: SP:16-2019 “Guidelines on Measuring Road Roughness and Norms” with the following equation;

$$BI = 630*(IRI)^{\wedge 1.12}$$

Where,

BI = Bump Integrator Roughness in mm/km

IRI = International Roughness Index.

Roughness data of Flexible & Rigid Pavement (Toll Plaza Section) was collected through Digital Laser Profilers System (DLP) and the same is presented in **Annexure-4.3**. The summary of Roughness values is presented in table below and along with pictorial representation.

Table 4.3: Summary of Pavement Roughness

Pavement Type	Condition	Roughness	RI	Length (Km)			
		Range (m/km)	Range (mm/km)	LHS-Inner (L1)	RHS-Inner (R1)	LHS-Outer (L2)	RHS-Outer (R2)
Asphalt	Good	< 2.55	<1800	48.2	59	37.5	56.2
	Fair	2.55 – 3.30	1800-2400	10.6	2.3	18.1	4.7
	Poor	> 3.30	>2400	4.6	1.6	7.8	2
	Total			**63.4**	**62.9**	**63.4**	**62.9**

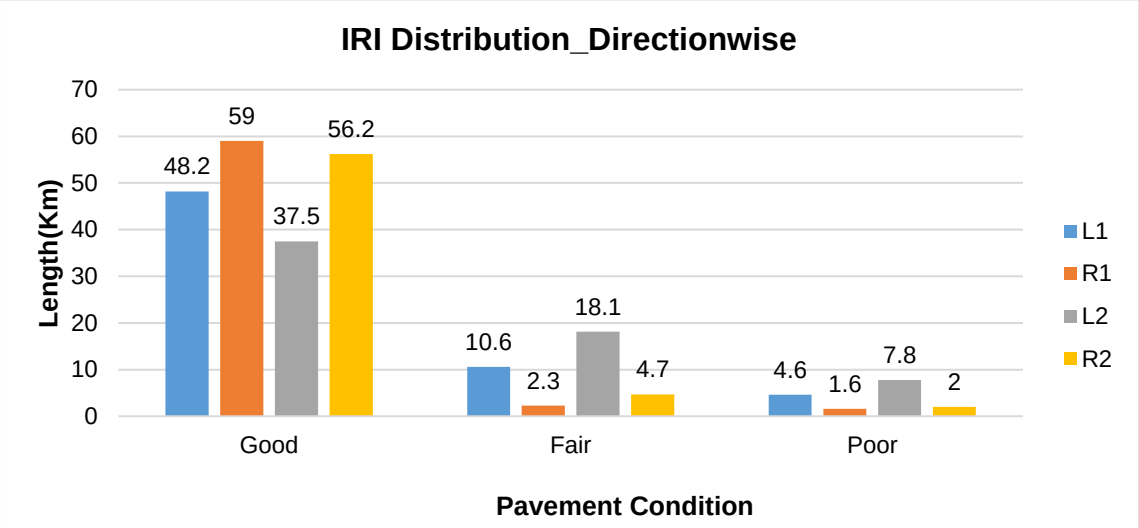


Figure 4.3: Pictorial Representation showing the Roughness Values in Project Section

4.2.3 Rutting

Rutting data of Flexible & Rigid Pavement has been collected through Digital Laser Profilers System (DLP) of NSV and the same is presented in **Annexure-4.4**. The summary of its analysis is presented in tables below separately for LHS & RHS Carriageway.

Pavement Type	Condition	Rut Depth Range (mm)	Length (Km)			
			LHS-Inner (L1)	RHS-Inner (R1)	LHS-Outer (L2)	RHS-Outer (R2)
Asphalt	Good	< 5	21.5	57.2	12.4	38.4
	Fair	5 - 10	38.0	5.1	44.7	24.5
	Poor	> 10	3.9	0.6	6.3	0.0
	Total		**63.4**	**62.9**	**63.4**	**62.9**

Observations:

The pavement rut depth is noted in LHS direction than RHS and same is evidenced from visual pavement condition survey also hence the areas showing higher rut depth needs to be rectified immediately.

4.2.4 Test Pit Investigations

Test pit investigations have been carried out at every 5km in a staggered manner ascertain the existing pavement composition (pavement course, material type, and thickness). The summary of existing pavement crust thickness is presented in **Table 4.4** and some of the photographs showing the pavement crust thickness are shown as below.

Table 4.4: Summary of Existing Pavement Crust Thickness

S. No.	Location (Km)	Side (LHS/ RHS)	Co-ordinates		Existing Crust details			
			Latitude	Longitude	Bituminous Layer	Granular Layer-I (WMM)	Granular Layer-II (GSB)	Total Thickness (mm)
1	1516+000	LHS	26°1'25.21"N	79°32'31.42"E	260	250	200	710
2	1521+500	RHS	26°2'31.41"N	79°35'33.91"E	260	220	200	680
3	1525+050	LHS	26° 3'39.52"N	79°37'47.16"E	260	250	200	710
4	1530+000	RHS	26°4'46.69"N	79°40'4.00"E	270	250	200	720
5	1535+200	LHS	26° 6'17.90"N	79°42'47.85"E	250	240	200	690
6	1544+000	RHS	26° 9'42.85"N	79°46'38.54"E	270	260	200	730
7	1549+000	LHS	26°11'32.58"N	79°48'11.44"E	280	260	200	740
8	1556+000	RHS	26°14'13.16"N	79°51'2.42"E	300	250	200	750
9	1560+000	LHS	26°15'59.17"N	79°52'37.55"E	300	250	200	750
10	1565+000	RHS	26°17'48.04"N	79°54'48.12"E	290	250	200	740
11	1569+600	LHS	26°19'19.15"N	79°57'4.93"E	280	250	200	730
12	1575+350	RHS	26°22'3.13"N	79°59'27.23"E	300	250	200	750

Figure 4.4: Pavement Composition & Thickness Measurement

Observations and Conclusions:

- The existing pavement along the project corridor is flexible in nature. The pavement composition comprises of bituminous layer, granular base/sub-base on subgrade.
- Throughout the project road, it is found that the consistent bituminous/ granular layer thickness with an average of 270mm bituminous layer over 450mm of granular layers.

During the above investigations, the existing subgrade soils samples were collected and tested in the laboratory to understand the properties of these foundation soils. The test results are presented in table below.

Table 4.5: Test Results

S. No.	Location (Km.)	Side (LHS/RHS)	Soil Classification as per IS: 1498	Gradation: Percent by weight passing through the Sieve (IS:2720-IV)			Clay & silt content %	Atterberg Limits [IS :2720-Pt-V]			Modified Proctor Test (IS:2720-Pt-VIII)		In-situ Density		4-Days Soaked CBR (%)	Free Swell Index (%)	Degree of Compaction (%)
				Gravel (%)	**Sand (%)**	**Clay & silt content %**		**Liquid Limit (LL) %**	**Plastic Limit (PL) %**	**Plasticity Index (PI)**	**Max. dry density gm/cc.**	**OMC (%)**	**FDD (gm/cc)**	**FMC (%)**			
1	1516+000	LHS	CL	3.5	33.8	62.7	62.7	32	21	11	1.82	9.2	1.8	8.0	7.5	20.0	98.2
2	1521+500	RHS	CL	5.2	29.8	65.0	65.0	35	23	12	1.91	10.0	1.9	9.0	7.7	22.5	99.1
3	1525+050	LHS	SC	10.2	56.2	33.6	33.6	29	17	12	2.01	10.2	2.0	9.0	7.9	20.0	98.1
4	1530+000	RHS	SC	11.5	57.9	30.6	30.6	27	14	13	2.00	9.6	2.0	10.0	8.2	15.0	98.5
5	1535+200	LHS	SC	8.7	53.8	37.5	37.5	30	15	15	1.82	10.2	1.7	9.0	8.5	16.7	94.0
6	1544+000	RHS	CL	9.2	33.8	57.0	57.0	32	20	12	1.88	9.2	1.9	10.0	7.6	20.0	99.2
7	1549+000	LHS	CL	10.9	36.7	52.4	52.4	33	17	16	1.82	11.0	1.7	11.0	7.8	33.3	95.2
8	1556+000	RHS	SC	15.5	50.7	33.8	33.8	29	20	9	1.75	8.8	1.7	10.0	8.2	15.0	94.6
9	1560+000	LHS	CL	13.0	32.6	54.4	54.4	32	14	18	1.77	10.5	1.7	11.0	7.4	33.3	96.6
10	1565+000	RHS	CL	6.0	36.8	57.2	57.2	33	15	18	1.89	10.8	1.8	12.0	7.8	35.0	97.7
11	1569+600	LHS	CL	8.5	29.8	61.7	61.7	30	20	10	1.75	9.9	1.6	9.0	8.1	20.0	94.2
12	1575+350	RHS	CL	9.7	32.5	57.8	57.8	35	16	19	1.90	9.5	1.9	12.0	7.8	35.0	97.9

Observations and Conclusions

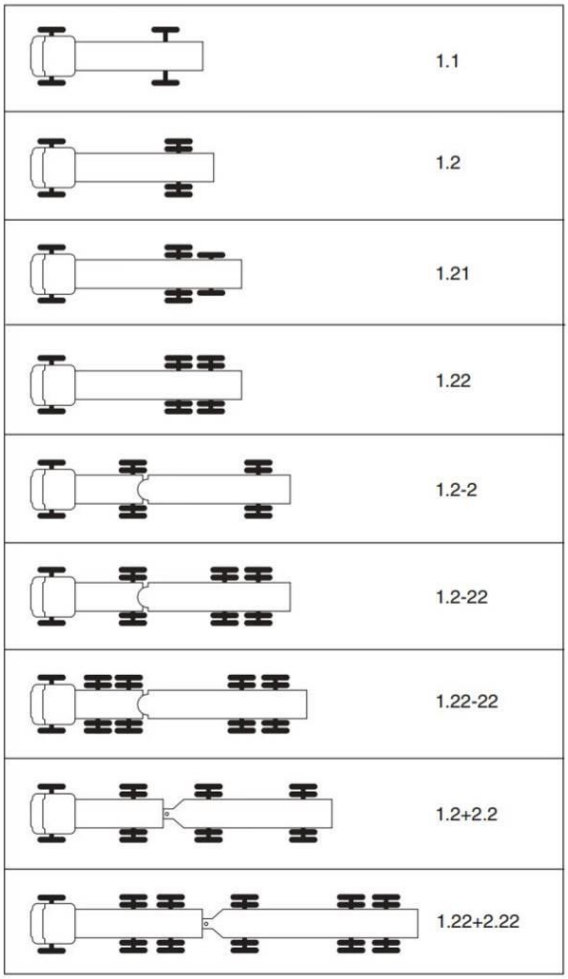
The subgrade soils are generally consistent throughout the project road and is predominantly Clays and Clayey sands, due to which, the Liquid Limit (LL) is ranging between 27-35 %, and these values are within the limit as per MoRTH specifications (<50%). The obtained maximum Plasticity Index of the subgrade soils is 9-19 % and the degree of free swell is 15-35 %. All the measured PI and FSI values are also within the acceptable limits as per MoRTH guidelines, of 25% and 50% respectively.

Further, the MDD values is ranging between 94.0 % - 99.2 %. The 4-days soaked CBR and is ranging from 7.4 % to 8.5 % with an average value of 7.9 %. Average Subgrade CBR Value is 8.0 % which is in line with design CBR.

4.3 Axle Load Survey

Vehicle axle loading has a significant impact on pavement performance and design. Thus, an axle load survey has been conducted on 02rd Dec-2022 in compliance with IRC 37 2018 and such survey was conducted for 48 hours (2 normal days) in both directions at the existing toll plaza location at km 1520+000 (Ukasa Toll Plaza).

The type of vehicle considered for axle load survey along with its axle configurations are presented in below. Few of the survey photographs were shown in Photos as below;



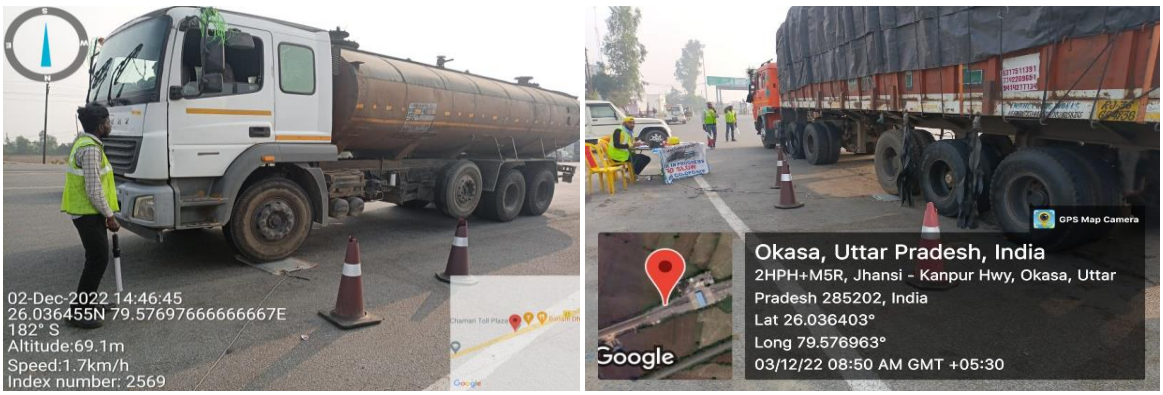


Figure 4.5: Axle Load Survey

The VDF analysis was carried out in line with section 4.4 of IRC: 37-2018 based on the axle load data. The equations for computing equivalency factor for single, tandem and tridem axles given below is used as directed in the IRC:37-2018 for converting different axle load repetitions into equivalent standard axle load repetitions;

- Single axle with single wheel on either side = {axle load in kN / 65}4
- Single axle with dual wheel on either side = {axle load in kN / 80}4
- Tandem axle with single wheel on either side = {axle load in kN /148}4
- Tridem axle with dual wheel on either side = {axle load in kN /224}4

With the stated above procedure, the Vehicle Damage Factor for each class of commercial vehicle on both the directions were calculated separately for empty and loaded vehicles. The Axle load data format and VDF analysis are presented in **Annexure 4.5** and obtained VDF values comparing the values adopted at the time of pavement design during construction summarized in table below.

Table 4.6: Vehicle Damage Factors (VDF)

S. No.	Vehicle Type	Direction	
		Orai-Kanpur (LHS)	Kanpur-Orai (RHS)
1	Bus	1.45	1.21
2	LCV	2.57	1.69
3	2-Axle	3.01	1.13
4	3-Axle	5.66	2.59
5	MAV	14.58	8.87

From the above, it is seen that there is a significant difference in axle loads of commercial vehicles flying in the two directions of traffic, where vehicles in the LHS direction has been overloaded than that of RHS direction.

4.4 Falling Weight Deflectometer (FWD)

The structural evaluation of pavement has been carried out in accordance with IRC: 115-2014, “Guidelines for Structural Evaluation and Strengthening of Flexible Road Pavements Using Falling Weight Deflectometer (FWD) Technique” to determine the remaining life of the pavement structure.

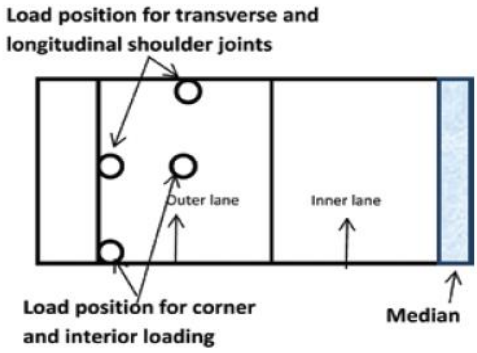
The principle and description of FWD and its methodology is provided in **Annexure-4.6.**

FWD deflection measurement has been carried out for each direction and the measurement has been carried out at a test point along outer wheel path of each direction which is at an offset of 1m from the outer edge of outer lane as specified in section 5.4.5 of IRC: 115-2014. At every measurement location, four drops were made, such that the first drop was the ‘**seating drop’** and with the remaining three drops deflections were recorded. Field survey photographs is shown below.

Figure 4.6: FWD Survey

The deflection testing has been carried out on the existing pavement as per IRC Codes at the rate of 5 points per km as stipulated in TOR of the Consultant.

Adopted measurement scheme is as under.

Adopted Measurement Scheme	Maximum Spacing(m) for test points along selected wheel path (Flexible Pavement)	Rigid Pavement
(i)measurement along outer wheel paths of outer lanes (3 points) (ii) measurement along the outer wheel path of inner lane (2 points)	200 400	

4.4.1 Back-calculation of Layer Moduli for Flexible Pavement

Layer moduli have been back-calculated using KGPBACK program. The pavement has been modelled as a three-layer system with bituminous layer, granular layer and subgrade. The following inputs have been provided for back analysis.

i) Single wheel load 40 kN and contact pressure 0.56 MPa
ii) No. of deflection sensors: 9

iii) Radial Distances of the Geophones i.e., 0,200, 300,450, 600, 900 and 1500mm
iv) Measured Surface Deflections normalized to 40kN in mm
v) Pavement Layer Thicknesses (as measured from Trial Pits)
vi) Poisson's ratio for different layers i.e., 0.35 for bituminous, granular and subgrade
vii) Range of Possible modulus value (Min.- Max.) of bituminous layer, granular layer and subgrade.

Ranges of different layer moduli have been given as input to KGPBACK for back-calculation. These ranges have been selected judiciously by experienced pavement engineering taking into considerations the approximate age of pavement, visual assessment of the condition of bituminous layer, climatic conditions prevailing at the time of deflection measurements and information available from test pits, and laboratory tests conducted as detailed below:

Range of modulus value of existing subgrade:

The range of moduli of existing subgrade is taken based on the subgrade CBR values for the analysis.

Range of modulus value of existing granular layers i.e., base and sub base:

The range of moduli of existing granular layers is based on Appendix III.8.4 of IRC 115-2014.The range for combined (base and sub-base) is taken as 100-500 MPa.

Range of modulus value of existing thick bituminous layers:

The range of moduli of existing thick bituminous layer has been determined on the basis of condition data. If the road condition is good the range is considered as 750 MPa to 3000 MPa, for sections with pavement condition is Fair- Poor, the range specified for thick bituminous layer 400 MPa to 1500 MPa as stipulated in Appendix III.8.4 of IRC: 115-2014 has been taken into consideration.

4.4.1.1 Correction for Temperature

Back-calculated moduli values of the bituminous layers evaluated by FWD survey are influenced by the pavement temperature. The standard pavement temperature for India is recommended as 35°C, hence the back-calculated moduli obtained at temperatures other than the identified standard temperature will have to be corrected using a suitable correction factor using equations 4 and 5 of IRC:115-2014 and the same is extracted below for ready reference.

$$E_{T1} = \lambda E_{T2} \ldots\ldots \textbf{(4)}$$

Where,

λ temperature correction factor, is given as

$$\lambda = \frac{(1-0.238 \ln T_1)}{(1-0.238 \ln T_1)} \ldots\ldots \textbf{(5)}$$

Where,

E_{T1} = Back-calculated modulus (MPa) at temperature $T_1^0\ C$

E_{T2} = Back-calculated modulus (MPa) at temperature $T_2^0\ C$

However, in few sections, after applying the temperature correction the E value of bituminous layers are coming more than 3000MPa. As the project road was constructed with VG-30/VG-40 grade bitumen, it is restricted to keep the maximum E value of 3000MPa, wherever it is exceeding. In these locations, the temperature correction factor was applied as 1.

4.4.1.2 Correction for Seasonal Variation

Moisture content affects the strength of subgrade and granular sub base/base layers. Therefore, the back-calculated moduli of subgrade and granular layers should be taken from field moduli using seasonal corrections. Seasonal correction equations 7 and 8 of IRC: 115-2014 has been extracted below for ready reference.

$$E_{sub\_mon=}\ 3.351 * \left(E_{sub\_win}\right)^{0.7688} - 28.9 \ldots (6)$$

$$E_{sub\_mon} = 0.8554 * (E_{sub\_sum}) - 8.461 \ldots (7)$$

where,

E_{sub_mon} = subgrade modulus in monsoon (MPa)

E_{sub_sum} = subgrade modulus in Summer (MPa)

E_{sub_win} = subgrade modulus in Winter (MPa)

$$E_{gran\_mon=}\ -0.0003 * \left(E_{gran\_sum}\right)^{2} + 0.9584 * \left(E_{gran\_sum}\right) - 32.989 \ldots (8)$$

$$E_{gran\_mon=}\ 10.5523 * \left(E_{gran\_win}\right)^{0.624} - 113.857 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

where,

E_{gran_mon} = granular layer modulus in monsoon (MPa)

E_{gran_sum} = granular layer modulus in Summer (MPa)

E_{gran_win} = granular layer modulus in Winter (MPa)

Since the deflection measurements have been carried out in the month of December hence seasonal correction factor is applicable.

The 15th percentile value (as the same has been recommended by IRC: 115-2014 for purpose of design) of back-calculated & corrected layer moduli of each identified homogeneous sub-sections of both directions separately are presented next.

4.4.1.3 Results of Back Calculated Modulii (E) of Pavement Layer

The summary of back calculated E values is presented in **Annexure 4.7**.

4.4.1.4 Remaining Life Estimation for Flexible Pavement

The in-service three-layer pavement system has been analysed with the back-calculated corrected layer moduli and layer thicknesses. The critical strains have been calculated by IITPAVE program. From the performance criteria equations, the residual/remaining rutting and fatigue life have been estimated.

Performance Criteria

The layer moduli of in-service pavement back calculated from FWD deflection data are used to analyse the pavement for critical strains which are indicators of pavement performance in terms of rutting and fatigue cracking. The following approach is proposed for design of bituminous overlays for existing flexible pavements. The mechanistic criteria (fatigue and rutting) adopted in the IRC:37-2018 "Guidelines for the Design of Flexible Pavements", forms the basis for the overlay design method. Performance models adopted in these guidelines are given below.

a) Fatigue in Bituminous layer:

As it specified in IRC: 115-2014, the fatigue model for 90 percent reliability was used as below

$$N_f = 0.711 * 10^{-04} \times [1/\varepsilon_t]^{3.89} * [1/M_R]^{0.854}$$

As it specified in IRC: 37-2012, the fatigue model for 80 percent reliability was used as below

$$N_f = 2.21 * 10^{-04} \times [1/\varepsilon_t]^{3.89} * [1/M_R]^{0.854}$$

Where,

N_f = fatigue life in number of standard axles,

ε_t = Maximum Tensile strain at the bottom of the bituminous layer

M_R= resilient modulus of the bituminous layer.

b) Rutting in Subgrade:

Rutting model for 90 percent reliability level as specified in IRC: 115-2014 was used as below.

$$N = 1.41 \times 10^{-08} [1/\varepsilon_v]^{4.5337}$$

As it specified in IRC: 37-2012, the rutting model for 80 percent reliability was used as below.

$$N = 4.1656 \times 10^{-08} [1/\varepsilon_v]^{4.5337}$$

Where,

N= Number of cumulative standard axles, and

ε_v= Vertical strain in the subgrade

The detailed remaining life analysis is done using 90 percent reliability equation of IRC: 115-2014 is presented in tables below for LHS and RHS carriageway.

Table 4.7: Pavement Remaining life for LHS Carriageway

S. No	Existing Chainage		15th Percentile E Value (Mpa)			Obtained Strains (through IITPAVE)		Remaining Life of Existing Pavement (MSA)		
	From	To	Bituminous Layer	Granular Layer	Sub-grade	Fatigue Strain	Rutting Strain	Fatigue Residual Life	Rutting Residual Life	Remaining life
1	1515.750	1525.000	874.7	136.8	102.6	0.0002278	0.0002098	32.3	668.4	32.3
2	1525.000	1535.000	962.3	110.4	92.8	0.0002378	0.0002205	25.2	533.5	25.2
3	1535.000	1545.989	742.6	121.7	100.7	0.0002745	0.0002358	18.0	393.6	18.0
4	1545.989	1556.951	1077.7	220.2	101.8	0.0001555	0.0001746	119.2	1537.0	119.2
5	1556.951	1567.944	1352.9	147.1	101.7	0.0001472	0.0001607	121.5	2238.7	121.5
6	1567.944	1578.009	1051.5	119.5	91.6	0.0001988	0.0002011	46.8	809.9	46.8

Table 4.8: Pavement Remaining life for RHS Carriageway

S. No	Existing Chainage		15th Percentile E Value (Mpa)			Obtained Strains (through IITPAVE)		Remaining Life of Existing Pavement (MSA)		
	From	To	Bituminous Layer	Granular Layer	Subgrade	Fatigue Strain	Rutting Strain	Fatigue Residual Life	Rutting Residual Life	Remaining life
1	1578.250	1569.743	1197.7	207.4	121.6	0.0001387	0.0001510	169.9	2968.9	169.9
2	1569.743	1558.751	1190.1	138.3	120.7	0.0001610	0.0001518	95.7	2898.6	95.7
3	1558.751	1547.751	1383.9	180.2	122.0	0.0001431	0.0001496	133.0	3096.9	133.0
4	1547.751	1536.731	1260.5	238.3	98.8	0.0001396	0.0001771	158.6	1441.0	158.6
5	1536.731	1526.754	1466.4	278.1	103.1	0.0001362	0.0001678	153.4	1840.3	153.4
6	1526.754	1515.750	1407.2	219.8	95.1	0.0001452	0.0001957	123.9	916.3	123.9

4.5 Mobile Bridge Inspection Unit (MBIU)

4.5.1 Specification

The Mobile Bridge Inspection Unit (referred as (MBIU) is an electro-mechanically driven articulated structure mounted on a vehicle (a truck) as an aid towards proper inspection of bridges or similar infrastructures by enabling an inspection team of 2-3 persons carrying instruments access to the underside of bridge decks over flowing rivers or gorges. The present version is the truck mounted system. As per TOR condition survey of existing structures greater than 60m shall be carried using MBIU.

The overall objective of the condition survey is to identify the need for structural maintenance, rehabilitation and replacement. Signs of distress such as spalling, scaling, cracking, leaching, excessive deflection, inadequate cover, settlement, exposed reinforcement, corrosion in the reinforcement; shear cracks etc. are identified during this exercise. Special emphasis is given on expansion joints and bearing. Also the condition of the Approaches, water way and bed protection is examined. The survey identify the bridges which are more distressed and require testing for their evaluation and rehabilitation measures. Also bridges which require general measures for rehabilitation. Inspection report is prepared in accordance with IRC: SP-35. The report provides recommendation whether a bridge is acceptable to continue in use, whether it can be repaired and/or modified e.g. widened or a new structure.

Figure 4.7: Mobile Bridge Inspection Unit used for Structure Condition Assessment

The structure inventory and condition assessment are given in **Annexure-4.8.** The following structures have been inspected using MBIU.

Table 4.9: List of Inspected Structures using MBIU

Sr. No.	Type of Structure	Chainage (Km)
1	Major Bridge	1540+800
2	Major Bridge	1567+060
3	Flyover	1550+700
4	Flyover	1578+360

4.5.2 Working Principle

MBIU increases the accessibility for inspection of underside of high level bridge decks and helps in continuous inspection of throughout the span of bridge. Inspection and maintenance experts can inspect underside of bridge by standing on the platform, note observations as per IRC SP-35 & IRC SP-52 and take photographs for reference.

4.5.3 Advantages

- A large operating range
- A high level of working comfort
- Maximum operational safety
- The shortest possible setting up and dismantling times
- Full mobility in inspection operation without stabilizer supports
- An optimum weight/performance ratio

Figure 4.8: MBIU Survey

4.6 Drone Videography of Entire Stretch

Videography of entire Project Stretch is captured through Drone cameras flown at about 40 m above ground. This shall be useful for observing various features of Project Stretch from bird's eye level.

Section 5: Review of Documents

5.1 General

Technical Consultant (TC), since the start of technical due diligence study, has requested for various documents from the Client. A list of documents required were shared with the Client before TC team started the study which was appended with few more queries after the conclusion of the site visit once the project site is appraised. Most of the queries were also discussed with the Client in many meetings. This section of the report deals with the documents requested by TC and its review along with highlighting major issues found during this review.

5.2 Documents Collected and Reviewed

List of documents requested, received and reviewed are given below:

S. No.	List of Documents	Status of Documents	Remarks on Review
DOCUMENTS RELATED TO CURRENT ACQUISITION			
1.	Concession Agreement	Available	Concession Agreement used at the time of round 2 acquisition is made available to the Consultant with the direction that same terms and conditions may be used for round 3 acquisition. Later on, a word copy of the CA applicable for round 3 projects were shared on 30th January 2023. Article 14 of the same CA is referred to assess the requirements regarding capacity augmentation. Expected impact of this on the instant projects are addressed in a separate section in this chapter. Article 15 of this CA deals with the operation and maintenance requirements for the project roads. Article 15.8 specifies about damages for breach of O&M obligations by the Concessionaire which would be higher of (a) 0.5% of Performance Security and (b) 0.1% of the cost of such repair or rectification as estimated by the Independent Engineer.
2.	Schedules	Technical Schedule Available	Draft schedules were shared with TC in on 18th Nov – 2022. Later revised technical schedule were shared on 17th Jan – 2023. These schedules are modified from the standard provisions given in manual as below: Sch A: Existing features Sch B: Scope of Work including facilities to be provided Sch C: Specifications and Standards Sch F: Maintenance Requirements Table 1 of Sch F provides maintenance criteria for pavements which has performance parameter, desirable and acceptable level of service, frequency of inspection and time limit for rectification/repair. Sch F specifies roughness value as 2000

S. No.	List of Documents	Status of Documents	Remarks on Review
			mm/km desirable and 2400mm/km acceptable for flexible pavement. These values are 2200mm/km and 3000 mm/km respectively for rigid pavement. Sch B states that the entire section is under BOT (Annuity) up to 12/12/2024 and no immediate major maintenance required. Hence concessionaire has to take major repair and rehabilitation of pavement after 12/12/2024 i.e. first renewal in 2027, second renewal in 2032, third renewal in 2039 and fourth renewal in 2044. Updated schedule was issued by NHAI and made available to the Consultant on 27-07-2023. Major change in this document is done by removing all the civil construction work (new construction) from the scope of the Concessionaire.
3.	Final Feasibility Report	Available	Main Report (Vol-1) done by M/s Ceinsys Tech Ltd for NHAI is made available. It is noted from the report that topographic survey, pavement material testing, NDT for structures and traffic survey was done in early 2018. FWD was done in July-2021 and NSV survey was done in April-2022. As topographic survey and FWD is before the recent major maintenance work done in 2021-22, these data may not be very relevant to the current project status. However new construction work specified in Sch B is matches with the new proposal given in the main report.
4.	FWD data	Available	The report of FWD done by M/s CEG Tesh House in February-2020 was available as a reference documents for TC. FWD survey was done in Dec-2019 for pavement evaluation work. Again FWD was done by M/s Ceinsys Tech Ltd in July-2021 to evaluate structure condition of the pavement. The Remaining Life of the pavement is evaluated using the FWD and Test-pit survey results.
5.	Latest MPRs	Available	MPRs by IE are available, the latest one is of October – 2022. As per this report, there is no pending issue. The report also indicates that there are several COSs submitted for approval related to construction of FoBs. As on date, there is no FOB at the site.
6.	Maintenance History	Available	First periodic renewal of pavement of main carriageway after 5 years of construction is completed with delay in May – 2017. Existing annuity concessionaire has completed balance surface renewal of service road, truck lay bye and bus bay in June 2021. 2nd periodic renewal was completed on 4th July 2022. Details of these overlay thicknesses are not available.
7.	O&M Agreement	Not available	No maintenance agreement was made available,

S. No.	List of Documents	Status of Documents	Remarks on Review
8.	NSV data	Available	The report of NSV done by M/s Technical Consultancy Services in August-2021 was available as a reference documents for TC. As per this report, roughness for all lanes for Orai – Bhognipur stretch is are fair whereas both lanes of LHS carriageway for Bhognipur – Barah stretch are poor. Roughness for RHS carriageway from Bhognipur to Barah isfair to good.
9.	AADT for each section and Growth rate	Available	AADT along with traffic projections for the project roads have been provided by the Client vide NHIIPL email dated 18.01.2023.
10.	Drawings/ Details for the proposed construction by NHAI (Sch B)	Available	In the revised schedule, new construction of 3.435 km 5.5m wide and 8.835 km 7.5 m wide, total 12.27 km linear length of service road, associated widening of 1 nr. minor bridge and 5 nr. Box culverts and 12.27 km of drain are proposed. Construction of 2 nr. Grade separators are also proposed in Sch B. Drawings for these construction works in the form of GADs and TCS are available for reference.
11.	Concession Period	Available	20 years concession period as per Article 3.1.1 of draft CA.
12.	Projected Escalation factor	Not available	In absence of projected escalation factor, all cost is given at the present rate as per direction of the Client.
DOCUMENTS RELATED TO 4-LANING			
13.	Concession Agreement at the time of 4 laning	Available	CA signed between NHAI & M/s OBIL on 27/04/2006 for 4-laning of Orai-Barah section of NH-27 (old NH-2) is available. Article 33.2 of this CA specify divestment requirements. One of the important requirements is to have all sections of each traffic lane (the "Carriageway") of the Project Highway shall have a roughness index of not more than 2500 mm per km an shall be free from defects in accordance with O&M requirements. Sch L specifies that renewal of wearing course of road pavement shall be done once every 5 years and strengthening course shall be provided on 'as required' basis.
14.	Supplementary agreements (if any) at the time of 4 lanning	Not available	
15.	As built drawings	Available	As-built drawings in the form of applicable cross-sections for roadworks and detailed drawings for the structures were available as a reference documents for TC.
16.	DPR Pavement design report of 4-lane highway	Not available	
17.	Existing ROW detail	Available	Chainage-wise existing ROW details are provided in revised Sch A.
18.	TMS Equipment Details	Available	Details of lane level equipment and plaza level equipment are available as a reference document for TC.
19.	Highway lighting details	Available	Location of street light are listed in Table 6-21 of Main Report (Vol-I). Lighting is provided in urban stretch.
DOCUMENTS RELATED TO MAINTENANCE OF EXISTING ASSETS			
20.	IC inspection report, if applicable	Available in form of MPRs	MPRs by IE are available, the latest one is of October – 2022. As per this report, there is no pending issue

S. No.	List of Documents	Status of Documents	Remarks on Review
21.	Maintenance and Rehabilitation details for existing 4-lane pavement	Not available	There are documents which indicate that renewal of pavement carriageway is done in 2017 and 2022, however details regarding what kind of rehabilitation has been done is missing.
22.	History of maintenance cost	Not available	
23.	Historical data of Roughness and Deflections (Pavement evaluation studies so far conducted)	Not available	There is no such records made available though it is required to test the pavement periodically as per provisions of existing CA.
24.	Manpower O&M	Not available	
25.	Source of construction materials	Available	A comparison was done on lead from source to plant location from aggregate sources Kabrai, Jamala and Bharatkoop. It is found that Jamala quarry source is nearest to the project site and accordingly it is adopted for rate analysis. Betwa river is considered for sand source.

5.3 Key Technical Issues

5.3.1 Present Pavement Condition

The present (as on Dec-2022) pavement condition on LHS carriageway is very poor having high severity alligator cracks, lateral displacement of asphalt mix, rutting/settlements etc. Below are some of the photographs depicting the various types of distresses present on the pavement and its severity level, even though renewal course of bituminous overlay on LHS carriageway has been completed in the year Nov-2021 as per the discussions with project site teams. This shows the structural deficiency in pavement layers, particularly asphalt layers, which results into cracks to progress and move upwards very fast with repeated application of heavier traffic loads.

The application of bituminous overlay works (2nd Renewal) on RHS carriageway has been commenced and completed these renewal works on 04.07.2022 and hence there were no major distresses as observed presently on the pavement surface. It was tried to explore the pavement condition before application of this renewal coat, but no information made available neither at site offices nor in available reports. Further, there is no historical data reports on pavement evaluation studies such as roughness and BBD survey. Discussions with site team's reveals that there are distresses such as alligator cracks and potholes of medium severity were also observed on non-renewal surface.

Structural distresses such as Alligator cracks and Rutting are the predominant mode of distress in the project highway as per the visual pavement condition assessment.

As per schedule B of TOT draft Concession Agreement, the entire section from Orai-Barah is under BOT (Annuity) up to 12/12/2024, so no immediate major rehabilitation/repairs are required. However, it is pertinent to mention that pavement has a structural deficiency and hence above structural failures of high severity needs to be rectified by the present Annuity Concessionaire before asset handing over to the TOT Concessionaire.

High Severity Alligator Cracks at Ch 1515.840 LHS

Hair line cracks Ch 1515.750 RHS

Rutting and Alligator cracks at Ch 1516.080 LHS

Rutting and Alligator cracks at Ch 1516.090 LHS

High Severity Potholes, Alligator Cracks at Ch 1518.200 LHS

Block cracks at Ch 1518.250 LHS

Alligator cracks at Ch 1518.310 LHS

Failed surface at Ch 1518.330 LHS

Block cracks and Rutting at Ch 1518.520 LHS

High severity Rutting and cracking
at Ch 1518.650 LHS

Alligator Cracks and Potholes
at Ch 1521.400 LHS

Surface rectification through Scarification
at Ch 1525.450 LHS

Alligator cracks and rutting
at Ch 1524.200 RHS

Rutting and Alligator cracks
at Ch 1525.480 LHS

Rutting and Alligator cracks
at Ch 1525.880 LHS

Rutting and Ravelling at Ch 1527.550 LHS

Rutting and Ravelling at Ch 1527.700 LHS

Ravelling and Alligator Cracks
at Ch 1528.180 LHS

Alligator Cracks at Ch 1529.280 LHS

Alligator Cracks and Potholes
at Ch 1534.430 LHS

Alligator Cracks at Ch 1534.500 LHS

Alligator Cracks and Potholes
at Ch 1544.400 LHS

Minor Cracks Surface at Ch 1544.300 RHS

Rutting and Alligator Cracks
at Ch 1549.670 LHS

Pothole and Alligator cracks
at Ch 1550.730 LHS

Alligator cracks at Ch 1556.180 RHS

Potholes and Cracks at Ch 1556.700 LHS

Hungry hariline Cracked Surface
Ch 1559.150 RHS

Rutting at Ch 1562.160 LHS

Rutting at Ch 1568.950 RHS

5.3.2 Safety Issue at Kalpi Bakra Mandi

There is a market named “Kalpi Bakra mandi” at Ch 1544+300. At this location, there is unauthorised median opening and mountable kerbs. A number of vehicles use this unauthorised opening and even over the mountable kerbs to cross the road which is a safety concern.

Section 6: Capital Expenditure (CapEx) Requirement

6.1 New Construction

Schedule B specifies the requirements of new construction which the concessionaire has to construct after the appointment date. Major works and reference used to quantify these construction requirements are listed below:

- Rainwater harvesting: Considered at 500m staggered interval
- Pedestrian Guard Rails: 13.18 km
- TMS

6.2 Immediate Maintenance Requirements

The entire section is under BOT (Annuity) up to 12/12/2024. So no immediate major repair has been required.

6.3 Capital Expenditure (CapEx) Requirement

Cost of capital expenditure (CapEx) are presented below.

Table 6.1: Cost of Capital Expenditure (CapEx)

Description	EGIS Cost (INR in Crores)
Cost of Miscellaneous Road Furniture	4.24
Cost of Rain Water Harvesting	1.89
Cost of Repair & Rehabilitation of Existing Structures	0.86
Cost of Improvement to Toll Plaza	2.69
Police Assistance	0.15
Total without GST	9.83
Total including GST (18%)	**11.61**

Section 7: Operation & Maintenance

7.1 General

The O & M requirements for the project facilities are specified in the Concession Agreement (CA) mainly under following Articles/ Schedules:

- Article 15 - Operation and Maintenance
- Article 16 - Monitoring and supervising during Operations
- Article 17 – Traffic Regulation
- Article 18 and Schedule H – Safety Requirements
- Schedule F- Maintenance Requirements

7.2 Requirement as per Concession Agreement

Schedule F of the Concession Agreement sets out the Operation and Maintenance requirements for the Project. As per this schedule, scope for Operation and Maintenance includes but not limited to following obligations:

- ✓ **Improvement** – This includes improvement of the existing assets as per requirement of this Agreement and safety audit.
- ✓ **Maintenance of Civil Works and Assets** – this includes maintenance of civil works and all assets as per requirement of this agreement.
- ✓ **Road Maintenance** – This includes routine maintenance, preventive maintenance, periodic maintenance as per IRC:82-2015, Design overlay as per Manual of 4- laning/6-laning, disaster maintenance, exigencies, and inspections.
- ✓ **Traffic Management** – This includes enforcement of regulations together with the relevant authorities. This also includes hazard response, information gathering and dissemination, Road patrols and ATMS surveillance etc.
- ✓ **Safety** – This includes accident prevention, after care, user education, enforcement, data collection and analysis.
- ✓ **Facility Management** – This includes periodic inspections, routine maintenance, Rehabilitation, and expansion planning.
- ✓ **Road property management** – This includes management of access, encroachment, and ribbon development.
- ✓ **General responsibilities** – This includes budgeting, compliance with legal and accounting requirements, and public relations.
- ✓ Maintaining public relations unit to interface with and attend to suggestions from users of the highway, the media, Govt. agencies and other external agencies.

Routine Maintenance: These are maintenance needs required on daily, weekly, monthly and annual basis for the smooth and efficient running of traffic and includes the activities of minor repairs of all project elements, cleaning of road furnitures, replacement of consumables, horticulture maintenance, keeping the project site /project facilities clean, tidy and orderly condition free of litters and debris, preventing unauthorized entry and exit including any encroachment etc.

Preventive Maintenance: Preventive maintenance shall include the activities related to each element and the system as a whole of the Project Highway to ensure that during the Concession Period and at its end is in sound, durable and functional condition. In other words Preventive maintenance are a planned strategy of cost-effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system (without significantly increasing the structural capacity).

Periodic Maintenance: These are maintenance needs required on periodic annual basis. The periodic maintenance can be further divided into two sub heads namely (i) functional overlay to improve the riding quality and (ii) structural overlay to improve the structural strength of the pavement.

Factor influencing periodic maintenance: performance parameter for flexible pavement in terms of roughness as given in Schedule F is 2000 mm/km as desirable and 2400 mm/km as acceptable. Clause 4 (III) of Schedule B states that periodic maintenance shall be carried out in full length of the project stretch including main carriageway, service/slip road and at facilities etc. either in every six years or in the year in which roughness index exceeds the limit given in schedule F, whichever comes earlier.

7.3 O&M Cost Estimation

7.3.1 Routine maintenance

This is a day to day work that is necessary to preserve and keep a pavement as close to as constructed condition and to ensure smooth and functional conditions all the times. The item in this subhead include maintenance of earthen shoulder, restoration of rain cuts, maintenance of slope protection works, cleaning of road side drains, cleaning of carriageway, maintenance of structures, repairs of road surface such as filling of potholes, repairing of cracks and patch works, carrying out of Road roughness survey, FWD test etc.

7.3.2 Repair/Maintenance

Repair/maintenance covers the minor repair which are required on day to day maintenance to maintain the assets in good condition. This is sub-divided in two categories as below:

a) **Preventive Maintenance:** The preventive maintenance is required to be done for further improve or extend the functional life of pavement surface whist in fair to good condition. Any of the treatment under preventive maintenance does not significantly increasing the structural capacity of pavement rather which decreases rate of surface deterioration, which may result in saving of pavement from leading to poor condition where major maintenance could be inevitable.

   Future preventive maintenance on the project road depends largely on routine inspection of the pavement with careful observation of specific distress and to take a decision at that time and suitable type of preventive maintenance treatment and its timing. All the narrow and wide surface cracks must be arrested immediately after identification with fog/slurry

seals as the most recommend preventive type maintenance measure for the in-service flexible pavement.

Based on the condition and distress identification survey as explained above paragraph, preventive maintenance treatments have to be taken up immediately to reduce rate of further damage to the surface and for enhance the pavement performance to the condition similar to non-distressed surface condition.

b) **Road Property Maintenance:** The items in this subhead covers the plantation/ maintenance of shrubs, turfing, replacement/ repair of damaged railing, crash barrier, kerbs, road delineators, signage, Road marking and painting etc.

7.3.3 Toll Management System

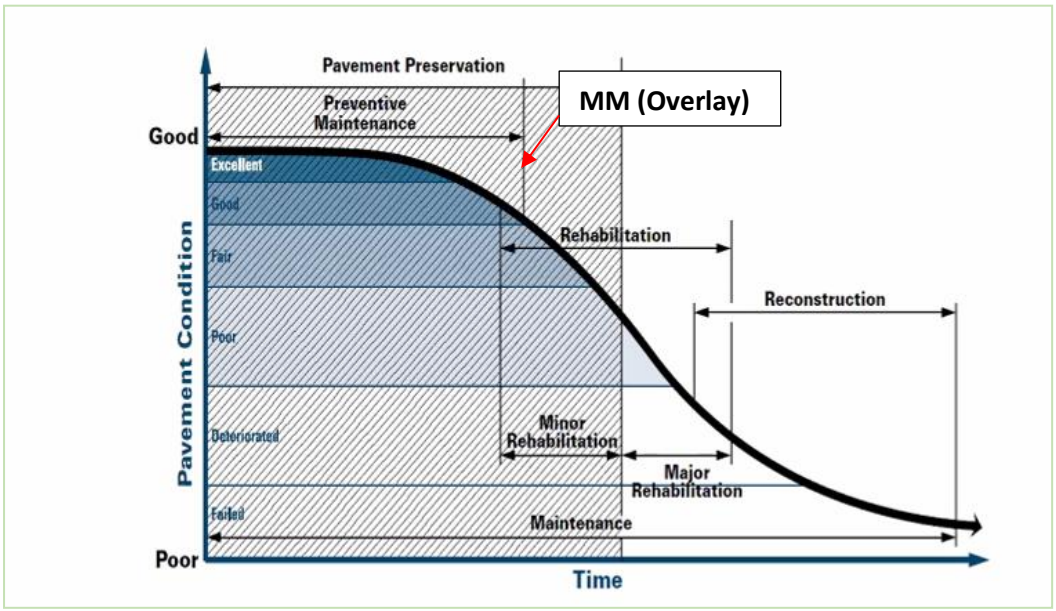
Cost estimate for Toll Management System was worked out by TC. Same was presented and deliberated during the investor meet on 6th of February where it was decided to adopt the rationalised cost finalized by IM.

7.3.4 Corridor Management

Incident Management: The items in this subhead include minimize the effects of incident and restore normal capacity and safety levels to all affected road facilities as efficiently as possible and. repair/ replacement of removing the dead animals & broken-down vehicles etc.

7.4 Major Maintenance

The pavement deteriorates with time caused by traffic movement and weather conditions. The rate of deterioration depends on the original design, type of maintenance being done/undertaken and time of application. Therefore, timely and appropriate maintenance of bituminous surface using suitable materials is essential to increase the pavement service life to a greater extent. Any delay in maintenance of the pavement substantially increase severity of the distresses, which results into poor condition of pavement as depicted in figure below and thereby increase in maintenance costs to bring the surface to a good condition.



Therefore, timely maintenance of the pavement is required for its satisfactory performance both in terms of functionally and structurally during the pavement service life.

Schedule F of the Concession Agreement set out the maintenance requirements in the Project. The performance parameters are indicated in schedule F descripting the nature of defect/deficiency along with time limits for repair/rectification for roads and bridges.

Schedule F, Pavement Roughness Value (Functional Overlay): The Periodic maintenance is required to be provided as and when performance parameters in terms of cracking, roughness and rutting etc. exceeded the limits as indicated in the schedule F anytime during the service life of the pavement. As per the provisions of Concession agreement, Surface roughness value is the major governing factor for selection of an appropriate pavement maintenance treatment required to bring the roughness value below the prescribed limit of 2000mm/km.

Pavement Strengthening (Structural Overlay): When the pavement is structurally deficient having high severity alligator/fatigue cracks, rutting and other associated distresses, then the structural overlay is required to be provided for strengthening of the pavement to cater for the anticipated design traffic. The pavement strengthening may be required when the

- Remaining life of the in-service pavement as evaluated using Falling Weight Deflectometer (FWD) is less the design traffic as calculated till end of the concession.
- Before expiry of initial design traffic as adopted at the time of asset construction.

7.4.1.1 Review of Pavement Design (4-lane Construction)

The Pavement design for Main Carriageway (Flexible type has adopted for entire project length except Toll Plaza where provided with rigid type) has been designed as per IRC-37-2001 for flexible pavement and IRC:58-2002 for rigid pavement.

There is no records made available for pavement design report of 4-lane construction. However, the composition has been specified in the drawings as enclosures to 4-laning CA.

Main Carriageway (MCW): Flexible Pavement

BC:50mm, DBM:165mm, WMM:250mm, GSB:230mm and subgrade:500mm

Service Roads (SR): Flexible Pavement

BC:40/50mm, DBM:70/165mm, WMM:250mm, GSB:230mm and subgrade:500mm

Toll Plaza Rigid pavement

PQC: Not available: from test pit investigations, the pavement composition consists of PQC 300mm, DLC 150mm and GSB 200mm and its performance also satisfactory.

7.4.1.2 Review of Major Maintenance History

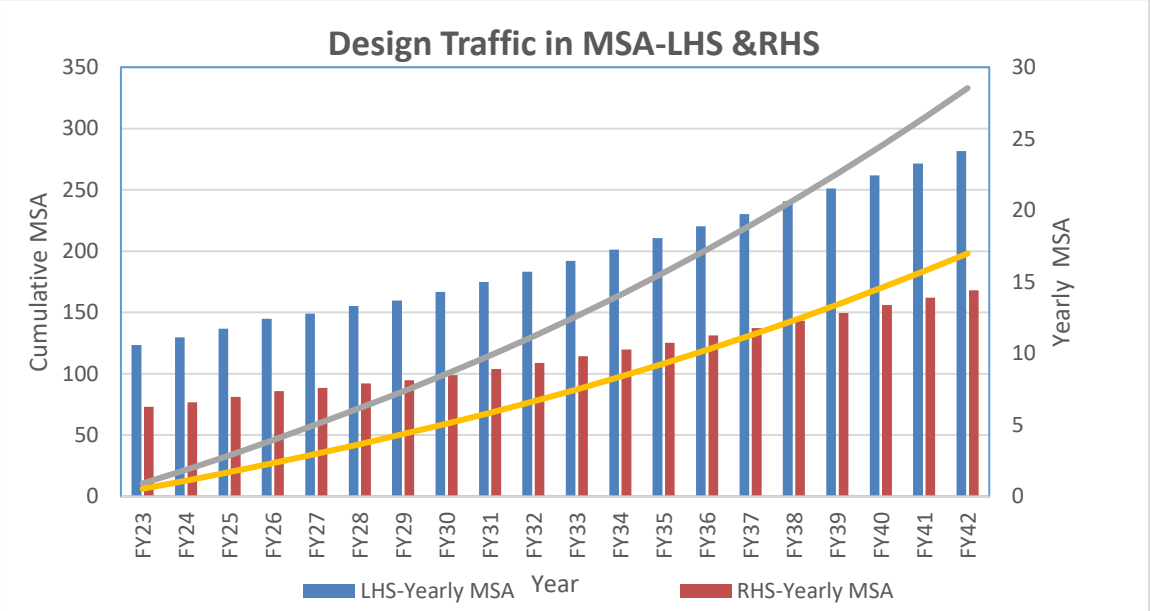
Based on the review of available reports, it is noted that the existing concessionaire has done two renewal coats where 1st renewal was completed in the year 2017 with a delay and the 2nd renewal done in the year 2022. However, no details made available regarding type of maintenance/rehabilitation has been undertaken by the existing Annuity concessionaire.

As per the schedule L, a renewal coat of bituminous concrete shall be laid every 5th year after initial construction. As on date, only two renewal coats commenced in the project with significant delay in application of renewal coat, due which there is drop in asset quality.

7.4.1.3 Design Traffic during the Concession Period

The design traffic in terms of MSA during the concession period has been calculated based on the current traffic pattern and data shared by the NHIIPL. The Vehicle Damage Factors (VDF) has been adopted as obtained from the present survey. The summary of design traffic during the concession period is as under.

Direction	Chainage, km		10 years MSA (FY32)	10 years MSA (FY42)
	From	To		
LHS	1515+713	1578+872	131	333
RHS	1515+713	1578+360	77	198



From the remaining life analysis as explained under surveys and investigation chapter, it is found that most of the pavement sections having remaining life more than the projected design traffic of 131 MSA and 77 respectively on LHS and RHS. However, some the sections on LHS carriageway the remaining life less than above design traffic. Therefore, pavement strengthening is required by Bituminous Concrete (BC) overlay with 50mm BC on LHS and 40mm on RHS immediately or at least before handing over of the asset to the TOT concessionaire in order to maintain the asset in serviceable condition and to extend the pavement life during operation and maintenance during TOT concession period.

7.4.1.4 Future Major Maintenance Requirement

Major maintenance is required in order to comply with provisions of concession agreement and to maintain performance levels as defined in schedule F throughout the operation and maintenance period.

As per schedule B, the TOT concessionaire shall carryout the periodic maintenance in full length of the project stretch including main carriageway, service roads and facilities in every 6th year or the year in which roughness index exceeds the limits given in schedule F, whichever comes earlier.

Further, also specified that concessionaire has to take the major repair and rehabilitation of pavement in the order of following cycles.

1st renewal: FY-28
2nd renewal: FY-33
3rd renewal: FY-40
4th renewal: FY-45

Therefore, considering the initial pavement design life, previous works of MMR cycles, in compliance to the provisions of schedule B, remaining life data and anticipated traffic loading during the concession period, the following cycles of Major maintenance is required for satisfactory performance of the pavement both functionally and structurally.

Table 7.1: Proposed Major Maintenance Cycles for Balance Concession period

S. No.	Financial Year	Description	MMR Proposal	
			MCW	Service/Slip Roads
1	FY-24	The project stretch is currently under BOT (Annuity) up to 12.12.2024, so no immediate major repair has been required as per clause 4.1.2, schedule B of CA. However, at present the pavement is having high severity distresses, which needs to be rectified by the existing concessionaire by suitable bituminous overlay of 40mm.		
2	FY-28	Structural overlay may be required since the initial 4-lane pavement was designed to cater operation period of the annuity which will be expired in 2024.	**Flexible Pavement:** 50mm BC for full length on LHS and 40mm on RHS side. **Rigid Pavement (Toll Plaza):** Nil	30mm BC overlay for full length
3	FY-33	Periodic Maintenance to improve the roughness	**Flexible Pavement:** 40mm BC overlay for full length for 90% length and 50mm BC overlay for10% length **Rigid Pavement (Toll Plaza):** Sealant replacement for 100% joint length and panel replacement for 0.5% of the total panels laid at Toll Plaza	30mm BC overlay for full length
4	FY-40	Periodic Maintenance to improve both pavement roughness and structural integrity	**Flexible Pavement:** 50mm BC overlay after milling to 50mm for entire length **Rigid Pavement (Toll Plaza):** Sealant replacement for 100% joint length	30mm BC for full length
5	FY-45	Periodic Maintenance to bring the roughness index below the prescribed limit (before handover)	**Flexible Pavement:** 40mm BC overlay for full length **Rigid Pavement (Toll Plaza):** Sealant replacement for 100% joint length and panel replacement for 0.5% of the total panels laid at Toll Plaza	30mm BC for full length

7.4.1.5 Structures

As no NDT reports are available and neither design documents stating design life are available it's not feasible to assess life expectancy of existing structures. However replacement cost of expansion joint, wearing course and bearings are considered in the maintenance cost at periodic interval.

7.4.1.6 Cost of Operation & Maintenance

Cost of Operation & Maintenance per annum are presented below.

Table 7.2: Cost of Operation & Maintenance (per annum)

Description	Cost (INR in Crores)	Six -laning Factor for Capacity Augmentation		
		Before Construction	During Construction	Post 6 Laning*
Tolling Operations	5.05	1	1	1.00
Incident Management	2.23	1	0	1.00
Routine Maintenance	2.33	1	0	1.25
Repairs	1.83	1	0	1.17
Electricity**	-	1	1	1.00
ATMS	-	-	-	-
Admin Expenses	4.34	1	1	1.00
Insurance	1.20	1	1	1.40
Total	**16.98**			

** Applicable from year FY 38 till end of concession*

*** Electricity cost included in Routine maintenance cost*

Table 7.3: Cost of Operation & Maintenance (entire concession period)

Year of Concession	O & M Year	O & M Cost in Crore
1	2023-24	16.98
2	2024-25	16.98
3	2025-26	16.98
4	2026-27	16.98
5	2027-28	16.98
6	2028-29	16.98
7	2029-30	16.98
8	2030-31	16.98
9	2031-32	16.98
10	2032-33	16.98
11	2033-34	16.98
12	2034-35	16.98
13	2035-36	16.98
14	2036-37	16.98
15	2037-38	16.98
16	2038-39	16.98

Year of Concession	O & M Year	O & M Cost in Crore
17	2039-40	16.98
18	2040-41	16.98
19	2041-42	16.98
20	2042-43	16.98
21	2043-44	16.98
22	2044-45	16.98

7.4.1.7 Periodic Maintenance

Cost of Periodic Maintenance (Base year 2024) including GST, but excluding escalation are presented below.

Table 7.4: Cost of Periodic Maintenance

Year	Periodic Maintenance (INR in Crores)				
	Functional +Structural overlay MCW+ S/R	Major Maintenance of Rigid Pavement	Replacement of ATMS	Replacement of TMS	Structure specified repairs
2023-2024					
2024-2025					
2025-2026					
2026-2027					
2027-2028	69.95				15.03
2028-2029					
2029-2030					
2030-2031				1.59	
2031-2032					
2032-2033	72.31				
2033-2034					
2034-2035					
2035-2036					
2036-2037					
2037-2038				3.18	
2038-2039					
2039-2040	81.05				
2040-2041					
2041-2042					
2042-2043					
2043-2044					
2044-2045	89.44				
2045-2046					
2046-2047					
2047-2048					
2048-2049					

Year	Periodic Maintenance (INR in Crores)				
	Functional +Structural overlay MCW+ S/R	Major Maintenance of Rigid Pavement	Replacement of ATMS	Replacement of TMS	Structure specified repairs
2049-2050					
2050-2051					
2051-2052					
2052-2053					
2053-2054					
Total	**312.75**	**–**	**–**	**4.77**	**15.03**
Grand Total					**332.55**

Section 8: Analysis & Comparisons with Seller Data

The cost estimates have been prepared for the project road includes cost of Grade Separated Structures, slip / service road, road furniture, toll plazas improvement & ATMS etc. CapEX and O&M cost estimated as described in above chapters are compared with the estimate prepared by the Consultant of NHAI. Outcome of this comparison is presented in this chapter.

8.1 CapEx

New construction work as provisioned in schedule B are quantified in details for each item to be executed. Rate analysis is done using SoR of Kanpur Nagar effective from 15th July 2022 as explained in section 6.3 of this report. NHAI estimate has referred schedule of rates for Kanpur Nagar, Uttar Pradesh which was effective from 15th June 2020 and was escalated it to make for year 2022-2023. Comparison of CapEx cost with NHAI is presented below in **Table 8.1**.

Table 8.1: Comparison of CapEX with NHAI Estimate (Cost Incl. GST)

Description	NHAI Cost (INR in Crores)	EGIS Cost (INR in Crores)
Cost of Miscellaneous Road Furniture	3.45	4.24
Cost of Rain Water Harvesting	0.63	1.89
Cost of Repair & Rehabilitation of Existing Structures	0.84	0.86
Cost of Improvement to Toll Plaza	-	2.69
Police Assistance	-	0.15
Total without GST	4.92	9.83
Total including GST (18%)	**5.81**	**11.61**

8.2 O&M Cost

Operational and routine maintenance cost are again compared with that of NHAI estimate. Considerable difference is noticed in the routine maintenance cost, reason for the same may be that admin expenses and ATMS maintenance costs are not included in NHAI estimate. Comparison of operational expenses in terms of number of toll booths and routine maintenance cost in terms of per km length is presented below in **Table 8.2**.

Table 8.2: O&M Cost Comparison

Description	NHAI Cost (INR in Crores)	EGIS Cost (INR in Crores)
Tolling Operations	5.86	5.05
Incident Management		2.23
Admin Expenses		4.34
Insurance		1.20
Routine Maintenance	5.32	2.33
Repairs		1.83
ATMS		-
Total	**11.18**	**16.98**

8.3 Major Maintenance

Major maintenance cost for any project is specific to the site condition such as traffic, climate, overloading, asset condition, workmanship during initial construction etc. Cost given in NHAI DPR is compared with the estimate prepared by TC. This comparison for total cost of CapEx, routine maintenance & operation and major maintenance is presented below in **Table 8.3**.

Table 8.3: Comparison with DPR Cost

Particulars	DPR Amount (INR in Crs.)	EGIS Amount (INR in Crs.)
Cycle 1		
Functional +Structural overlay MCW+ S/R	**80.62**	69.96
Replacement of **ATMS**		-
Replacement of **TMS**		-
Structure specified repairs		15.03
Total		**84.99**
Cycle 2		
Functional +Structural overlay MCW+ S/R	**98.75**	72.31
Replacement of **ATMS**		-
Replacement of **TMS**		1.59
Structure specified repairs		-
Total		**73.90**
Cycle 3		
Functional +Structural overlay MCW+ S/R	**98.75**	81.05
Replacement of **ATMS**		-
Replacement of **TMS**		3.18
Structure specified repairs		-
Total		**84.23**
Cycle 4		
Functional +Structural overlay MCW+ S/R	**102.87**	89.44
Replacement of **ATMS**		-
Replacement of **TMS**		-
Structure specified repairs		-
Total		**89.44**

Section 9: Conclusion

The entire section of the project highway is under BOT (Annuity) up to 12.12.2024. Two periodic renewals has undertaken by the exiting Annuity Concessionaire with significant delay and completed in the years 2017 and 2022 respectively for 1st and 2nd renewal. As per schedule L of annuity concession agreement, periodic overlay with Bituminous Concrete shall be laid every 5 years and accordingly 3rd renewal may be anticipated so as to improve the present condition of asset in respect of structural integrity and riding quality as per the CA provisions. As part of present study, various physical testing and visual site inspections was conducted to evaluate the asset condition and to take required maintenance decisions. Based on the site reconnaissance, it is appraised that majority of the locations, pavement on LHS carriageway is experiencing structural distresses like alligator/block cracking, rutting etc. for which requires immediate treatments to avoid further drop in pavement quality. Based on the results of physical testing and review of available reports/data, analysis of remaining life, the recommendations are made in proposing suitable the major maintenance strategy to be adopted during the concession period.

Based upon the site visit for assessment of condition of CD structures including MJB, MNBs, Flyovers, VUPs, Culverts and toll plaza buildings in the project corridor and observations submitted in various chapters of this report it is concluded that right now there is no major repairs involved in the structures other than what has been specified in this report which is of minor nature.

The assessment of estimated cost of anticipated future repair and rehabilitation cost are considered in the cost estimate of this report.

FINAL TECHNICAL DUE-DILIGENCE REPORT

(Annexures)

Technical Consultant Services for National Highways Infra Trust

Orai to Barah Section of NH-27 in the State of Uttar Pradesh

October 2023

egis India
Consulting engineers pvt. ltd.

List of Annexures

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Annexure – 3.2 : Inventory and Condition Survey of Structures

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Annexure – 4.1 : Methodology of NSV

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Annexure – 4.7 : Summary of Back Calculation of E Values

Annexure – 4.8 : Mobile Bridge Inspection Unit (MBIU)

Annexure – 3.1

Road Inventory

Road Inventory (Part-I)																					
Road Name: NH-27 (ORAI-BARAH ROAD PROJECT)																	Date : 10-12-2022				
Direction:																	Weather :				
Chainage (km)		Terrain[1]	Land Use[2]	Carriageway Surface LHS				Chainage (km)		Land Use[2]	Carriageway Surface RHS				Shoulder Chainage(LHS)		Shoulder/Seperator LHS		Shoulder Chainage(RHS)		Shoulder/Seperator RHS	
				Main Carriageway		Paved Shoulder					Main Carriageway		Paved Shoulder									
From	To		LHS	Type[3]	Width (m)	Type[3]	Width (m)	From	To	RHS	Type[3]	Width (m)	Type[3]	Width (m)	Start Chainage	End Chainage	Type[4]	Width (m)	Start Chainage	End Chainage	Type[4]	Width (m)
1515713	1516716	P	Agriculture	BT	7.25	BT	1.5	1515713	1516757	Residential	BT	7.2	BT	1.5	1515713	1537950	Gravel	1	1578530	1578150	Gravel	1
1516716	1518830	P	Barren	BT	7.25	BT	1.5	1516757	1521314	Agriculture	BT	7.2	BT	1.5	1537950	1540250	Paved	1	1578150	1577990	Paved	1
1518830	1522421	P	Agriculture	BT	7.2	BT	1.5	1521314	1522961	Residential	BT	7.2	BT	1.5	1540250	1540575	Gravel	1	1577990	1574010	Gravel	1
1522421	1523931	P	Residential	BT	7.25	BT	1.5	1522961	1528807	Agriculture	BT	7.2	BT	1.5	1540575	1543080	Paved	1	1574010	1573199	Paved	1
1523931	1529091	P	Agriculture	BT	7.2	BT	1.5	1528807	1529342	Residential	BT	7.2	BT	1.5	1543080	1546500	Gravel	1	1573199	1572995	Gravel	1
1529091	1529433	P	Residential	BT	7.2	BT	1.5	1529342	1532600	Agriculture	BT	7.2	BT	1.5	1546500	1547150	Paved	1	1572995	1572730	Paved	1
1529433	1533841	P	Agriculture	BT	7.5	BT	1.5	1532600	1532798	Residential	BT	7.2	BT	1.5	1547150	1548345	Gravel	1	1572730	1571910	Gravel	1
1533841	1534000	P	Residential	BT	7.2	BT	1.5	1532798	1533610	Agriculture	BT	7.25	BT	1.5	1548345	1548715	Paved	1	1571910	1570100	Paved	1
1534000	1535559	P	Commercial	BT	7.5	BT	1.5	1533610	1534804	Commercial	BT	7.5	BT	1.5	1548715	1549075	Gravel	1	1570100	1569565	Gravel	1
1535559	1537600	P	Agriculture	BT	7.2	BT	1.5	1534804	1537979	Agriculture	BT	7.2	BT	1.5	1549075	1549400	Paved	1	1569565	1569420	Paved	1
1537600	1546366	P	Residential	BT	7.2	BT	1.5	1537979	1540182	Residential	BT	7.2	BT	1.5	1549400	1550270	Gravel	1	1569420	1567425	Gravel	1
1546366	1548871	P	Agriculture	BT	7.2	BT	1.5	1540182	1540212	Commercial	BT	7.2	BT	1.5	1550270	1551410	Paved	1	1567425	1666860	Paved	1
1548871	1559771	P	Residential	BT	7.2	BT	1.5	1540212	1544037	Agriculture	BT	7.2	BT	1.5	1551410	1551725	Gravel	1	1666860	1566685	Gravel	1
1559771	1560987	P	Agriculture	BT	7.2	BT	1.5	1544037	1544611	Residential	BT	7.2	BT	1.5	1551725	1553350	Paved	1	1566685	1566435	Paved	1
1560987	1561536	P	Residential	BT	7.2	BT	1.5	1544611	1545150	Agriculture	BT	7.2	BT	1.5	1553350	1556395	Gravel	1	1566435	1566100	Gravel	1
1561536	1562390	P	Agriculture	BT	7.2	BT	1.5	1545150	1545195	Agriculture	BT	7.2	BT	1.5	1556395	1557755	Paved	1	1566100	1565935	Paved	1
1562390	1564773	P	Residential	BT	7.2	BT	1.5	1545195	1545807	Residential	BT	7.2	BT	1.5	1557755	1558390	Gravel	1	1565935	1564665	Gravel	1
1564773	1569451	P	Agriculture	BT	7.25	BT	1.5	1545807	1548055	Agriculture	BT	7.25	BT	1.5	1558390	1559445	Paved	1	1564665	1563900	Paved	1
1569451	1578872	P	Residential	BT	7.25	BT	1.5	1548055	1551530	Commercial	BT	7.5	BT	1.5	1559445	1563030	Gravel	1	1563900	1563305	Gravel	1
								1551530	1555109	Residential	BT	7.2	BT	1.5	1563030	1563325	Paved	1	1563305	1562570	Paved	1
								1555109	1556661	Commercial	BT	7.5	BT	1.5	1563325	1563915	Gravel	1	1562570	1559525	Gravel	1
								1556661	1558295	Agriculture	BT	7.25	BT	1.5	1563915	1564715	Paved	1	1559525	1557520	Paved	1
								1558295	1559303	Residential	BT	7.2	BT	1.5	1564715	1566485	Gravel	1	1557520	1557380	Gravel	1
								1559303	1561052	Agriculture	BT	7.2	BT	1.5	1566485	1566680	Paved	1	1557380	1556100	Paved	1
								1561052	1561235	Residential	BT	7.2	BT	1.5	1566680	1566865	Gravel	1	1556100	1554890	Gravel	1

Chainage (km)		Terrain[1]	Land Use[2]	Carriageway Surface LHS				Chainage (km)		Land Use[2]	Carriageway Surface RHS				Shoulder Chainage(LHS)		Shoulder/Seperator LHS		Shoulder Chainage(RHS)		Shoulder/Seperator RHS	
				Main Carriageway		Paved Shoulder					Main Carriageway		Paved Shoulder									
From	To		LHS	Type[3]	Width (m)	Type[3]	Width (m)	From	To	RHS	Type[3]	Width (m)	Type[3]	Width (m)	Start Chainage	End Chainage	Type[4]	Width (m)	Start Chainage	End Chainage	Type[4]	Width (m)
								1561235	1561294	Commercial	BT	7.5	BT	1.5	1566865	1567430	Paved	1	1554890	1551920	Paved	1
								1561294	1568650	Agriculture	BT	7.25	BT	1.5	1567430	1568190	Gravel	1	1551920	1551300	Gravel	1
								1568650	1572079	Residential	BT	7.25	BT	1.5	1568190	1568455	Paved	1	1551300	1550220	Paved	1
								1572079	1572508	Agriculture	BT	7.2	BT	1.5	1568455	1570125	Gravel	1	1550220	1545150	Gravel	1
								1572508	1578360	Commercial	BT	7.5	BT	1.5	1570125	1570885	Paved	1	1545150	1545015	Paved	1
															1570885	1571420	Gravel	1	1545015	1542790	Gravel	1
															1571420	1571910	Paved	1	1542790	1541365	Paved	1
															1571910	1572725	Gravel	1	1541365	1540565	Paved	1
															1572725	1573035	Paved	1	1540565	1538245	Paved	1
															1573035	1573275	Gravel	1	1538245	1537940	Gravel	1
															1573275	1574050	Paved	1	1537940	1537500	Paved	1
															1574050	1575650	Gravel	1	1537500	1537365	Gravel	1
															1575650	1576855	Paved	1	1537365	1536925	Paved	1
															1576855	1578065	Gravel	1	1536925	1534640	Gravel	1
															1578065	1579077	Paved	1	1534640	1534440	Paved	1
																			1534440	1517935	Gravel	1
																			1517935	1517410	Paved	1
																			1517410	1515713	Gravel	1

1. Terrain : P- Plain(0-10%) , R- Rolling(10-25%) , M- Mountainous(25-60%), S - Steep(>60%)

2. Land use: A- Agricultural, B - Barren, F - Forest, SU- Semi Urban, R - Residential, C - Commercial, I - Industrial

3. Surface Type : BT - Bitumen, CC - Concrete, G – Gravel

4. Shoulder Type : G – Gravel, E – Earthen

Road Inventory (Part-II)

Road Name: NH-27 (ORAI-BARAH ROAD PROJECT)

Direction: BHS

Date : 06/12/2022 to 08/12/2022

Chainage (km)		Median Width (m)	Service Road LHS		Service Road RHS		Road side Drain/Foot path LHS				Road side Drain/Foot path RHS				Remarks
From	To		Type[5]	Width	Type[5]	Width	Type[6]	Width (m)	Depth (m)	Condt[7]	Type[6]	Width	Depth	Condt[7]	
1537+883	1540+213	1.5 To 3.0	BT	5.0	-	-	-	-	-	-	-	-	-	-	
1537+880	1540+215	1.5 To 3.0	-	-	-	-	Covered-RCC Lined Drain	0.8	1.2	G	-	-	-	-	
1538+260	1540+215	1.5 To 3.0	-	-	-	-	-	-	-	-	Covered-RCC Lined Drain	0.8	1.2	G	
1538+263	1540+243	1.5 To 3.0	-	-	BT	5.5	-	-	-	-	-	-	-	-	
1550+150	1551+330	4.5 To 2.5	BT	7.5	-	-	-	-	-	-	-	-	-	-	
1550+253	1551+343	4.5 To 2.5	-	-	BT	7.5	-	-	-	-	-	-	-	-	
1550+260	1551+330	4.5 To 2.5	-	-	-	-	Covered-RCC Lined Drain	0.8	1.5	G	-	-	-	-	
1550+260	1551+330	4.5 To 2.5	-	-	-	-	-	-	-	-	Covered-RCC Lined Drain	0.8	1.5	G	
1551+550	1554+800	2.5	BT	5.5	-	-	-	-	-	-	-	-	-	-	
1551+550	1554+260	2.5	-	-	-	-	-	-	-	-	Covered-RCC Lined Drain	0.8	1.5	G	
1551+850	1554+800	2.5	-	-	BT	5.25	-	-	-	-	-	-	-	-	
1551+850	1554+250	2.5	-	-	-	-	Covered-RCC Lined Drain	0.8	1.0	G	-	-	-	-	
1554+260	1554+800	2.5	-	-	-	-	Covered-RCC Lined Drain	0.8	1.0	G	-	-	-	-	
1554+260	1554+800	2.5	-	-	-	-	-	-	-	-	Covered-RCC Lined Drain	0.8	1.0	G	
1556+250	1557+650	2.5	BT	5.5	-	-	-	-	-	-	-	-	-	-	

Chainage (km)		Median Width (m)	Service Road LHS		Service Road RHS		Road side Drain/Foot path LHS				Road side Drain/Foot path RHS				Remarks
From	To		Type[5]	Width	Type[5]	Width	Type[6]	Width (m)	Depth (m)	Condt[7]	Type[6]	Width	Depth	Condt[7]	
1556+250	1557+100	2.5	-	-	BT	5.5	-	-	-	-	-	-	-	-	
1556+250	1557+100	2.5	-	-	-	-	Covered-RCC Lined Drain	0.8	1.0	G	-	-	-	-	
1556+250	1557+650	2.5	-	-	-	-	-	-	-	-	Covered-RCC Lined Drain	0.8	1.0	G	
1557+470	1559+250	2.5	-	-	BT	5.5	-	-	-	-	-	-	-	-	
1557+470	1559+250	2.5	-	-	-	-	Covered-RCC Lined Drain	0.8	1.0	G	-	-	-	-	
1558+200	1559+250	2.5	BT	5.5	-	-	-	-	-	-	-	-	-	-	
1558+200	1559+250	2.5	-	-	-	-	-	-	-	-	Covered-RCC Lined Drain	0.8	1.0	G	
1562+675	1562+925	4.5	-	-	BT	7.25	-	-	-	-	-	-	-	-	
1562+675	1562+925	4.5	-	-	-	-	Opened-Lined Drain	0.8	1.0	G	-	-	-	-	
1563+800	1564+600	1.2	BT	7.25	-	-	-	-	-	-	-	-	-	-	
1563+800	1564+600	1.2	-	-	BT	7.25	-	-	-	-	-	-	-	-	
1563+800	1564+600	1.2	-	-	-	-	Covered-RCC Lined Drain	0.8	1.0	G	-	-	-	-	
1563+800	1564+600	1.2	-	-	-	-	-	-	-	-	Covered-RCC Lined Drain	0.8	1.0	G	
1570+000	1570+750	1.5 & 4.5	BT	5.5	-	-	-	-	-	-	-	-	-	-	
1570+000	1571+950	1.5 & 4.5	-	-	BT	5.5	-	-	-	-	-	-	-	-	
1570+000	1571+370	1.5 & 4.5	-	-	-	-	Covered-RCC Lined Drain	0.8	1.0	G	-	-	-	-	
1570+000	1570+750	1.5 & 4.5	-	-	-	-	-	-	-	-	Opened-Lined Drain	0.8	1.0	G	

Chainage (km)		Median Width (m)	Service Road LHS		Service Road RHS		Road side Drain/Foot path LHS				Road side Drain/Foot path RHS				Remarks
From	To		Type[5]	Width	Type[5]	Width	Type[6]	Width (m)	Depth (m)	Condt[7]	Type[6]	Width	Depth	Condt[7]	
1571+220	1571+710	1.5 & 4.5	BT	5.25	-	-	-	-	-	-	-	-	-	-	
1571+250	1571+950	1.5	-	-	-	-	-	-	-	-	Covered-RCC Lined Drain	0.8	1.0	G	
1571+370	1571+800	1.5	-	-	-	-	Covered-RCC Lined Drain	0.8	1.0	G	-	-	-	-	
1571+800	1571+950	1.5	-	-	-	-	Covered-RCC Lined Drain	0.8	1.0	G	-	-	-	-	
1572+650	1572+950	1.5	BT	5.25	-	-	-	-	-	-	-	-	-	-	
1572+650	1572+950	2.5 & 4.5	-	-	BT	5.5	-	-	-	-	-	-	-	-	
1572+650	1572+950	2.5 & 4.5	-	-	-	-	-	-	-	-	Covered-RCC Lined Drain	0.8	1.0	G	
1572+650	1572+950	2.5 & 4.5	-	-	-	-	Covered-RCC Lined Drain	0.8	1.0	G	-	-	-	-	
1573+200	1574+000	1.5 & 4.5	BT	7.5	-	-	-	-	-	-	-	-	-	-	
1573+200	1574+000	1.5 & 4.5	-	-	BT	7.0	-	-	-	-	-	-	-	-	
1573+200	1574+000	1.5 & 4.5	-	-	-	-	-	-	-	-	Covered-RCC Lined Drain	0.8	1.0	G	
1573+200	1574+000	1.5 & 4.5	-	-	-	-	Covered-RCC Lined Drain	0.8	1.0	G	-	-	-	-	
1575+600	1576+800	4.5	BT	5.25	-	-	-	-	-	-	-	-	-	-	
1575+600	1576+800	4.5	-	-	-	-	-	-	-	-	Covered-RCC Lined Drain	0.8	1.0	G	
1577+850	1578+050	-	-	-	-	-	-	-	-	-	Covered-RCC Lined Drain	0.8	1.0	G	
1577+950	1578+400	-	BT	7.00	-	-	-	-	-	-	-	-	-	-	
1577+950	1578+400	-	-	-	-	-	Covered-RCC Lined Drain	0.8	1.0	G	-	-	-	-	

5. Surface Type : BT - Bitumen, C - Concrete, G – Gravel

6. Road Side Drain : CD- Covered Drain / Foot Path, LD- Lined Drain, UD- Unlined Drain, NO- No Drain

7. Condition of Drain : FC - Fully Choked, FD - Damaged, G – Good condition

Road Inventory (Part-III)				
Road Name: NH-27 (ORAI-BARAH ROAD PROJECT)				
Direction :				
Road/Rail Junction Details & Built-up Area				
Chainage (km)	**Location / Village Name**	**Shape[9]**	**Destination**	
			Left	**Right**
1518+370	Chamari	Y	BT	-
1518+600	Okasa	T	-	BT
1519+490	Chamari / Okasa	X	EARTHEN	BT
1522+115	Aata	Y	-	CC
1522+200	Aata	T	BT	-
1522+460	Aata	T	BT	-
1522+720	Bhadhrekhi	T	-	BT
1523+025	Bhadhrekhi	Y	-	EARTHEN
1524+850	Bhabhuaa	T	BT	-
1527+330	-	Y	-	EARTHEN
1529+150	Usargaon	Y	-	BT
1529+220	Sarsela	T	BT	-
1529+465	Usargaon	Y	BT	-
1531+215	Khairai	T	-	BT
1532+615	Village	T	BT	-
1533+890	Chhok	Y	BT	-
1535+050	Chak Lohamandi	Y	-	EARTHEN
1536+650	Aagapur	Y	-	BT
1537+610	Village	T	-	BT
1538+180	Kalpi	Y	-	CC
1538+210	Kalpi	Y	BT	
1538+800	Kalpi	Y	-	CC
1538+830	Kalpi / Kalpi	Y	BT	-
1539+225	Kalpi / Kalpi	X	CC	CC
1539+460	-	T	-	BT
1539+545	Kalpi / Kalpi	X	BT	BT
1539+600	Kalpi / Kalpi	X	BT	BT
1539+735	Kalpi / Kalpi	X	BT	BT
1540+050	Kalpi / Kalpi	X	BT	BT

Road/Rail Junction Details & Built-up Area				
Chainage (km)	Location / Village Name	Shape[9]	Destination	
			Left	Right
1542+100	Daulatpur	Y	BT	-
1542+200	Daulatpur	Y	-	BT
1542+715	Daulatpur	T	-	BT
1543+500	Daulatpur	Y	-	BT
1544+025	Kanpur Dehat	T	BT	-
1544+600	Kanpur Dehat	Y	-	BT
1545+275	Chaunrah / Kariyapur Bhoganipur	T	BT	-
1545+315	-	T	-	BT
1545+610	Chaunrah	T	BT	-
1546+400	Kanpur Dehat / Kariyapur Bhoganipur	X	BT	BT
1546+700	Kanpur Dehat / Kariyapur Bhoganipur	X	EARTHEN	BT
1546+835	Pipri	T	-	BT
1548+050	Jalpura	T	CC	-
1548+080	Jalpura	T	BT	-
1548+180	Jalpura / Amraudha	X	CC	BT
1548+965	Budhera Bhoganipur	T	-	BT
1550+220	Bhognipur	Y	-	CC
1550+325	Kanpur Dehat	Y	BT	-
1550+800	Kanpur Dehat / Bhognipur	X	BT	BT
1551+005	Kanpur Dehat / Bhognipur	X	BT	CC
1551+490	Raigawa	Y	-	EARTHEN
1551+500	Sikhamapur	Y	EARTHEN	-
1551+950	Kushrjapur	T	-	BT
1552+400	Sikhamapur	T	BT	-
1552+500	Sikhamapur	Y	BT	-
1552+900	Pukhrayan / Ahrauli Shekh	X	BT	CC
1553+090	Ahrauli Shekh	T	-	CC
1553+165	Pukhrayan / Ahrauli Shekh	X	BT/PAVER	BT/CC
1553+280	Pukhrayan	Y	BT	-
1553+600	Pukhrayan / Kanpur Dehat	X	BT	BT

Road/Rail Junction Details & Built-up Area				
Chainage (km)	Location / Village Name	Shape[9]	Destination	
			Left	Right
1553+700	Pukhrayan	T	CC	-
1553+750	-	T	-	BT
1553+850	Pukhrayan / Hardua Aima	T	-	CC
1554+180	-	Y	CC	-
1554+240	Pukhrayan / Hardua Aima	X	CC	BT
1554+530	Pukhrayan / Hardua Aima	X	BT	BT
1554+650	-	T	-	CC
1554+790	Pukhrayan / Hardua Aima	X	CC	BT
1554+860	Pukhrayan	T	EARTHEN	-
1555+075	Pukhrayan	T	CC	-
1555+635	Pukhrayan	Y	CC	-
1555+670	Barhauli	Y	-	BT
1556+290	Pukhrayan	Y	BT	-
1556+400	Barhauli	T	-	CC
1556+470	-	T	BT	
1557+470	Barhauli	T	-	BT
1557+900	Gadaikhera	T	BT	-
1558+110	Haidarapur	T	-	BT
1558+500	Haidarapur	Y	-	BT
1558+900	Haidarapur	T	-	BT
1559+090	Hansemau	T	BT	-
1559+210	Hansemau / Haidarapur	X	CC	BT
1560+880	Andawan	Y	-	BT
1561+050	Village	T	BT	-
1561+280	Village	T	BT	-
1561+320	-	T	-	EARTHEN
1561+975	Jalalpur	T	-	BT
1562+860	Murlipur	X	BT	BT
1563+210	-	Y	BT	-
1564+160	- / Muradpur	X	BT	BT
1565+275	-	T	CC	-

Road/Rail Junction Details & Built-up Area				
Chainage (km)	Location / Village Name	Shape[9]	Destination	
			Left	Right
1566+040	-	T	-	BT
1566+575	-	T	-	BT
1566+800	Mawar	T	-	CC
1566+830	Mawar	T	-	BT
1568+615	-	T	BT	-
1568+800	Gaura Nagar	T	-	BT
1570+165	Mawar	Y	BT	-
1571+260	Patepur / Dargawan	X	EARTHEN	EARTHEN
1571+280	Patepur / Dargawan	X	BT	-
1571+570	Muridpur / Muridpur	X	CC	BT
1571+800	Muridpur / Muridpur	X	CC	CC
1572+025	Temple	T	CC	-
1572+150	-	T	CC	-
1572+430	Mati Kishunpur	T	BT	-
1572+685	Alam Chandpur	Y	-	BT
1573+045	Mati Kishunpur	T	BT	-
1573+060	Alam Chandpur	T	BT	-
1573+070	Alam Chandpur	T	BT	-
1573+515	Alam Chandpur	T	-	BT
1573+630	Alam Chandpur	T	-	BT
1574+250	-	X	CC	CC
1574+550	Nagin Jasi	T	-	BT
1574+630	Nagin Jasi / Nagin Jasi	X	BT	BT
1574+670	Nagin Jasi / Nagin Jasi	X	BT	BT
1574+775	Nagin Jasi / Nagin Jasi	X	-	BT
1574+860	Nagin Jasi	T	BT	-
1575+070	Nagin Jasi / Nagin Jasi	T	BT	-
1575+490	Nagin Jasi / Nagin Jasi	X	BT	BT
1576+600	-	T	-	BT
1576+900	Nagin Jasi	T	BT	-
1577+235	Banar Ali	Y	-	BT

Road Inventory (Part-IV)											
Road Name: NH-27 (ORAI-BARAH ROAD PROJECT)								**Date: 10.12.2022**			
Direction:								**Weather:**			
Crash Barrier					**Gantry,VMS Board, HTMS**			**Bus Bays / Truck lay Byes**			
Chainage (km)			**Placement Location[14]**	**Type[15]**	**Location**	**Side**	**Type[16]**	**Location**	**Side**	**Length**	**Type[17]**
From	**To**										
1516+850	1517+050	200.00	LHS	W	1519+600	LHS	C	Atta	LHS	170	BB
1516+950	1517+050	100.00	LHS	W	1533+700	LHS	C	Atta	RHS	170	BB
1517+250	1517+450	200.00	LHS	W	1549+870	LHS	C	Usar Goan	RHS	155	BB
1517+370	1517+450	80.00	LHS	W	1551+980	LHS	C	Usar Goan	LHS	120	BB
1517+500	1517+875	375.00	LHS	W	1563+800	LHS	C	Chaura	RHS	150	BB
1517+500	1517+900	400.00	LHS	W	1578+000	LHS	C	Chaura	LHS	140	BB
1523+720	1523+970	250.00	LHS	W	1520+830	RHS	C	Pipari	LHS	150	BB
1523+800	1523+980	180.00	LHS	W	1551+660	RHS	C	Pipari	RHS	150	BB
1524+820	1524+840	20.00	LHS	W	1555+170	RHS	C	Bhoganipur	LHS	80	BB
1524+820	1524+840	20.00	LHS	W	-	-	-	Bhoganipur	RHS	100	BB
1526+570	1526+590	20.00	LHS	W	-	-	-	Pukhrayan	LHS	20	BB
1531+080	1531+100	20.00	LHS	W	-	-	-	Pukhrayan	RHS	20	BB
1531+350	1531+450	100.00	LHS	W	-	-	-	Badoli Mod	RHS	170	BB
1535+450	1535+630	180.00	LHS	W	-	-	-	Hasenmau	LHS	140	BB
1535+550	1535+630	80.00	LHS	W	-	-	-	Hasenmau	RHS	120	BB
1536+050	1536+200	150.00	LHS	W	-	-	-	Deengh	RHS	180	BB
1536+100	1536+350	250.00	LHS	W	-	-	-	Mohmadpur	RHS	140	BB
1536+800	1537+100	300.00	LHS	W	-	-	-	Lalpur/ Patepur	LHS	140	BB
1536+800	1537+800	1000.00	LHS	W	-	-	-	Lalpur/ Patepur	RHS	170	BB
1537+700	1537+900	200.00	LHS	W	-	-	-	Matti	RHS	140	BB
1538+000	1538+300	300.00	LHS	W	-	-	-	Matti	LHS	70	BB
1538+000	1538+600	600.00	LHS	W	-	-	-	Jainpur	RHS	200	BB
1538+220	1538+300	80.00	LHS	W	-	-	-	Barajor	LHS	70	BB
1538+400	1538+580	180.00	LHS	W	-	-	-	Barajor	RHS	80	BB
1539+000	1539+080	80.00	LHS	W	-	-	-	Amrit Dhaba	RHS	270	TB
1539+000	1539+070	70.00	LHS	W	-	-	-	Bhoganipur	RHS	350	TB
1539+100	1539+180	80.00	LHS	W	-	-	-	Deengh	RHS	140	TB

Crash Barrier					Gantry,VMS Board, HTMS			Bus Bays / Truck lay Byes			
Chainage (km)			Placement Location[14]	Type[15]	Location	Side	Type[16]	Location	Side	Length	Type[17]
From	To										
1539+120	1539+180	60.00	LHS	W	-	-	-	Jholupur	RHS	410	TB
1539+900	1540+000	100.00	LHS	W	-	-	-	Jholupur	LHS	270	TB
1540+000	1540+080	80.00	LHS	W	-	-	-	-	-	-	-
1540+000	1540+080	80.00	LHS	W	-	-	-	-	-	-	-
1540+500	1540+700	200.00	LHS	W	-	-	-	-	-	-	-
1540+500	1540+700	200.00	LHS	W	-	-	-	-	-	-	-
1540+550	1540+700	150.00	LHS-I	W	-	-	-	-	-	-	-
1541+300	1543+000	1700.00	LHS-II	W	-	-	-	-	-	-	-
1541+300	1543+000	1700.00	LHS	W	-	-	-	-	-	-	-
1541+300	1542+830	1530.00	LHS	W	-	-	-	-	-	-	-
1541+300	1542+830	1530.00	LHS	W	-	-	-	-	-	-	-
1542+900	1543+000	100.00	LHS	W	-	-	-	-	-	-	-
1543+080	1543+150	70.00	LHS	W	-	-	-	-	-	-	-
1543+120	1543+170	50.00	LHS	W	-	-	-	-	-	-	-
1543+625	1543+910	285.00	LHS	W	-	-	-	-	-	-	-
1543+750	1543+900	150.00	LHS	W	-	-	-	-	-	-	-
1544+900	1545+100	200.00	LHS	W	-	-	-	-	-	-	-
1544+950	1545+050	100.00	LHS	W	-	-	-	-	-	-	-
1545+280	1545+400	120.00	LHS	W	-	-	-	-	-	-	-
1545+290	1545+360	70.00	LHS	W	-	-	-	-	-	-	-
1546+280	1546+300	20.00	LHS	W	-	-	-	-	-	-	-
1546+330	1546+600	270.00	LHS	W	-	-	-	-	-	-	-
1546+620	1547+220	600.00	LHS	W	-	-	-	-	-	-	-
1546+700	1547+100	400.00	LHS	W	-	-	-	-	-	-	-
1548+320	1548+610	290.00	RHS	W	-	-	-	-	-	-	-
1548+780	1548+850	70.00	RHS	W	-	-	-	-	-	-	-
1548+960	1549+300	340.00	RHS	W	-	-	-	-	-	-	-
1549+520	1549+600	80.00	RHS	W	-	-	-	-	-	-	-
1549+670	1550+070	400.00	RHS	W	-	-	-	-	-	-	-
1554+970	1555+250	280.00	RHS	W	-	-	-	-	-	-	-
1555+775	1555+905	130.00	RHS	W	-	-	-	-	-	-	-
1556+015	1556+215	200.00	RHS	W	-	-	-	-	-	-	-
1560+630	1560+700	70.00	RHS	W	-	-	-	-	-	-	-
1561+020	1561+150	130.00	RHS	W	-	-	-	-	-	-	-

Crash Barrier					Gantry,VMS Board, HTMS			Bus Bays / Truck lay Byes			
Chainage (km)			Placement Location[14]	Type[15]	Location	Side	Type[16]	Location	Side	Length	Type[17]
From	To										
1561+280	1561+320	40.00	RHS	W	-	-	-	-	-	-	-
1562+260	1562+270	10.00	RHS	W	-	-	-	-	-	-	-
1562+950	1563+250	300.00	RHS	W	-	-	-	-	-	-	-
1562+950	1563+000	50.00	RHS	W	-	-	-	-	-	-	-
1563+040	1563+250	210.00	RHS	W	-	-	-	-	-	-	-
1564+720	1564+750	30.00	RHS	W	-	-	-	-	-	-	-
1564+720	1564+750	30.00	RHS - I	W	-	-	-	-	-	-	-
1565+380	1565+425	45.00	RHS - II	W	-	-	-	-	-	-	-
1565+820	1566+005	185.00	RHS - I	W	-	-	-	-	-	-	-
1565+820	1566+005	185.00	RHS - II	W	-	-	-	-	-	-	-
1566+400	1566+600	200.00	RHS	W	-	-	-	-	-	-	-
1566+430	1566+600	170.00	RHS	W	-	-	-	-	-	-	-
1566+775	1567+070	295.00	RHS	W	-	-	-	-	-	-	-
1566+775	1567+070	295.00	RHS	W	-	-	-	-	-	-	-
1567+120	1567+300	180.00	RHS	W	-	-	-	-	-	-	-
1567+120	1567+300	180.00	RHS	W	-	-	-	-	-	-	-
1567+400	1567+480	80.00	RHS	W	-	-	-	-	-	-	-
1567+770	1567+800	30.00	RHS	W	-	-	-	-	-	-	-
1567+950	1567+985	35.00	RHS	W	-	-	-	-	-	-	-
1568+100	1568+370	270.00	RHS	W	-	-	-	-	-	-	-
1568+100	1568+370	270.00	RHS	W	-	-	-	-	-	-	-
1568+425	1568+525	100.00	RHS	W	-	-	-	-	-	-	-
1568+465	1568+525	60.00	RHS	W	-	-	-	-	-	-	-
1569+240	1569+415	175.00	RHS	W	-	-	-	-	-	-	-
1569+335	1569+480	145.00	RHS	W	-	-	-	-	-	-	-
1569+540	1569+580	40.00	RHS	W	-	-	-	-	-	-	-
		20880.00									

13. Material Type: RCC, PCC, RR-Random Rubble
14. Placement location: LHS, RHS, Both , Median Single , Medain Both Sides
15. Crash Barrier Type: W-beam, CC-Concrete, NJ-New Jersy
16.Gantry Type: C-Cantilever, P- Portal, ECB- Emergency Call Box
17.Lay Byes : BB-Bus Bays ,TB-Truck Lay Byes

Annexure – 3.2

Inventory and Condition of Structures

GENERAL														SUPERSTRUCTURE		
S.NO.	BRIDGE NO.	LOCATION (Km)	NAME OF RIVER/BRIDGE	YEAR OF CONSTRUCTION	NUMBER OF SPANS	SPAN ARRANGEMENT (EXPANSION JOINT TO EXPANSION JOINT) (m)	CLEAR SPANS (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	H/L OR SUBMERSIBLE	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1		1517+510 (LHS)	Nallah	-	3	3x14.6	13.6	43.8	HL	7.5	2	8.8	1.5	RCC T-Girder	Pot-PTFE	RCC
		1517+510 (RHS)		-	3	3x14.6	13.6	43.8	HL	10.9	3	11.90	-	RCC T-Girder	Pot-PTFE	RCC
2		1539+255 (LHS)	Nallah	-	1	1x6.8	6.8	7.8	HL	7.5	2	27	-	RCC Box	NA	RCC
		1539+255 (RHS)		-	1	1x6.8	6.8	7.8	HL	7.5	2	27	-	RCC Box	NA	RCC
3		1574+655 (LHS)	Nallah	-	3	3x6.0	5	18	H/L	7.5	2	10.25	1.5	RCC Slab	Elasto meric	RCC
		1574+655 (RHS)		-	3	3x6.0	5	18	H/L	7.5	2	8.5	-	RCC Slab	Elasto meric	RCC

INVENTORY OF EXISTING BRIDGES

			APPURTENENCE WORK				SUB - STRUCTURE			FOUNDATION						
			Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used		Pier		Abutment		Protection Work		
S.NO.	BRIDGE NO.	LOCATION (Km)	HAND RAIL/PARAPET-TYPE & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER	TYPE	MATERIAL	TYPE	MATERIAL	BED PROTECTION WORK	BANK PROTECTION	RIVER TRAINING WORKS
1	2	3	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1		1517+510 (LHS)	H/R & RCC C.B	BT	Strip Seal	-	Wall	RCC	RCC	N.V	N.V	N.V	N.V	-	-	-
		1517+510 (RHS)	H/R	BT	Strip Seal	-	Wall	RCC	RCC	N.A	N.A	N.V	N.V	-	-	-
2		1539+255 (LHS)	RCC C.B	BT	Buried	-	Wall	RCC	N.A	N.A	N.A	N.V	N.V	-	-	-
		1539+255 (RHS)	RCC C.B	BT	Buried	-	Wall	RCC	N.A	N.A	N.A	N.V	N.V	-	-	-
3		1574+655 (LHS)	H/R & RCC C.B	BT	Buried	-	Wall	RCC	RCC	N.A	N.A	N.V	N.V	-	-	-
		1574+655 (RHS)	H/R & RCC C.B	BT	Buried	-	Wall	RCC	Brick Masonry	N.A	N.A	N.V	N.V	-	-	-

			PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS									
S.NO.	BRIDGE NO.	LOCATION (Km)	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET	PROTECTION WORK	EXPANSION JOINTS	VERTICAL CLEARANCE	REMARKS
1	2	3	32	33	34	35	36	37	38	39	40	41
1		1517+510 (LHS)	Good	Good	Good	Fair		Fair	NV	Fair	4	1) Strip seal is buried 2) Hand Railing is damaged 3) Material not removed from cap 4) Vegetation at Retaining wall 5) Grating at drainage spout not available
		1517+510 (RHS)	Good	Good	Good	Fair		Fair	NV	Fair	4	
2		1539+255 (LHS)	Good	-	Fair	Fair		Fair	NV	-	2	1) Vegetation 2) Weep hole not clear
		1539+255 (RHS)	Good	-	Fair	Fair		Fair	NV	-	2	
3		1574+655 (LHS)	Good	Good	Fair	Fair		Fair	NV	Fair	3	1) Reinforcement exposed and concrete damaged at slab 2) Vegetation at Pier cap 3) Hand railing is damaged 4) Expansion joint is buried
		1574+655 (RHS)	Fair	Poor	Fair	Fair		Fair	NV	Fair	1.5	

INVENTORY OF EXISTING LIGHT VEHICULAR UNDERPASSES

GENERAL										SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE			FOUNDATION				PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS							VERTICAL CLEARANCE	REMARKS
													Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used		Pier		Abutment										
S.NO.	BRIDGE NO.	LOCATION (Km)	YEAR OF CONSTRUCTION	SPAN ARRANGEMENT (EXPANSION JOINT TO EXPANSION JOINT) (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET- TYPE & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER	TYPE	MATERIAL	TYPE	MATERIAL	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	Exp. Joints	HAND RAIL / PARAPET		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1	Flyover	1539+600 (LHS)	-	1x30.0	30	9.25	2	10.25	-	PSC I-Girder	POT-PTFE	RCC	RCC Crash Barrier	BT	Strip Seal	-	Wall	RCC	-	-	-	N.V	N.V	Good	-	Good	Fair	Good	Poor	-	5.5	1) Honeycombing at bottom surface of Girder 2) Reinforcement exposed at bottom of surface of slab (small portion) 3) Drainage pipe is damaged 4) Strip Seal is not good condition
		1539+600 (RHS)	-	1x30.0	30	9.25	2	10.25	-	PSC I-Girder	POT-PTFE	RCC	RCC Crash Barrier	BT	Strip Seal	-	Wall	RCC	-	-	-	N.V	N.V	Good	-	Good	Fair	Good	Poor	-	5.5	
2	**Flyover**	**1550+700 (LHS)**	**-**	**11x26.2**	**288.2**	**7.5**	**2**	**9.25**	**0.75**	**PSC I-Girder**		**RCC**																				**MBIU**
		1550+700 (RHS)	**-**	**11x26.2**	**288.2**	**7.5**	**2**	**9.25**	**0.75**	**PSC I-Girder**		**RCC**																				
3	Flyover	1564+180 (LHS)	-	1x30.5	30.5	9.25	2	9.25	-	PSC I-Girder		RCC	RCC Crash Barrier	BT	Strip Seal	-	Wall	RCC	-	-	-	N.V	N.V	Good	-	Good	Fair	Good	Fair	-	5.5	1) Honeycombing at Crash Barrier, Dirt wall and bottom of Girder (Small Portion) 2) Tie rod not removed at wall and Girder 3) Reinforcement and cracks are found at RE Panel
		1564+180 (RHS)	-	1x30.5	30.5	9.25	2	9.25	-	PSC I-Girder		RCC	RCC Crash Barrier	BT	Strip Seal	-	Wall	RCC	-	-	-	N.V	N.V	Good	-	Good	Fair	Good	Fair	-	5.5	
4	Flyover	1573+510 (LHS)	-	1x30.5	30.5	9.25	2	9.25	-	PSC I-Girder		RCC	RCC Crash Barrier	BT	Strip Seal	50	Wall	RCC	-	-	-	N.V	N.V	Good	-	Good	Good	Good	Fair	-	5.5	1) Drainage Spout is not good condition 2) Material not removed from Abutment cap
		1573+510 (RHS)	-	1x30.5	30.5	9.25	2	9.25	-	PSC I-Girder		RCC	RCC Crash Barrier	BT	Strip Seal	50	Wall	RCC	-	-	-	N.V	N.V	Good	-	Good	Good	Good	Fair	-	5.5	
5	**Flyover**	**1578+360 (LHS)**	**-**	**2x31.0**	**62**	**9.25**	**2**	**10.25**	**-**	**PSC I-Girder**		**RCC**																				**MBIU**
		1578+360 (RHS)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**																			

INVENTORY OF EXISTING UNDERPASSES (PUP & SVUP)

GENERAL										SUPERSTRUCTURE			APPURTENENCE WORK				SUB - STRUCTURE			FOUNDATION				PRESENT CONDITION OF BRIDGE DISTRESS AND REPAIRS						VERTICAL CLEARANCE	REMARKS
													Details of railing	Details of Wearing Course	Details of Exp. Joints		Type	Materials Used		Pier		Abutment									
S.NO.	BRIDGE NO.	LOCATION (Km)	YEAR OF CONSTRUCTION	CLEAR SPAN ARRANGEMENT (m)	LENGTH OF BRIDGE FACE TO FACE OF DIRT WALL (m)	CARRIAGEWAY WIDTH BETWEEN KERBS (m)	NO. OF LANES	TOTAL OUTER WIDTH OF BRIDGE (m)	WIDTH OF FOOTPATH (m)	TYPE	TYPE OF BEARINGS	MATERIAL OF SUPERSTRUCTURE	HAND RAIL/PARAPET- TYPE & HEIGHT (m)	TYPE	TYPE	WIDTH (mm)	ABUTMENT/PIER	ABUTMENT	PIER	TYPE	MATERIAL	TYPE	MATERIAL	ABUTMENTS	PIERS	SUPERSTRUCTURE	WEARING COURSE	BEARINGS	HAND RAIL / PARAPET		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	PUP	1539+227 (LHS)	-	1X7.0	8	9.25	2-Lane	10.35	-	RCC Box	-	RCC	RCC Crash Barrier	BT	NA	NA	Wall	RCC	NA	NA	NA	Box Type	RCC	Good		Good	Fair	-	Good	3.5	1) Honeycombing at slab in small portion
		1539+227 (RHS)	-	1X7.0	8	9.25	2-Lane	10.35	-	RCC Box	-	RCC	RCC Crash Barrier	BT	NA	NA	Wall	RCC	NA	NA	NA	Box Type	RCC	Good		Good	Fair	-	Good	3.5	
2	PUP	1539+730 (LHS)	-	1X7.0	8	9.25	2-Lane	10.35	-	RCC Box	-	RCC	RCC Crash Barrier	BT	NA	NA	Wall	RCC	NA	NA	NA	Box Type	RCC	Good		Good	Fair	-	Good	3.5	1) Honeycombing at slab in small portion
		1539+730 (RHS)		1X7.0	8	9.25	2-Lane	10.35	-	RCC Box	-	RCC	RCC Crash Barrier	BT	NA	NA	Wall	RCC	NA	NA	NA	Box Type	RCC	Good		Good	Fair	-	Good	3.5	
3	SVUP	1551+000 (LHS)	-	1X7.0	8	9.25	2-Lane	10.35	-	RCC Box	-	RCC	RCC Crash Barrier	BT	NA	NA	Wall	RCC	NA	NA	NA	Box Type	RCC	Good		Good	Fair	-	Poor	4.3	1) Honeycombing at crash barrier of structure portion and approache portion
		1551+000 (RHS)		1X7.0	8	9.25	2-Lane	10.35	-	RCC Box	-	RCC	RCC Crash Barrier	BT	NA	NA	Wall	RCC	NA	NA	NA	Box Type	RCC	Good		Good	Fair	-	Poor	4.3	
4	SVUP	1554+525 (LHS)	-	1X10.5	11.5	9.25	2-Lane	10.35	-	RCC Box	-	RCC	RCC Crash Barrier	BT	NA	NA	Wall	RCC	NA	NA	NA	Box Type	RCC	Good		Good	Fair	-	Fair	4.0	1) Concrete damaged and honeycombing at edge of slab in small portion 2) Honeycombing at crash barrier and bottm of approach slab 3) Reiforcement exposed and cracks at 15 Nos RE Panel 4) Toe rod not removed
		1554+525 (RHS)		1X10.5	11.5	9.25	2-Lane	10.35	-	RCC Box	-	RCC	RCC Crash Barrier	BT	NA	NA	Wall	RCC	NA	NA	NA	Box Type	RCC	Good		Good	Fair	-	Fair	4.0	
5	PUP	1571+533 (LHS)	-	1X10.5	11.5	9.25	2-Lane	10.35	-	RCC Box	-	RCC	RCC Crash Barrier	BT	NA	NA	Wall	RCC	NA	NA	NA	Box Type	RCC	Good		Good	Poor	-	Good	3.5	
		1571+533 (RHS)		1X10.5	11.5	9.25	2-Lane	10.35	-	RCC Box	-	RCC	RCC Crash Barrier	BT	NA	NA	Wall	RCC	NA	NA	NA	Box Type	RCC	Good		Good	Poor	-	Good	3.5	

Annexure – 3.3

Inventory and Condition of Culverts

INVENTORY AND CONDITION SURVEY FOR CULVERTS

SL. No.	Location (Km)	Type of Structure (Pipe / Slab / Box / Arch)	Span Arrangement (No. x Slab Length) (m)	Superstructure		Substructure		Vent Height (m)	Median Width (m)	Carriageway Width (m)	Fill (m)	Formation Width (m)	Width of Culvert (m)	Length of Wing/Return Wall (m)		Parapet / Head Wall / CB				Condition of various Components of Culvert						Bed protections		Scour		Adequacy of Water way	Remarks
				Type	Thick	Type	Thick							Length (m)	Material	Height (m)	Width (m)	Length (m)	Material	Pipe/ Slab/ Box/ Arch	Head Wall	Abut ment Wall	Wing Wall	Return Wall	Parapet / Hand Rail	U/S	D/S	U/S	D/S		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	1516+455	Box	1x2.0	-	-	-	-	-	4.5	17.50	-	23.00	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1. Vegetation. 2.Hand railing/Parapet wall not found on BHS.
2	1517+410	Box	1x3.0	RCC	0.25	RCC	0.25	4.00	4.5	17.50	-	23.00	24	Return wal 7.0	RCC	CB 0.95	0.45	4.00	RCC	Good	Good	Good	-	Good	Good	-	-	-	-	-	-
3	1518+475	Box	1x2.0	RCC	0.25	RCC	0.25	1.50	4.5	17.50	-	25.50	26.5	Return wall 3.0	RCC	NA	NA	NA	NA	Good	-	Good	-	Good	-	-	-	-	-	-	1. Vegetation. 2.Hand railing/Parapet wall not found on BHS.
4	1519+500	Box	1x4.0	RCC	0.30	RCC	0.3	2.00	4.5	17.50	0.3	27.00	28	Return wall 8.0	RCC	Parapet 0.35m	0.3	12	Brick Masonry	Good	-	Fair	-	Good	Fair	-	-	-	-	-	1. Lined Canal. 2. Abutment wall Crack on LHS
5	1520+410	Box	1x1.5	RCC	0.25	RCC	0.25	1.00	4.5	17.50	0.3	28.00	29	Return wall 3.0	RCC	-	-	-	-	Good	-	Good	-	Good	-	-	-	-	-	-	1. Vegetation. 2.Hand railing/Parapet wall not found on BHS.
6	1521+340	Box	1x3.0	-	-	-	-	N.V	4.5	17.50	-	27.00	28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1. Vegetation. 2.Hand railing/Parapet wall not found on BHS.
7	1522+157	Box	1x2.0	-	-	-	-	N.V	4.5	17.50	-	30.00	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1. Not Found at site 2. Hand railing/Parapet wall not found on BHS.
8	1523+080	Box	1x2.0	RCC	0.25	RCC	0.25	2.00	4.5	17.50	-	29.00	30	Return wall 5m.	RCC	-	-	-	-	Good	-	Good	-	Good	-	-	-	-	-	-	1. Vegetation. 2.Hand railing/Parapet wall not found on BHS.
9	1523+250	Box	1x2.0	RCC	0.25	RCC	0.25	2.00	4.5	17.50	-	25.00	26	Return wall 9m.	RCC	CB 0.95	0.45	4.00	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	-
10	1523+670	Box	1x2.0	-	-	-	-	-	4.5	17.50	-	29.00	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1. Not Found at site 2. Hand railing/Parapet wall not found on BHS.
11	1524+235	Box	1x3.0	RCC	0.25	RCC	0.25	2.50	4.5	17.50	-	25.00	26	Return wall 9m.	RCC	-	-	-	-	Good	-	Good	-	Good	-	-	-	-	-	-	1. Vegetation. 2.Hand railing/Parapet wall not found on BHS.
12	1524+810	Box	1x4.0	RCC	0.25	RCC	0.25	2.50	4.5	17.50	-	29.00	30	Return wall 9m.	RCC	MBCB	-	10	-	Good	-	Good	-	Good	-	-	-	-	-	-	1. Vegetation. 2.Hand railing/Parapet wall not found on BHS.
13	1524+970	Box	1x5.0	RCC	0.25	RCC	0.25	2.50	4.5	17.50	-	29.00	30	Return wall 9m L/S	RCC	-	-	-	-	Good	-	Good	-	Good	-	-	-	-	-	-	1. Vegetation. 2.Hand railing/Parapet wall not found on BHS.
14	1525+380	Box	1x1.5	-	-	RCC	0.25	1.00	4.5	17.50	-	29.00	30	Return wall 6M	RCC	-	-	-	-	Good	-	Good	-	Good	-	-	-	-	-	-	1. Vegetation. 2.Hand railing/Parapet wall not found on BHS.
15	1526+560	Box	1x3.5	RCC	0.25	RCC	0.25	2.00	4.5	17.50	-	26.00	27	Return wall 12m	RCC	MBCB R/S	-	-	-	Good	-	Good	-	Fair	-	-	-	-	-	-	1.Vegetation. 2. Hand railing/Parapet wall not found on BHS. 3. Metal beam Crush barrier damaged R/S
16	1527+535	Box	1x1.5	RCC	0.25	RCC	0.25	2.50	4.5	17.50	0.4	33.00	34	Return wall 9m	RCC	-	-	-	-	Good	-	Good	-	Good	-	-	-	-	-	-	1.Vegetation. 2. Hand railing/Parapet wall not found on BHS.
17	1528+170	Box	1x1.5	RCC	0.25	RCC	0.25	1.20	4.5	17.50	-	26.00	27	Return wall 9m	RCC	-	-	-	-	Good	-	Good	-	Good	-	-	-	-	-	-	1.Vegetation. 2. Hand railing/Parapet wall not found on BHS.
18	1529+313	Box	1x1.5	RCC	0.25	RCC	0.25	0.60	4.5	17.50	-	26.00	27	Return wall 4.1	RCC	CB 0.95	0.45	10.20	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	1. Vegetation.
19	1529+772	Box	1x1.5	RCC	0.25	RCC	0.25	0.60	4.5	17.50	-	27.00	28	Return wall 3.0	RCC	-	-	-	-	Good	-	Good	-	Good	-	-	-	-	-	-	1.Vegetation. 2. Hand railing/Parapet wall not found on BHS.
20	1531+085	Box	1x2.0	RCC	0.25	RCC	0.25	0.60	4.5	17.50	-	32.00	33	Return wall 3.0	RCC	-	-	-	-	Good	-	Good	-	Good	-	-	-	-	-	-	1.Vegetation on RHS. 2. Hand railing/Parapet wall not found on BHS.
21	1531+500	Box	1x2.0	RCC	0.25	RCC	0.25	0.60	4.5	17.50	-	31.00	32	Return wall 3.0	RCC	-	-	-	-	Good	-	Good	-	Good	-	-	-	-	-	-	1.Vegetation on RHS. 2. Hand railing/Parapet wall not found on BHS.

SL. No.	Location (Km)	Type of Structure (Pipe / Slab / Box / Arch)	Span Arrangement (No. x Slab Length) (m)	Superstructure		Substructure		Vent Height (m)	Median Width (m)	Carriageway Width (m)	Fill (m)	Formation Width (m)	Width of Culvert (m)	Length of Wing/Return Wall (m)		Parapet / Head Wall / CB				Condition of various Components of Culvert						Bed protections		Scour		Adequacy of Water way	Remarks
				Type	Thick	Type	Thick							Length (m)	Material	Height (m)	Width (m)	Length (m)	Material	Pipe/ Slab/ Box/ Arch	Head Wall	Abut ment Wall	Wing Wall	Return Wall	Parapet / Hand Rail	U/S	D/S	U/S	D/S		
22	1532+405	Box	1x2.0	-	-	-	-	-	4.5	17.50	NV	31.00	32	NV	NV	-	-	-	-	Good	-	Good	-	Good	-	-	-	-	-	-	1.Vegetation 2. Hand railing/Parapet wall not found on BHS.
23	1532+960	Box	1x1.5	RCC	0.25	RCC	0.25	0.60	4.5	17.50	0.5	27.00	28	Return wall 3.0m	RCC	-	-	-	-	Good	-	Good	-	Good	-	-	-	-	-	-	1.Vegetation 2. Hand railing/Parapet wall not found on BHS.
24	1533+800	Box	1x2	RCC	0.30	RCC	0.25	0.60	4.5	17.50	0.3	26.00	27	Return wall 3.0	RCC	-	-	-	-	Good	-	Good	-	Good	-	-	-	-	-	-	1. Not visible due to heavy vegitation B/S. 2. Hand railing/Parapet wall not found on BHS.
25	1534+105	Box (LHS)	1x3.0	-	-	-	-	-	2.25	8.75	NV	28	29	NV	NV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1. Not visible both side due heavy vegitation. 2. Hand railing/Parapet wall not found on BHS.
		Slab (RHS)	1x3.0	-	-	-	-	-	2.25	8.75	NV			NV	NV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
26	1534+723	Box	1x2.5	RCC	0.25	RCC	0.25	0.40	4.5	17.50	NV	26.00	27	Return wall 1.0m	RCC	-	-	-	-	Good	-	Good	-	Good	-	-	-	-	-	-	1. Hand railing/Parapet wall not found on BHS. 2. Vegetation and Water Logining
27	1535+255	Box	1x2.0	RCC	0.25	RCC	0.25	1.20	4.5	17.50	NV	25.00	26	Return wall 3.3m	RCC	-	-	-	-	Good	-	Good	-	Good	-	-	-	-	-	-	1. Rainforce expose at top. 2. Hand railing/Parapet wall not found on BHS. 3. Vegetation and Water Logining
28	1535+510	Box	1x2.0	NV	NV	NV	NV	NV	4.5	17.50	-	32.00	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1. Not Found at site 2. Hand railing/Parapet wall not found on BHS.
29	1535+670	Box	1x2.0	RCC	0.30	RCC	0.25	1.00	4.5	17.50	0.6	33.00	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1. Vegetation and Water Logining 2.Hand railing/Parapet wall not found on BHS.
30	1536+185	Box	1x2.5	RCC	0.30	RCC	0.25	1.50	4.5	17.50	1.2	33.00	34	Return wall 3.0m	RCC	-	-	-	-	Good	-	Good	-	Good	-	-	-	-	-	-	1. Vegetation and Water Logining 2.Hand railing/Parapet wall not found on BHS.
31	1536+775	Box	1x1.5	RCC	0.30	RCC	0.30	-	4.5	17.50	2.0	35.00	36	NV	NV	-	-	-	-	Good	-	Good	-	Good	-	-	-	-	-	-	1. Vegetation and Water Logining 2.Hand railing/Parapet wall not found on BHS.
32	1537+345	Box	1x1.5	RCC	0.25	RCC	0.25	1.40	4.5	17.50	-	31.00	32	Return wall 4.5m	RCC	-	-	-	-	Good	-	Good	-	Good	-	-	-	-	-	-	1. Vegetation and Water Logining 2.Hand railing/Parapet wall not found on BHS.
33	1537+660	Box	1x1.5	-	-	-	-	-	3.00	17.50	-	34.00	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1. Not Found at site 2. Hand railing/Parapet wall not found on BHS.
34	1538+090	Box	1x2.0	RCC	0.25	RCC	0.25	1.00	1.50	17.50	-	30.00	31	Return wall 4.0m	RCC	CB 0.95	0.45	10.00	RCC	Good	-	Good	-	Good	-	-	-	-	-	-	1. Vegetation and Water Logining 2.Hand railing/Parapet wall not found on RHS.
35	1538+230	Pipe	2x1	-	-	-	-	-	1.50	17.50	-	31.00	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
36	1538+281	Box	1 x 1.5	-	-	-	-	-	1.50	17.50	-	39.00	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1. Not Found at site 2. Hand railing/Parapet wall not found on BHS.
37	1538+700	Box	1x3.0	RCC	0.40	RCC	0.50	3.70	1.50	17.50	-	37.00	38	Return wall 8.0m	RCC	Parapet 0.5	0.5	0.40	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
38	1539+220	Pipe	2x1	-	-	-	-	-	2.50	17.50	-	33.00	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
39	1539+311	Box	1x3.0	-	-	-	-	-	2.50	17.50	-	33.00	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1. Not Found at site 2. Hand railing/Parapet wall not found on BHS.
40	1539+363	Pipe	1x1	-	-	-	-	-	2.50	17.50	-	34.00	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
41	1539+515	Pipe	1x1	-	-	-	-	-	2.50	17.50	-	34.00	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
42	1539+709	Box	1x3.0	RCC	0.50	RCC	0.50	4.20	2.50	17.50	-	33.00	34	Return wall 6.5m	RCC	CB 0.95	0.45	6.50	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
43	1540+085	Box	1x1.5	RCC	0.25	RCC	0.25	2.00	2.50	17.50	-	33.00	34	Return wall 3.0m	RCC	NA	NA	NA	NA	Good	-	-	-	-	-	-	-	-	-	-	1. Vegetation and Water Logining 2.Hand railing/Parapet wall not found on BHS.

SL. No.	Location (Km)	Type of Structure (Pipe / Slab / Box / Arch)	Span Arrangement (No. x Slab Length) (m)	Superstructure		Substructure		Vent Height (m)	Median Width (m)	Carriageway Width (m)	Fill (m)	Formation Width (m)	Width of Culvert (m)	Length of Wing/Return Wall (m)		Parapet / Head Wall / CB				Condition of various Components of Culvert						Bed protections		Scour		Adequacy of Water way	Remarks
				Type	Thick	Type	Thick							Length (m)	Material	Height (m)	Width (m)	Length (m)	Material	Pipe/ Slab/ Box/ Arch	Head Wall	Abut ment Wall	Wing Wall	Return Wall	Parapet / Hand Rail	U/S	D/S	U/S	D/S		
44	1540+290	Pipe	2x1.2	-	-	-	-	5.00	-	-	-	57.45	58.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
45	1542+270	Pipe	2x1.2	-	-	-	-	2.00	-	-	-	34.40	35.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
46	1543+750	Pipe	4x1.2	-	-	-	-	-	4.50	17.50	-	48.40	49.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
47	1545+390	Box	1x3.0	RCC	0.30	RCC	0.25	1.00	4.50	17.50	1.2	27.00	28	Return wall 3.5m	RCC	-	-	-	-	Good	-	Good	-	Good	-	-	-	-	-	-	1. Vegetation and Water Logining 2.Hand railing/Parapet wall not found on BHS.
48	1546+675	Box (LHS)	1x3.0	RCC	0.50	RCC	0.50	1.30	2.25	8.75	-	27	28	-	-	-	-	-	-	Good	-	Good	-	-	-	-	-	-	-	-	1. Vegetation and Water Logining 2.Hand railing/Parapet wall not found on BHS. 3.returnwall not found on LHS
		Slab (RHS)		RCC	0.40	Brick Masonry	0.60	1.30	2.25	8.75	-			Return wall 3.5m	RCC	-	-	-	-	Fair	-	Fair	-	Fair	-	-	-	-	-	-	
49	1547+660	Box (LHS)	1x3.0	RCC	0.30	RCC	0.30	1.70	2.25	8.75	0.5	25	26	Return wall 5.0m	RCC	-	-	-	-	Good	-	Good	-	-	-	-	-	-	-	-	1. Vegetation and Water Logining 2.Hand railing/Parapet wall not found on BHS.
		Slab (RHS)		RCC	0.30	Brick Masonry	0.50	1.30	2.25	8.75	0.3			W/Wall 3.0m	Brick Masonry	-	-	-	-	Fair	-	Fair	-	Fair	-	-	-	-	-	-	
50	1548+275	Box	1x3.0	RCC	0.30	RCC	0.30	1.70	4.50	17.50	1.2	33	34	Return wall 4.0m	RCC	-	-	-	-	Good	-	Good	-	Good	-	-	-	-	-	-	1. Vegetation and Water Logining 2.Hand railing/Parapet wall not found on BHS.
51	1549+220	Box	1x3.0	-	-	-	-	-	4.50	17.50	-	31	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1. Not Found at site 2. Hand railing/Parapet wall not found on BHS.
52	1550+230	Box (Service road end to end)	1x2.0	RCC	0.40	RCC	0.40	0.60	1.50	15.00	-	36	37	Return wall 4.0m	RCC	CB 0.95	0.45	11.50	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	1. RCC C.B Damaged 0.5m
53	1551+535	Box	1x1.5	RCC	0.25	RCC	0.25	1.20	2.25	17.50	-	25	26	Return wall 3.0m	RCC	CB 0.95	0.45	8.00	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
54	1552+660	Box	1x1.5	RCC	0.25	RCC	0.25	0.70	2.25	17.50	-	34	35	Return wall 4.0m	RCC	CB 0.95 & Parapet 1.0	0.45	CB 2.5 & Parapet 8.0	RCC & Brick	Good	-	Good	-	Good	Good	-	-	-	-	-	
55	1553+045	Box	1 x 1.0	-	-	-	-	-	2.25	17.50	-	34	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1. Not Found at site 2. Hand railing/Parapet wall not found on BHS.
56	1553+875	Box	1x2.0	RCC	0.30	RCC	0.30	0.40	2.50	17.50	-	34	35	Return wall 4.0m	RCC	CB 0.95	0.45	3.50	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
57	1554+780	Box	1x3.0	RCC	0.40	RCC	0.40	1.00	1.20	17.50	0.8	39	40	Return wall 5.0m	RCC	CB 0.95	0.45	4.80	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
58	1555+120	Box	1x 1.5	RCC	0.30	RCC	0.30	1.20	2.50	17.50	-	39	40	Return wall 4.0m	RCC	-	-	-	-	Good	-	Good	-	Good	-	-	-	-	-	-	1. Vegetation and Water Logining 2.Hand railing/Parapet wall not found on BHS.
59	1556+385	Box	1x1.0	RCC	0.25	RCC	0.25	1.20	2.25	17.50	1.2	35	36	Return wall 3.2m	RCC	CB 0.95	0.45	2.50	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
60	1557+290	Box	1x2.5	RCC	0.25	RCC	0.25	0.60	2.50	17.50	-	29	30	Return wall 2.5m	RCC	-	-	-	-	Good	-	Good	-	-	-	-	-	-	-	-	1. Vegetation and Water Logining 2.Hand railing/Parapet wall not found on BHS.
61	1558+080	Box	1 x 1.0	RCC	0.25	RCC	0.25	0.50	2.50	17.50	-	39	40	Return wall 3.5m	RCC	-	-	-	-	Good	-	Good	-	-	-	-	-	-	-	-	1. Vegetation. 2.Hand railing/Parapet wall not found on BHS.
62	1558+440	Box (LHS)	1x 2.0	RCC	0.30	NV	NV	NV	1.25	8.75	-	40	41	-	RCC	CB 0.95	0.45	7.00	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
		Slab (RHS)		RCC	0.30	NV	NV	NV	1.25	8.75	-			-	-	-	-	-	-	Fair	-	Fair	-	-	-	-	-	-	-	-	1. Vegetation 2.Hand railing/Parapet wall not found on RHS.
63	1558+820	Box	1x1.0	RCC	0.30	RCC	0.30	0.50	2.50	17.50	-	36	37	Return wall 4.0m	RCC	CB 0.95	0.45	10.20	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
64	1560+705	Box (LHS)	1x1.5	RCC	0.30	RCC	0.30	0.50	2.25	8.75	-	27	28	Return wall 3.5m	RCC	CB 0.95	0.45	2.50	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
		Slab (RHS)		RCC	0.30	RCC	0.50	0.50	2.25	8.75	-			Return wall 1.2m	Brick Masonry	Parapet 1.0	0.40	3.00	RCC	Fair	-	Fair	-	Fair	Fair	-	-	-	-	-	

SL. No.	Location (Km)	Type of Structure (Pipe / Slab / Box / Arch)	Span Arrangement (No. x Slab Length) (m)	Superstructure		Substructure		Vent Height (m)	Median Width (m)	Carriageway Width (m)	Fill (m)	Formation Width (m)	Width of Culvert (m)	Length of Wing/Return Wall (m)		Parapet / Head Wall / CB				Condition of various Components of Culvert						Bed protections		Scour		Adequacy of Water way	Remarks
				Type	Thick	Type	Thick							Length (m)	Material	Height (m)	Width (m)	Length (m)	Material	Pipe/ Slab/ Box/ Arch	Head Wall	Abut ment Wall	Wing Wall	Return Wall	Parapet / Hand Rail	U/S	D/S	U/S	D/S		
65	1561+305	Box	1x1.0	RCC	0.30	RCC	0.30	0.50	4.50	17.50	-	27	28	Return wall 3.5m	RCC	CB 0.95	0.45	2.50	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	1. Vegetation. 2.Hand railing/Parapet wall not found on RHS.
66	1562+000	Box	1x1.5	RCC	0.25	RCC	0.25	0.60	4.25	17.50	-	26	27	Return wall 1.0m	RCC	CB 0.95	0.45	2.00	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
67	1562+150	Box (LHS)	1x1.95	RCC	0.30	RCC	0.30	1.30	4.25	17.50	-	26	27	Return wall 4.5m	RCC	CB 0.95	0.45	2.50	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	1. Vegetation. 2.Hand railing/Parapet wall not found on RHS. 3. Return Wall Damge on BHS 4.Reinforcement exposed at slab edge corner on RHS
		Slab (RHS)		RCC	0.30	Brick Masonry	0.50	1.30			-			Return wall 2.0m	Brick Masonry	-	-	-	-	Fair	-	Fair	-	Fair	Fair	-	-	-	-	-	
68	1563+060	Box	1x3.0	RCC	0.30	RCC	0.30	1.10	4.50	17.50	-	26	27	Return wall 4.5m	RCC	CB 0.95	0.45	3.50	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
69	1564+277	Box	1x1.40	RCC	-	RCC	-	-	4.50	17.50	-	26	27	Return wall 3.0m	RCC	CB 0.95	0.45	2.50	RCC	Good	-	Good	-	Good	-	-	-	-	-	-	1. Not Found at site 2. Hand railing/Parapet wall not found on BHS.
70	1565+175	Box	1x2.0	RCC	0.25	RCC	0.25	1.00	4.50	17.50	-	26	27	Return wall 3.0m	RCC	CB 0.95	0.45	2.50	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
71	1565+955	Box (LHS)	1x4.0	RCC	0.40	RCC	0.40	1.90	2.25	8.75	-	26	27	Return wall 3.5m	RCC	CB 0.95	0.45	4.50	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
		Slab (RHS)		RCC	0.40	Brick Masonry	0.50	2.20	2.25	8.75	-			W/Wall 4.0m	RCC	Parapet 1.0m	0.50	5.00	Brick Masonry	Fair	-	Fair	-	Fair	Fair	-	-	-	-	-	
72	1567+730	Box (LHS)	1x3.0	RCC	0.40	RCC	0.40	1.20	2.125	8.75	-	28	29	Return wall 1.8m	RCC	CB 0.95	0.45	3.50	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
		Slab (RHS)		RCC	0.40	Brick Masonry	0.50	1.40	2.125	8.75	-			Return wall 1.8m	RCC	Parapet 1.0m	0.50	7.50	Brick Masonry	Fair	-	Fair	-	Fair	Fair	-	-	-	-	-	
73	1568+455	Box (LHS)	1x4.8	RCC	0.40	RCC	0.40	1.20	2.125	8.75	-	28.5	29.5	Return wall 4.0m	RCC	CB 0.95	0.45	5.50	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
		Slab (RHS)		RCC	0.40	Brick Masonry	0.60	1.60	2.125	8.75	-			Return wall 2.0m	Brick Masonry	Parapet 1.0m	0.50	6.00	Brick Masonry	Fair	-	Fair	-	Fair	Fair	-	-	-	-	-	
74	1569+535	Box	1x1.5	RCC	0.25	RCC	0.25	0.30	4.50	17.50	-	27	28	Return wall 4.0m	RCC	CB 0.95	0.45	2.00	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
75	1570+450	Box	1x1.5	RCC	0.25	RCC	0.25	2.20	1.50	17.50	0.6	35	36	Return wall 4.5m	RCC	CB 0.95	0.45	11.50	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
76	1571+265	Box	1x5.0	RCC	0.40	RCC	0.40	2.40	4.25	17.50	-	38	39	Return wall 4.5m	RCC	CB 0.95	0.45	14.30	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
77	1572+300	Box	1x2.0	RCC	0.25	RCC	0.25	1.20	4.50	17.50	-	25	26	Return wall 3.0m	RCC	CB 0.95	0.45	2.50	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
78	1572+872	Box	1x3.0	RCC	0.25	RCC	0.25	2.00	4.25	17.50	-	34	35	Return wall 3.5m	RCC	CB 0.95	0.45	3.50	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
79	1573+392	Box	1x1.5	RCC	0.25	RCC	0.25	1.20	1.25	17.90	-	39	40	Return wall 3.5m	RCC	CB 0.95	0.45	2.00	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
80	1574+505	Box	1x1.5	RCC	0.25	RCC	0.25	1.00	4.25	17.50	-	29	30	Return wall 3.5m	RCC	CB 0.95	0.45	2.00	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
81	1574+850	Box (LHS)	1x4.3	RCC	0.40	RCC	0.40	3.00	2.150	8.75	-	25	26	W/Wall 3.0m	RCC	Parapet 1.0m	0.45	5.10	Brick Masonry	Good	-	Good	Fair	-	Good	-	-	-	-	-	
		Slab (RHS)		RCC	0.40	Brick Masonry	0.60	3.00	2.150	8.75	-			NV	NV	Parapet 1.0m	0.50	6.00	Brick Masonry	Fair	-	Good	-	-	Good	-	-	-	-	-	
82	1574+970	Box	1x1.0	RCC	0.25	RCC	0.25	0.60	4.30	17.50	-	27	28	Return wall 3.5m	RCC	CB 0.95	0.45	1.50	RCC	Fair	-	Fair	-	Good	Good	-	-	-	-	-	1. Vegetation. 2. Reinforcement exposed at slab edge corner on RHS 3. Vent Closed by local public on LHS.
83	1575+350	Box	1x1.5	RCC	0.25	RCC	0.25	1.40	4.25	17.50	-	27	28	Return wall 4.0m	RCC	CB 0.95	0.45	2.00	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
84	1576+420	Box	1x1.5	RCC	0.25	RCC	0.25	1.40	4.40	17.50	-	30.5	31.5	Return wall 3.0m	RCC	CB 0.95	0.45	2.00	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	
85	1577+680	Box	1x6.0	RCC	0.40	RCC	0.40	1.40	4.25	16.25	-	24	25	Return wall 4.0m	RCC	CB 0.95	0.45	6.50	RCC	Good	-	Good	-	Good	Good	-	-	-	-	-	

Annexure – 4.1

Methodology of NSV

1 NETWORK SURVEY VEHICLE (NSV)

The NSV was used for collection of condition data for the project highway. Road Runner (NSV) is a multi-faceted road survey equipment which could be configured to collect a wide range of pavement condition and asset inventory data.

Road Runner NSV is capable of collecting Road Roughness, Rutting, Pavement distresses, Asset Inventory along with GPS and Reference/ corresponding chainage simultaneously.

The main components which are integrated into Road Runner NSV are

a) Digital Laser Profilers (DLP) -Road roughness and rutting.
b) Digital Imaging System (DIS) -Pavement distresses and road assets data.
c) Differential Global Positioning System (DGPS).
d) High Resolution Distance Measuring Instrument (HRDMI).

Figure 1: Road Runner NSV

a) Digital Laser Profiler (DLP)

- DLP is integrated into the NSV consisting of eleven lasers to collect Road Roughness and Rutting.
- This inertial profiler is capable of recording the data continuously along each wheel path.

a) Roughness

Road Runner NSV equipment fitted with dual wheel path Laser Profilometer to collect Roughness data. The roughness data was collected and reported for 100 m interval.

The outputs of the lasers and accelerometers located in each wheel path (750 mm either side of the Centre line of the vehicle) are sampled every 15 mm of longitudinal travel and used to calculate the longitudinal profile of the road.

The profile is then passed through the Quarter Car model to calculate the International Roughness Index (IRI) lane roughness as per the methodologies specified in the ASTM E-950.

b) Rutting

Rutting will be measure and reported through DLP and the data will be recorded at every 100m interval on both the wheel paths.

c) Digital Imaging System (DIS)

Digital Imaging System (DIS) in Network Survey Vehicle (NSV) consist of 5 high resolution roof mounted cameras to capture pavement distresses and road assets data. These cameras are oriented in a certain configuration to ensure that the information of interest, such as inventory or condition, is being recorded in the camera field of view. Three cameras are forward facing and mounted on front side of vehicle (Left corner, Centre and Right corner), covers 160° angle images and are set to sample at every 10m interval. Another two cameras are mounted on back side of the vehicle (Left corner, Right corner) to capture the distress image of pavement 10m*4m (length*width) i.e., captures @10m interval.

Digital image system is capable of

- Collecting real time digital images.
- Achieving a sampling rate of at least one set per 2.5 meters for Distress camera's and one set per 10 meters for Asset cameras.
- Incorporating real time Differentially corrected GPS (DGPS).
- Capturing & recording at highway speeds.
- Providing real time on-screen displays for operator verification during collection.
- Storing images straight to PC's / NAS (Network Attached Storage).
- Linking into the client's referencing system via distance and GPS.

d) Geo Referencing (DGPS Data)

Road Runner NSV is equipped with DGPS system, and it do collect all the data and images with geo-reference. Reference that image against GPS co-ordinates by logging the latitude, longitude of the specific image.

e) Distance Measuring Instrument (DMI)

Road Runner NSV is equipped with DMI, and it is fitted to rear tyre of the Network survey vehicle. The Distance and speed measurement performed by the distance measuring instrument which is a distance transducer and highly accurate and GPS distance and speed can also be calculated.

Figure 2: Distance Measuring Instrument

Annexure – 4.2

Strip Chart for Pavement Distresses

Orai to Barah Section of NH-27 in the state of Uttar Pradesh

LHS Carriageway

From km		1515+713	1516+000	1517+000	1518+000	1519+000	1520+000	1521+000	1522+000	1523+000	1524+000	1525+000	1526+000	1527+000	1528+000	1529+000	1530+000	1531+000	1532+000	1533+000	1534+000	1535+000	1536+000	1537+000	1538+000	1539+000	1540+000	1541+000	1542+000	1543+000	1544+000	1545+000	1546+000
To Km		1516+000	1517+000	1518+000	1519+000	1520+000	1521+000	1522+000	1523+000	1524+000	1525+000	1526+000	1527+000	1528+000	1529+000	1530+000	1531+000	1532+000	1533+000	1534+000	1535+000	1536+000	1537+000	1538+000	1539+000	1540+000	1541+000	1542+000	1543+000	1544+000	1545+000	1546+000	1547+000
Cracking	Area (%)	8.40%	2.33%	1.54%	0.80%	0.40%	2.74%	0.10%	1.68%	0.70%	0.88%	2.62%	3.15%	3.39%	2.23%	1.77%	3.81%	2.87%	0.43%	1.15%	5.94%	7.56%	7.61%	12.41%	12.46%	17.15%	7.81%	4.35%	2.25%	4.77%	4.18%	7.04%	1.50%
	Rating																																
Patching (%)	Area (%)	0.43%	1.41%	0.76%	1.27%	0.11%	0.21%	0.14%	0.15%	0.38%	0.05%	1.09%	0.74%	1.68%	1.07%	1.04%	0.29%	0.83%	0.07%	0.10%	0.16%	0.04%	0.12%	0.56%	0.53%	0.53%	0.37%	0.10%	0.10%	0.02%	0.06%	0.52%	0.23%
	Rating																																
Rutting	mm	8	9	7	11	8	8	7	7	8	6	10	11	10	8	6	6	6	6	6	6	6	6	7	8	10	6	6	6	6	6	6	6
	Rating																																
Rughness	UI (mm/km)	2073	2040	2167	2487	2176	1503	1155	1480	1459	1422	2194	3032	3000	1944	1899	1579	1783	1549	1251	1771	1303	1397	1585	2690	2528	2698	1989	1523	1509	1369	1419	1444
	Rating																																
Condition On Distress		FAIR	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	FAIR	FAIR	FAIR	POOR	POOR	POOR	FAIR	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD
Condition on roughness		FAIR	FAIR	FAIR	POOR	FAIR	GOOD	GOOD	GOOD	GOOD	GOOD	FAIR	POOR	POOR	FAIR	FAIR	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	POOR	POOR	POOR	FAIR	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD

GOOD
FAIR
POOIR

Orai to Barah Section of NH-27 in the state of Uttar Pradesh

LHS Carriageway

From km		1547+000	1548+000	1549+000	1550+000	1551+000	1552+000	1553+000	1554+000	1555+000	1556+000	1557+000	1558+000	1559+000	1560+000	1561+000	1562+000	1563+000	1564+000	1565+000	1566+000	1567+000	1568+000	1569+000	1570+000	1571+000	1572+000	1573+000	1574+000	1575+000	1576+000	1577+000	1578+000
To Km		1548+000	1549+000	1550+000	1551+000	1552+000	1553+000	1554+000	1555+000	1556+000	1557+000	1558+000	1559+000	1560+000	1561+000	1562+000	1563+000	1564+000	1565+000	1566+000	1567+000	1568+000	1569+000	1570+000	1571+000	1572+000	1573+000	1574+000	1575+000	1576+000	1577+000	1578+000	1579+000
Cracking	Area (%)	1.04%	1.95%	5.79%	0.98%	3.42%	0.98%	0.41%	1.40%	0.34%	1.55%	0.82%	1.62%	0.02%	0.44%	0.02%	0.16%	1.13%	1.04%	0.00%	0.41%	0.34%	0.00%	0.28%	0.34%	0.56%	0.16%	0.00%	0.15%	0.17%	0.14%	0.00%	0.10%
	Rating																																
Patching (%)	Area (%)	0.04%	0.18%	0.11%	0.12%	0.15%	0.05%	0.35%	0.31%	0.39%	0.59%	0.34%	0.88%	0.29%	0.65%	0.12%	0.13%	0.21%	0.19%	0.06%	0.02%	0.00%	0.03%	0.07%	0.01%	0.16%	0.05%	0.06%	0.46%	0.01%	0.00%	0.05%	0.04%
	Rating																																
Rutting	mm	5	5	6	5	6	5	8	9	7	6	7	7	5	6	5	5	5	6	5	4	5	5	5	5	5	4	5	5	6	5	6	6
	Rating																																
Rughness	UI (mm/km)	1097	1152	1298	1864	1731	1563	1543	2039	1684	1532	1252	1821	1106	1291	1276	1473	1726	2206	1171	1356	1593	1288	1517	1717	1765	1729	1657	1692	1585	1370	1269	1575
	Rating																																
Condition On Distress		GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD
Condition on roughness		GOOD	GOOD	GOOD	FAIR	GOOD	GOOD	GOOD	FAIR	GOOD	GOOD	GOOD	FAIR	GOOD	GOOD	GOOD	GOOD	GOOD	FAIR	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD

GOOD
FAIR
POOIR

Orai to Barah Section of NH-27 in the state of Uttar Pradesh

RHS Carriageway

From km		1578+530	1516+000	1517+000	1518+000	1519+000	1520+000	1521+000	1522+000	1523+000	1524+000	1525+000	1526+000	1527+000	1528+000	1529+000	1530+000	1531+000	1532+000	1533+000	1534+000	1535+000	1536+000	1537+000	1538+000	1539+000	1540+000	1541+000	1542+000	1543+000	1544+000	1545+000	1546+000
To Km		1578+500	1517+000	1518+000	1519+000	1520+000	1521+000	1522+000	1523+000	1524+000	1525+000	1526+000	1527+000	1528+000	1529+000	1530+000	1531+000	1532+000	1533+000	1534+000	1535+000	1536+000	1537+000	1538+000	1539+000	1540+000	1541+000	1542+000	1543+000	1544+000	1545+000	1546+000	1547+000
Cracking	Area (%)	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Rating																																
Patching (%)	Area (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.05%	0.03%	0.04%	0.00%	0.02%	0.16%	0.02%	0.02%	0.20%	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.08%	0.00%	0.00%
	Rating																																
Rutting	mm	3	3	3	3	3	3	3	3	4	3	3	3	4	4	4	4	3	3	4	3	3	3	4	4	3	3	3	4	5	5	4	5
	Rating																																
Rughness	UI (mm/km)	1072	928	889	1107	1119	1358	1209	1194	1028	1042	864	1025	1275	985	1431	1210	1062	1033	1032	1010	1101	1103	957	924	1188	1156	1163	1256	1634	1086	1013	1065
	Rating																																
Condition On Distress		GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD
Condition on roughness		GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD

GOOD
FAIR
POOR

Orai to Barah Section of NH-27 in the state of Uttar Pradesh

RHS Carriageway

From km		1547+000	1548+000	1549+000	1550+000	1551+000	1552+000	1553+000	1554+000	1555+000	1556+000	1557+000	1558+000	1559+000	1560+000	1561+000	1562+000	1563+000	1564+000	1565+000	1566+000	1567+000	1568+000	1569+000	1570+000	1571+000	1572+000	1573+000	1574+000	1575+000	1576+000	1577+000	1578+000
To Km		1548+000	1549+000	1550+000	1551+000	1552+000	1553+000	1554+000	1555+000	1556+000	1557+000	1558+000	1559+000	1560+000	1561+000	1562+000	1563+000	1564+000	1565+000	1566+000	1567+000	1568+000	1569+000	1570+000	1571+000	1572+000	1573+000	1574+000	1575+000	1576+000	1577+000	1578+000	1579+000
Cracking	Area (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.31%	1.80%	0.10%	0.52%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.12%	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.08%	0.00%	0.00%	0.00%	0.00%
	Rating																																	
Patching (%)	Area (%)	0.00%	0.00%	0.01%	0.02%	0.00%	0.05%	0.35%	0.17%	0.01%	0.02%	0.00%	0.00%	0.00%	0.00%	0.05%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03%	0.00%	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Rating																																	
Rutting	mm	4	4	4	5	4	5	8	5	6	5	5	5	5	5	5	5	6	5	4	5	5	5	5	4	5	5	5	4	5	5	5	5	5
	Rating																																	
Rughness	UI (mm/km)	973	935	1127	1174	1086	1408	3082	2162	2444	1444	1118	1147	1270	1168	1048	1076	1019	1177	911	1072	1090	1052	1022	1011	1256	1040	977	1434	1089	1456	1024	1157
	Rating																																	
Condition On Distress		GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD
Condition on roughness		GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	POOR	FAIR	POOR	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD

GOOD
FAIR
POOR

Annexure – 4.3

Roughness Data

Roughness											
NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1515713	1515800	I	L1	2.71	3.01	2.86	20	10/Dec/2022	26.02255348	79.53906313
NH27	1515800	1515900	I	L1	1.77	1.91	1.84	20	10/Dec/2022	26.02282691	79.53985244
NH27	1515900	1516000	I	L1	3.25	2.93	3.09	20	10/Dec/2022	26.023506	79.54172465
NH27	1516000	1516100	I	L1	3.02	3.1	3.06	36	10/Dec/2022	26.02383716	79.54264903
NH27	1516100	1516200	I	L1	2.7	2.54	2.62	44	10/Dec/2022	26.02416974	79.54357329
NH27	1516200	1516300	I	L1	1.68	1.55	1.62	50	10/Dec/2022	26.02450649	79.54449594
NH27	1516300	1516400	I	L1	2.86	2.07	2.47	53	10/Dec/2022	26.0248426	79.54541975
NH27	1516400	1516500	I	L1	2.18	1.7	1.94	54	10/Dec/2022	26.02517818	79.54634433
NH27	1516500	1516600	I	L1	2.5	2.5	2.5	54	10/Dec/2022	26.02551967	79.54726574
NH27	1516600	1516700	I	L1	2.01	2.12	2.07	47	10/Dec/2022	26.0258615	79.54818881
NH27	1516700	1516800	I	L1	2.48	2.42	2.45	36	10/Dec/2022	26.02620196	79.5491122
NH27	1516800	1516900	I	L1	2.43	2.33	2.38	34	10/Dec/2022	26.02654294	79.55003441
NH27	1516900	1517000	I	L1	3.16	3.01	3.09	41	10/Dec/2022	26.026886	79.55095497
NH27	1517000	1517100	I	L1	3.02	3.44	3.23	40	10/Dec/2022	26.02722934	79.55187676
NH27	1517100	1517200	I	L1	4.26	3.23	3.75	45	10/Dec/2022	26.02756942	79.55279921
NH27	1517200	1517300	I	L1	2.01	2.08	2.05	53	10/Dec/2022	26.02790561	79.5537224
NH27	1517300	1517400	I	L1	3.09	3.27	3.18	51	10/Dec/2022	26.02825375	79.55464229
NH27	1517400	1517500	I	L1	3.01	3.15	3.08	49	10/Dec/2022	26.02860433	79.55556124
NH27	1517500	1517600	I	L1	3.22	3.18	3.2	48	10/Dec/2022	26.02891301	79.5564976
NH27	1517600	1517700	I	L1	2.62	1.87	2.25	53	10/Dec/2022	26.0292097	79.55743705
NH27	1517700	1517800	I	L1	3.37	2.39	2.88	56	10/Dec/2022	26.0295462	79.5583584
NH27	1517800	1517900	I	L1	2.5	2.89	2.7	56	10/Dec/2022	26.02988669	79.55928104
NH27	1517900	1518000	I	L1	2.46	2.31	2.39	59	10/Dec/2022	26.03022844	79.56020201
NH27	1518000	1518100	I	L1	2.01	1.74	1.88	62	10/Dec/2022	26.03056975	79.5611225
NH27	1518100	1518200	I	L1	2.88	1.64	2.26	59	10/Dec/2022	26.03091324	79.56204334
NH27	1518200	1518300	I	L1	3.92	4.32	4.12	56	10/Dec/2022	26.0312567	79.5629642
NH27	1518300	1518400	I	L1	3	2.26	2.63	56	10/Dec/2022	26.03159658	79.56388662
NH27	1518400	1518500	I	L1	5	5.16	5.08	57	10/Dec/2022	26.03193462	79.56480964
NH27	1518500	1518600	I	L1	2.99	2.67	2.83	58	10/Dec/2022	26.03227001	79.5657341
NH27	1518600	1518700	I	L1	2.45	2.44	2.45	60	10/Dec/2022	26.03260588	79.56665818
NH27	1518700	1518800	I	L1	2.56	1.88	2.22	61	10/Dec/2022	26.03293877	79.56758383
NH27	1518800	1518900	I	L1	3.47	2.3	2.89	62	10/Dec/2022	26.03327066	79.56850998
NH27	1518900	1519000	I	L1	2.26	1.84	2.05	60	10/Dec/2022	26.03360243	79.56943698
NH27	1519000	1519100	I	L1	3	2.44	2.72	59	10/Dec/2022	26.0339385	79.57036208
NH27	1519100	1519200	I	L1	2.6	1.68	2.14	58	10/Dec/2022	26.03427171	79.57128843
NH27	1519200	1519300	I	L1	3.04	3.12	3.08	50	10/Dec/2022	26.03460448	79.57221611
NH27	1519300	1519400	I	L1	2.4	2.17	2.29	54	10/Dec/2022	26.03494032	79.57314001

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1519400	1519500	I	L1	2.47	1.59	2.03	56	10/Dec/2022	26.03526965	79.57406733
NH27	1519500	1519600	I	L1	2.7	2.18	2.44	58	10/Dec/2022	26.03561275	79.57498804
NH27	1519600	1519700	I	L1	2.23	1.97	2.1	56	10/Dec/2022	26.03594507	79.5759152
NH27	1519700	1519800	I	L1	4.09	2.53	3.31	48	10/Dec/2022	26.03628608	79.57683865
NH27	1519800	1519900	I	L1	6.55	6.68	6.62	13	10/Dec/2022	26.03665739	79.57774984
NH27	1519900	1520000	I	L1	5.02	5.1	5.06	31	10/Dec/2022	26.0369625	79.57868658
NH27	1520000	1520100	I	L1	3.24	3	3.12	47	10/Dec/2022	26.03727658	79.57961741
NH27	1520100	1520200	I	L1	2.79	2.78	2.79	53	10/Dec/2022	26.03760213	79.5805455
NH27	1520200	1520300	I	L1	2.46	2.55	2.51	57	10/Dec/2022	26.03794452	79.58146648
NH27	1520300	1520400	I	L1	1.68	1.3	1.49	59	10/Dec/2022	26.03828317	79.5823897
NH27	1520400	1520500	I	L1	2.31	1.96	2.14	61	10/Dec/2022	26.03862748	79.5833104
NH27	1520500	1520600	I	L1	1.56	1.16	1.36	62	10/Dec/2022	26.03897885	79.58422824
NH27	1520600	1520700	I	L1	2.41	1.44	1.93	60	10/Dec/2022	26.03932749	79.58514832
NH27	1520700	1520800	I	L1	2.04	1.52	1.78	55	10/Dec/2022	26.03967185	79.58607093
NH27	1520800	1520900	I	L1	1.38	1.35	1.37	55	10/Dec/2022	26.04002345	79.58698879
NH27	1520900	1521000	I	L1	1.49	1.47	1.48	57	10/Dec/2022	26.04037101	79.58790801
NH27	1521000	1521100	I	L1	1.48	1.21	1.35	57	10/Dec/2022	26.04071989	79.58882686
NH27	1521100	1521200	I	L1	1.65	1.13	1.39	60	10/Dec/2022	26.04106592	79.5897462
NH27	1521200	1521300	I	L1	1.54	1.43	1.49	61	10/Dec/2022	26.04141669	79.59066417
NH27	1521300	1521400	I	L1	2.5	2.05	2.28	59	10/Dec/2022	26.04176548	79.59158369
NH27	1521400	1521500	I	L1	2.21	2.3	2.26	59	10/Dec/2022	26.04211095	79.59250465
NH27	1521500	1521600	I	L1	2.27	1.76	2.02	59	10/Dec/2022	26.04245797	79.59342507
NH27	1521600	1521700	I	L1	1.51	1.19	1.35	59	10/Dec/2022	26.04281035	79.59434266
NH27	1521700	1521800	I	L1	1.13	1.13	1.13	60	10/Dec/2022	26.04319471	79.59524386
NH27	1521800	1521900	I	L1	1.99	1.58	1.79	60	10/Dec/2022	26.04360704	79.59613001
NH27	1521900	1522000	I	L1	1.65	1.4	1.53	60	10/Dec/2022	26.04404383	79.59700156
NH27	1522000	1522100	I	L1	1.55	1.13	1.34	61	10/Dec/2022	26.0445152	79.59785085
NH27	1522100	1522200	I	L1	1.71	1.42	1.57	59	10/Dec/2022	26.04499369	79.59869586
NH27	1522200	1522300	I	L1	2.32	1.73	2.03	59	10/Dec/2022	26.04546541	79.59954542
NH27	1522300	1522400	I	L1	2.4	1.88	2.14	58	10/Dec/2022	26.04592531	79.60040286
NH27	1522400	1522500	I	L1	3.15	1.75	2.45	60	10/Dec/2022	26.04640114	79.60124901
NH27	1522500	1522600	I	L1	2.65	1.84	2.25	61	10/Dec/2022	26.04688074	79.60209269
NH27	1522600	1522700	I	L1	1.81	1.42	1.62	62	10/Dec/2022	26.04736119	79.60293635
NH27	1522700	1522800	I	L1	2.15	1.45	1.8	61	10/Dec/2022	26.04783617	79.60378404
NH27	1522800	1522900	I	L1	2.34	2.75	2.55	62	10/Dec/2022	26.04832446	79.60462097
NH27	1522900	1523000	I	L1	1.67	1.45	1.56	64	10/Dec/2022	26.04884354	79.60543529
NH27	1523000	1523100	I	L1	2.19	1.64	1.92	65	10/Dec/2022	26.04935812	79.60625362
NH27	1523100	1523200	I	L1	2.82	2	2.41	65	10/Dec/2022	26.04987597	79.60706948

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1523200	1523300	I	L1	1.73	1.41	1.57	63	10/Dec/2022	26.050392	79.60788711
NH27	1523300	1523400	I	L1	2.11	1.75	1.93	59	10/Dec/2022	26.05091013	79.60870403
NH27	1523400	1523500	I	L1	1.4	1.21	1.31	58	10/Dec/2022	26.05142539	79.60952193
NH27	1523500	1523600	I	L1	1.6	1.55	1.58	60	10/Dec/2022	26.05194042	79.61033947
NH27	1523600	1523700	I	L1	1.47	1.36	1.42	61	10/Dec/2022	26.05245551	79.6111573
NH27	1523700	1523800	I	L1	1.83	1.58	1.71	61	10/Dec/2022	26.05296955	79.61197598
NH27	1523800	1523900	I	L1	1.38	1.62	1.5	62	10/Dec/2022	26.05344283	79.61282404
NH27	1523900	1524000	I	L1	1.48	1.48	1.48	63	10/Dec/2022	26.05383273	79.61372247
NH27	1524000	1524100	I	L1	2.01	1.89	1.95	64	10/Dec/2022	26.05415166	79.61465503
NH27	1524100	1524200	I	L1	1.7	1.18	1.44	63	10/Dec/2022	26.05446045	79.61559221
NH27	1524200	1524300	I	L1	2.18	1.87	2.03	63	10/Dec/2022	26.05476875	79.61652937
NH27	1524300	1524400	I	L1	2.23	1.65	1.94	65	10/Dec/2022	26.05511444	79.61744944
NH27	1524400	1524500	I	L1	2.06	1.95	2.01	65	10/Dec/2022	26.05549792	79.6183515
NH27	1524500	1524600	I	L1	1.87	1.68	1.78	62	10/Dec/2022	26.05592534	79.61922993
NH27	1524600	1524700	I	L1	1.24	0.9	1.07	63	10/Dec/2022	26.05636144	79.62010225
NH27	1524700	1524800	I	L1	1.59	1.25	1.42	61	10/Dec/2022	26.05680243	79.62097253
NH27	1524800	1524900	I	L1	3.18	2.97	3.08	61	10/Dec/2022	26.05723986	79.62184463
NH27	1524900	1525000	I	L1	2.78	2.21	2.5	61	10/Dec/2022	26.05767773	79.62271615
NH27	1525000	1525100	I	L1	3.46	2.66	3.06	57	10/Dec/2022	26.05811263	79.62359066
NH27	1525100	1525200	I	L1	1.85	2.17	2.01	58	10/Dec/2022	26.05854805	79.62446226
NH27	1525200	1525300	I	L1	2.36	2.14	2.25	60	10/Dec/2022	26.05899169	79.62532986
NH27	1525300	1525400	I	L1	2.23	3.04	2.64	62	10/Dec/2022	26.05943055	79.62620051
NH27	1525400	1525500	I	L1	2.39	2.45	2.42	62	10/Dec/2022	26.05986562	79.62707358
NH27	1525500	1525600	I	L1	2.75	2.11	2.43	61	10/Dec/2022	26.06030994	79.62794152
NH27	1525600	1525700	I	L1	3.72	2.46	3.09	60	10/Dec/2022	26.06074412	79.6288159
NH27	1525700	1525800	I	L1	2.34	1.69	2.02	62	10/Dec/2022	26.06118557	79.62968492
NH27	1525800	1525900	I	L1	3.17	2.59	2.88	63	10/Dec/2022	26.06162067	79.63055808
NH27	1525900	1526000	I	L1	3.07	2.72	2.9	64	10/Dec/2022	26.06206408	79.63142621
NH27	1526000	1526100	I	L1	5.86	4.02	4.94	62	10/Dec/2022	26.06250141	79.63229923
NH27	1526100	1526200	I	L1	3.69	2.72	3.21	63	10/Dec/2022	26.06294106	79.63316958
NH27	1526200	1526300	I	L1	2.1	2.06	2.08	64	10/Dec/2022	26.06337149	79.6340454
NH27	1526300	1526400	I	L1	5.01	4.53	4.77	62	10/Dec/2022	26.06380502	79.6349212
NH27	1526400	1526500	I	L1	3.12	3	3.06	62	10/Dec/2022	26.0642399	79.6357951
NH27	1526500	1526600	I	L1	2.05	2.62	2.34	63	10/Dec/2022	26.06468361	79.63667455
NH27	1526600	1526700	I	L1	4.75	3.74	4.25	65	10/Dec/2022	26.06511896	79.63754807
NH27	1526700	1526800	I	L1	4.09	2.52	3.31	64	10/Dec/2022	26.06555195	79.63842269
NH27	1526800	1526900	I	L1	2.38	1.68	2.03	62	10/Dec/2022	26.06598776	79.63929639
NH27	1526900	1527000	I	L1	4.57	2.51	3.54	58	10/Dec/2022	26.06642271	79.64017152

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1527000	1527100	I	L1	2.5	2.17	2.34	46	10/Dec/2022	26.06685609	79.64104797
NH27	1527100	1527200	I	L1	1.65	1.9	1.78	45	10/Dec/2022	26.06728029	79.6419282
NH27	1527200	1527300	I	L1	1.82	2.43	2.13	54	10/Dec/2022	26.06771663	79.64279722
NH27	1527300	1527400	I	L1	3.02	4.54	3.78	51	10/Dec/2022	26.06816043	79.64366652
NH27	1527400	1527500	I	L1	1.89	2.56	2.23	54	10/Dec/2022	26.06859526	79.6445397
NH27	1527500	1527600	I	L1	3.28	5.9	4.59	51	10/Dec/2022	26.0690328	79.64541251
NH27	1527600	1527700	I	L1	4.02	4.23	4.13	56	10/Dec/2022	26.06946632	79.64628613
NH27	1527700	1527800	I	L1	3.89	6.33	5.11	57	10/Dec/2022	26.06990365	79.6471584
NH27	1527800	1527900	I	L1	2.14	3.07	2.61	61	10/Dec/2022	26.07033524	79.64803326
NH27	1527900	1528000	I	L1	1.61	1.59	1.6	61	10/Dec/2022	26.07076661	79.64890954
NH27	1528000	1528100	I	L1	2.01	1.7	1.86	62	10/Dec/2022	26.0712029	79.64978243
NH27	1528100	1528200	I	L1	2.26	2.04	2.15	61	10/Dec/2022	26.07163814	79.6506565
NH27	1528200	1528300	I	L1	3.02	3.01	3.02	61	10/Dec/2022	26.07207502	79.65152954
NH27	1528300	1528400	I	L1	2.8	3.11	2.96	62	10/Dec/2022	26.07251015	79.65240315
NH27	1528400	1528500	I	L1	1.65	1.6	1.63	62	10/Dec/2022	26.07294032	79.65328021
NH27	1528500	1528600	I	L1	1.97	1.84	1.91	64	10/Dec/2022	26.07337196	79.65415574
NH27	1528600	1528700	I	L1	2.09	1.38	1.74	64	10/Dec/2022	26.07379082	79.6550395
NH27	1528700	1528800	I	L1	1.71	1.42	1.57	64	10/Dec/2022	26.0742106	79.6559227
NH27	1528800	1528900	I	L1	2.33	1.7	2.02	62	10/Dec/2022	26.07463011	79.65680669
NH27	1528900	1529000	I	L1	1.71	1.32	1.52	62	10/Dec/2022	26.07504747	79.65769107
NH27	1529000	1529100	I	L1	2.55	2.16	2.36	63	10/Dec/2022	26.07546672	79.6585742
NH27	1529100	1529200	I	L1	2.75	2.61	2.68	63	10/Dec/2022	26.07588317	79.65945919
NH27	1529200	1529300	I	L1	3.57	3.49	3.53	62	10/Dec/2022	26.07630159	79.66034383
NH27	1529300	1529400	I	L1	2.34	2.01	2.18	63	10/Dec/2022	26.07672184	79.66122654
NH27	1529400	1529500	I	L1	1.88	1.66	1.77	65	10/Dec/2022	26.07713838	79.66211129
NH27	1529500	1529600	I	L1	1.73	1.48	1.61	65	10/Dec/2022	26.07755274	79.66299754
NH27	1529600	1529700	I	L1	2.73	2.1	2.42	66	10/Dec/2022	26.07797436	79.66387941
NH27	1529700	1529800	I	L1	4.21	3.11	3.66	66	10/Dec/2022	26.07839187	79.66476453
NH27	1529800	1529900	I	L1	3.94	3.17	3.56	53	10/Dec/2022	26.07881038	79.6656517
NH27	1529900	1530000	I	L1	2.04	1.54	1.79	45	10/Dec/2022	26.07922608	79.66653863
NH27	1530000	1530100	I	L1	1.81	1.93	1.87	40	10/Dec/2022	26.079643	79.66742304
NH27	1530100	1530200	I	L1	1.53	1.35	1.44	49	10/Dec/2022	26.08003986	79.66831733
NH27	1530200	1530300	I	L1	3.27	2.02	2.65	54	10/Dec/2022	26.08047354	79.66918979
NH27	1530300	1530400	I	L1	2.12	2.09	2.11	56	10/Dec/2022	26.08089428	79.67007232
NH27	1530400	1530500	I	L1	2.97	2.5	2.74	60	10/Dec/2022	26.08130219	79.67096165
NH27	1530500	1530600	I	L1	2.61	1.53	2.07	63	10/Dec/2022	26.08170933	79.67185133
NH27	1530600	1530700	I	L1	1.82	2.06	1.94	65	10/Dec/2022	26.08211446	79.6727426
NH27	1530700	1530800	I	L1	1.91	1.33	1.62	66	10/Dec/2022	26.08251904	79.67363434

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1530800	1530900	I	L1	2.21	1.49	1.85	66	10/Dec/2022	26.08292632	79.67452477
NH27	1530900	1531000	I	L1	2.68	1.52	2.1	66	10/Dec/2022	26.08333312	79.6754154
NH27	1531000	1531100	I	L1	2.14	1.55	1.85	66	10/Dec/2022	26.08373819	79.67630703
NH27	1531100	1531200	I	L1	3.04	2.59	2.82	65	10/Dec/2022	26.08414326	79.67719872
NH27	1531200	1531300	I	L1	1.97	1.57	1.77	63	10/Dec/2022	26.08455008	79.67808995
NH27	1531300	1531400	I	L1	2.51	1.68	2.1	63	10/Dec/2022	26.08494849	79.67898561
NH27	1531400	1531500	I	L1	1.92	2.67	2.3	64	10/Dec/2022	26.08536113	79.67987242
NH27	1531500	1531600	I	L1	2.74	2.46	2.6	64	10/Dec/2022	26.08576316	79.68076553
NH27	1531600	1531700	I	L1	3.02	3.14	3.08	64	10/Dec/2022	26.08616763	79.681657
NH27	1531700	1531800	I	L1	2.45	1.42	1.94	64	10/Dec/2022	26.08657496	79.6825478
NH27	1531800	1531900	I	L1	2.64	1.49	2.07	63	10/Dec/2022	26.08697988	79.68343998
NH27	1531900	1532000	I	L1	2.27	1.58	1.93	63	10/Dec/2022	26.08738572	79.6843309
NH27	1532000	1532100	I	L1	2.21	1.79	2	64	10/Dec/2022	26.08779166	79.68522181
NH27	1532100	1532200	I	L1	5.37	4.27	4.82	62	10/Dec/2022	26.0881957	79.6861148
NH27	1532200	1532300	I	L1	2.22	2.07	2.15	62	10/Dec/2022	26.08858782	79.68701324
NH27	1532300	1532400	I	L1	1.82	1.77	1.8	62	10/Dec/2022	26.08900465	79.6878983
NH27	1532400	1532500	I	L1	2.03	2.3	2.17	63	10/Dec/2022	26.08940384	79.68879259
NH27	1532500	1532600	I	L1	1.77	1.8	1.79	64	10/Dec/2022	26.08980402	79.68968662
NH27	1532600	1532700	I	L1	1.85	1.63	1.74	65	10/Dec/2022	26.09021924	79.69057221
NH27	1532700	1532800	I	L1	1.58	1.47	1.53	66	10/Dec/2022	26.0906299	79.69146015
NH27	1532800	1532900	I	L1	2.19	2.09	2.14	66	10/Dec/2022	26.09105258	79.69234094
NH27	1532900	1533000	I	L1	1.57	1.33	1.45	65	10/Dec/2022	26.09149647	79.6932094
NH27	1533000	1533100	I	L1	1.69	1.62	1.66	64	10/Dec/2022	26.09195673	79.69406776
NH27	1533100	1533200	I	L1	2.57	2.13	2.35	61	10/Dec/2022	26.09243326	79.69491577
NH27	1533200	1533300	I	L1	2	1.52	1.76	60	10/Dec/2022	26.09292671	79.69575087
NH27	1533300	1533400	I	L1	1.39	1.33	1.36	60	10/Dec/2022	26.09343828	79.6965726
NH27	1533400	1533500	I	L1	1.61	1.27	1.44	60	10/Dec/2022	26.09396723	79.69738046
NH27	1533500	1533600	I	L1	1.88	1.67	1.78	53	10/Dec/2022	26.09450607	79.69818246
NH27	1533600	1533700	I	L1	1.3	1.51	1.41	48	10/Dec/2022	26.09504398	79.69898509
NH27	1533700	1533800	I	L1	1.5	1.74	1.62	47	10/Dec/2022	26.09559098	79.69977791
NH27	1533800	1533900	I	L1	1.88	1.64	1.76	46	10/Dec/2022	26.09613365	79.70057519
NH27	1533900	1534000	I	L1	1.83	1.53	1.68	19	10/Dec/2022	26.09667621	79.7013744
NH27	1534000	1534100	I	L1	2.81	2.14	2.48	32	10/Dec/2022	26.09724937	79.70222619
NH27	1534100	1534200	I	L1	2.79	2.6	2.7	41	10/Dec/2022	26.09779185	79.70302082
NH27	1534200	1534300	I	L1	2.83	2.79	2.81	28	10/Dec/2022	26.0983335	79.70382072
NH27	1534300	1534400	I	L1	2.27	2.81	2.54	33	10/Dec/2022	26.09888923	79.70460322
NH27	1534400	1534500	I	L1	1.77	2.07	1.92	48	10/Dec/2022	26.0994431	79.70538727
NH27	1534500	1534600	I	L1	1.78	1.92	1.85	51	10/Dec/2022	26.09999697	79.70617345

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1534600	1534700	I	L1	1.8	1.98	1.89	52	10/Dec/2022	26.1005535	79.70695808
NH27	1534700	1534800	I	L1	2.12	2.65	2.39	53	10/Dec/2022	26.10110751	79.70774489
NH27	1534800	1534900	I	L1	1.72	1.9	1.81	54	10/Dec/2022	26.10166192	79.70853172
NH27	1534900	1535000	I	L1	2.16	2.53	2.35	52	10/Dec/2022	26.10221842	79.70931768
NH27	1535000	1535100	I	L1	1.46	1.72	1.59	52	10/Dec/2022	26.10277436	79.71010317
NH27	1535100	1535200	I	L1	1.45	1.59	1.52	53	10/Dec/2022	26.10332731	79.71089059
NH27	1535200	1535300	I	L1	1.54	1.29	1.42	52	10/Dec/2022	26.10388339	79.71167659
NH27	1535300	1535400	I	L1	1.87	1.87	1.87	54	10/Dec/2022	26.10443	79.71246932
NH27	1535400	1535500	I	L1	1.77	1.64	1.71	57	10/Dec/2022	26.10499634	79.71324515
NH27	1535500	1535600	I	L1	1.74	1.94	1.84	58	10/Dec/2022	26.10554663	79.71403521
NH27	1535600	1535700	I	L1	1.9	1.96	1.93	55	10/Dec/2022	26.1060726	79.71484619
NH27	1535700	1535800	I	L1	1.55	1.6	1.58	56	10/Dec/2022	26.1065642	79.7156811
NH27	1535800	1535900	I	L1	1.55	1.57	1.56	56	10/Dec/2022	26.10705461	79.7165177
NH27	1535900	1536000	I	L1	2.31	2.57	2.44	57	10/Dec/2022	26.10754196	79.71735686
NH27	1536000	1536100	I	L1	2.41	2.7	2.56	58	10/Dec/2022	26.10804589	79.71818416
NH27	1536100	1536200	I	L1	2	2.07	2.04	58	10/Dec/2022	26.10859734	79.7189737
NH27	1536200	1536300	I	L1	1.87	1.89	1.88	60	10/Dec/2022	26.10913763	79.71977241
NH27	1536300	1536400	I	L1	1.41	1.64	1.53	59	10/Dec/2022	26.10965431	79.72058959
NH27	1536400	1536500	I	L1	1.42	1.26	1.34	59	10/Dec/2022	26.11016613	79.72141045
NH27	1536500	1536600	I	L1	1.6	1.34	1.47	58	10/Dec/2022	26.11067868	79.72223086
NH27	1536600	1536700	I	L1	2	1.43	1.72	57	10/Dec/2022	26.11118841	79.72305382
NH27	1536700	1536800	I	L1	2	2.34	2.17	58	10/Dec/2022	26.11169979	79.72387511
NH27	1536800	1536900	I	L1	2.05	1.97	2.01	56	10/Dec/2022	26.1122132	79.72469542
NH27	1536900	1537000	I	L1	2.41	2.28	2.35	55	10/Dec/2022	26.11269817	79.72553651
NH27	1537000	1537100	I	L1	2.25	2.28	2.27	57	10/Dec/2022	26.11304626	79.72645608
NH27	1537100	1537200	I	L1	2.07	2.37	2.22	58	10/Dec/2022	26.1132286	79.72743321
NH27	1537200	1537300	I	L1	1.57	2.23	1.9	58	10/Dec/2022	26.11328822	79.72842951
NH27	1537300	1537400	I	L1	3.24	2.51	2.88	57	10/Dec/2022	26.11334438	79.72942587
NH27	1537400	1537500	I	L1	1.75	1.92	1.84	55	10/Dec/2022	26.11340093	79.73042253
NH27	1537500	1537600	I	L1	1.56	1.58	1.57	38	10/Dec/2022	26.11354146	79.73140949
NH27	1537600	1537700	I	L1	1.56	1.28	1.42	27	10/Dec/2022	26.11370481	79.73239176
NH27	1537700	1537800	I	L1	1.88	1.98	1.93	27	10/Dec/2022	26.11377862	79.73338485
NH27	1537800	1537900	I	L1	2.43	2.22	2.33	30	10/Dec/2022	26.113639	79.73436952
NH27	1537900	1538000	I	L1	2.01	3.29	2.65	33	10/Dec/2022	26.11341218	79.73533537
NH27	1538000	1538100	I	L1	3.1	4.03	3.57	50	10/Dec/2022	26.11321732	79.73630701
NH27	1538100	1538200	I	L1	4.59	4.66	4.63	55	10/Dec/2022	26.11319128	79.73729975
NH27	1538200	1538300	I	L1	4.28	3.66	3.97	57	10/Dec/2022	26.11342034	79.73826053
NH27	1538300	1538400	I	L1	4.59	3.54	4.07	57	10/Dec/2022	26.11388247	79.73911156

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1538400	1538500	I	L1	4.16	3.48	3.82	56	10/Dec/2022	26.1145304	79.7398004
NH27	1538500	1538600	I	L1	5.05	5.41	5.23	57	10/Dec/2022	26.11528764	79.74034017
NH27	1538600	1538700	I	L1	2.83	2.72	2.78	57	10/Dec/2022	26.11605485	79.74086415
NH27	1538700	1538800	I	L1	3.98	4.14	4.06	52	10/Dec/2022	26.11682152	79.74139119
NH27	1538800	1538900	I	L1	2.42	2.2	2.31	53	10/Dec/2022	26.11758546	79.74192022
NH27	1538900	1539000	I	L1	2.66	2.33	2.5	54	10/Dec/2022	26.11835957	79.74242916
NH27	1539000	1539100	I	L1	2.33	2.56	2.45	52	10/Dec/2022	26.11910115	79.74299602
NH27	1539100	1539200	I	L1	4.32	4.02	4.17	50	10/Dec/2022	26.11969034	79.74374721
NH27	1539200	1539300	I	L1	3.71	4.16	3.94	51	10/Dec/2022	26.12014889	79.74460183
NH27	1539300	1539400	I	L1	3.72	3.87	3.8	54	10/Dec/2022	26.12057659	79.74547772
NH27	1539400	1539500	I	L1	3.63	3.78	3.71	55	10/Dec/2022	26.12099872	79.74635823
NH27	1539500	1539600	I	L1	2.77	2.91	2.84	54	10/Dec/2022	26.12147374	79.74720492
NH27	1539600	1539700	I	L1	3.54	3.02	3.28	40	10/Dec/2022	26.12206108	79.74796236
NH27	1539700	1539800	I	L1	2.99	2.97	2.98	51	10/Dec/2022	26.12273812	79.74861705
NH27	1539800	1539900	I	L1	2.66	2.75	2.71	57	10/Dec/2022	26.12343629	79.74924654
NH27	1539900	1540000	I	L1	3.18	3.6	3.39	56	10/Dec/2022	26.12417255	79.74982287
NH27	1540000	1540100	I	L1	4.78	4.78	4.78	49	10/Dec/2022	26.1249599	79.75030601
NH27	1540100	1540200	I	L1	5.9	4.92	5.41	46	10/Dec/2022	26.12580134	79.750663
NH27	1540200	1540300	I	L1	3.74	3.97	3.86	42	10/Dec/2022	26.12666313	79.75095351
NH27	1540300	1540400	I	L1	2.8	2.28	2.54	36	10/Dec/2022	26.12751209	79.7512876
NH27	1540400	1540500	I	L1	2.57	2.65	2.61	48	10/Dec/2022	26.12833703	79.75168313
NH27	1540500	1540600	I	L1	5.54	6.02	5.78	26	10/Dec/2022	26.12914097	79.75213692
NH27	1540600	1540700	I	L1	3.58	2.62	3.1	42	10/Dec/2022	26.12994938	79.75257238
NH27	1540700	1540800	I	L1	3.02	3.11	3.07	48	10/Dec/2022	26.13075716	79.75301198
NH27	1540800	1540900	I	L1	3.26	3.09	3.18	50	10/Dec/2022	26.13156454	79.75345387
NH27	1540900	1541000	I	L1	2.89	2.6	2.75	52	10/Dec/2022	26.13237237	79.75389493
NH27	1541000	1541100	I	L1	2.87	3.02	2.95	51	10/Dec/2022	26.13318166	79.75433493
NH27	1541100	1541200	I	L1	3.1	3.02	3.06	48	10/Dec/2022	26.13399051	79.75477602
NH27	1541200	1541300	I	L1	3.12	2.11	2.62	52	10/Dec/2022	26.13479763	79.75521769
NH27	1541300	1541400	I	L1	4.01	4.05	4.03	47	10/Dec/2022	26.13560576	79.75565974
NH27	1541400	1541500	I	L1	3.32	2.47	2.9	51	10/Dec/2022	26.13641222	79.75610367
NH27	1541500	1541600	I	L1	1.64	2.64	2.14	47	10/Dec/2022	26.13721636	79.75655636
NH27	1541600	1541700	I	L1	1.98	1.67	1.83	50	10/Dec/2022	26.13802744	79.75698884
NH27	1541700	1541800	I	L1	1.39	1.27	1.33	54	10/Dec/2022	26.13883147	79.757439
NH27	1541800	1541900	I	L1	1.1	1.39	1.25	52	10/Dec/2022	26.13963685	79.75788872
NH27	1541900	1542000	I	L1	1.58	2.28	1.93	53	10/Dec/2022	26.14044632	79.75832597
NH27	1542000	1542100	I	L1	1.91	1.45	1.68	55	10/Dec/2022	26.14125037	79.75877551
NH27	1542100	1542200	I	L1	1.74	1.51	1.63	54	10/Dec/2022	26.14205422	79.75922691

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1542200	1542300	I	L1	1.68	1.61	1.65	55	10/Dec/2022	26.14286175	79.75966844
NH27	1542300	1542400	I	L1	1.47	1.21	1.34	55	10/Dec/2022	26.14366268	79.76012611
NH27	1542400	1542500	I	L1	1.89	2.37	2.13	56	10/Dec/2022	26.1444282	79.76065135
NH27	1542500	1542600	I	L1	2.63	2.96	2.8	55	10/Dec/2022	26.14517902	79.76120228
NH27	1542600	1542700	I	L1	2.66	1.96	2.31	56	10/Dec/2022	26.14588483	79.76182291
NH27	1542700	1542800	I	L1	2.99	2.1	2.55	57	10/Dec/2022	26.14656446	79.76247881
NH27	1542800	1542900	I	L1	2.86	2.69	2.78	56	10/Dec/2022	26.14724007	79.76313955
NH27	1542900	1543000	I	L1	1.3	1.24	1.27	57	10/Dec/2022	26.14792072	79.76379378
NH27	1543000	1543100	I	L1	1.56	1.37	1.47	57	10/Dec/2022	26.14859617	79.76445434
NH27	1543100	1543200	I	L1	1.07	1.33	1.2	56	10/Dec/2022	26.14927313	79.76511263
NH27	1543200	1543300	I	L1	1.33	1.36	1.35	53	10/Dec/2022	26.14995119	79.76576869
NH27	1543300	1543400	I	L1	2.31	2.42	2.37	53	10/Dec/2022	26.15063059	79.76642332
NH27	1543400	1543500	I	L1	2.8	2.8	2.8	55	10/Dec/2022	26.15130347	79.76708612
NH27	1543500	1543600	I	L1	2.64	1.77	2.21	56	10/Dec/2022	26.15198467	79.76773874
NH27	1543600	1543700	I	L1	2.58	1.99	2.29	58	10/Dec/2022	26.15266413	79.76839407
NH27	1543700	1543800	I	L1	1.76	1.25	1.51	59	10/Dec/2022	26.15334067	79.76905268
NH27	1543800	1543900	I	L1	2.11	2.09	2.1	58	10/Dec/2022	26.15401972	79.76970888
NH27	1543900	1544000	I	L1	1.6	1.58	1.59	50	10/Dec/2022	26.15469548	79.7703704
NH27	1544000	1544100	I	L1	2.4	2.16	2.28	46	10/Dec/2022	26.15537032	79.77103077
NH27	1544100	1544200	I	L1	1.99	1.59	1.79	50	10/Dec/2022	26.1560499	79.7716835
NH27	1544200	1544300	I	L1	2.11	1.75	1.93	53	10/Dec/2022	26.15672715	79.77234092
NH27	1544300	1544400	I	L1	1.66	1.47	1.57	53	10/Dec/2022	26.15740165	79.77300247
NH27	1544400	1544500	I	L1	1.75	1.9	1.83	52	10/Dec/2022	26.15807901	79.77366107
NH27	1544500	1544600	I	L1	1.82	2.13	1.98	51	10/Dec/2022	26.15876363	79.77432525
NH27	1544600	1544700	I	L1	1.98	1.53	1.76	54	10/Dec/2022	26.1594438	79.7749794
NH27	1544700	1544800	I	L1	1.96	1.66	1.81	55	10/Dec/2022	26.1601237	79.7756348
NH27	1544800	1544900	I	L1	1.2	1.15	1.18	56	10/Dec/2022	26.16079957	79.77629468
NH27	1544900	1545000	I	L1	1.62	1.61	1.62	57	10/Dec/2022	26.16147864	79.77695138
NH27	1545000	1545100	I	L1	1.66	1.7	1.68	53	10/Dec/2022	26.16217831	79.7775819
NH27	1545100	1545200	I	L1	1.48	1.97	1.73	34	10/Dec/2022	26.1629178	79.77815557
NH27	1545200	1545300	I	L1	1.85	1.92	1.89	50	10/Dec/2022	26.16367977	79.77868169
NH27	1545300	1545400	I	L1	2	1.41	1.71	56	10/Dec/2022	26.1644418	79.7792125
NH27	1545400	1545500	I	L1	2.46	2.11	2.29	57	10/Dec/2022	26.16519993	79.77975233
NH27	1545500	1545600	I	L1	1.62	1.77	1.7	56	10/Dec/2022	26.16595475	79.78029787
NH27	1545600	1545700	I	L1	2.43	1.66	2.05	57	10/Dec/2022	26.16671878	79.78082752
NH27	1545700	1545800	I	L1	1.73	1.89	1.81	58	10/Dec/2022	26.16748256	79.78135752
NH27	1545800	1545900	I	L1	1.79	1.74	1.77	57	10/Dec/2022	26.16823328	79.7819112
NH27	1545900	1546000	I	L1	2.09	1.76	1.93	51	10/Dec/2022	26.16896429	79.78249624

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1546000	1546100	I	L1	1.55	1.88	1.72	56	10/Dec/2022	26.16970797	79.78305872
NH27	1546100	1546200	I	L1	1.68	1.94	1.81	57	10/Dec/2022	26.17044236	79.78363702
NH27	1546200	1546300	I	L1	1.99	1.75	1.87	58	10/Dec/2022	26.17118582	79.78420119
NH27	1546300	1546400	I	L1	2.2	2.15	2.18	57	10/Dec/2022	26.17192251	79.78477737
NH27	1546400	1546500	I	L1	2.37	3.05	2.71	50	10/Dec/2022	26.17265512	79.78536119
NH27	1546500	1546600	I	L1	1.83	2.24	2.04	54	10/Dec/2022	26.17339881	79.78592358
NH27	1546600	1546700	I	L1	1.92	1.84	1.88	58	10/Dec/2022	26.17413521	79.78649744
NH27	1546700	1546800	I	L1	1.65	1.67	1.66	60	10/Dec/2022	26.17487044	79.78707445
NH27	1546800	1546900	I	L1	1.73	1.75	1.74	60	10/Dec/2022	26.17560937	79.78764645
NH27	1546900	1547000	I	L1	1.89	1.71	1.8	60	10/Dec/2022	26.17634891	79.78821713
NH27	1547000	1547100	I	L1	1.92	1.54	1.73	59	10/Dec/2022	26.17708575	79.78879281
NH27	1547100	1547200	I	L1	1.67	1.55	1.61	58	10/Dec/2022	26.17782421	79.78936657
NH27	1547200	1547300	I	L1	1.03	1.12	1.08	58	10/Dec/2022	26.17855973	79.78994322
NH27	1547300	1547400	I	L1	1.91	1.56	1.74	57	10/Dec/2022	26.17929982	79.79051389
NH27	1547400	1547500	I	L1	1.55	1.5	1.53	58	10/Dec/2022	26.18004028	79.79108303
NH27	1547500	1547600	I	L1	1.37	1.66	1.52	58	10/Dec/2022	26.18077718	79.79165823
NH27	1547600	1547700	I	L1	2.11	1.9	2.01	59	10/Dec/2022	26.18151434	79.79223233
NH27	1547700	1547800	I	L1	1.81	1.82	1.82	53	10/Dec/2022	26.18224719	79.79281517
NH27	1547800	1547900	I	L1	1.23	1.32	1.28	59	10/Dec/2022	26.18298569	79.79338452
NH27	1547900	1548000	I	L1	1.38	1.58	1.48	60	10/Dec/2022	26.18372632	79.79395321
NH27	1548000	1548100	I	L1	1.32	1.61	1.47	58	10/Dec/2022	26.1844629	79.79452909
NH27	1548100	1548200	I	L1	1.61	1.85	1.73	59	10/Dec/2022	26.18519745	79.79510668
NH27	1548200	1548300	I	L1	1.82	1.75	1.79	60	10/Dec/2022	26.18591846	79.79570541
NH27	1548300	1548400	I	L1	1.79	1.4	1.6	62	10/Dec/2022	26.18659736	79.79636161
NH27	1548400	1548500	I	L1	1.24	1.28	1.26	63	10/Dec/2022	26.18723799	79.79706412
NH27	1548500	1548600	I	L1	1.78	1.81	1.8	62	10/Dec/2022	26.18786296	79.79778428
NH27	1548600	1548700	I	L1	1.12	1.3	1.21	60	10/Dec/2022	26.18848967	79.7985027
NH27	1548700	1548800	I	L1	1.31	1.47	1.39	59	10/Dec/2022	26.18911316	79.79922402
NH27	1548800	1548900	I	L1	1.73	2.16	1.95	59	10/Dec/2022	26.18973756	79.79994433
NH27	1548900	1549000	I	L1	1.4	1.55	1.48	58	10/Dec/2022	26.19037146	79.80065438
NH27	1549000	1549100	I	L1	1.8	1.42	1.61	58	10/Dec/2022	26.19099822	79.80137222
NH27	1549100	1549200	I	L1	2.15	1.67	1.91	59	10/Dec/2022	26.19162391	79.80209082
NH27	1549200	1549300	I	L1	1.46	1.84	1.65	58	10/Dec/2022	26.19225089	79.80280885
NH27	1549300	1549400	I	L1	1.49	1.34	1.42	56	10/Dec/2022	26.19287299	79.80353268
NH27	1549400	1549500	I	L1	1.27	1.33	1.3	55	10/Dec/2022	26.19350007	79.80425036
NH27	1549500	1549600	I	L1	1.9	2.78	2.34	54	10/Dec/2022	26.19412518	79.80497034
NH27	1549600	1549700	I	L1	1.74	2.68	2.21	54	10/Dec/2022	26.19474971	79.80569013
NH27	1549700	1549800	I	L1	1.46	1.83	1.65	54	10/Dec/2022	26.19537854	79.80640613

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1549800	1549900	I	L1	2.07	2.27	2.17	54	10/Dec/2022	26.19600614	79.80712297
NH27	1549900	1550000	I	L1	1.72	1.58	1.65	52	10/Dec/2022	26.19662846	79.80784654
NH27	1550000	1550100	I	L1	1.71	1.49	1.6	47	10/Dec/2022	26.1972586	79.80856247
NH27	1550100	1550200	I	L1	1.97	2.05	2.01	45	10/Dec/2022	26.19788683	79.80927969
NH27	1550200	1550300	I	L1	3.16	3.05	3.11	49	10/Dec/2022	26.1985062	79.81000382
NH27	1550300	1550400	I	L1	2.06	1.89	1.98	52	10/Dec/2022	26.19913601	79.81071515
NH27	1550400	1550500	I	L1	1.63	1.59	1.61	54	10/Dec/2022	26.19980664	79.81137722
NH27	1550500	1550600	I	L1	1.57	1.41	1.49	55	10/Dec/2022	26.20052407	79.81197909
NH27	1550600	1550700	I	L1	2.74	2.6	2.67	52	10/Dec/2022	26.20124487	79.81257904
NH27	1550700	1550800	I	L1	4.49	3.36	3.93	48	10/Dec/2022	26.20196672	79.81317916
NH27	1550800	1550900	I	L1	3.15	4.02	3.59	51	10/Dec/2022	26.20268846	79.813776
NH27	1550900	1551000	I	L1	3.59	3.45	3.52	52	10/Dec/2022	26.20340721	79.81437884
NH27	1551000	1551100	I	L1	1.36	1.75	1.56	52	10/Dec/2022	26.20411099	79.81500468
NH27	1551100	1551200	I	L1	2.14	2.02	2.08	46	10/Dec/2022	26.20477765	79.81567841
NH27	1551200	1551300	I	L1	2.09	2.01	2.05	52	10/Dec/2022	26.20540709	79.81639265
NH27	1551300	1551400	I	L1	2.15	1.97	2.06	52	10/Dec/2022	26.20601824	79.81712645
NH27	1551400	1551500	I	L1	2.85	3.16	3.01	53	10/Dec/2022	26.20662578	79.81786394
NH27	1551500	1551600	I	L1	2.29	2.29	2.29	54	10/Dec/2022	26.2072298	79.81860462
NH27	1551600	1551700	I	L1	2.53	2.15	2.34	56	10/Dec/2022	26.20783509	79.8193446
NH27	1551700	1551800	I	L1	1.41	1.44	1.43	55	10/Dec/2022	26.20841692	79.82010824
NH27	1551800	1551900	I	L1	3.22	3.38	3.3	51	10/Dec/2022	26.20897452	79.82089461
NH27	1551900	1552000	I	L1	1.48	1.58	1.53	49	10/Dec/2022	26.20954058	79.8216725
NH27	1552000	1552100	I	L1	1.63	2.34	1.99	51	10/Dec/2022	26.21011131	79.82244525
NH27	1552100	1552200	I	L1	2.64	2.45	2.55	33	10/Dec/2022	26.21064342	79.82325413
NH27	1552200	1552300	I	L1	1.49	2.11	1.8	41	10/Dec/2022	26.21118678	79.82404859
NH27	1552300	1552400	I	L1	1.47	1.43	1.45	50	10/Dec/2022	26.21177637	79.82480088
NH27	1552400	1552500	I	L1	1.84	1.81	1.83	55	10/Dec/2022	26.21243357	79.82548199
NH27	1552500	1552600	I	L1	1.69	1.71	1.7	58	10/Dec/2022	26.21313172	79.82611167
NH27	1552600	1552700	I	L1	1.71	1.68	1.7	59	10/Dec/2022	26.2138674	79.8266867
NH27	1552700	1552800	I	L1	2.57	2.83	2.7	58	10/Dec/2022	26.21466905	79.82714015
NH27	1552800	1552900	I	L1	1.92	2	1.96	46	10/Dec/2022	26.21551241	79.82749502
NH27	1552900	1553000	I	L1	2.02	2.44	2.23	46	10/Dec/2022	26.21637435	79.82777504
NH27	1553000	1553100	I	L1	2.03	1.87	1.95	54	10/Dec/2022	26.21723938	79.82805072
NH27	1553100	1553200	I	L1	1.78	1.35	1.57	56	10/Dec/2022	26.21810486	79.82832691
NH27	1553200	1553300	I	L1	1.58	1.64	1.61	56	10/Dec/2022	26.21897008	79.82860712
NH27	1553300	1553400	I	L1	1.92	1.47	1.7	47	10/Dec/2022	26.21983652	79.82888687
NH27	1553400	1553500	I	L1	2.02	1.81	1.92	43	10/Dec/2022	26.22070355	79.82915962
NH27	1553500	1553600	I	L1	2.61	1.97	2.29	49	10/Dec/2022	26.22156917	79.82943398

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1553600	1553700	I	L1	2.64	1.74	2.19	45	10/Dec/2022	26.22243637	79.82970785
NH27	1553700	1553800	I	L1	2.3	2.56	2.43	54	10/Dec/2022	26.22329971	79.82998743
NH27	1553800	1553900	I	L1	1.94	1.55	1.75	58	10/Dec/2022	26.22416403	79.83026674
NH27	1553900	1554000	I	L1	2.64	1.93	2.29	58	10/Dec/2022	26.22502982	79.8305441
NH27	1554000	1554100	I	L1	2.48	1.91	2.2	54	10/Dec/2022	26.22589634	79.83082258
NH27	1554100	1554200	I	L1	2.26	2.66	2.46	52	10/Dec/2022	26.22676335	79.83109777
NH27	1554200	1554300	I	L1	2.06	2.5	2.28	49	10/Dec/2022	26.22762149	79.83140589
NH27	1554300	1554400	I	L1	3.26	3.36	3.31	51	10/Dec/2022	26.22844605	79.83180764
NH27	1554400	1554500	I	L1	2.24	2.39	2.32	56	10/Dec/2022	26.22922467	79.83230659
NH27	1554500	1554600	I	L1	2.76	2.32	2.54	57	10/Dec/2022	26.22995176	79.83289529
NH27	1554600	1554700	I	L1	4.55	4.72	4.64	54	10/Dec/2022	26.23062103	79.83356562
NH27	1554700	1554800	I	L1	2.41	2.12	2.27	56	10/Dec/2022	26.23121764	79.83431454
NH27	1554800	1554900	I	L1	2.17	1.95	2.06	52	10/Dec/2022	26.23173082	79.83513661
NH27	1554900	1555000	I	L1	2.84	2.57	2.71	53	10/Dec/2022	26.23217743	79.83600391
NH27	1555000	1555100	I	L1	2.07	1.82	1.95	56	10/Dec/2022	26.23252077	79.83692675
NH27	1555100	1555200	I	L1	1.57	1.58	1.58	57	10/Dec/2022	26.23278361	79.83788209
NH27	1555200	1555300	I	L1	2.6	2.44	2.52	55	10/Dec/2022	26.23302507	79.8388448
NH27	1555300	1555400	I	L1	1.8	1.83	1.82	54	10/Dec/2022	26.2332635	79.83980816
NH27	1555400	1555500	I	L1	2.46	2.53	2.5	55	10/Dec/2022	26.23349585	79.8407735
NH27	1555500	1555600	I	L1	2.3	2.64	2.47	54	10/Dec/2022	26.23373558	79.84173636
NH27	1555600	1555700	I	L1	2.56	2.38	2.47	56	10/Dec/2022	26.23398191	79.84269704
NH27	1555700	1555800	I	L1	2.38	2.55	2.47	57	10/Dec/2022	26.23422297	79.84365944
NH27	1555800	1555900	I	L1	2.29	1.85	2.07	57	10/Dec/2022	26.23446377	79.8446327
NH27	1555900	1556000	I	L1	1.71	1.47	1.59	57	10/Dec/2022	26.23469946	79.84559736
NH27	1556000	1556100	I	L1	1.34	1.56	1.45	56	10/Dec/2022	26.23494933	79.84655759
NH27	1556100	1556200	I	L1	1.96	2.16	2.06	56	10/Dec/2022	26.235263	79.84749312
NH27	1556200	1556300	I	L1	2.09	2.85	2.47	55	10/Dec/2022	26.23565544	79.84839197
NH27	1556300	1556400	I	L1	2.81	2.35	2.58	53	10/Dec/2022	26.23613072	79.84923998
NH27	1556400	1556500	I	L1	2.35	2.03	2.19	56	10/Dec/2022	26.23667917	79.85003083
NH27	1556500	1556600	I	L1	1.51	1.83	1.67	57	10/Dec/2022	26.23729764	79.85075625
NH27	1556600	1556700	I	L1	2.9	3.27	3.09	58	10/Dec/2022	26.23798309	79.85140313
NH27	1556700	1556800	I	L1	1.72	2.55	2.14	58	10/Dec/2022	26.23872246	79.85197333
NH27	1556800	1556900	I	L1	2.1	1.86	1.98	58	10/Dec/2022	26.23948777	79.85250189
NH27	1556900	1557000	I	L1	2.12	1.44	1.78	57	10/Dec/2022	26.24025008	79.85303557
NH27	1557000	1557100	I	L1	1.49	1.71	1.6	58	10/Dec/2022	26.24102149	79.8535518
NH27	1557100	1557200	I	L1	1.68	1.47	1.58	59	10/Dec/2022	26.24178944	79.85407503
NH27	1557200	1557300	I	L1	1.43	1.45	1.44	59	10/Dec/2022	26.24255668	79.85459888
NH27	1557300	1557400	I	L1	1.5	1.44	1.47	59	10/Dec/2022	26.24332405	79.85512281

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1557400	1557500	I	L1	1.55	1.73	1.64	57	10/Dec/2022	26.24408906	79.85565114
NH27	1557500	1557600	I	L1	2.35	1.86	2.11	56	10/Dec/2022	26.24485461	79.85617889
NH27	1557600	1557700	I	L1	2.11	2.14	2.13	57	10/Dec/2022	26.24562233	79.85670175
NH27	1557700	1557800	I	L1	1.67	1.84	1.76	58	10/Dec/2022	26.24638854	79.85722728
NH27	1557800	1557900	I	L1	1.79	1.66	1.73	58	10/Dec/2022	26.24715426	79.85775457
NH27	1557900	1558000	I	L1	1.76	2.4	2.08	57	10/Dec/2022	26.2478826	79.85834268
NH27	1558000	1558100	I	L1	1.96	2.42	2.19	56	10/Dec/2022	26.24852176	79.8590471
NH27	1558100	1558200	I	L1	2.11	2.29	2.2	55	10/Dec/2022	26.24910398	79.85981033
NH27	1558200	1558300	I	L1	2.61	3.42	3.02	57	10/Dec/2022	26.24968656	79.86057215
NH27	1558300	1558400	I	L1	1.58	3.05	2.32	56	10/Dec/2022	26.25026461	79.86133916
NH27	1558400	1558500	I	L1	3.03	3.86	3.45	57	10/Dec/2022	26.25084807	79.86210092
NH27	1558500	1558600	I	L1	2.85	2.81	2.83	58	10/Dec/2022	26.25142723	79.86286639
NH27	1558600	1558700	I	L1	1.49	1.45	1.47	55	10/Dec/2022	26.25200695	79.86363265
NH27	1558700	1558800	I	L1	1.63	1.69	1.66	55	10/Dec/2022	26.25258204	79.86440155
NH27	1558800	1558900	I	L1	1.56	1.48	1.52	55	10/Dec/2022	26.25316958	79.86515961
NH27	1558900	1559000	I	L1	2.19	4.22	3.21	54	10/Dec/2022	26.25373947	79.86593411
NH27	1559000	1559100	I	L1	1.4	2.21	1.81	55	10/Dec/2022	26.25433122	79.86668737
NH27	1559100	1559200	I	L1	1.32	1.28	1.3	52	10/Dec/2022	26.25491424	79.86744994
NH27	1559200	1559300	I	L1	1.75	1.55	1.65	55	10/Dec/2022	26.25549136	79.86821609
NH27	1559300	1559400	I	L1	1.49	1.11	1.3	57	10/Dec/2022	26.25609366	79.86895792
NH27	1559400	1559500	I	L1	1.74	1.55	1.65	60	10/Dec/2022	26.25674896	79.8696414
NH27	1559500	1559600	I	L1	1.38	1.57	1.48	62	10/Dec/2022	26.25746281	79.87024918
NH27	1559600	1559700	I	L1	1.6	0.93	1.27	61	10/Dec/2022	26.25820773	79.87081206
NH27	1559700	1559800	I	L1	1.09	1	1.05	60	10/Dec/2022	26.25894898	79.8713803
NH27	1559800	1559900	I	L1	1.71	1.71	1.71	62	10/Dec/2022	26.2596923	79.87194428
NH27	1559900	1560000	I	L1	2.29	2	2.15	63	10/Dec/2022	26.26043772	79.87250537
NH27	1560000	1560100	I	L1	2.1	1.89	2	62	10/Dec/2022	26.26117846	79.87307507
NH27	1560100	1560200	I	L1	1.5	1.33	1.42	61	10/Dec/2022	26.26192303	79.87363864
NH27	1560200	1560300	I	L1	1.32	1.33	1.33	60	10/Dec/2022	26.26266721	79.87420344
NH27	1560300	1560400	I	L1	1.25	1.23	1.24	58	10/Dec/2022	26.26341102	79.87476848
NH27	1560400	1560500	I	L1	2.01	1.58	1.8	58	10/Dec/2022	26.26415805	79.87532815
NH27	1560500	1560600	I	L1	1.71	1.64	1.68	58	10/Dec/2022	26.26489992	79.87589534
NH27	1560600	1560700	I	L1	1.83	1.25	1.54	57	10/Dec/2022	26.26564408	79.87645957
NH27	1560700	1560800	I	L1	1.95	1.45	1.7	57	10/Dec/2022	26.26638819	79.87702341
NH27	1560800	1560900	I	L1	2.11	1.17	1.64	57	10/Dec/2022	26.26713145	79.87758926
NH27	1560900	1561000	I	L1	1.44	1.25	1.35	57	10/Dec/2022	26.26787607	79.87815204
NH27	1561000	1561100	I	L1	1.8	1.38	1.59	57	10/Dec/2022	26.26861179	79.87872971
NH27	1561100	1561200	I	L1	2.12	2.14	2.13	53	10/Dec/2022	26.26932529	79.87934105

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1561200	1561300	I	L1	1.54	1.6	1.57	55	10/Dec/2022	26.26999388	79.88000955
NH27	1561300	1561400	I	L1	2.18	1.95	2.07	55	10/Dec/2022	26.27065082	79.88069357
NH27	1561400	1561500	I	L1	1.63	1.51	1.57	57	10/Dec/2022	26.27130612	79.88137955
NH27	1561500	1561600	I	L1	2.05	1.74	1.9	58	10/Dec/2022	26.27196189	79.88206498
NH27	1561600	1561700	I	L1	2.06	1.82	1.94	58	10/Dec/2022	26.27261753	79.88275064
NH27	1561700	1561800	I	L1	1.41	1.56	1.49	58	10/Dec/2022	26.27327578	79.88343299
NH27	1561800	1561900	I	L1	1.42	1.44	1.43	58	10/Dec/2022	26.27392852	79.88412232
NH27	1561900	1562000	I	L1	1.56	1.76	1.66	57	10/Dec/2022	26.2745807	79.88481239
NH27	1562000	1562100	I	L1	1.9	1.8	1.85	56	10/Dec/2022	26.27523685	79.88549804
NH27	1562100	1562200	I	L1	2.4	1.73	2.07	55	10/Dec/2022	26.2758883	79.8861893
NH27	1562200	1562300	I	L1	1.57	1.62	1.6	53	10/Dec/2022	26.27653708	79.88688328
NH27	1562300	1562400	I	L1	2.08	2.21	2.15	53	10/Dec/2022	26.27718671	79.88757583
NH27	1562400	1562500	I	L1	2.52	2.04	2.28	51	10/Dec/2022	26.27783501	79.88827058
NH27	1562500	1562600	I	L1	1.43	1.47	1.45	53	10/Dec/2022	26.27848631	79.88896096
NH27	1562600	1562700	I	L1	1.08	1.06	1.07	53	10/Dec/2022	26.27914015	79.88964895
NH27	1562700	1562800	I	L1	1.66	1.73	1.7	54	10/Dec/2022	26.27978907	79.89034236
NH27	1562800	1562900	I	L1	1.99	2.19	2.09	53	10/Dec/2022	26.28045319	79.89101672
NH27	1562900	1563000	I	L1	3.03	2.5	2.77	55	10/Dec/2022	26.28121973	79.89153638
NH27	1563000	1563100	I	L1	2.22	2.46	2.34	57	10/Dec/2022	26.28200286	79.89202946
NH27	1563100	1563200	I	L1	2.05	2.07	2.06	58	10/Dec/2022	26.28272414	79.89262781
NH27	1563200	1563300	I	L1	1.42	1.33	1.38	57	10/Dec/2022	26.28337038	79.89332444
NH27	1563300	1563400	I	L1	2.14	1.76	1.95	55	10/Dec/2022	26.28398255	79.89405861
NH27	1563400	1563500	I	L1	2.61	1.92	2.27	55	10/Dec/2022	26.28458797	79.89479925
NH27	1563500	1563600	I	L1	2.78	2.94	2.86	54	10/Dec/2022	26.28520333	79.89552964
NH27	1563600	1563700	I	L1	1.23	1.44	1.34	53	10/Dec/2022	26.28581268	79.89626645
NH27	1563700	1563800	I	L1	2.34	2.39	2.37	50	10/Dec/2022	26.28639854	79.89702664
NH27	1563800	1563900	I	L1	2.35	3.48	2.92	52	10/Dec/2022	26.28700743	79.89776296
NH27	1563900	1564000	I	L1	3.15	2.43	2.79	52	10/Dec/2022	26.28759025	79.89852336
NH27	1564000	1564100	I	L1	2.23	2.62	2.43	55	10/Dec/2022	26.28815256	79.89930181
NH27	1564100	1564200	I	L1	1.6	1.79	1.7	55	10/Dec/2022	26.28865354	79.90013078
NH27	1564200	1564300	I	L1	3.24	3.97	3.61	48	10/Dec/2022	26.28908442	79.90101026
NH27	1564300	1564400	I	L1	4.71	4.08	4.4	53	10/Dec/2022	26.28946677	79.90191552
NH27	1564400	1564500	I	L1	3.32	2.77	3.05	55	10/Dec/2022	26.28985147	79.90282035
NH27	1564500	1564600	I	L1	3.13	2.94	3.04	54	10/Dec/2022	26.29023393	79.90372657
NH27	1564600	1564700	I	L1	3.21	3.11	3.16	55	10/Dec/2022	26.29067132	79.90459831
NH27	1564700	1564800	I	L1	3.09	2.98	3.04	54	10/Dec/2022	26.29120243	79.90540553
NH27	1564800	1564900	I	L1	2.88	2.43	2.66	53	10/Dec/2022	26.29177174	79.90618097
NH27	1564900	1565000	I	L1	2.11	1.92	2.02	56	10/Dec/2022	26.2923368	79.9069593

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1565000	1565100	I	L1	2.01	2.06	2.04	57	10/Dec/2022	26.29290422	79.9077358
NH27	1565100	1565200	I	L1	1.43	1.91	1.67	57	10/Dec/2022	26.29347138	79.90851316
NH27	1565200	1565300	I	L1	3.05	2.48	2.77	55	10/Dec/2022	26.29404008	79.90928921
NH27	1565300	1565400	I	L1	1.57	1.47	1.52	53	10/Dec/2022	26.29460871	79.91006573
NH27	1565400	1565500	I	L1	1.33	1.25	1.29	54	10/Dec/2022	26.29517389	79.91084427
NH27	1565500	1565600	I	L1	1.97	1.66	1.82	53	10/Dec/2022	26.29573279	79.91162881
NH27	1565600	1565700	I	L1	1.21	1.4	1.31	58	10/Dec/2022	26.29630367	79.91240015
NH27	1565700	1565800	I	L1	1.32	1.27	1.3	60	10/Dec/2022	26.29687428	79.91317367
NH27	1565800	1565900	I	L1	1.07	1.39	1.23	59	10/Dec/2022	26.29744709	79.91394588
NH27	1565900	1566000	I	L1	1.73	1.61	1.67	59	10/Dec/2022	26.29806854	79.91466916
NH27	1566000	1566100	I	L1	2.06	2.19	2.13	57	10/Dec/2022	26.29870129	79.91538231
NH27	1566100	1566200	I	L1	2.63	2.1	2.37	57	10/Dec/2022	26.29933868	79.91608919
NH27	1566200	1566300	I	L1	1.82	2.05	1.94	58	10/Dec/2022	26.29995771	79.91681661
NH27	1566300	1566400	I	L1	2.14	1.84	1.99	55	10/Dec/2022	26.30055656	79.91756536
NH27	1566400	1566500	I	L1	1.51	1.72	1.62	58	10/Dec/2022	26.30118797	79.9182778
NH27	1566500	1566600	I	L1	1.57	1.64	1.61	59	10/Dec/2022	26.30178055	79.91903097
NH27	1566600	1566700	I	L1	1.43	1.77	1.6	55	10/Dec/2022	26.30230264	79.91984744
NH27	1566700	1566800	I	L1	1.68	1.47	1.58	56	10/Dec/2022	26.30277595	79.92069892
NH27	1566800	1566900	I	L1	1.24	1.12	1.18	57	10/Dec/2022	26.30326049	79.92154173
NH27	1566900	1567000	I	L1	1.76	1.4	1.58	56	10/Dec/2022	26.3038568	79.92228362
NH27	1567000	1567100	I	L1	1.98	1.71	1.85	56	10/Dec/2022	26.30463108	79.92278571
NH27	1567100	1567200	I	L1	3.25	3.17	3.21	47	10/Dec/2022	26.30549611	79.92309783
NH27	1567200	1567300	I	L1	3.99	3.31	3.65	54	10/Dec/2022	26.3063306	79.92346594
NH27	1567300	1567400	I	L1	2.88	2.62	2.75	56	10/Dec/2022	26.30705023	79.92406462
NH27	1567400	1567500	I	L1	1.75	1.97	1.86	50	10/Dec/2022	26.3077197	79.92473478
NH27	1567500	1567600	I	L1	1.75	1.68	1.72	48	10/Dec/2022	26.30837944	79.92541504
NH27	1567600	1567700	I	L1	1.78	1.83	1.81	53	10/Dec/2022	26.30905704	79.92607126
NH27	1567700	1567800	I	L1	3.1	2.61	2.86	58	10/Dec/2022	26.30972255	79.9267432
NH27	1567800	1567900	I	L1	2.06	1.75	1.91	60	10/Dec/2022	26.31038729	79.92741698
NH27	1567900	1568000	I	L1	1.48	1.51	1.5	59	10/Dec/2022	26.31105472	79.92808842
NH27	1568000	1568100	I	L1	2.23	1.79	2.01	59	10/Dec/2022	26.31172255	79.92875926
NH27	1568100	1568200	I	L1	1.34	1.38	1.36	58	10/Dec/2022	26.31239001	79.92943139
NH27	1568200	1568300	I	L1	1.53	1.84	1.69	61	10/Dec/2022	26.31302728	79.93013726
NH27	1568300	1568400	I	L1	1.43	1.53	1.48	61	10/Dec/2022	26.31355817	79.93094507
NH27	1568400	1568500	I	L1	1.29	1.56	1.43	61	10/Dec/2022	26.31402025	79.9318041
NH27	1568500	1568600	I	L1	3.28	3.27	3.28	60	10/Dec/2022	26.31447624	79.93266704
NH27	1568600	1568700	I	L1	1.62	1.7	1.66	58	10/Dec/2022	26.31492982	79.93353015
NH27	1568700	1568800	I	L1	1.29	1.35	1.32	57	10/Dec/2022	26.31538255	79.93439403

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1568800	1568900	I	L1	2.11	2	2.06	57	10/Dec/2022	26.31583668	79.93525678
NH27	1568900	1569000	I	L1	1.87	1.56	1.72	57	10/Dec/2022	26.31625806	79.93614015
NH27	1569000	1569100	I	L1	1.97	1.78	1.88	58	10/Dec/2022	26.31663618	79.93704741
NH27	1569100	1569200	I	L1	2.75	2.56	2.66	57	10/Dec/2022	26.31700659	79.93795869
NH27	1569200	1569300	I	L1	1.94	1.81	1.88	53	10/Dec/2022	26.31737786	79.9388703
NH27	1569300	1569400	I	L1	1.81	1.59	1.7	44	10/Dec/2022	26.31775111	79.93978182
NH27	1569400	1569500	I	L1	1.83	1.67	1.75	37	10/Dec/2022	26.31818011	79.94065955
NH27	1569500	1569600	I	L1	2.72	2.26	2.49	43	10/Dec/2022	26.31870196	79.94147381
NH27	1569600	1569700	I	L1	2.51	2.51	2.51	43	10/Dec/2022	26.31923273	79.9422823
NH27	1569700	1569800	I	L1	2.77	2.19	2.48	38	10/Dec/2022	26.31976706	79.94308878
NH27	1569800	1569900	I	L1	1.57	1.46	1.52	47	10/Dec/2022	26.3202703	79.94391603
NH27	1569900	1570000	I	L1	1.45	1.41	1.43	48	10/Dec/2022	26.32076332	79.94475308
NH27	1570000	1570100	I	L1	2.23	2.1	2.17	45	10/Dec/2022	26.32117278	79.94564481
NH27	1570100	1570200	I	L1	2.32	1.97	2.15	34	10/Dec/2022	26.32155087	79.94655459
NH27	1570200	1570300	I	L1	3.02	3.14	3.08	44	10/Dec/2022	26.32191558	79.94746683
NH27	1570300	1570400	I	L1	2.49	2.84	2.67	48	10/Dec/2022	26.32231271	79.94836391
NH27	1570400	1570500	I	L1	2.11	2.19	2.15	43	10/Dec/2022	26.32274724	79.94924028
NH27	1570500	1570600	I	L1	3.05	2.63	2.84	40	10/Dec/2022	26.32326479	79.95005834
NH27	1570600	1570700	I	L1	2.27	2.01	2.14	36	10/Dec/2022	26.32385249	79.9508162
NH27	1570700	1570800	I	L1	1.89	1.91	1.9	40	10/Dec/2022	26.32445448	79.95155947
NH27	1570800	1570900	I	L1	1.6	1.54	1.57	48	10/Dec/2022	26.32510228	79.95224982
NH27	1570900	1571000	I	L1	1.64	1.4	1.52	55	10/Dec/2022	26.32577872	79.95290708
NH27	1571000	1571100	I	L1	1.91	1.63	1.77	51	10/Dec/2022	26.32648561	79.95352799
NH27	1571100	1571200	I	L1	1.68	1.69	1.69	52	10/Dec/2022	26.32718355	79.95416052
NH27	1571200	1571300	I	L1	1.93	2.03	1.98	54	10/Dec/2022	26.32788932	79.95478127
NH27	1571300	1571400	I	L1	3.08	2.54	2.81	55	10/Dec/2022	26.32856767	79.95543951
NH27	1571400	1571500	I	L1	2.95	2.97	2.96	56	10/Dec/2022	26.32926846	79.95606635
NH27	1571500	1571600	I	L1	3.02	3.26	3.14	54	10/Dec/2022	26.32997676	79.95668331
NH27	1571600	1571700	I	L1	2.43	2.74	2.59	51	10/Dec/2022	26.33068128	79.95730754
NH27	1571700	1571800	I	L1	3.02	3.14	3.08	50	10/Dec/2022	26.33139214	79.95792385
NH27	1571800	1571900	I	L1	3.01	2.5	2.76	46	10/Dec/2022	26.33210028	79.95854414
NH27	1571900	1572000	I	L1	2.26	1.97	2.12	43	10/Dec/2022	26.33282239	79.95914297
NH27	1572000	1572100	I	L1	2.61	2.29	2.45	43	10/Dec/2022	26.33355366	79.95972705
NH27	1572100	1572200	I	L1	2	1.88	1.94	46	10/Dec/2022	26.33431049	79.9602689
NH27	1572200	1572300	I	L1	2.37	2.32	2.35	51	10/Dec/2022	26.33507036	79.9608047
NH27	1572300	1572400	I	L1	2.55	2.61	2.58	51	10/Dec/2022	26.33580877	79.96137822
NH27	1572400	1572500	I	L1	1.62	1.46	1.54	52	10/Dec/2022	26.33654826	79.9619491
NH27	1572500	1572600	I	L1	2.97	2.78	2.88	50	10/Dec/2022	26.33728772	79.96252129

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1572600	1572700	I	L1	2.59	2.99	2.79	50	10/Dec/2022	26.3380464	79.96305968
NH27	1572700	1572800	I	L1	2.15	1.93	2.04	48	10/Dec/2022	26.33880022	79.96360796
NH27	1572800	1572900	I	L1	2.63	2.65	2.64	48	10/Dec/2022	26.33949746	79.96424141
NH27	1572900	1573000	I	L1	2.33	2.32	2.33	43	10/Dec/2022	26.3401244	79.96496128
NH27	1573000	1573100	I	L1	2.48	2.66	2.57	34	10/Dec/2022	26.34072502	79.96570868
NH27	1573100	1573200	I	L1	1.68	1.72	1.7	47	10/Dec/2022	26.34134265	79.96643293
NH27	1573200	1573300	I	L1	1.86	2.44	2.15	51	10/Dec/2022	26.34194222	79.96717881
NH27	1573300	1573400	I	L1	1.54	1.78	1.66	51	10/Dec/2022	26.34254604	79.96791896
NH27	1573400	1573500	I	L1	1.6	1.62	1.61	50	10/Dec/2022	26.34314795	79.96866136
NH27	1573500	1573600	I	L1	2.06	2.24	2.15	49	10/Dec/2022	26.34375511	79.96939894
NH27	1573600	1573700	I	L1	3.21	3.44	3.33	50	10/Dec/2022	26.34436506	79.97013558
NH27	1573700	1573800	I	L1	2.53	2.52	2.53	55	10/Dec/2022	26.34497149	79.97087508
NH27	1573800	1573900	I	L1	1.67	1.58	1.63	59	10/Dec/2022	26.34557811	79.97161486
NH27	1573900	1574000	I	L1	2.07	2.45	2.26	57	10/Dec/2022	26.34620021	79.97233999
NH27	1574000	1574100	I	L1	1.97	2.47	2.22	54	10/Dec/2022	26.34683642	79.9730489
NH27	1574100	1574200	I	L1	1.54	1.77	1.66	54	10/Dec/2022	26.34744945	79.97378263
NH27	1574200	1574300	I	L1	2.08	2.21	2.15	53	10/Dec/2022	26.34805547	79.97452251
NH27	1574300	1574400	I	L1	1.84	1.81	1.83	48	10/Dec/2022	26.34866732	79.9752582
NH27	1574400	1574500	I	L1	2.39	3.37	2.88	50	10/Dec/2022	26.34927349	79.97599749
NH27	1574500	1574600	I	L1	2.2	2.38	2.29	51	10/Dec/2022	26.3498873	79.97672968
NH27	1574600	1574700	I	L1	1.78	1.57	1.68	47	10/Dec/2022	26.35049081	79.97747354
NH27	1574700	1574800	I	L1	3.01	3.15	3.08	39	10/Dec/2022	26.35109573	79.97821587
NH27	1574800	1574900	I	L1	2.88	2.88	2.88	34	10/Dec/2022	26.35169794	79.9789609
NH27	1574900	1575000	I	L1	2.75	2.32	2.54	42	10/Dec/2022	26.3523057	79.97969544
NH27	1575000	1575100	I	L1	3.14	2.32	2.73	46	10/Dec/2022	26.35291996	79.98042574
NH27	1575100	1575200	I	L1	3.16	3.32	3.24	49	10/Dec/2022	26.35352393	79.9811678
NH27	1575200	1575300	I	L1	1.68	1.9	1.79	51	10/Dec/2022	26.35412947	79.98190823
NH27	1575300	1575400	I	L1	1.58	1.92	1.75	53	10/Dec/2022	26.35473894	79.98264422
NH27	1575400	1575500	I	L1	2.33	2.58	2.46	50	10/Dec/2022	26.35538722	79.98333852
NH27	1575500	1575600	I	L1	1.67	1.75	1.71	49	10/Dec/2022	26.35608835	79.98396579
NH27	1575600	1575700	I	L1	1.76	2.03	1.9	52	10/Dec/2022	26.35683761	79.98451936
NH27	1575700	1575800	I	L1	1.41	1.48	1.45	53	10/Dec/2022	26.3576229	79.98500905
NH27	1575800	1575900	I	L1	1.45	1.82	1.64	50	10/Dec/2022	26.35841131	79.98549485
NH27	1575900	1576000	I	L1	1.68	2.29	1.99	52	10/Dec/2022	26.35920764	79.98596097
NH27	1576000	1576100	I	L1	1.37	1.52	1.45	50	10/Dec/2022	26.35999848	79.9864412
NH27	1576100	1576200	I	L1	2.01	2.3	2.16	49	10/Dec/2022	26.36078972	79.98692001
NH27	1576200	1576300	I	L1	1.53	1.46	1.5	53	10/Dec/2022	26.36158368	79.98739148
NH27	1576300	1576400	I	L1	1.77	1.74	1.76	53	10/Dec/2022	26.36237713	79.98786552

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1576400	1576500	I	L1	1.57	1.71	1.64	53	10/Dec/2022	26.36316989	79.98834132
NH27	1576500	1576600	I	L1	2.81	2.33	2.57	53	10/Dec/2022	26.36396122	79.98881964
NH27	1576600	1576700	I	L1	1.59	1.84	1.72	53	10/Dec/2022	26.36475413	79.9892949
NH27	1576700	1576800	I	L1	1.23	1.17	1.2	52	10/Dec/2022	26.36554537	79.98977408
NH27	1576800	1576900	I	L1	2.04	1.83	1.94	54	10/Dec/2022	26.36633991	79.99024444
NH27	1576900	1577000	I	L1	1.9	1.68	1.79	53	10/Dec/2022	26.36714519	79.99069385
NH27	1577000	1577100	I	L1	1.86	2.2	2.03	47	10/Dec/2022	26.36794742	79.99115152
NH27	1577100	1577200	I	L1	1.76	1.84	1.8	46	10/Dec/2022	26.36874046	79.99162717
NH27	1577200	1577300	I	L1	1.76	2.41	2.09	48	10/Dec/2022	26.36953256	79.99210346
NH27	1577300	1577400	I	L1	1.98	2.53	2.26	44	10/Dec/2022	26.37032592	79.99257922
NH27	1577400	1577500	I	L1	1.27	1.71	1.49	46	10/Dec/2022	26.37111853	79.99305395
NH27	1577500	1577600	I	L1	1.53	1.75	1.64	49	10/Dec/2022	26.37190992	79.99353155
NH27	1577600	1577700	I	L1	1.59	1.61	1.6	50	10/Dec/2022	26.3727009	79.99401017
NH27	1577700	1577800	I	L1	1.52	1.41	1.47	48	10/Dec/2022	26.37348323	79.99450856
NH27	1577800	1577900	I	L1	1.94	2.02	1.98	14	10/Dec/2022	26.37426964	79.99500176
NH27	1577900	1578000	I	L1	2.02	2.15	2.09	34	10/Dec/2022	26.37505122	79.99549099
NH27	1578000	1578100	I	L1	2.29	2.44	2.37	47	10/Dec/2022	26.37583847	79.9959731
NH27	1578100	1578200	I	L1	1.77	1.85	1.81	52	10/Dec/2022	26.37662658	79.99645397
NH27	1578200	1578300	I	L1	1.74	2.24	1.99	52	10/Dec/2022	26.37738707	79.99698568
NH27	1578300	1578400	I	L1	1.39	2.07	1.73	52	10/Dec/2022	26.37808484	79.9976159
NH27	1578400	1578500	I	L1	1.54	1.79	1.67	53	10/Dec/2022	26.37878025	79.99826661
NH27	1578500	1578600	I	L1	2.49	2.58	2.54	53	10/Dec/2022	26.37945992	79.99892395
NH27	1578600	1578700	I	L1	1.78	2.35	2.07	52	10/Dec/2022	26.38000356	79.99972009
NH27	1578700	1578800	I	L1	3.03	3	3.02	50	10/Dec/2022	26.38000356	79.99972009
NH27	1578800	1578900	I	L1	1.87	2.84	2.36	51	10/Dec/2022	26.38028269	80.0006701
NH27	1578900	1579000	I	L1	2.3	2.56	2.43	51	10/Dec/2022	26.38041202	80.00166057
NH27	1579000	1579077	I	L1	3.02	2.15	2.59	51	10/Dec/2022	26.38064625	80.00262428
NH27	1515713	1515800	I	L2	2.65	2.82	2.74	22	10/Dec/2022	26.02258997	79.53914393
NH27	1515800	1515900	I	L2	3.73	3.25	3.49	44	10/Dec/2022	26.02287248	79.53992772
NH27	1515900	1516000	I	L2	3.61	3.03	3.32	45	10/Dec/2022	26.02320537	79.54085317
NH27	1516000	1516100	I	L2	3.99	2.74	3.37	39	10/Dec/2022	26.02354231	79.54177837
NH27	1516100	1516200	I	L2	2.91	2.4	2.66	44	10/Dec/2022	26.02387608	79.54270296
NH27	1516200	1516300	I	L2	2.54	2.68	2.61	42	10/Dec/2022	26.02421252	79.54362794
NH27	1516300	1516400	I	L2	2.78	2.83	2.8	38	10/Dec/2022	26.02454623	79.54455413
NH27	1516400	1516500	I	L2	3.68	4.23	3.96	32	10/Dec/2022	26.02487829	79.54548136
NH27	1516500	1516600	I	L2	3.17	3.27	3.22	10	10/Dec/2022	26.02521335	79.54642699
NH27	1516600	1516700	I	L2	3.28	2.89	3.09	33	10/Dec/2022	26.02555591	79.54734587

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1516700	1516800	I	L2	4	3.63	3.82	46	10/Dec/2022	26.0258978	79.5482655
NH27	1516800	1516900	I	L2	4.71	3.84	4.28	49	10/Dec/2022	26.02623822	79.54918716
NH27	1516900	1517000	I	L2	3.22	2.61	2.92	53	10/Dec/2022	26.02658081	79.55010825
NH27	1517000	1517100	I	L2	4.25	3.01	3.63	57	10/Dec/2022	26.02692223	79.55103001
NH27	1517100	1517200	I	L2	3.22	3.53	3.38	56	10/Dec/2022	26.0272613	79.55195487
NH27	1517200	1517300	I	L2	2.34	2.69	2.52	61	10/Dec/2022	26.02760123	79.5528779
NH27	1517300	1517400	I	L2	3.17	4.25	3.71	60	10/Dec/2022	26.0279464	79.55379992
NH27	1517400	1517500	I	L2	3.02	3.18	3.1	55	10/Dec/2022	26.02828722	79.55472413
NH27	1517500	1517600	I	L2	3.14	2.98	3.06	52	10/Dec/2022	26.02864164	79.5556421
NH27	1517600	1517700	I	L2	2.98	3.2	3.09	51	10/Dec/2022	26.02894492	79.55658038
NH27	1517700	1517800	I	L2	2.83	2.63	2.73	55	10/Dec/2022	26.02924496	79.5575194
NH27	1517800	1517900	I	L2	3.17	3.13	3.15	50	10/Dec/2022	26.02958403	79.55844415
NH27	1517900	1518000	I	L2	3.18	3.02	3.1	52	10/Dec/2022	26.02992186	79.55936761
NH27	1518000	1518100	I	L2	1.86	2.16	2.01	57	10/Dec/2022	26.03027894	79.56028134
NH27	1518100	1518200	I	L2	2.87	2.22	2.55	65	10/Dec/2022	26.03062812	79.56119756
NH27	1518200	1518300	I	L2	5.02	4.32	4.67	61	10/Dec/2022	26.03094707	79.56212999
NH27	1518300	1518400	I	L2	4.17	5.95	5.06	56	10/Dec/2022	26.03128643	79.56305387
NH27	1518400	1518500	I	L2	5.54	5.59	5.57	56	10/Dec/2022	26.03162681	79.56397665
NH27	1518500	1518600	I	L2	7.52	3.44	5.48	57	10/Dec/2022	26.0319671	79.56489905
NH27	1518600	1518700	I	L2	6.95	3.12	5.04	57	10/Dec/2022	26.03230024	79.56582437
NH27	1518700	1518800	I	L2	2.34	2.55	2.45	58	10/Dec/2022	26.03263356	79.56675004
NH27	1518800	1518900	I	L2	3.15	3.02	3.09	59	10/Dec/2022	26.03296843	79.56767496
NH27	1518900	1519000	I	L2	3.6	2.96	3.28	60	10/Dec/2022	26.0333025	79.56860058
NH27	1519000	1519100	I	L2	3.24	2.52	2.88	61	10/Dec/2022	26.03363685	79.56952631
NH27	1519100	1519200	I	L2	2.41	2.55	2.48	60	10/Dec/2022	26.03397117	79.57045235
NH27	1519200	1519300	I	L2	3.17	3.12	3.15	59	10/Dec/2022	26.03430517	79.57137839
NH27	1519300	1519400	I	L2	3.49	2.86	3.18	58	10/Dec/2022	26.03464006	79.57230421
NH27	1519400	1519500	I	L2	2.11	2.26	2.19	58	10/Dec/2022	26.03497633	79.57322893
NH27	1519500	1519600	I	L2	2.14	3	2.57	59	10/Dec/2022	26.03530878	79.57415562
NH27	1519600	1519700	I	L2	2.51	3.17	2.84	58	10/Dec/2022	26.03564103	79.57508267
NH27	1519700	1519800	I	L2	2.47	2.77	2.62	55	10/Dec/2022	26.03597834	79.57600803
NH27	1519800	1519900	I	L2	3.02	3.14	3.08	42	10/Dec/2022	26.03631776	79.57693387
NH27	1519900	1520000	I	L2	3.24	3.44	3.34	7	10/Dec/2022	26.03667489	79.57784941
NH27	1520000	1520100	I	L2	2.9	3.03	2.97	37	10/Dec/2022	26.03698226	79.57878302
NH27	1520100	1520200	I	L2	2.98	3.43	3.21	46	10/Dec/2022	26.03730737	79.57971
NH27	1520200	1520300	I	L2	2.82	2.39	2.61	54	10/Dec/2022	26.03764218	79.58063382
NH27	1520300	1520400	I	L2	1.79	2.78	2.29	58	10/Dec/2022	26.03797616	79.58155927
NH27	1520400	1520500	I	L2	2.56	2.16	2.36	59	10/Dec/2022	26.03831438	79.5824832

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1520500	1520600	I	L2	1.55	1.75	1.65	60	10/Dec/2022	26.03866377	79.58340275
NH27	1520600	1520700	I	L2	1.55	2.01	1.78	56	10/Dec/2022	26.03901182	79.58432329
NH27	1520700	1520800	I	L2	2.12	2.65	2.39	58	10/Dec/2022	26.03935868	79.58524349
NH27	1520800	1520900	I	L2	1.69	2.55	2.12	60	10/Dec/2022	26.03970801	79.58616243
NH27	1520900	1521000	I	L2	1.72	2.16	1.94	63	10/Dec/2022	26.04005897	79.58708034
NH27	1521000	1521100	I	L2	1.48	1.92	1.7	61	10/Dec/2022	26.04040822	79.58800029
NH27	1521100	1521200	I	L2	1.83	2.18	2.01	60	10/Dec/2022	26.04075686	79.58891949
NH27	1521200	1521300	I	L2	1.78	1.52	1.65	62	10/Dec/2022	26.04110438	79.58983864
NH27	1521300	1521400	I	L2	2.15	1.88	2.02	58	10/Dec/2022	26.04145464	79.59075839
NH27	1521400	1521500	I	L2	1.74	2.42	2.08	50	10/Dec/2022	26.04182429	79.59166883
NH27	1521500	1521600	I	L2	1.66	1.22	1.44	58	10/Dec/2022	26.04217111	79.59258784
NH27	1521600	1521700	I	L2	1.65	1.97	1.81	55	10/Dec/2022	26.04250881	79.59351327
NH27	1521700	1521800	I	L2	1.31	1.66	1.49	47	10/Dec/2022	26.04285548	79.59443464
NH27	1521800	1521900	I	L2	1.81	1.77	1.79	50	10/Dec/2022	26.0432468	79.59533127
NH27	1521900	1522000	I	L2	1.74	1.69	1.72	64	10/Dec/2022	26.04367396	79.59620592
NH27	1522000	1522100	I	L2	1.66	2.33	2	64	10/Dec/2022	26.04409278	79.59708837
NH27	1522100	1522200	I	L2	2.14	2.38	2.26	61	10/Dec/2022	26.04456573	79.59793794
NH27	1522200	1522300	I	L2	1.74	2.2	1.97	59	10/Dec/2022	26.04504507	79.59878307
NH27	1522300	1522400	I	L2	1.94	2.03	1.99	57	10/Dec/2022	26.04551507	79.59963532
NH27	1522400	1522500	I	L2	2.66	2.19	2.43	52	10/Dec/2022	26.04597311	79.60049539
NH27	1522500	1522600	I	L2	2.45	2.51	2.48	31	10/Dec/2022	26.04645649	79.60133946
NH27	1522600	1522700	I	L2	2.8	2.73	2.77	33	10/Dec/2022	26.04693569	79.60218314
NH27	1522700	1522800	I	L2	2.68	2.74	2.71	41	10/Dec/2022	26.0474139	79.60302681
NH27	1522800	1522900	I	L2	3.38	3.07	3.23	42	10/Dec/2022	26.04789749	79.60386887
NH27	1522900	1523000	I	L2	1.69	1.52	1.61	55	10/Dec/2022	26.04839494	79.60469664
NH27	1523000	1523100	I	L2	2.14	2.35	2.25	68	10/Dec/2022	26.04892317	79.60550122
NH27	1523100	1523200	I	L2	2.44	2.82	2.63	71	10/Dec/2022	26.0494145	79.60633653
NH27	1523200	1523300	I	L2	1.94	2.43	2.19	73	10/Dec/2022	26.04993024	79.60715387
NH27	1523300	1523400	I	L2	2.3	2.97	2.64	71	10/Dec/2022	26.05044603	79.60797271
NH27	1523400	1523500	I	L2	1.44	1.78	1.61	68	10/Dec/2022	26.05096407	79.60879024
NH27	1523500	1523600	I	L2	4.47	3.61	4.04	66	10/Dec/2022	26.05147988	79.60960845
NH27	1523600	1523700	I	L2	3.17	2.63	2.9	65	10/Dec/2022	26.05199741	79.61042598
NH27	1523700	1523800	I	L2	2.14	2.55	2.35	64	10/Dec/2022	26.05251386	79.61124349
NH27	1523800	1523900	I	L2	2.35	2.98	2.67	63	10/Dec/2022	26.05302722	79.61206344
NH27	1523900	1524000	I	L2	1.65	2.36	2.01	64	10/Dec/2022	26.05349577	79.61291498
NH27	1524000	1524100	I	L2	2.25	2.61	2.43	64	10/Dec/2022	26.05387457	79.61381964
NH27	1524100	1524200	I	L2	1.48	1.56	1.52	65	10/Dec/2022	26.0541874	79.61475502
NH27	1524200	1524300	I	L2	2.18	2.49	2.34	65	10/Dec/2022	26.05449558	79.61569219

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1524300	1524400	I	L2	2.2	2.55	2.38	65	10/Dec/2022	26.05480551	79.61662864
NH27	1524400	1524500	I	L2	2.18	2.54	2.36	65	10/Dec/2022	26.05515729	79.61754685
NH27	1524500	1524600	I	L2	1.97	2.24	2.11	65	10/Dec/2022	26.05554558	79.61844621
NH27	1524600	1524700	I	L2	1.25	1.36	1.31	63	10/Dec/2022	26.05597269	79.61932491
NH27	1524700	1524800	I	L2	2.09	2.46	2.28	62	10/Dec/2022	26.05641188	79.62019696
NH27	1524800	1524900	I	L2	2.85	3.02	2.94	59	10/Dec/2022	26.05685082	79.6210695
NH27	1524900	1525000	I	L2	2.29	2.35	2.32	54	10/Dec/2022	26.05729059	79.62194185
NH27	1525000	1525100	I	L2	3.29	2.82	3.06	56	10/Dec/2022	26.05775008	79.62279974
NH27	1525100	1525200	I	L2	2.56	1.79	2.18	59	10/Dec/2022	26.05817402	79.62367911
NH27	1525200	1525300	I	L2	2.88	2.35	2.62	58	10/Dec/2022	26.05860649	79.62455445
NH27	1525300	1525400	I	L2	2.47	2.52	2.5	53	10/Dec/2022	26.05904416	79.62542826
NH27	1525400	1525500	I	L2	4.45	5.27	4.86	53	10/Dec/2022	26.05948277	79.62630005
NH27	1525500	1525600	I	L2	5.04	5.94	5.49	31	10/Dec/2022	26.05992294	79.62717337
NH27	1525600	1525700	I	L2	2.17	2.45	2.31	38	10/Dec/2022	26.06037688	79.62803208
NH27	1525700	1525800	I	L2	1.86	2.4	2.13	49	10/Dec/2022	26.06079994	79.62891034
NH27	1525800	1525900	I	L2	2.3	2.42	2.36	56	10/Dec/2022	26.06123468	79.62978256
NH27	1525900	1526000	I	L2	6.91	7.45	7.18	48	10/Dec/2022	26.06167479	79.63065509
NH27	1526000	1526100	I	L2	6.35	6.09	6.22	38	10/Dec/2022	26.0621124	79.63152741
NH27	1526100	1526200	I	L2	4.46	4.6	4.53	42	10/Dec/2022	26.06254998	79.63239893
NH27	1526200	1526300	I	L2	2.91	2.64	2.78	50	10/Dec/2022	26.06298698	79.63326998
NH27	1526300	1526400	I	L2	6.35	5.9	6.13	51	10/Dec/2022	26.06342296	79.63414308
NH27	1526400	1526500	I	L2	4.76	3.63	4.2	49	10/Dec/2022	26.06385674	79.63501761
NH27	1526500	1526600	I	L2	3.14	2.29	2.72	52	10/Dec/2022	26.0642919	79.63589027
NH27	1526600	1526700	I	L2	5.33	3.85	4.59	56	10/Dec/2022	26.06472817	79.63676228
NH27	1526700	1526800	I	L2	4.95	2.2	3.58	57	10/Dec/2022	26.06516304	79.63763591
NH27	1526800	1526900	I	L2	6.16	6.25	6.21	56	10/Dec/2022	26.06559906	79.63850908
NH27	1526900	1527000	I	L2	6.54	6.02	6.28	54	10/Dec/2022	26.06603422	79.63938293
NH27	1527000	1527100	I	L2	5.45	3.13	4.29	52	10/Dec/2022	26.06646653	79.64025887
NH27	1527100	1527200	I	L2	2.13	2.61	2.37	54	10/Dec/2022	26.06690733	79.6411403
NH27	1527200	1527300	I	L2	2.38	2.63	2.51	57	10/Dec/2022	26.0673393	79.64201525
NH27	1527300	1527400	I	L2	4.68	3.04	3.86	55	10/Dec/2022	26.06777588	79.64288891
NH27	1527400	1527500	I	L2	2.24	2.52	2.38	52	10/Dec/2022	26.068213	79.64376248
NH27	1527500	1527600	I	L2	6.15	7.61	6.88	55	10/Dec/2022	26.06864577	79.64463691
NH27	1527600	1527700	I	L2	6.11	6.3	6.21	45	10/Dec/2022	26.06908356	79.64551156
NH27	1527700	1527800	I	L2	6.62	7.03	6.83	33	10/Dec/2022	26.06951807	79.64638729
NH27	1527800	1527900	I	L2	6	6.36	6.18	36	10/Dec/2022	26.06996785	79.64724953
NH27	1527900	1528000	I	L2	7.96	7.45	7.71	42	10/Dec/2022	26.07038423	79.64813256
NH27	1528000	1528100	I	L2	1.9	1.8	1.85	48	10/Dec/2022	26.07081811	79.64900617

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1528100	1528200	I	L2	6.8	6.31	6.56	54	10/Dec/2022	26.07125512	79.64987728
NH27	1528200	1528300	I	L2	5.19	5.4	5.3	54	10/Dec/2022	26.07168805	79.65075309
NH27	1528300	1528400	I	L2	6.02	5.78	5.9	45	10/Dec/2022	26.07212388	79.65162731
NH27	1528400	1528500	I	L2	2.96	2.04	2.5	53	10/Dec/2022	26.07256073	79.65249783
NH27	1528500	1528600	I	L2	1.65	1.86	1.76	56	10/Dec/2022	26.07299401	79.65337189
NH27	1528600	1528700	I	L2	3.39	2.75	3.07	58	10/Dec/2022	26.07342324	79.65424851
NH27	1528700	1528800	I	L2	1.54	1.81	1.68	56	10/Dec/2022	26.07384438	79.6551314
NH27	1528800	1528900	I	L2	2.48	3.22	2.85	60	10/Dec/2022	26.07428589	79.65600057
NH27	1528900	1529000	I	L2	2.22	1.87	2.05	60	10/Dec/2022	26.07467843	79.65689919
NH27	1529000	1529100	I	L2	2.88	3.41	3.15	61	10/Dec/2022	26.07509579	79.65778339
NH27	1529100	1529200	I	L2	3.64	2.83	3.24	60	10/Dec/2022	26.07551485	79.65866772
NH27	1529200	1529300	I	L2	2.68	2.57	2.63	59	10/Dec/2022	26.07593243	79.65955284
NH27	1529300	1529400	I	L2	2.61	2.27	2.44	58	10/Dec/2022	26.07635167	79.66043701
NH27	1529400	1529500	I	L2	1.56	1.76	1.66	57	10/Dec/2022	26.07676886	79.66132165
NH27	1529500	1529600	I	L2	2.06	2.11	2.09	58	10/Dec/2022	26.07718605	79.66220629
NH27	1529600	1529700	I	L2	2.93	2.35	2.64	59	10/Dec/2022	26.07760387	79.66309006
NH27	1529700	1529800	I	L2	5.87	2.46	4.17	59	10/Dec/2022	26.07802159	79.66397453
NH27	1529800	1529900	I	L2	5.08	2.22	3.65	58	10/Dec/2022	26.07844073	79.66485854
NH27	1529900	1530000	I	L2	2.15	2.03	2.09	59	10/Dec/2022	26.07885996	79.66574198
NH27	1530000	1530100	I	L2	2.24	2.74	2.49	59	10/Dec/2022	26.07927674	79.66662659
NH27	1530100	1530200	I	L2	2	2.05	2.03	60	10/Dec/2022	26.07969156	79.66751222
NH27	1530200	1530300	I	L2	3.02	1.83	2.43	61	10/Dec/2022	26.08011043	79.66839592
NH27	1530300	1530400	I	L2	3	3.18	3.09	62	10/Dec/2022	26.08053148	79.6692787
NH27	1530400	1530500	I	L2	4.02	2.99	3.51	61	10/Dec/2022	26.08094625	79.67016543
NH27	1530500	1530600	I	L2	2.31	1.4	1.86	60	10/Dec/2022	26.08135919	79.67105296
NH27	1530600	1530700	I	L2	4.05	1.69	2.87	61	10/Dec/2022	26.08175992	79.67194672
NH27	1530700	1530800	I	L2	2.39	1.86	2.13	61	10/Dec/2022	26.08216668	79.67283783
NH27	1530800	1530900	I	L2	2.51	1.84	2.18	61	10/Dec/2022	26.08256866	79.67373175
NH27	1530900	1531000	I	L2	2.52	2.09	2.31	62	10/Dec/2022	26.08297556	79.67462248
NH27	1531000	1531100	I	L2	5.23	3.02	4.13	62	10/Dec/2022	26.08338041	79.67551457
NH27	1531100	1531200	I	L2	3.56	2.31	2.94	61	10/Dec/2022	26.08378817	79.67640507
NH27	1531200	1531300	I	L2	2.33	2.65	2.49	60	10/Dec/2022	26.08419061	79.67729872
NH27	1531300	1531400	I	L2	2.63	2.25	2.44	59	10/Dec/2022	26.08459994	79.67818785
NH27	1531400	1531500	I	L2	2.95	2.15	2.55	59	10/Dec/2022	26.0850027	79.67908097
NH27	1531500	1531600	I	L2	3.31	2.35	2.83	60	10/Dec/2022	26.08540926	79.67997163
NH27	1531600	1531700	I	L2	3.73	3.98	3.86	62	10/Dec/2022	26.08581213	79.68086417
NH27	1531700	1531800	I	L2	3.02	1.76	2.39	62	10/Dec/2022	26.08621803	79.68175539
NH27	1531800	1531900	I	L2	2.54	2.11	2.33	59	10/Dec/2022	26.08662398	79.68264795

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1531900	1532000	I	L2	1.93	2.17	2.05	57	10/Dec/2022	26.08702928	79.68354041
NH27	1532000	1532100	I	L2	1.77	2.01	1.89	55	10/Dec/2022	26.08745308	79.68442181
NH27	1532100	1532200	I	L2	2.56	1.94	2.25	62	10/Dec/2022	26.08785416	79.68531435
NH27	1532200	1532300	I	L2	2.46	3.03	2.75	58	10/Dec/2022	26.08824328	79.68621553
NH27	1532300	1532400	I	L2	1.74	2.28	2.01	58	10/Dec/2022	26.08864737	79.68710793
NH27	1532400	1532500	I	L2	2.67	2.29	2.48	58	10/Dec/2022	26.08905181	79.68800035
NH27	1532500	1532600	I	L2	2.09	3.01	2.55	59	10/Dec/2022	26.08945872	79.68889142
NH27	1532600	1532700	I	L2	2.53	2.71	2.62	57	10/Dec/2022	26.08986527	79.68978323
NH27	1532700	1532800	I	L2	1.95	2.05	2	58	10/Dec/2022	26.09027033	79.69067521
NH27	1532800	1532900	I	L2	2.32	2.8	2.56	59	10/Dec/2022	26.09067949	79.69156405
NH27	1532900	1533000	I	L2	1.54	1.92	1.73	57	10/Dec/2022	26.09110948	79.69244175
NH27	1533000	1533100	I	L2	2.2	2.19	2.2	55	10/Dec/2022	26.09155262	79.69331116
NH27	1533100	1533200	I	L2	2.24	2.43	2.34	56	10/Dec/2022	26.09201489	79.69416841
NH27	1533200	1533300	I	L2	1.73	2.05	1.89	56	10/Dec/2022	26.09250454	79.69500648
NH27	1533300	1533400	I	L2	1.38	1.8	1.59	57	10/Dec/2022	26.0930162	79.69582833
NH27	1533400	1533500	I	L2	1.46	2.25	1.86	54	10/Dec/2022	26.0935021	79.69666995
NH27	1533500	1533600	I	L2	2.75	2.85	2.8	55	10/Dec/2022	26.0940341	79.69747546
NH27	1533600	1533700	I	L2	1.62	1.94	1.78	56	10/Dec/2022	26.09457651	79.69827276
NH27	1533700	1533800	I	L2	1.36	1.83	1.6	60	10/Dec/2022	26.09513038	79.69905942
NH27	1533800	1533900	I	L2	1.49	2.17	1.83	69	10/Dec/2022	26.09567798	79.6998502
NH27	1533900	1534000	I	L2	2.23	2.01	2.12	69	10/Dec/2022	26.09620535	79.70066017
NH27	1534000	1534100	I	L2	2.5	2.11	2.31	61	10/Dec/2022	26.09673769	79.70146795
NH27	1534100	1534200	I	L2	2.57	3.02	2.8	56	10/Dec/2022	26.09728221	79.70226471
NH27	1534200	1534300	I	L2	3.2	2.68	2.94	52	10/Dec/2022	26.09782721	79.70306109
NH27	1534300	1534400	I	L2	3.32	4.11	3.72	51	10/Dec/2022	26.09836881	79.70385892
NH27	1534400	1534500	I	L2	2.92	3.32	3.12	52	10/Dec/2022	26.09892698	79.70464267
NH27	1534500	1534600	I	L2	2.27	2.26	2.27	51	10/Dec/2022	26.09948406	79.70542733
NH27	1534600	1534700	I	L2	1.72	2.5	2.11	49	10/Dec/2022	26.10004558	79.70620867
NH27	1534700	1534800	I	L2	3.2	4.16	3.68	53	10/Dec/2022	26.1006037	79.70699177
NH27	1534800	1534900	I	L2	1.84	2.37	2.11	41	10/Dec/2022	26.10114589	79.70779103
NH27	1534900	1535000	I	L2	2.08	2.72	2.4	37	10/Dec/2022	26.10170929	79.70857137
NH27	1535000	1535100	I	L2	1.93	2.07	2	52	10/Dec/2022	26.10227297	79.70934664
NH27	1535100	1535200	I	L2	1.85	1.87	1.86	55	10/Dec/2022	26.10281106	79.71014652
NH27	1535200	1535300	I	L2	1.53	1.68	1.61	58	10/Dec/2022	26.10336583	79.71093248
NH27	1535300	1535400	I	L2	1.87	2.33	2.1	60	10/Dec/2022	26.10392063	79.71171927
NH27	1535400	1535500	I	L2	1.77	2.22	2	62	10/Dec/2022	26.10447692	79.71250508
NH27	1535500	1535600	I	L2	2.39	2.92	2.66	62	10/Dec/2022	26.10503312	79.71329127
NH27	1535600	1535700	I	L2	1.52	1.84	1.68	61	10/Dec/2022	26.10558475	79.71408109

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1535700	1535800	I	L2	1.57	2.08	1.83	62	10/Dec/2022	26.1061109	79.71489158
NH27	1535800	1535900	I	L2	2.27	2.01	2.14	61	10/Dec/2022	26.10660363	79.71572748
NH27	1535900	1536000	I	L2	2.72	2.98	2.85	59	10/Dec/2022	26.10709086	79.71656723
NH27	1536000	1536100	I	L2	2.86	3.01	2.94	60	10/Dec/2022	26.1075787	79.71740644
NH27	1536100	1536200	I	L2	2.17	2.43	2.3	62	10/Dec/2022	26.1080848	79.71823223
NH27	1536200	1536300	I	L2	1.95	2.74	2.35	63	10/Dec/2022	26.10863984	79.71901888
NH27	1536300	1536400	I	L2	1.89	2.85	2.37	62	10/Dec/2022	26.10917631	79.71982202
NH27	1536400	1536500	I	L2	1.2	1.42	1.31	60	10/Dec/2022	26.10968836	79.72064386
NH27	1536500	1536600	I	L2	1.38	1.74	1.56	59	10/Dec/2022	26.11020028	79.72146562
NH27	1536600	1536700	I	L2	1.41	1.81	1.61	57	10/Dec/2022	26.11071386	79.72228637
NH27	1536700	1536800	I	L2	2.82	2.59	2.71	54	10/Dec/2022	26.11122733	79.72310754
NH27	1536800	1536900	I	L2	1.85	2.53	2.19	54	10/Dec/2022	26.1117382	79.72393006
NH27	1536900	1537000	I	L2	2.04	2.31	2.18	48	10/Dec/2022	26.11225295	79.72475084
NH27	1537000	1537100	I	L2	2.31	2.5	2.41	48	10/Dec/2022	26.11272836	79.72559867
NH27	1537100	1537200	I	L2	2.07	2.59	2.33	45	10/Dec/2022	26.11307346	79.72652172
NH27	1537200	1537300	I	L2	1.69	2.25	1.97	58	10/Dec/2022	26.11325822	79.7274949
NH27	1537300	1537400	I	L2	2.68	3.05	2.87	58	10/Dec/2022	26.1132915	79.72849293
NH27	1537400	1537500	I	L2	1.72	1.55	1.64	49	10/Dec/2022	26.11333984	79.72949157
NH27	1537500	1537600	I	L2	1.68	1.82	1.75	47	10/Dec/2022	26.11340194	79.73048754
NH27	1537600	1537700	I	L2	1.63	1.72	1.68	43	10/Dec/2022	26.11355076	79.73147323
NH27	1537700	1537800	I	L2	3.07	3.02	3.05	44	10/Dec/2022	26.11370614	79.73245708
NH27	1537800	1537900	I	L2	2.21	3.13	2.67	42	10/Dec/2022	26.11375722	79.73345281
NH27	1537900	1538000	I	L2	3.7	4.33	4.02	43	10/Dec/2022	26.11360648	79.7344363
NH27	1538000	1538100	I	L2	3.23	3.85	3.54	38	10/Dec/2022	26.11338412	79.73540495
NH27	1538100	1538200	I	L2	5.85	5.89	5.87	42	10/Dec/2022	26.1131904	79.73637875
NH27	1538200	1538300	I	L2	4.23	3.88	4.06	39	10/Dec/2022	26.11319575	79.73737445
NH27	1538300	1538400	I	L2	3.58	3.33	3.46	51	10/Dec/2022	26.11347775	79.73831713
NH27	1538400	1538500	I	L2	3.17	3.02	3.1	58	10/Dec/2022	26.11393718	79.73917879
NH27	1538500	1538600	I	L2	4	4.82	4.41	58	10/Dec/2022	26.11460593	79.73984218
NH27	1538600	1538700	I	L2	3.25	3.02	3.14	52	10/Dec/2022	26.11536603	79.74038123
NH27	1538700	1538800	I	L2	3.79	3.66	3.73	51	10/Dec/2022	26.11613447	79.74090419
NH27	1538800	1538900	I	L2	2.43	2.45	2.44	53	10/Dec/2022	26.11691172	79.74140892
NH27	1538900	1539000	I	L2	2.41	1.8	2.11	59	10/Dec/2022	26.11767622	79.74193646
NH27	1539000	1539100	I	L2	2.87	2.58	2.73	61	10/Dec/2022	26.11843878	79.74246749
NH27	1539100	1539200	I	L2	5.67	3.92	4.8	56	10/Dec/2022	26.11917351	79.74304668
NH27	1539200	1539300	I	L2	3.73	4.19	3.96	53	10/Dec/2022	26.11975444	79.74380725
NH27	1539300	1539400	I	L2	4.2	4.98	4.59	53	10/Dec/2022	26.12019576	79.74467539
NH27	1539400	1539500	I	L2	4.67	3.54	4.11	50	10/Dec/2022	26.12061534	79.74555875

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1539500	1539600	I	L2	2.99	2.95	2.97	49	10/Dec/2022	26.1210413	79.74643762
NH27	1539600	1539700	I	L2	5	5.14	5.07	52	10/Dec/2022	26.12154747	79.74726005
NH27	1539700	1539800	I	L2	2.51	1.94	2.23	44	10/Dec/2022	26.12213227	79.7480213
NH27	1539800	1539900	I	L2	2.4	2.47	2.44	51	10/Dec/2022	26.12281113	79.74867488
NH27	1539900	1540000	I	L2	2.86	2.66	2.76	52	10/Dec/2022	26.12351554	79.74929787
NH27	1540000	1540100	I	L2	6.22	4.74	5.48	50	10/Dec/2022	26.12425617	79.74986842
NH27	1540100	1540200	I	L2	4.23	4.12	4.18	41	10/Dec/2022	26.12505082	79.75033774
NH27	1540200	1540300	I	L2	4.49	5.11	4.8	41	10/Dec/2022	26.1258952	79.75068681
NH27	1540300	1540400	I	L2	2.46	2.85	2.66	39	10/Dec/2022	26.12675878	79.75097264
NH27	1540400	1540500	I	L2	1.74	2.25	2	37	10/Dec/2022	26.12760674	79.75131297
NH27	1540500	1540600	I	L2	6.26	4.83	5.55	30	10/Dec/2022	26.12842798	79.75172763
NH27	1540600	1540700	I	L2	3.06	2.51	2.79	29	10/Dec/2022	26.12923607	79.75217035
NH27	1540700	1540800	I	L2	2.91	2.99	2.95	31	10/Dec/2022	26.13004439	79.75261126
NH27	1540800	1540900	I	L2	2.92	2.71	2.82	35	10/Dec/2022	26.13085336	79.75305015
NH27	1540900	1541000	I	L2	2.54	2.51	2.53	34	10/Dec/2022	26.13166007	79.75349543
NH27	1541000	1541100	I	L2	2.78	2.62	2.7	38	10/Dec/2022	26.13246886	79.75393336
NH27	1541100	1541200	I	L2	3.02	3.02	3.02	45	10/Dec/2022	26.1332755	79.75437558
NH27	1541200	1541300	I	L2	2.71	3.79	3.25	50	10/Dec/2022	26.13408312	79.75481587
NH27	1541300	1541400	I	L2	5.34	5.27	5.31	51	10/Dec/2022	26.13489038	79.75525912
NH27	1541400	1541500	I	L2	4.83	3.84	4.34	47	10/Dec/2022	26.1357	79.75569933
NH27	1541500	1541600	I	L2	2.61	2.29	2.45	47	10/Dec/2022	26.13650708	79.75614476
NH27	1541600	1541700	I	L2	2.48	2.14	2.31	40	10/Dec/2022	26.13731524	79.75659066
NH27	1541700	1541800	I	L2	2.48	2.29	2.39	41	10/Dec/2022	26.13812253	79.75703596
NH27	1541800	1541900	I	L2	2.13	2.51	2.32	43	10/Dec/2022	26.13892961	79.7574815
NH27	1541900	1542000	I	L2	2.77	3.83	3.3	40	10/Dec/2022	26.13973734	79.75792625
NH27	1542000	1542100	I	L2	1.6	2.26	1.93	40	10/Dec/2022	26.14054334	79.75837343
NH27	1542100	1542200	I	L2	2.01	2.49	2.25	42	10/Dec/2022	26.14134921	79.75882078
NH27	1542200	1542300	I	L2	1.82	2.49	2.16	40	10/Dec/2022	26.14215576	79.75926705
NH27	1542300	1542400	I	L2	1.57	2.33	1.95	38	10/Dec/2022	26.14296096	79.75971684
NH27	1542400	1542500	I	L2	2.58	3.14	2.86	41	10/Dec/2022	26.14376213	79.76017319
NH27	1542500	1542600	I	L2	3.02	3.12	3.07	44	10/Dec/2022	26.14453332	79.76068886
NH27	1542600	1542700	I	L2	1.98	2.37	2.18	39	10/Dec/2022	26.14527055	79.761264
NH27	1542700	1542800	I	L2	2.5	3.02	2.76	37	10/Dec/2022	26.14597346	79.76189021
NH27	1542800	1542900	I	L2	2.62	3.07	2.85	34	10/Dec/2022	26.14665124	79.76254975
NH27	1542900	1543000	I	L2	1.63	1.72	1.68	35	10/Dec/2022	26.14732593	79.76321212
NH27	1543000	1543100	I	L2	1.7	2.08	1.89	34	10/Dec/2022	26.14800465	79.76386981
NH27	1543100	1543200	I	L2	1.51	1.93	1.72	35	10/Dec/2022	26.14868196	79.76452806
NH27	1543200	1543300	I	L2	1.72	2.13	1.93	32	10/Dec/2022	26.14936011	79.7651858

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1543300	1543400	I	L2	4.02	4.14	4.08	22	10/Dec/2022	26.15003858	79.76584385
NH27	1543400	1543500	I	L2	2.54	2.34	2.44	27	10/Dec/2022	26.15071583	79.76650129
NH27	1543500	1543600	I	L2	2.21	2.14	2.18	10	10/Dec/2022	26.15137721	79.76718004
NH27	1543600	1543700	I	L2	2.17	2.01	2.09	39	10/Dec/2022	26.15210207	79.76783096
NH27	1543700	1543800	I	L2	2.14	1.89	2.02	52	10/Dec/2022	26.15277602	79.76848925
NH27	1543800	1543900	I	L2	3.82	3.24	3.53	60	10/Dec/2022	26.15345303	79.76914428
NH27	1543900	1544000	I	L2	2.43	2.8	2.62	64	10/Dec/2022	26.15413003	79.76979977
NH27	1544000	1544100	I	L2	2.88	2.85	2.87	65	10/Dec/2022	26.15480519	79.77045825
NH27	1544100	1544200	I	L2	2.1	2.61	2.36	64	10/Dec/2022	26.15548272	79.7711138
NH27	1544200	1544300	I	L2	1.86	2.39	2.13	63	10/Dec/2022	26.15615875	79.77177296
NH27	1544300	1544400	I	L2	2.15	2.41	2.28	62	10/Dec/2022	26.15683484	79.77243249
NH27	1544400	1544500	I	L2	1.83	2.57	2.2	61	10/Dec/2022	26.15751305	79.77308939
NH27	1544500	1544600	I	L2	2.42	2.53	2.48	60	10/Dec/2022	26.15818913	79.77374922
NH27	1544600	1544700	I	L2	2.25	2.82	2.54	59	10/Dec/2022	26.15886635	79.77440744
NH27	1544700	1544800	I	L2	1.89	2.3	2.1	56	10/Dec/2022	26.15954935	79.77506022
NH27	1544800	1544900	I	L2	1.56	1.6	1.58	45	10/Dec/2022	26.1602287	79.77571887
NH27	1544900	1545000	I	L2	1.52	1.69	1.61	33	10/Dec/2022	26.16091286	79.77636972
NH27	1545000	1545100	I	L2	2.07	2.11	2.09	39	10/Dec/2022	26.16160153	79.77701217
NH27	1545100	1545200	I	L2	3.12	2.2	2.66	48	10/Dec/2022	26.16228718	79.77765633
NH27	1545200	1545300	I	L2	2.08	2.44	2.26	57	10/Dec/2022	26.16303619	79.77820674
NH27	1545300	1545400	I	L2	1.8	2.05	1.93	58	10/Dec/2022	26.16379593	79.77874257
NH27	1545400	1545500	I	L2	1.85	2.2	2.03	61	10/Dec/2022	26.16455492	79.77927892
NH27	1545500	1545600	I	L2	2.06	2.09	2.08	62	10/Dec/2022	26.16531369	79.779817
NH27	1545600	1545700	I	L2	2.72	2.52	2.62	62	10/Dec/2022	26.16607008	79.78035936
NH27	1545700	1545800	I	L2	3.19	2.37	2.78	63	10/Dec/2022	26.16683288	79.78089099
NH27	1545800	1545900	I	L2	2.71	1.98	2.35	63	10/Dec/2022	26.16759353	79.78142635
NH27	1545900	1546000	I	L2	1.59	2.16	1.88	62	10/Dec/2022	26.16834303	79.78198106
NH27	1546000	1546100	I	L2	1.79	2.32	2.06	63	10/Dec/2022	26.16907998	79.78255538
NH27	1546100	1546200	I	L2	2.14	2.28	2.21	63	10/Dec/2022	26.16982008	79.78312484
NH27	1546200	1546300	I	L2	1.63	1.85	1.74	63	10/Dec/2022	26.1705557	79.78370139
NH27	1546300	1546400	I	L2	3.72	2.5	3.11	63	10/Dec/2022	26.1712943	79.78427329
NH27	1546400	1546500	I	L2	3.05	2.38	2.72	62	10/Dec/2022	26.17203208	79.78484658
NH27	1546500	1546600	I	L2	2.57	2.14	2.36	63	10/Dec/2022	26.17276848	79.78542148
NH27	1546600	1546700	I	L2	2	2.14	2.07	65	10/Dec/2022	26.17350731	79.78599218
NH27	1546700	1546800	I	L2	2.27	2.21	2.24	66	10/Dec/2022	26.17424445	79.78656559
NH27	1546800	1546900	I	L2	2.07	1.97	2.02	65	10/Dec/2022	26.1749824	79.78713848
NH27	1546900	1547000	I	L2	2.17	1.71	1.94	65	10/Dec/2022	26.17572018	79.78771156
NH27	1547000	1547100	I	L2	1.81	1.68	1.75	64	10/Dec/2022	26.17645891	79.78828358

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1547100	1547200	I	L2	1.11	1.07	1.09	63	10/Dec/2022	26.17720685	79.78884085
NH27	1547200	1547300	I	L2	1.53	1.85	1.69	64	10/Dec/2022	26.17793283	79.78943192
NH27	1547300	1547400	I	L2	1.62	1.89	1.76	64	10/Dec/2022	26.17867012	79.79000531
NH27	1547400	1547500	I	L2	1.54	1.63	1.59	64	10/Dec/2022	26.17940695	79.7905798
NH27	1547500	1547600	I	L2	1.68	1.95	1.82	64	10/Dec/2022	26.18014549	79.79115189
NH27	1547600	1547700	I	L2	1.97	2.24	2.11	64	10/Dec/2022	26.18088306	79.79172545
NH27	1547700	1547800	I	L2	1.52	1.71	1.62	65	10/Dec/2022	26.18162032	79.79229934
NH27	1547800	1547900	I	L2	1.47	1.65	1.56	65	10/Dec/2022	26.18235721	79.79287371
NH27	1547900	1548000	I	L2	2.15	1.77	1.96	64	10/Dec/2022	26.18309552	79.79344606
NH27	1548000	1548100	I	L2	1.64	1.67	1.66	64	10/Dec/2022	26.18383355	79.79401837
NH27	1548100	1548200	I	L2	2.02	2.17	2.1	64	10/Dec/2022	26.18457113	79.79459156
NH27	1548200	1548300	I	L2	2.26	3	2.63	64	10/Dec/2022	26.18530201	79.79517531
NH27	1548300	1548400	I	L2	1.8	2.49	2.15	64	10/Dec/2022	26.1860194	79.79577976
NH27	1548400	1548500	I	L2	1.42	1.7	1.56	63	10/Dec/2022	26.18669283	79.79644449
NH27	1548500	1548600	I	L2	1.65	2.13	1.89	62	10/Dec/2022	26.1873509	79.79712706
NH27	1548600	1548700	I	L2	1.44	1.48	1.46	63	10/Dec/2022	26.18795671	79.7978662
NH27	1548700	1548800	I	L2	1.77	1.83	1.8	49	10/Dec/2022	26.18858571	79.79858384
NH27	1548800	1548900	I	L2	1.76	1.83	1.8	42	10/Dec/2022	26.18922365	79.7992897
NH27	1548900	1549000	I	L2	1.29	1.67	1.48	43	10/Dec/2022	26.18985186	79.80000504
NH27	1549000	1549100	I	L2	1.42	1.48	1.45	52	10/Dec/2022	26.19047859	79.80072026
NH27	1549100	1549200	I	L2	1.96	1.93	1.95	60	10/Dec/2022	26.19108701	79.80145441
NH27	1549200	1549300	I	L2	2.01	2.49	2.25	62	10/Dec/2022	26.19171265	79.8021723
NH27	1549300	1549400	I	L2	1.85	1.65	1.75	61	10/Dec/2022	26.19233965	79.80288976
NH27	1549400	1549500	I	L2	1.39	1.89	1.64	59	10/Dec/2022	26.19296609	79.80360842
NH27	1549500	1549600	I	L2	2.38	2.69	2.54	57	10/Dec/2022	26.19359129	79.80432848
NH27	1549600	1549700	I	L2	2.48	2.02	2.25	54	10/Dec/2022	26.19421851	79.80504659
NH27	1549700	1549800	I	L2	2.13	2.19	2.16	50	10/Dec/2022	26.19484494	79.80576535
NH27	1549800	1549900	I	L2	2.13	2.32	2.23	50	10/Dec/2022	26.1954738	79.80648109
NH27	1549900	1550000	I	L2	1.81	2.04	1.93	49	10/Dec/2022	26.19609882	79.80720105
NH27	1550000	1550100	I	L2	1.52	1.93	1.73	42	10/Dec/2022	26.19672572	79.80792024
NH27	1550100	1550200	I	L2	2.15	2.74	2.45	46	10/Dec/2022	26.19735459	79.8086347
NH27	1550200	1550300	I	L2	3.02	3.14	3.08	22	10/Dec/2022	26.1979787	79.80935777
NH27	1550300	1550400	I	L2	2.01	2.44	2.23	50	10/Dec/2022	26.19859443	79.81008029
NH27	1550400	1550500	I	L2	1.85	2.24	2.05	54	10/Dec/2022	26.19922562	79.8107899
NH27	1550500	1550600	I	L2	1.55	2.04	1.8	57	10/Dec/2022	26.19990317	79.81144286
NH27	1550600	1550700	I	L2	3.37	3.87	3.62	53	10/Dec/2022	26.20062233	79.81204466
NH27	1550700	1550800	I	L2	3.22	3.84	3.53	44	10/Dec/2022	26.2013468	79.81264057
NH27	1550800	1550900	I	L2	3.35	3.15	3.25	49	10/Dec/2022	26.20207951	79.81321929

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1550900	1551000	I	L2	3.02	3.24	3.13	56	10/Dec/2022	26.20278933	79.8138312
NH27	1551000	1551100	I	L2	1.96	2.56	2.26	53	10/Dec/2022	26.20350627	79.81443851
NH27	1551100	1551200	I	L2	1.96	2.78	2.37	54	10/Dec/2022	26.20420465	79.81507064
NH27	1551200	1551300	I	L2	2.18	3.19	2.69	54	10/Dec/2022	26.20486813	79.81574852
NH27	1551300	1551400	I	L2	2.84	3.47	3.16	53	10/Dec/2022	26.20549138	79.81647094
NH27	1551400	1551500	I	L2	3.02	3.14	3.08	51	10/Dec/2022	26.20610083	79.81720712
NH27	1551500	1551600	I	L2	3.57	2.87	3.22	49	10/Dec/2022	26.20670812	79.81794539
NH27	1551600	1551700	I	L2	3.09	3.11	3.1	50	10/Dec/2022	26.20731466	79.81868323
NH27	1551700	1551800	I	L2	2.18	2.59	2.39	51	10/Dec/2022	26.20791831	79.819425
NH27	1551800	1551900	I	L2	3.02	2.84	2.93	50	10/Dec/2022	26.20849619	79.82019193
NH27	1551900	1552000	I	L2	1.97	2.6	2.29	50	10/Dec/2022	26.20905289	79.82097789
NH27	1552000	1552100	I	L2	2.14	2.29	2.22	48	10/Dec/2022	26.20962626	79.82174893
NH27	1552100	1552200	I	L2	3.03	3.16	3.1	49	10/Dec/2022	26.21018728	79.82253044
NH27	1552200	1552300	I	L2	2.44	2.77	2.61	51	10/Dec/2022	26.21071986	79.8233357
NH27	1552300	1552400	I	L2	1.77	2.11	1.94	51	10/Dec/2022	26.21126957	79.82412721
NH27	1552400	1552500	I	L2	3.11	3.31	3.21	41	10/Dec/2022	26.21186641	79.82487529
NH27	1552500	1552600	I	L2	2.35	2.56	2.46	43	10/Dec/2022	26.21252599	79.82555482
NH27	1552600	1552700	I	L2	1.72	1.91	1.82	52	10/Dec/2022	26.21322888	79.82617632
NH27	1552700	1552800	I	L2	2.88	2.85	2.87	56	10/Dec/2022	26.21397289	79.82673639
NH27	1552800	1552900	I	L2	1.93	2.16	2.05	57	10/Dec/2022	26.21479149	79.82715096
NH27	1552900	1553000	I	L2	2.32	3.05	2.69	54	10/Dec/2022	26.215628	79.82752168
NH27	1553000	1553100	I	L2	1.87	1.9	1.89	53	10/Dec/2022	26.21649177	79.82780522
NH27	1553100	1553200	I	L2	2.5	2.39	2.45	54	10/Dec/2022	26.21735717	79.82808189
NH27	1553200	1553300	I	L2	3.08	1.95	2.52	54	10/Dec/2022	26.21822224	79.82836176
NH27	1553300	1553400	I	L2	1.94	1.91	1.93	50	10/Dec/2022	26.21908875	79.82863813
NH27	1553400	1553500	I	L2	2.57	2.02	2.3	50	10/Dec/2022	26.21995398	79.82891652
NH27	1553500	1553600	I	L2	3.18	2.18	2.68	52	10/Dec/2022	26.22081889	79.82919532
NH27	1553600	1553700	I	L2	3.25	2.9	3.08	53	10/Dec/2022	26.22168456	79.82946998
NH27	1553700	1553800	I	L2	2.9	2.05	2.48	51	10/Dec/2022	26.22255135	79.82974411
NH27	1553800	1553900	I	L2	2.8	2.53	2.67	52	10/Dec/2022	26.22341618	79.83002308
NH27	1553900	1554000	I	L2	3.01	2.43	2.72	50	10/Dec/2022	26.22428255	79.83029821
NH27	1554000	1554100	I	L2	2.72	2.7	2.71	49	10/Dec/2022	26.22514848	79.83057496
NH27	1554100	1554200	I	L2	2.99	2.93	2.96	39	10/Dec/2022	26.22602443	79.83085528
NH27	1554200	1554300	I	L2	3.52	2.91	3.22	40	10/Dec/2022	26.2268917	79.83112436
NH27	1554300	1554400	I	L2	2.79	2.94	2.87	47	10/Dec/2022	26.22774059	79.8314534
NH27	1554400	1554500	I	L2	2.55	2.74	2.65	57	10/Dec/2022	26.22855903	79.83186484
NH27	1554500	1554600	I	L2	2.71	2.46	2.59	60	10/Dec/2022	26.22933353	79.83237131
NH27	1554600	1554700	I	L2	4.35	4.55	4.45	53	10/Dec/2022	26.23005358	79.83297264

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1554700	1554800	I	L2	3.68	3.26	3.47	51	10/Dec/2022	26.2307116	79.83365601
NH27	1554800	1554900	I	L2	2.46	2.57	2.52	53	10/Dec/2022	26.23129579	79.8344163
NH27	1554900	1555000	I	L2	2.36	3	2.68	48	10/Dec/2022	26.23180594	79.83524092
NH27	1555000	1555100	I	L2	2.49	3.23	2.86	48	10/Dec/2022	26.23223641	79.83611811
NH27	1555100	1555200	I	L2	1.91	2.13	2.02	45	10/Dec/2022	26.23257146	79.83704598
NH27	1555200	1555300	I	L2	2.37	2.54	2.46	54	10/Dec/2022	26.23285494	79.83799278
NH27	1555300	1555400	I	L2	2.88	2.05	2.47	52	10/Dec/2022	26.23306307	79.83896532
NH27	1555400	1555500	I	L2	2.99	3.54	3.27	47	10/Dec/2022	26.23329995	79.83993012
NH27	1555500	1555600	I	L2	3.42	3.06	3.24	49	10/Dec/2022	26.23353689	79.84089403
NH27	1555600	1555700	I	L2	2.24	2.18	2.21	43	10/Dec/2022	26.23378271	79.84185623
NH27	1555700	1555800	I	L2	2.98	3.02	3	53	10/Dec/2022	26.23404869	79.84280904
NH27	1555800	1555900	I	L2	2.93	2.26	2.6	54	10/Dec/2022	26.23425549	79.84378122
NH27	1555900	1556000	I	L2	2.2	2.68	2.44	53	10/Dec/2022	26.23449689	79.84474429
NH27	1556000	1556100	I	L2	3.41	1.99	2.7	48	10/Dec/2022	26.23473652	79.84570793
NH27	1556100	1556200	I	L2	3.93	2.09	3.01	52	10/Dec/2022	26.23498816	79.84666623
NH27	1556200	1556300	I	L2	1.75	1.44	1.6	54	10/Dec/2022	26.23530905	79.84759837
NH27	1556300	1556400	I	L2	2.44	2.32	2.38	51	10/Dec/2022	26.23572031	79.84848733
NH27	1556400	1556500	I	L2	2.27	1.95	2.11	52	10/Dec/2022	26.23619682	79.84933379
NH27	1556500	1556600	I	L2	2.6	2.49	2.55	52	10/Dec/2022	26.23675653	79.85011561
NH27	1556600	1556700	I	L2	1.58	1.72	1.65	51	10/Dec/2022	26.23738289	79.85083353
NH27	1556700	1556800	I	L2	3.7	3	3.35	53	10/Dec/2022	26.238076	79.85146978
NH27	1556800	1556900	I	L2	1.82	1.6	1.71	49	10/Dec/2022	26.23882258	79.85202963
NH27	1556900	1557000	I	L2	1.81	1.38	1.6	52	10/Dec/2022	26.23958816	79.85255529
NH27	1557000	1557100	I	L2	1.99	1.93	1.96	54	10/Dec/2022	26.24035451	79.85308077
NH27	1557100	1557200	I	L2	1.75	1.87	1.81	54	10/Dec/2022	26.24112111	79.85360588
NH27	1557200	1557300	I	L2	1.59	1.82	1.71	53	10/Dec/2022	26.24188847	79.85413102
NH27	1557300	1557400	I	L2	1.88	1.38	1.63	50	10/Dec/2022	26.24265433	79.85465844
NH27	1557400	1557500	I	L2	1.6	1.28	1.44	52	10/Dec/2022	26.24342168	79.85518146
NH27	1557500	1557600	I	L2	2.28	1.93	2.11	50	10/Dec/2022	26.24418825	79.85570732
NH27	1557600	1557700	I	L2	1.9	1.86	1.88	47	10/Dec/2022	26.244956	79.85623111
NH27	1557700	1557800	I	L2	1.46	1.89	1.68	51	10/Dec/2022	26.24571816	79.85676286
NH27	1557800	1557900	I	L2	2.09	1.81	1.95	52	10/Dec/2022	26.24648602	79.85728586
NH27	1557900	1558000	I	L2	3.48	2.79	3.14	51	10/Dec/2022	26.24725358	79.85780972
NH27	1558000	1558100	I	L2	2.49	3.07	2.78	44	10/Dec/2022	26.24797441	79.85841023
NH27	1558100	1558200	I	L2	2.6	2.88	2.74	50	10/Dec/2022	26.24861182	79.85911428
NH27	1558200	1558300	I	L2	3.01	2.95	2.98	54	10/Dec/2022	26.24919577	79.85987501
NH27	1558300	1558400	I	L2	4.44	2.94	3.69	51	10/Dec/2022	26.24975838	79.86065618
NH27	1558400	1558500	I	L2	4.5	3.6	4.05	49	10/Dec/2022	26.25033978	79.86141977
NH27	1558500	1558600	I	L2	3.55	2.7	3.13	49	10/Dec/2022	26.25092155	79.86218323

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1558600	1558700	I	L2	2.31	2.03	2.17	54	10/Dec/2022	26.25150059	79.86294766
NH27	1558700	1558800	I	L2	1.43	1.47	1.45	54	10/Dec/2022	26.25208058	79.86371217
NH27	1558800	1558900	I	L2	2.07	1.8	1.94	53	10/Dec/2022	26.25266026	79.86447737
NH27	1558900	1559000	I	L2	2.75	2.31	2.53	56	10/Dec/2022	26.25324408	79.86523808
NH27	1559000	1559100	I	L2	3.18	2.08	2.63	56	10/Dec/2022	26.25382579	79.86600139
NH27	1559100	1559200	I	L2	1.38	1.53	1.46	52	10/Dec/2022	26.25440618	79.86676684
NH27	1559200	1559300	I	L2	1.94	2.01	1.98	52	10/Dec/2022	26.25498446	79.86753326
NH27	1559300	1559400	I	L2	1.47	1.42	1.45	54	10/Dec/2022	26.25556731	79.86829437
NH27	1559400	1559500	I	L2	1.69	1.61	1.65	54	10/Dec/2022	26.25617943	79.86902656
NH27	1559500	1559600	I	L2	1.46	1.65	1.56	57	10/Dec/2022	26.2568541	79.86968779
NH27	1559600	1559700	I	L2	1.13	1.28	1.21	55	10/Dec/2022	26.2575579	79.87031068
NH27	1559700	1559800	I	L2	1.79	1.58	1.69	55	10/Dec/2022	26.25829842	79.87087981
NH27	1559800	1559900	I	L2	2.09	2.39	2.24	58	10/Dec/2022	26.25904448	79.87143879
NH27	1559900	1560000	I	L2	1.94	1.5	1.72	59	10/Dec/2022	26.2597888	79.87200185
NH27	1560000	1560100	I	L2	2.89	2.29	2.59	60	10/Dec/2022	26.26053505	79.87256194
NH27	1560100	1560200	I	L2	1.81	1.78	1.8	58	10/Dec/2022	26.2612763	79.87313089
NH27	1560200	1560300	I	L2	2.45	2.63	2.54	54	10/Dec/2022	26.26202318	79.8736914
NH27	1560300	1560400	I	L2	1.46	1.25	1.36	58	10/Dec/2022	26.26277623	79.87423914
NH27	1560400	1560500	I	L2	1.6	1.58	1.59	64	10/Dec/2022	26.26352171	79.8747978
NH27	1560500	1560600	I	L2	3.71	2.43	3.07	60	10/Dec/2022	26.26424985	79.87538849
NH27	1560600	1560700	I	L2	2.87	1.57	2.22	58	10/Dec/2022	26.26499367	79.8759533
NH27	1560700	1560800	I	L2	3.02	2.63	2.83	57	10/Dec/2022	26.26573779	79.8765166
NH27	1560800	1560900	I	L2	2.18	1.62	1.9	59	10/Dec/2022	26.26648063	79.87708164
NH27	1560900	1561000	I	L2	2.71	1.66	2.19	60	10/Dec/2022	26.26722462	79.87764517
NH27	1561000	1561100	I	L2	1.83	1.64	1.74	60	10/Dec/2022	26.26796985	79.8782073
NH27	1561100	1561200	I	L2	2.24	2.9	2.57	58	10/Dec/2022	26.2687099	79.87877832
NH27	1561200	1561300	I	L2	2	1.58	1.79	57	10/Dec/2022	26.26941564	79.87939976
NH27	1561300	1561400	I	L2	1.66	1.8	1.73	57	10/Dec/2022	26.27007696	79.88007849
NH27	1561400	1561500	I	L2	2.37	2.2	2.29	58	10/Dec/2022	26.27073378	79.88076258
NH27	1561500	1561600	I	L2	2	2.16	2.08	60	10/Dec/2022	26.27139085	79.88144607
NH27	1561600	1561700	I	L2	1.75	1.92	1.84	60	10/Dec/2022	26.27204641	79.88213192
NH27	1561700	1561800	I	L2	2.06	1.73	1.9	62	10/Dec/2022	26.27270291	79.88281593
NH27	1561800	1561900	I	L2	1.94	2.15	2.05	63	10/Dec/2022	26.27335863	79.88350124
NH27	1561900	1562000	I	L2	1.85	2.46	2.16	62	10/Dec/2022	26.27401227	79.88418975
NH27	1562000	1562100	I	L2	2.15	1.65	1.9	65	10/Dec/2022	26.27467989	79.88485957
NH27	1562100	1562200	I	L2	1.8	2.12	1.96	63	10/Dec/2022	26.27532446	79.88555936
NH27	1562200	1562300	I	L2	4.55	3.02	3.79	63	10/Dec/2022	26.2759674	79.88625948
NH27	1562300	1562400	I	L2	2.26	2.33	2.3	61	10/Dec/2022	26.27661674	79.8869529
NH27	1562400	1562500	I	L2	2.43	1.99	2.21	60	10/Dec/2022	26.27726761	79.88764433

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1562500	1562600	I	L2	1.52	1.8	1.66	60	10/Dec/2022	26.27791706	79.88833712
NH27	1562600	1562700	I	L2	1.71	1.9	1.81	60	10/Dec/2022	26.27857002	79.88902617
NH27	1562700	1562800	I	L2	2.57	2.16	2.37	60	10/Dec/2022	26.27921997	79.88971865
NH27	1562800	1562900	I	L2	2.29	2.34	2.32	60	10/Dec/2022	26.27987051	79.89041037
NH27	1562900	1563000	I	L2	3.44	2.87	3.16	61	10/Dec/2022	26.28054296	79.89107364
NH27	1563000	1563100	I	L2	2.59	3.34	2.97	60	10/Dec/2022	26.2813161	79.89158385
NH27	1563100	1563200	I	L2	1.59	1.96	1.78	57	10/Dec/2022	26.28209536	79.89208699
NH27	1563200	1563300	I	L2	1.38	1.51	1.45	58	10/Dec/2022	26.28282345	79.89267569
NH27	1563300	1563400	I	L2	2.7	2.49	2.6	61	10/Dec/2022	26.28345371	79.89338846
NH27	1563400	1563500	I	L2	2.49	2.19	2.34	60	10/Dec/2022	26.2840553	79.89413161
NH27	1563500	1563600	I	L2	3.26	2.73	3	59	10/Dec/2022	26.28466873	79.89486413
NH27	1563600	1563700	I	L2	2.28	2.53	2.41	59	10/Dec/2022	26.28527924	79.89559921
NH27	1563700	1563800	I	L2	2.46	2.57	2.52	59	10/Dec/2022	26.28588838	79.89633585
NH27	1563800	1563900	I	L2	3.7	3.67	3.69	61	10/Dec/2022	26.28648997	79.89707999
NH27	1563900	1564000	I	L2	3.54	4.31	3.93	60	10/Dec/2022	26.28707883	79.89783729
NH27	1564000	1564100	I	L2	2.67	2.66	2.67	57	10/Dec/2022	26.28766394	79.8985965
NH27	1564100	1564200	I	L2	2.33	2.41	2.37	50	10/Dec/2022	26.28822296	79.89938111
NH27	1564200	1564300	I	L2	4.35	4.22	4.29	33	10/Dec/2022	26.2887133	79.90022109
NH27	1564300	1564400	I	L2	3.99	3.44	3.72	33	10/Dec/2022	26.2891351	79.9011039
NH27	1564400	1564500	I	L2	3.47	2.57	3.02	45	10/Dec/2022	26.28951632	79.90200882
NH27	1564500	1564600	I	L2	4.05	2.93	3.49	48	10/Dec/2022	26.2898997	79.90291446
NH27	1564600	1564700	I	L2	3.09	3.36	3.23	49	10/Dec/2022	26.29028525	79.90381898
NH27	1564700	1564800	I	L2	2.98	3.17	3.08	49	10/Dec/2022	26.29073682	79.90468199
NH27	1564800	1564900	I	L2	3.15	3.2	3.18	50	10/Dec/2022	26.29127515	79.90548245
NH27	1564900	1565000	I	L2	2.8	3	2.9	47	10/Dec/2022	26.29184339	79.9062596
NH27	1565000	1565100	I	L2	1.79	2.16	1.98	48	10/Dec/2022	26.29241705	79.9070301
NH27	1565100	1565200	I	L2	1.39	1.76	1.58	57	10/Dec/2022	26.29299493	79.90779551
NH27	1565200	1565300	I	L2	2.71	2.34	2.53	54	10/Dec/2022	26.29354328	79.90858982
NH27	1565300	1565400	I	L2	2.24	1.6	1.92	49	10/Dec/2022	26.29411066	79.90936752
NH27	1565400	1565500	I	L2	1.74	2.15	1.95	50	10/Dec/2022	26.29468153	79.9101542
NH27	1565500	1565600	I	L2	1.71	1.5	1.61	51	10/Dec/2022	26.29525047	79.91092938
NH27	1565600	1565700	I	L2	1.6	1.6	1.6	51	10/Dec/2022	26.29581813	79.91170579
NH27	1565700	1565800	I	L2	1.41	1.53	1.47	58	10/Dec/2022	26.29638641	79.91248023
NH27	1565800	1565900	I	L2	1.24	1.38	1.31	63	10/Dec/2022	26.29696851	79.9132423
NH27	1565900	1566000	I	L2	1.99	2.24	2.12	63	10/Dec/2022	26.29753536	79.9140199
NH27	1566000	1566100	I	L2	2.75	2.67	2.71	62	10/Dec/2022	26.29815057	79.9147497
NH27	1566100	1566200	I	L2	2.11	2.13	2.12	60	10/Dec/2022	26.29878947	79.91545616
NH27	1566200	1566300	I	L2	2.87	3.61	3.24	60	10/Dec/2022	26.29942024	79.91616994
NH27	1566300	1566400	I	L2	2.04	2.55	2.3	63	10/Dec/2022	26.30003531	79.91690069

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1566400	1566500	I	L2	1.87	2.55	2.21	62	10/Dec/2022	26.3006371	79.91764626
NH27	1566500	1566600	I	L2	1.7	2.17	1.94	61	10/Dec/2022	26.30126912	79.91835947
NH27	1566600	1566700	I	L2	1.89	2.03	1.96	62	10/Dec/2022	26.30185391	79.91912037
NH27	1566700	1566800	I	L2	1.8	2.04	1.92	64	10/Dec/2022	26.30236275	79.91994582
NH27	1566800	1566900	I	L2	1.75	1.92	1.84	65	10/Dec/2022	26.30283846	79.92079526
NH27	1566900	1567000	I	L2	1.53	1.84	1.69	62	10/Dec/2022	26.30332317	79.92163842
NH27	1567000	1567100	I	L2	2.36	3.08	2.72	59	10/Dec/2022	26.30394944	79.92235172
NH27	1567100	1567200	I	L2	2.93	2.89	2.91	60	10/Dec/2022	26.30473861	79.92282302
NH27	1567200	1567300	I	L2	2.43	2.54	2.49	54	10/Dec/2022	26.30559798	79.92312527
NH27	1567300	1567400	I	L2	2.49	2.44	2.47	53	10/Dec/2022	26.30642286	79.92352117
NH27	1567400	1567500	I	L2	2.35	1.92	2.14	55	10/Dec/2022	26.30713042	79.92413699
NH27	1567500	1567600	I	L2	1.65	1.86	1.76	57	10/Dec/2022	26.30779961	79.9248046
NH27	1567600	1567700	I	L2	2.47	2.26	2.37	58	10/Dec/2022	26.30846655	79.92547485
NH27	1567700	1567800	I	L2	1.83	1.99	1.91	59	10/Dec/2022	26.30913443	79.92614494
NH27	1567800	1567900	I	L2	1.99	2.15	2.07	59	10/Dec/2022	26.30980133	79.9268165
NH27	1567900	1568000	I	L2	1.69	1.62	1.66	62	10/Dec/2022	26.31046988	79.92748507
NH27	1568000	1568100	I	L2	2	1.43	1.72	59	10/Dec/2022	26.31113944	79.92815468
NH27	1568100	1568200	I	L2	1.46	1.37	1.42	60	10/Dec/2022	26.31182532	79.92880243
NH27	1568200	1568300	I	L2	1.79	2.3	2.05	62	10/Dec/2022	26.31248766	79.92948012
NH27	1568300	1568400	I	L2	1.62	1.87	1.75	64	10/Dec/2022	26.31309457	79.930219
NH27	1568400	1568500	I	L2	1.98	1.76	1.87	63	10/Dec/2022	26.31361632	79.93103406
NH27	1568500	1568600	I	L2	2.9	3.26	3.08	63	10/Dec/2022	26.3140754	79.93189497
NH27	1568600	1568700	I	L2	1.75	2.26	2.01	61	10/Dec/2022	26.31453233	79.93275729
NH27	1568700	1568800	I	L2	1.62	1.66	1.64	60	10/Dec/2022	26.31498489	79.93362107
NH27	1568800	1568900	I	L2	2.04	2.12	2.08	59	10/Dec/2022	26.31543873	79.93448408
NH27	1568900	1569000	I	L2	1.84	2.36	2.1	57	10/Dec/2022	26.31589308	79.93534704
NH27	1569000	1569100	I	L2	2.24	2.42	2.33	58	10/Dec/2022	26.31630754	79.93623457
NH27	1569100	1569200	I	L2	2.74	2.17	2.46	56	10/Dec/2022	26.31670509	79.93713153
NH27	1569200	1569300	I	L2	2.5	3.07	2.79	55	10/Dec/2022	26.31705111	79.93805466
NH27	1569300	1569400	I	L2	1.91	2.15	2.03	57	10/Dec/2022	26.31741861	79.93896669
NH27	1569400	1569500	I	L2	2.07	2.77	2.42	58	10/Dec/2022	26.31779667	79.93987365
NH27	1569500	1569600	I	L2	2.84	2.74	2.79	59	10/Dec/2022	26.31824218	79.94074102
NH27	1569600	1569700	I	L2	3.11	2.3	2.71	60	10/Dec/2022	26.31876873	79.94155162
NH27	1569700	1569800	I	L2	2.86	2.4	2.63	61	10/Dec/2022	26.31930246	79.94235725
NH27	1569800	1569900	I	L2	1.57	1.65	1.61	59	10/Dec/2022	26.31983613	79.94316337
NH27	1569900	1570000	I	L2	1.39	1.89	1.64	60	10/Dec/2022	26.32034864	79.9439857
NH27	1570000	1570100	I	L2	3.14	3.05	3.1	60	10/Dec/2022	26.32081563	79.94484116
NH27	1570100	1570200	I	L2	2.29	3.12	2.71	59	10/Dec/2022	26.32122323	79.94573339
NH27	1570200	1570300	I	L2	3.02	3.14	3.08	56	10/Dec/2022	26.32159996	79.94664243

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1570300	1570400	I	L2	3.11	2.97	3.04	55	10/Dec/2022	26.32197446	79.94755265
NH27	1570400	1570500	I	L2	2.58	3.49	3.04	57	10/Dec/2022	26.322356	79.94845838
NH27	1570500	1570600	I	L2	2.98	3.02	3	57	10/Dec/2022	26.32279959	79.94932753
NH27	1570600	1570700	I	L2	2.59	3.72	3.16	57	10/Dec/2022	26.32332729	79.9501371
NH27	1570700	1570800	I	L2	2.05	2.31	2.18	56	10/Dec/2022	26.32392642	79.95088333
NH27	1570800	1570900	I	L2	1.35	1.52	1.44	40	10/Dec/2022	26.32454299	79.95161495
NH27	1570900	1571000	I	L2	1.58	2.07	1.83	48	10/Dec/2022	26.32518479	79.95231375
NH27	1571000	1571100	I	L2	1.68	2.27	1.98	48	10/Dec/2022	26.32585807	79.95297637
NH27	1571100	1571200	I	L2	2.01	2.24	2.13	40	10/Dec/2022	26.32656882	79.95359336
NH27	1571200	1571300	I	L2	2	1.86	1.93	52	10/Dec/2022	26.32729293	79.95418389
NH27	1571300	1571400	I	L2	2.94	3.37	3.16	33	10/Dec/2022	26.32797119	79.95484505
NH27	1571400	1571500	I	L2	2.76	2.68	2.72	21	10/Dec/2022	26.32865067	79.95549924
NH27	1571500	1571600	I	L2	3.02	2.91	2.97	45	10/Dec/2022	26.32935153	79.95612148
NH27	1571600	1571700	I	L2	2.01	2.92	2.47	51	10/Dec/2022	26.33005338	79.9567444
NH27	1571700	1571800	I	L2	2.05	2.73	2.39	54	10/Dec/2022	26.33076106	79.95736226
NH27	1571800	1571900	I	L2	2.46	3.59	3.03	56	10/Dec/2022	26.33146834	79.95798278
NH27	1571900	1572000	I	L2	2.03	2.73	2.38	56	10/Dec/2022	26.33217968	79.95859708
NH27	1572000	1572100	I	L2	2.58	2.26	2.42	57	10/Dec/2022	26.33290178	79.95919424
NH27	1572100	1572200	I	L2	2.03	2.43	2.23	57	10/Dec/2022	26.33363787	79.95977085
NH27	1572200	1572300	I	L2	2.23	1.93	2.08	53	10/Dec/2022	26.33440593	79.96029347
NH27	1572300	1572400	I	L2	2.62	2.83	2.73	59	10/Dec/2022	26.33516506	79.9608301
NH27	1572400	1572500	I	L2	1.67	1.91	1.79	63	10/Dec/2022	26.33588531	79.96142883
NH27	1572500	1572600	I	L2	2.42	2.1	2.26	65	10/Dec/2022	26.33662473	79.96199959
NH27	1572600	1572700	I	L2	2.21	2.76	2.49	66	10/Dec/2022	26.33736413	79.96257
NH27	1572700	1572800	I	L2	1.95	2.97	2.46	63	10/Dec/2022	26.33812617	79.96310408
NH27	1572800	1572900	I	L2	3.52	4.39	3.96	63	10/Dec/2022	26.33887945	79.96365265
NH27	1572900	1573000	I	L2	2.88	3.47	3.18	63	10/Dec/2022	26.33956688	79.96429841
NH27	1573000	1573100	I	L2	2.58	2.84	2.71	64	10/Dec/2022	26.34018659	79.96502424
NH27	1573100	1573200	I	L2	1.53	1.69	1.61	67	10/Dec/2022	26.34079782	79.96575813
NH27	1573200	1573300	I	L2	3.02	3.14	3.08	71	10/Dec/2022	26.34140382	79.96649674
NH27	1573300	1573400	I	L2	2.2	3.05	2.63	73	10/Dec/2022	26.34200279	79.96724301
NH27	1573400	1573500	I	L2	1.9	2.5	2.2	72	10/Dec/2022	26.34260634	79.96798422
NH27	1573500	1573600	I	L2	2.31	3.05	2.68	70	10/Dec/2022	26.34321134	79.96872426
NH27	1573600	1573700	I	L2	3.57	3.02	3.3	54	10/Dec/2022	26.34382133	79.96946296
NH27	1573700	1573800	I	L2	2.54	2.4	2.47	53	10/Dec/2022	26.34444843	79.97018147
NH27	1573800	1573900	I	L2	1.8	2.39	2.1	62	10/Dec/2022	26.34503539	79.97093911
NH27	1573900	1574000	I	L2	2.57	3.25	2.91	62	10/Dec/2022	26.34564138	79.97168057
NH27	1574000	1574100	I	L2	2.98	3.35	3.17	59	10/Dec/2022	26.34626725	79.9724014
NH27	1574100	1574200	I	L2	2.07	2.37	2.22	58	10/Dec/2022	26.34690141	79.97311263

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1574200	1574300	I	L2	1.99	2.17	2.08	60	10/Dec/2022	26.34751747	79.97384172
NH27	1574300	1574400	I	L2	1.97	2.13	2.05	60	10/Dec/2022	26.34813795	79.97456712
NH27	1574400	1574500	I	L2	2.99	3.1	3.05	61	10/Dec/2022	26.34874185	79.97530909
NH27	1574500	1574600	I	L2	2.79	2.6	2.7	59	10/Dec/2022	26.34934053	79.97605647
NH27	1574600	1574700	I	L2	2.2	2.23	2.22	58	10/Dec/2022	26.34994894	79.97679429
NH27	1574700	1574800	I	L2	2.65	2.57	2.61	59	10/Dec/2022	26.35055315	79.97753577
NH27	1574800	1574900	I	L2	2.41	2.98	2.7	56	10/Dec/2022	26.35116065	79.97827548
NH27	1574900	1575000	I	L2	2.12	2.29	2.21	55	10/Dec/2022	26.35176692	79.9790157
NH27	1575000	1575100	I	L2	1.95	2.8	2.38	58	10/Dec/2022	26.35237443	79.97975355
NH27	1575100	1575200	I	L2	3.01	3.14	3.08	51	10/Dec/2022	26.35299071	79.98048496
NH27	1575200	1575300	I	L2	2.81	3.2	3.01	57	10/Dec/2022	26.35358944	79.9812309
NH27	1575300	1575400	I	L2	2.47	2.72	2.6	62	10/Dec/2022	26.35419544	79.98196946
NH27	1575400	1575500	I	L2	2.87	2.69	2.78	66	10/Dec/2022	26.3548032	79.98270639
NH27	1575500	1575600	I	L2	2.34	2.57	2.46	65	10/Dec/2022	26.35545445	79.9833963
NH27	1575600	1575700	I	L2	2.13	2.21	2.17	64	10/Dec/2022	26.35616012	79.98401786
NH27	1575700	1575800	I	L2	1.99	2.04	2.02	65	10/Dec/2022	26.35691349	79.98456513
NH27	1575800	1575900	I	L2	1.9	2.18	2.04	66	10/Dec/2022	26.35770203	79.98504854
NH27	1575900	1576000	I	L2	1.97	2.55	2.26	62	10/Dec/2022	26.35849432	79.98552699
NH27	1576000	1576100	I	L2	2.22	2.45	2.34	62	10/Dec/2022	26.35928692	79.98600316
NH27	1576100	1576200	I	L2	2.69	2.98	2.84	60	10/Dec/2022	26.3600797	79.98647966
NH27	1576200	1576300	I	L2	1.81	1.91	1.86	58	10/Dec/2022	26.36087241	79.98695669
NH27	1576300	1576400	I	L2	2.02	2.72	2.37	61	10/Dec/2022	26.36166454	79.98743235
NH27	1576400	1576500	I	L2	2.61	2.66	2.64	63	10/Dec/2022	26.36245702	79.98790731
NH27	1576500	1576600	I	L2	2.16	2.15	2.16	64	10/Dec/2022	26.36324943	79.98838309
NH27	1576600	1576700	I	L2	1.73	2.06	1.9	64	10/Dec/2022	26.3640409	79.98886099
NH27	1576700	1576800	I	L2	1.74	1.99	1.87	67	10/Dec/2022	26.36484175	79.98933937
NH27	1576800	1576900	I	L2	1.95	2.7	2.33	68	10/Dec/2022	26.36563391	79.9898155
NH27	1576900	1577000	I	L2	1.73	2.02	1.88	67	10/Dec/2022	26.36642809	79.99028786
NH27	1577000	1577100	I	L2	2.53	3.06	2.8	67	10/Dec/2022	26.36723288	79.99073754
NH27	1577100	1577200	I	L2	1.76	1.44	1.6	68	10/Dec/2022	26.3680341	79.9911951
NH27	1577200	1577300	I	L2	2.88	2.14	2.51	62	10/Dec/2022	26.36882689	79.99167422
NH27	1577300	1577400	I	L2	1.81	1.78	1.8	61	10/Dec/2022	26.36962247	79.9921448
NH27	1577400	1577500	I	L2	1.32	1.5	1.41	60	10/Dec/2022	26.37042386	79.99260211
NH27	1577500	1577600	I	L2	1.34	1.37	1.36	62	10/Dec/2022	26.37121297	79.99308483
NH27	1577600	1577700	I	L2	1.5	1.77	1.64	61	10/Dec/2022	26.3719958	79.99357997
NH27	1577700	1577800	I	L2	1.45	1.81	1.63	39	10/Dec/2022	26.37279224	79.99405265
NH27	1577800	1577900	I	L2	1.74	1.91	1.83	44	10/Dec/2022	26.37357006	79.99455675
NH27	1577900	1578000	I	L2	2.15	2.38	2.27	48	10/Dec/2022	26.37435302	79.99504961
NH27	1578000	1578100	I	L2	2.16	2.04	2.1	55	10/Dec/2022	26.37513917	79.9955357

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1578100	1578200	I	L2	1.78	1.7	1.74	57	10/Dec/2022	26.37592699	79.99602002
NH27	1578200	1578300	I	L2	1.72	1.47	1.6	60	10/Dec/2022	26.37671466	79.9965023
NH27	1578300	1578400	I	L2	2.05	1.99	2.02	59	10/Dec/2022	26.37747034	79.99704357
NH27	1578400	1578500	I	L2	2.32	2.3	2.31	57	10/Dec/2022	26.37816421	79.99768009
NH27	1578500	1578600	I	L2	2.26	1.99	2.13	54	10/Dec/2022	26.37885326	79.99832548
NH27	1578600	1578700	I	L2	2.61	1.99	2.3	57	10/Dec/2022	26.3795288	79.99898721
NH27	1578700	1578800	I	L2	3.09	2.49	2.79	56	10/Dec/2022	26.38004534	79.99980463
NH27	1578800	1578900	I	L2	2.41	2.13	2.27	54	10/Dec/2022	26.38029409	80.00076553
NH27	1578900	1579000	I	L2	2.96	2.69	2.83	51	10/Dec/2022	26.38042715	80.00175614
NH27	1579000	1579077	I	L2	3.02	3.14	3.08	40	10/Dec/2022	26.38067586	80.00271643
NH27	1578530	1578450	D	R1	2.01	1.98	1.99	10	10/Dec/2022	26.37877324	79.998663
NH27	1578450	1578350	D	R1	2.03	2.15	2.09	29	10/Dec/2022	26.37833486	79.99803618
NH27	1578350	1578250	D	R1	1.75	1.42	1.59	38	10/Dec/2022	26.37765301	79.99738546
NH27	1578250	1578150	D	R1	1.66	1.35	1.51	25	10/Dec/2022	26.37692844	79.99679256
NH27	1578150	1578050	D	R1	2.02	2.15	2.09	12	10/Dec/2022	26.37614501	79.99629916
NH27	1578050	1577950	D	R1	2	1.94	1.97	34	10/Dec/2022	26.37531095	79.99579345
NH27	1577950	1577850	D	R1	1.27	1.14	1.21	43	10/Dec/2022	26.37451901	79.99532089
NH27	1577850	1577750	D	R1	1.76	1.33	1.55	44	10/Dec/2022	26.37373104	79.99483785
NH27	1577750	1577650	D	R1	1.65	1.87	1.76	51	10/Dec/2022	26.3729523	79.99433807
NH27	1577650	1577550	D	R1	1.68	1.73	1.71	55	10/Dec/2022	26.37216286	79.99385851
NH27	1577550	1577450	D	R1	1.16	1.14	1.15	53	10/Dec/2022	26.37137105	79.99338181
NH27	1577450	1577350	D	R1	1.32	1.19	1.26	55	10/Dec/2022	26.37058042	79.99290384
NH27	1577350	1577250	D	R1	1.27	1.15	1.21	55	10/Dec/2022	26.36978929	79.99242616
NH27	1577250	1577150	D	R1	1.44	1.3	1.37	54	10/Dec/2022	26.36899782	79.9919493
NH27	1577150	1577050	D	R1	1.14	1.3	1.22	54	10/Dec/2022	26.36820427	79.99147639
NH27	1577050	1576950	D	R1	2.58	2.6	2.59	51	10/Dec/2022	26.36740938	79.99100456
NH27	1576950	1576850	D	R1	1.46	1.18	1.32	53	10/Dec/2022	26.36659942	79.99056991
NH27	1576850	1576750	D	R1	1.18	1.13	1.16	56	10/Dec/2022	26.3658048	79.9901008
NH27	1576750	1576650	D	R1	1.26	1.27	1.27	57	10/Dec/2022	26.36501396	79.98962324
NH27	1576650	1576550	D	R1	1.41	1.08	1.25	58	10/Dec/2022	26.36422164	79.98914776
NH27	1576550	1576450	D	R1	1.3	1.1	1.2	58	10/Dec/2022	26.36342975	79.98867169
NH27	1576450	1576350	D	R1	1.4	1.16	1.28	59	10/Dec/2022	26.36263854	79.98819422
NH27	1576350	1576250	D	R1	1.07	1.21	1.14	56	10/Dec/2022	26.36184735	79.98771457
NH27	1576250	1576150	D	R1	1.76	1.51	1.64	54	10/Dec/2022	26.3610555	79.98723801
NH27	1576150	1576050	D	R1	1.23	1.41	1.32	53	10/Dec/2022	26.36026238	79.98676392
NH27	1576050	1575950	D	R1	1.94	2	1.97	47	10/Dec/2022	26.35946841	79.98628977
NH27	1575950	1575850	D	R1	1.34	1.29	1.32	48	10/Dec/2022	26.35867859	79.98581047
NH27	1575850	1575750	D	R1	1.2	1.45	1.33	59	10/Dec/2022	26.35788554	79.98534136
NH27	1575750	1575650	D	R1	1.23	1.29	1.26	65	10/Dec/2022	26.35709788	79.98485991

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1575650	1575550	D	R1	1.09	1.17	1.13	66	10/Dec/2022	26.35632788	79.98434162
NH27	1575550	1575450	D	R1	1.72	2.02	1.87	69	10/Dec/2022	26.35560758	79.98374255
NH27	1575450	1575350	D	R1	1.65	1.4	1.53	69	10/Dec/2022	26.3549349	79.9830784
NH27	1575350	1575250	D	R1	1.22	1.3	1.26	70	10/Dec/2022	26.35431435	79.98235414
NH27	1575250	1575150	D	R1	1.23	1.44	1.34	69	10/Dec/2022	26.35370882	79.98161392
NH27	1575150	1575050	D	R1	1.34	1.05	1.2	66	10/Dec/2022	26.35310535	79.98087058
NH27	1575050	1574950	D	R1	1.12	1.43	1.28	29	10/Dec/2022	26.35250783	79.98011811
NH27	1574950	1574850	D	R1	1.23	1.46	1.35	40	10/Dec/2022	26.35188972	79.97939646
NH27	1574850	1574750	D	R1	2.78	2.37	2.58	43	10/Dec/2022	26.35128466	79.97865551
NH27	1574750	1574650	D	R1	1.56	1.59	1.58	45	10/Dec/2022	26.35067729	79.97791932
NH27	1574650	1574550	D	R1	1.52	1.26	1.39	54	10/Dec/2022	26.35007121	79.97718192
NH27	1574550	1574450	D	R1	1.17	1.19	1.18	56	10/Dec/2022	26.34946359	79.97644445
NH27	1574450	1574350	D	R1	1.22	1.54	1.38	51	10/Dec/2022	26.34886005	79.97570111
NH27	1574350	1574250	D	R1	1.14	1.05	1.1	53	10/Dec/2022	26.34825192	79.97496529
NH27	1574250	1574150	D	R1	1.22	1.02	1.12	59	10/Dec/2022	26.34763894	79.97423456
NH27	1574150	1574050	D	R1	1.24	1.08	1.16	60	10/Dec/2022	26.34703371	79.97349433
NH27	1574050	1573950	D	R1	1.38	1.37	1.38	61	10/Dec/2022	26.34641653	79.97276658
NH27	1573950	1573850	D	R1	1.08	1.07	1.08	60	10/Dec/2022	26.34579465	79.97204413
NH27	1573850	1573750	D	R1	1.39	1.31	1.35	56	10/Dec/2022	26.34518305	79.97131114
NH27	1573750	1573650	D	R1	3.02	2.88	2.95	54	10/Dec/2022	26.34457895	79.97057104
NH27	1573650	1573550	D	R1	2.91	2.88	2.9	55	10/Dec/2022	26.34397361	79.96983192
NH27	1573550	1573450	D	R1	1.16	1.14	1.15	60	10/Dec/2022	26.34336448	79.96909567
NH27	1573450	1573350	D	R1	2.49	2.38	2.44	66	10/Dec/2022	26.34275942	79.96835542
NH27	1573350	1573250	D	R1	1.58	1.48	1.53	67	10/Dec/2022	26.34214943	79.96761893
NH27	1573250	1573150	D	R1	1.57	1.57	1.57	66	10/Dec/2022	26.34153503	79.96688716
NH27	1573150	1573050	D	R1	2.24	1.86	2.05	64	10/Dec/2022	26.34092655	79.96614913
NH27	1573050	1572950	D	R1	2.05	1.8	1.93	59	10/Dec/2022	26.3403204	79.96540774
NH27	1572950	1572850	D	R1	2.17	1.84	2.01	42	10/Dec/2022	26.33971606	79.96466377
NH27	1572850	1572750	D	R1	1.96	2.1	2.03	42	10/Dec/2022	26.33907416	79.96396732
NH27	1572750	1572650	D	R1	1.34	1.27	1.31	49	10/Dec/2022	26.33833017	79.96340718
NH27	1572650	1572550	D	R1	1.74	1.58	1.66	55	10/Dec/2022	26.33755745	79.96289571
NH27	1572550	1572450	D	R1	1.34	1.27	1.31	59	10/Dec/2022	26.33681188	79.96233565
NH27	1572450	1572350	D	R1	1.4	1.43	1.42	60	10/Dec/2022	26.33607397	79.96176269
NH27	1572350	1572250	D	R1	1.1	1.24	1.17	59	10/Dec/2022	26.33533552	79.9611902
NH27	1572250	1572150	D	R1	1.88	1.69	1.79	58	10/Dec/2022	26.33459111	79.96062679
NH27	1572150	1572050	D	R1	1.93	1.79	1.86	56	10/Dec/2022	26.33383652	79.96008014
NH27	1572050	1571950	D	R1	1.92	1.54	1.73	54	10/Dec/2022	26.33309711	79.95950815
NH27	1571950	1571850	D	R1	1.62	1.29	1.46	55	10/Dec/2022	26.33236728	79.95892223
NH27	1571850	1571750	D	R1	1.88	1.89	1.89	56	10/Dec/2022	26.33165744	79.95830807
NH27	1571750	1571650	D	R1	1.91	1.95	1.93	54	10/Dec/2022	26.33095246	79.9576867

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1571650	1571550	D	R1	1.09	1.22	1.16	54	10/Dec/2022	26.33024451	79.95706829
NH27	1571550	1571450	D	R1	1.08	1.01	1.05	54	10/Dec/2022	26.32953783	79.95644723
NH27	1571450	1571350	D	R1	1.72	1.52	1.62	56	10/Dec/2022	26.32883108	79.95582736
NH27	1571350	1571250	D	R1	1.56	1.64	1.6	55	10/Dec/2022	26.32812727	79.95520276
NH27	1571250	1571150	D	R1	1.17	1.85	1.51	55	10/Dec/2022	26.32744256	79.95455312
NH27	1571150	1571050	D	R1	1.36	1.86	1.61	56	10/Dec/2022	26.32673539	79.95393441
NH27	1571050	1570950	D	R1	1.34	1.42	1.38	56	10/Dec/2022	26.32602605	79.95331824
NH27	1570950	1570850	D	R1	1.21	1.45	1.33	57	10/Dec/2022	26.32532787	79.95268684
NH27	1570850	1570750	D	R1	1.45	1.42	1.44	58	10/Dec/2022	26.32468406	79.95198767
NH27	1570750	1570650	D	R1	1.44	1.4	1.42	59	10/Dec/2022	26.32407507	79.95125111
NH27	1570650	1570550	D	R1	1.2	1.43	1.32	57	10/Dec/2022	26.32346541	79.95051508
NH27	1570550	1570450	D	R1	1.51	1.27	1.39	56	10/Dec/2022	26.3229064	79.94973115
NH27	1570450	1570350	D	R1	1.37	1.74	1.56	55	10/Dec/2022	26.32243245	79.94888129
NH27	1570350	1570250	D	R1	1.39	1.85	1.62	55	10/Dec/2022	26.32203064	79.9479866
NH27	1570250	1570150	D	R1	1.5	1.66	1.58	55	10/Dec/2022	26.32165441	79.94707871
NH27	1570150	1570050	D	R1	1.54	1.7	1.62	57	10/Dec/2022	26.3212752	79.94617229
NH27	1570050	1569950	D	R1	1.29	1.29	1.29	58	10/Dec/2022	26.32087252	79.94527854
NH27	1569950	1569850	D	R1	1.34	1.36	1.35	58	10/Dec/2022	26.32042818	79.94440905
NH27	1569850	1569750	D	R1	1.69	1.63	1.66	57	10/Dec/2022	26.3199295	79.94357707
NH27	1569750	1569650	D	R1	1.2	1.58	1.39	57	10/Dec/2022	26.31939775	79.94276968
NH27	1569650	1569550	D	R1	1.3	1.36	1.33	54	10/Dec/2022	26.31886571	79.94196192
NH27	1569550	1569450	D	R1	1.15	1.65	1.4	55	10/Dec/2022	26.31833379	79.94115537
NH27	1569450	1569350	D	R1	1.32	1.2	1.26	53	10/Dec/2022	26.31785733	79.94030679
NH27	1569350	1569250	D	R1	1.71	1.19	1.45	55	10/Dec/2022	26.31745003	79.93941551
NH27	1569250	1569150	D	R1	1.38	1.08	1.23	54	10/Dec/2022	26.3170764	79.93850524
NH27	1569150	1569050	D	R1	1.32	1.5	1.41	57	10/Dec/2022	26.31670946	79.93759303
NH27	1569050	1568950	D	R1	1.25	1.04	1.15	60	10/Dec/2022	26.3163399	79.93668144
NH27	1568950	1568850	D	R1	1.23	1.09	1.16	60	10/Dec/2022	26.31595384	79.93577882
NH27	1568850	1568750	D	R1	1.32	1.54	1.43	59	10/Dec/2022	26.3155033	79.93491246
NH27	1568750	1568650	D	R1	1.05	1.22	1.14	59	10/Dec/2022	26.31504764	79.93404879
NH27	1568650	1568550	D	R1	1.44	1.48	1.46	60	10/Dec/2022	26.3145899	79.93318661
NH27	1568550	1568450	D	R1	1.18	1.31	1.25	57	10/Dec/2022	26.31413596	79.93232215
NH27	1568450	1568350	D	R1	1.52	1.43	1.48	45	10/Dec/2022	26.31368734	79.93142827
NH27	1568350	1568250	D	R1	1.12	1.23	1.18	50	10/Dec/2022	26.31320154	79.93059021
NH27	1568250	1568150	D	R1	1	1.16	1.08	55	10/Dec/2022	26.31261111	79.92983984
NH27	1568150	1568050	D	R1	1.12	1.21	1.17	56	10/Dec/2022	26.3119458	79.92916699
NH27	1568050	1567950	D	R1	1.32	1.86	1.59	56	10/Dec/2022	26.31127936	79.92849469
NH27	1567950	1567850	D	R1	1.53	1.53	1.53	56	10/Dec/2022	26.31061269	79.92782216
NH27	1567850	1567750	D	R1	1.14	1.34	1.24	56	10/Dec/2022	26.30994535	79.9271511
NH27	1567750	1567650	D	R1	1.13	1.19	1.16	55	10/Dec/2022	26.30927587	79.92648197

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1567650	1567550	D	R1	1.41	1.24	1.33	56	10/Dec/2022	26.30860557	79.92581453
NH27	1567550	1567450	D	R1	2.31	1.95	2.13	58	10/Dec/2022	26.30794023	79.92514062
NH27	1567450	1567350	D	R1	1.97	1.26	1.62	58	10/Dec/2022	26.30727354	79.9244677
NH27	1567350	1567250	D	R1	2.35	2.14	2.24	54	10/Dec/2022	26.30658231	79.92383063
NH27	1567250	1567150	D	R1	2.23	2.06	2.15	53	10/Dec/2022	26.30577477	79.92339551
NH27	1567150	1567050	D	R1	1.52	1.56	1.54	51	10/Dec/2022	26.30491234	79.92310837
NH27	1567050	1566950	D	R1	1.4	1.4	1.4	53	10/Dec/2022	26.30410763	79.92266726
NH27	1566950	1566850	D	R1	1.11	1.24	1.18	54	10/Dec/2022	26.30342936	79.92201153
NH27	1566850	1566750	D	R1	1.28	1.58	1.43	53	10/Dec/2022	26.30291189	79.92119486
NH27	1566750	1566650	D	R1	1.16	1.43	1.3	54	10/Dec/2022	26.30243949	79.920345
NH27	1566650	1566550	D	R1	1.33	1.12	1.23	53	10/Dec/2022	26.30195477	79.91950363
NH27	1566550	1566450	D	R1	2.31	2.18	2.25	54	10/Dec/2022	26.301396	79.9187223
NH27	1566450	1566350	D	R1	1.53	1.76	1.65	53	10/Dec/2022	26.3007862	79.91798841
NH27	1566350	1566250	D	R1	1.84	1.94	1.89	49	10/Dec/2022	26.30015922	79.91727098
NH27	1566250	1566150	D	R1	1.48	1.37	1.43	51	10/Dec/2022	26.29955743	79.91652946
NH27	1566150	1566050	D	R1	1.21	1.42	1.32	58	10/Dec/2022	26.29892397	79.91582144
NH27	1566050	1565950	D	R1	1.5	1.42	1.46	61	10/Dec/2022	26.2982931	79.91510957
NH27	1565950	1565850	D	R1	1.24	1.48	1.36	59	10/Dec/2022	26.29766167	79.91439626
NH27	1565850	1565750	D	R1	1.06	1.16	1.11	58	10/Dec/2022	26.2970688	79.91364378
NH27	1565750	1565650	D	R1	1.96	1.58	1.77	58	10/Dec/2022	26.29650228	79.91286719
NH27	1565650	1565550	D	R1	1.91	1.18	1.55	58	10/Dec/2022	26.29593667	79.91208996
NH27	1565550	1565450	D	R1	1.98	1.92	1.95	58	10/Dec/2022	26.29536668	79.9113164
NH27	1565450	1565350	D	R1	1.2	1.06	1.13	58	10/Dec/2022	26.29479867	79.91054111
NH27	1565350	1565250	D	R1	1.6	1.67	1.64	61	10/Dec/2022	26.29423255	79.90976473
NH27	1565250	1565150	D	R1	1.02	1.99	1.51	60	10/Dec/2022	26.29366618	79.9089876
NH27	1565150	1565050	D	R1	1.37	1.45	1.41	63	10/Dec/2022	26.29309772	79.90821324
NH27	1565050	1564950	D	R1	1.09	1.05	1.07	64	10/Dec/2022	26.29253293	79.9074353
NH27	1564950	1564850	D	R1	1.24	1.6	1.42	64	10/Dec/2022	26.29196559	79.90665949
NH27	1564850	1564750	D	R1	1.89	1.9	1.9	64	10/Dec/2022	26.29139969	79.90588232
NH27	1564750	1564650	D	R1	1.5	1.68	1.59	64	10/Dec/2022	26.29084418	79.90509558
NH27	1564650	1564550	D	R1	1.73	1.99	1.86	65	10/Dec/2022	26.29037403	79.90424382
NH27	1564550	1564450	D	R1	2.82	2.49	2.66	56	10/Dec/2022	26.28997921	79.90334455
NH27	1564450	1564350	D	R1	2.41	2.24	2.33	53	10/Dec/2022	26.289594	79.90244235
NH27	1564350	1564250	D	R1	2.02	2.14	2.08	58	10/Dec/2022	26.28921205	79.90154004
NH27	1564250	1564150	D	R1	1.41	1.61	1.51	57	10/Dec/2022	26.2888142	79.90064279
NH27	1564150	1564050	D	R1	1.34	1.32	1.33	64	10/Dec/2022	26.28835335	79.89978592
NH27	1564050	1563950	D	R1	1.54	1.66	1.6	68	10/Dec/2022	26.28782117	79.89898066
NH27	1563950	1563850	D	R1	1.91	2.12	2.02	71	10/Dec/2022	26.28723269	79.89822411
NH27	1563850	1563750	D	R1	1.35	1.68	1.52	69	10/Dec/2022	26.28663301	79.89747779
NH27	1563750	1563650	D	R1	1.21	1.7	1.46	67	10/Dec/2022	26.28603502	79.89672954

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1563650	1563550	D	R1	1.64	2.05	1.85	65	10/Dec/2022	26.28543582	79.89598277
NH27	1563550	1563450	D	R1	1.46	1.82	1.64	65	10/Dec/2022	26.28481387	79.89525987
NH27	1563450	1563350	D	R1	1.32	1.36	1.34	65	10/Dec/2022	26.2842035	79.8945244
NH27	1563350	1563250	D	R1	1.46	1.37	1.42	64	10/Dec/2022	26.28359924	79.89378305
NH27	1563250	1563150	D	R1	1.56	1.23	1.4	66	10/Dec/2022	26.28297402	79.89306465
NH27	1563150	1563050	D	R1	1.35	1.58	1.47	68	10/Dec/2022	26.28228876	79.89241966
NH27	1563050	1562950	D	R1	1.53	1.52	1.53	69	10/Dec/2022	26.28152922	79.89188542
NH27	1562950	1562850	D	R1	1.04	1.57	1.31	68	10/Dec/2022	26.2807421	79.8913998
NH27	1562850	1562750	D	R1	1.71	1.63	1.67	68	10/Dec/2022	26.28003305	79.89078447
NH27	1562750	1562650	D	R1	1.97	1.14	1.56	68	10/Dec/2022	26.27938129	79.89009447
NH27	1562650	1562550	D	R1	1.28	1.44	1.36	68	10/Dec/2022	26.2787305	79.88940334
NH27	1562550	1562450	D	R1	1.99	1.31	1.65	68	10/Dec/2022	26.27808002	79.888712
NH27	1562450	1562350	D	R1	1.83	1.99	1.91	68	10/Dec/2022	26.27742942	79.88802061
NH27	1562350	1562250	D	R1	1.32	1.29	1.31	68	10/Dec/2022	26.27677955	79.88732842
NH27	1562250	1562150	D	R1	1.4	1.55	1.48	69	10/Dec/2022	26.27613063	79.88663512
NH27	1562150	1562050	D	R1	1.15	1.46	1.31	69	10/Dec/2022	26.27547845	79.88594568
NH27	1562050	1561950	D	R1	1.89	1.27	1.58	69	10/Dec/2022	26.27482634	79.88525621
NH27	1561950	1561850	D	R1	1.16	1.54	1.35	69	10/Dec/2022	26.27417276	79.88456829
NH27	1561850	1561750	D	R1	1.13	1.32	1.23	69	10/Dec/2022	26.27351857	79.88388104
NH27	1561750	1561650	D	R1	2.23	2.31	2.27	69	10/Dec/2022	26.2728651	79.88319281
NH27	1561650	1561550	D	R1	1.21	1.08	1.15	69	10/Dec/2022	26.27221062	79.88250603
NH27	1561550	1561450	D	R1	1.17	1.28	1.23	70	10/Dec/2022	26.27155463	79.88182138
NH27	1561450	1561350	D	R1	1.3	1.31	1.31	69	10/Dec/2022	26.27089721	79.88113706
NH27	1561350	1561250	D	R1	1.24	1.36	1.3	64	10/Dec/2022	26.27023942	79.8804523
NH27	1561250	1561150	D	R1	1.06	1.02	1.04	65	10/Dec/2022	26.26957915	79.87977265
NH27	1561150	1561050	D	R1	1.67	1.8	1.74	66	10/Dec/2022	26.26889864	79.87911919
NH27	1561050	1560950	D	R1	1.17	1.46	1.32	70	10/Dec/2022	26.2681633	79.87854393
NH27	1560950	1560850	D	R1	1.31	1.23	1.27	71	10/Dec/2022	26.26742248	79.87797559
NH27	1560850	1560750	D	R1	1.25	1.24	1.25	67	10/Dec/2022	26.26668007	79.87740733
NH27	1560750	1560650	D	R1	2.48	2.09	2.29	67	10/Dec/2022	26.26593268	79.87684964
NH27	1560650	1560550	D	R1	1.96	1.35	1.66	68	10/Dec/2022	26.26518879	79.87628602
NH27	1560550	1560450	D	R1	1.3	1.3	1.3	67	10/Dec/2022	26.26444713	79.87571784
NH27	1560450	1560350	D	R1	1.1	1.48	1.29	55	10/Dec/2022	26.2637124	79.87513641
NH27	1560350	1560250	D	R1	1.46	1.59	1.53	61	10/Dec/2022	26.26295865	79.87459124
NH27	1560250	1560150	D	R1	1.18	1.67	1.43	66	10/Dec/2022	26.26221651	79.87402662
NH27	1560150	1560050	D	R1	1.05	1.26	1.16	69	10/Dec/2022	26.26147304	79.87346335
NH27	1560050	1559950	D	R1	1.13	1.22	1.18	64	10/Dec/2022	26.26073317	79.87289013
NH27	1559950	1559850	D	R1	1.11	1.22	1.17	65	10/Dec/2022	26.25998496	79.87233501
NH27	1559850	1559750	D	R1	1.97	1.21	1.59	65	10/Dec/2022	26.25924279	79.87176844
NH27	1559750	1559650	D	R1	1.01	1.2	1.11	66	10/Dec/2022	26.25849878	79.87120529

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1559650	1559550	D	R1	1.16	1.42	1.29	67	10/Dec/2022	26.25775441	79.87064305
NH27	1559550	1559450	D	R1	1.08	1.27	1.18	68	10/Dec/2022	26.25702355	79.87005878
NH27	1559450	1559350	D	R1	1.52	1.56	1.54	68	10/Dec/2022	26.25633527	79.86941409
NH27	1559350	1559250	D	R1	1.48	1.76	1.62	65	10/Dec/2022	26.25572109	79.86868165
NH27	1559250	1559150	D	R1	1.53	1.61	1.57	66	10/Dec/2022	26.25513369	79.8679237
NH27	1559150	1559050	D	R1	1.94	1.18	1.56	65	10/Dec/2022	26.25455494	79.86715693
NH27	1559050	1558950	D	R1	1.9	1.17	1.54	64	10/Dec/2022	26.25398211	79.8663848
NH27	1558950	1558850	D	R1	1.15	1.36	1.26	65	10/Dec/2022	26.25339144	79.86563023
NH27	1558850	1558750	D	R1	1.39	1.72	1.56	63	10/Dec/2022	26.25281704	79.86485968
NH27	1558750	1558650	D	R1	1.08	1.47	1.28	63	10/Dec/2022	26.25223355	79.86409909
NH27	1558650	1558550	D	R1	1.23	1.29	1.26	64	10/Dec/2022	26.25165051	79.86333687
NH27	1558550	1558450	D	R1	2.43	2.73	2.58	64	10/Dec/2022	26.25107113	79.86257155
NH27	1558450	1558350	D	R1	1.4	1.47	1.44	64	10/Dec/2022	26.2504908	79.86180664
NH27	1558350	1558250	D	R1	1.9	1.13	1.52	66	10/Dec/2022	26.24991062	79.86104291
NH27	1558250	1558150	D	R1	1.14	1.16	1.15	67	10/Dec/2022	26.24932587	79.86028269
NH27	1558150	1558050	D	R1	1.33	1.43	1.38	66	10/Dec/2022	26.24874524	79.85951741
NH27	1558050	1557950	D	R1	2.06	1.97	2.02	51	10/Dec/2022	26.24814778	79.85875486
NH27	1557950	1557850	D	R1	1.28	1.25	1.27	56	10/Dec/2022	26.24745243	79.85812359
NH27	1557850	1557750	D	R1	1.94	1.24	1.59	64	10/Dec/2022	26.2466972	79.85758284
NH27	1557750	1557650	D	R1	1.42	1.69	1.56	62	10/Dec/2022	26.24593676	79.85704519
NH27	1557650	1557550	D	R1	1.44	1.22	1.33	62	10/Dec/2022	26.24516537	79.85652958
NH27	1557550	1557450	D	R1	1.33	1.6	1.47	60	10/Dec/2022	26.24439755	79.85600477
NH27	1557450	1557350	D	R1	1.28	1.4	1.34	60	10/Dec/2022	26.24363119	79.85547898
NH27	1557350	1557250	D	R1	1.4	1.39	1.4	61	10/Dec/2022	26.24286251	79.85495759
NH27	1557250	1557150	D	R1	1.05	1.14	1.1	63	10/Dec/2022	26.2420981	79.85442946
NH27	1557150	1557050	D	R1	1.14	1.07	1.11	64	10/Dec/2022	26.24132966	79.85390732
NH27	1557050	1556950	D	R1	1.36	1.34	1.35	63	10/Dec/2022	26.24056256	79.8533824
NH27	1556950	1556850	D	R1	1.47	1.76	1.62	63	10/Dec/2022	26.23979507	79.85285853
NH27	1556850	1556750	D	R1	1.2	1.17	1.19	63	10/Dec/2022	26.23902999	79.85233099
NH27	1556750	1556650	D	R1	1.18	1.41	1.3	62	10/Dec/2022	26.23827125	79.85179152
NH27	1556650	1556550	D	R1	1.18	1.22	1.2	62	10/Dec/2022	26.23755937	79.85117969
NH27	1556550	1556450	D	R1	1.38	1.29	1.34	63	10/Dec/2022	26.23690734	79.85049034
NH27	1556450	1556350	D	R1	1.57	1.74	1.66	59	10/Dec/2022	26.23631732	79.84973412
NH27	1556350	1556250	D	R1	1.55	1.59	1.57	35	10/Dec/2022	26.23580581	79.84891002
NH27	1556250	1556150	D	R1	1.12	1.28	1.2	52	10/Dec/2022	26.23536848	79.84803997
NH27	1556150	1556050	D	R1	1.97	1.33	1.65	61	10/Dec/2022	26.23501284	79.84712445
NH27	1556050	1555950	D	R1	1.14	1.32	1.23	65	10/Dec/2022	26.23474378	79.84617174
NH27	1555950	1555850	D	R1	1.24	1.37	1.31	47	10/Dec/2022	26.2345109	79.84520402
NH27	1555850	1555750	D	R1	1.27	1.11	1.19	54	10/Dec/2022	26.23426292	79.84424572
NH27	1555750	1555650	D	R1	1.21	1.29	1.25	58	10/Dec/2022	26.23402093	79.84328405

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1555650	1555550	D	R1	1.07	1.36	1.22	58	10/Dec/2022	26.23378487	79.84231979
NH27	1555550	1555450	D	R1	1.61	1.92	1.77	57	10/Dec/2022	26.23354546	79.84135573
NH27	1555450	1555350	D	R1	1.31	1.46	1.39	58	10/Dec/2022	26.23331108	79.84039122
NH27	1555350	1555250	D	R1	1.34	1.11	1.23	60	10/Dec/2022	26.2330708	79.8394288
NH27	1555250	1555150	D	R1	1.42	1.34	1.38	65	10/Dec/2022	26.23283073	79.83846683
NH27	1555150	1555050	D	R1	1.18	1.08	1.13	67	10/Dec/2022	26.23258634	79.83750606
NH27	1555050	1554950	D	R1	1.42	1.58	1.5	71	10/Dec/2022	26.23229069	79.83656453
NH27	1554950	1554850	D	R1	1.69	2.31	2	67	10/Dec/2022	26.23190911	79.83565887
NH27	1554850	1554750	D	R1	1.52	1.56	1.54	65	10/Dec/2022	26.23142852	79.83481583
NH27	1554750	1554650	D	R1	1.34	1.11	1.23	66	10/Dec/2022	26.2308699	79.83403417
NH27	1554650	1554550	D	R1	2.38	2.49	2.44	68	10/Dec/2022	26.23024061	79.83332225
NH27	1554550	1554450	D	R1	1.26	1.16	1.21	71	10/Dec/2022	26.22954384	79.83269079
NH27	1554450	1554350	D	R1	1.45	1.28	1.37	73	10/Dec/2022	26.22878784	79.8321486
NH27	1554350	1554250	D	R1	1.73	1.47	1.6	72	10/Dec/2022	26.22798225	79.83170238
NH27	1554250	1554150	D	R1	2.22	2.21	2.22	70	10/Dec/2022	26.22713737	79.83135698
NH27	1554150	1554050	D	R1	1.37	1.66	1.52	69	10/Dec/2022	26.22627318	79.8310731
NH27	1554050	1553950	D	R1	1.6	1.65	1.63	67	10/Dec/2022	26.22540761	79.83079129
NH27	1553950	1553850	D	R1	1.24	1.12	1.18	62	10/Dec/2022	26.22453948	79.83052287
NH27	1553850	1553750	D	R1	1.88	1.25	1.57	66	10/Dec/2022	26.22367348	79.83024847
NH27	1553750	1553650	D	R1	1.22	1.26	1.24	67	10/Dec/2022	26.2228089	79.82996802
NH27	1553650	1553550	D	R1	1.65	1.62	1.64	69	10/Dec/2022	26.22194555	79.82968258
NH27	1553550	1553450	D	R1	1.69	1.64	1.67	70	10/Dec/2022	26.22107754	79.82941479
NH27	1553450	1553350	D	R1	1.17	1.21	1.19	68	10/Dec/2022	26.22021182	79.82913602
NH27	1553350	1553250	D	R1	1.01	1.98	1.5	66	10/Dec/2022	26.21934612	79.8288567
NH27	1553250	1553150	D	R1	1.13	1.02	1.08	68	10/Dec/2022	26.21848	79.82858264
NH27	1553150	1553050	D	R1	1.22	1.16	1.19	70	10/Dec/2022	26.21761441	79.82830617
NH27	1553050	1552950	D	R1	2.29	1.59	1.94	70	10/Dec/2022	26.21674904	79.82802814
NH27	1552950	1552850	D	R1	1.24	1.45	1.35	69	10/Dec/2022	26.21588335	79.82774972
NH27	1552850	1552750	D	R1	1.47	1.77	1.62	69	10/Dec/2022	26.21502709	79.82743789
NH27	1552750	1552650	D	R1	1.9	1.9	1.9	70	10/Dec/2022	26.21420362	79.827033
NH27	1552650	1552550	D	R1	1.29	1.24	1.27	64	10/Dec/2022	26.21340961	79.82655733
NH27	1552550	1552450	D	R1	1.48	1.68	1.58	43	10/Dec/2022	26.21266807	79.82598852
NH27	1552450	1552350	D	R1	1.46	1.55	1.51	56	10/Dec/2022	26.21200333	79.82531817
NH27	1552350	1552250	D	R1	1.59	1.48	1.54	61	10/Dec/2022	26.21142275	79.82455528
NH27	1552250	1552150	D	R1	1.92	1.38	1.65	63	10/Dec/2022	26.21086627	79.82376972
NH27	1552150	1552050	D	R1	1.5	1.39	1.45	40	10/Dec/2022	26.21033244	79.82296113
NH27	1552050	1551950	D	R1	1.13	1.02	1.08	51	10/Dec/2022	26.20978975	79.82216835
NH27	1551950	1551850	D	R1	1.2	1.16	1.18	61	10/Dec/2022	26.20921095	79.8214055
NH27	1551850	1551750	D	R1	1.32	1.44	1.38	62	10/Dec/2022	26.20865395	79.82062027
NH27	1551750	1551650	D	R1	1.47	1.67	1.57	60	10/Dec/2022	26.20809001	79.81984018

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1551650	1551550	D	R1	1.67	1.65	1.66	48	10/Dec/2022	26.20750764	79.81907723
NH27	1551550	1551450	D	R1	1.62	1.4	1.51	56	10/Dec/2022	26.20688477	79.81835743
NH27	1551450	1551350	D	R1	2.34	2.41	2.38	56	10/Dec/2022	26.20628407	79.81761245
NH27	1551350	1551250	D	R1	2.21	2.41	2.31	30	10/Dec/2022	26.20568066	79.81686671
NH27	1551250	1551150	D	R1	2.17	2.1	2.14	37	10/Dec/2022	26.20506909	79.81614061
NH27	1551150	1551050	D	R1	2.79	2.12	2.46	53	10/Dec/2022	26.2044282	79.81544541
NH27	1551050	1550950	D	R1	1.47	1.14	1.31	58	10/Dec/2022	26.20374346	79.81480033
NH27	1550950	1550850	D	R1	2.25	2.18	2.22	61	10/Dec/2022	26.20303006	79.81419214
NH27	1550850	1550750	D	R1	2.19	2.13	2.16	62	10/Dec/2022	26.20230658	79.81359658
NH27	1550750	1550650	D	R1	2.34	2.05	2.2	61	10/Dec/2022	26.20158591	79.81299583
NH27	1550650	1550550	D	R1	2.04	1.61	1.83	56	10/Dec/2022	26.20086444	79.81239478
NH27	1550550	1550450	D	R1	1.85	1.75	1.8	61	10/Dec/2022	26.20014357	79.81179617
NH27	1550450	1550350	D	R1	2.01	1.74	1.88	63	10/Dec/2022	26.19943569	79.81117726
NH27	1550350	1550250	D	R1	2.65	2.57	2.61	55	10/Dec/2022	26.19879111	79.81047569
NH27	1550250	1550150	D	R1	2.66	2.38	2.52	19	10/Dec/2022	26.19817434	79.80974842
NH27	1550150	1550050	D	R1	1.29	1.41	1.35	36	10/Dec/2022	26.19754	79.80904323
NH27	1550050	1549950	D	R1	1.18	1.33	1.26	44	10/Dec/2022	26.19690934	79.80833237
NH27	1549950	1549850	D	R1	1.33	1.34	1.34	28	10/Dec/2022	26.1962801	79.8076153
NH27	1549850	1549750	D	R1	1.65	1.54	1.6	36	10/Dec/2022	26.19564914	79.80690385
NH27	1549750	1549650	D	R1	1.61	1.69	1.65	47	10/Dec/2022	26.19502288	79.80618811
NH27	1549650	1549550	D	R1	1.46	1.5	1.48	39	10/Dec/2022	26.1943974	79.80546854
NH27	1549550	1549450	D	R1	1.1	1.01	1.06	43	10/Dec/2022	26.19378367	79.80473923
NH27	1549450	1549350	D	R1	1.2	1.01	1.11	47	10/Dec/2022	26.19314233	79.80403894
NH27	1549350	1549250	D	R1	1.2	1.33	1.27	59	10/Dec/2022	26.19252199	79.80331826
NH27	1549250	1549150	D	R1	1.29	1.16	1.23	66	10/Dec/2022	26.19189486	79.80260302
NH27	1549150	1549050	D	R1	1.36	1.13	1.25	69	10/Dec/2022	26.1912672	79.80188718
NH27	1549050	1548950	D	R1	1.45	1.37	1.41	68	10/Dec/2022	26.19064054	79.80116853
NH27	1548950	1548850	D	R1	1.85	1.48	1.67	68	10/Dec/2022	26.19001204	79.80045172
NH27	1548850	1548750	D	R1	1.27	1.5	1.39	66	10/Dec/2022	26.18938612	79.79973206
NH27	1548750	1548650	D	R1	1.59	1.83	1.71	65	10/Dec/2022	26.18875662	79.79901634
NH27	1548650	1548550	D	R1	2.63	1.47	2.05	59	10/Dec/2022	26.18812958	79.79829637
NH27	1548550	1548450	D	R1	1.21	1.06	1.14	54	10/Dec/2022	26.18750092	79.79757909
NH27	1548450	1548350	D	R1	1.38	1.2	1.29	56	10/Dec/2022	26.18687358	79.79686242
NH27	1548350	1548250	D	R1	1.82	1.66	1.74	57	10/Dec/2022	26.18622012	79.79617536
NH27	1548250	1548150	D	R1	1.74	1.82	1.78	45	10/Dec/2022	26.18552697	79.79553613
NH27	1548150	1548050	D	R1	1.44	1.22	1.33	37	10/Dec/2022	26.18479599	79.79495152
NH27	1548050	1547950	D	R1	1.31	1.4	1.36	56	10/Dec/2022	26.18405495	79.79438895
NH27	1547950	1547850	D	R1	1.43	1.38	1.41	64	10/Dec/2022	26.1833181	79.79381667
NH27	1547850	1547750	D	R1	1.6	1.53	1.57	67	10/Dec/2022	26.18258009	79.79324465
NH27	1547750	1547650	D	R1	1.97	1.92	1.95	68	10/Dec/2022	26.18184403	79.79266768

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1547650	1547550	D	R1	1.17	1.1	1.14	68	10/Dec/2022	26.18110747	79.79209224
NH27	1547550	1547450	D	R1	1.13	1	1.07	67	10/Dec/2022	26.18036844	79.79152017
NH27	1547450	1547350	D	R1	1.11	1.17	1.14	67	10/Dec/2022	26.17963199	79.79094425
NH27	1547350	1547250	D	R1	1.36	1.31	1.34	65	10/Dec/2022	26.1788984	79.79036358
NH27	1547250	1547150	D	R1	2.08	2.1	2.09	65	10/Dec/2022	26.17816059	79.78978995
NH27	1547150	1547050	D	R1	1.59	1.6	1.6	43	10/Dec/2022	26.17742087	79.78921427
NH27	1547050	1546950	D	R1	1.05	1.02	1.04	47	10/Dec/2022	26.17668153	79.78864524
NH27	1546950	1546850	D	R1	1.37	1.23	1.3	59	10/Dec/2022	26.17594186	79.78807918
NH27	1546850	1546750	D	R1	1.13	1.13	1.13	62	10/Dec/2022	26.17520247	79.78750923
NH27	1546750	1546650	D	R1	1.28	1.15	1.22	67	10/Dec/2022	26.17445867	79.78693033
NH27	1546650	1546550	D	R1	1.09	1.07	1.08	70	10/Dec/2022	26.17372209	79.7863558
NH27	1546550	1546450	D	R1	1.28	1.17	1.23	71	10/Dec/2022	26.17298403	79.78578294
NH27	1546450	1546350	D	R1	1.08	1.26	1.17	71	10/Dec/2022	26.17224612	79.78520906
NH27	1546350	1546250	D	R1	1.12	1.14	1.13	70	10/Dec/2022	26.17150878	79.78463399
NH27	1546250	1546150	D	R1	1.14	1.15	1.15	68	10/Dec/2022	26.17077127	79.78405886
NH27	1546150	1546050	D	R1	1.34	1.49	1.42	67	10/Dec/2022	26.17003194	79.78348656
NH27	1546050	1545950	D	R1	1.21	1.14	1.18	64	10/Dec/2022	26.16929404	79.78291151
NH27	1545950	1545850	D	R1	1.45	1.52	1.49	55	10/Dec/2022	26.16855417	79.78233839
NH27	1545850	1545750	D	R1	1.08	1.16	1.12	48	10/Dec/2022	26.16780781	79.78177608
NH27	1545750	1545650	D	R1	1.24	1.38	1.31	39	10/Dec/2022	26.16705023	79.78123346
NH27	1545650	1545550	D	R1	1.01	1.93	1.47	37	10/Dec/2022	26.16629039	79.78069579
NH27	1545550	1545450	D	R1	1.22	1.98	1.6	36	10/Dec/2022	26.16553142	79.78015703
NH27	1545450	1545350	D	R1	1.1	1.96	1.53	41	10/Dec/2022	26.16476958	79.77962487
NH27	1545350	1545250	D	R1	1.14	1.16	1.15	43	10/Dec/2022	26.16400942	79.77908878
NH27	1545250	1545150	D	R1	1.42	2.02	1.72	32	10/Dec/2022	26.16324795	79.77855231
NH27	1545150	1545050	D	R1	1.15	1.32	1.23	10	10/Dec/2022	26.16249977	79.77801924
NH27	1545050	1544950	D	R1	1.17	1.41	1.29	39	10/Dec/2022	26.16178034	79.77742366
NH27	1544950	1544850	D	R1	1.31	1.5	1.41	50	10/Dec/2022	26.16109723	79.77677573
NH27	1544850	1544750	D	R1	1.29	1.46	1.38	52	10/Dec/2022	26.16042059	79.77611747
NH27	1544750	1544650	D	R1	1.39	1.77	1.58	40	10/Dec/2022	26.15974484	79.77545433
NH27	1544650	1544550	D	R1	1.95	2.55	2.25	37	10/Dec/2022	26.1590682	79.7747956
NH27	1544550	1544450	D	R1	1.2	1.09	1.15	52	10/Dec/2022	26.15838513	79.77414902
NH27	1544450	1544350	D	R1	1.27	1.45	1.36	55	10/Dec/2022	26.15771213	79.77348549
NH27	1544350	1544250	D	R1	1.62	1.76	1.69	54	10/Dec/2022	26.15704563	79.7728147
NH27	1544250	1544150	D	R1	1.03	1.08	1.06	58	10/Dec/2022	26.15635847	79.77216993
NH27	1544150	1544050	D	R1	1.6	1.35	1.48	51	10/Dec/2022	26.15568805	79.77149994
NH27	1544050	1543950	D	R1	1.42	1.1	1.26	58	10/Dec/2022	26.1549982	79.77085943
NH27	1543950	1543850	D	R1	1.2	1.05	1.13	63	10/Dec/2022	26.15432131	79.77020091
NH27	1543850	1543750	D	R1	1.47	1.25	1.36	65	10/Dec/2022	26.15364468	79.76954204
NH27	1543750	1543650	D	R1	1.43	1.49	1.46	61	10/Dec/2022	26.15296735	79.76888148

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1543650	1543550	D	R1	1.71	1.57	1.64	52	10/Dec/2022	26.15228875	79.76822271
NH27	1543550	1543450	D	R1	2.48	1.78	2.13	58	10/Dec/2022	26.15160944	79.76756834
NH27	1543450	1543350	D	R1	2.2	1.9	2.05	63	10/Dec/2022	26.15093137	79.76691207
NH27	1543350	1543250	D	R1	2.03	3.01	2.52	67	10/Dec/2022	26.15025306	79.7662556
NH27	1543250	1543150	D	R1	2.11	2.44	2.28	69	10/Dec/2022	26.14957544	79.76559658
NH27	1543150	1543050	D	R1	1.2	1.56	1.38	69	10/Dec/2022	26.14889413	79.76494213
NH27	1543050	1542950	D	R1	1.36	1.03	1.19	69	10/Dec/2022	26.14821852	79.76428162
NH27	1542950	1542850	D	R1	1.79	2.28	2.03	64	10/Dec/2022	26.14753806	79.76362535
NH27	1542850	1542750	D	R1	1.65	1.93	1.79	59	10/Dec/2022	26.14686445	79.76296066
NH27	1542750	1542650	D	R1	1.65	1.83	1.74	63	10/Dec/2022	26.14614552	79.76236223
NH27	1542650	1542550	D	R1	1.1	1.33	1.22	65	10/Dec/2022	26.14537842	79.76184041
NH27	1542550	1542450	D	R1	1.11	1.13	1.12	63	10/Dec/2022	26.14457552	79.76138701
NH27	1542450	1542350	D	R1	1.69	1.47	1.58	54	10/Dec/2022	26.1437691	79.76093744
NH27	1542350	1542250	D	R1	1.57	2.31	1.94	57	10/Dec/2022	26.14296545	79.7604889
NH27	1542250	1542150	D	R1	1.47	1.88	1.68	60	10/Dec/2022	26.14215234	79.76005891
NH27	1542150	1542050	D	R1	1.37	2.02	1.7	54	10/Dec/2022	26.14134393	79.75961667
NH27	1542050	1541950	D	R1	2.33	2.41	2.37	50	10/Dec/2022	26.14053606	79.75917265
NH27	1541950	1541850	D	R1	1.44	1.82	1.63	53	10/Dec/2022	26.13973029	79.75872768
NH27	1541850	1541750	D	R1	1.33	1.65	1.49	56	10/Dec/2022	26.13891807	79.75829771
NH27	1541750	1541650	D	R1	1.77	1.55	1.66	55	10/Dec/2022	26.13811808	79.75784133
NH27	1541650	1541550	D	R1	1.52	1.69	1.61	60	10/Dec/2022	26.13730418	79.75741723
NH27	1541550	1541450	D	R1	1.64	2.22	1.93	62	10/Dec/2022	26.13649757	79.75697494
NH27	1541450	1541350	D	R1	3.97	3.86	3.92	63	10/Dec/2022	26.13568946	79.75653336
NH27	1541350	1541250	D	R1	2.51	2.56	2.53	49	10/Dec/2022	26.13487959	79.75609052
NH27	1541250	1541150	D	R1	3.63	3.68	3.66	55	10/Dec/2022	26.13407335	79.75564815
NH27	1541150	1541050	D	R1	4.63	4.37	4.5	59	10/Dec/2022	26.13326627	79.75520612
NH27	1541050	1540950	D	R1	5.09	5	5.05	60	10/Dec/2022	26.13245773	79.75476634
NH27	1540950	1540850	D	R1	5.02	5.28	5.15	57	10/Dec/2022	26.13164881	79.75432506
NH27	1540850	1540750	D	R1	5.32	4.98	5.15	57	10/Dec/2022	26.130842	79.75388093
NH27	1540750	1540650	D	R1	4.3	4.11	4.21	49	10/Dec/2022	26.13003593	79.75343233
NH27	1540650	1540550	D	R1	4.29	3.88	4.09	55	10/Dec/2022	26.12922495	79.75300106
NH27	1540550	1540450	D	R1	2.11	2.66	2.39	45	10/Dec/2022	26.12841513	79.75256062
NH27	1540450	1540350	D	R1	1.64	2.02	1.83	55	10/Dec/2022	26.12760865	79.75211991
NH27	1540350	1540250	D	R1	3.5	3.25	3.38	56	10/Dec/2022	26.12680086	79.7516785
NH27	1540250	1540150	D	R1	3.18	3.55	3.36	48	10/Dec/2022	26.12603258	79.75116109
NH27	1540150	1540050	D	R1	2.54	3.02	2.78	12	10/Dec/2022	26.12528678	79.75060416
NH27	1540050	1539950	D	R1	2.71	2.83	2.77	43	10/Dec/2022	26.12447523	79.75018147
NH27	1539950	1539850	D	R1	2.14	2.14	2.14	53	10/Dec/2022	26.12372293	79.74963784
NH27	1539850	1539750	D	R1	2.21	2.4	2.31	61	10/Dec/2022	26.12300717	79.74903523
NH27	1539750	1539650	D	R1	3.02	3.14	5.27	65	10/Dec/2022	26.12231798	79.74839477

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1539650	1539550	D	R1	3.22	2.98	3.51	55	10/Dec/2022	26.12168433	79.74768352
NH27	1539550	1539450	D	R1	2.72	2.95	2.84	57	10/Dec/2022	26.12113909	79.74689021
NH27	1539450	1539350	D	R1	2.67	2.72	2.7	51	10/Dec/2022	26.12072212	79.74600397
NH27	1539350	1539250	D	R1	2.53	3.01	2.77	59	10/Dec/2022	26.1202874	79.7451316
NH27	1539250	1539150	D	R1	2.84	2.51	2.68	58	10/Dec/2022	26.1198597	79.74425183
NH27	1539150	1539050	D	R1	2.87	3.02	3.44	56	10/Dec/2022	26.11935108	79.74342983
NH27	1539050	1538950	D	R1	2.49	2.71	2.6	50	10/Dec/2022	26.11867356	79.74277989
NH27	1538950	1538850	D	R1	2.68	2.21	2.45	34	10/Dec/2022	26.11791726	79.74223762
NH27	1538850	1538750	D	R1	2.48	2.22	5.16	51	10/Dec/2022	26.1171368	79.74174478
NH27	1538750	1538650	D	R1	2.4	3.42	2.91	55	10/Dec/2022	26.11636937	79.741224
NH27	1538650	1538550	D	R1	4.02	4.14	5.11	58	10/Dec/2022	26.11560199	79.74070234
NH27	1538550	1538450	D	R1	3.01	3.16	3.09	58	10/Dec/2022	26.11483552	79.74017848
NH27	1538450	1538350	D	R1	2.02	1.99	2.01	58	10/Dec/2022	26.11411934	79.73957521
NH27	1538350	1538250	D	R1	2.58	2.94	2.76	57	10/Dec/2022	26.11355734	79.73879775
NH27	1538250	1538150	D	R1	2.05	2.14	4.11	52	10/Dec/2022	26.11319901	79.73788426
NH27	1538150	1538050	D	R1	1.79	2.28	2.03	49	10/Dec/2022	26.11307789	79.73689809
NH27	1538050	1537950	D	R1	1.53	1.71	1.62	55	10/Dec/2022	26.11318975	79.73591019
NH27	1537950	1537850	D	R1	2.15	2.23	2.19	59	10/Dec/2022	26.11340543	79.73494208
NH27	1537850	1537750	D	R1	2.13	1.91	2.02	61	10/Dec/2022	26.11360255	79.73396928
NH27	1537750	1537650	D	R1	1.59	1.86	1.73	60	10/Dec/2022	26.11365335	79.73297636
NH27	1537650	1537550	D	R1	1.45	1.31	1.38	59	10/Dec/2022	26.11352807	79.7319902
NH27	1537550	1537450	D	R1	1.38	1.91	1.65	58	10/Dec/2022	26.11336479	79.73100935
NH27	1537450	1537350	D	R1	2.23	2.39	2.31	59	10/Dec/2022	26.11325621	79.7300195
NH27	1537350	1537250	D	R1	1.49	1.53	1.51	61	10/Dec/2022	26.1132009	79.72902409
NH27	1537250	1537150	D	R1	1.74	1.46	1.6	59	10/Dec/2022	26.11314389	79.72802804
NH27	1537150	1537050	D	R1	1.68	1.43	1.56	54	10/Dec/2022	26.11304904	79.72703594
NH27	1537050	1536950	D	R1	1.37	1.78	1.58	58	10/Dec/2022	26.11278892	79.72608369
NH27	1536950	1536850	D	R1	2.4	2.2	2.3	62	10/Dec/2022	26.11236635	79.72520615
NH27	1536850	1536750	D	R1	1.75	1.6	1.68	64	10/Dec/2022	26.11185907	79.72438185
NH27	1536750	1536650	D	R1	1.45	1.14	1.3	65	10/Dec/2022	26.11134673	79.72356088
NH27	1536650	1536550	D	R1	1.57	1.57	1.57	66	10/Dec/2022	26.11083389	79.72274
NH27	1536550	1536450	D	R1	1.34	1.33	1.34	67	10/Dec/2022	26.11032262	79.72191787
NH27	1536450	1536350	D	R1	1.24	1.06	1.15	67	10/Dec/2022	26.10981145	79.72109558
NH27	1536350	1536250	D	R1	1.51	1.4	1.46	68	10/Dec/2022	26.10929698	79.72027569
NH27	1536250	1536150	D	R1	2.29	1.94	2.12	66	10/Dec/2022	26.1087765	79.71946147
NH27	1536150	1536050	D	R1	1.06	1.12	1.09	64	10/Dec/2022	26.10822274	79.7186746
NH27	1536050	1535950	D	R1	1.25	1.83	1.54	63	10/Dec/2022	26.10769221	79.71786851
NH27	1535950	1535850	D	R1	1.54	1.65	1.6	64	10/Dec/2022	26.10720111	79.71703243
NH27	1535850	1535750	D	R1	1.39	1.5	1.45	65	10/Dec/2022	26.10671304	79.71619284
NH27	1535750	1535650	D	R1	1.61	1.54	1.58	63	10/Dec/2022	26.10622439	79.71535294

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1535650	1535550	D	R1	1.48	1.48	1.48	64	10/Dec/2022	26.10571973	79.71452653
NH27	1535550	1535450	D	R1	1.43	1.6	1.52	62	10/Dec/2022	26.10517566	79.7137301
NH27	1535450	1535350	D	R1	1.75	1.78	1.77	62	10/Dec/2022	26.10462055	79.71294527
NH27	1535350	1535250	D	R1	1.29	1.31	1.3	62	10/Dec/2022	26.10406123	79.71216354
NH27	1535250	1535150	D	R1	1.59	1.54	1.57	63	10/Dec/2022	26.10350557	79.71137864
NH27	1535150	1535050	D	R1	1.77	1.64	1.71	64	10/Dec/2022	26.10294852	79.71059424
NH27	1535050	1534950	D	R1	1.12	1.19	1.16	64	10/Dec/2022	26.10239688	79.70980515
NH27	1534950	1534850	D	R1	1.27	1.28	1.28	64	10/Dec/2022	26.10184191	79.70901875
NH27	1534850	1534750	D	R1	1.74	1.59	1.67	64	10/Dec/2022	26.10128801	79.70823153
NH27	1534750	1534650	D	R1	1.11	1.82	1.47	62	10/Dec/2022	26.10073156	79.70744535
NH27	1534650	1534550	D	R1	1.58	1.69	1.64	59	10/Dec/2022	26.10017998	79.70665516
NH27	1534550	1534450	D	R1	1.61	1.82	1.72	61	10/Dec/2022	26.09961567	79.70586446
NH27	1534450	1534350	D	R1	1.45	1.48	1.47	38	10/Dec/2022	26.09906825	79.70506841
NH27	1534350	1534250	D	R1	3.24	3.11	3.18	46	10/Dec/2022	26.09850647	79.70428901
NH27	1534250	1534150	D	R1	2.52	2.49	2.51	41	10/Dec/2022	26.09797951	79.70347895
NH27	1534150	1534050	D	R1	1.6	1.8	1.7	46	10/Dec/2022	26.09742325	79.70269512
NH27	1534050	1533950	D	R1	1.23	1.29	1.26	54	10/Dec/2022	26.09687321	79.70190738
NH27	1533950	1533850	D	R1	0.99	1.33	1.16	61	10/Dec/2022	26.09633135	79.70111186
NH27	1533850	1533750	D	R1	1.73	1.81	1.77	63	10/Dec/2022	26.09579179	79.7003132
NH27	1533750	1533650	D	R1	1.16	1.4	1.28	65	10/Dec/2022	26.0952544	79.69951305
NH27	1533650	1533550	D	R1	1.54	1.82	1.68	65	10/Dec/2022	26.09470883	79.69871869
NH27	1533550	1533450	D	R1	1.17	1.52	1.35	65	10/Dec/2022	26.09416823	79.69792023
NH27	1533450	1533350	D	R1	1.18	1.26	1.22	65	10/Dec/2022	26.09363282	79.69711756
NH27	1533350	1533250	D	R1	1.65	1.51	1.58	65	10/Dec/2022	26.09311313	79.69630208
NH27	1533250	1533150	D	R1	1.55	1.35	1.45	66	10/Dec/2022	26.09260515	79.69547755
NH27	1533150	1533050	D	R1	1.42	1.29	1.36	66	10/Dec/2022	26.09212076	79.69463559
NH27	1533050	1532950	D	R1	1.34	1.26	1.3	65	10/Dec/2022	26.09164823	79.69378554
NH27	1532950	1532850	D	R1	1.42	1.52	1.47	65	10/Dec/2022	26.0911943	79.69292291
NH27	1532850	1532750	D	R1	1.28	1.43	1.36	65	10/Dec/2022	26.09076079	79.69204773
NH27	1532750	1532650	D	R1	1.51	1.5	1.51	65	10/Dec/2022	26.09034461	79.69116222
NH27	1532650	1532550	D	R1	1.02	1.21	1.12	64	10/Dec/2022	26.08993722	79.69027127
NH27	1532550	1532450	D	R1	1.26	1.21	1.24	24	10/Dec/2022	26.08952689	79.68937138
NH27	1532450	1532350	D	R1	2.32	1.89	2.11	24	10/Dec/2022	26.08912101	79.68847938
NH27	1532350	1532250	D	R1	1.32	1.57	1.45	24	10/Dec/2022	26.08871513	79.68758737
NH27	1532250	1532150	D	R1	1.45	1.49	1.47	24	10/Dec/2022	26.08830925	79.68669537
NH27	1532150	1532050	D	R1	1.68	1.63	1.66	40	10/Dec/2022	26.08792402	79.6858368
NH27	1532050	1531950	D	R1	1.13	1.11	1.12	44	10/Dec/2022	26.08751879	79.68494648
NH27	1531950	1531850	D	R1	1.32	1.06	1.19	48	10/Dec/2022	26.08711367	79.68405638
NH27	1531850	1531750	D	R1	1.12	1.97	1.55	52	10/Dec/2022	26.08671167	79.68316464
NH27	1531750	1531650	D	R1	1.17	1.04	1.11	55	10/Dec/2022	26.08630792	79.68227355

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1531650	1531550	D	R1	1.64	1.4	1.52	56	10/Dec/2022	26.08590305	79.68138263
NH27	1531550	1531450	D	R1	1.81	1.51	1.66	57	10/Dec/2022	26.08549737	79.68049175
NH27	1531450	1531350	D	R1	1.96	1.97	1.97	56	10/Dec/2022	26.08508964	79.67960206
NH27	1531350	1531250	D	R1	1.58	1.28	1.43	54	10/Dec/2022	26.08468438	79.67871044
NH27	1531250	1531150	D	R1	1.4	1.37	1.39	54	10/Dec/2022	26.08428118	79.67781827
NH27	1531150	1531050	D	R1	2.03	1.68	1.86	54	10/Dec/2022	26.08387198	79.67692923
NH27	1531050	1530950	D	R1	1.55	1.12	1.34	52	10/Dec/2022	26.0834699	79.67603611
NH27	1530950	1530850	D	R1	1.16	1.91	1.54	52	10/Dec/2022	26.08306108	79.67514697
NH27	1530850	1530750	D	R1	1.7	1.54	1.62	52	10/Dec/2022	26.08266034	79.67425386
NH27	1530750	1530650	D	R1	1.19	1.46	1.33	52	10/Dec/2022	26.08225993	79.67336005
NH27	1530650	1530550	D	R1	1.04	1.17	1.11	52	10/Dec/2022	26.08185437	79.67247077
NH27	1530550	1530450	D	R1	1.36	1.41	1.39	53	10/Dec/2022	26.08144403	79.67158266
NH27	1530450	1530350	D	R1	1.28	1.56	1.42	53	10/Dec/2022	26.08103893	79.67069141
NH27	1530350	1530250	D	R1	1.35	1.5	1.43	52	10/Dec/2022	26.08062944	79.66980269
NH27	1530250	1530150	D	R1	1.44	1.56	1.5	53	10/Dec/2022	26.08021124	79.66891918
NH27	1530150	1530050	D	R1	1.13	1.58	1.36	54	10/Dec/2022	26.07980755	79.66802769
NH27	1530050	1529950	D	R1	1.14	1.27	1.21	56	10/Dec/2022	26.079375	79.66715306
NH27	1529950	1529850	D	R1	1.23	1.39	1.31	57	10/Dec/2022	26.07895737	79.66626903
NH27	1529850	1529750	D	R1	1.8	1.58	1.69	58	10/Dec/2022	26.07853787	79.66538633
NH27	1529750	1529650	D	R1	1.67	1.49	1.58	58	10/Dec/2022	26.07811791	79.66450366
NH27	1529650	1529550	D	R1	1.61	1.55	1.58	58	10/Dec/2022	26.07770216	79.66361868
NH27	1529550	1529450	D	R1	1.51	1.37	1.44	57	10/Dec/2022	26.07728529	79.66273404
NH27	1529450	1529350	D	R1	2.02	2.28	2.15	57	10/Dec/2022	26.07686985	79.66184869
NH27	1529350	1529250	D	R1	1.8	1.92	1.86	58	10/Dec/2022	26.07645312	79.66096418
NH27	1529250	1529150	D	R1	1.09	1.06	1.08	59	10/Dec/2022	26.07603497	79.6600811
NH27	1529150	1529050	D	R1	1.23	1.04	1.14	61	10/Dec/2022	26.07561572	79.65919855
NH27	1529050	1528950	D	R1	1.22	1.15	1.19	62	10/Dec/2022	26.0751978	79.6583149
NH27	1528950	1528850	D	R1	1.51	1.47	1.49	61	10/Dec/2022	26.07478059	79.65743038
NH27	1528850	1528750	D	R1	1.34	1.3	1.32	61	10/Dec/2022	26.07436517	79.65654536
NH27	1528750	1528650	D	R1	1.27	1.18	1.23	61	10/Dec/2022	26.07393669	79.65566759
NH27	1528650	1528550	D	R1	1.98	1.88	1.93	61	10/Dec/2022	26.07352445	79.65478071
NH27	1528550	1528450	D	R1	1.15	1.97	1.56	60	10/Dec/2022	26.07309789	79.65390188
NH27	1528450	1528350	D	R1	1.19	1.21	1.2	60	10/Dec/2022	26.07266825	79.65302497
NH27	1528350	1528250	D	R1	1.43	1.19	1.31	61	10/Dec/2022	26.07223419	79.65215107
NH27	1528250	1528150	D	R1	1.77	1.53	1.65	61	10/Dec/2022	26.07179843	79.65127757
NH27	1528150	1528050	D	R1	1.32	1.21	1.27	60	10/Dec/2022	26.07136296	79.65040394
NH27	1528050	1527950	D	R1	1.49	1.33	1.41	59	10/Dec/2022	26.07092633	79.64953097
NH27	1527950	1527850	D	R1	1.61	1.3	1.46	60	10/Dec/2022	26.07049501	79.64865491
NH27	1527850	1527750	D	R1	1.4	1.46	1.43	60	10/Dec/2022	26.07006003	79.64778115
NH27	1527750	1527650	D	R1	1.44	1.07	1.26	61	10/Dec/2022	26.069625	79.64690787

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1527650	1527550	D	R1	1.58	1.57	1.58	61	10/Dec/2022	26.06918937	79.64603462
NH27	1527550	1527450	D	R1	1.62	1.65	1.64	60	10/Dec/2022	26.06875545	79.64515985
NH27	1527450	1527350	D	R1	1.25	1.21	1.23	60	10/Dec/2022	26.06832063	79.64428592
NH27	1527350	1527250	D	R1	1.59	1.54	1.57	59	10/Dec/2022	26.06788385	79.64341299
NH27	1527250	1527150	D	R1	1.55	2.07	1.81	59	10/Dec/2022	26.06745016	79.64253846
NH27	1527150	1527050	D	R1	1.91	1.9	1.91	60	10/Dec/2022	26.06701474	79.64166517
NH27	1527050	1526950	D	R1	1.73	1.62	1.68	60	10/Dec/2022	26.06658074	79.64079098
NH27	1526950	1526850	D	R1	1.24	1.02	1.13	62	10/Dec/2022	26.06614572	79.6399176
NH27	1526850	1526750	D	R1	1.56	1.53	1.55	63	10/Dec/2022	26.06571142	79.63904352
NH27	1526750	1526650	D	R1	1.18	1.65	1.42	65	10/Dec/2022	26.06527631	79.63817055
NH27	1526650	1526550	D	R1	1.74	1.43	1.59	66	10/Dec/2022	26.06484141	79.63729705
NH27	1526550	1526450	D	R1	1.77	1.68	1.73	66	10/Dec/2022	26.06440369	79.63642509
NH27	1526450	1526350	D	R1	1.79	1.42	1.61	66	10/Dec/2022	26.0639709	79.63555028
NH27	1526350	1526250	D	R1	1.51	1.23	1.37	67	10/Dec/2022	26.06353527	79.63467715
NH27	1526250	1526150	D	R1	1	1.05	1.03	67	10/Dec/2022	26.06310167	79.63380279
NH27	1526150	1526050	D	R1	1.91	1.93	1.92	67	10/Dec/2022	26.06266221	79.63293172
NH27	1526050	1525950	D	R1	1.13	1.12	1.13	67	10/Dec/2022	26.06222566	79.6320589
NH27	1525950	1525850	D	R1	1.99	1.35	1.67	66	10/Dec/2022	26.06178816	79.63118664
NH27	1525850	1525750	D	R1	1.09	1.26	1.18	65	10/Dec/2022	26.06134863	79.63031545
NH27	1525750	1525650	D	R1	1.99	1.2	1.6	64	10/Dec/2022	26.06091103	79.62944342
NH27	1525650	1525550	D	R1	1.05	1.83	1.44	64	10/Dec/2022	26.0604711	79.6285726
NH27	1525550	1525450	D	R1	1.37	1.39	1.38	63	10/Dec/2022	26.06003181	79.6277012
NH27	1525450	1525350	D	R1	1.58	1.63	1.61	63	10/Dec/2022	26.05959213	79.62682996
NH27	1525350	1525250	D	R1	1.69	1.78	1.74	61	10/Dec/2022	26.05918015	79.62594181
NH27	1525250	1525150	D	R1	1.04	1.08	1.06	65	10/Dec/2022	26.05872455	79.62508265
NH27	1525150	1525050	D	R1	1.15	1.87	1.51	66	10/Dec/2022	26.05827782	79.62421598
NH27	1525050	1524950	D	R1	2.2	2.42	2.31	66	10/Dec/2022	26.05784078	79.62334337
NH27	1524950	1524850	D	R1	1.91	1.87	1.89	66	10/Dec/2022	26.05740267	79.62247127
NH27	1524850	1524750	D	R1	1.39	1.22	1.31	65	10/Dec/2022	26.05696418	79.6215994
NH27	1524750	1524650	D	R1	1.32	1.97	1.65	65	10/Dec/2022	26.05652445	79.62072827
NH27	1524650	1524550	D	R1	1.09	1.1	1.1	65	10/Dec/2022	26.0560845	79.61985738
NH27	1524550	1524450	D	R1	1.21	1.17	1.19	65	10/Dec/2022	26.05565041	79.61898313
NH27	1524450	1524350	D	R1	1	1.12	1.06	65	10/Dec/2022	26.05524369	79.61809231
NH27	1524350	1524250	D	R1	1.26	1.88	1.57	61	10/Dec/2022	26.05487645	79.61717949
NH27	1524250	1524150	D	R1	2.09	2.11	2.1	56	10/Dec/2022	26.05455174	79.61624799
NH27	1524150	1524050	D	R1	1.09	1.27	1.18	60	10/Dec/2022	26.05423228	79.61531574
NH27	1524050	1523950	D	R1	1.31	1.09	1.2	62	10/Dec/2022	26.05392218	79.61437942
NH27	1523950	1523850	D	R1	1.23	1.98	1.61	64	10/Dec/2022	26.05358401	79.61345583
NH27	1523850	1523750	D	R1	1.47	1.24	1.36	65	10/Dec/2022	26.05316285	79.61257502
NH27	1523750	1523650	D	R1	1.81	1.72	1.77	65	10/Dec/2022	26.05266344	79.61174507

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1523650	1523550	D	R1	1.57	1.33	1.45	65	10/Dec/2022	26.05214792	79.61092652
NH27	1523550	1523450	D	R1	1.02	1.04	1.03	66	10/Dec/2022	26.05163133	79.61010886
NH27	1523450	1523350	D	R1	1.93	1.28	1.61	66	10/Dec/2022	26.05111568	79.60929043
NH27	1523350	1523250	D	R1	1.48	1.27	1.38	65	10/Dec/2022	26.05059941	79.60847225
NH27	1523250	1523150	D	R1	1.17	1.07	1.12	65	10/Dec/2022	26.05008046	79.60765642
NH27	1523150	1523050	D	R1	1.72	1.12	1.42	65	10/Dec/2022	26.0495638	79.60683917
NH27	1523050	1522950	D	R1	1.07	1.03	1.05	66	10/Dec/2022	26.04904562	79.60602298
NH27	1522950	1522850	D	R1	1.39	1.38	1.39	66	10/Dec/2022	26.04852856	79.60520585
NH27	1522850	1522750	D	R1	1.62	1.47	1.55	66	10/Dec/2022	26.04802294	79.60437972
NH27	1522750	1522650	D	R1	2.05	1.89	1.97	66	10/Dec/2022	26.04754309	79.60353499
NH27	1522650	1522550	D	R1	2.38	2.63	2.51	62	10/Dec/2022	26.0470616	79.60269034
NH27	1522550	1522450	D	R1	3.4	2.24	2.82	52	10/Dec/2022	26.04658536	79.60184088
NH27	1522450	1522350	D	R1	1.49	1.55	1.52	9	10/Dec/2022	26.04608988	79.60100417
NH27	1522350	1522250	D	R1	1.43	1.08	1.26	38	10/Dec/2022	26.04563454	79.60014718
NH27	1522250	1522150	D	R1	1.75	1.71	1.73	53	10/Dec/2022	26.04517146	79.59929443
NH27	1522150	1522050	D	R1	1.47	1.6	1.54	48	10/Dec/2022	26.04469453	79.59844675
NH27	1522050	1521950	D	R1	1.13	1.17	1.15	49	10/Dec/2022	26.04421294	79.59759148
NH27	1521950	1521850	D	R1	1.81	1.47	1.64	52	10/Dec/2022	26.04375638	79.59673182
NH27	1521850	1521750	D	R1	1.59	1.29	1.44	55	10/Dec/2022	26.0433272	79.59585521
NH27	1521750	1521650	D	R1	1.12	1.15	1.14	61	10/Dec/2022	26.04292887	79.59496206
NH27	1521650	1521550	D	R1	1.27	1.1	1.19	62	10/Dec/2022	26.04255892	79.59405243
NH27	1521550	1521450	D	R1	1.88	1.85	1.87	60	10/Dec/2022	26.04221067	79.59313164
NH27	1521450	1521350	D	R1	1.52	1.57	1.55	60	10/Dec/2022	26.04186154	79.59221205
NH27	1521350	1521250	D	R1	1.48	1.3	1.39	62	10/Dec/2022	26.04151399	79.59129246
NH27	1521250	1521150	D	R1	1.34	1.27	1.31	64	10/Dec/2022	26.04116401	79.5903732
NH27	1521150	1521050	D	R1	1.1	1.09	1.1	65	10/Dec/2022	26.04081913	79.58945134
NH27	1521050	1520950	D	R1	1.4	1.17	1.29	65	10/Dec/2022	26.04046839	79.58853196
NH27	1520950	1520850	D	R1	1.55	1.7	1.63	65	10/Dec/2022	26.04011882	79.58761231
NH27	1520850	1520750	D	R1	1.33	1.37	1.35	65	10/Dec/2022	26.0397719	79.58669108
NH27	1520750	1520650	D	R1	1.34	1.65	1.5	61	10/Dec/2022	26.03942804	79.58576769
NH27	1520650	1520550	D	R1	1.01	1.07	1.04	66	10/Dec/2022	26.03909041	79.58484423
NH27	1520550	1520450	D	R1	1.61	1.57	1.59	69	10/Dec/2022	26.0387326	79.58392931
NH27	1520450	1520350	D	R1	1.63	1.49	1.56	69	10/Dec/2022	26.03837957	79.58301132
NH27	1520350	1520250	D	R1	1.99	1.86	1.93	69	10/Dec/2022	26.03803235	79.58208987
NH27	1520250	1520150	D	R1	1.33	1.25	1.29	65	10/Dec/2022	26.03769865	79.58116193
NH27	1520150	1520050	D	R1	2.14	2.25	2.2	60	10/Dec/2022	26.03736196	79.58023496
NH27	1520050	1519950	D	R1	3.28	3.25	3.27	56	10/Dec/2022	26.03700855	79.57931606
NH27	1519950	1519850	D	R1	3.28	3.22	3.25	22	10/Dec/2022	26.03664378	79.57840042
NH27	1519850	1519750	D	R1	3.15	3.07	3.11	32	10/Dec/2022	26.03633378	79.5774659
NH27	1519750	1519650	D	R1	1.74	1.53	1.64	46	10/Dec/2022	26.0360188	79.57653422

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1519650	1519550	D	R1	1.25	1.24	1.25	57	10/Dec/2022	26.03569281	79.57560678
NH27	1519550	1519450	D	R1	1.36	1.18	1.27	64	10/Dec/2022	26.0353581	79.57468295
NH27	1519450	1519350	D	R1	1.42	1.38	1.4	66	10/Dec/2022	26.03502404	79.57375673
NH27	1519350	1519250	D	R1	1.58	1.34	1.46	69	10/Dec/2022	26.03468841	79.57283175
NH27	1519250	1519150	D	R1	1.38	1.04	1.21	71	10/Dec/2022	26.03435464	79.57190555
NH27	1519150	1519050	D	R1	1.38	1.07	1.23	72	10/Dec/2022	26.03402192	79.57097893
NH27	1519050	1518950	D	R1	1.38	1.19	1.29	73	10/Dec/2022	26.03368538	79.57005351
NH27	1518950	1518850	D	R1	1.76	1.66	1.71	73	10/Dec/2022	26.0333523	79.56912638
NH27	1518850	1518750	D	R1	1.44	1.52	1.48	72	10/Dec/2022	26.03301741	79.56820001
NH27	1518750	1518650	D	R1	1.18	1.18	1.18	72	10/Dec/2022	26.03268209	79.56727346
NH27	1518650	1518550	D	R1	1.46	1.41	1.44	71	10/Dec/2022	26.0323496	79.5663458
NH27	1518550	1518450	D	R1	2.11	1.67	1.89	71	10/Dec/2022	26.03201452	79.56541934
NH27	1518450	1518350	D	R1	1.93	1.85	1.89	71	10/Dec/2022	26.03167332	79.56449592
NH27	1518350	1518250	D	R1	1.3	1.34	1.32	71	10/Dec/2022	26.03133536	79.56357062
NH27	1518250	1518150	D	R1	1.61	1.27	1.44	73	10/Dec/2022	26.03099433	79.56264687
NH27	1518150	1518050	D	R1	1.65	1.29	1.47	75	10/Dec/2022	26.03065137	79.56172393
NH27	1518050	1517950	D	R1	1.84	2.01	1.93	75	10/Dec/2022	26.03030982	79.56079973
NH27	1517950	1517850	D	R1	1.85	1.31	1.58	73	10/Dec/2022	26.02996724	79.55987611
NH27	1517850	1517750	D	R1	2.57	2.35	2.46	69	10/Dec/2022	26.02962139	79.5589531
NH27	1517750	1517650	D	R1	2.51	2.24	2.38	64	10/Dec/2022	26.0292947	79.55802175
NH27	1517650	1517550	D	R1	2.02	2.44	2.23	64	10/Dec/2022	26.02897097	79.5570909
NH27	1517550	1517450	D	R1	2.15	2.33	2.24	54	10/Dec/2022	26.02865223	79.55615603
NH27	1517450	1517350	D	R1	2.66	2.02	2.34	51	10/Dec/2022	26.02833128	79.55522341
NH27	1517350	1517250	D	R1	1.4	1.56	1.48	60	10/Dec/2022	26.02798628	79.55430492
NH27	1517250	1517150	D	R1	1.3	1.37	1.34	63	10/Dec/2022	26.02766214	79.55337633
NH27	1517150	1517050	D	R1	1.81	1.65	1.73	65	10/Dec/2022	26.02730432	79.55246257
NH27	1517050	1516950	D	R1	1.09	1.48	1.29	65	10/Dec/2022	26.02696357	79.5515403
NH27	1516950	1516850	D	R1	1.29	1.25	1.27	69	10/Dec/2022	26.0266206	79.55061892
NH27	1516850	1516750	D	R1	1.17	1.2	1.19	71	10/Dec/2022	26.02627844	79.54969623
NH27	1516750	1516650	D	R1	1.59	1.28	1.44	71	10/Dec/2022	26.02593714	79.54877268
NH27	1516650	1516550	D	R1	1.41	1.39	1.4	70	10/Dec/2022	26.02559438	79.54784973
NH27	1516550	1516450	D	R1	1.95	2.04	2	70	10/Dec/2022	26.02525284	79.54692612
NH27	1516450	1516350	D	R1	1.7	1.76	1.73	69	10/Dec/2022	26.02491245	79.54600212
NH27	1516350	1516250	D	R1	1.7	1.43	1.57	68	10/Dec/2022	26.02457765	79.54507553
NH27	1516250	1516150	D	R1	1.1	1.03	1.07	67	10/Dec/2022	26.02424006	79.54415024
NH27	1516150	1516050	D	R1	1.16	1.13	1.15	67	10/Dec/2022	26.02390226	79.54322557
NH27	1516050	1515950	D	R1	1.2	1.2	1.2	63	10/Dec/2022	26.0235674	79.54229777
NH27	1515950	1515850	D	R1	1.96	2.02	1.99	57	10/Dec/2022	26.02323558	79.54136833
NH27	1515850	1515750	D	R1	1.57	1.82	1.7	48	10/Dec/2022	26.02290099	79.54043977
NH27	1515750	1515713	D	R1	2.9	2.78	2.84	28	10/Dec/2022	26.02256563	79.53951195

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1578530	1578450	D	R2	1.51	1.35	1.43	10	10/Dec/2022	26.37877324	79.998663
NH27	1578450	1578350	D	R2	1.48	1.27	1.38	29	10/Dec/2022	26.37833486	79.99803618
NH27	1578350	1578250	D	R2	1.22	1.05	1.14	38	10/Dec/2022	26.37765301	79.99738546
NH27	1578250	1578150	D	R2	1.16	1.15	1.16	25	10/Dec/2022	26.37692844	79.99679256
NH27	1578150	1578050	D	R2	1.64	1.78	1.71	12	10/Dec/2022	26.37614501	79.99629916
NH27	1578050	1577950	D	R2	1.61	1.49	1.55	34	10/Dec/2022	26.37531095	79.99579345
NH27	1577950	1577850	D	R2	1.1	1.14	1.12	43	10/Dec/2022	26.37451901	79.99532089
NH27	1577850	1577750	D	R2	1.35	1.46	1.41	44	10/Dec/2022	26.37373104	79.99483785
NH27	1577750	1577650	D	R2	1.35	1.08	1	51	10/Dec/2022	26.3729523	79.99433807
NH27	1577650	1577550	D	R2	1.24	1.25	1.25	55	10/Dec/2022	26.37216286	79.99385851
NH27	1577550	1577450	D	R2	1.02	1.27	1.15	53	10/Dec/2022	26.37137105	79.99338181
NH27	1577450	1577350	D	R2	1.26	1.37	1.32	55	10/Dec/2022	26.37058042	79.99290384
NH27	1577350	1577250	D	R2	1.01	1.21	1.11	55	10/Dec/2022	26.36978929	79.99242616
NH27	1577250	1577150	D	R2	1.1	1.27	1.18	54	10/Dec/2022	26.36899782	79.9919493
NH27	1577150	1577050	D	R2	1.08	1.06	1.07	54	10/Dec/2022	26.36820427	79.99147639
NH27	1577050	1576950	D	R2	1.67	1.92	1.8	51	10/Dec/2022	26.36740938	79.99100456
NH27	1576950	1576850	D	R2	1.28	1.43	1.36	53	10/Dec/2022	26.36659942	79.99056991
NH27	1576850	1576750	D	R2	1.18	1.46	1.32	56	10/Dec/2022	26.3658048	79.9901008
NH27	1576750	1576650	D	R2	0.99	1.12	1.06	57	10/Dec/2022	26.36501396	79.98962324
NH27	1576650	1576550	D	R2	1.24	1.25	1.25	58	10/Dec/2022	26.36422164	79.98914776
NH27	1576550	1576450	D	R2	1.25	1.36	1.15	58	10/Dec/2022	26.36342975	79.98867169
NH27	1576450	1576350	D	R2	1.09	1.4	1.25	59	10/Dec/2022	26.36263854	79.98819422
NH27	1576350	1576250	D	R2	1.45	2.27	1.86	56	10/Dec/2022	26.36184735	79.98771457
NH27	1576250	1576150	D	R2	1.27	2.28	1.78	54	10/Dec/2022	26.3610555	79.98723801
NH27	1576150	1576050	D	R2	1.58	2.08	1.83	53	10/Dec/2022	26.36026238	79.98676392
NH27	1576050	1575950	D	R2	2.04	2.42	2.23	47	10/Dec/2022	26.35946841	79.98628977
NH27	1575950	1575850	D	R2	1.36	1.68	1.52	48	10/Dec/2022	26.35867859	79.98581047
NH27	1575850	1575750	D	R2	1.42	1.84	1.63	59	10/Dec/2022	26.35788554	79.98534136
NH27	1575750	1575650	D	R2	1.82	2.62	2.22	65	10/Dec/2022	26.35709788	79.98485991
NH27	1575650	1575550	D	R2	1.11	1.71	1.41	66	10/Dec/2022	26.35632788	79.98434162
NH27	1575550	1575450	D	R2	2.31	2.86	2.59	69	10/Dec/2022	26.35560758	79.98374255
NH27	1575450	1575350	D	R2	1.41	1.82	1.62	69	10/Dec/2022	26.3549349	79.9830784
NH27	1575350	1575250	D	R2	1.36	1.68	1.52	70	10/Dec/2022	26.35431435	79.98235414
NH27	1575250	1575150	D	R2	1.58	2.36	1.97	69	10/Dec/2022	26.35370882	79.98161392
NH27	1575150	1575050	D	R2	1	1.87	1.44	66	10/Dec/2022	26.35310535	79.98087058
NH27	1575050	1574950	D	R2	1.51	2.14	1.83	29	10/Dec/2022	26.35250783	79.98011811
NH27	1574950	1574850	D	R2	1.28	1.65	1.46	40	10/Dec/2022	26.35188972	79.97939646
NH27	1574850	1574750	D	R2	2.81	3.44	3.13	43	10/Dec/2022	26.35128466	79.97865551
NH27	1574750	1574650	D	R2	1.65	2.01	1.83	45	10/Dec/2022	26.35067729	79.97791932

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1574650	1574550	D	R2	1.48	1.98	1.73	54	10/Dec/2022	26.35007121	79.97718192
NH27	1574550	1574450	D	R2	1.28	2.36	1.82	56	10/Dec/2022	26.34946359	79.97644445
NH27	1574450	1574350	D	R2	1.68	2.67	2.18	51	10/Dec/2022	26.34886005	79.97570111
NH27	1574350	1574250	D	R2	1.34	1.59	1.47	53	10/Dec/2022	26.34825192	79.97496529
NH27	1574250	1574150	D	R2	1.06	1.4	1.23	59	10/Dec/2022	26.34763894	79.97423456
NH27	1574150	1574050	D	R2	1.11	1.41	1.26	60	10/Dec/2022	26.34703371	79.97349433
NH27	1574050	1573950	D	R2	1.77	2.02	1.9	61	10/Dec/2022	26.34641653	79.97276658
NH27	1573950	1573850	D	R2	1.42	1.87	1.65	60	10/Dec/2022	26.34579465	79.97204413
NH27	1573850	1573750	D	R2	1.56	3.09	2.32	56	10/Dec/2022	26.34518305	79.97131114
NH27	1573750	1573650	D	R2	2.46	2.35	3.37	54	10/Dec/2022	26.34457895	79.97057104
NH27	1573650	1573550	D	R2	3.01	2.11	4.1	55	10/Dec/2022	26.34397361	79.96983192
NH27	1573550	1573450	D	R2	1.48	2.1	1.79	60	10/Dec/2022	26.34336448	79.96909567
NH27	1573450	1573350	D	R2	2.5	2.54	2.52	66	10/Dec/2022	26.34275942	79.96835542
NH27	1573350	1573250	D	R2	1.97	2.22	2.1	67	10/Dec/2022	26.34214943	79.96761893
NH27	1573250	1573150	D	R2	1.6	2	1.8	66	10/Dec/2022	26.34153503	79.96688716
NH27	1573150	1573050	D	R2	1.52	1.66	1.59	64	10/Dec/2022	26.34092655	79.96614913
NH27	1573050	1572950	D	R2	2.09	2.07	2.08	59	10/Dec/2022	26.3403204	79.96540774
NH27	1572950	1572850	D	R2	1.62	2.18	1.9	42	10/Dec/2022	26.33971606	79.96466377
NH27	1572850	1572750	D	R2	2.16	2.56	2.36	42	10/Dec/2022	26.33907416	79.96396732
NH27	1572750	1572650	D	R2	1.5	2.25	1.88	49	10/Dec/2022	26.33833017	79.96340718
NH27	1572650	1572550	D	R2	1.86	3.36	2.61	55	10/Dec/2022	26.33755745	79.96289571
NH27	1572550	1572450	D	R2	1.48	2.52	2	59	10/Dec/2022	26.33681188	79.96233565
NH27	1572450	1572350	D	R2	1.55	2.01	1.78	60	10/Dec/2022	26.33607397	79.96176269
NH27	1572350	1572250	D	R2	1.01	1.46	1.24	59	10/Dec/2022	26.33533552	79.9611902
NH27	1572250	1572150	D	R2	2.38	3.22	2.8	58	10/Dec/2022	26.33459111	79.96062679
NH27	1572150	1572050	D	R2	1.81	2.47	2.14	56	10/Dec/2022	26.33383652	79.96008014
NH27	1572050	1571950	D	R2	1.5	1.39	1.45	54	10/Dec/2022	26.33309711	79.95950815
NH27	1571950	1571850	D	R2	1.35	1.28	1.32	55	10/Dec/2022	26.33236728	79.95892223
NH27	1571850	1571750	D	R2	1.84	1.93	1.89	56	10/Dec/2022	26.33165744	79.95830807
NH27	1571750	1571650	D	R2	2.11	2.49	2.3	54	10/Dec/2022	26.33095246	79.9576867
NH27	1571650	1571550	D	R2	1.84	2.24	2.04	54	10/Dec/2022	26.33024451	79.95706829
NH27	1571550	1571450	D	R2	1.35	1.98	1.67	54	10/Dec/2022	26.32953783	79.95644723
NH27	1571450	1571350	D	R2	1.71	2.05	1.88	56	10/Dec/2022	26.32883108	79.95582736
NH27	1571350	1571250	D	R2	1.54	1.89	1.71	55	10/Dec/2022	26.32812727	79.95520276
NH27	1571250	1571150	D	R2	1.5	1.42	1.46	55	10/Dec/2022	26.32744256	79.95455312
NH27	1571150	1571050	D	R2	1.43	1.53	1.48	56	10/Dec/2022	26.32673539	79.95393441
NH27	1571050	1570950	D	R2	1.03	1.22	1.13	56	10/Dec/2022	26.32602605	79.95331824
NH27	1570950	1570850	D	R2	1.31	1.1	1.2	57	10/Dec/2022	26.32532787	79.95268684
NH27	1570850	1570750	D	R2	1.46	1.74	1.6	58	10/Dec/2022	26.32468406	79.95198767
NH27	1570750	1570650	D	R2	1.4	1.53	1.46	59	10/Dec/2022	26.32407507	79.95125111

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1570650	1570550	D	R2	1.61	2.23	1.92	57	10/Dec/2022	26.32346541	79.95051508
NH27	1570550	1570450	D	R2	1.18	1.89	1.54	56	10/Dec/2022	26.3229064	79.94973115
NH27	1570450	1570350	D	R2	2.07	2.72	2.4	55	10/Dec/2022	26.32243245	79.94888129
NH27	1570350	1570250	D	R2	2.14	2.14	2.14	55	10/Dec/2022	26.32203064	79.9479866
NH27	1570250	1570150	D	R2	1.77	1.68	1.72	55	10/Dec/2022	26.32165441	79.94707871
NH27	1570150	1570050	D	R2	1.68	1.83	1.76	57	10/Dec/2022	26.3212752	79.94617229
NH27	1570050	1569950	D	R2	1.29	1.63	1.46	58	10/Dec/2022	26.32087252	79.94527854
NH27	1569950	1569850	D	R2	1.51	1.44	1.48	58	10/Dec/2022	26.32042818	79.94440905
NH27	1569850	1569750	D	R2	1.57	2.05	1.81	57	10/Dec/2022	26.3199295	79.94357707
NH27	1569750	1569650	D	R2	1.42	1.82	1.62	57	10/Dec/2022	26.31939775	79.94276968
NH27	1569650	1569550	D	R2	1.37	2.05	1.71	54	10/Dec/2022	26.31886571	79.94196192
NH27	1569550	1569450	D	R2	1.86	3.03	2.45	55	10/Dec/2022	26.31833379	79.94115537
NH27	1569450	1569350	D	R2	1.29	1.51	1.4	53	10/Dec/2022	26.31785733	79.94030679
NH27	1569350	1569250	D	R2	1.32	1.77	1.55	55	10/Dec/2022	26.31745003	79.93941551
NH27	1569250	1569150	D	R2	1.02	1.32	1.17	54	10/Dec/2022	26.3170764	79.93850524
NH27	1569150	1569050	D	R2	1.58	1.49	1.54	57	10/Dec/2022	26.31670946	79.93759303
NH27	1569050	1568950	D	R2	1.19	1.2	1.2	60	10/Dec/2022	26.3163399	79.93668144
NH27	1568950	1568850	D	R2	1.29	1.13	1.21	60	10/Dec/2022	26.31595384	79.93577882
NH27	1568850	1568750	D	R2	1.57	1.78	1.68	59	10/Dec/2022	26.3155033	79.93491246
NH27	1568750	1568650	D	R2	1.02	1.34	1.18	59	10/Dec/2022	26.31504764	79.93404879
NH27	1568650	1568550	D	R2	1.44	1.93	1.69	60	10/Dec/2022	26.3145899	79.93318661
NH27	1568550	1568450	D	R2	1.11	1.48	1.3	57	10/Dec/2022	26.31413596	79.93232215
NH27	1568450	1568350	D	R2	1.22	1.68	1.45	60	10/Dec/2022	26.31368734	79.93142827
NH27	1568350	1568250	D	R2	1.06	1.3	1.18	57	10/Dec/2022	26.31320154	79.93059021
NH27	1568250	1568150	D	R2	1.07	1.31	1.19	45	10/Dec/2022	26.31261111	79.92983984
NH27	1568150	1568050	D	R2	1.39	1.73	1.56	50	10/Dec/2022	26.3119458	79.92916699
NH27	1568050	1567950	D	R2	1.39	1.74	1.57	55	10/Dec/2022	26.31127936	79.92849469
NH27	1567950	1567850	D	R2	1.34	1.44	1.39	56	10/Dec/2022	26.31061269	79.92782216
NH27	1567850	1567750	D	R2	1.23	1.33	1.28	56	10/Dec/2022	26.30994535	79.9271511
NH27	1567750	1567650	D	R2	1.19	1.44	1.32	56	10/Dec/2022	26.30927587	79.92648197
NH27	1567650	1567550	D	R2	1.24	1.61	1.43	56	10/Dec/2022	26.30860557	79.92581453
NH27	1567550	1567450	D	R2	1.97	1.83	1.9	55	10/Dec/2022	26.30794023	79.92514062
NH27	1567450	1567350	D	R2	2.64	1.49	2.07	56	10/Dec/2022	26.30727354	79.9244677
NH27	1567350	1567250	D	R2	2.06	1.94	2	58	10/Dec/2022	26.30658231	79.92383063
NH27	1567250	1567150	D	R2	1.96	2.89	2.43	58	10/Dec/2022	26.30577477	79.92339551
NH27	1567150	1567050	D	R2	2	2.82	2.41	54	10/Dec/2022	26.30491234	79.92310837
NH27	1567050	1566950	D	R2	1.5	1.97	1.74	53	10/Dec/2022	26.30410763	79.92266726
NH27	1566950	1566850	D	R2	2.07	2.35	2.21	51	10/Dec/2022	26.30342936	79.92201153
NH27	1566850	1566750	D	R2	1.53	2.04	1.79	53	10/Dec/2022	26.30291189	79.92119486
NH27	1566750	1566650	D	R2	1.56	1.95	1.76	54	10/Dec/2022	26.30243949	79.920345

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1566650	1566550	D	R2	1.17	1.45	1.31	53	10/Dec/2022	26.30195477	79.91950363
NH27	1566550	1566450	D	R2	3.53	3.95	3.74	54	10/Dec/2022	26.301396	79.9187223
NH27	1566450	1566350	D	R2	1.46	1.7	1.58	53	10/Dec/2022	26.3007862	79.91798841
NH27	1566350	1566250	D	R2	2.22	2.45	2.34	54	10/Dec/2022	26.30015922	79.91727098
NH27	1566250	1566150	D	R2	1.49	2.13	1.81	53	10/Dec/2022	26.29955743	79.91652946
NH27	1566150	1566050	D	R2	1.56	2.05	1.81	49	10/Dec/2022	26.29892397	79.91582144
NH27	1566050	1565950	D	R2	1.42	1.66	1.54	51	10/Dec/2022	26.2982931	79.91510957
NH27	1565950	1565850	D	R2	1.31	1.42	1.37	58	10/Dec/2022	26.29766167	79.91439626
NH27	1565850	1565750	D	R2	1.17	1.72	1.45	61	10/Dec/2022	26.2970688	79.91364378
NH27	1565750	1565650	D	R2	1.11	1.38	1.25	59	10/Dec/2022	26.29650228	79.91286719
NH27	1565650	1565550	D	R2	1.22	2.6	1.91	58	10/Dec/2022	26.29593667	79.91208996
NH27	1565550	1565450	D	R2	0.85	1.24	1.05	58	10/Dec/2022	26.29536668	79.9113164
NH27	1565450	1565350	D	R2	0.96	1.17	1.06	58	10/Dec/2022	26.29479867	79.91054111
NH27	1565350	1565250	D	R2	1.74	1.84	1.79	58	10/Dec/2022	26.29423255	79.90976473
NH27	1565250	1565150	D	R2	1.2	1.36	1.28	58	10/Dec/2022	26.29366618	79.9089876
NH27	1565150	1565050	D	R2	1.5	2.04	1.77	61	10/Dec/2022	26.29309772	79.90821324
NH27	1565050	1564950	D	R2	1.2	1.55	1.38	60	10/Dec/2022	26.29253293	79.9074353
NH27	1564950	1564850	D	R2	1.29	2.24	1.77	63	10/Dec/2022	26.29196559	79.90665949
NH27	1564850	1564750	D	R2	1.87	2.28	2.08	64	10/Dec/2022	26.29139969	79.90588232
NH27	1564750	1564650	D	R2	2.09	2.74	2.42	64	10/Dec/2022	26.29084418	79.90509558
NH27	1564650	1564550	D	R2	2.22	3.01	2.62	64	10/Dec/2022	26.29037403	79.90424382
NH27	1564550	1564450	D	R2	2.35	2.54	2.45	64	10/Dec/2022	26.28997921	79.90334455
NH27	1564450	1564350	D	R2	2.32	2.02	3.75	65	10/Dec/2022	26.289594	79.90244235
NH27	1564350	1564250	D	R2	2.14	1.98	3.95	56	10/Dec/2022	26.28921205	79.90154004
NH27	1564250	1564150	D	R2	1.55	1.93	1.74	53	10/Dec/2022	26.2888142	79.90064279
NH27	1564150	1564050	D	R2	1.46	1.79	1.63	58	10/Dec/2022	26.28835335	79.89978592
NH27	1564050	1563950	D	R2	1.89	2.45	2.17	57	10/Dec/2022	26.28782117	79.89898066
NH27	1563950	1563850	D	R2	2.3	2.89	2.6	64	10/Dec/2022	26.28723269	79.89822411
NH27	1563850	1563750	D	R2	1.81	2.6	2.21	68	10/Dec/2022	26.28663301	79.89747779
NH27	1563750	1563650	D	R2	1.67	2.09	1.88	71	10/Dec/2022	26.28603502	79.89672954
NH27	1563650	1563550	D	R2	2.12	2.7	2.41	69	10/Dec/2022	26.28543582	79.89598277
NH27	1563550	1563450	D	R2	1.93	2.05	1.99	67	10/Dec/2022	26.28481387	79.89525987
NH27	1563450	1563350	D	R2	1.4	2	1.7	65	10/Dec/2022	26.2842035	79.8945244
NH27	1563350	1563250	D	R2	1.55	1.86	1.71	65	10/Dec/2022	26.28359924	79.89378305
NH27	1563250	1563150	D	R2	1.33	1.77	1.55	65	10/Dec/2022	26.28297402	79.89306465
NH27	1563150	1563050	D	R2	1.49	1.97	1.73	64	10/Dec/2022	26.28228876	79.89241966
NH27	1563050	1562950	D	R2	1.79	2.51	2.15	66	10/Dec/2022	26.28152922	79.89188542
NH27	1562950	1562850	D	R2	1.59	2.04	1.82	68	10/Dec/2022	26.2807421	79.8913998
NH27	1562850	1562750	D	R2	1.53	1.96	1.75	69	10/Dec/2022	26.28003305	79.89078447
NH27	1562750	1562650	D	R2	1.2	1.53	1.37	68	10/Dec/2022	26.27938129	79.89009447

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1562650	1562550	D	R2	1.41	1.95	1.68	68	10/Dec/2022	26.2787305	79.88940334
NH27	1562550	1562450	D	R2	1.18	1.74	1.46	68	10/Dec/2022	26.27808002	79.888712
NH27	1562450	1562350	D	R2	1.08	1.64	1.36	68	10/Dec/2022	26.27742942	79.88802061
NH27	1562350	1562250	D	R2	1.53	2.09	1.81	68	10/Dec/2022	26.27677955	79.88732842
NH27	1562250	1562150	D	R2	1.69	2.05	1.87	68	10/Dec/2022	26.27613063	79.88663512
NH27	1562150	1562050	D	R2	1.29	1.6	1.45	68	10/Dec/2022	26.27547845	79.88594568
NH27	1562050	1561950	D	R2	1.37	1.83	1.6	69	10/Dec/2022	26.27482634	79.88525621
NH27	1561950	1561850	D	R2	1.54	2.1	1.82	69	10/Dec/2022	26.27417276	79.88456829
NH27	1561850	1561750	D	R2	1.55	1.42	1.48	69	10/Dec/2022	26.27351857	79.88388104
NH27	1561750	1561650	D	R2	2.43	3.45	2.94	69	10/Dec/2022	26.2728651	79.88319281
NH27	1561650	1561550	D	R2	1.03	1.26	1.15	69	10/Dec/2022	26.27221062	79.88250603
NH27	1561550	1561450	D	R2	1.12	1.39	1.26	69	10/Dec/2022	26.27155463	79.88182138
NH27	1561450	1561350	D	R2	1.19	1.48	1.34	69	10/Dec/2022	26.27089721	79.88113706
NH27	1561350	1561250	D	R2	1.5	2.21	1.86	70	10/Dec/2022	26.27023942	79.8804523
NH27	1561250	1561150	D	R2	1.05	1.38	1.21	69	10/Dec/2022	26.26957915	79.87977265
NH27	1561150	1561050	D	R2	2.04	2.28	2.16	64	10/Dec/2022	26.26889864	79.87911919
NH27	1561050	1560950	D	R2	1.27	1.16	1.21	65	10/Dec/2022	26.2681633	79.87854393
NH27	1560950	1560850	D	R2	1.23	1.31	1.27	66	10/Dec/2022	26.26742248	79.87797559
NH27	1560850	1560750	D	R2	1.35	1.52	1.44	70	10/Dec/2022	26.26668007	79.87740733
NH27	1560750	1560650	D	R2	1.88	2.15	2.02	71	10/Dec/2022	26.26593268	79.87684964
NH27	1560650	1560550	D	R2	1.54	2.03	1.79	67	10/Dec/2022	26.26518879	79.87628602
NH27	1560550	1560450	D	R2	1.56	2.44	2	67	10/Dec/2022	26.26444713	79.87571784
NH27	1560450	1560350	D	R2	1.51	1.94	1.73	68	10/Dec/2022	26.2637124	79.87513641
NH27	1560350	1560250	D	R2	1.44	1.49	1.47	67	10/Dec/2022	26.26295865	79.87459124
NH27	1560250	1560150	D	R2	1.31	1.44	1.38	55	10/Dec/2022	26.26221651	79.87402662
NH27	1560150	1560050	D	R2	1.31	1.57	1.44	61	10/Dec/2022	26.26147304	79.87346335
NH27	1560050	1559950	D	R2	1.35	1.67	1.51	66	10/Dec/2022	26.26073317	79.87289013
NH27	1559950	1559850	D	R2	1.37	1.95	1.66	69	10/Dec/2022	26.25998496	79.87233501
NH27	1559850	1559750	D	R2	1.19	1.51	1.35	64	10/Dec/2022	26.25924279	79.87176844
NH27	1559750	1559650	D	R2	1.45	1.68	1.57	65	10/Dec/2022	26.25849878	79.87120529
NH27	1559650	1559550	D	R2	1.41	2	1.71	65	10/Dec/2022	26.25775441	79.87064305
NH27	1559550	1559450	D	R2	1.6	1.86	1.73	66	10/Dec/2022	26.25702355	79.87005878
NH27	1559450	1559350	D	R2	2.23	2.39	2.31	67	10/Dec/2022	26.25633527	79.86941409
NH27	1559350	1559250	D	R2	2.27	2.68	2.47	68	10/Dec/2022	26.25572109	79.86868165
NH27	1559250	1559150	D	R2	1.66	2.1	1.88	68	10/Dec/2022	26.25513369	79.8679237
NH27	1559150	1559050	D	R2	2.62	2.05	2.34	65	10/Dec/2022	26.25455494	79.86715693
NH27	1559050	1558950	D	R2	1.11	1.26	1.18	66	10/Dec/2022	26.25398211	79.8663848
NH27	1558950	1558850	D	R2	1.67	1.78	1.72	65	10/Dec/2022	26.25339144	79.86563023
NH27	1558850	1558750	D	R2	1.51	1.81	1.66	64	10/Dec/2022	26.25281704	79.86485968
NH27	1558750	1558650	D	R2	1.28	1.46	1.37	65	10/Dec/2022	26.25223355	79.86409909

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1558650	1558550	D	R2	1.54	1.9	1.72	63	10/Dec/2022	26.25165051	79.86333687
NH27	1558550	1558450	D	R2	2.44	2.3	2.37	63	10/Dec/2022	26.25107113	79.86257155
NH27	1558450	1558350	D	R2	1.55	1.65	1.6	64	10/Dec/2022	26.2504908	79.86180664
NH27	1558350	1558250	D	R2	1.31	1.51	1.41	64	10/Dec/2022	26.24991062	79.86104291
NH27	1558250	1558150	D	R2	1.51	1.83	1.67	64	10/Dec/2022	26.24932587	79.86028269
NH27	1558150	1558050	D	R2	1.72	1.91	1.82	66	10/Dec/2022	26.24874524	79.85951741
NH27	1558050	1557950	D	R2	2.06	2.42	2.24	67	10/Dec/2022	26.24814778	79.85875486
NH27	1557950	1557850	D	R2	1.33	1.83	1.58	66	10/Dec/2022	26.24745243	79.85812359
NH27	1557850	1557750	D	R2	1.44	1.91	1.68	51	10/Dec/2022	26.2466972	79.85758284
NH27	1557750	1557650	D	R2	1.59	1.91	1.75	56	10/Dec/2022	26.24593676	79.85704519
NH27	1557650	1557550	D	R2	1.51	2.01	1.76	64	10/Dec/2022	26.24516537	79.85652958
NH27	1557550	1557450	D	R2	1.88	2.33	2.11	62	10/Dec/2022	26.24439755	79.85600477
NH27	1557450	1557350	D	R2	1.8	2	1.9	62	10/Dec/2022	26.24363119	79.85547898
NH27	1557350	1557250	D	R2	1.72	2.07	1.9	60	10/Dec/2022	26.24286251	79.85495759
NH27	1557250	1557150	D	R2	1.32	1.37	1.35	60	10/Dec/2022	26.2420981	79.85442946
NH27	1557150	1557050	D	R2	1.41	1.86	1.64	61	10/Dec/2022	26.24132966	79.85390732
NH27	1557050	1556950	D	R2	1.49	1.94	1.72	63	10/Dec/2022	26.24056256	79.8533824
NH27	1556950	1556850	D	R2	1.76	1.85	1.81	64	10/Dec/2022	26.23979507	79.85285853
NH27	1556850	1556750	D	R2	1.37	1.73	1.55	63	10/Dec/2022	26.23902999	79.85233099
NH27	1556750	1556650	D	R2	1.33	1.44	1.39	63	10/Dec/2022	26.23827125	79.85179152
NH27	1556650	1556550	D	R2	1.19	1.31	1.25	63	10/Dec/2022	26.23755937	79.85117969
NH27	1556550	1556450	D	R2	1.28	1.08	1.18	62	10/Dec/2022	26.23690734	79.85049034
NH27	1556450	1556350	D	R2	2.21	2.11	2.16	62	10/Dec/2022	26.23631732	79.84973412
NH27	1556350	1556250	D	R2	1.51	1.5	1.51	63	10/Dec/2022	26.23580581	79.84891002
NH27	1556250	1556150	D	R2	1.42	2.13	1.78	59	10/Dec/2022	26.23536848	79.84803997
NH27	1556150	1556050	D	R2	1.13	1.18	1.16	35	10/Dec/2022	26.23501284	79.84712445
NH27	1556050	1555950	D	R2	1.36	1.53	1.45	52	10/Dec/2022	26.23474378	79.84617174
NH27	1555950	1555850	D	R2	1.41	1.4	1.41	61	10/Dec/2022	26.2345109	79.84520402
NH27	1555850	1555750	D	R2	1.33	1.21	1.27	65	10/Dec/2022	26.23426292	79.84424572
NH27	1555750	1555650	D	R2	1.43	1.55	1.49	47	10/Dec/2022	26.23402093	79.84328405
NH27	1555650	1555550	D	R2	1.55	1.82	1.69	54	10/Dec/2022	26.23378487	79.84231979
NH27	1555550	1555450	D	R2	1.48	1.51	1.5	58	10/Dec/2022	26.23354546	79.84135573
NH27	1555450	1555350	D	R2	1.83	1.6	1.72	58	10/Dec/2022	26.23331108	79.84039122
NH27	1555350	1555250	D	R2	1.11	1.32	1.22	57	10/Dec/2022	26.2330708	79.8394288
NH27	1555250	1555150	D	R2	1.49	1.62	1.56	58	10/Dec/2022	26.23283073	79.83846683
NH27	1555150	1555050	D	R2	1.29	1.61	1.45	60	10/Dec/2022	26.23258634	79.83750606
NH27	1555050	1554950	D	R2	1.89	2.33	2.11	65	10/Dec/2022	26.23229069	79.83656453
NH27	1554950	1554850	D	R2	2.05	2.36	2.21	67	10/Dec/2022	26.23190911	79.83565887
NH27	1554850	1554750	D	R2	2.42	2.49	2.46	71	10/Dec/2022	26.23142852	79.83481583
NH27	1554750	1554650	D	R2	1.8	1.69	1.75	67	10/Dec/2022	26.2308699	79.83403417

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1554650	1554550	D	R2	2.84	3.22	3.03	65	10/Dec/2022	26.23024061	79.83332225
NH27	1554550	1554450	D	R2	1.61	1.94	1.78	66	10/Dec/2022	26.22954384	79.83269079
NH27	1554450	1554350	D	R2	1.66	1.9	1.78	68	10/Dec/2022	26.22878784	79.8321486
NH27	1554350	1554250	D	R2	1.43	1.69	1.56	71	10/Dec/2022	26.22798225	79.83170238
NH27	1554250	1554150	D	R2	2.36	2.58	2.47	73	10/Dec/2022	26.22713737	79.83135698
NH27	1554150	1554050	D	R2	2.35	2.73	2.54	72	10/Dec/2022	26.22627318	79.8310731
NH27	1554050	1553950	D	R2	1.99	2.61	2.3	70	10/Dec/2022	26.22540761	79.83079129
NH27	1553950	1553850	D	R2	1.35	1.73	1.54	69	10/Dec/2022	26.22453948	79.83052287
NH27	1553850	1553750	D	R2	1.23	1.51	1.37	67	10/Dec/2022	26.22367348	79.83024847
NH27	1553750	1553650	D	R2	1.4	1.78	1.59	62	10/Dec/2022	26.2228089	79.82996802
NH27	1553650	1553550	D	R2	1.74	2.17	1.96	66	10/Dec/2022	26.22194555	79.82968258
NH27	1553550	1553450	D	R2	1.82	2.13	1.98	67	10/Dec/2022	26.22107754	79.82941479
NH27	1553450	1553350	D	R2	1.61	2.01	1.81	69	10/Dec/2022	26.22021182	79.82913602
NH27	1553350	1553250	D	R2	1.28	1.45	1.37	70	10/Dec/2022	26.21934612	79.8288567
NH27	1553250	1553150	D	R2	1.24	1.4	1.32	68	10/Dec/2022	26.21848	79.82858264
NH27	1553150	1553050	D	R2	1.38	1.52	1.45	66	10/Dec/2022	26.21761441	79.82830617
NH27	1553050	1552950	D	R2	1.98	2.58	2.28	68	10/Dec/2022	26.21674904	79.82802814
NH27	1552950	1552850	D	R2	1.63	2.24	1.94	70	10/Dec/2022	26.21588335	79.82774972
NH27	1552850	1552750	D	R2	2.19	2.02	2.11	70	10/Dec/2022	26.21502709	79.82743789
NH27	1552750	1552650	D	R2	2.08	2.76	2.42	69	10/Dec/2022	26.21420362	79.827033
NH27	1552650	1552550	D	R2	1.47	1.86	1.67	69	10/Dec/2022	26.21340961	79.82655733
NH27	1552550	1552450	D	R2	1.81	2.25	2.03	70	10/Dec/2022	26.21266807	79.82598852
NH27	1552450	1552350	D	R2	2.19	2.72	2.46	64	10/Dec/2022	26.21200333	79.82531817
NH27	1552350	1552250	D	R2	1.73	1.89	1.81	43	10/Dec/2022	26.21142275	79.82455528
NH27	1552250	1552150	D	R2	1.3	1.58	1.44	56	10/Dec/2022	26.21086627	79.82376972
NH27	1552150	1552050	D	R2	1.44	1.53	1.49	61	10/Dec/2022	26.21033244	79.82296113
NH27	1552050	1551950	D	R2	1.54	1.94	1.74	63	10/Dec/2022	26.20978975	79.82216835
NH27	1551950	1551850	D	R2	1.53	1.78	1.66	40	10/Dec/2022	26.20921095	79.8214055
NH27	1551850	1551750	D	R2	2.24	2.14	2.19	51	10/Dec/2022	26.20865395	79.82062027
NH27	1551750	1551650	D	R2	2.18	3	2.59	61	10/Dec/2022	26.20809001	79.81984018
NH27	1551650	1551550	D	R2	1.93	2.11	2.02	62	10/Dec/2022	26.20750764	79.81907723
NH27	1551550	1551450	D	R2	1.81	2.98	2.4	60	10/Dec/2022	26.20688477	79.81835743
NH27	1551450	1551350	D	R2	2.47	2.86	2.67	48	10/Dec/2022	26.20628407	79.81761245
NH27	1551350	1551250	D	R2	2.33	2.7	2.52	56	10/Dec/2022	26.20568066	79.81686671
NH27	1551250	1551150	D	R2	1.82	2.27	2.05	56	10/Dec/2022	26.20506909	79.81614061
NH27	1551150	1551050	D	R2	2.47	3.11	2.79	30	10/Dec/2022	26.2044282	79.81544541
NH27	1551050	1550950	D	R2	1.54	2.18	1.86	37	10/Dec/2022	26.20374346	79.81480033
NH27	1550950	1550850	D	R2	2.15	3.01	2.58	53	10/Dec/2022	26.20303006	79.81419214
NH27	1550850	1550750	D	R2	3.26	2.81	3.04	58	10/Dec/2022	26.20230658	79.81359658
NH27	1550750	1550650	D	R2	2.99	3.06	3.03	61	10/Dec/2022	26.20158591	79.81299583

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1550650	1550550	D	R2	3.13	3.02	3.08	62	10/Dec/2022	26.20086444	79.81239478
NH27	1550550	1550450	D	R2	2.19	2.64	2.42	61	10/Dec/2022	26.20014357	79.81179617
NH27	1550450	1550350	D	R2	2.19	2.7	2.45	56	10/Dec/2022	26.19943569	79.81117726
NH27	1550350	1550250	D	R2	3.02	2.57	2.8	61	10/Dec/2022	26.19879111	79.81047569
NH27	1550250	1550150	D	R2	2.15	2.98	2.57	63	10/Dec/2022	26.19817434	79.80974842
NH27	1550150	1550050	D	R2	1.45	1.47	1.46	55	10/Dec/2022	26.19754	79.80904323
NH27	1550050	1549950	D	R2	1.25	1.42	1.34	19	10/Dec/2022	26.19690934	79.80833237
NH27	1549950	1549850	D	R2	1.51	1.98	1.75	36	10/Dec/2022	26.1962801	79.8076153
NH27	1549850	1549750	D	R2	1.79	2.16	1.98	44	10/Dec/2022	26.19564914	79.80690385
NH27	1549750	1549650	D	R2	1.99	2.46	2.23	28	10/Dec/2022	26.19502288	79.80618811
NH27	1549650	1549550	D	R2	1.25	1.64	1.45	36	10/Dec/2022	26.1943974	79.80546854
NH27	1549550	1549450	D	R2	1.45	1.74	1.6	47	10/Dec/2022	26.19378367	79.80473923
NH27	1549450	1549350	D	R2	1.43	1.95	1.69	39	10/Dec/2022	26.19314233	79.80403894
NH27	1549350	1549250	D	R2	1.62	1.75	1.69	43	10/Dec/2022	26.19252199	79.80331826
NH27	1549250	1549150	D	R2	1.23	1.52	1.38	47	10/Dec/2022	26.19189486	79.80260302
NH27	1549150	1549050	D	R2	1.7	2.22	1.96	59	10/Dec/2022	26.1912672	79.80188718
NH27	1549050	1548950	D	R2	1.46	1.72	1.59	66	10/Dec/2022	26.19064054	79.80116853
NH27	1548950	1548850	D	R2	1.54	1.46	1.5	69	10/Dec/2022	26.19001204	79.80045172
NH27	1548850	1548750	D	R2	1.32	1.32	1.32	68	10/Dec/2022	26.18938612	79.79973206
NH27	1548750	1548650	D	R2	1.97	2.15	2.06	68	10/Dec/2022	26.18875662	79.79901634
NH27	1548650	1548550	D	R2	1.38	1.61	1.5	66	10/Dec/2022	26.18812958	79.79829637
NH27	1548550	1548450	D	R2	1.42	1.49	1.46	65	10/Dec/2022	26.18750092	79.79757909
NH27	1548450	1548350	D	R2	1.25	1.3	1.28	59	10/Dec/2022	26.18687358	79.79686242
NH27	1548350	1548250	D	R2	1.65	1.5	1.58	54	10/Dec/2022	26.18622012	79.79617536
NH27	1548250	1548150	D	R2	1.73	2.36	2.05	56	10/Dec/2022	26.18552697	79.79553613
NH27	1548150	1548050	D	R2	2.15	2.41	2.28	57	10/Dec/2022	26.18479599	79.79495152
NH27	1548050	1547950	D	R2	2.06	2.44	2.25	45	10/Dec/2022	26.18405495	79.79438895
NH27	1547950	1547850	D	R2	1.81	1.84	1.83	37	10/Dec/2022	26.1833181	79.79381667
NH27	1547850	1547750	D	R2	1.71	1.72	1.72	56	10/Dec/2022	26.18258009	79.79324465
NH27	1547750	1547650	D	R2	1.93	2.14	2.04	64	10/Dec/2022	26.18184403	79.79266768
NH27	1547650	1547550	D	R2	1.38	1.7	1.54	67	10/Dec/2022	26.18110747	79.79209224
NH27	1547550	1547450	D	R2	1.25	1.36	1.31	68	10/Dec/2022	26.18036844	79.79152017
NH27	1547450	1547350	D	R2	1.05	1.4	1.23	68	10/Dec/2022	26.17963199	79.79094425
NH27	1547350	1547250	D	R2	1.4	1.63	1.52	67	10/Dec/2022	26.1788984	79.79036358
NH27	1547250	1547150	D	R2	2.04	2.01	2.03	67	10/Dec/2022	26.17816059	79.78978995
NH27	1547150	1547050	D	R2	2.25	2.11	2.18	65	10/Dec/2022	26.17742087	79.78921427
NH27	1547050	1546950	D	R2	1.4	1.56	1.48	65	10/Dec/2022	26.17668153	79.78864524
NH27	1546950	1546850	D	R2	1.81	1.86	1.84	43	10/Dec/2022	26.17594186	79.78807918
NH27	1546850	1546750	D	R2	1.22	1.44	1.33	47	10/Dec/2022	26.17520247	79.78750923
NH27	1546750	1546650	D	R2	1.67	1.68	1.68	59	10/Dec/2022	26.17445867	79.78693033

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1546650	1546550	D	R2	1.6	1.73	1.67	62	10/Dec/2022	26.17372209	79.7863558
NH27	1546550	1546450	D	R2	1.16	1.44	1.3	67	10/Dec/2022	26.17298403	79.78578294
NH27	1546450	1546350	D	R2	1.48	1.71	1.6	70	10/Dec/2022	26.17224612	79.78520906
NH27	1546350	1546250	D	R2	1.14	1.48	1.31	71	10/Dec/2022	26.17150878	79.78463399
NH27	1546250	1546150	D	R2	1.15	1.31	1.23	71	10/Dec/2022	26.17077127	79.78405886
NH27	1546150	1546050	D	R2	1.44	1.69	1.57	70	10/Dec/2022	26.17003194	79.78348656
NH27	1546050	1545950	D	R2	1.11	1.31	1.21	68	10/Dec/2022	26.16929404	79.78291151
NH27	1545950	1545850	D	R2	1.71	2.03	1.87	67	10/Dec/2022	26.16855417	79.78233839
NH27	1545850	1545750	D	R2	1.68	1.95	1.82	64	10/Dec/2022	26.16780781	79.78177608
NH27	1545750	1545650	D	R2	1.82	1.86	1.84	55	10/Dec/2022	26.16705023	79.78123346
NH27	1545650	1545550	D	R2	1.71	1.48	1.6	48	10/Dec/2022	26.16629039	79.78069579
NH27	1545550	1545450	D	R2	1.21	1.37	1.29	39	10/Dec/2022	26.16553142	79.78015703
NH27	1545450	1545350	D	R2	1.19	1.36	1.28	37	10/Dec/2022	26.16476958	79.77962487
NH27	1545350	1545250	D	R2	1.23	1.33	1.28	36	10/Dec/2022	26.16400942	79.77908878
NH27	1545250	1545150	D	R2	0.96	1.07	1.02	41	10/Dec/2022	26.16324795	79.77855231
NH27	1545150	1545050	D	R2	1.72	2.18	1.95	43	10/Dec/2022	26.16249977	79.77801924
NH27	1545050	1544950	D	R2	1.97	2.2	2.09	32	10/Dec/2022	26.16178034	79.77742366
NH27	1544950	1544850	D	R2	1.9	1.77	1.84	10	10/Dec/2022	26.16109723	79.77677573
NH27	1544850	1544750	D	R2	1.66	1.61	1.64	39	10/Dec/2022	26.16042059	79.77611747
NH27	1544750	1544650	D	R2	1.82	2.15	1.99	50	10/Dec/2022	26.15974484	79.77545433
NH27	1544650	1544550	D	R2	2.91	2.8	2.86	52	10/Dec/2022	26.1590682	79.7747956
NH27	1544550	1544450	D	R2	1.29	1.69	1.49	40	10/Dec/2022	26.15838513	79.77414902
NH27	1544450	1544350	D	R2	1.19	1.4	1.3	37	10/Dec/2022	26.15771213	79.77348549
NH27	1544350	1544250	D	R2	2.2	2.29	2.25	52	10/Dec/2022	26.15704563	79.7728147
NH27	1544250	1544150	D	R2	1.12	1.16	1.14	55	10/Dec/2022	26.15635847	79.77216993
NH27	1544150	1544050	D	R2	1.29	1.52	1.41	54	10/Dec/2022	26.15568805	79.77149994
NH27	1544050	1543950	D	R2	1.3	1.52	1.41	58	10/Dec/2022	26.1549982	79.77085943
NH27	1543950	1543850	D	R2	1.39	1.72	1.56	51	10/Dec/2022	26.15432131	79.77020091
NH27	1543850	1543750	D	R2	1.23	1.25	1.24	58	10/Dec/2022	26.15364468	79.76954204
NH27	1543750	1543650	D	R2	1.75	1.94	1.85	63	10/Dec/2022	26.15296735	79.76888148
NH27	1543650	1543550	D	R2	1.79	1.79	1.79	65	10/Dec/2022	26.15228875	79.76822271
NH27	1543550	1543450	D	R2	2.5	2.38	2.44	61	10/Dec/2022	26.15160944	79.76756834
NH27	1543450	1543350	D	R2	2.57	3.29	2.93	52	10/Dec/2022	26.15093137	79.76691207
NH27	1543350	1543250	D	R2	2.42	3.2	2.81	58	10/Dec/2022	26.15025306	79.7662556
NH27	1543250	1543150	D	R2	1.62	1.45	1.54	63	10/Dec/2022	26.14957544	79.76559658
NH27	1543150	1543050	D	R2	1.24	1.22	1.23	67	10/Dec/2022	26.14889413	79.76494213
NH27	1543050	1542950	D	R2	1.33	1.17	1.25	69	10/Dec/2022	26.14821852	79.76428162
NH27	1542950	1542850	D	R2	1.35	1.99	1.67	69	10/Dec/2022	26.14753806	79.76362535
NH27	1542850	1542750	D	R2	2.63	2.21	2.42	69	10/Dec/2022	26.14686445	79.76296066
NH27	1542750	1542650	D	R2	1.93	1.94	1.94	64	10/Dec/2022	26.14614552	79.76236223

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1542650	1542550	D	R2	1.65	1.93	1.79	59	10/Dec/2022	26.14537842	79.76184041
NH27	1542550	1542450	D	R2	1.08	1.55	1.32	63	10/Dec/2022	26.14457552	79.76138701
NH27	1542450	1542350	D	R2	1.4	1.5	1.45	65	10/Dec/2022	26.1437691	79.76093744
NH27	1542350	1542250	D	R2	1.71	1.39	1.55	63	10/Dec/2022	26.14296545	79.7604889
NH27	1542250	1542150	D	R2	1.69	1.58	1.64	54	10/Dec/2022	26.14215234	79.76005891
NH27	1542150	1542050	D	R2	1.84	1.84	1.84	57	10/Dec/2022	26.14134393	79.75961667
NH27	1542050	1541950	D	R2	1.89	1.75	1.82	60	10/Dec/2022	26.14053606	79.75917265
NH27	1541950	1541850	D	R2	1.21	1.49	1.35	54	10/Dec/2022	26.13973029	79.75872768
NH27	1541850	1541750	D	R2	1.66	1.31	1.49	50	10/Dec/2022	26.13891807	79.75829771
NH27	1541750	1541650	D	R2	1.29	1.79	1.54	53	10/Dec/2022	26.13811808	79.75784133
NH27	1541650	1541550	D	R2	1.48	1.34	1.41	56	10/Dec/2022	26.13730418	79.75741723
NH27	1541550	1541450	D	R2	1.75	1.74	1.75	55	10/Dec/2022	26.13649757	79.75697494
NH27	1541450	1541350	D	R2	3.16	3.5	3.33	60	10/Dec/2022	26.13568946	79.75653336
NH27	1541350	1541250	D	R2	3.73	4.26	4	62	10/Dec/2022	26.13487959	79.75609052
NH27	1541250	1541150	D	R2	2.76	3.83	3.3	63	10/Dec/2022	26.13407335	79.75564815
NH27	1541150	1541050	D	R2	4.09	5.81	4.95	49	10/Dec/2022	26.13326627	79.75520612
NH27	1541050	1540950	D	R2	5.58	5.86	5.72	55	10/Dec/2022	26.13245773	79.75476634
NH27	1540950	1540850	D	R2	6.54	6.74	6.64	59	10/Dec/2022	26.13164881	79.75432506
NH27	1540850	1540750	D	R2	4.46	7.13	5.8	60	10/Dec/2022	26.130842	79.75388093
NH27	1540750	1540650	D	R2	4.14	4.5	4.32	57	10/Dec/2022	26.13003593	79.75343233
NH27	1540650	1540550	D	R2	3.23	3.34	3.29	57	10/Dec/2022	26.12922495	79.75300106
NH27	1540550	1540450	D	R2	3.38	3.47	3.43	49	10/Dec/2022	26.12841513	79.75256062
NH27	1540450	1540350	D	R2	1.72	2.08	1.9	55	10/Dec/2022	26.12760865	79.75211991
NH27	1540350	1540250	D	R2	3.04	3.56	3.3	45	10/Dec/2022	26.12680086	79.7516785
NH27	1540250	1540150	D	R2	3.32	3.1	3.21	55	10/Dec/2022	26.12603258	79.75116109
NH27	1540150	1540050	D	R2	3.15	3.11	3.13	56	10/Dec/2022	26.12528678	79.75060416
NH27	1540050	1539950	D	R2	3.1	3.02	3.06	48	10/Dec/2022	26.12447523	79.75018147
NH27	1539950	1539850	D	R2	2.23	2.13	2.18	12	10/Dec/2022	26.12372293	79.74963784
NH27	1539850	1539750	D	R2	2.11	2.09	2.1	43	10/Dec/2022	26.12300717	79.74903523
NH27	1539750	1539650	D	R2	3.36	4.09	3.73	53	10/Dec/2022	26.12231798	79.74839477
NH27	1539650	1539550	D	R2	3.83	4.18	4.01	61	10/Dec/2022	26.12168433	79.74768352
NH27	1539550	1539450	D	R2	2.54	2.7	2.62	65	10/Dec/2022	26.12113909	79.74689021
NH27	1539450	1539350	D	R2	2.29	2.3	2.3	55	10/Dec/2022	26.12072212	79.74600397
NH27	1539350	1539250	D	R2	3.22	3.08	3.15	57	10/Dec/2022	26.1202874	79.7451316
NH27	1539250	1539150	D	R2	3.18	3.12	3.15	51	10/Dec/2022	26.1198597	79.74425183
NH27	1539150	1539050	D	R2	3.17	3.02	3.1	59	10/Dec/2022	26.11935108	79.74342983
NH27	1539050	1538950	D	R2	2.64	2.37	2.51	58	10/Dec/2022	26.11867356	79.74277989
NH27	1538950	1538850	D	R2	2.11	2.51	2.31	56	10/Dec/2022	26.11791726	79.74223762
NH27	1538850	1538750	D	R2	4.8	4.84	4.82	50	10/Dec/2022	26.1171368	79.74174478
NH27	1538750	1538650	D	R2	2.83	3.41	3.12	34	10/Dec/2022	26.11636937	79.741224

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1538650	1538550	D	R2	5.79	6.41	6.1	51	10/Dec/2022	26.11560199	79.74070234
NH27	1538550	1538450	D	R2	3.22	3.73	3.48	55	10/Dec/2022	26.11483552	79.74017848
NH27	1538450	1538350	D	R2	2.38	2.53	2.46	58	10/Dec/2022	26.11411934	79.73957521
NH27	1538350	1538250	D	R2	3.85	3.06	3.46	58	10/Dec/2022	26.11355734	79.73879775
NH27	1538250	1538150	D	R2	2.72	2.8	2.76	58	10/Dec/2022	26.11319901	79.73788426
NH27	1538150	1538050	D	R2	3.93	4.6	4.27	57	10/Dec/2022	26.11307789	79.73689809
NH27	1538050	1537950	D	R2	1.76	1.5	1.63	52	10/Dec/2022	26.11318975	79.73591019
NH27	1537950	1537850	D	R2	1.9	2.25	2.08	49	10/Dec/2022	26.11340543	79.73494208
NH27	1537850	1537750	D	R2	2.19	1.78	1.99	55	10/Dec/2022	26.11360255	79.73396928
NH27	1537750	1537650	D	R2	2.17	2.15	2.16	59	10/Dec/2022	26.11365335	79.73297636
NH27	1537650	1537550	D	R2	1.22	1.44	1.33	61	10/Dec/2022	26.11352807	79.7319902
NH27	1537550	1537450	D	R2	1.82	2.08	1.95	60	10/Dec/2022	26.11336479	79.73100935
NH27	1537450	1537350	D	R2	1.26	1.12	1.19	59	10/Dec/2022	26.11325621	79.7300195
NH27	1537350	1537250	D	R2	1.53	1.91	1.72	58	10/Dec/2022	26.1132009	79.72902409
NH27	1537250	1537150	D	R2	1.98	2.04	2.01	59	10/Dec/2022	26.11314389	79.72802804
NH27	1537150	1537050	D	R2	1.37	1.26	1.32	61	10/Dec/2022	26.11304904	79.72703594
NH27	1537050	1536950	D	R2	1.44	1.56	1.5	59	10/Dec/2022	26.11278892	79.72608369
NH27	1536950	1536850	D	R2	1.87	2.05	1.96	54	10/Dec/2022	26.11236635	79.72520615
NH27	1536850	1536750	D	R2	2.41	2.62	2.52	58	10/Dec/2022	26.11185907	79.72438185
NH27	1536750	1536650	D	R2	1.66	2.05	1.86	62	10/Dec/2022	26.11134673	79.72356088
NH27	1536650	1536550	D	R2	1.5	1.88	1.69	64	10/Dec/2022	26.11083389	79.72274
NH27	1536550	1536450	D	R2	2.07	2.27	2.17	65	10/Dec/2022	26.11032262	79.72191787
NH27	1536450	1536350	D	R2	1.14	1.47	1.31	66	10/Dec/2022	26.10981145	79.72109558
NH27	1536350	1536250	D	R2	1.4	1.43	1.42	67	10/Dec/2022	26.10929698	79.72027569
NH27	1536250	1536150	D	R2	2.13	2.12	2.13	67	10/Dec/2022	26.1087765	79.71946147
NH27	1536150	1536050	D	R2	1.31	2.13	1.72	68	10/Dec/2022	26.10822274	79.7186746
NH27	1536050	1535950	D	R2	2	2.22	2.11	66	10/Dec/2022	26.10769221	79.71786851
NH27	1535950	1535850	D	R2	1.8	1.84	1.82	64	10/Dec/2022	26.10720111	79.71703243
NH27	1535850	1535750	D	R2	1.78	2.1	1.94	63	10/Dec/2022	26.10671304	79.71619284
NH27	1535750	1535650	D	R2	1.61	1.61	1.61	64	10/Dec/2022	26.10622439	79.71535294
NH27	1535650	1535550	D	R2	1.66	2.11	1.89	65	10/Dec/2022	26.10571973	79.71452653
NH27	1535550	1535450	D	R2	2.25	2.33	2.29	63	10/Dec/2022	26.10517566	79.7137301
NH27	1535450	1535350	D	R2	1.62	2.14	1.88	64	10/Dec/2022	26.10462055	79.71294527
NH27	1535350	1535250	D	R2	1.16	1.34	1.25	62	10/Dec/2022	26.10406123	79.71216354
NH27	1535250	1535150	D	R2	1.5	1.88	1.69	62	10/Dec/2022	26.10350557	79.71137864
NH27	1535150	1535050	D	R2	1.98	2.26	2.12	62	10/Dec/2022	26.10294852	79.71059424
NH27	1535050	1534950	D	R2	1.16	1.34	1.25	63	10/Dec/2022	26.10239688	79.70980515
NH27	1534950	1534850	D	R2	1.26	1.36	1.31	64	10/Dec/2022	26.10184191	79.70901875
NH27	1534850	1534750	D	R2	1.69	2.03	1.86	64	10/Dec/2022	26.10128801	79.70823153
NH27	1534750	1534650	D	R2	1.81	2.35	2.08	64	10/Dec/2022	26.10073156	79.70744535

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1534650	1534550	D	R2	2.2	2.22	2.21	64	10/Dec/2022	26.10017998	79.70665516
NH27	1534550	1534450	D	R2	2.05	2.89	2.47	62	10/Dec/2022	26.09961567	79.70586446
NH27	1534450	1534350	D	R2	1.84	2.39	2.12	59	10/Dec/2022	26.09906825	79.70506841
NH27	1534350	1534250	D	R2	3.08	3.39	3.24	61	10/Dec/2022	26.09850647	79.70428901
NH27	1534250	1534150	D	R2	2.49	3.51	3	38	10/Dec/2022	26.09797951	79.70347895
NH27	1534150	1534050	D	R2	2.54	2.43	2.49	46	10/Dec/2022	26.09742325	79.70269512
NH27	1534050	1533950	D	R2	1.95	2.25	2.1	41	10/Dec/2022	26.09687321	79.70190738
NH27	1533950	1533850	D	R2	1.17	2.08	1.63	46	10/Dec/2022	26.09633135	79.70111186
NH27	1533850	1533750	D	R2	1.38	1.91	1.65	54	10/Dec/2022	26.09579179	79.7003132
NH27	1533750	1533650	D	R2	1.62	1.95	1.79	61	10/Dec/2022	26.0952544	79.69951305
NH27	1533650	1533550	D	R2	1.58	1.58	1.58	63	10/Dec/2022	26.09470883	79.69871869
NH27	1533550	1533450	D	R2	1.53	1.51	1.52	65	10/Dec/2022	26.09416823	79.69792023
NH27	1533450	1533350	D	R2	1.45	1.72	1.59	65	10/Dec/2022	26.09363282	79.69711756
NH27	1533350	1533250	D	R2	1.58	1.84	1.71	65	10/Dec/2022	26.09311313	79.69630208
NH27	1533250	1533150	D	R2	1.3	1.52	1.41	65	10/Dec/2022	26.09260515	79.69547755
NH27	1533150	1533050	D	R2	1.4	1.56	1.48	65	10/Dec/2022	26.09212076	79.69463559
NH27	1533050	1532950	D	R2	1.49	1.72	1.61	66	10/Dec/2022	26.09164823	79.69378554
NH27	1532950	1532850	D	R2	1.45	1.62	1.54	66	10/Dec/2022	26.0911943	79.69292291
NH27	1532850	1532750	D	R2	1.89	2.2	2.05	65	10/Dec/2022	26.09076079	79.69204773
NH27	1532750	1532650	D	R2	1.59	2.38	1.99	65	10/Dec/2022	26.09034461	79.69116222
NH27	1532650	1532550	D	R2	1	1.35	1.18	65	10/Dec/2022	26.08993722	79.69027127
NH27	1532550	1532450	D	R2	1.54	1.81	1.68	65	10/Dec/2022	26.08952689	79.68937138
NH27	1532450	1532350	D	R2	1.43	1.89	1.66	64	10/Dec/2022	26.08912101	79.68847938
NH27	1532350	1532250	D	R2	2.48	2.41	2.45	24	10/Dec/2022	26.08871513	79.68758737
NH27	1532250	1532150	D	R2	2.21	2.46	2.34	24	10/Dec/2022	26.08830925	79.68669537
NH27	1532150	1532050	D	R2	1.69	2.09	1.89	24	10/Dec/2022	26.08792402	79.6858368
NH27	1532050	1531950	D	R2	1.57	1.93	1.75	24	10/Dec/2022	26.08751879	79.68494648
NH27	1531950	1531850	D	R2	1.26	1.4	1.33	40	10/Dec/2022	26.08711367	79.68405638
NH27	1531850	1531750	D	R2	1.4	1.28	1.34	44	10/Dec/2022	26.08671167	79.68316464
NH27	1531750	1531650	D	R2	1.22	1.47	1.35	48	10/Dec/2022	26.08630792	79.68227355
NH27	1531650	1531550	D	R2	1.57	1.72	1.65	52	10/Dec/2022	26.08590305	79.68138263
NH27	1531550	1531450	D	R2	1.82	1.84	1.83	55	10/Dec/2022	26.08549737	79.68049175
NH27	1531450	1531350	D	R2	2.67	2.52	2.6	56	10/Dec/2022	26.08508964	79.67960206
NH27	1531350	1531250	D	R2	1.35	1.42	1.39	57	10/Dec/2022	26.08468438	79.67871044
NH27	1531250	1531150	D	R2	1.56	1.63	1.6	56	10/Dec/2022	26.08428118	79.67781827
NH27	1531150	1531050	D	R2	2	1.95	1.98	54	10/Dec/2022	26.08387198	79.67692923
NH27	1531050	1530950	D	R2	1.39	1.35	1.37	54	10/Dec/2022	26.0834699	79.67603611
NH27	1530950	1530850	D	R2	1.37	1.36	1.37	54	10/Dec/2022	26.08306108	79.67514697
NH27	1530850	1530750	D	R2	1.82	1.83	1.83	52	10/Dec/2022	26.08266034	79.67425386
NH27	1530750	1530650	D	R2	1.44	1.56	1.5	52	10/Dec/2022	26.08225993	79.67336005

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1530650	1530550	D	R2	1.45	1.25	1.35	52	10/Dec/2022	26.08185437	79.67247077
NH27	1530550	1530450	D	R2	1.61	1.73	1.67	52	10/Dec/2022	26.08144403	79.67158266
NH27	1530450	1530350	D	R2	1.54	1.49	1.52	52	10/Dec/2022	26.08103893	79.67069141
NH27	1530350	1530250	D	R2	2.07	2.07	2.07	53	10/Dec/2022	26.08062944	79.66980269
NH27	1530250	1530150	D	R2	1.37	1.53	1.45	53	10/Dec/2022	26.08021124	79.66891918
NH27	1530150	1530050	D	R2	1.2	1.42	1.31	52	10/Dec/2022	26.07980755	79.66802769
NH27	1530050	1529950	D	R2	1.36	1.26	1.31	53	10/Dec/2022	26.079375	79.66715306
NH27	1529950	1529850	D	R2	1.74	1.73	1.74	54	10/Dec/2022	26.07895737	79.66626903
NH27	1529850	1529750	D	R2	2.4	2.73	2.57	56	10/Dec/2022	26.07853787	79.66538633
NH27	1529750	1529650	D	R2	2.02	2.21	2.12	57	10/Dec/2022	26.07811791	79.66450366
NH27	1529650	1529550	D	R2	2.16	2.31	2.24	58	10/Dec/2022	26.07770216	79.66361868
NH27	1529550	1529450	D	R2	1.82	1.73	1.78	58	10/Dec/2022	26.07728529	79.66273404
NH27	1529450	1529350	D	R2	2.62	2.04	2.33	58	10/Dec/2022	26.07686985	79.66184869
NH27	1529350	1529250	D	R2	2.42	2.2	2.31	57	10/Dec/2022	26.07645312	79.66096418
NH27	1529250	1529150	D	R2	1.65	1.91	1.78	57	10/Dec/2022	26.07603497	79.6600811
NH27	1529150	1529050	D	R2	1.15	1.22	1.19	58	10/Dec/2022	26.07561572	79.65919855
NH27	1529050	1528950	D	R2	1.09	1.14	1.12	59	10/Dec/2022	26.0751978	79.6583149
NH27	1528950	1528850	D	R2	1.57	1.79	1.68	61	10/Dec/2022	26.07478059	79.65743038
NH27	1528850	1528750	D	R2	1.64	1.63	1.64	62	10/Dec/2022	26.07436517	79.65654536
NH27	1528750	1528650	D	R2	1.3	1.46	1.38	61	10/Dec/2022	26.07393669	79.65566759
NH27	1528650	1528550	D	R2	1.3	1.54	1.42	61	10/Dec/2022	26.07352445	79.65478071
NH27	1528550	1528450	D	R2	1.24	1.44	1.34	61	10/Dec/2022	26.07309789	79.65390188
NH27	1528450	1528350	D	R2	1.22	1.42	1.32	61	10/Dec/2022	26.07266825	79.65302497
NH27	1528350	1528250	D	R2	1.44	1.43	1.44	60	10/Dec/2022	26.07223419	79.65215107
NH27	1528250	1528150	D	R2	1.57	1.78	1.68	60	10/Dec/2022	26.07179843	79.65127757
NH27	1528150	1528050	D	R2	1.46	1.8	1.63	61	10/Dec/2022	26.07136296	79.65040394
NH27	1528050	1527950	D	R2	1.28	1.45	1.37	61	10/Dec/2022	26.07092633	79.64953097
NH27	1527950	1527850	D	R2	1.48	1.77	1.63	60	10/Dec/2022	26.07049501	79.64865491
NH27	1527850	1527750	D	R2	2.18	2.72	2.45	59	10/Dec/2022	26.07006003	79.64778115
NH27	1527750	1527650	D	R2	1.53	1.78	1.66	60	10/Dec/2022	26.069625	79.64690787
NH27	1527650	1527550	D	R2	1.65	2.07	1.86	60	10/Dec/2022	26.06918937	79.64603462
NH27	1527550	1527450	D	R2	2.16	1.8	1.98	61	10/Dec/2022	26.06875545	79.64515985
NH27	1527450	1527350	D	R2	1.46	1.48	1.47	61	10/Dec/2022	26.06832063	79.64428592
NH27	1527350	1527250	D	R2	1.97	1.76	1.87	60	10/Dec/2022	26.06788385	79.64341299
NH27	1527250	1527150	D	R2	1.92	2.08	2	60	10/Dec/2022	26.06745016	79.64253846
NH27	1527150	1527050	D	R2	1.29	1.52	1.41	59	10/Dec/2022	26.06701474	79.64166517
NH27	1527050	1526950	D	R2	2.09	2.31	2.2	59	10/Dec/2022	26.06658074	79.64079098
NH27	1526950	1526850	D	R2	1.46	1.65	1.56	60	10/Dec/2022	26.06614572	79.6399176
NH27	1526850	1526750	D	R2	1.78	1.39	1.59	60	10/Dec/2022	26.06571142	79.63904352
NH27	1526750	1526650	D	R2	1.54	1.63	1.59	62	10/Dec/2022	26.06527631	79.63817055

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1526650	1526550	D	R2	1.47	1.56	1.52	63	10/Dec/2022	26.06484141	79.63729705
NH27	1526550	1526450	D	R2	2.03	2.29	2.16	65	10/Dec/2022	26.06440369	79.63642509
NH27	1526450	1526350	D	R2	1.35	1.38	1.37	66	10/Dec/2022	26.0639709	79.63555028
NH27	1526350	1526250	D	R2	1.38	1.39	1.39	66	10/Dec/2022	26.06353527	79.63467715
NH27	1526250	1526150	D	R2	1.52	1.31	1.42	66	10/Dec/2022	26.06310167	79.63380279
NH27	1526150	1526050	D	R2	2.64	3.12	2.88	67	10/Dec/2022	26.06266221	79.63293172
NH27	1526050	1525950	D	R2	1.33	1.51	1.42	67	10/Dec/2022	26.06222566	79.6320589
NH27	1525950	1525850	D	R2	1.29	1.36	1.33	67	10/Dec/2022	26.06178816	79.63118664
NH27	1525850	1525750	D	R2	1.31	1.59	1.45	67	10/Dec/2022	26.06134863	79.63031545
NH27	1525750	1525650	D	R2	1.59	1.57	1.58	66	10/Dec/2022	26.06091103	79.62944342
NH27	1525650	1525550	D	R2	1.32	1.41	1.37	65	10/Dec/2022	26.0604711	79.6285726
NH27	1525550	1525450	D	R2	1.67	1.8	1.74	64	10/Dec/2022	26.06003181	79.6277012
NH27	1525450	1525350	D	R2	1.64	1.94	1.79	64	10/Dec/2022	26.05959213	79.62682996
NH27	1525350	1525250	D	R2	1.85	1.78	1.82	63	10/Dec/2022	26.05918015	79.62594181
NH27	1525250	1525150	D	R2	1.37	1.55	1.46	63	10/Dec/2022	26.05872455	79.62508265
NH27	1525150	1525050	D	R2	1.27	1.16	1.22	61	10/Dec/2022	26.05827782	79.62421598
NH27	1525050	1524950	D	R2	2.71	2.42	2.57	65	10/Dec/2022	26.05784078	79.62334337
NH27	1524950	1524850	D	R2	2.1	2.19	2.15	66	10/Dec/2022	26.05740267	79.62247127
NH27	1524850	1524750	D	R2	1.8	1.99	1.9	66	10/Dec/2022	26.05696418	79.6215994
NH27	1524750	1524650	D	R2	1.37	1.43	1.4	66	10/Dec/2022	26.05652445	79.62072827
NH27	1524650	1524550	D	R2	1.2	1.1	1.15	65	10/Dec/2022	26.0560845	79.61985738
NH27	1524550	1524450	D	R2	1.28	1.24	1.26	65	10/Dec/2022	26.05565041	79.61898313
NH27	1524450	1524350	D	R2	1.3	1.39	1.35	65	10/Dec/2022	26.05524369	79.61809231
NH27	1524350	1524250	D	R2	1.84	1.28	1.56	65	10/Dec/2022	26.05487645	79.61717949
NH27	1524250	1524150	D	R2	2.2	2.44	2.32	65	10/Dec/2022	26.05455174	79.61624799
NH27	1524150	1524050	D	R2	1.8	2.05	1.93	61	10/Dec/2022	26.05423228	79.61531574
NH27	1524050	1523950	D	R2	1.16	1.7	1.43	56	10/Dec/2022	26.05392218	79.61437942
NH27	1523950	1523850	D	R2	1.02	1.27	1.15	60	10/Dec/2022	26.05358401	79.61345583
NH27	1523850	1523750	D	R2	1.47	1.6	1.54	62	10/Dec/2022	26.05316285	79.61257502
NH27	1523750	1523650	D	R2	1.76	2.28	2.02	64	10/Dec/2022	26.05266344	79.61174507
NH27	1523650	1523550	D	R2	1.66	1.6	1.63	65	10/Dec/2022	26.05214792	79.61092652
NH27	1523550	1523450	D	R2	1.13	1.27	1.2	65	10/Dec/2022	26.05163133	79.61010886
NH27	1523450	1523350	D	R2	1.32	1.07	1.2	65	10/Dec/2022	26.05111568	79.60929043
NH27	1523350	1523250	D	R2	1.16	1.45	1.31	66	10/Dec/2022	26.05059941	79.60847225
NH27	1523250	1523150	D	R2	1.11	1.07	1.09	66	10/Dec/2022	26.05008046	79.60765642
NH27	1523150	1523050	D	R2	1.2	1.26	1.23	65	10/Dec/2022	26.0495638	79.60683917
NH27	1523050	1522950	D	R2	2.02	2.1	2.06	65	10/Dec/2022	26.04904562	79.60602298
NH27	1522950	1522850	D	R2	2.04	2.13	2.09	65	10/Dec/2022	26.04852856	79.60520585
NH27	1522850	1522750	D	R2	2.16	2.17	2.17	66	10/Dec/2022	26.04802294	79.60437972
NH27	1522750	1522650	D	R2	2.08	2.03	2.06	66	10/Dec/2022	26.04754309	79.60353499

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1522650	1522550	D	R2	3.21	2.66	2.94	66	10/Dec/2022	26.0470616	79.60269034
NH27	1522550	1522450	D	R2	2.91	2.87	2.89	66	10/Dec/2022	26.04658536	79.60184088
NH27	1522450	1522350	D	R2	2.11	2.06	2.09	62	10/Dec/2022	26.04608988	79.60100417
NH27	1522350	1522250	D	R2	1.47	1.71	1.59	52	10/Dec/2022	26.04563454	79.60014718
NH27	1522250	1522150	D	R2	1.81	1.7	1.76	9	10/Dec/2022	26.04517146	79.59929443
NH27	1522150	1522050	D	R2	1.93	1.98	1.96	38	10/Dec/2022	26.04469453	79.59844675
NH27	1522050	1521950	D	R2	1.54	1.81	1.68	53	10/Dec/2022	26.04421294	79.59759148
NH27	1521950	1521850	D	R2	1.68	1.62	1.65	48	10/Dec/2022	26.04375638	79.59673182
NH27	1521850	1521750	D	R2	1.83	1.54	1.69	49	10/Dec/2022	26.0433272	79.59585521
NH27	1521750	1521650	D	R2	1.65	1.6	1.63	52	10/Dec/2022	26.04292887	79.59496206
NH27	1521650	1521550	D	R2	1.39	1.61	1.5	55	10/Dec/2022	26.04255892	79.59405243
NH27	1521550	1521450	D	R2	0.93	1.08	1.01	61	10/Dec/2022	26.04221067	79.59313164
NH27	1521450	1521350	D	R2	1.86	2.12	1.99	62	10/Dec/2022	26.04186154	79.59221205
NH27	1521350	1521250	D	R2	1.65	1.78	1.72	60	10/Dec/2022	26.04151399	79.59129246
NH27	1521250	1521150	D	R2	1.5	1.6	1.55	60	10/Dec/2022	26.04116401	79.5903732
NH27	1521150	1521050	D	R2	1.36	1.44	1.4	62	10/Dec/2022	26.04081913	79.58945134
NH27	1521050	1520950	D	R2	1.37	1.44	1.41	64	10/Dec/2022	26.04046839	79.58853196
NH27	1520950	1520850	D	R2	1.69	1.91	1.8	65	10/Dec/2022	26.04011882	79.58761231
NH27	1520850	1520750	D	R2	1.41	1.65	1.53	65	10/Dec/2022	26.0397719	79.58669108
NH27	1520750	1520650	D	R2	1.74	1.75	1.75	65	10/Dec/2022	26.03942804	79.58576769
NH27	1520650	1520550	D	R2	1.25	1.15	1.2	65	10/Dec/2022	26.03909041	79.58484423
NH27	1520550	1520450	D	R2	1.33	1.46	1.4	61	10/Dec/2022	26.0387326	79.58392931
NH27	1520450	1520350	D	R2	2.06	2.2	2.13	66	10/Dec/2022	26.03837957	79.58301132
NH27	1520350	1520250	D	R2	1.08	1.06	1.07	69	10/Dec/2022	26.03803235	79.58208987
NH27	1520250	1520150	D	R2	1.5	1.6	1.55	69	10/Dec/2022	26.03769865	79.58116193
NH27	1520150	1520050	D	R2	2.62	2.12	2.37	69	10/Dec/2022	26.03736196	79.58023496
NH27	1520050	1519950	D	R2	3.85	2.69	3.27	65	10/Dec/2022	26.03700855	79.57931606
NH27	1519950	1519850	D	R2	3.02	3.15	3.09	60	10/Dec/2022	26.03664378	79.57840042
NH27	1519850	1519750	D	R2	2.52	2.19	2.36	56	10/Dec/2022	26.03633378	79.5774659
NH27	1519750	1519650	D	R2	2.05	2.02	2.04	22	10/Dec/2022	26.0360188	79.57653422
NH27	1519650	1519550	D	R2	1.85	1.59	1.72	32	10/Dec/2022	26.03569281	79.57560678
NH27	1519550	1519450	D	R2	1.36	1.45	1.41	46	10/Dec/2022	26.0353581	79.57468295
NH27	1519450	1519350	D	R2	1.67	1.84	1.76	57	10/Dec/2022	26.03502404	79.57375673
NH27	1519350	1519250	D	R2	1.56	1.79	1.68	64	10/Dec/2022	26.03468841	79.57283175
NH27	1519250	1519150	D	R2	1.71	1.4	1.56	66	10/Dec/2022	26.03435464	79.57190555
NH27	1519150	1519050	D	R2	1.42	1.52	1.47	69	10/Dec/2022	26.03402192	79.57097893
NH27	1519050	1518950	D	R2	1.29	1.64	1.47	71	10/Dec/2022	26.03368538	79.57005351
NH27	1518950	1518850	D	R2	1.32	1.18	1.25	72	10/Dec/2022	26.0333523	79.56912638
NH27	1518850	1518750	D	R2	1.82	2.03	1.93	73	10/Dec/2022	26.03301741	79.56820001
NH27	1518750	1518650	D	R2	1.47	1.53	1.5	73	10/Dec/2022	26.03268209	79.56727346

NH Number	Start Chainage	End Chainage	Direction	Lane Number	LwpIri	RwpIri	LaneIri	Speed	Survey Date	Latitude	Longitude
NH27	1518650	1518550	D	R2	1.33	1.57	1.45	72	10/Dec/2022	26.0323496	79.5663458
NH27	1518550	1518450	D	R2	2.29	2.32	2.31	72	10/Dec/2022	26.03201452	79.56541934
NH27	1518450	1518350	D	R2	3.56	2.54	3.05	71	10/Dec/2022	26.03167332	79.56449592
NH27	1518350	1518250	D	R2	1.74	1.93	1.84	71	10/Dec/2022	26.03133536	79.56357062
NH27	1518250	1518150	D	R2	1.53	1.76	1.65	71	10/Dec/2022	26.03099433	79.56264687
NH27	1518150	1518050	D	R2	1.18	1.32	1.25	71	10/Dec/2022	26.03065137	79.56172393
NH27	1518050	1517950	D	R2	2.28	2.48	2.38	73	10/Dec/2022	26.03030982	79.56079973
NH27	1517950	1517850	D	R2	1.5	1.38	1.44	75	10/Dec/2022	26.02996724	79.55987611
NH27	1517850	1517750	D	R2	2.71	2.4	2.56	75	10/Dec/2022	26.02962139	79.5589531
NH27	1517750	1517650	D	R2	2.51	2.34	2.43	73	10/Dec/2022	26.0292947	79.55802175
NH27	1517650	1517550	D	R2	3.25	3	3.13	69	10/Dec/2022	26.02897097	79.5570909
NH27	1517550	1517450	D	R2	3.02	3.1	3.06	64	10/Dec/2022	26.02865223	79.55615603
NH27	1517450	1517350	D	R2	3.01	3.11	3.06	64	10/Dec/2022	26.02833128	79.55522341
NH27	1517350	1517250	D	R2	1.57	1.52	1.55	54	10/Dec/2022	26.02798628	79.55430492
NH27	1517250	1517150	D	R2	1.54	1.6	1.57	51	10/Dec/2022	26.02766214	79.55337633
NH27	1517150	1517050	D	R2	1.64	2.02	1.83	60	10/Dec/2022	26.02730432	79.55246257
NH27	1517050	1516950	D	R2	1.83	2.29	2.06	63	10/Dec/2022	26.02696357	79.5515403
NH27	1516950	1516850	D	R2	1.47	1.4	1.44	65	10/Dec/2022	26.0266206	79.55061892
NH27	1516850	1516750	D	R2	1.1	1.43	1.27	65	10/Dec/2022	26.02627844	79.54969623
NH27	1516750	1516650	D	R2	1.33	1.17	1.25	69	10/Dec/2022	26.02593714	79.54877268
NH27	1516650	1516550	D	R2	1.31	1.4	1.36	71	10/Dec/2022	26.02559438	79.54784973
NH27	1516550	1516450	D	R2	1.9	1.94	1.92	71	10/Dec/2022	26.02525284	79.54692612
NH27	1516450	1516350	D	R2	1.96	1.78	1.87	70	10/Dec/2022	26.02491245	79.54600212
NH27	1516350	1516250	D	R2	1.15	1.37	1.26	70	10/Dec/2022	26.02457765	79.54507553
NH27	1516250	1516150	D	R2	1.34	1.39	1.37	69	10/Dec/2022	26.02424006	79.54415024
NH27	1516150	1516050	D	R2	1.55	1.92	1.74	68	10/Dec/2022	26.02390226	79.54322557
NH27	1516050	1515950	D	R2	1.41	1.37	1.39	67	10/Dec/2022	26.0235674	79.54229777
NH27	1515950	1515850	D	R2	2.02	2.11	2.07	67	10/Dec/2022	26.02323558	79.54136833
NH27	1515850	1515750	D	R2	2.04	1.89	1.97	63	10/Dec/2022	26.02290099	79.54043977
NH27	1515750	1515713	D	R2	1.95	2.17	2.06	57	10/Dec/2022	26.02256563	79.53951195

Annexure – 4.4

Rutting Data

Rut depth											
NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1515713	1515800	I	L1	6.5	5.9	6.2	20	10/Dec/2022	26.02255348	79.53906313
NH27	1515800	1515900	I	L1	7.8	7.5	7.6	20	10/Dec/2022	26.02282691	79.53985244
NH27	1515900	1516000	I	L1	8.9	9	8.95	22	10/Dec/2022	26.023506	79.54172465
NH27	1516000	1516100	I	L1	6.9	6.5	6.7	22	10/Dec/2022	26.023506	79.54172465
NH27	1516100	1516200	I	L1	5.7	4.3	5	36	10/Dec/2022	26.02383716	79.54264903
NH27	1516200	1516300	I	L1	5	4	4.5	44	10/Dec/2022	26.02416974	79.54357329
NH27	1516300	1516400	I	L1	6.3	3.7	5	50	10/Dec/2022	26.02450649	79.54449594
NH27	1516400	1516500	I	L1	6.3	6.7	6.5	53	10/Dec/2022	26.0248426	79.54541975
NH27	1516500	1516600	I	L1	9.2	7	8.1	54	10/Dec/2022	26.02517818	79.54634433
NH27	1516600	1516700	I	L1	10.3	6.3	8.3	54	10/Dec/2022	26.02551967	79.54726574
NH27	1516700	1516800	I	L1	7.6	6.1	6.85	47	10/Dec/2022	26.0258615	79.54818881
NH27	1516800	1516900	I	L1	6.5	6.8	6.65	36	10/Dec/2022	26.02620196	79.5491122
NH27	1516900	1517000	I	L1	6.2	7	6.6	34	10/Dec/2022	26.02654294	79.55003441
NH27	1517000	1517100	I	L1	8.9	9.4	9.15	41	10/Dec/2022	26.026886	79.55095497
NH27	1517100	1517200	I	L1	7.2	6.6	6.9	40	10/Dec/2022	26.02722934	79.55187676
NH27	1517200	1517300	I	L1	4.7	5.6	5.15	45	10/Dec/2022	26.02756942	79.55279921
NH27	1517300	1517400	I	L1	5.6	5.8	5.7	53	10/Dec/2022	26.02790561	79.5537224
NH27	1517400	1517500	I	L1	5	5.1	5.05	51	10/Dec/2022	26.02825375	79.55464229
NH27	1517500	1517600	I	L1	4.8	4.2	4.5	49	10/Dec/2022	26.02860433	79.55556124
NH27	1517600	1517700	I	L1	5.5	4.3	4.9	48	10/Dec/2022	26.02891301	79.5564976
NH27	1517700	1517800	I	L1	8.5	6.7	7.6	53	10/Dec/2022	26.0292097	79.55743705
NH27	1517800	1517900	I	L1	7.9	8.5	8.2	56	10/Dec/2022	26.0295462	79.5583584
NH27	1517900	1518000	I	L1	7.8	8.3	8.05	56	10/Dec/2022	26.02988669	79.55928104
NH27	1518000	1518100	I	L1	8.1	6.7	7.4	59	10/Dec/2022	26.03022844	79.56020201
NH27	1518100	1518200	I	L1	12.8	8.6	10.7	62	10/Dec/2022	26.03056975	79.5611225
NH27	1518200	1518300	I	L1	11.1	11.5	11.3	59	10/Dec/2022	26.03091324	79.56204334
NH27	1518300	1518400	I	L1	7.5	7.4	7.45	56	10/Dec/2022	26.0312567	79.5629642
NH27	1518400	1518500	I	L1	10.9	9.7	10.3	56	10/Dec/2022	26.03159658	79.56388662
NH27	1518500	1518600	I	L1	9.7	9.3	9.5	57	10/Dec/2022	26.03193462	79.56480964
NH27	1518600	1518700	I	L1	9.8	10.7	10.25	58	10/Dec/2022	26.03227001	79.5657341
NH27	1518700	1518800	I	L1	8.9	9	8.95	60	10/Dec/2022	26.03260588	79.56665818
NH27	1518800	1518900	I	L1	15.4	11.9	13.65	61	10/Dec/2022	26.03293877	79.56758383
NH27	1518900	1519000	I	L1	10.2	10	10.1	62	10/Dec/2022	26.03327066	79.56850998
NH27	1519000	1519100	I	L1	11	10.7	10.85	60	10/Dec/2022	26.03360243	79.56943698
NH27	1519100	1519200	I	L1	8.7	10.4	9.55	59	10/Dec/2022	26.0339385	79.57036208
NH27	1519200	1519300	I	L1	10.3	11.3	10.8	58	10/Dec/2022	26.03427171	79.57128843
NH27	1519300	1519400	I	L1	9.7	9.7	9.7	50	10/Dec/2022	26.03460448	79.57221611
NH27	1519400	1519500	I	L1	7.7	8.6	8.15	54	10/Dec/2022	26.03494032	79.57314001
NH27	1519500	1519600	I	L1	5	5.7	5.35	56	10/Dec/2022	26.03526965	79.57406733

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1519600	1519700	I	L1	5.3	4.9	5.1	58	10/Dec/2022	26.03561275	79.57498804
NH27	1519700	1519800	I	L1	6	6.1	6.05	56	10/Dec/2022	26.03594507	79.5759152
NH27	1519800	1519900	I	L1	6.3	5.4	5.85	48	10/Dec/2022	26.03628608	79.57683865
NH27	1519900	1520000	I	L1	5.4	5.3	5.35	13	10/Dec/2022	26.03665739	79.57774984
NH27	1520000	1520100	I	L1	5.6	4.6	5.1	31	10/Dec/2022	26.0369625	79.57868658
NH27	1520100	1520200	I	L1	8.3	5.1	6.7	47	10/Dec/2022	26.03727658	79.57961741
NH27	1520200	1520300	I	L1	5.8	5.5	5.65	53	10/Dec/2022	26.03760213	79.5805455
NH27	1520300	1520400	I	L1	6.2	6.4	6.3	57	10/Dec/2022	26.03794452	79.58146648
NH27	1520400	1520500	I	L1	6.7	7	6.85	59	10/Dec/2022	26.03828317	79.5823897
NH27	1520500	1520600	I	L1	6.4	5.9	6.15	61	10/Dec/2022	26.03862748	79.5833104
NH27	1520600	1520700	I	L1	4.9	4.9	4.9	62	10/Dec/2022	26.03897885	79.58422824
NH27	1520700	1520800	I	L1	6.1	6.5	6.3	60	10/Dec/2022	26.03932749	79.58514832
NH27	1520800	1520900	I	L1	8	7.3	7.65	55	10/Dec/2022	26.03967185	79.58607093
NH27	1520900	1521000	I	L1	9.8	8	8.9	55	10/Dec/2022	26.04002345	79.58698879
NH27	1521000	1521100	I	L1	8.8	8.1	8.45	57	10/Dec/2022	26.04037101	79.58790801
NH27	1521100	1521200	I	L1	10.3	9.7	10	57	10/Dec/2022	26.04071989	79.58882686
NH27	1521200	1521300	I	L1	8.5	9.7	9.1	60	10/Dec/2022	26.04106592	79.5897462
NH27	1521300	1521400	I	L1	8.1	7.2	7.65	61	10/Dec/2022	26.04141669	79.59066417
NH27	1521400	1521500	I	L1	7	7.7	7.35	59	10/Dec/2022	26.04176548	79.59158369
NH27	1521500	1521600	I	L1	6.8	6.7	6.75	59	10/Dec/2022	26.04211095	79.59250465
NH27	1521600	1521700	I	L1	5.5	6.2	5.85	59	10/Dec/2022	26.04245797	79.59342507
NH27	1521700	1521800	I	L1	5.8	6.3	6.05	59	10/Dec/2022	26.04281035	79.59434266
NH27	1521800	1521900	I	L1	6.2	5.9	6.05	60	10/Dec/2022	26.04319471	79.59524386
NH27	1521900	1522000	I	L1	6.9	7.8	7.35	60	10/Dec/2022	26.04360704	79.59613001
NH27	1522000	1522100	I	L1	7.3	6.4	6.85	60	10/Dec/2022	26.04404383	79.59700156
NH27	1522100	1522200	I	L1	6.5	5.9	6.2	61	10/Dec/2022	26.0445152	79.59785085
NH27	1522200	1522300	I	L1	5.2	5.1	5.15	59	10/Dec/2022	26.04499369	79.59869586
NH27	1522300	1522400	I	L1	5.3	4.9	5.1	59	10/Dec/2022	26.04546541	79.59954542
NH27	1522400	1522500	I	L1	9.8	4.3	7.05	58	10/Dec/2022	26.04592531	79.60040286
NH27	1522500	1522600	I	L1	7.5	4.1	5.8	60	10/Dec/2022	26.04640114	79.60124901
NH27	1522600	1522700	I	L1	4.6	5.1	4.85	61	10/Dec/2022	26.04688074	79.60209269
NH27	1522700	1522800	I	L1	5	5.1	5.05	62	10/Dec/2022	26.04736119	79.60293635
NH27	1522800	1522900	I	L1	4.6	3.8	4.2	61	10/Dec/2022	26.04783617	79.60378404
NH27	1522900	1523000	I	L1	5.7	5.7	5.7	62	10/Dec/2022	26.04832446	79.60462097
NH27	1523000	1523100	I	L1	6.5	7.9	7.2	64	10/Dec/2022	26.04884354	79.60543529
NH27	1523100	1523200	I	L1	5.8	7.8	6.8	65	10/Dec/2022	26.04935812	79.60625362
NH27	1523200	1523300	I	L1	5.5	6.9	6.2	65	10/Dec/2022	26.04987597	79.60706948
NH27	1523300	1523400	I	L1	5.2	4.8	5	63	10/Dec/2022	26.050392	79.60788711
NH27	1523400	1523500	I	L1	5.2	5.8	5.5	59	10/Dec/2022	26.05091013	79.60870403
NH27	1523500	1523600	I	L1	5.7	6.4	6.05	58	10/Dec/2022	26.05142539	79.60952193

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1523600	1523700	I	L1	4.7	5.7	5.2	60	10/Dec/2022	26.05194042	79.61033947
NH27	1523700	1523800	I	L1	5	6.1	5.55	61	10/Dec/2022	26.05245551	79.6111573
NH27	1523800	1523900	I	L1	4.8	6.9	5.85	61	10/Dec/2022	26.05296955	79.61197598
NH27	1523900	1524000	I	L1	5	7.4	6.2	62	10/Dec/2022	26.05344283	79.61282404
NH27	1524000	1524100	I	L1	5.5	6	5.75	63	10/Dec/2022	26.05383273	79.61372247
NH27	1524100	1524200	I	L1	5.9	7.1	6.5	64	10/Dec/2022	26.05415166	79.61465503
NH27	1524200	1524300	I	L1	5.2	5.8	5.5	63	10/Dec/2022	26.05446045	79.61559221
NH27	1524300	1524400	I	L1	5.4	4.5	4.95	63	10/Dec/2022	26.05476875	79.61652937
NH27	1524400	1524500	I	L1	5.7	6.6	6.15	65	10/Dec/2022	26.05511444	79.61744944
NH27	1524500	1524600	I	L1	6.1	6.4	6.25	65	10/Dec/2022	26.05549792	79.6183515
NH27	1524600	1524700	I	L1	5.7	6.9	6.3	62	10/Dec/2022	26.05592534	79.61922993
NH27	1524700	1524800	I	L1	6.5	6.7	6.6	63	10/Dec/2022	26.05636144	79.62010225
NH27	1524800	1524900	I	L1	6.1	5.7	5.9	61	10/Dec/2022	26.05680243	79.62097253
NH27	1524900	1525000	I	L1	6.4	6.4	6.4	61	10/Dec/2022	26.05723986	79.62184463
NH27	1525000	1525100	I	L1	7	6.6	6.8	61	10/Dec/2022	26.05767773	79.62271615
NH27	1525100	1525200	I	L1	5.2	6.5	5.85	57	10/Dec/2022	26.05811263	79.62359066
NH27	1525200	1525300	I	L1	7.1	7.2	7.15	58	10/Dec/2022	26.05854805	79.62446226
NH27	1525300	1525400	I	L1	8.6	8.8	8.7	60	10/Dec/2022	26.05899169	79.62532986
NH27	1525400	1525500	I	L1	8.5	9.02	8.76	62	10/Dec/2022	26.05943055	79.62620051
NH27	1525500	1525600	I	L1	8.8	10.3	9.55	62	10/Dec/2022	26.05986562	79.62707358
NH27	1525600	1525700	I	L1	10.2	11.1	10.65	61	10/Dec/2022	26.06030994	79.62794152
NH27	1525700	1525800	I	L1	13.4	9.5	11.45	60	10/Dec/2022	26.06074412	79.6288159
NH27	1525800	1525900	I	L1	13.5	12.2	12.85	62	10/Dec/2022	26.06118557	79.62968492
NH27	1525900	1526000	I	L1	15	15	15	63	10/Dec/2022	26.06162067	79.63055808
NH27	1526000	1526100	I	L1	15	10.1	12.55	64	10/Dec/2022	26.06206408	79.63142621
NH27	1526100	1526200	I	L1	10.8	8.2	9.5	62	10/Dec/2022	26.06250141	79.63229923
NH27	1526200	1526300	I	L1	11.3	14.5	12.9	63	10/Dec/2022	26.06294106	79.63316958
NH27	1526300	1526400	I	L1	17.4	19.8	18.6	64	10/Dec/2022	26.06337149	79.6340454
NH27	1526400	1526500	I	L1	18.4	19.2	18.8	62	10/Dec/2022	26.06380502	79.6349212
NH27	1526500	1526600	I	L1	15.8	14.6	15.2	62	10/Dec/2022	26.0642399	79.6357951
NH27	1526600	1526700	I	L1	7.1	5.8	6.45	63	10/Dec/2022	26.06468361	79.63667455
NH27	1526700	1526800	I	L1	9.5	11.1	10.3	65	10/Dec/2022	26.06511896	79.63754807
NH27	1526800	1526900	I	L1	7.5	8.9	8.2	64	10/Dec/2022	26.06555195	79.63842269
NH27	1526900	1527000	I	L1	12.5	12.3	12.4	62	10/Dec/2022	26.06598776	79.63929639
NH27	1527000	1527100	I	L1	9.8	13.5	11.65	58	10/Dec/2022	26.06642271	79.64017152
NH27	1527100	1527200	I	L1	8	10	9	46	10/Dec/2022	26.06685609	79.64104797
NH27	1527200	1527300	I	L1	5.6	5.6	5.6	45	10/Dec/2022	26.06728029	79.6419282
NH27	1527300	1527400	I	L1	8.7	13.2	10.95	54	10/Dec/2022	26.06771663	79.64279722
NH27	1527400	1527500	I	L1	6.6	9	7.8	51	10/Dec/2022	26.06816043	79.64366652
NH27	1527500	1527600	I	L1	8.2	9.3	8.75	54	10/Dec/2022	26.06859526	79.6445397

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1527600	1527700	I	L1	10.1	11.2	10.65	51	10/Dec/2022	26.0690328	79.64541251
NH27	1527700	1527800	I	L1	14.6	11.9	13.25	56	10/Dec/2022	26.06946632	79.64628613
NH27	1527800	1527900	I	L1	7.7	8.3	8	57	10/Dec/2022	26.06990365	79.6471584
NH27	1527900	1528000	I	L1	7.7	8.3	8	61	10/Dec/2022	26.07033524	79.64803326
NH27	1528000	1528100	I	L1	10.2	10.5	10.35	61	10/Dec/2022	26.07076661	79.64890954
NH27	1528100	1528200	I	L1	8.5	11.2	9.85	62	10/Dec/2022	26.0712029	79.64978243
NH27	1528200	1528300	I	L1	10.8	10.3	10.55	61	10/Dec/2022	26.07163814	79.6506565
NH27	1528300	1528400	I	L1	8.6	8.8	8.7	61	10/Dec/2022	26.07207502	79.65152954
NH27	1528400	1528500	I	L1	6.9	6.9	6.9	62	10/Dec/2022	26.07251015	79.65240315
NH27	1528500	1528600	I	L1	7	7.2	7.1	62	10/Dec/2022	26.07294032	79.65328021
NH27	1528600	1528700	I	L1	6.2	7.9	7.05	64	10/Dec/2022	26.07337196	79.65415574
NH27	1528700	1528800	I	L1	6.4	6.3	6.35	64	10/Dec/2022	26.07379082	79.6550395
NH27	1528800	1528900	I	L1	5.7	6.5	6.1	64	10/Dec/2022	26.0742106	79.6559227
NH27	1528900	1529000	I	L1	4.5	6.5	5.5	62	10/Dec/2022	26.07463011	79.65680669
NH27	1529000	1529100	I	L1	7.1	5.7	6.4	62	10/Dec/2022	26.07504747	79.65769107
NH27	1529100	1529200	I	L1	5.6	4.4	5	63	10/Dec/2022	26.07546672	79.6585742
NH27	1529200	1529300	I	L1	6.4	5.5	5.95	63	10/Dec/2022	26.07588317	79.65945919
NH27	1529300	1529400	I	L1	5.4	5.5	5.45	62	10/Dec/2022	26.07630159	79.66034383
NH27	1529400	1529500	I	L1	5.1	7.3	6.2	63	10/Dec/2022	26.07672184	79.66122654
NH27	1529500	1529600	I	L1	4.6	5.2	4.9	65	10/Dec/2022	26.07713838	79.66211129
NH27	1529600	1529700	I	L1	4.4	5.3	4.85	65	10/Dec/2022	26.07755274	79.66299754
NH27	1529700	1529800	I	L1	7.1	6.6	6.85	66	10/Dec/2022	26.07797436	79.66387941
NH27	1529800	1529900	I	L1	7.3	5.7	6.5	66	10/Dec/2022	26.07839187	79.66476453
NH27	1529900	1530000	I	L1	4.6	4.5	4.55	53	10/Dec/2022	26.07881038	79.6656517
NH27	1530000	1530100	I	L1	4	3.4	3.7	45	10/Dec/2022	26.07922608	79.66653863
NH27	1530100	1530200	I	L1	5.6	5.1	5.35	40	10/Dec/2022	26.079643	79.66742304
NH27	1530200	1530300	I	L1	9.3	9.3	9.3	49	10/Dec/2022	26.08003986	79.66831733
NH27	1530300	1530400	I	L1	4.1	4.8	4.45	54	10/Dec/2022	26.08047354	79.66918979
NH27	1530400	1530500	I	L1	5.5	4.6	5.05	56	10/Dec/2022	26.08089428	79.67007232
NH27	1530500	1530600	I	L1	6.2	5.5	5.85	60	10/Dec/2022	26.08130219	79.67096165
NH27	1530600	1530700	I	L1	5.8	6.6	6.2	63	10/Dec/2022	26.08170933	79.67185133
NH27	1530700	1530800	I	L1	4.5	4.3	4.4	65	10/Dec/2022	26.08211446	79.6727426
NH27	1530800	1530900	I	L1	5.2	6.1	5.65	66	10/Dec/2022	26.08251904	79.67363434
NH27	1530900	1531000	I	L1	6.8	4.7	5.75	66	10/Dec/2022	26.08292632	79.67452477
NH27	1531000	1531100	I	L1	6	5.1	5.55	66	10/Dec/2022	26.08333312	79.6754154
NH27	1531100	1531200	I	L1	8.1	3.8	5.95	66	10/Dec/2022	26.08373819	79.67630703
NH27	1531200	1531300	I	L1	6.3	3.5	4.9	65	10/Dec/2022	26.08414326	79.67719872
NH27	1531300	1531400	I	L1	5.8	4.2	5	63	10/Dec/2022	26.08455008	79.67808995
NH27	1531400	1531500	I	L1	4.7	5.6	5.15	63	10/Dec/2022	26.08494849	79.67898561
NH27	1531500	1531600	I	L1	7.5	5	6.25	64	10/Dec/2022	26.08536113	79.67987242

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1531600	1531700	I	L1	7.3	4.2	5.75	64	10/Dec/2022	26.08576316	79.68076553
NH27	1531700	1531800	I	L1	5.5	5.8	5.65	64	10/Dec/2022	26.08616763	79.681657
NH27	1531800	1531900	I	L1	5.8	6.2	6	64	10/Dec/2022	26.08657496	79.6825478
NH27	1531900	1532000	I	L1	5.1	5.5	5.3	63	10/Dec/2022	26.08697988	79.68343998
NH27	1532000	1532100	I	L1	6.6	4.6	5.6	63	10/Dec/2022	26.08738572	79.6843309
NH27	1532100	1532200	I	L1	7	6.8	6.9	64	10/Dec/2022	26.08779166	79.68522181
NH27	1532200	1532300	I	L1	5.5	6.7	6.1	62	10/Dec/2022	26.0881957	79.6861148
NH27	1532300	1532400	I	L1	4.8	5.3	5.05	62	10/Dec/2022	26.08858782	79.68701324
NH27	1532400	1532500	I	L1	4.2	6.8	5.5	62	10/Dec/2022	26.08900465	79.6878983
NH27	1532500	1532600	I	L1	4.7	4.5	4.6	63	10/Dec/2022	26.08940384	79.68879259
NH27	1532600	1532700	I	L1	4.8	4.7	4.75	64	10/Dec/2022	26.08980402	79.68968662
NH27	1532700	1532800	I	L1	5.6	4.4	5	65	10/Dec/2022	26.09021924	79.69057221
NH27	1532800	1532900	I	L1	5.1	5.8	5.45	66	10/Dec/2022	26.0906299	79.69146015
NH27	1532900	1533000	I	L1	4.9	5.8	5.35	66	10/Dec/2022	26.09105258	79.69234094
NH27	1533000	1533100	I	L1	5.7	5.8	5.75	65	10/Dec/2022	26.09149647	79.6932094
NH27	1533100	1533200	I	L1	6.7	7	6.85	64	10/Dec/2022	26.09195673	79.69406776
NH27	1533200	1533300	I	L1	6.8	6.4	6.6	61	10/Dec/2022	26.09243326	79.69491577
NH27	1533300	1533400	I	L1	6.8	7.6	7.2	60	10/Dec/2022	26.09292671	79.69575087
NH27	1533400	1533500	I	L1	6.4	6.8	6.6	60	10/Dec/2022	26.09343828	79.6965726
NH27	1533500	1533600	I	L1	5.3	6.7	6	60	10/Dec/2022	26.09396723	79.69738046
NH27	1533600	1533700	I	L1	5.1	4.9	5	53	10/Dec/2022	26.09450607	79.69818246
NH27	1533700	1533800	I	L1	4	4.1	4.05	48	10/Dec/2022	26.09504398	79.69898509
NH27	1533800	1533900	I	L1	4.5	2.5	3.5	47	10/Dec/2022	26.09559098	79.69977791
NH27	1533900	1534000	I	L1	4.7	2.9	3.8	46	10/Dec/2022	26.09613365	79.70057519
NH27	1534000	1534100	I	L1	5.4	6.2	5.8	19	10/Dec/2022	26.09667621	79.7013744
NH27	1534100	1534200	I	L1	5.8	5.1	5.5	32	10/Dec/2022	26.09724937	79.70222619
NH27	1534200	1534300	I	L1	4.4	3.4	3.9	41	10/Dec/2022	26.09779185	79.70302082
NH27	1534300	1534400	I	L1	6.3	8.3	7.3	28	10/Dec/2022	26.0983335	79.70382072
NH27	1534400	1534500	I	L1	5.3	6.3	5.8	33	10/Dec/2022	26.09888923	79.70460322
NH27	1534500	1534600	I	L1	4.5	5.1	4.8	48	10/Dec/2022	26.0994431	79.70538727
NH27	1534600	1534700	I	L1	5.6	6	5.8	51	10/Dec/2022	26.09999697	79.70617345
NH27	1534700	1534800	I	L1	5.8	6.7	6.3	52	10/Dec/2022	26.1005535	79.70695808
NH27	1534800	1534900	I	L1	5.3	6.2	5.8	53	10/Dec/2022	26.10110751	79.70774489
NH27	1534900	1535000	I	L1	6	6	6	54	10/Dec/2022	26.10166192	79.70853172
NH27	1535000	1535100	I	L1	5.5	6.2	5.9	52	10/Dec/2022	26.10221842	79.70931768
NH27	1535100	1535200	I	L1	6.3	6.8	6.6	52	10/Dec/2022	26.10277436	79.71010317
NH27	1535200	1535300	I	L1	6.3	6.8	6.6	53	10/Dec/2022	26.10332731	79.71089059
NH27	1535300	1535400	I	L1	5	5.4	5.2	52	10/Dec/2022	26.10388339	79.71167659
NH27	1535400	1535500	I	L1	5.3	4.7	5	54	10/Dec/2022	26.10443	79.71246932
NH27	1535500	1535600	I	L1	6.7	5.9	6.3	57	10/Dec/2022	26.10499634	79.71324515

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1535600	1535700	I	L1	6.2	6	6.1	58	10/Dec/2022	26.10554663	79.71403521
NH27	1535700	1535800	I	L1	5.1	5.1	5.1	55	10/Dec/2022	26.1060726	79.71484619
NH27	1535800	1535900	I	L1	7.9	5.9	6.9	56	10/Dec/2022	26.1065642	79.7156811
NH27	1535900	1536000	I	L1	8.2	5.9	7.1	56	10/Dec/2022	26.10705461	79.7165177
NH27	1536000	1536100	I	L1	6.8	5.4	6.1	57	10/Dec/2022	26.10754196	79.71735686
NH27	1536100	1536200	I	L1	5	5.1	5.1	58	10/Dec/2022	26.10804589	79.71818416
NH27	1536200	1536300	I	L1	6.1	5.8	6	58	10/Dec/2022	26.10859734	79.7189737
NH27	1536300	1536400	I	L1	5.8	6.1	6	60	10/Dec/2022	26.10913763	79.71977241
NH27	1536400	1536500	I	L1	5.8	6.4	6.1	59	10/Dec/2022	26.10965431	79.72058959
NH27	1536500	1536600	I	L1	6.8	6.4	6.6	59	10/Dec/2022	26.11016613	79.72141045
NH27	1536600	1536700	I	L1	6.6	5.6	6.1	58	10/Dec/2022	26.11067868	79.72223086
NH27	1536700	1536800	I	L1	6	6	6	57	10/Dec/2022	26.11118841	79.72305382
NH27	1536800	1536900	I	L1	8.2	6.4	7.3	58	10/Dec/2022	26.11169979	79.72387511
NH27	1536900	1537000	I	L1	6.9	7.8	7.4	56	10/Dec/2022	26.1122132	79.72469542
NH27	1537000	1537100	I	L1	8.5	9.2	8.9	55	10/Dec/2022	26.11269817	79.72553651
NH27	1537100	1537200	I	L1	7.7	8.8	8.3	57	10/Dec/2022	26.11304626	79.72645608
NH27	1537200	1537300	I	L1	5.8	6.9	6.4	58	10/Dec/2022	26.1132286	79.72743321
NH27	1537300	1537400	I	L1	6.3	6.6	6.5	58	10/Dec/2022	26.11328822	79.72842951
NH27	1537400	1537500	I	L1	5.5	7	6.3	57	10/Dec/2022	26.11334438	79.72942587
NH27	1537500	1537600	I	L1	5.5	5.2	5.4	55	10/Dec/2022	26.11340093	79.73042253
NH27	1537600	1537700	I	L1	6.2	6.3	6.3	38	10/Dec/2022	26.11354146	79.73140949
NH27	1537700	1537800	I	L1	6	4.3	5.2	27	10/Dec/2022	26.11370481	79.73239176
NH27	1537800	1537900	I	L1	5.7	7.5	6.6	27	10/Dec/2022	26.11377862	79.73338485
NH27	1537900	1538000	I	L1	5.3	9.5	7.4	30	10/Dec/2022	26.113639	79.73436952
NH27	1538000	1538100	I	L1	8.3	6.3	7.3	33	10/Dec/2022	26.11341218	79.73533537
NH27	1538100	1538200	I	L1	8	9.1	8.6	50	10/Dec/2022	26.11321732	79.73630701
NH27	1538200	1538300	I	L1	5.9	6.4	6.2	55	10/Dec/2022	26.11319128	79.73729975
NH27	1538300	1538400	I	L1	8	5.7	6.9	57	10/Dec/2022	26.11342034	79.73826053
NH27	1538400	1538500	I	L1	9.6	6	7.8	57	10/Dec/2022	26.11388247	79.73911156
NH27	1538500	1538600	I	L1	6.7	9	7.9	56	10/Dec/2022	26.1145304	79.7398004
NH27	1538600	1538700	I	L1	3.7	5.3	4.5	57	10/Dec/2022	26.11528764	79.74034017
NH27	1538700	1538800	I	L1	6.6	8.5	7.6	57	10/Dec/2022	26.11605485	79.74086415
NH27	1538800	1538900	I	L1	6.7	7.9	7.3	52	10/Dec/2022	26.11682152	79.74139119
NH27	1538900	1539000	I	L1	9.8	13.5	11.7	53	10/Dec/2022	26.11758546	79.74192022
NH27	1539000	1539100	I	L1	6.7	6.3	6.5	54	10/Dec/2022	26.11835957	79.74242916
NH27	1539100	1539200	I	L1	13.7	15.1	14.4	52	10/Dec/2022	26.11910115	79.74299602
NH27	1539200	1539300	I	L1	9.7	15.6	12.7	50	10/Dec/2022	26.11969034	79.74374721
NH27	1539300	1539400	I	L1	8.8	9.8	9.3	51	10/Dec/2022	26.12014889	79.74460183
NH27	1539400	1539500	I	L1	7.6	8.4	8	54	10/Dec/2022	26.12057659	79.74547772
NH27	1539500	1539600	I	L1	8.7	8.9	8.8	55	10/Dec/2022	26.12099872	79.74635823

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1539600	1539700	I	L1	12.8	17.7	15.3	54	10/Dec/2022	26.12147374	79.74720492
NH27	1539700	1539800	I	L1	15.5	12.2	13.9	40	10/Dec/2022	26.12206108	79.74796236
NH27	1539800	1539900	I	L1	17.2	14.2	15.7	51	10/Dec/2022	26.12273812	79.74861705
NH27	1539900	1540000	I	L1	13.6	15.3	14.5	57	10/Dec/2022	26.12343629	79.74924654
NH27	1540000	1540100	I	L1	6.8	8.5	7.7	56	10/Dec/2022	26.12417255	79.74982287
NH27	1540100	1540200	I	L1	10.3	9.6	10	49	10/Dec/2022	26.1249599	79.75030601
NH27	1540200	1540300	I	L1	6.5	8.2	7.4	46	10/Dec/2022	26.12580134	79.750663
NH27	1540300	1540400	I	L1	5.6	4.1	4.9	42	10/Dec/2022	26.12666313	79.75095351
NH27	1540400	1540500	I	L1	6.4	4.3	5.4	36	10/Dec/2022	26.12751209	79.7512876
NH27	1540500	1540600	I	L1	7.9	11.1	9.5	48	10/Dec/2022	26.12833703	79.75168313
NH27	1540600	1540700	I	L1	5.6	2.3	4	26	10/Dec/2022	26.12914097	79.75213692
NH27	1540700	1540800	I	L1	6.7	2.1	4.4	42	10/Dec/2022	26.12994938	79.75257238
NH27	1540800	1540900	I	L1	7.8	1.8	4.8	48	10/Dec/2022	26.13075716	79.75301198
NH27	1540900	1541000	I	L1	8.1	2.1	5.1	50	10/Dec/2022	26.13156454	79.75345387
NH27	1541000	1541100	I	L1	7.6	2.4	5	52	10/Dec/2022	26.13237237	79.75389493
NH27	1541100	1541200	I	L1	8.2	2.4	5.3	51	10/Dec/2022	26.13318166	79.75433493
NH27	1541200	1541300	I	L1	7.8	2.4	5.1	48	10/Dec/2022	26.13399051	79.75477602
NH27	1541300	1541400	I	L1	10.2	2.4	6.3	52	10/Dec/2022	26.13479763	79.75521769
NH27	1541400	1541500	I	L1	10.1	3.8	7	47	10/Dec/2022	26.13560576	79.75565974
NH27	1541500	1541600	I	L1	5.6	7.7	6.7	51	10/Dec/2022	26.13641222	79.75610367
NH27	1541600	1541700	I	L1	6.3	7.3	6.8	47	10/Dec/2022	26.13721636	79.75655636
NH27	1541700	1541800	I	L1	6.8	5.3	6.1	50	10/Dec/2022	26.13802744	79.75698884
NH27	1541800	1541900	I	L1	5.1	6	5.6	54	10/Dec/2022	26.13883147	79.757439
NH27	1541900	1542000	I	L1	5	5.1	5.1	52	10/Dec/2022	26.13963685	79.75788872
NH27	1542000	1542100	I	L1	6.9	3.2	5.1	53	10/Dec/2022	26.14044632	79.75832597
NH27	1542100	1542200	I	L1	5.1	5	5.1	55	10/Dec/2022	26.14125037	79.75877551
NH27	1542200	1542300	I	L1	4.1	3.8	4	54	10/Dec/2022	26.14205422	79.75922691
NH27	1542300	1542400	I	L1	6.7	4.9	5.8	55	10/Dec/2022	26.14286175	79.75966844
NH27	1542400	1542500	I	L1	4.5	5.2	4.9	55	10/Dec/2022	26.14366268	79.76012611
NH27	1542500	1542600	I	L1	5	5	5	56	10/Dec/2022	26.1444282	79.76065135
NH27	1542600	1542700	I	L1	5.8	3.9	4.9	55	10/Dec/2022	26.14517902	79.76120228
NH27	1542700	1542800	I	L1	4.9	3.8	4.4	56	10/Dec/2022	26.14588483	79.76182291
NH27	1542800	1542900	I	L1	5.3	4.2	4.8	57	10/Dec/2022	26.14656446	79.76247881
NH27	1542900	1543000	I	L1	5.2	4.7	5	56	10/Dec/2022	26.14724007	79.76313955
NH27	1543000	1543100	I	L1	7.4	5.1	6.3	57	10/Dec/2022	26.14792072	79.76379378
NH27	1543100	1543200	I	L1	5.5	5	5.3	57	10/Dec/2022	26.14859617	79.76445434
NH27	1543200	1543300	I	L1	4	5	4.5	56	10/Dec/2022	26.14927313	79.76511263
NH27	1543300	1543400	I	L1	6.5	5.6	6.1	53	10/Dec/2022	26.14995119	79.76576869
NH27	1543400	1543500	I	L1	8	4.3	6.2	53	10/Dec/2022	26.15063059	79.76642332
NH27	1543500	1543600	I	L1	8.3	4.7	6.5	55	10/Dec/2022	26.15130347	79.76708612

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1543600	1543700	I	L1	8.2	4	6.1	56	10/Dec/2022	26.15198467	79.76773874
NH27	1543700	1543800	I	L1	5.9	4.9	5.4	58	10/Dec/2022	26.15266413	79.76839407
NH27	1543800	1543900	I	L1	6.9	5.4	6.2	59	10/Dec/2022	26.15334067	79.76905268
NH27	1543900	1544000	I	L1	6.8	5.9	6.4	58	10/Dec/2022	26.15401972	79.76970888
NH27	1544000	1544100	I	L1	5.1	4.3	4.7	50	10/Dec/2022	26.15469548	79.7703704
NH27	1544100	1544200	I	L1	5.4	3.3	4.4	46	10/Dec/2022	26.15537032	79.77103077
NH27	1544200	1544300	I	L1	5.9	4.2	5.1	50	10/Dec/2022	26.1560499	79.7716835
NH27	1544300	1544400	I	L1	5.2	2.6	3.9	53	10/Dec/2022	26.15672715	79.77234092
NH27	1544400	1544500	I	L1	4.3	1.8	3.1	53	10/Dec/2022	26.15740165	79.77300247
NH27	1544500	1544600	I	L1	5.6	2.4	4	52	10/Dec/2022	26.15807901	79.77366107
NH27	1544600	1544700	I	L1	5.3	2	3.7	51	10/Dec/2022	26.15876363	79.77432525
NH27	1544700	1544800	I	L1	6.1	2.5	4.3	54	10/Dec/2022	26.1594438	79.7749794
NH27	1544800	1544900	I	L1	4.3	3.2	3.8	55	10/Dec/2022	26.1601237	79.7756348
NH27	1544900	1545000	I	L1	4.9	4.2	4.6	56	10/Dec/2022	26.16079957	79.77629468
NH27	1545000	1545100	I	L1	5.1	3.8	4.5	57	10/Dec/2022	26.16147864	79.77695138
NH27	1545100	1545200	I	L1	3.4	3.7	3.6	53	10/Dec/2022	26.16217831	79.7775819
NH27	1545200	1545300	I	L1	5.3	3.9	4.6	34	10/Dec/2022	26.1629178	79.77815557
NH27	1545300	1545400	I	L1	5	4.5	4.8	50	10/Dec/2022	26.16367977	79.77868169
NH27	1545400	1545500	I	L1	5.4	4.9	5.2	56	10/Dec/2022	26.1644418	79.7792125
NH27	1545500	1545600	I	L1	3.4	4.5	4	57	10/Dec/2022	26.16519993	79.77975233
NH27	1545600	1545700	I	L1	3.6	2.5	3.1	56	10/Dec/2022	26.16595475	79.78029787
NH27	1545700	1545800	I	L1	4.5	3.3	3.9	57	10/Dec/2022	26.16671878	79.78082752
NH27	1545800	1545900	I	L1	4.2	3.5	3.9	58	10/Dec/2022	26.16748256	79.78135752
NH27	1545900	1546000	I	L1	3.6	4.5	4.1	57	10/Dec/2022	26.16823328	79.7819112
NH27	1546000	1546100	I	L1	3.6	4.5	4.1	51	10/Dec/2022	26.16896429	79.78249624
NH27	1546100	1546200	I	L1	3	3.5	3.3	56	10/Dec/2022	26.16970797	79.78305872
NH27	1546200	1546300	I	L1	4.6	3.8	4.2	57	10/Dec/2022	26.17044236	79.78363702
NH27	1546300	1546400	I	L1	5.9	5.7	5.8	58	10/Dec/2022	26.17118582	79.78420119
NH27	1546400	1546500	I	L1	4.7	6.6	5.7	57	10/Dec/2022	26.17192251	79.78477737
NH27	1546500	1546600	I	L1	5.1	5.6	5.4	50	10/Dec/2022	26.17265512	79.78536119
NH27	1546600	1546700	I	L1	6.4	5.5	6	54	10/Dec/2022	26.17339881	79.78592358
NH27	1546700	1546800	I	L1	4	4.7	4.4	58	10/Dec/2022	26.17413521	79.78649744
NH27	1546800	1546900	I	L1	3.7	4.8	4.3	60	10/Dec/2022	26.17487044	79.78707445
NH27	1546900	1547000	I	L1	4.4	4.4	4.4	60	10/Dec/2022	26.17560937	79.78764645
NH27	1547000	1547100	I	L1	4.7	4.6	4.7	60	10/Dec/2022	26.17634891	79.78821713
NH27	1547100	1547200	I	L1	4.9	6.4	5.7	59	10/Dec/2022	26.17708575	79.78879281
NH27	1547200	1547300	I	L1	4.1	4.7	4.4	58	10/Dec/2022	26.17782421	79.78936657
NH27	1547300	1547400	I	L1	4.7	4.8	4.8	58	10/Dec/2022	26.17855973	79.78994322
NH27	1547400	1547500	I	L1	3.5	4.6	4.1	57	10/Dec/2022	26.17929982	79.79051389
NH27	1547500	1547600	I	L1	4.2	3.6	3.9	58	10/Dec/2022	26.18004028	79.79108303

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1547600	1547700	I	L1	4.5	4.5	4.5	58	10/Dec/2022	26.18077718	79.79165823
NH27	1547700	1547800	I	L1	4.2	4	4.1	59	10/Dec/2022	26.18151434	79.79223233
NH27	1547800	1547900	I	L1	3.9	2.9	3.4	53	10/Dec/2022	26.18224719	79.79281517
NH27	1547900	1548000	I	L1	5.1	4.4	4.8	59	10/Dec/2022	26.18298569	79.79338452
NH27	1548000	1548100	I	L1	3.6	3.2	3.4	60	10/Dec/2022	26.18372632	79.79395321
NH27	1548100	1548200	I	L1	6.3	3.8	5.1	58	10/Dec/2022	26.1844629	79.79452909
NH27	1548200	1548300	I	L1	5.9	5.6	5.8	59	10/Dec/2022	26.18519745	79.79510668
NH27	1548300	1548400	I	L1	6.2	5.3	5.8	60	10/Dec/2022	26.18591846	79.79570541
NH27	1548400	1548500	I	L1	5.7	5.5	5.6	62	10/Dec/2022	26.18659736	79.79636161
NH27	1548500	1548600	I	L1	5.3	4.8	5.1	63	10/Dec/2022	26.18723799	79.79706412
NH27	1548600	1548700	I	L1	5.5	4.3	4.9	62	10/Dec/2022	26.18786296	79.79778428
NH27	1548700	1548800	I	L1	5	3.8	4.4	60	10/Dec/2022	26.18848967	79.7985027
NH27	1548800	1548900	I	L1	4.3	4.1	4.2	59	10/Dec/2022	26.18911316	79.79922402
NH27	1548900	1549000	I	L1	5.2	5	5.1	59	10/Dec/2022	26.18973756	79.79994433
NH27	1549000	1549100	I	L1	5.8	4.6	5.2	58	10/Dec/2022	26.19037146	79.80065438
NH27	1549100	1549200	I	L1	5.4	4.7	5.1	58	10/Dec/2022	26.19099822	79.80137222
NH27	1549200	1549300	I	L1	6.1	4.2	5.2	59	10/Dec/2022	26.19162391	79.80209082
NH27	1549300	1549400	I	L1	4.5	3.4	4	58	10/Dec/2022	26.19225089	79.80280885
NH27	1549400	1549500	I	L1	4.5	2.6	3.6	56	10/Dec/2022	26.19287299	79.80353268
NH27	1549500	1549600	I	L1	3.9	8.1	6	55	10/Dec/2022	26.19350007	79.80425036
NH27	1549600	1549700	I	L1	3.2	9.2	6.2	54	10/Dec/2022	26.19412518	79.80497034
NH27	1549700	1549800	I	L1	3.9	6.1	5	54	10/Dec/2022	26.19474971	79.80569013
NH27	1549800	1549900	I	L1	4.3	7.6	6	54	10/Dec/2022	26.19537854	79.80640613
NH27	1549900	1550000	I	L1	3.8	3.9	3.9	54	10/Dec/2022	26.19600614	79.80712297
NH27	1550000	1550100	I	L1	3.4	5.5	4.5	52	10/Dec/2022	26.19662846	79.80784654
NH27	1550100	1550200	I	L1	3.7	3.1	3.4	47	10/Dec/2022	26.1972586	79.80856247
NH27	1550200	1550300	I	L1	4	3.2	3.6	45	10/Dec/2022	26.19788683	79.80927969
NH27	1550300	1550400	I	L1	6.6	2.7	4.7	49	10/Dec/2022	26.1985062	79.81000382
NH27	1550400	1550500	I	L1	6.7	3	4.9	52	10/Dec/2022	26.19913601	79.81071515
NH27	1550500	1550600	I	L1	7.3	3.9	5.6	54	10/Dec/2022	26.19980664	79.81137722
NH27	1550600	1550700	I	L1	5.3	3.3	4.3	55	10/Dec/2022	26.20052407	79.81197909
NH27	1550700	1550800	I	L1	8.5	3.9	6.2	52	10/Dec/2022	26.20124487	79.81257904
NH27	1550800	1550900	I	L1	11.2	3.5	7.4	48	10/Dec/2022	26.20196672	79.81317916
NH27	1550900	1551000	I	L1	6.5	2.7	4.6	51	10/Dec/2022	26.20268846	79.813776
NH27	1551000	1551100	I	L1	6.4	2.6	4.5	52	10/Dec/2022	26.20340721	79.81437884
NH27	1551100	1551200	I	L1	4.1	4.5	4.3	52	10/Dec/2022	26.20411099	79.81500468
NH27	1551200	1551300	I	L1	6.3	2.3	4.3	46	10/Dec/2022	26.20477765	79.81567841
NH27	1551300	1551400	I	L1	4.6	2.7	3.7	52	10/Dec/2022	26.20540709	79.81639265
NH27	1551400	1551500	I	L1	6.3	7.9	7.1	52	10/Dec/2022	26.20601824	79.81712645
NH27	1551500	1551600	I	L1	6	8.3	7.2	53	10/Dec/2022	26.20662578	79.81786394

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1551600	1551700	I	L1	6.8	6.1	6.5	54	10/Dec/2022	26.2072298	79.81860462
NH27	1551700	1551800	I	L1	4.1	3.6	3.9	56	10/Dec/2022	26.20783509	79.8193446
NH27	1551800	1551900	I	L1	4.7	3.7	4.2	55	10/Dec/2022	26.20841692	79.82010824
NH27	1551900	1552000	I	L1	4.3	3.9	4.1	51	10/Dec/2022	26.20897452	79.82089461
NH27	1552000	1552100	I	L1	5.7	9.7	7.7	49	10/Dec/2022	26.20954058	79.8216725
NH27	1552100	1552200	I	L1	4.6	4.5	4.6	51	10/Dec/2022	26.21011131	79.82244525
NH27	1552200	1552300	I	L1	3.5	4.5	4	33	10/Dec/2022	26.21064342	79.82325413
NH27	1552300	1552400	I	L1	4.6	4.9	4.8	41	10/Dec/2022	26.21118678	79.82404859
NH27	1552400	1552500	I	L1	4.5	3.8	4.2	50	10/Dec/2022	26.21177637	79.82480088
NH27	1552500	1552600	I	L1	3.9	3.6	3.8	55	10/Dec/2022	26.21243357	79.82548199
NH27	1552600	1552700	I	L1	7	5.7	6.4	58	10/Dec/2022	26.21313172	79.82611167
NH27	1552700	1552800	I	L1	5.8	3.6	4.7	59	10/Dec/2022	26.2138674	79.8266867
NH27	1552800	1552900	I	L1	6.5	3.1	4.8	58	10/Dec/2022	26.21466905	79.82714015
NH27	1552900	1553000	I	L1	6.5	6.5	6.5	46	10/Dec/2022	26.21551241	79.82749502
NH27	1553000	1553100	I	L1	10.8	8.1	9.5	46	10/Dec/2022	26.21637435	79.82777504
NH27	1553100	1553200	I	L1	8.2	7.5	7.9	54	10/Dec/2022	26.21723938	79.82805072
NH27	1553200	1553300	I	L1	9.1	8.7	8.9	56	10/Dec/2022	26.21810486	79.82832691
NH27	1553300	1553400	I	L1	7.2	9.4	8.3	56	10/Dec/2022	26.21897008	79.82860712
NH27	1553400	1553500	I	L1	7.1	8.7	7.9	47	10/Dec/2022	26.21983652	79.82888687
NH27	1553500	1553600	I	L1	8.9	6.7	7.8	43	10/Dec/2022	26.22070355	79.82915962
NH27	1553600	1553700	I	L1	7.9	7.8	7.9	49	10/Dec/2022	26.22156917	79.82943398
NH27	1553700	1553800	I	L1	10.5	6.1	8.3	45	10/Dec/2022	26.22243637	79.82970785
NH27	1553800	1553900	I	L1	7.6	7.8	7.7	54	10/Dec/2022	26.22329971	79.82998743
NH27	1553900	1554000	I	L1	6.6	9.5	8.1	58	10/Dec/2022	26.22416403	79.83026674
NH27	1554000	1554100	I	L1	6.6	9.6	8.1	58	10/Dec/2022	26.22502982	79.8305441
NH27	1554100	1554200	I	L1	9.4	8.1	8.8	54	10/Dec/2022	26.22589634	79.83082258
NH27	1554200	1554300	I	L1	9.4	4.7	7.1	52	10/Dec/2022	26.22676335	79.83109777
NH27	1554300	1554400	I	L1	8.5	9.1	8.8	49	10/Dec/2022	26.22762149	79.83140589
NH27	1554400	1554500	I	L1	10.9	14	12.5	51	10/Dec/2022	26.22844605	79.83180764
NH27	1554500	1554600	I	L1	10.4	13.5	12	56	10/Dec/2022	26.22922467	79.83230659
NH27	1554600	1554700	I	L1	12.6	13.8	13.2	57	10/Dec/2022	26.22995176	79.83289529
NH27	1554700	1554800	I	L1	6.2	9.5	7.9	54	10/Dec/2022	26.23062103	79.83356562
NH27	1554800	1554900	I	L1	6.9	9.2	8.1	56	10/Dec/2022	26.23121764	79.83431454
NH27	1554900	1555000	I	L1	6.9	7.9	7.4	52	10/Dec/2022	26.23173082	79.83513661
NH27	1555000	1555100	I	L1	5.8	7.4	6.6	53	10/Dec/2022	26.23217743	79.83600391
NH27	1555100	1555200	I	L1	5.4	6.3	5.9	56	10/Dec/2022	26.23252077	79.83692675
NH27	1555200	1555300	I	L1	7.2	10.8	9	57	10/Dec/2022	26.23278361	79.83788209
NH27	1555300	1555400	I	L1	3.9	5.4	4.7	55	10/Dec/2022	26.23302507	79.8388448
NH27	1555400	1555500	I	L1	9.7	5.9	7.8	54	10/Dec/2022	26.2332635	79.83980816
NH27	1555500	1555600	I	L1	6.9	7	7	55	10/Dec/2022	26.23349585	79.8407735

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1555600	1555700	I	L1	6.9	3.5	5.2	54	10/Dec/2022	26.23373558	79.84173636
NH27	1555700	1555800	I	L1	6.8	4.8	5.8	56	10/Dec/2022	26.23398191	79.84269704
NH27	1555800	1555900	I	L1	7.2	5.6	6.4	57	10/Dec/2022	26.23422297	79.84365944
NH27	1555900	1556000	I	L1	5.7	7.6	6.7	57	10/Dec/2022	26.23446377	79.8446327
NH27	1556000	1556100	I	L1	5.4	8.1	6.8	57	10/Dec/2022	26.23469946	79.84559736
NH27	1556100	1556200	I	L1	5.7	6.2	6	56	10/Dec/2022	26.23494933	79.84655759
NH27	1556200	1556300	I	L1	6.5	3.8	5.2	56	10/Dec/2022	26.235263	79.84749312
NH27	1556300	1556400	I	L1	8.7	6.5	7.6	55	10/Dec/2022	26.23565544	79.84839197
NH27	1556400	1556500	I	L1	5.8	4.6	5.2	53	10/Dec/2022	26.23613072	79.84923998
NH27	1556500	1556600	I	L1	5.8	6.6	6.2	56	10/Dec/2022	26.23667917	79.85003083
NH27	1556600	1556700	I	L1	5.9	6.7	6.3	57	10/Dec/2022	26.23729764	79.85075625
NH27	1556700	1556800	I	L1	6.6	7.8	7.2	58	10/Dec/2022	26.23798309	79.85140313
NH27	1556800	1556900	I	L1	8.3	6.1	7.2	58	10/Dec/2022	26.23872246	79.85197333
NH27	1556900	1557000	I	L1	8.4	5.9	7.2	58	10/Dec/2022	26.23948777	79.85250189
NH27	1557000	1557100	I	L1	5.9	5.5	5.7	57	10/Dec/2022	26.24025008	79.85303557
NH27	1557100	1557200	I	L1	6.7	7.2	7	58	10/Dec/2022	26.24102149	79.8535518
NH27	1557200	1557300	I	L1	5.7	8.3	7	59	10/Dec/2022	26.24178944	79.85407503
NH27	1557300	1557400	I	L1	6.1	6.1	6.1	59	10/Dec/2022	26.24255668	79.85459888
NH27	1557400	1557500	I	L1	6.2	8.5	7.4	59	10/Dec/2022	26.24332405	79.85512281
NH27	1557500	1557600	I	L1	7.8	11.6	9.7	57	10/Dec/2022	26.24408906	79.85565114
NH27	1557600	1557700	I	L1	9.3	9.7	9.5	56	10/Dec/2022	26.24485461	79.85617889
NH27	1557700	1557800	I	L1	12.7	11.2	12	57	10/Dec/2022	26.24562233	79.85670175
NH27	1557800	1557900	I	L1	6.9	9	8	58	10/Dec/2022	26.24638854	79.85722728
NH27	1557900	1558000	I	L1	4.5	5.8	5.2	58	10/Dec/2022	26.24715426	79.85775457
NH27	1558000	1558100	I	L1	6.4	6.2	6.3	57	10/Dec/2022	26.2478826	79.85834268
NH27	1558100	1558200	I	L1	7	5.6	6.3	56	10/Dec/2022	26.24852176	79.8590471
NH27	1558200	1558300	I	L1	9	9.1	9.1	55	10/Dec/2022	26.24910398	79.85981033
NH27	1558300	1558400	I	L1	6.5	8.7	7.6	57	10/Dec/2022	26.24968656	79.86057215
NH27	1558400	1558500	I	L1	11.4	8.4	9.9	56	10/Dec/2022	26.25026461	79.86133916
NH27	1558500	1558600	I	L1	6.3	7.7	7	57	10/Dec/2022	26.25084807	79.86210092
NH27	1558600	1558700	I	L1	5.6	6.4	6	58	10/Dec/2022	26.25142723	79.86286639
NH27	1558700	1558800	I	L1	4.5	5.6	5.1	55	10/Dec/2022	26.25200695	79.86363265
NH27	1558800	1558900	I	L1	4.9	5.6	5.3	55	10/Dec/2022	26.25258204	79.86440155
NH27	1558900	1559000	I	L1	7.1	7.4	7.3	55	10/Dec/2022	26.25316958	79.86515961
NH27	1559000	1559100	I	L1	7.3	7.5	7.4	54	10/Dec/2022	26.25373947	79.86593411
NH27	1559100	1559200	I	L1	5.3	6.1	5.7	55	10/Dec/2022	26.25433122	79.86668737
NH27	1559200	1559300	I	L1	6.9	5.5	6.2	52	10/Dec/2022	26.25491424	79.86744994
NH27	1559300	1559400	I	L1	5	5.4	5.2	55	10/Dec/2022	26.25549136	79.86821609
NH27	1559400	1559500	I	L1	5.5	5.8	5.7	57	10/Dec/2022	26.25609366	79.86895792
NH27	1559500	1559600	I	L1	5.6	6.1	5.9	60	10/Dec/2022	26.25674896	79.8696414

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1559600	1559700	I	L1	4.7	6.6	5.7	62	10/Dec/2022	26.25746281	79.87024918
NH27	1559700	1559800	I	L1	4.5	5.9	5.2	61	10/Dec/2022	26.25820773	79.87081206
NH27	1559800	1559900	I	L1	5.1	5.9	5.5	60	10/Dec/2022	26.25894898	79.8713803
NH27	1559900	1560000	I	L1	5.2	6.6	5.9	62	10/Dec/2022	26.2596923	79.87194428
NH27	1560000	1560100	I	L1	4.2	5.8	5	63	10/Dec/2022	26.26043772	79.87250537
NH27	1560100	1560200	I	L1	4.3	4.7	4.5	62	10/Dec/2022	26.26117846	79.87307507
NH27	1560200	1560300	I	L1	4.9	6.6	5.8	61	10/Dec/2022	26.26192303	79.87363864
NH27	1560300	1560400	I	L1	5.5	5.8	5.7	60	10/Dec/2022	26.26266721	79.87420344
NH27	1560400	1560500	I	L1	6	5.1	5.6	58	10/Dec/2022	26.26341102	79.87476848
NH27	1560500	1560600	I	L1	6.5	8	7.3	58	10/Dec/2022	26.26415805	79.87532815
NH27	1560600	1560700	I	L1	7.1	8.5	7.8	58	10/Dec/2022	26.26489992	79.87589534
NH27	1560700	1560800	I	L1	6.8	7.3	7.1	57	10/Dec/2022	26.26564408	79.87645957
NH27	1560800	1560900	I	L1	7.6	8.2	7.9	57	10/Dec/2022	26.26638819	79.87702341
NH27	1560900	1561000	I	L1	7.5	7	7.3	57	10/Dec/2022	26.26713145	79.87758926
NH27	1561000	1561100	I	L1	6.6	6.5	6.6	57	10/Dec/2022	26.26787607	79.87815204
NH27	1561100	1561200	I	L1	6.5	4.5	5.5	57	10/Dec/2022	26.26861179	79.87872971
NH27	1561200	1561300	I	L1	5.8	6	5.9	53	10/Dec/2022	26.26932529	79.87934105
NH27	1561300	1561400	I	L1	4.7	5.1	4.9	55	10/Dec/2022	26.26999388	79.88000955
NH27	1561400	1561500	I	L1	3.4	4.4	3.9	55	10/Dec/2022	26.27065082	79.88069357
NH27	1561500	1561600	I	L1	4.3	4.9	4.6	57	10/Dec/2022	26.27130612	79.88137955
NH27	1561600	1561700	I	L1	3.9	5.3	4.6	58	10/Dec/2022	26.27196189	79.88206498
NH27	1561700	1561800	I	L1	4.5	4.6	4.6	58	10/Dec/2022	26.27261753	79.88275064
NH27	1561800	1561900	I	L1	5.7	4.2	5	58	10/Dec/2022	26.27327578	79.88343299
NH27	1561900	1562000	I	L1	3.8	5.2	4.5	58	10/Dec/2022	26.27392852	79.88412232
NH27	1562000	1562100	I	L1	4.4	4.9	4.7	57	10/Dec/2022	26.2745807	79.88481239
NH27	1562100	1562200	I	L1	4.2	4.2	4.2	56	10/Dec/2022	26.27523685	79.88549804
NH27	1562200	1562300	I	L1	4.4	4.9	4.7	55	10/Dec/2022	26.2758883	79.8861893
NH27	1562300	1562400	I	L1	8.3	5.1	6.7	53	10/Dec/2022	26.27653708	79.88688328
NH27	1562400	1562500	I	L1	8.1	5.3	6.7	53	10/Dec/2022	26.27718671	79.88757583
NH27	1562500	1562600	I	L1	3.2	3.7	3.5	51	10/Dec/2022	26.27783501	79.88827058
NH27	1562600	1562700	I	L1	4	3.4	3.7	53	10/Dec/2022	26.27848631	79.88896096
NH27	1562700	1562800	I	L1	4.1	4.8	4.5	53	10/Dec/2022	26.27914015	79.88964895
NH27	1562800	1562900	I	L1	4.1	4.2	4.2	54	10/Dec/2022	26.27978907	79.89034236
NH27	1562900	1563000	I	L1	4.7	3.4	4.1	53	10/Dec/2022	26.28045319	79.89101672
NH27	1563000	1563100	I	L1	8.1	3.6	5.9	55	10/Dec/2022	26.28121973	79.89153638
NH27	1563100	1563200	I	L1	7.4	2.8	5.1	57	10/Dec/2022	26.28200286	79.89202946
NH27	1563200	1563300	I	L1	5.4	3.9	4.7	58	10/Dec/2022	26.28272414	79.89262781
NH27	1563300	1563400	I	L1	5.6	3.5	4.6	57	10/Dec/2022	26.28337038	79.89332444
NH27	1563400	1563500	I	L1	5.6	2.9	4.3	55	10/Dec/2022	26.28398255	79.89405861
NH27	1563500	1563600	I	L1	3.3	10.3	6.8	55	10/Dec/2022	26.28458797	79.89479925

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1563600	1563700	I	L1	3.6	2.6	3.1	54	10/Dec/2022	26.28520333	79.89552964
NH27	1563700	1563800	I	L1	3.7	3.6	3.7	53	10/Dec/2022	26.28581268	79.89626645
NH27	1563800	1563900	I	L1	6.6	6.8	6.7	50	10/Dec/2022	26.28639854	79.89702664
NH27	1563900	1564000	I	L1	7.2	6.5	6.9	52	10/Dec/2022	26.28700743	79.89776296
NH27	1564000	1564100	I	L1	4.7	5.5	5.1	52	10/Dec/2022	26.28759025	79.89852336
NH27	1564100	1564200	I	L1	5	5.9	5.5	55	10/Dec/2022	26.28815256	79.89930181
NH27	1564200	1564300	I	L1	4.7	6	5.4	55	10/Dec/2022	26.28865354	79.90013078
NH27	1564300	1564400	I	L1	5.8	7.5	6.7	48	10/Dec/2022	26.28908442	79.90101026
NH27	1564400	1564500	I	L1	6.2	7.6	6.9	53	10/Dec/2022	26.28946677	79.90191552
NH27	1564500	1564600	I	L1	5.9	8.6	7.3	55	10/Dec/2022	26.28985147	79.90282035
NH27	1564600	1564700	I	L1	5.6	7	6.3	54	10/Dec/2022	26.29023393	79.90372657
NH27	1564700	1564800	I	L1	4.7	4.7	4.7	55	10/Dec/2022	26.29067132	79.90459831
NH27	1564800	1564900	I	L1	5.5	5	5.3	54	10/Dec/2022	26.29120243	79.90540553
NH27	1564900	1565000	I	L1	4.1	4.9	4.5	53	10/Dec/2022	26.29177174	79.90618097
NH27	1565000	1565100	I	L1	6.6	5.1	5.9	56	10/Dec/2022	26.2923368	79.9069593
NH27	1565100	1565200	I	L1	4.4	4.2	4.3	57	10/Dec/2022	26.29290422	79.9077358
NH27	1565200	1565300	I	L1	5.3	5.2	5.3	57	10/Dec/2022	26.29347138	79.90851316
NH27	1565300	1565400	I	L1	4.5	4.6	4.6	55	10/Dec/2022	26.29404008	79.90928921
NH27	1565400	1565500	I	L1	4.7	4.7	4.7	53	10/Dec/2022	26.29460871	79.91006573
NH27	1565500	1565600	I	L1	4.4	4.7	4.6	54	10/Dec/2022	26.29517389	79.91084427
NH27	1565600	1565700	I	L1	4.2	5.2	4.7	53	10/Dec/2022	26.29573279	79.91162881
NH27	1565700	1565800	I	L1	4.4	4.2	4.3	58	10/Dec/2022	26.29630367	79.91240015
NH27	1565800	1565900	I	L1	4.3	3.7	4	60	10/Dec/2022	26.29687428	79.91317367
NH27	1565900	1566000	I	L1	4.7	3.7	4.2	59	10/Dec/2022	26.29744709	79.91394588
NH27	1566000	1566100	I	L1	4.5	3.3	3.9	59	10/Dec/2022	26.29806854	79.91466916
NH27	1566100	1566200	I	L1	5.1	3.7	4.4	57	10/Dec/2022	26.29870129	79.91538231
NH27	1566200	1566300	I	L1	5.1	3.5	4.3	57	10/Dec/2022	26.29933868	79.91608919
NH27	1566300	1566400	I	L1	4.8	3.4	4.1	58	10/Dec/2022	26.29995771	79.91681661
NH27	1566400	1566500	I	L1	5.1	3.2	4.2	55	10/Dec/2022	26.30055656	79.91756536
NH27	1566500	1566600	I	L1	4.5	3.8	4.2	58	10/Dec/2022	26.30118797	79.9182778
NH27	1566600	1566700	I	L1	4.3	4.2	4.3	59	10/Dec/2022	26.30178055	79.91903097
NH27	1566700	1566800	I	L1	5.6	3.9	4.8	55	10/Dec/2022	26.30230264	79.91984744
NH27	1566800	1566900	I	L1	3.9	2.6	3.3	56	10/Dec/2022	26.30277595	79.92069892
NH27	1566900	1567000	I	L1	4.5	3.1	3.8	57	10/Dec/2022	26.30326049	79.92154173
NH27	1567000	1567100	I	L1	4.2	3.4	3.8	56	10/Dec/2022	26.3038568	79.92228362
NH27	1567100	1567200	I	L1	7.6	3.1	5.4	56	10/Dec/2022	26.30463108	79.92278571
NH27	1567200	1567300	I	L1	6.8	3.7	5.3	47	10/Dec/2022	26.30549611	79.92309783
NH27	1567300	1567400	I	L1	6.3	3.3	4.8	54	10/Dec/2022	26.3063306	79.92346594
NH27	1567400	1567500	I	L1	7.9	4.3	6.1	56	10/Dec/2022	26.30705023	79.92406462
NH27	1567500	1567600	I	L1	5.5	4.3	4.9	50	10/Dec/2022	26.3077197	79.92473478

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1567600	1567700	I	L1	4.9	6.2	5.6	48	10/Dec/2022	26.30837944	79.92541504
NH27	1567700	1567800	I	L1	7.6	5.2	6.4	53	10/Dec/2022	26.30905704	79.92607126
NH27	1567800	1567900	I	L1	6.4	3.8	5.1	58	10/Dec/2022	26.30972255	79.9267432
NH27	1567900	1568000	I	L1	5.1	5.3	5.2	60	10/Dec/2022	26.31038729	79.92741698
NH27	1568000	1568100	I	L1	6	5.6	5.8	59	10/Dec/2022	26.31105472	79.92808842
NH27	1568100	1568200	I	L1	4.3	3.9	4.1	59	10/Dec/2022	26.31172255	79.92875926
NH27	1568200	1568300	I	L1	5.4	4.8	5.1	58	10/Dec/2022	26.31239001	79.92943139
NH27	1568300	1568400	I	L1	5	4.8	4.9	61	10/Dec/2022	26.31302728	79.93013726
NH27	1568400	1568500	I	L1	5.6	4.7	5.2	61	10/Dec/2022	26.31355817	79.93094507
NH27	1568500	1568600	I	L1	5.8	4.3	5.1	61	10/Dec/2022	26.31402025	79.9318041
NH27	1568600	1568700	I	L1	6.7	5.8	6.3	60	10/Dec/2022	26.31447624	79.93266704
NH27	1568700	1568800	I	L1	6.5	5.1	5.8	58	10/Dec/2022	26.31492982	79.93353015
NH27	1568800	1568900	I	L1	5.7	3.5	4.6	57	10/Dec/2022	26.31538255	79.93439403
NH27	1568900	1569000	I	L1	4.4	3.2	3.8	57	10/Dec/2022	26.31583668	79.93525678
NH27	1569000	1569100	I	L1	4.5	3	3.8	57	10/Dec/2022	26.31625806	79.93614015
NH27	1569100	1569200	I	L1	5.3	2.8	4.1	58	10/Dec/2022	26.31663618	79.93704741
NH27	1569200	1569300	I	L1	5.1	4.8	5	57	10/Dec/2022	26.31700659	79.93795869
NH27	1569300	1569400	I	L1	4.8	4.1	4.5	53	10/Dec/2022	26.31737786	79.9388703
NH27	1569400	1569500	I	L1	3.7	3.3	3.5	44	10/Dec/2022	26.31775111	79.93978182
NH27	1569500	1569600	I	L1	3.8	3.3	3.6	37	10/Dec/2022	26.31818011	79.94065955
NH27	1569600	1569700	I	L1	4.6	3.3	4	43	10/Dec/2022	26.31870196	79.94147381
NH27	1569700	1569800	I	L1	3.3	2.3	2.8	43	10/Dec/2022	26.31923273	79.9422823
NH27	1569800	1569900	I	L1	2.9	3.1	3	38	10/Dec/2022	26.31976706	79.94308878
NH27	1569900	1570000	I	L1	3.6	3.8	3.7	47	10/Dec/2022	26.3202703	79.94391603
NH27	1570000	1570100	I	L1	5.8	3.2	4.5	48	10/Dec/2022	26.32076332	79.94475308
NH27	1570100	1570200	I	L1	3.2	2.7	3	45	10/Dec/2022	26.32117278	79.94564481
NH27	1570200	1570300	I	L1	3.1	5.4	4.3	34	10/Dec/2022	26.32155087	79.94655459
NH27	1570300	1570400	I	L1	3.5	5.5	4.5	44	10/Dec/2022	26.32191558	79.94746683
NH27	1570400	1570500	I	L1	5.6	3	4.3	48	10/Dec/2022	26.32231271	79.94836391
NH27	1570500	1570600	I	L1	5.3	3.8	4.6	43	10/Dec/2022	26.32274724	79.94924028
NH27	1570600	1570700	I	L1	4.3	3.9	4.1	40	10/Dec/2022	26.32326479	79.95005834
NH27	1570700	1570800	I	L1	3.6	3	3.3	36	10/Dec/2022	26.32385249	79.9508162
NH27	1570800	1570900	I	L1	3.4	3	3.2	40	10/Dec/2022	26.32445448	79.95155947
NH27	1570900	1571000	I	L1	5.2	2.6	3.9	48	10/Dec/2022	26.32510228	79.95224982
NH27	1571000	1571100	I	L1	5.5	3.7	4.6	55	10/Dec/2022	26.32577872	79.95290708
NH27	1571100	1571200	I	L1	3.5	3.2	3.4	51	10/Dec/2022	26.32648561	79.95352799
NH27	1571200	1571300	I	L1	4.6	3.5	4.1	52	10/Dec/2022	26.32718355	79.95416052
NH27	1571300	1571400	I	L1	4.3	2.7	3.5	54	10/Dec/2022	26.32788932	79.95478127
NH27	1571400	1571500	I	L1	3.7	3.4	3.6	55	10/Dec/2022	26.32856767	79.95543951
NH27	1571500	1571600	I	L1	5	6	5.5	56	10/Dec/2022	26.32926846	79.95606635

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1571600	1571700	I	L1	3.9	4.8	4.4	54	10/Dec/2022	26.32997676	79.95668331
NH27	1571700	1571800	I	L1	4.7	5.8	5.3	51	10/Dec/2022	26.33068128	79.95730754
NH27	1571800	1571900	I	L1	4.3	5.5	4.9	50	10/Dec/2022	26.33139214	79.95792385
NH27	1571900	1572000	I	L1	4.5	2.6	3.6	46	10/Dec/2022	26.33210028	79.95854414
NH27	1572000	1572100	I	L1	3.5	2.6	3.1	43	10/Dec/2022	26.33282239	79.95914297
NH27	1572100	1572200	I	L1	3.4	2	2.7	43	10/Dec/2022	26.33355366	79.95972705
NH27	1572200	1572300	I	L1	3.5	3.6	3.6	46	10/Dec/2022	26.33431049	79.9602689
NH27	1572300	1572400	I	L1	5.2	3.8	4.5	51	10/Dec/2022	26.33507036	79.9608047
NH27	1572400	1572500	I	L1	5.4	3.2	4.3	51	10/Dec/2022	26.33580877	79.96137822
NH27	1572500	1572600	I	L1	5.3	3.8	4.6	52	10/Dec/2022	26.33654826	79.9619491
NH27	1572600	1572700	I	L1	5	4	4.5	50	10/Dec/2022	26.33728772	79.96252129
NH27	1572700	1572800	I	L1	4.2	2.6	3.4	50	10/Dec/2022	26.3380464	79.96305968
NH27	1572800	1572900	I	L1	4.4	2.2	3.3	48	10/Dec/2022	26.33880022	79.96360796
NH27	1572900	1573000	I	L1	4.6	2.5	3.6	48	10/Dec/2022	26.33949746	79.96424141
NH27	1573000	1573100	I	L1	3.6	3	3.3	43	10/Dec/2022	26.3401244	79.96496128
NH27	1573100	1573200	I	L1	4.1	3.5	3.8	34	10/Dec/2022	26.34072502	79.96570868
NH27	1573200	1573300	I	L1	4.9	3.4	4.2	47	10/Dec/2022	26.34134265	79.96643293
NH27	1573300	1573400	I	L1	5.5	2.9	4.2	51	10/Dec/2022	26.34194222	79.96717881
NH27	1573400	1573500	I	L1	4.3	4	4.2	51	10/Dec/2022	26.34254604	79.96791896
NH27	1573500	1573600	I	L1	4.4	4.2	4.3	50	10/Dec/2022	26.34314795	79.96866136
NH27	1573600	1573700	I	L1	8.6	6.6	7.6	49	10/Dec/2022	26.34375511	79.96939894
NH27	1573700	1573800	I	L1	6.3	4.6	5.5	50	10/Dec/2022	26.34436506	79.97013558
NH27	1573800	1573900	I	L1	4.7	5.5	5.1	55	10/Dec/2022	26.34497149	79.97087508
NH27	1573900	1574000	I	L1	5.6	3.9	4.8	59	10/Dec/2022	26.34557811	79.97161486
NH27	1574000	1574100	I	L1	3.7	3	3.4	57	10/Dec/2022	26.34620021	79.97233999
NH27	1574100	1574200	I	L1	3.9	3.7	3.8	54	10/Dec/2022	26.34683642	79.9730489
NH27	1574200	1574300	I	L1	3.7	2.6	3.2	54	10/Dec/2022	26.34744945	79.97378263
NH27	1574300	1574400	I	L1	3.5	2.8	3.2	53	10/Dec/2022	26.34805547	79.97452251
NH27	1574400	1574500	I	L1	4.4	4.3	4.4	48	10/Dec/2022	26.34866732	79.9752582
NH27	1574500	1574600	I	L1	5.9	2.4	4.2	50	10/Dec/2022	26.34927349	79.97599749
NH27	1574600	1574700	I	L1	4.8	2.4	3.6	51	10/Dec/2022	26.3498873	79.97672968
NH27	1574700	1574800	I	L1	3.6	4.1	3.9	47	10/Dec/2022	26.35049081	79.97747354
NH27	1574800	1574900	I	L1	4.7	3.6	4.2	39	10/Dec/2022	26.35109573	79.97821587
NH27	1574900	1575000	I	L1	6	6.3	6.2	34	10/Dec/2022	26.35169794	79.9789609
NH27	1575000	1575100	I	L1	9.1	4.4	6.8	42	10/Dec/2022	26.3523057	79.97969544
NH27	1575100	1575200	I	L1	7.1	5.9	6.5	46	10/Dec/2022	26.35291996	79.98042574
NH27	1575200	1575300	I	L1	4.9	2.8	3.9	49	10/Dec/2022	26.35352393	79.9811678
NH27	1575300	1575400	I	L1	5.6	3.7	4.7	51	10/Dec/2022	26.35412947	79.98190823
NH27	1575400	1575500	I	L1	6.2	3.6	4.9	53	10/Dec/2022	26.35473894	79.98264422
NH27	1575500	1575600	I	L1	5.8	2.9	4.4	50	10/Dec/2022	26.35538722	79.98333852

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1575600	1575700	I	L1	6	2.9	4.5	49	10/Dec/2022	26.35608835	79.98396579
NH27	1575700	1575800	I	L1	6.1	2.5	4.3	52	10/Dec/2022	26.35683761	79.98451936
NH27	1575800	1575900	I	L1	5.3	2.5	3.9	53	10/Dec/2022	26.3576229	79.98500905
NH27	1575900	1576000	I	L1	4.4	3.4	3.9	50	10/Dec/2022	26.35841131	79.98549485
NH27	1576000	1576100	I	L1	6.2	3.1	4.7	52	10/Dec/2022	26.35920764	79.98596097
NH27	1576100	1576200	I	L1	3.3	2.1	2.7	50	10/Dec/2022	26.35999848	79.9864412
NH27	1576200	1576300	I	L1	4.5	3.3	3.9	49	10/Dec/2022	26.36078972	79.98692001
NH27	1576300	1576400	I	L1	5.4	3.1	4.3	53	10/Dec/2022	26.36158368	79.98739148
NH27	1576400	1576500	I	L1	5.6	3.1	4.4	53	10/Dec/2022	26.36237713	79.98786552
NH27	1576500	1576600	I	L1	5.7	5.3	5.5	53	10/Dec/2022	26.36316989	79.98834132
NH27	1576600	1576700	I	L1	5.8	5.3	5.6	53	10/Dec/2022	26.36396122	79.98881964
NH27	1576700	1576800	I	L1	5.2	5.2	5.2	53	10/Dec/2022	26.36475413	79.9892949
NH27	1576800	1576900	I	L1	5.1	4	4.6	52	10/Dec/2022	26.36554537	79.98977408
NH27	1576900	1577000	I	L1	5.3	3.2	4.3	54	10/Dec/2022	26.36633991	79.99024444
NH27	1577000	1577100	I	L1	4.7	3.6	4.2	53	10/Dec/2022	26.36714519	79.99069385
NH27	1577100	1577200	I	L1	5.4	2.1	3.8	47	10/Dec/2022	26.36794742	79.99115152
NH27	1577200	1577300	I	L1	5	3.8	4.4	46	10/Dec/2022	26.36874046	79.99162717
NH27	1577300	1577400	I	L1	5.2	2.9	4.1	48	10/Dec/2022	26.36953256	79.99210346
NH27	1577400	1577500	I	L1	5	5.2	5.1	44	10/Dec/2022	26.37032592	79.99257922
NH27	1577500	1577600	I	L1	5.4	6.1	5.8	46	10/Dec/2022	26.37111853	79.99305395
NH27	1577600	1577700	I	L1	5.4	6	5.7	49	10/Dec/2022	26.37190992	79.99353155
NH27	1577700	1577800	I	L1	6.2	5.1	5.7	50	10/Dec/2022	26.3727009	79.99401017
NH27	1577800	1577900	I	L1	5.8	5.3	5.6	48	10/Dec/2022	26.37348323	79.99450856
NH27	1577900	1578000	I	L1	6.1	6.3	6.2	14	10/Dec/2022	26.37426964	79.99500176
NH27	1578000	1578100	I	L1	3.2	3.1	3.2	34	10/Dec/2022	26.37505122	79.99549099
NH27	1578100	1578200	I	L1	5.3	4.5	4.9	47	10/Dec/2022	26.37583847	79.9959731
NH27	1578200	1578300	I	L1	7.7	10.9	9.3	52	10/Dec/2022	26.37662658	79.99645397
NH27	1578300	1578400	I	L1	5.9	7.4	6.7	52	10/Dec/2022	26.37738707	79.99698568
NH27	1578400	1578500	I	L1	7	5.6	6.3	52	10/Dec/2022	26.37808484	79.9976159
NH27	1578500	1578600	I	L1	6.2	6.9	6.6	53	10/Dec/2022	26.37878025	79.99826661
NH27	1578600	1578700	I	L1	6.4	3.7	5.1	53	10/Dec/2022	26.37945992	79.99892395
NH27	1578700	1578800	I	L1	7.7	12.3	10	52	10/Dec/2022	26.38000356	79.99972009
NH27	1578800	1578900	I	L1	8.9	8.02	8.5	50	10/Dec/2022	26.38028269	80.0006701
NH27	1578900	1579000	I	L1	5.3	7.8	6.6	51	10/Dec/2022	26.38041202	80.00166057
NH27	1579000	1579077	I	L1	6.1	6.3	6.2	51	10/Dec/2022	26.38064625	80.00262428
NH27	1515713	1515800	I	L2	8.3	9	8.7	22	10/Dec/2022	26.02258997	79.53914393
NH27	1515800	1515900	I	L2	11.2	9.3	10.3	44	10/Dec/2022	26.02287248	79.53992772
NH27	1515900	1516000	I	L2	4.7	9.7	7.2	44	10/Dec/2022	26.02320537	79.54085317
NH27	1516000	1516100	I	L2	12.8	13.5	13.2	45	10/Dec/2022	26.02320537	79.54085317

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1516100	1516200	I	L2	11.8	10.7	11.3	39	10/Dec/2022	26.02354231	79.54177837
NH27	1516200	1516300	I	L2	11.2	8.4	9.8	44	10/Dec/2022	26.02387608	79.54270296
NH27	1516300	1516400	I	L2	6.6	5.5	6.1	42	10/Dec/2022	26.02421252	79.54362794
NH27	1516400	1516500	I	L2	7.5	13.1	10.3	38	10/Dec/2022	26.02454623	79.54455413
NH27	1516500	1516600	I	L2	14.2	10.7	12.5	32	10/Dec/2022	26.02487829	79.54548136
NH27	1516600	1516700	I	L2	11.7	10.3	11	10	10/Dec/2022	26.02521335	79.54642699
NH27	1516700	1516800	I	L2	10	9.9	10	33	10/Dec/2022	26.02555591	79.54734587
NH27	1516800	1516900	I	L2	11.9	11.6	11.8	46	10/Dec/2022	26.0258978	79.5482655
NH27	1516900	1517000	I	L2	11.4	10.4	10.9	49	10/Dec/2022	26.02623822	79.54918716
NH27	1517000	1517100	I	L2	8.7	9.5	9.1	53	10/Dec/2022	26.02658081	79.55010825
NH27	1517100	1517200	I	L2	6.4	7.8	7.1	57	10/Dec/2022	26.02692223	79.55103001
NH27	1517200	1517300	I	L2	5.6	6.8	6.2	56	10/Dec/2022	26.0272613	79.55195487
NH27	1517300	1517400	I	L2	7	12.1	9.6	61	10/Dec/2022	26.02760123	79.5528779
NH27	1517400	1517500	I	L2	4.7	9.7	7.2	60	10/Dec/2022	26.0279464	79.55379992
NH27	1517500	1517600	I	L2	5.7	7.1	6.4	55	10/Dec/2022	26.02828722	79.55472413
NH27	1517600	1517700	I	L2	9.7	7.1	8.4	52	10/Dec/2022	26.02864164	79.5556421
NH27	1517700	1517800	I	L2	9	4.6	6.8	51	10/Dec/2022	26.02894492	79.55658038
NH27	1517800	1517900	I	L2	9	6.9	8	55	10/Dec/2022	26.02924496	79.5575194
NH27	1517900	1518000	I	L2	6.9	7.8	7.4	50	10/Dec/2022	26.02958403	79.55844415
NH27	1518000	1518100	I	L2	5.1	5.8	5.5	52	10/Dec/2022	26.02992186	79.55936761
NH27	1518100	1518200	I	L2	8.4	8.2	8.3	57	10/Dec/2022	26.03027894	79.56028134
NH27	1518200	1518300	I	L2	12	7.6	9.8	65	10/Dec/2022	26.03062812	79.56119756
NH27	1518300	1518400	I	L2	8.7	8.5	8.6	61	10/Dec/2022	26.03094707	79.56212999
NH27	1518400	1518500	I	L2	14.5	13.9	14.2	56	10/Dec/2022	26.03128643	79.56305387
NH27	1518500	1518600	I	L2	14.7	14.2	14.5	56	10/Dec/2022	26.03162681	79.56397665
NH27	1518600	1518700	I	L2	14.4	14.8	14.6	57	10/Dec/2022	26.0319671	79.56489905
NH27	1518700	1518800	I	L2	14.8	13.3	14.1	57	10/Dec/2022	26.03230024	79.56582437
NH27	1518800	1518900	I	L2	14.4	13.8	14.1	58	10/Dec/2022	26.03263356	79.56675004
NH27	1518900	1519000	I	L2	12.1	13.4	12.8	59	10/Dec/2022	26.03296843	79.56767496
NH27	1519000	1519100	I	L2	15.8	15.1	15.5	60	10/Dec/2022	26.0333025	79.56860058
NH27	1519100	1519200	I	L2	5.5	7.7	6.6	61	10/Dec/2022	26.03363685	79.56952631
NH27	1519200	1519300	I	L2	7.1	7.7	7.4	60	10/Dec/2022	26.03397117	79.57045235
NH27	1519300	1519400	I	L2	5	6.1	5.6	59	10/Dec/2022	26.03430517	79.57137839
NH27	1519400	1519500	I	L2	6.2	5.9	6.1	58	10/Dec/2022	26.03464006	79.57230421
NH27	1519500	1519600	I	L2	6.7	6.7	6.7	58	10/Dec/2022	26.03497633	79.57322893
NH27	1519600	1519700	I	L2	6.3	6.4	6.4	59	10/Dec/2022	26.03530878	79.57415562
NH27	1519700	1519800	I	L2	4	6.2	5.1	58	10/Dec/2022	26.03564103	79.57508267
NH27	1519800	1519900	I	L2	8.9	8.8	8.9	55	10/Dec/2022	26.03597834	79.57600803
NH27	1519900	1520000	I	L2	7.1	6.6	6.9	42	10/Dec/2022	26.03631776	79.57693387
NH27	1520000	1520100	I	L2	4.1	5	4.6	7	10/Dec/2022	26.03667489	79.57784941

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1520100	1520200	I	L2	7.3	8.2	7.8	37	10/Dec/2022	26.03698226	79.57878302
NH27	1520200	1520300	I	L2	7.6	7.5	7.6	46	10/Dec/2022	26.03730737	79.57971
NH27	1520300	1520400	I	L2	10.2	14.9	12.6	54	10/Dec/2022	26.03764218	79.58063382
NH27	1520400	1520500	I	L2	7.6	12.6	10.1	58	10/Dec/2022	26.03797616	79.58155927
NH27	1520500	1520600	I	L2	8.2	13.3	10.8	59	10/Dec/2022	26.03831438	79.5824832
NH27	1520600	1520700	I	L2	8.2	8	8.1	60	10/Dec/2022	26.03866377	79.58340275
NH27	1520700	1520800	I	L2	9.7	7.1	8.4	56	10/Dec/2022	26.03901182	79.58432329
NH27	1520800	1520900	I	L2	10	13.8	11.9	58	10/Dec/2022	26.03935868	79.58524349
NH27	1520900	1521000	I	L2	7.7	6.8	7.3	60	10/Dec/2022	26.03970801	79.58616243
NH27	1521000	1521100	I	L2	7.1	4.6	5.9	63	10/Dec/2022	26.04005897	79.58708034
NH27	1521100	1521200	I	L2	8.3	6.1	7.2	61	10/Dec/2022	26.04040822	79.58800029
NH27	1521200	1521300	I	L2	5.4	5.8	5.6	60	10/Dec/2022	26.04075686	79.58891949
NH27	1521300	1521400	I	L2	7.4	6.2	6.8	62	10/Dec/2022	26.04110438	79.58983864
NH27	1521400	1521500	I	L2	4.2	6.1	5.2	58	10/Dec/2022	26.04145464	79.59075839
NH27	1521500	1521600	I	L2	3.8	5.1	4.5	50	10/Dec/2022	26.04182429	79.59166883
NH27	1521600	1521700	I	L2	6.9	3.5	5.2	58	10/Dec/2022	26.04217111	79.59258784
NH27	1521700	1521800	I	L2	6.4	5.1	5.8	55	10/Dec/2022	26.04250881	79.59351327
NH27	1521800	1521900	I	L2	4.3	6.4	5.4	47	10/Dec/2022	26.04285548	79.59443464
NH27	1521900	1522000	I	L2	5.7	6.4	6.1	50	10/Dec/2022	26.0432468	79.59533127
NH27	1522000	1522100	I	L2	8.5	12.6	10.6	64	10/Dec/2022	26.04367396	79.59620592
NH27	1522100	1522200	I	L2	8.8	8.3	8.6	64	10/Dec/2022	26.04409278	79.59708837
NH27	1522200	1522300	I	L2	6.3	11.5	8.9	61	10/Dec/2022	26.04456573	79.59793794
NH27	1522300	1522400	I	L2	8.3	8.8	8.6	59	10/Dec/2022	26.04504507	79.59878307
NH27	1522400	1522500	I	L2	8.7	9.6	9.2	57	10/Dec/2022	26.04551507	79.59963532
NH27	1522500	1522600	I	L2	5.7	5.5	5.6	52	10/Dec/2022	26.04597311	79.60049539
NH27	1522600	1522700	I	L2	8.8	9.6	9.2	31	10/Dec/2022	26.04645649	79.60133946
NH27	1522700	1522800	I	L2	8	11.2	9.6	33	10/Dec/2022	26.04693569	79.60218314
NH27	1522800	1522900	I	L2	6.1	5.8	6	41	10/Dec/2022	26.0474139	79.60302681
NH27	1522900	1523000	I	L2	4.1	4.6	4.4	42	10/Dec/2022	26.04789749	79.60386887
NH27	1523000	1523100	I	L2	5.8	6.2	6	55	10/Dec/2022	26.04839494	79.60469664
NH27	1523100	1523200	I	L2	9.4	12.5	11	68	10/Dec/2022	26.04892317	79.60550122
NH27	1523200	1523300	I	L2	10.4	14.1	12.3	71	10/Dec/2022	26.0494145	79.60633653
NH27	1523300	1523400	I	L2	7.5	9.5	8.5	73	10/Dec/2022	26.04993024	79.60715387
NH27	1523400	1523500	I	L2	6.9	8.8	7.9	71	10/Dec/2022	26.05044603	79.60797271
NH27	1523500	1523600	I	L2	11.5	12.2	11.9	68	10/Dec/2022	26.05096407	79.60879024
NH27	1523600	1523700	I	L2	10.6	13.1	11.9	66	10/Dec/2022	26.05147988	79.60960845
NH27	1523700	1523800	I	L2	7.5	8.9	8.2	65	10/Dec/2022	26.05199741	79.61042598
NH27	1523800	1523900	I	L2	5.9	9.7	7.8	64	10/Dec/2022	26.05251386	79.61124349
NH27	1523900	1524000	I	L2	4.5	7.3	5.9	63	10/Dec/2022	26.05302722	79.61206344
NH27	1524000	1524100	I	L2	6.2	10.4	8.3	64	10/Dec/2022	26.05349577	79.61291498

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1524100	1524200	I	L2	7	6.1	6.6	64	10/Dec/2022	26.05387457	79.61381964
NH27	1524200	1524300	I	L2	5.5	4.8	5.2	65	10/Dec/2022	26.0541874	79.61475502
NH27	1524300	1524400	I	L2	5.7	5.2	5.5	65	10/Dec/2022	26.05449558	79.61569219
NH27	1524400	1524500	I	L2	6.1	7.2	6.7	65	10/Dec/2022	26.05480551	79.61662864
NH27	1524500	1524600	I	L2	5.9	9.8	7.9	65	10/Dec/2022	26.05515729	79.61754685
NH27	1524600	1524700	I	L2	5.9	6.5	6.2	65	10/Dec/2022	26.05554558	79.61844621
NH27	1524700	1524800	I	L2	6.3	10.5	8.4	63	10/Dec/2022	26.05597269	79.61932491
NH27	1524800	1524900	I	L2	9.3	6.8	8.1	62	10/Dec/2022	26.05641188	79.62019696
NH27	1524900	1525000	I	L2	5.8	5.9	5.9	59	10/Dec/2022	26.05685082	79.6210695
NH27	1525000	1525100	I	L2	4.3	5.9	5.1	54	10/Dec/2022	26.05729059	79.62194185
NH27	1525100	1525200	I	L2	7.2	6.8	7	56	10/Dec/2022	26.05775008	79.62279974
NH27	1525200	1525300	I	L2	11.2	13.9	12.6	59	10/Dec/2022	26.05817402	79.62367911
NH27	1525300	1525400	I	L2	11.5	12	11.8	58	10/Dec/2022	26.05860649	79.62455445
NH27	1525400	1525500	I	L2	12.7	13.9	13.3	53	10/Dec/2022	26.05904416	79.62542826
NH27	1525500	1525600	I	L2	12.6	12.3	12.5	53	10/Dec/2022	26.05948277	79.62630005
NH27	1525600	1525700	I	L2	6	8.2	7.1	31	10/Dec/2022	26.05992294	79.62717337
NH27	1525700	1525800	I	L2	5.7	9.3	7.5	38	10/Dec/2022	26.06037688	79.62803208
NH27	1525800	1525900	I	L2	7.7	12.7	10.2	49	10/Dec/2022	26.06079994	79.62891034
NH27	1525900	1526000	I	L2	11.1	11.1	11.1	56	10/Dec/2022	26.06123468	79.62978256
NH27	1526000	1526100	I	L2	11.6	11.6	11.6	48	10/Dec/2022	26.06167479	79.63065509
NH27	1526100	1526200	I	L2	8	7.2	7.6	38	10/Dec/2022	26.0621124	79.63152741
NH27	1526200	1526300	I	L2	10.3	10	10.2	42	10/Dec/2022	26.06254998	79.63239893
NH27	1526300	1526400	I	L2	10.6	11.1	10.9	50	10/Dec/2022	26.06298698	79.63326998
NH27	1526400	1526500	I	L2	11.6	10.2	10.9	51	10/Dec/2022	26.06342296	79.63414308
NH27	1526500	1526600	I	L2	6.8	5.8	6.3	49	10/Dec/2022	26.06385674	79.63501761
NH27	1526600	1526700	I	L2	10.8	11.9	11.4	52	10/Dec/2022	26.0642919	79.63589027
NH27	1526700	1526800	I	L2	10.2	10.9	10.6	56	10/Dec/2022	26.06472817	79.63676228
NH27	1526800	1526900	I	L2	10.8	10.9	10.9	57	10/Dec/2022	26.06516304	79.63763591
NH27	1526900	1527000	I	L2	11.1	11.4	11.3	56	10/Dec/2022	26.06559906	79.63850908
NH27	1527000	1527100	I	L2	10	11.1	10.6	54	10/Dec/2022	26.06603422	79.63938293
NH27	1527100	1527200	I	L2	7.9	8	8	52	10/Dec/2022	26.06646653	79.64025887
NH27	1527200	1527300	I	L2	6.2	5.2	5.7	54	10/Dec/2022	26.06690733	79.6411403
NH27	1527300	1527400	I	L2	9.9	9.9	9.9	57	10/Dec/2022	26.0673393	79.64201525
NH27	1527400	1527500	I	L2	6.8	9.4	8.1	55	10/Dec/2022	26.06777588	79.64288891
NH27	1527500	1527600	I	L2	12.6	13.9	13.3	52	10/Dec/2022	26.068213	79.64376248
NH27	1527600	1527700	I	L2	15.8	13.7	14.8	55	10/Dec/2022	26.06864577	79.64463691
NH27	1527700	1527800	I	L2	14	15.1	14.6	45	10/Dec/2022	26.06908356	79.64551156
NH27	1527800	1527900	I	L2	9.7	14.2	12	33	10/Dec/2022	26.06951807	79.64638729
NH27	1527900	1528000	I	L2	9.7	6.5	8.1	36	10/Dec/2022	26.06996785	79.64724953
NH27	1528000	1528100	I	L2	9.1	10.1	9.6	42	10/Dec/2022	26.07038423	79.64813256

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1528100	1528200	I	L2	11.3	11.6	11.5	48	10/Dec/2022	26.07081811	79.64900617
NH27	1528200	1528300	I	L2	10.5	11.1	10.8	54	10/Dec/2022	26.07125512	79.64987728
NH27	1528300	1528400	I	L2	11.7	7.1	9.4	54	10/Dec/2022	26.07168805	79.65075309
NH27	1528400	1528500	I	L2	6.7	3.8	5.3	45	10/Dec/2022	26.07212388	79.65162731
NH27	1528500	1528600	I	L2	10.8	5.9	8.4	53	10/Dec/2022	26.07256073	79.65249783
NH27	1528600	1528700	I	L2	8.2	6	7.1	56	10/Dec/2022	26.07299401	79.65337189
NH27	1528700	1528800	I	L2	6.4	6.5	6.5	58	10/Dec/2022	26.07342324	79.65424851
NH27	1528800	1528900	I	L2	6.4	8.1	7.3	56	10/Dec/2022	26.07384438	79.6551314
NH27	1528900	1529000	I	L2	6.9	8.8	7.9	60	10/Dec/2022	26.07428589	79.65600057
NH27	1529000	1529100	I	L2	6.8	6.7	6.8	60	10/Dec/2022	26.07467843	79.65689919
NH27	1529100	1529200	I	L2	6.8	5.8	6.3	61	10/Dec/2022	26.07509579	79.65778339
NH27	1529200	1529300	I	L2	7.4	7.1	7.3	60	10/Dec/2022	26.07551485	79.65866772
NH27	1529300	1529400	I	L2	4.2	3.4	3.8	59	10/Dec/2022	26.07593243	79.65955284
NH27	1529400	1529500	I	L2	5.9	7.9	6.9	58	10/Dec/2022	26.07635167	79.66043701
NH27	1529500	1529600	I	L2	7.9	6.3	7.1	57	10/Dec/2022	26.07676886	79.66132165
NH27	1529600	1529700	I	L2	8.9	8.3	8.6	58	10/Dec/2022	26.07718605	79.66220629
NH27	1529700	1529800	I	L2	10.1	6.5	8.3	59	10/Dec/2022	26.07760387	79.66309006
NH27	1529800	1529900	I	L2	10.4	6.7	8.6	59	10/Dec/2022	26.07802159	79.66397453
NH27	1529900	1530000	I	L2	8	3.7	5.9	58	10/Dec/2022	26.07844073	79.66485854
NH27	1530000	1530100	I	L2	6.6	9.9	8.3	59	10/Dec/2022	26.07885996	79.66574198
NH27	1530100	1530200	I	L2	7.5	5.4	6.5	59	10/Dec/2022	26.07927674	79.66662659
NH27	1530200	1530300	I	L2	10	5.2	7.6	60	10/Dec/2022	26.07969156	79.66751222
NH27	1530300	1530400	I	L2	5.8	5.4	5.6	61	10/Dec/2022	26.08011043	79.66839592
NH27	1530400	1530500	I	L2	9.3	6.5	7.9	62	10/Dec/2022	26.08053148	79.6692787
NH27	1530500	1530600	I	L2	8.4	5.5	7	61	10/Dec/2022	26.08094625	79.67016543
NH27	1530600	1530700	I	L2	9.5	6.5	8	60	10/Dec/2022	26.08135919	79.67105296
NH27	1530700	1530800	I	L2	6.2	4.5	5.4	61	10/Dec/2022	26.08175992	79.67194672
NH27	1530800	1530900	I	L2	6	6.3	6.2	61	10/Dec/2022	26.08216668	79.67283783
NH27	1530900	1531000	I	L2	8.2	5.5	6.9	61	10/Dec/2022	26.08256866	79.67373175
NH27	1531000	1531100	I	L2	6.2	5.7	6	62	10/Dec/2022	26.08297556	79.67462248
NH27	1531100	1531200	I	L2	7.8	7.5	7.7	62	10/Dec/2022	26.08338041	79.67551457
NH27	1531200	1531300	I	L2	5.9	6.2	6.1	61	10/Dec/2022	26.08378817	79.67640507
NH27	1531300	1531400	I	L2	5.8	4	4.9	60	10/Dec/2022	26.08419061	79.67729872
NH27	1531400	1531500	I	L2	7.1	3.6	5.4	59	10/Dec/2022	26.08459994	79.67818785
NH27	1531500	1531600	I	L2	7.1	5.2	6.2	59	10/Dec/2022	26.0850027	79.67908097
NH27	1531600	1531700	I	L2	6.7	7	6.9	60	10/Dec/2022	26.08540926	79.67997163
NH27	1531700	1531800	I	L2	9.9	5.6	7.8	62	10/Dec/2022	26.08581213	79.68086417
NH27	1531800	1531900	I	L2	8	4	6	62	10/Dec/2022	26.08621803	79.68175539
NH27	1531900	1532000	I	L2	5	5.5	5.3	59	10/Dec/2022	26.08662398	79.68264795
NH27	1532000	1532100	I	L2	3.2	4.4	3.8	57	10/Dec/2022	26.08702928	79.68354041

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1532100	1532200	I	L2	8.6	7	7.8	55	10/Dec/2022	26.08745308	79.68442181
NH27	1532200	1532300	I	L2	8.6	10.4	9.5	62	10/Dec/2022	26.08785416	79.68531435
NH27	1532300	1532400	I	L2	6.1	10.6	8.4	58	10/Dec/2022	26.08824328	79.68621553
NH27	1532400	1532500	I	L2	8.1	10.8	9.5	58	10/Dec/2022	26.08864737	79.68710793
NH27	1532500	1532600	I	L2	7.5	6.7	7.1	58	10/Dec/2022	26.08905181	79.68800035
NH27	1532600	1532700	I	L2	8.6	6.9	7.8	59	10/Dec/2022	26.08945872	79.68889142
NH27	1532700	1532800	I	L2	7.3	7.8	7.6	57	10/Dec/2022	26.08986527	79.68978323
NH27	1532800	1532900	I	L2	6.6	7.5	7.1	58	10/Dec/2022	26.09027033	79.69067521
NH27	1532900	1533000	I	L2	5.7	4.3	5	59	10/Dec/2022	26.09067949	79.69156405
NH27	1533000	1533100	I	L2	8.1	11.5	9.8	57	10/Dec/2022	26.09110948	79.69244175
NH27	1533100	1533200	I	L2	8.2	8.2	8.2	55	10/Dec/2022	26.09155262	79.69331116
NH27	1533200	1533300	I	L2	4.7	8.5	6.6	56	10/Dec/2022	26.09201489	79.69416841
NH27	1533300	1533400	I	L2	6	9.9	8	56	10/Dec/2022	26.09250454	79.69500648
NH27	1533400	1533500	I	L2	6.2	5.8	6	57	10/Dec/2022	26.0930162	79.69582833
NH27	1533500	1533600	I	L2	5	6.8	5.9	54	10/Dec/2022	26.0935021	79.69666995
NH27	1533600	1533700	I	L2	4.3	4.7	4.5	55	10/Dec/2022	26.0940341	79.69747546
NH27	1533700	1533800	I	L2	3	3.3	3.2	56	10/Dec/2022	26.09457651	79.69827276
NH27	1533800	1533900	I	L2	3.7	6.8	5.3	60	10/Dec/2022	26.09513038	79.69905942
NH27	1533900	1534000	I	L2	7.8	7.4	7.6	69	10/Dec/2022	26.09567798	79.6998502
NH27	1534000	1534100	I	L2	5.4	5.6	5.5	69	10/Dec/2022	26.09620535	79.70066017
NH27	1534100	1534200	I	L2	8.5	9.6	9.1	61	10/Dec/2022	26.09673769	79.70146795
NH27	1534200	1534300	I	L2	4.5	6.5	5.5	56	10/Dec/2022	26.09728221	79.70226471
NH27	1534300	1534400	I	L2	8.3	12	10.2	52	10/Dec/2022	26.09782721	79.70306109
NH27	1534400	1534500	I	L2	8.4	9.6	9	51	10/Dec/2022	26.09836881	79.70385892
NH27	1534500	1534600	I	L2	8.9	4	6.5	52	10/Dec/2022	26.09892698	79.70464267
NH27	1534600	1534700	I	L2	4.5	7.9	6.2	51	10/Dec/2022	26.09948406	79.70542733
NH27	1534700	1534800	I	L2	5.6	5.9	5.8	49	10/Dec/2022	26.10004558	79.70620867
NH27	1534800	1534900	I	L2	5.7	6.2	6	53	10/Dec/2022	26.1006037	79.70699177
NH27	1534900	1535000	I	L2	3.8	6.4	5.1	41	10/Dec/2022	26.10114589	79.70779103
NH27	1535000	1535100	I	L2	6.8	7.6	7.2	37	10/Dec/2022	26.10170929	79.70857137
NH27	1535100	1535200	I	L2	6.2	7.7	7	52	10/Dec/2022	26.10227297	79.70934664
NH27	1535200	1535300	I	L2	5.2	6.4	5.8	55	10/Dec/2022	26.10281106	79.71014652
NH27	1535300	1535400	I	L2	4.8	7.6	6.2	58	10/Dec/2022	26.10336583	79.71093248
NH27	1535400	1535500	I	L2	4.4	7.8	6.1	60	10/Dec/2022	26.10392063	79.71171927
NH27	1535500	1535600	I	L2	5.1	6.8	6	62	10/Dec/2022	26.10447692	79.71250508
NH27	1535600	1535700	I	L2	5	6.2	5.6	62	10/Dec/2022	26.10503312	79.71329127
NH27	1535700	1535800	I	L2	4.9	7.3	6.1	61	10/Dec/2022	26.10558475	79.71408109
NH27	1535800	1535900	I	L2	5.5	3.9	4.7	62	10/Dec/2022	26.1061109	79.71489158
NH27	1535900	1536000	I	L2	6.2	6.4	6.3	61	10/Dec/2022	26.10660363	79.71572748
NH27	1536000	1536100	I	L2	6.4	8.6	7.5	59	10/Dec/2022	26.10709086	79.71656723

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1536100	1536200	I	L2	7	6	6.5	60	10/Dec/2022	26.1075787	79.71740644
NH27	1536200	1536300	I	L2	5.8	5.1	5.5	62	10/Dec/2022	26.1080848	79.71823223
NH27	1536300	1536400	I	L2	5.8	5.1	5.5	63	10/Dec/2022	26.10863984	79.71901888
NH27	1536400	1536500	I	L2	4.9	5.3	5.1	62	10/Dec/2022	26.10917631	79.71982202
NH27	1536500	1536600	I	L2	6.8	5.5	6.2	60	10/Dec/2022	26.10968836	79.72064386
NH27	1536600	1536700	I	L2	6.1	7	6.6	59	10/Dec/2022	26.11020028	79.72146562
NH27	1536700	1536800	I	L2	4.7	4.2	4.5	57	10/Dec/2022	26.11071386	79.72228637
NH27	1536800	1536900	I	L2	4.9	6.8	5.9	54	10/Dec/2022	26.11122733	79.72310754
NH27	1536900	1537000	I	L2	6	4.2	5.1	54	10/Dec/2022	26.1117382	79.72393006
NH27	1537000	1537100	I	L2	4.2	6.5	5.4	48	10/Dec/2022	26.11225295	79.72475084
NH27	1537100	1537200	I	L2	7.7	7	7.4	48	10/Dec/2022	26.11272836	79.72559867
NH27	1537200	1537300	I	L2	5.3	6.6	6	45	10/Dec/2022	26.11307346	79.72652172
NH27	1537300	1537400	I	L2	6.3	8.8	7.6	58	10/Dec/2022	26.11325822	79.7274949
NH27	1537400	1537500	I	L2	3.8	5	4.4	58	10/Dec/2022	26.1132915	79.72849293
NH27	1537500	1537600	I	L2	4.9	8.6	6.8	49	10/Dec/2022	26.11333984	79.72949157
NH27	1537600	1537700	I	L2	5.6	8.7	7.2	47	10/Dec/2022	26.11340194	79.73048754
NH27	1537700	1537800	I	L2	7.2	6.1	6.7	43	10/Dec/2022	26.11355076	79.73147323
NH27	1537800	1537900	I	L2	6.1	8.6	7.4	44	10/Dec/2022	26.11370614	79.73245708
NH27	1537900	1538000	I	L2	8.2	6.5	7.4	42	10/Dec/2022	26.11375722	79.73345281
NH27	1538000	1538100	I	L2	7.7	8.8	8.3	43	10/Dec/2022	26.11360648	79.7344363
NH27	1538100	1538200	I	L2	8.1	9.4	8.8	38	10/Dec/2022	26.11338412	79.73540495
NH27	1538200	1538300	I	L2	4.8	6.1	5.5	42	10/Dec/2022	26.1131904	79.73637875
NH27	1538300	1538400	I	L2	6.1	6.3	6.2	39	10/Dec/2022	26.11319575	79.73737445
NH27	1538400	1538500	I	L2	5.1	7.6	6.4	51	10/Dec/2022	26.11347775	79.73831713
NH27	1538500	1538600	I	L2	9.2	6.6	7.9	58	10/Dec/2022	26.11393718	79.73917879
NH27	1538600	1538700	I	L2	9.8	7.4	8.6	58	10/Dec/2022	26.11460593	79.73984218
NH27	1538700	1538800	I	L2	8.7	8.4	8.6	52	10/Dec/2022	26.11536603	79.74038123
NH27	1538800	1538900	I	L2	9.9	9.6	9.8	51	10/Dec/2022	26.11613447	79.74090419
NH27	1538900	1539000	I	L2	7.4	9.3	8.4	53	10/Dec/2022	26.11691172	79.74140892
NH27	1539000	1539100	I	L2	7.9	8.5	8.2	59	10/Dec/2022	26.11767622	79.74193646
NH27	1539100	1539200	I	L2	9.5	7.9	8.7	61	10/Dec/2022	26.11843878	79.74246749
NH27	1539200	1539300	I	L2	7.7	7.2	7.5	56	10/Dec/2022	26.11917351	79.74304668
NH27	1539300	1539400	I	L2	8.8	9.1	9	53	10/Dec/2022	26.11975444	79.74380725
NH27	1539400	1539500	I	L2	8.8	8	8.4	53	10/Dec/2022	26.12019576	79.74467539
NH27	1539500	1539600	I	L2	8	8.5	8.3	50	10/Dec/2022	26.12061534	79.74555875
NH27	1539600	1539700	I	L2	8.5	7.2	7.9	49	10/Dec/2022	26.1210413	79.74643762
NH27	1539700	1539800	I	L2	9.8	7.7	8.8	52	10/Dec/2022	26.12154747	79.74726005
NH27	1539800	1539900	I	L2	8.9	8.4	8.7	44	10/Dec/2022	26.12213227	79.7480213
NH27	1539900	1540000	I	L2	8	10.6	9.3	51	10/Dec/2022	26.12281113	79.74867488
NH27	1540000	1540100	I	L2	11.5	10.6	11.1	52	10/Dec/2022	26.12351554	79.74929787

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1540100	1540200	I	L2	9.5	10.7	10.1	50	10/Dec/2022	26.12425617	79.74986842
NH27	1540200	1540300	I	L2	4.8	4.5	4.7	41	10/Dec/2022	26.12505082	79.75033774
NH27	1540300	1540400	I	L2	3.9	2.6	3.3	41	10/Dec/2022	26.1258952	79.75068681
NH27	1540400	1540500	I	L2	2.8	2.9	2.9	39	10/Dec/2022	26.12675878	79.75097264
NH27	1540500	1540600	I	L2	9.1	9.5	9.3	37	10/Dec/2022	26.12760674	79.75131297
NH27	1540600	1540700	I	L2	4.1	5.5	4.8	30	10/Dec/2022	26.12842798	79.75172763
NH27	1540700	1540800	I	L2	2.1	2.2	2.2	29	10/Dec/2022	26.12923607	79.75217035
NH27	1540800	1540900	I	L2	2.7	2	2.4	31	10/Dec/2022	26.13004439	79.75261126
NH27	1540900	1541000	I	L2	2.1	2.8	2.5	35	10/Dec/2022	26.13085336	79.75305015
NH27	1541000	1541100	I	L2	1.9	3	2.5	34	10/Dec/2022	26.13166007	79.75349543
NH27	1541100	1541200	I	L2	1.6	2.3	2	38	10/Dec/2022	26.13246886	79.75393336
NH27	1541200	1541300	I	L2	1.7	2.5	2.1	45	10/Dec/2022	26.1332755	79.75437558
NH27	1541300	1541400	I	L2	5.8	6.8	6.3	50	10/Dec/2022	26.13408312	79.75481587
NH27	1541400	1541500	I	L2	6.5	5.3	5.9	51	10/Dec/2022	26.13489038	79.75525912
NH27	1541500	1541600	I	L2	5	9.1	7.1	47	10/Dec/2022	26.1357	79.75569933
NH27	1541600	1541700	I	L2	5.2	8.5	6.9	47	10/Dec/2022	26.13650708	79.75614476
NH27	1541700	1541800	I	L2	7.8	9.5	8.7	40	10/Dec/2022	26.13731524	79.75659066
NH27	1541800	1541900	I	L2	7.6	10.5	9.1	41	10/Dec/2022	26.13812253	79.75703596
NH27	1541900	1542000	I	L2	7.2	7.1	7.2	43	10/Dec/2022	26.13892961	79.7574815
NH27	1542000	1542100	I	L2	4.9	6.6	5.8	40	10/Dec/2022	26.13973734	79.75792625
NH27	1542100	1542200	I	L2	6.2	7.4	6.8	40	10/Dec/2022	26.14054334	79.75837343
NH27	1542200	1542300	I	L2	5.5	9.8	7.7	42	10/Dec/2022	26.14134921	79.75882078
NH27	1542300	1542400	I	L2	5.9	7.5	6.7	40	10/Dec/2022	26.14215576	79.75926705
NH27	1542400	1542500	I	L2	6.8	7.7	7.3	38	10/Dec/2022	26.14296096	79.75971684
NH27	1542500	1542600	I	L2	7.3	9.6	8.5	41	10/Dec/2022	26.14376213	79.76017319
NH27	1542600	1542700	I	L2	5.5	6.9	6.2	44	10/Dec/2022	26.14453332	79.76068886
NH27	1542700	1542800	I	L2	6.9	6.4	6.7	39	10/Dec/2022	26.14527055	79.761264
NH27	1542800	1542900	I	L2	6.7	7.5	7.1	37	10/Dec/2022	26.14597346	79.76189021
NH27	1542900	1543000	I	L2	6.3	7.4	6.9	34	10/Dec/2022	26.14665124	79.76254975
NH27	1543000	1543100	I	L2	6.6	5.3	6	35	10/Dec/2022	26.14732593	79.76321212
NH27	1543100	1543200	I	L2	8.6	5.3	7	34	10/Dec/2022	26.14800465	79.76386981
NH27	1543200	1543300	I	L2	7.1	5.5	6.3	35	10/Dec/2022	26.14868196	79.76452806
NH27	1543300	1543400	I	L2	5.1	5	5.1	32	10/Dec/2022	26.14936011	79.7651858
NH27	1543400	1543500	I	L2	4.3	6	5.2	22	10/Dec/2022	26.15003858	79.76584385
NH27	1543500	1543600	I	L2	6.7	7.7	7.2	27	10/Dec/2022	26.15071583	79.76650129
NH27	1543600	1543700	I	L2	3.9	4.5	4.2	10	10/Dec/2022	26.15137721	79.76718004
NH27	1543700	1543800	I	L2	5.1	9.1	7.1	10	10/Dec/2022	26.15137721	79.76718004
NH27	1543800	1543900	I	L2	8.8	9.9	9.4	39	10/Dec/2022	26.15210207	79.76783096
NH27	1543900	1544000	I	L2	7.7	12.6	10.2	52	10/Dec/2022	26.15277602	79.76848925
NH27	1544000	1544100	I	L2	6.2	8.9	7.6	60	10/Dec/2022	26.15345303	79.76914428

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1544100	1544200	I	L2	6.6	10.2	8.4	64	10/Dec/2022	26.15413003	79.76979977
NH27	1544200	1544300	I	L2	7.4	6.4	6.9	65	10/Dec/2022	26.15480519	79.77045825
NH27	1544300	1544400	I	L2	8.6	8.2	8.4	64	10/Dec/2022	26.15548272	79.7711138
NH27	1544400	1544500	I	L2	12.6	11.5	12.1	63	10/Dec/2022	26.15615875	79.77177296
NH27	1544500	1544600	I	L2	6	6.9	6.5	62	10/Dec/2022	26.15683484	79.77243249
NH27	1544600	1544700	I	L2	8.3	10.1	9.2	61	10/Dec/2022	26.15751305	79.77308939
NH27	1544700	1544800	I	L2	5.4	6.1	5.8	60	10/Dec/2022	26.15818913	79.77374922
NH27	1544800	1544900	I	L2	3.7	4.3	4	59	10/Dec/2022	26.15886635	79.77440744
NH27	1544900	1545000	I	L2	3.3	3.5	3.4	56	10/Dec/2022	26.15954935	79.77506022
NH27	1545000	1545100	I	L2	6.2	4.9	5.6	45	10/Dec/2022	26.1602287	79.77571887
NH27	1545100	1545200	I	L2	10.9	7.1	9	33	10/Dec/2022	26.16091286	79.77636972
NH27	1545200	1545300	I	L2	6.1	5.1	5.6	39	10/Dec/2022	26.16160153	79.77701217
NH27	1545300	1545400	I	L2	6.2	5.6	5.9	48	10/Dec/2022	26.16228718	79.77765633
NH27	1545400	1545500	I	L2	7	6.2	6.6	57	10/Dec/2022	26.16303619	79.77820674
NH27	1545500	1545600	I	L2	6.9	7.8	7.4	58	10/Dec/2022	26.16379593	79.77874257
NH27	1545600	1545700	I	L2	6.6	8.5	7.6	61	10/Dec/2022	26.16455492	79.77927892
NH27	1545700	1545800	I	L2	7.9	8.1	8	62	10/Dec/2022	26.16531369	79.779817
NH27	1545800	1545900	I	L2	8.1	12.3	10.2	62	10/Dec/2022	26.16607008	79.78035936
NH27	1545900	1546000	I	L2	5.1	5.6	5.4	63	10/Dec/2022	26.16683288	79.78089099
NH27	1546000	1546100	I	L2	6	5.3	5.7	63	10/Dec/2022	26.16759353	79.78142635
NH27	1546100	1546200	I	L2	6	5.8	5.9	62	10/Dec/2022	26.16834303	79.78198106
NH27	1546200	1546300	I	L2	5.5	5	5.3	63	10/Dec/2022	26.16907998	79.78255538
NH27	1546300	1546400	I	L2	6.2	5.6	5.9	63	10/Dec/2022	26.16982008	79.78312484
NH27	1546400	1546500	I	L2	7.9	12.2	10.1	63	10/Dec/2022	26.1705557	79.78370139
NH27	1546500	1546600	I	L2	10.2	10.4	10.3	63	10/Dec/2022	26.1712943	79.78427329
NH27	1546600	1546700	I	L2	5.1	5.5	5.3	62	10/Dec/2022	26.17203208	79.78484658
NH27	1546700	1546800	I	L2	6.8	6.7	6.8	63	10/Dec/2022	26.17276848	79.78542148
NH27	1546800	1546900	I	L2	6.7	5.9	6.3	65	10/Dec/2022	26.17350731	79.78599218
NH27	1546900	1547000	I	L2	4.8	4.9	4.9	66	10/Dec/2022	26.17424445	79.78656559
NH27	1547000	1547100	I	L2	3.7	4	3.9	65	10/Dec/2022	26.1749824	79.78713848
NH27	1547100	1547200	I	L2	4.2	4	4.1	65	10/Dec/2022	26.17572018	79.78771156
NH27	1547200	1547300	I	L2	5.9	8.9	7.4	64	10/Dec/2022	26.17645891	79.78828358
NH27	1547300	1547400	I	L2	6.2	8.8	7.5	63	10/Dec/2022	26.17720685	79.78884085
NH27	1547400	1547500	I	L2	4.9	6.7	5.8	64	10/Dec/2022	26.17793283	79.78943192
NH27	1547500	1547600	I	L2	5.8	5.7	5.8	64	10/Dec/2022	26.17867012	79.79000531
NH27	1547600	1547700	I	L2	4.8	6.1	5.5	64	10/Dec/2022	26.17940695	79.7905798
NH27	1547700	1547800	I	L2	4.1	5.4	4.8	64	10/Dec/2022	26.18014549	79.79115189
NH27	1547800	1547900	I	L2	4.9	8.3	6.6	64	10/Dec/2022	26.18088306	79.79172545
NH27	1547900	1548000	I	L2	8.8	8	8.4	65	10/Dec/2022	26.18162032	79.79229934
NH27	1548000	1548100	I	L2	6.2	6.9	6.6	65	10/Dec/2022	26.18235721	79.79287371

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1548100	1548200	I	L2	7.2	10.7	9	64	10/Dec/2022	26.18309552	79.79344606
NH27	1548200	1548300	I	L2	6.8	5.6	6.2	64	10/Dec/2022	26.18383355	79.79401837
NH27	1548300	1548400	I	L2	6.7	5	5.9	64	10/Dec/2022	26.18457113	79.79459156
NH27	1548400	1548500	I	L2	5.1	5.2	5.2	64	10/Dec/2022	26.18530201	79.79517531
NH27	1548500	1548600	I	L2	4.3	4.1	4.2	64	10/Dec/2022	26.1860194	79.79577976
NH27	1548600	1548700	I	L2	4.9	5.3	5.1	63	10/Dec/2022	26.18669283	79.79644449
NH27	1548700	1548800	I	L2	4.3	3.4	3.9	62	10/Dec/2022	26.1873509	79.79712706
NH27	1548800	1548900	I	L2	3.4	4	3.7	63	10/Dec/2022	26.18795671	79.7978662
NH27	1548900	1549000	I	L2	3.8	3.8	3.8	49	10/Dec/2022	26.18858571	79.79858384
NH27	1549000	1549100	I	L2	3.5	3.4	3.5	42	10/Dec/2022	26.18922365	79.7992897
NH27	1549100	1549200	I	L2	5.5	5.7	5.6	43	10/Dec/2022	26.18985186	79.80000504
NH27	1549200	1549300	I	L2	5.8	8.2	7	52	10/Dec/2022	26.19047859	79.80072026
NH27	1549300	1549400	I	L2	5.8	8.5	7.2	60	10/Dec/2022	26.19108701	79.80145441
NH27	1549400	1549500	I	L2	6	6.3	6.2	62	10/Dec/2022	26.19171265	79.8021723
NH27	1549500	1549600	I	L2	10.8	6.2	8.5	61	10/Dec/2022	26.19233965	79.80288976
NH27	1549600	1549700	I	L2	8.5	4.2	6.4	59	10/Dec/2022	26.19296609	79.80360842
NH27	1549700	1549800	I	L2	8.2	4.4	6.3	57	10/Dec/2022	26.19359129	79.80432848
NH27	1549800	1549900	I	L2	7.8	6.7	7.3	54	10/Dec/2022	26.19421851	79.80504659
NH27	1549900	1550000	I	L2	5.4	4.1	4.8	50	10/Dec/2022	26.19484494	79.80576535
NH27	1550000	1550100	I	L2	4.7	4.2	4.5	50	10/Dec/2022	26.1954738	79.80648109
NH27	1550100	1550200	I	L2	6.9	5.5	6.2	49	10/Dec/2022	26.19609882	79.80720105
NH27	1550200	1550300	I	L2	4.8	5.6	5.2	42	10/Dec/2022	26.19672572	79.80792024
NH27	1550300	1550400	I	L2	2.5	4.9	3.7	46	10/Dec/2022	26.19735459	79.8086347
NH27	1550400	1550500	I	L2	4.5	5.1	4.8	22	10/Dec/2022	26.1979787	79.80935777
NH27	1550500	1550600	I	L2	4.3	4.7	4.5	50	10/Dec/2022	26.19859443	79.81008029
NH27	1550600	1550700	I	L2	3.6	5	4.3	54	10/Dec/2022	26.19922562	79.8107899
NH27	1550700	1550800	I	L2	4	4.2	4.1	57	10/Dec/2022	26.19990317	79.81144286
NH27	1550800	1550900	I	L2	6	3.6	4.8	53	10/Dec/2022	26.20062233	79.81204466
NH27	1550900	1551000	I	L2	4.2	3.8	4	44	10/Dec/2022	26.2013468	79.81264057
NH27	1551000	1551100	I	L2	3.5	6.9	5.2	49	10/Dec/2022	26.20207951	79.81321929
NH27	1551100	1551200	I	L2	5.2	4.2	4.7	56	10/Dec/2022	26.20278933	79.8138312
NH27	1551200	1551300	I	L2	4.4	6.5	5.5	53	10/Dec/2022	26.20350627	79.81443851
NH27	1551300	1551400	I	L2	5.1	9.9	7.5	54	10/Dec/2022	26.20420465	79.81507064
NH27	1551400	1551500	I	L2	5.2	9.6	7.4	54	10/Dec/2022	26.20486813	79.81574852
NH27	1551500	1551600	I	L2	7.3	9.8	8.6	53	10/Dec/2022	26.20549138	79.81647094
NH27	1551600	1551700	I	L2	8.2	7	7.6	51	10/Dec/2022	26.20610083	79.81720712
NH27	1551700	1551800	I	L2	6.8	6.9	6.9	49	10/Dec/2022	26.20670812	79.81794539
NH27	1551800	1551900	I	L2	6.5	6.2	6.4	50	10/Dec/2022	26.20731466	79.81868323
NH27	1551900	1552000	I	L2	6.7	6.6	6.7	51	10/Dec/2022	26.20791831	79.819425
NH27	1552000	1552100	I	L2	6.7	6.9	6.8	50	10/Dec/2022	26.20849619	79.82019193

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1552100	1552200	I	L2	7.1	7.2	7.2	50	10/Dec/2022	26.20905289	79.82097789
NH27	1552200	1552300	I	L2	6.4	5.9	6.2	48	10/Dec/2022	26.20962626	79.82174893
NH27	1552300	1552400	I	L2	4.5	3.3	3.9	49	10/Dec/2022	26.21018728	79.82253044
NH27	1552400	1552500	I	L2	6.3	5.4	5.9	51	10/Dec/2022	26.21071986	79.8233357
NH27	1552500	1552600	I	L2	6	3.2	4.6	51	10/Dec/2022	26.21126957	79.82412721
NH27	1552600	1552700	I	L2	6.8	2	4.4	41	10/Dec/2022	26.21186641	79.82487529
NH27	1552700	1552800	I	L2	6.5	5.4	6	43	10/Dec/2022	26.21252599	79.82555482
NH27	1552800	1552900	I	L2	7.3	4.1	5.7	52	10/Dec/2022	26.21322888	79.82617632
NH27	1552900	1553000	I	L2	7.8	5.8	6.8	56	10/Dec/2022	26.21397289	79.82673639
NH27	1553000	1553100	I	L2	4.3	3.5	3.9	57	10/Dec/2022	26.21479149	79.82715096
NH27	1553100	1553200	I	L2	6.8	6.7	6.8	54	10/Dec/2022	26.215628	79.82752168
NH27	1553200	1553300	I	L2	9.7	6.6	8.2	53	10/Dec/2022	26.21649177	79.82780522
NH27	1553300	1553400	I	L2	6.9	5.4	6.2	54	10/Dec/2022	26.21735717	79.82808189
NH27	1553400	1553500	I	L2	10	9.7	9.9	54	10/Dec/2022	26.21822224	79.82836176
NH27	1553500	1553600	I	L2	9.6	5.8	7.7	50	10/Dec/2022	26.21908875	79.82863813
NH27	1553600	1553700	I	L2	10.3	5.9	8.1	50	10/Dec/2022	26.21995398	79.82891652
NH27	1553700	1553800	I	L2	7.7	4.8	6.3	52	10/Dec/2022	26.22081889	79.82919532
NH27	1553800	1553900	I	L2	11.8	10.1	11	53	10/Dec/2022	26.22168456	79.82946998
NH27	1553900	1554000	I	L2	12	9.2	10.6	51	10/Dec/2022	26.22255135	79.82974411
NH27	1554000	1554100	I	L2	10.4	9	9.7	52	10/Dec/2022	26.22341618	79.83002308
NH27	1554100	1554200	I	L2	11	8.7	9.9	50	10/Dec/2022	26.22428255	79.83029821
NH27	1554200	1554300	I	L2	8.7	10.2	9.5	49	10/Dec/2022	26.22514848	79.83057496
NH27	1554300	1554400	I	L2	6	8.9	7.5	39	10/Dec/2022	26.22602443	79.83085528
NH27	1554400	1554500	I	L2	7.6	8.3	8	40	10/Dec/2022	26.2268917	79.83112436
NH27	1554500	1554600	I	L2	8	8.1	8.1	47	10/Dec/2022	26.22774059	79.8314534
NH27	1554600	1554700	I	L2	6.3	8.5	7.4	57	10/Dec/2022	26.22855903	79.83186484
NH27	1554700	1554800	I	L2	6.6	8.8	7.7	60	10/Dec/2022	26.22933353	79.83237131
NH27	1554800	1554900	I	L2	7	9.4	8.2	53	10/Dec/2022	26.23005358	79.83297264
NH27	1554900	1555000	I	L2	6.8	8.2	7.5	51	10/Dec/2022	26.2307116	79.83365601
NH27	1555000	1555100	I	L2	6.6	5.8	6.2	53	10/Dec/2022	26.23129579	79.8344163
NH27	1555100	1555200	I	L2	6.3	8.3	7.3	48	10/Dec/2022	26.23180594	79.83524092
NH27	1555200	1555300	I	L2	6.2	8.2	7.2	48	10/Dec/2022	26.23223641	79.83611811
NH27	1555300	1555400	I	L2	6.3	8.7	7.5	45	10/Dec/2022	26.23257146	79.83704598
NH27	1555400	1555500	I	L2	8.6	12.1	10.4	54	10/Dec/2022	26.23285494	79.83799278
NH27	1555500	1555600	I	L2	8.1	9.7	8.9	52	10/Dec/2022	26.23306307	79.83896532
NH27	1555600	1555700	I	L2	6.5	5.2	5.9	47	10/Dec/2022	26.23329995	79.83993012
NH27	1555700	1555800	I	L2	8.8	8	8.4	49	10/Dec/2022	26.23353689	79.84089403
NH27	1555800	1555900	I	L2	8.4	7.5	8	43	10/Dec/2022	26.23378271	79.84185623
NH27	1555900	1556000	I	L2	8.7	8.4	8.6	53	10/Dec/2022	26.23404869	79.84280904
NH27	1556000	1556100	I	L2	6.7	5.6	6.2	54	10/Dec/2022	26.23425549	79.84378122

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1556100	1556200	I	L2	7	6.4	6.7	53	10/Dec/2022	26.23449689	79.84474429
NH27	1556200	1556300	I	L2	7	6.3	6.7	48	10/Dec/2022	26.23473652	79.84570793
NH27	1556300	1556400	I	L2	7.2	6.1	6.7	52	10/Dec/2022	26.23498816	79.84666623
NH27	1556400	1556500	I	L2	6.7	5.8	6.3	54	10/Dec/2022	26.23530905	79.84759837
NH27	1556500	1556600	I	L2	8.8	7.6	8.2	51	10/Dec/2022	26.23572031	79.84848733
NH27	1556600	1556700	I	L2	6.6	7.2	6.9	52	10/Dec/2022	26.23619682	79.84933379
NH27	1556700	1556800	I	L2	6.5	4.3	5.4	52	10/Dec/2022	26.23675653	79.85011561
NH27	1556800	1556900	I	L2	6.5	4	5.3	51	10/Dec/2022	26.23738289	79.85083353
NH27	1556900	1557000	I	L2	6.7	3	4.9	53	10/Dec/2022	26.238076	79.85146978
NH27	1557000	1557100	I	L2	6.3	2.5	4.4	49	10/Dec/2022	26.23882258	79.85202963
NH27	1557100	1557200	I	L2	6.6	3.4	5	52	10/Dec/2022	26.23958816	79.85255529
NH27	1557200	1557300	I	L2	6	4.3	5.2	54	10/Dec/2022	26.24035451	79.85308077
NH27	1557300	1557400	I	L2	6.8	4	5.4	54	10/Dec/2022	26.24112111	79.85360588
NH27	1557400	1557500	I	L2	6.6	3.9	5.3	53	10/Dec/2022	26.24188847	79.85413102
NH27	1557500	1557600	I	L2	8.3	4.3	6.3	50	10/Dec/2022	26.24265433	79.85465844
NH27	1557600	1557700	I	L2	7.8	6	6.9	52	10/Dec/2022	26.24342168	79.85518146
NH27	1557700	1557800	I	L2	6.9	7.2	7.1	50	10/Dec/2022	26.24418825	79.85570732
NH27	1557800	1557900	I	L2	6.4	4.5	5.5	47	10/Dec/2022	26.244956	79.85623111
NH27	1557900	1558000	I	L2	5.8	5.7	5.8	51	10/Dec/2022	26.24571816	79.85676286
NH27	1558000	1558100	I	L2	6.4	8.7	7.6	52	10/Dec/2022	26.24648602	79.85728586
NH27	1558100	1558200	I	L2	7.5	6.1	6.8	51	10/Dec/2022	26.24725358	79.85780972
NH27	1558200	1558300	I	L2	6.5	7.5	7	44	10/Dec/2022	26.24797441	79.85841023
NH27	1558300	1558400	I	L2	6.4	9.5	8	50	10/Dec/2022	26.24861182	79.85911428
NH27	1558400	1558500	I	L2	6.8	7.2	7	54	10/Dec/2022	26.24919577	79.85987501
NH27	1558500	1558600	I	L2	7.3	7.6	7.5	51	10/Dec/2022	26.24975838	79.86065618
NH27	1558600	1558700	I	L2	5.2	8.6	6.9	49	10/Dec/2022	26.25033978	79.86141977
NH27	1558700	1558800	I	L2	3.9	8.6	6.3	49	10/Dec/2022	26.25092155	79.86218323
NH27	1558800	1558900	I	L2	4.6	6.2	5.4	54	10/Dec/2022	26.25150059	79.86294766
NH27	1558900	1559000	I	L2	6.5	2.2	4.4	54	10/Dec/2022	26.25208058	79.86371217
NH27	1559000	1559100	I	L2	7.7	2.3	5	53	10/Dec/2022	26.25266026	79.86447737
NH27	1559100	1559200	I	L2	3.6	4.8	4.2	56	10/Dec/2022	26.25324408	79.86523808
NH27	1559200	1559300	I	L2	6.4	2.4	4.4	56	10/Dec/2022	26.25382579	79.86600139
NH27	1559300	1559400	I	L2	5	4	4.5	52	10/Dec/2022	26.25440618	79.86676684
NH27	1559400	1559500	I	L2	4.3	5.2	4.8	52	10/Dec/2022	26.25498446	79.86753326
NH27	1559500	1559600	I	L2	4.1	4	4.1	54	10/Dec/2022	26.25556731	79.86829437
NH27	1559600	1559700	I	L2	4.7	8.9	6.8	54	10/Dec/2022	26.25617943	79.86902656
NH27	1559700	1559800	I	L2	6.2	7	6.6	57	10/Dec/2022	26.2568541	79.86968779
NH27	1559800	1559900	I	L2	6.5	4.1	5.3	55	10/Dec/2022	26.2575579	79.87031068
NH27	1559900	1560000	I	L2	5.7	3	4.4	55	10/Dec/2022	26.25829842	79.87087981
NH27	1560000	1560100	I	L2	6	3.5	4.8	58	10/Dec/2022	26.25904448	79.87143879

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1560100	1560200	I	L2	6.5	1.9	4.2	59	10/Dec/2022	26.2597888	79.87200185
NH27	1560200	1560300	I	L2	7.5	6.7	7.1	60	10/Dec/2022	26.26053505	79.87256194
NH27	1560300	1560400	I	L2	5.4	5.6	5.5	58	10/Dec/2022	26.2612763	79.87313089
NH27	1560400	1560500	I	L2	4.9	5.1	5	54	10/Dec/2022	26.26202318	79.8736914
NH27	1560500	1560600	I	L2	6.8	9.8	8.3	58	10/Dec/2022	26.26277623	79.87423914
NH27	1560600	1560700	I	L2	7	7	7	64	10/Dec/2022	26.26352171	79.8747978
NH27	1560700	1560800	I	L2	6.3	8.7	7.5	60	10/Dec/2022	26.26424985	79.87538849
NH27	1560800	1560900	I	L2	7	3.3	5.2	58	10/Dec/2022	26.26499367	79.8759533
NH27	1560900	1561000	I	L2	6.7	3.9	5.3	57	10/Dec/2022	26.26573779	79.8765166
NH27	1561000	1561100	I	L2	5.1	3.8	4.5	59	10/Dec/2022	26.26648063	79.87708164
NH27	1561100	1561200	I	L2	5.4	8.4	6.9	60	10/Dec/2022	26.26722462	79.87764517
NH27	1561200	1561300	I	L2	3.5	2.9	3.2	60	10/Dec/2022	26.26796985	79.8782073
NH27	1561300	1561400	I	L2	3	2.4	2.7	58	10/Dec/2022	26.2687099	79.87877832
NH27	1561400	1561500	I	L2	4.8	3.3	4.1	57	10/Dec/2022	26.26941564	79.87939976
NH27	1561500	1561600	I	L2	3.4	4	3.7	57	10/Dec/2022	26.27007696	79.88007849
NH27	1561600	1561700	I	L2	4.2	2.3	3.3	58	10/Dec/2022	26.27073378	79.88076258
NH27	1561700	1561800	I	L2	5.2	2.7	4	60	10/Dec/2022	26.27139085	79.88144607
NH27	1561800	1561900	I	L2	4.2	2.3	3.3	60	10/Dec/2022	26.27204641	79.88213192
NH27	1561900	1562000	I	L2	7.1	7	7.1	62	10/Dec/2022	26.27270291	79.88281593
NH27	1562000	1562100	I	L2	3.7	5.6	4.7	63	10/Dec/2022	26.27335863	79.88350124
NH27	1562100	1562200	I	L2	6.4	2.5	4.5	62	10/Dec/2022	26.27401227	79.88418975
NH27	1562200	1562300	I	L2	8.5	7.2	7.9	65	10/Dec/2022	26.27467989	79.88485957
NH27	1562300	1562400	I	L2	8.2	2.8	5.5	63	10/Dec/2022	26.27532446	79.88555936
NH27	1562400	1562500	I	L2	7.5	3.8	5.7	63	10/Dec/2022	26.2759674	79.88625948
NH27	1562500	1562600	I	L2	5.3	3.5	4.4	61	10/Dec/2022	26.27661674	79.8869529
NH27	1562600	1562700	I	L2	7.6	1.9	4.8	60	10/Dec/2022	26.27726761	79.88764433
NH27	1562700	1562800	I	L2	6.9	1.8	4.4	60	10/Dec/2022	26.27791706	79.88833712
NH27	1562800	1562900	I	L2	5.5	2	3.8	60	10/Dec/2022	26.27857002	79.88902617
NH27	1562900	1563000	I	L2	6.7	7.2	7	60	10/Dec/2022	26.27921997	79.88971865
NH27	1563000	1563100	I	L2	5.2	4.8	5	60	10/Dec/2022	26.27987051	79.89041037
NH27	1563100	1563200	I	L2	3.1	3.2	3.2	61	10/Dec/2022	26.28054296	79.89107364
NH27	1563200	1563300	I	L2	3.7	4.1	3.9	60	10/Dec/2022	26.2813161	79.89158385
NH27	1563300	1563400	I	L2	5.6	5.7	5.7	57	10/Dec/2022	26.28209536	79.89208699
NH27	1563400	1563500	I	L2	5.2	5.3	5.3	58	10/Dec/2022	26.28282345	79.89267569
NH27	1563500	1563600	I	L2	5.8	5.5	5.7	61	10/Dec/2022	26.28345371	79.89338846
NH27	1563600	1563700	I	L2	5.4	5.2	5.3	60	10/Dec/2022	26.2840553	79.89413161
NH27	1563700	1563800	I	L2	4.9	7.8	6.4	59	10/Dec/2022	26.28466873	79.89486413
NH27	1563800	1563900	I	L2	7.3	6	6.7	59	10/Dec/2022	26.28527924	79.89559921
NH27	1563900	1564000	I	L2	6.8	5.6	6.2	59	10/Dec/2022	26.28588838	79.89633585
NH27	1564000	1564100	I	L2	7.3	3.9	5.6	61	10/Dec/2022	26.28648997	79.89707999

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1564100	1564200	I	L2	9	11.8	10.4	60	10/Dec/2022	26.28707883	79.89783729
NH27	1564200	1564300	I	L2	9.3	5.5	7.4	57	10/Dec/2022	26.28766394	79.8985965
NH27	1564300	1564400	I	L2	8	8.1	8.1	50	10/Dec/2022	26.28822296	79.89938111
NH27	1564400	1564500	I	L2	8.9	4.5	6.7	33	10/Dec/2022	26.2887133	79.90022109
NH27	1564500	1564600	I	L2	10.3	5.6	8	33	10/Dec/2022	26.2891351	79.9011039
NH27	1564600	1564700	I	L2	6	6.3	6.2	45	10/Dec/2022	26.28951632	79.90200882
NH27	1564700	1564800	I	L2	7.7	5.2	6.5	48	10/Dec/2022	26.2898997	79.90291446
NH27	1564800	1564900	I	L2	3.8	2.8	3.3	49	10/Dec/2022	26.29028525	79.90381898
NH27	1564900	1565000	I	L2	7.9	5	6.5	49	10/Dec/2022	26.29073682	79.90468199
NH27	1565000	1565100	I	L2	3.3	5.9	4.6	50	10/Dec/2022	26.29127515	79.90548245
NH27	1565100	1565200	I	L2	3.5	4.7	4.1	47	10/Dec/2022	26.29184339	79.9062596
NH27	1565200	1565300	I	L2	7.1	9.1	8.1	48	10/Dec/2022	26.29241705	79.9070301
NH27	1565300	1565400	I	L2	4.6	7.7	6.2	57	10/Dec/2022	26.29299493	79.90779551
NH27	1565400	1565500	I	L2	6.6	10.1	8.4	54	10/Dec/2022	26.29354328	79.90858982
NH27	1565500	1565600	I	L2	5	6.3	5.7	49	10/Dec/2022	26.29411066	79.90936752
NH27	1565600	1565700	I	L2	5.4	4.5	5	50	10/Dec/2022	26.29468153	79.9101542
NH27	1565700	1565800	I	L2	3.7	4	3.9	51	10/Dec/2022	26.29525047	79.91092938
NH27	1565800	1565900	I	L2	3.2	3.9	3.6	51	10/Dec/2022	26.29581813	79.91170579
NH27	1565900	1566000	I	L2	4.5	6.2	5.4	58	10/Dec/2022	26.29638641	79.91248023
NH27	1566000	1566100	I	L2	9	6.4	7.7	63	10/Dec/2022	26.29696851	79.9132423
NH27	1566100	1566200	I	L2	5.8	6.8	6.3	63	10/Dec/2022	26.29753536	79.9140199
NH27	1566200	1566300	I	L2	5.1	4.2	4.7	62	10/Dec/2022	26.29815057	79.9147497
NH27	1566300	1566400	I	L2	3.7	2.8	3.3	60	10/Dec/2022	26.29878947	79.91545616
NH27	1566400	1566500	I	L2	2.4	6.5	4.5	60	10/Dec/2022	26.29942024	79.91616994
NH27	1566500	1566600	I	L2	2.2	6.6	4.4	63	10/Dec/2022	26.30003531	79.91690069
NH27	1566600	1566700	I	L2	3.3	3.8	3.6	62	10/Dec/2022	26.3006371	79.91764626
NH27	1566700	1566800	I	L2	4	6.1	5.1	61	10/Dec/2022	26.30126912	79.91835947
NH27	1566800	1566900	I	L2	4.7	3.1	3.9	62	10/Dec/2022	26.30185391	79.91912037
NH27	1566900	1567000	I	L2	2.7	3.9	3.3	64	10/Dec/2022	26.30236275	79.91994582
NH27	1567000	1567100	I	L2	4.4	7	5.7	65	10/Dec/2022	26.30283846	79.92079526
NH27	1567100	1567200	I	L2	2.8	4.3	3.6	62	10/Dec/2022	26.30332317	79.92163842
NH27	1567200	1567300	I	L2	4.6	2.4	3.5	59	10/Dec/2022	26.30394944	79.92235172
NH27	1567300	1567400	I	L2	5.5	8.5	7	60	10/Dec/2022	26.30473861	79.92282302
NH27	1567400	1567500	I	L2	7.4	2.9	5.2	54	10/Dec/2022	26.30559798	79.92312527
NH27	1567500	1567600	I	L2	6.2	4.6	5.4	53	10/Dec/2022	26.30642286	79.92352117
NH27	1567600	1567700	I	L2	7.7	4.6	6.2	55	10/Dec/2022	26.30713042	79.92413699
NH27	1567700	1567800	I	L2	4.8	2.7	3.8	57	10/Dec/2022	26.30779961	79.9248046
NH27	1567800	1567900	I	L2	6.2	4.4	5.3	58	10/Dec/2022	26.30846655	79.92547485
NH27	1567900	1568000	I	L2	7.3	3.3	5.3	59	10/Dec/2022	26.30913443	79.92614494
NH27	1568000	1568100	I	L2	4.4	4.9	4.7	59	10/Dec/2022	26.30980133	79.9268165

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1568100	1568200	I	L2	5	4.5	4.8	62	10/Dec/2022	26.31046988	79.92748507
NH27	1568200	1568300	I	L2	2.9	6.2	4.6	59	10/Dec/2022	26.31113944	79.92815468
NH27	1568300	1568400	I	L2	2.5	5.9	4.2	60	10/Dec/2022	26.31182532	79.92880243
NH27	1568400	1568500	I	L2	4	5	4.5	62	10/Dec/2022	26.31248766	79.92948012
NH27	1568500	1568600	I	L2	5.8	4.8	5.3	64	10/Dec/2022	26.31309457	79.930219
NH27	1568600	1568700	I	L2	3.8	3.1	3.5	63	10/Dec/2022	26.31361632	79.93103406
NH27	1568700	1568800	I	L2	4.5	3	3.8	63	10/Dec/2022	26.3140754	79.93189497
NH27	1568800	1568900	I	L2	8.2	4.5	6.4	61	10/Dec/2022	26.31453233	79.93275729
NH27	1568900	1569000	I	L2	5.2	8.8	7	60	10/Dec/2022	26.31498489	79.93362107
NH27	1569000	1569100	I	L2	3.9	4	4	59	10/Dec/2022	26.31543873	79.93448408
NH27	1569100	1569200	I	L2	3.4	3.4	3.4	57	10/Dec/2022	26.31589308	79.93534704
NH27	1569200	1569300	I	L2	6.3	10.5	8.4	58	10/Dec/2022	26.31630754	79.93623457
NH27	1569300	1569400	I	L2	5.8	6.6	6.2	56	10/Dec/2022	26.31670509	79.93713153
NH27	1569400	1569500	I	L2	6.3	6.2	6.3	55	10/Dec/2022	26.31705111	79.93805466
NH27	1569500	1569600	I	L2	7	5.9	6.5	57	10/Dec/2022	26.31741861	79.93896669
NH27	1569600	1569700	I	L2	8.3	3.4	5.9	58	10/Dec/2022	26.31779667	79.93987365
NH27	1569700	1569800	I	L2	6.4	3.3	4.9	59	10/Dec/2022	26.31824218	79.94074102
NH27	1569800	1569900	I	L2	3.8	4.1	4	60	10/Dec/2022	26.31876873	79.94155162
NH27	1569900	1570000	I	L2	3.4	3.7	3.6	61	10/Dec/2022	26.31930246	79.94235725
NH27	1570000	1570100	I	L2	5.8	7.8	6.8	59	10/Dec/2022	26.31983613	79.94316337
NH27	1570100	1570200	I	L2	4.2	2.7	3.5	60	10/Dec/2022	26.32034864	79.9439857
NH27	1570200	1570300	I	L2	8.5	4.7	6.6	60	10/Dec/2022	26.32081563	79.94484116
NH27	1570300	1570400	I	L2	7.5	11	9.3	59	10/Dec/2022	26.32122323	79.94573339
NH27	1570400	1570500	I	L2	4.6	8.3	6.5	56	10/Dec/2022	26.32159996	79.94664243
NH27	1570500	1570600	I	L2	5.1	6	5.6	55	10/Dec/2022	26.32197446	79.94755265
NH27	1570600	1570700	I	L2	6.1	5.4	5.8	57	10/Dec/2022	26.322356	79.94845838
NH27	1570700	1570800	I	L2	3.6	2.5	3.1	57	10/Dec/2022	26.32279959	79.94932753
NH27	1570800	1570900	I	L2	2.4	4.1	3.3	57	10/Dec/2022	26.32332729	79.9501371
NH27	1570900	1571000	I	L2	5.9	9.1	7.5	56	10/Dec/2022	26.32392642	79.95088333
NH27	1571000	1571100	I	L2	6.9	11.3	9.1	40	10/Dec/2022	26.32454299	79.95161495
NH27	1571100	1571200	I	L2	3.2	4.7	4	48	10/Dec/2022	26.32518479	79.95231375
NH27	1571200	1571300	I	L2	3.5	3.6	3.6	48	10/Dec/2022	26.32585807	79.95297637
NH27	1571300	1571400	I	L2	3.5	4.8	4.2	40	10/Dec/2022	26.32656882	79.95359336
NH27	1571400	1571500	I	L2	3.7	5	4.4	52	10/Dec/2022	26.32729293	79.95418389
NH27	1571500	1571600	I	L2	7.7	11.9	9.8	33	10/Dec/2022	26.32797119	79.95484505
NH27	1571600	1571700	I	L2	7.9	12.4	10.2	21	10/Dec/2022	26.32865067	79.95549924
NH27	1571700	1571800	I	L2	8.2	11.8	10	45	10/Dec/2022	26.32935153	79.95612148
NH27	1571800	1571900	I	L2	6.9	6.7	6.8	51	10/Dec/2022	26.33005338	79.9567444
NH27	1571900	1572000	I	L2	4.5	3.5	4	54	10/Dec/2022	26.33076106	79.95736226
NH27	1572000	1572100	I	L2	4.5	3.6	4.1	56	10/Dec/2022	26.33146834	79.95798278

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1572100	1572200	I	L2	3.3	3	3.2	56	10/Dec/2022	26.33217968	79.95859708
NH27	1572200	1572300	I	L2	3.7	3.3	3.5	57	10/Dec/2022	26.33290178	79.95919424
NH27	1572300	1572400	I	L2	3.9	5.4	4.7	57	10/Dec/2022	26.33363787	79.95977085
NH27	1572400	1572500	I	L2	4.3	8.2	6.3	53	10/Dec/2022	26.33440593	79.96029347
NH27	1572500	1572600	I	L2	4.9	4.9	4.9	59	10/Dec/2022	26.33516506	79.9608301
NH27	1572600	1572700	I	L2	4.9	8.9	6.9	63	10/Dec/2022	26.33588531	79.96142883
NH27	1572700	1572800	I	L2	3.3	6.9	5.1	65	10/Dec/2022	26.33662473	79.96199959
NH27	1572800	1572900	I	L2	4.4	8.8	6.6	66	10/Dec/2022	26.33736413	79.96257
NH27	1572900	1573000	I	L2	6.1	7.9	7	63	10/Dec/2022	26.33812617	79.96310408
NH27	1573000	1573100	I	L2	6.5	8.1	7.3	63	10/Dec/2022	26.33887945	79.96365265
NH27	1573100	1573200	I	L2	4.9	7.9	6.4	63	10/Dec/2022	26.33956688	79.96429841
NH27	1573200	1573300	I	L2	5.2	9.8	7.5	64	10/Dec/2022	26.34018659	79.96502424
NH27	1573300	1573400	I	L2	6.2	6.8	6.5	67	10/Dec/2022	26.34079782	79.96575813
NH27	1573400	1573500	I	L2	5.4	5.8	5.6	71	10/Dec/2022	26.34140382	79.96649674
NH27	1573500	1573600	I	L2	4.4	7.9	6.2	73	10/Dec/2022	26.34200279	79.96724301
NH27	1573600	1573700	I	L2	5.3	5.6	5.5	72	10/Dec/2022	26.34260634	79.96798422
NH27	1573700	1573800	I	L2	4.3	4.5	4.4	70	10/Dec/2022	26.34321134	79.96872426
NH27	1573800	1573900	I	L2	4.4	8	6.2	54	10/Dec/2022	26.34382133	79.96946296
NH27	1573900	1574000	I	L2	4.6	7.2	5.9	53	10/Dec/2022	26.34444843	79.97018147
NH27	1574000	1574100	I	L2	5.3	9.9	7.6	62	10/Dec/2022	26.34503539	79.97093911
NH27	1574100	1574200	I	L2	6.7	9	7.9	62	10/Dec/2022	26.34564138	79.97168057
NH27	1574200	1574300	I	L2	3.2	5.4	4.3	59	10/Dec/2022	26.34626725	79.9724014
NH27	1574300	1574400	I	L2	3	3.9	3.5	58	10/Dec/2022	26.34690141	79.97311263
NH27	1574400	1574500	I	L2	6.1	6.9	6.5	60	10/Dec/2022	26.34751747	79.97384172
NH27	1574500	1574600	I	L2	6.7	5.7	6.2	60	10/Dec/2022	26.34813795	79.97456712
NH27	1574600	1574700	I	L2	6.9	9.1	8	61	10/Dec/2022	26.34874185	79.97530909
NH27	1574700	1574800	I	L2	4.2	9.8	7	59	10/Dec/2022	26.34934053	79.97605647
NH27	1574800	1574900	I	L2	6.2	8.8	7.5	58	10/Dec/2022	26.34994894	79.97679429
NH27	1574900	1575000	I	L2	8.1	9.3	8.7	59	10/Dec/2022	26.35055315	79.97753577
NH27	1575000	1575100	I	L2	5.5	6.8	6.2	56	10/Dec/2022	26.35116065	79.97827548
NH27	1575100	1575200	I	L2	14.5	8.8	11.7	55	10/Dec/2022	26.35176692	79.9790157
NH27	1575200	1575300	I	L2	9.2	6.6	7.9	58	10/Dec/2022	26.35237443	79.97975355
NH27	1575300	1575400	I	L2	8.8	5.4	7.1	51	10/Dec/2022	26.35299071	79.98048496
NH27	1575400	1575500	I	L2	9.1	12	10.6	57	10/Dec/2022	26.35358944	79.9812309
NH27	1575500	1575600	I	L2	8.1	12.2	10.2	62	10/Dec/2022	26.35419544	79.98196946
NH27	1575600	1575700	I	L2	5.7	8.2	7	66	10/Dec/2022	26.3548032	79.98270639
NH27	1575700	1575800	I	L2	6.1	7.4	6.8	65	10/Dec/2022	26.35545445	79.9833963
NH27	1575800	1575900	I	L2	4.4	5.7	5.1	64	10/Dec/2022	26.35616012	79.98401786
NH27	1575900	1576000	I	L2	3.7	8.1	5.9	65	10/Dec/2022	26.35691349	79.98456513
NH27	1576000	1576100	I	L2	6.7	10.6	8.7	66	10/Dec/2022	26.35770203	79.98504854

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1576100	1576200	I	L2	4.6	5.9	5.3	62	10/Dec/2022	26.35849432	79.98552699
NH27	1576200	1576300	I	L2	6.1	7.1	6.6	62	10/Dec/2022	26.35928692	79.98600316
NH27	1576300	1576400	I	L2	3.4	5.6	4.5	60	10/Dec/2022	26.3600797	79.98647966
NH27	1576400	1576500	I	L2	5.4	5.8	5.6	58	10/Dec/2022	26.36087241	79.98695669
NH27	1576500	1576600	I	L2	5.6	6.7	6.2	61	10/Dec/2022	26.36166454	79.98743235
NH27	1576600	1576700	I	L2	6.2	6.4	6.3	63	10/Dec/2022	26.36245702	79.98790731
NH27	1576700	1576800	I	L2	6.1	5.3	5.7	64	10/Dec/2022	26.36324943	79.98838309
NH27	1576800	1576900	I	L2	4.9	3.2	4.1	64	10/Dec/2022	26.3640409	79.98886099
NH27	1576900	1577000	I	L2	4.7	5.3	5	67	10/Dec/2022	26.36484175	79.98933937
NH27	1577000	1577100	I	L2	6.3	9.2	7.8	68	10/Dec/2022	26.36563391	79.9898155
NH27	1577100	1577200	I	L2	10.8	8.5	9.7	67	10/Dec/2022	26.36642809	79.99028786
NH27	1577200	1577300	I	L2	7.3	6.2	6.8	67	10/Dec/2022	26.36723288	79.99073754
NH27	1577300	1577400	I	L2	3.5	3.8	3.7	68	10/Dec/2022	26.3680341	79.9911951
NH27	1577400	1577500	I	L2	5.3	4.2	4.8	62	10/Dec/2022	26.36882689	79.99167422
NH27	1577500	1577600	I	L2	7.4	5.7	6.6	61	10/Dec/2022	26.36962247	79.9921448
NH27	1577600	1577700	I	L2	6	5.1	5.6	60	10/Dec/2022	26.37042386	79.99260211
NH27	1577700	1577800	I	L2	5.1	5	5.1	62	10/Dec/2022	26.37121297	79.99308483
NH27	1577800	1577900	I	L2	3.8	3.9	3.9	61	10/Dec/2022	26.3719958	79.99357997
NH27	1577900	1578000	I	L2	7.4	6.3	6.9	39	10/Dec/2022	26.37279224	79.99405265
NH27	1578000	1578100	I	L2	2.4	4.8	3.6	44	10/Dec/2022	26.37357006	79.99455675
NH27	1578100	1578200	I	L2	4.7	5.3	5	48	10/Dec/2022	26.37435302	79.99504961
NH27	1578200	1578300	I	L2	4.7	5.1	4.9	55	10/Dec/2022	26.37513917	79.9955357
NH27	1578300	1578400	I	L2	4.1	7.5	5.8	57	10/Dec/2022	26.37592699	79.99602002
NH27	1578400	1578500	I	L2	4.6	6.6	5.6	60	10/Dec/2022	26.37671466	79.9965023
NH27	1578500	1578600	I	L2	6.4	7	6.7	59	10/Dec/2022	26.37747034	79.99704357
NH27	1578600	1578700	I	L2	11.3	7.4	9.4	57	10/Dec/2022	26.37816421	79.99768009
NH27	1578700	1578800	I	L2	5.7	5.3	5.5	54	10/Dec/2022	26.37885326	79.99832548
NH27	1578800	1578900	I	L2	4.6	6	5.3	57	10/Dec/2022	26.3795288	79.99898721
NH27	1578900	1579000	I	L2	3.5	6.8	5.2	56	10/Dec/2022	26.38004534	79.99980463
NH27	1579000	1579077	I	L2	3.5	6.8	5.2	54	10/Dec/2022	26.38029409	80.00076553
NH27	1578530	1578450	D	R1	3.2	3.1	3.1	10	10/Dec/2022	26.37877324	79.998663
NH27	1578450	1578350	D	R1	3	2.4	2.7	29	10/Dec/2022	26.37833486	79.99803618
NH27	1578350	1578250	D	R1	3.3	3.1	3.2	38	10/Dec/2022	26.37765301	79.99738546
NH27	1578250	1578150	D	R1	2.5	3.6	3.1	25	10/Dec/2022	26.37692844	79.99679256
NH27	1578150	1578050	D	R1	3.1	3.3	3.2	12	10/Dec/2022	26.37614501	79.99629916
NH27	1578050	1577950	D	R1	3.7	3.5	3.6	34	10/Dec/2022	26.37531095	79.99579345
NH27	1577950	1577850	D	R1	3.9	2.9	3.4	43	10/Dec/2022	26.37451901	79.99532089
NH27	1577850	1577750	D	R1	2.6	2.5	2.6	44	10/Dec/2022	26.37373104	79.99483785
NH27	1577750	1577650	D	R1	3.1	1.8	2.5	51	10/Dec/2022	26.3729523	79.99433807

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1577650	1577550	D	R1	3.5	2.2	2.9	55	10/Dec/2022	26.37216286	79.99385851
NH27	1577550	1577450	D	R1	3.1	2.2	2.7	53	10/Dec/2022	26.37137105	79.99338181
NH27	1577450	1577350	D	R1	3.6	3.3	3.5	55	10/Dec/2022	26.37058042	79.99290384
NH27	1577350	1577250	D	R1	3.5	3.5	3.5	55	10/Dec/2022	26.36978929	79.99242616
NH27	1577250	1577150	D	R1	2.9	2.3	2.6	54	10/Dec/2022	26.36899782	79.9919493
NH27	1577150	1577050	D	R1	3.9	2.4	3.2	54	10/Dec/2022	26.36820427	79.99147639
NH27	1577050	1576950	D	R1	3.6	4.3	4	51	10/Dec/2022	26.36740938	79.99100456
NH27	1576950	1576850	D	R1	3.8	3.6	3.7	53	10/Dec/2022	26.36659942	79.99056991
NH27	1576850	1576750	D	R1	3.4	4.8	4.1	56	10/Dec/2022	26.3658048	79.9901008
NH27	1576750	1576650	D	R1	3.1	4.5	3.8	57	10/Dec/2022	26.36501396	79.98962324
NH27	1576650	1576550	D	R1	3.4	4.2	3.8	58	10/Dec/2022	26.36422164	79.98914776
NH27	1576550	1576450	D	R1	3	4.1	3.6	58	10/Dec/2022	26.36342975	79.98867169
NH27	1576450	1576350	D	R1	2.8	4	3.4	59	10/Dec/2022	26.36263854	79.98819422
NH27	1576350	1576250	D	R1	2.4	3.7	3.1	56	10/Dec/2022	26.36184735	79.98771457
NH27	1576250	1576150	D	R1	2.3	3.6	3	54	10/Dec/2022	26.3610555	79.98723801
NH27	1576150	1576050	D	R1	2.5	3.6	3.1	53	10/Dec/2022	26.36026238	79.98676392
NH27	1576050	1575950	D	R1	2.6	4.6	3.6	47	10/Dec/2022	26.35946841	79.98628977
NH27	1575950	1575850	D	R1	3.3	4.1	3.7	48	10/Dec/2022	26.35867859	79.98581047
NH27	1575850	1575750	D	R1	3.4	4.2	3.8	59	10/Dec/2022	26.35788554	79.98534136
NH27	1575750	1575650	D	R1	3.6	4.3	4	65	10/Dec/2022	26.35709788	79.98485991
NH27	1575650	1575550	D	R1	2.9	4.2	3.6	66	10/Dec/2022	26.35632788	79.98434162
NH27	1575550	1575450	D	R1	3.2	4.5	3.9	69	10/Dec/2022	26.35560758	79.98374255
NH27	1575450	1575350	D	R1	3.7	4.5	4.1	69	10/Dec/2022	26.3549349	79.9830784
NH27	1575350	1575250	D	R1	3.2	4.2	3.7	70	10/Dec/2022	26.35431435	79.98235414
NH27	1575250	1575150	D	R1	2.6	3.8	3.2	69	10/Dec/2022	26.35370882	79.98161392
NH27	1575150	1575050	D	R1	2.1	2.8	2.5	66	10/Dec/2022	26.35310535	79.98087058
NH27	1575050	1574950	D	R1	2.9	5.4	4.2	29	10/Dec/2022	26.35250783	79.98011811
NH27	1574950	1574850	D	R1	2.7	3.9	3.3	40	10/Dec/2022	26.35188972	79.97939646
NH27	1574850	1574750	D	R1	2.5	3.2	2.9	43	10/Dec/2022	26.35128466	79.97865551
NH27	1574750	1574650	D	R1	3.1	3.5	3.3	45	10/Dec/2022	26.35067729	79.97791932
NH27	1574650	1574550	D	R1	3.6	3.2	3.4	54	10/Dec/2022	26.35007121	79.97718192
NH27	1574550	1574450	D	R1	3.2	4.6	3.9	56	10/Dec/2022	26.34946359	79.97644445
NH27	1574450	1574350	D	R1	2.8	3.2	3	51	10/Dec/2022	26.34886005	79.97570111
NH27	1574350	1574250	D	R1	3.9	4.4	4.2	53	10/Dec/2022	26.34825192	79.97496529
NH27	1574250	1574150	D	R1	3.5	3.8	3.7	59	10/Dec/2022	26.34763894	79.97423456
NH27	1574150	1574050	D	R1	2.6	3.7	3.2	60	10/Dec/2022	26.34703371	79.97349433
NH27	1574050	1573950	D	R1	3.2	3.5	3.4	61	10/Dec/2022	26.34641653	79.97276658
NH27	1573950	1573850	D	R1	3.2	4	3.6	60	10/Dec/2022	26.34579465	79.97204413
NH27	1573850	1573750	D	R1	3.8	4	3.9	56	10/Dec/2022	26.34518305	79.97131114
NH27	1573750	1573650	D	R1	3.6	3.1	3.4	54	10/Dec/2022	26.34457895	79.97057104

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1573650	1573550	D	R1	3.7	3.5	3.6	55	10/Dec/2022	26.34397361	79.96983192
NH27	1573550	1573450	D	R1	3.6	3.1	3.4	60	10/Dec/2022	26.34336448	79.96909567
NH27	1573450	1573350	D	R1	3.2	3.7	3.5	66	10/Dec/2022	26.34275942	79.96835542
NH27	1573350	1573250	D	R1	4.2	3.1	3.7	67	10/Dec/2022	26.34214943	79.96761893
NH27	1573250	1573150	D	R1	3.5	3.4	3.5	66	10/Dec/2022	26.34153503	79.96688716
NH27	1573150	1573050	D	R1	3.6	4	3.8	64	10/Dec/2022	26.34092655	79.96614913
NH27	1573050	1572950	D	R1	3.3	3.9	3.6	59	10/Dec/2022	26.3403204	79.96540774
NH27	1572950	1572850	D	R1	3.8	4.5	4.2	42	10/Dec/2022	26.33971606	79.96466377
NH27	1572850	1572750	D	R1	3.3	3.7	3.5	42	10/Dec/2022	26.33907416	79.96396732
NH27	1572750	1572650	D	R1	3.4	4.5	4	49	10/Dec/2022	26.33833017	79.96340718
NH27	1572650	1572550	D	R1	4.2	3.3	3.8	55	10/Dec/2022	26.33755745	79.96289571
NH27	1572550	1572450	D	R1	3.6	3.1	3.4	59	10/Dec/2022	26.33681188	79.96233565
NH27	1572450	1572350	D	R1	3.7	3.3	3.5	60	10/Dec/2022	26.33607397	79.96176269
NH27	1572350	1572250	D	R1	3.5	3.6	3.6	59	10/Dec/2022	26.33533552	79.9611902
NH27	1572250	1572150	D	R1	4	3.1	3.6	58	10/Dec/2022	26.33459111	79.96062679
NH27	1572150	1572050	D	R1	3.7	3.2	3.5	56	10/Dec/2022	26.33383652	79.96008014
NH27	1572050	1571950	D	R1	3.5	3.8	3.7	54	10/Dec/2022	26.33309711	79.95950815
NH27	1571950	1571850	D	R1	3.6	3.4	3.5	55	10/Dec/2022	26.33236728	79.95892223
NH27	1571850	1571750	D	R1	3.5	3.6	3.6	56	10/Dec/2022	26.33165744	79.95830807
NH27	1571750	1571650	D	R1	3.4	3.8	3.6	54	10/Dec/2022	26.33095246	79.9576867
NH27	1571650	1571550	D	R1	3.2	3.4	3.3	54	10/Dec/2022	26.33024451	79.95706829
NH27	1571550	1571450	D	R1	2.7	3	2.9	54	10/Dec/2022	26.32953783	79.95644723
NH27	1571450	1571350	D	R1	3	3.4	3.2	56	10/Dec/2022	26.32883108	79.95582736
NH27	1571350	1571250	D	R1	3.2	4.8	4	55	10/Dec/2022	26.32812727	79.95520276
NH27	1571250	1571150	D	R1	5.4	8	6.7	55	10/Dec/2022	26.32744256	79.95455312
NH27	1571150	1571050	D	R1	5.5	6.5	6	56	10/Dec/2022	26.32673539	79.95393441
NH27	1571050	1570950	D	R1	5.1	5.1	5.1	56	10/Dec/2022	26.32602605	79.95331824
NH27	1570950	1570850	D	R1	4.7	3.7	4.2	57	10/Dec/2022	26.32532787	79.95268684
NH27	1570850	1570750	D	R1	5.2	5.7	5.5	58	10/Dec/2022	26.32468406	79.95198767
NH27	1570750	1570650	D	R1	5.3	5.4	5.4	59	10/Dec/2022	26.32407507	79.95125111
NH27	1570650	1570550	D	R1	5.2	5.7	5.5	57	10/Dec/2022	26.32346541	79.95051508
NH27	1570550	1570450	D	R1	4.6	4.4	4.5	56	10/Dec/2022	26.3229064	79.94973115
NH27	1570450	1570350	D	R1	4.6	6	5.3	55	10/Dec/2022	26.32243245	79.94888129
NH27	1570350	1570250	D	R1	4.5	3.2	3.9	55	10/Dec/2022	26.32203064	79.9479866
NH27	1570250	1570150	D	R1	3.8	4.1	4	55	10/Dec/2022	26.32165441	79.94707871
NH27	1570150	1570050	D	R1	3.1	5.1	4.1	57	10/Dec/2022	26.3212752	79.94617229
NH27	1570050	1569950	D	R1	3.1	5.2	4.2	58	10/Dec/2022	26.32087252	79.94527854
NH27	1569950	1569850	D	R1	2.4	3.9	3.2	58	10/Dec/2022	26.32042818	79.94440905
NH27	1569850	1569750	D	R1	3.4	5.1	4.3	57	10/Dec/2022	26.3199295	79.94357707
NH27	1569750	1569650	D	R1	3.7	4.7	4.2	57	10/Dec/2022	26.31939775	79.94276968

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1569650	1569550	D	R1	4	3.5	3.8	54	10/Dec/2022	26.31886571	79.94196192
NH27	1569550	1569450	D	R1	3.7	3.7	3.7	55	10/Dec/2022	26.31833379	79.94115537
NH27	1569450	1569350	D	R1	3.4	4.7	4.1	53	10/Dec/2022	26.31785733	79.94030679
NH27	1569350	1569250	D	R1	3.5	2.8	3.2	55	10/Dec/2022	26.31745003	79.93941551
NH27	1569250	1569150	D	R1	3.5	4.2	3.9	54	10/Dec/2022	26.3170764	79.93850524
NH27	1569150	1569050	D	R1	3.5	3.2	3.4	57	10/Dec/2022	26.31670946	79.93759303
NH27	1569050	1568950	D	R1	2.4	2.8	2.6	60	10/Dec/2022	26.3163399	79.93668144
NH27	1568950	1568850	D	R1	2.7	3.4	3.1	60	10/Dec/2022	26.31595384	79.93577882
NH27	1568850	1568750	D	R1	3.5	4.3	3.9	59	10/Dec/2022	26.3155033	79.93491246
NH27	1568750	1568650	D	R1	3.8	4.3	4.1	59	10/Dec/2022	26.31504764	79.93404879
NH27	1568650	1568550	D	R1	3.7	4.4	4.1	60	10/Dec/2022	26.3145899	79.93318661
NH27	1568550	1568450	D	R1	3.1	4.1	3.6	57	10/Dec/2022	26.31413596	79.93232215
NH27	1568450	1568350	D	R1	3.7	4.9	4.3	45	10/Dec/2022	26.31368734	79.93142827
NH27	1568350	1568250	D	R1	3	4.6	3.8	50	10/Dec/2022	26.31320154	79.93059021
NH27	1568250	1568150	D	R1	3.4	4	3.7	55	10/Dec/2022	26.31261111	79.92983984
NH27	1568150	1568050	D	R1	3.8	3.9	3.9	56	10/Dec/2022	26.3119458	79.92916699
NH27	1568050	1567950	D	R1	2.9	4.4	3.7	56	10/Dec/2022	26.31127936	79.92849469
NH27	1567950	1567850	D	R1	1.9	3.5	2.7	56	10/Dec/2022	26.31061269	79.92782216
NH27	1567850	1567750	D	R1	2.6	3.9	3.3	56	10/Dec/2022	26.30994535	79.9271511
NH27	1567750	1567650	D	R1	3	5	4	55	10/Dec/2022	26.30927587	79.92648197
NH27	1567650	1567550	D	R1	2.7	4.7	3.7	56	10/Dec/2022	26.30860557	79.92581453
NH27	1567550	1567450	D	R1	2.5	3.9	3.2	58	10/Dec/2022	26.30794023	79.92514062
NH27	1567450	1567350	D	R1	2.6	2.8	2.7	58	10/Dec/2022	26.30727354	79.9244677
NH27	1567350	1567250	D	R1	2.9	4.9	3.9	54	10/Dec/2022	26.30658231	79.92383063
NH27	1567250	1567150	D	R1	3.8	3.7	3.7	53	10/Dec/2022	26.30577477	79.92339551
NH27	1567150	1567050	D	R1	3.4	4.1	3.7	51	10/Dec/2022	26.30491234	79.92310837
NH27	1567050	1566950	D	R1	3	3.5	3.3	53	10/Dec/2022	26.30410763	79.92266726
NH27	1566950	1566850	D	R1	3.7	4.6	4.1	54	10/Dec/2022	26.30342936	79.92201153
NH27	1566850	1566750	D	R1	3.3	4.7	4	53	10/Dec/2022	26.30291189	79.92119486
NH27	1566750	1566650	D	R1	2.7	5	3.9	54	10/Dec/2022	26.30243949	79.920345
NH27	1566650	1566550	D	R1	3.3	4.5	3.9	53	10/Dec/2022	26.30195477	79.91950363
NH27	1566550	1566450	D	R1	3.7	3.9	3.8	54	10/Dec/2022	26.301396	79.9187223
NH27	1566450	1566350	D	R1	3.1	4.3	3.7	53	10/Dec/2022	26.3007862	79.91798841
NH27	1566350	1566250	D	R1	3	5.1	4.1	49	10/Dec/2022	26.30015922	79.91727098
NH27	1566250	1566150	D	R1	3.5	4.7	4.1	51	10/Dec/2022	26.29955743	79.91652946
NH27	1566150	1566050	D	R1	3.4	4.7	4.1	58	10/Dec/2022	26.29892397	79.91582144
NH27	1566050	1565950	D	R1	3	4.9	3.9	61	10/Dec/2022	26.2982931	79.91510957
NH27	1565950	1565850	D	R1	3.4	4.8	4.1	59	10/Dec/2022	26.29766167	79.91439626
NH27	1565850	1565750	D	R1	2.4	4.7	3.6	58	10/Dec/2022	26.2970688	79.91364378
NH27	1565750	1565650	D	R1	2.6	4.4	3.5	58	10/Dec/2022	26.29650228	79.91286719

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1565650	1565550	D	R1	3	5.6	4.3	58	10/Dec/2022	26.29593667	79.91208996
NH27	1565550	1565450	D	R1	3.6	4.4	4	58	10/Dec/2022	26.29536668	79.9113164
NH27	1565450	1565350	D	R1	2.8	5	3.9	58	10/Dec/2022	26.29479867	79.91054111
NH27	1565350	1565250	D	R1	3.1	5.2	4.1	61	10/Dec/2022	26.29423255	79.90976473
NH27	1565250	1565150	D	R1	3	4.7	3.9	60	10/Dec/2022	26.29366618	79.9089876
NH27	1565150	1565050	D	R1	3	4.9	3.9	63	10/Dec/2022	26.29309772	79.90821324
NH27	1565050	1564950	D	R1	2.7	5.2	4	64	10/Dec/2022	26.29253293	79.9074353
NH27	1564950	1564850	D	R1	2.8	5.1	4	64	10/Dec/2022	26.29196559	79.90665949
NH27	1564850	1564750	D	R1	3.6	4.8	4.2	64	10/Dec/2022	26.29139969	79.90588232
NH27	1564750	1564650	D	R1	2.6	3.2	2.9	64	10/Dec/2022	26.29084418	79.90509558
NH27	1564650	1564550	D	R1	4.3	4.6	4.4	65	10/Dec/2022	26.29037403	79.90424382
NH27	1564550	1564450	D	R1	5.5	7.2	6.4	56	10/Dec/2022	26.28997921	79.90334455
NH27	1564450	1564350	D	R1	3.7	5.6	4.7	53	10/Dec/2022	26.289594	79.90244235
NH27	1564350	1564250	D	R1	4.6	4.4	4.5	58	10/Dec/2022	26.28921205	79.90154004
NH27	1564250	1564150	D	R1	3.2	4.8	4	57	10/Dec/2022	26.2888142	79.90064279
NH27	1564150	1564050	D	R1	2.5	4	3.2	64	10/Dec/2022	26.28835335	79.89978592
NH27	1564050	1563950	D	R1	2.7	3.7	3.2	68	10/Dec/2022	26.28782117	79.89898066
NH27	1563950	1563850	D	R1	2.9	4	3.5	71	10/Dec/2022	26.28723269	79.89822411
NH27	1563850	1563750	D	R1	1.9	3.1	2.5	69	10/Dec/2022	26.28663301	79.89747779
NH27	1563750	1563650	D	R1	2.7	3.6	3.1	67	10/Dec/2022	26.28603502	79.89672954
NH27	1563650	1563550	D	R1	3.1	4.3	3.7	65	10/Dec/2022	26.28543582	79.89598277
NH27	1563550	1563450	D	R1	2.9	4.3	3.6	65	10/Dec/2022	26.28481387	79.89525987
NH27	1563450	1563350	D	R1	2.8	3.8	3.3	65	10/Dec/2022	26.2842035	79.8945244
NH27	1563350	1563250	D	R1	2.5	3.9	3.2	64	10/Dec/2022	26.28359924	79.89378305
NH27	1563250	1563150	D	R1	2.5	3.8	3.2	66	10/Dec/2022	26.28297402	79.89306465
NH27	1563150	1563050	D	R1	2.5	4.2	3.3	68	10/Dec/2022	26.28228876	79.89241966
NH27	1563050	1562950	D	R1	2.7	3.7	3.2	69	10/Dec/2022	26.28152922	79.89188542
NH27	1562950	1562850	D	R1	2.3	2.8	2.5	68	10/Dec/2022	26.2807421	79.8913998
NH27	1562850	1562750	D	R1	2.7	4.4	3.5	68	10/Dec/2022	26.28003305	79.89078447
NH27	1562750	1562650	D	R1	2.4	3.5	2.9	68	10/Dec/2022	26.27938129	79.89009447
NH27	1562650	1562550	D	R1	2.7	4.2	3.5	68	10/Dec/2022	26.2787305	79.88940334
NH27	1562550	1562450	D	R1	3.1	4.9	4	68	10/Dec/2022	26.27808002	79.888712
NH27	1562450	1562350	D	R1	2.5	4.2	3.4	68	10/Dec/2022	26.27742942	79.88802061
NH27	1562350	1562250	D	R1	2.4	3.7	3	68	10/Dec/2022	26.27677955	79.88732842
NH27	1562250	1562150	D	R1	2.5	4.3	3.4	69	10/Dec/2022	26.27613063	79.88663512
NH27	1562150	1562050	D	R1	2.6	4.6	3.6	69	10/Dec/2022	26.27547845	79.88594568
NH27	1562050	1561950	D	R1	2.5	4.4	3.5	69	10/Dec/2022	26.27482634	79.88525621
NH27	1561950	1561850	D	R1	2.6	4.8	3.7	69	10/Dec/2022	26.27417276	79.88456829
NH27	1561850	1561750	D	R1	2.6	4.8	3.7	69	10/Dec/2022	26.27351857	79.88388104
NH27	1561750	1561650	D	R1	2.6	4.6	3.6	69	10/Dec/2022	26.2728651	79.88319281

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1561650	1561550	D	R1	1.9	3.7	2.8	69	10/Dec/2022	26.27221062	79.88250603
NH27	1561550	1561450	D	R1	2.7	4.1	3.4	70	10/Dec/2022	26.27155463	79.88182138
NH27	1561450	1561350	D	R1	2.3	4.4	3.3	69	10/Dec/2022	26.27089721	79.88113706
NH27	1561350	1561250	D	R1	2.9	3.9	3.4	64	10/Dec/2022	26.27023942	79.8804523
NH27	1561250	1561150	D	R1	3	3.5	3.3	65	10/Dec/2022	26.26957915	79.87977265
NH27	1561150	1561050	D	R1	2.5	4.5	3.5	66	10/Dec/2022	26.26889864	79.87911919
NH27	1561050	1560950	D	R1	2.6	4.8	3.7	70	10/Dec/2022	26.2681633	79.87854393
NH27	1560950	1560850	D	R1	2.2	3.1	2.7	71	10/Dec/2022	26.26742248	79.87797559
NH27	1560850	1560750	D	R1	3	4.4	3.7	67	10/Dec/2022	26.26668007	79.87740733
NH27	1560750	1560650	D	R1	3.2	4.8	4	67	10/Dec/2022	26.26593268	79.87684964
NH27	1560650	1560550	D	R1	3	5.1	4.1	68	10/Dec/2022	26.26518879	79.87628602
NH27	1560550	1560450	D	R1	2.9	3.2	3.1	67	10/Dec/2022	26.26444713	79.87571784
NH27	1560450	1560350	D	R1	2.8	3.7	3.3	55	10/Dec/2022	26.2637124	79.87513641
NH27	1560350	1560250	D	R1	2.9	4.7	3.8	61	10/Dec/2022	26.26295865	79.87459124
NH27	1560250	1560150	D	R1	2.9	4.1	3.5	66	10/Dec/2022	26.26221651	79.87402662
NH27	1560150	1560050	D	R1	2.3	3.2	2.8	69	10/Dec/2022	26.26147304	79.87346335
NH27	1560050	1559950	D	R1	2.7	3.9	3.3	64	10/Dec/2022	26.26073317	79.87289013
NH27	1559950	1559850	D	R1	2.5	4	3.2	65	10/Dec/2022	26.25998496	79.87233501
NH27	1559850	1559750	D	R1	2.7	4.1	3.4	65	10/Dec/2022	26.25924279	79.87176844
NH27	1559750	1559650	D	R1	3.1	4.1	3.6	66	10/Dec/2022	26.25849878	79.87120529
NH27	1559650	1559550	D	R1	1.9	3.3	2.6	67	10/Dec/2022	26.25775441	79.87064305
NH27	1559550	1559450	D	R1	2.4	3.8	3.1	68	10/Dec/2022	26.25702355	79.87005878
NH27	1559450	1559350	D	R1	2.7	2.7	2.7	68	10/Dec/2022	26.25633527	79.86941409
NH27	1559350	1559250	D	R1	2.8	3.6	3.2	65	10/Dec/2022	26.25572109	79.86868165
NH27	1559250	1559150	D	R1	2.7	4.5	3.6	66	10/Dec/2022	26.25513369	79.8679237
NH27	1559150	1559050	D	R1	2.3	4	3.2	65	10/Dec/2022	26.25455494	79.86715693
NH27	1559050	1558950	D	R1	2.4	3.6	3	64	10/Dec/2022	26.25398211	79.8663848
NH27	1558950	1558850	D	R1	2.6	3.3	3	65	10/Dec/2022	26.25339144	79.86563023
NH27	1558850	1558750	D	R1	2.8	3.1	3	63	10/Dec/2022	26.25281704	79.86485968
NH27	1558750	1558650	D	R1	2.5	4.2	3.4	63	10/Dec/2022	26.25223355	79.86409909
NH27	1558650	1558550	D	R1	2.2	3.3	2.8	64	10/Dec/2022	26.25165051	79.86333687
NH27	1558550	1558450	D	R1	2.6	4.4	3.5	64	10/Dec/2022	26.25107113	79.86257155
NH27	1558450	1558350	D	R1	2.5	2.9	2.7	64	10/Dec/2022	26.2504908	79.86180664
NH27	1558350	1558250	D	R1	2.8	4.4	3.6	66	10/Dec/2022	26.24991062	79.86104291
NH27	1558250	1558150	D	R1	3	4	3.5	67	10/Dec/2022	26.24932587	79.86028269
NH27	1558150	1558050	D	R1	2.5	3.7	3.1	66	10/Dec/2022	26.24874524	79.85951741
NH27	1558050	1557950	D	R1	2.5	3.1	2.8	51	10/Dec/2022	26.24814778	79.85875486
NH27	1557950	1557850	D	R1	3	3.3	3.1	56	10/Dec/2022	26.24745243	79.85812359
NH27	1557850	1557750	D	R1	2.4	3.4	2.9	64	10/Dec/2022	26.2466972	79.85758284
NH27	1557750	1557650	D	R1	2.8	2.6	2.7	62	10/Dec/2022	26.24593676	79.85704519

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1557650	1557550	D	R1	2.3	3.5	2.9	62	10/Dec/2022	26.24516537	79.85652958
NH27	1557550	1557450	D	R1	1.9	3.2	2.6	60	10/Dec/2022	26.24439755	79.85600477
NH27	1557450	1557350	D	R1	2.6	4.2	3.4	60	10/Dec/2022	26.24363119	79.85547898
NH27	1557350	1557250	D	R1	2.1	3.3	2.7	61	10/Dec/2022	26.24286251	79.85495759
NH27	1557250	1557150	D	R1	3.2	4.2	3.7	63	10/Dec/2022	26.2420981	79.85442946
NH27	1557150	1557050	D	R1	2.9	4.5	3.7	64	10/Dec/2022	26.24132966	79.85390732
NH27	1557050	1556950	D	R1	2.7	4.5	3.6	63	10/Dec/2022	26.24056256	79.8533824
NH27	1556950	1556850	D	R1	4.4	5.3	4.9	63	10/Dec/2022	26.23979507	79.85285853
NH27	1556850	1556750	D	R1	4	5.5	4.7	63	10/Dec/2022	26.23902999	79.85233099
NH27	1556750	1556650	D	R1	3.5	5.3	4.4	62	10/Dec/2022	26.23827125	79.85179152
NH27	1556650	1556550	D	R1	4.3	5	4.6	62	10/Dec/2022	26.23755937	79.85117969
NH27	1556550	1556450	D	R1	4.4	3.7	4.1	63	10/Dec/2022	26.23690734	79.85049034
NH27	1556450	1556350	D	R1	3.7	5.4	4.5	59	10/Dec/2022	26.23631732	79.84973412
NH27	1556350	1556250	D	R1	4.4	4.6	4.5	35	10/Dec/2022	26.23580581	79.84891002
NH27	1556250	1556150	D	R1	4.2	6.5	5.3	52	10/Dec/2022	26.23536848	79.84803997
NH27	1556150	1556050	D	R1	3.6	7.8	5.7	61	10/Dec/2022	26.23501284	79.84712445
NH27	1556050	1555950	D	R1	3.1	3.9	3.5	65	10/Dec/2022	26.23474378	79.84617174
NH27	1555950	1555850	D	R1	3.4	4.4	3.9	47	10/Dec/2022	26.2345109	79.84520402
NH27	1555850	1555750	D	R1	3.8	5.5	4.6	54	10/Dec/2022	26.23426292	79.84424572
NH27	1555750	1555650	D	R1	4.3	5.6	4.9	58	10/Dec/2022	26.23402093	79.84328405
NH27	1555650	1555550	D	R1	4.6	7.4	6	58	10/Dec/2022	26.23378487	79.84231979
NH27	1555550	1555450	D	R1	3.5	6.7	5.1	57	10/Dec/2022	26.23354546	79.84135573
NH27	1555450	1555350	D	R1	1.8	3.4	2.6	58	10/Dec/2022	26.23331108	79.84039122
NH27	1555350	1555250	D	R1	2.1	3.9	3	60	10/Dec/2022	26.2330708	79.8394288
NH27	1555250	1555150	D	R1	2.5	4.4	3.4	65	10/Dec/2022	26.23283073	79.83846683
NH27	1555150	1555050	D	R1	2.4	4.1	3.3	67	10/Dec/2022	26.23258634	79.83750606
NH27	1555050	1554950	D	R1	1.8	3	2.4	71	10/Dec/2022	26.23229069	79.83656453
NH27	1554950	1554850	D	R1	2.4	4.4	3.4	67	10/Dec/2022	26.23190911	79.83565887
NH27	1554850	1554750	D	R1	3	3.6	3.3	65	10/Dec/2022	26.23142852	79.83481583
NH27	1554750	1554650	D	R1	3.7	3.2	3.4	66	10/Dec/2022	26.2308699	79.83403417
NH27	1554650	1554550	D	R1	3.1	4.2	3.7	68	10/Dec/2022	26.23024061	79.83332225
NH27	1554550	1554450	D	R1	2.7	4.5	3.6	71	10/Dec/2022	26.22954384	79.83269079
NH27	1554450	1554350	D	R1	2.4	3.4	2.9	73	10/Dec/2022	26.22878784	79.8321486
NH27	1554350	1554250	D	R1	2.6	4	3.3	72	10/Dec/2022	26.22798225	79.83170238
NH27	1554250	1554150	D	R1	2.6	3.8	3.2	70	10/Dec/2022	26.22713737	79.83135698
NH27	1554150	1554050	D	R1	1.9	3.2	2.5	69	10/Dec/2022	26.22627318	79.8310731
NH27	1554050	1553950	D	R1	2.6	3.7	3.2	67	10/Dec/2022	26.22540761	79.83079129
NH27	1553950	1553850	D	R1	3.7	3.3	3.5	62	10/Dec/2022	26.22453948	79.83052287
NH27	1553850	1553750	D	R1	2.7	3.6	3.1	66	10/Dec/2022	26.22367348	79.83024847
NH27	1553750	1553650	D	R1	2.4	3	2.7	67	10/Dec/2022	26.2228089	79.82996802

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1553650	1553550	D	R1	2.3	3.3	2.8	69	10/Dec/2022	26.22194555	79.82968258
NH27	1553550	1553450	D	R1	2.4	3.9	3.1	70	10/Dec/2022	26.22107754	79.82941479
NH27	1553450	1553350	D	R1	2.3	4.1	3.2	68	10/Dec/2022	26.22021182	79.82913602
NH27	1553350	1553250	D	R1	2.1	4	3	66	10/Dec/2022	26.21934612	79.8288567
NH27	1553250	1553150	D	R1	2.6	4.4	3.5	68	10/Dec/2022	26.21848	79.82858264
NH27	1553150	1553050	D	R1	2.4	3.8	3.1	70	10/Dec/2022	26.21761441	79.82830617
NH27	1553050	1552950	D	R1	2.5	3.8	3.2	70	10/Dec/2022	26.21674904	79.82802814
NH27	1552950	1552850	D	R1	2.3	3.2	2.7	69	10/Dec/2022	26.21588335	79.82774972
NH27	1552850	1552750	D	R1	2.6	3.9	3.3	69	10/Dec/2022	26.21502709	79.82743789
NH27	1552750	1552650	D	R1	2.4	3.6	3	70	10/Dec/2022	26.21420362	79.827033
NH27	1552650	1552550	D	R1	2.4	3.6	3	64	10/Dec/2022	26.21340961	79.82655733
NH27	1552550	1552450	D	R1	2.8	3.9	3.4	43	10/Dec/2022	26.21266807	79.82598852
NH27	1552450	1552350	D	R1	1.8	2.6	2.2	56	10/Dec/2022	26.21200333	79.82531817
NH27	1552350	1552250	D	R1	2.6	3.5	3	61	10/Dec/2022	26.21142275	79.82455528
NH27	1552250	1552150	D	R1	1.7	3	2.3	63	10/Dec/2022	26.21086627	79.82376972
NH27	1552150	1552050	D	R1	2.7	3.2	2.9	40	10/Dec/2022	26.21033244	79.82296113
NH27	1552050	1551950	D	R1	2.6	3.3	3	51	10/Dec/2022	26.20978975	79.82216835
NH27	1551950	1551850	D	R1	1.8	3.4	2.6	61	10/Dec/2022	26.20921095	79.8214055
NH27	1551850	1551750	D	R1	2.3	3.5	2.9	62	10/Dec/2022	26.20865395	79.82062027
NH27	1551750	1551650	D	R1	2.7	3.4	3.1	60	10/Dec/2022	26.20809001	79.81984018
NH27	1551650	1551550	D	R1	2.4	3.7	3.1	48	10/Dec/2022	26.20750764	79.81907723
NH27	1551550	1551450	D	R1	2.5	2.9	2.7	56	10/Dec/2022	26.20688477	79.81835743
NH27	1551450	1551350	D	R1	3.5	3.8	3.6	56	10/Dec/2022	26.20628407	79.81761245
NH27	1551350	1551250	D	R1	3.9	3.2	3.5	30	10/Dec/2022	26.20568066	79.81686671
NH27	1551250	1551150	D	R1	3.6	2.6	3.1	37	10/Dec/2022	26.20506909	79.81614061
NH27	1551150	1551050	D	R1	5.4	2.7	4.1	53	10/Dec/2022	26.2044282	79.81544541
NH27	1551050	1550950	D	R1	6	2.8	4.4	58	10/Dec/2022	26.20374346	79.81480033
NH27	1550950	1550850	D	R1	4.2	3.3	3.8	61	10/Dec/2022	26.20303006	79.81419214
NH27	1550850	1550750	D	R1	4.7	3.2	4	62	10/Dec/2022	26.20230658	79.81359658
NH27	1550750	1550650	D	R1	4.8	2.7	3.8	61	10/Dec/2022	26.20158591	79.81299583
NH27	1550650	1550550	D	R1	6.7	2.7	4.7	56	10/Dec/2022	26.20086444	79.81239478
NH27	1550550	1550450	D	R1	5.1	2.4	3.8	61	10/Dec/2022	26.20014357	79.81179617
NH27	1550450	1550350	D	R1	3.7	2.5	3.1	63	10/Dec/2022	26.19943569	79.81117726
NH27	1550350	1550250	D	R1	3.5	3	3.3	55	10/Dec/2022	26.19879111	79.81047569
NH27	1550250	1550150	D	R1	3.3	3.3	3.3	19	10/Dec/2022	26.19817434	79.80974842
NH27	1550150	1550050	D	R1	2.6	2.6	2.6	36	10/Dec/2022	26.19754	79.80904323
NH27	1550050	1549950	D	R1	2.7	2.8	2.8	44	10/Dec/2022	26.19690934	79.80833237
NH27	1549950	1549850	D	R1	2.9	3.7	3.3	28	10/Dec/2022	26.1962801	79.8076153
NH27	1549850	1549750	D	R1	3.3	3.9	3.6	36	10/Dec/2022	26.19564914	79.80690385
NH27	1549750	1549650	D	R1	2	3.8	2.9	47	10/Dec/2022	26.19502288	79.80618811

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1549650	1549550	D	R1	2.5	4.4	3.5	39	10/Dec/2022	26.1943974	79.80546854
NH27	1549550	1549450	D	R1	2.6	3.6	3.1	43	10/Dec/2022	26.19378367	79.80473923
NH27	1549450	1549350	D	R1	2.3	3.8	3	47	10/Dec/2022	26.19314233	79.80403894
NH27	1549350	1549250	D	R1	2.3	3.8	3	59	10/Dec/2022	26.19252199	79.80331826
NH27	1549250	1549150	D	R1	2.4	3.8	3.1	66	10/Dec/2022	26.19189486	79.80260302
NH27	1549150	1549050	D	R1	2.8	3.2	3	69	10/Dec/2022	26.1912672	79.80188718
NH27	1549050	1548950	D	R1	2.7	4.2	3.4	68	10/Dec/2022	26.19064054	79.80116853
NH27	1548950	1548850	D	R1	2.5	4.3	3.4	68	10/Dec/2022	26.19001204	79.80045172
NH27	1548850	1548750	D	R1	2.9	3.9	3.4	66	10/Dec/2022	26.18938612	79.79973206
NH27	1548750	1548650	D	R1	2.8	4.1	3.4	65	10/Dec/2022	26.18875662	79.79901634
NH27	1548650	1548550	D	R1	3.9	5	4.5	59	10/Dec/2022	26.18812958	79.79829637
NH27	1548550	1548450	D	R1	3.1	4.2	3.6	54	10/Dec/2022	26.18750092	79.79757909
NH27	1548450	1548350	D	R1	2.7	3.7	3.2	56	10/Dec/2022	26.18687358	79.79686242
NH27	1548350	1548250	D	R1	2.6	2.9	2.7	57	10/Dec/2022	26.18622012	79.79617536
NH27	1548250	1548150	D	R1	1.6	2.6	2.1	45	10/Dec/2022	26.18552697	79.79553613
NH27	1548150	1548050	D	R1	3.5	4.4	3.9	37	10/Dec/2022	26.18479599	79.79495152
NH27	1548050	1547950	D	R1	3.1	4.6	3.8	56	10/Dec/2022	26.18405495	79.79438895
NH27	1547950	1547850	D	R1	4.1	3.2	3.6	64	10/Dec/2022	26.1833181	79.79381667
NH27	1547850	1547750	D	R1	3.1	3.2	3.1	67	10/Dec/2022	26.18258009	79.79324465
NH27	1547750	1547650	D	R1	2.5	3.3	2.9	68	10/Dec/2022	26.18184403	79.79266768
NH27	1547650	1547550	D	R1	2.5	4.2	3.4	68	10/Dec/2022	26.18110747	79.79209224
NH27	1547550	1547450	D	R1	2.6	3.6	3.1	67	10/Dec/2022	26.18036844	79.79152017
NH27	1547450	1547350	D	R1	2.3	3.4	2.9	67	10/Dec/2022	26.17963199	79.79094425
NH27	1547350	1547250	D	R1	2.8	4.6	3.7	65	10/Dec/2022	26.1788984	79.79036358
NH27	1547250	1547150	D	R1	2	3.2	2.6	65	10/Dec/2022	26.17816059	79.78978995
NH27	1547150	1547050	D	R1	1.9	2.9	2.4	43	10/Dec/2022	26.17742087	79.78921427
NH27	1547050	1546950	D	R1	2.7	3.4	3	47	10/Dec/2022	26.17668153	79.78864524
NH27	1546950	1546850	D	R1	3.7	4.4	4.1	59	10/Dec/2022	26.17594186	79.78807918
NH27	1546850	1546750	D	R1	3.9	4.3	4.1	62	10/Dec/2022	26.17520247	79.78750923
NH27	1546750	1546650	D	R1	3.7	3.6	3.7	67	10/Dec/2022	26.17445867	79.78693033
NH27	1546650	1546550	D	R1	3.1	4.7	3.9	70	10/Dec/2022	26.17372209	79.7863558
NH27	1546550	1546450	D	R1	3.5	4.5	4	71	10/Dec/2022	26.17298403	79.78578294
NH27	1546450	1546350	D	R1	3.4	3.6	3.5	71	10/Dec/2022	26.17224612	79.78520906
NH27	1546350	1546250	D	R1	2.6	3.7	3.2	70	10/Dec/2022	26.17150878	79.78463399
NH27	1546250	1546150	D	R1	3.1	4.8	3.9	68	10/Dec/2022	26.17077127	79.78405886
NH27	1546150	1546050	D	R1	2.9	4.2	3.5	67	10/Dec/2022	26.17003194	79.78348656
NH27	1546050	1545950	D	R1	2.7	4.2	3.5	64	10/Dec/2022	26.16929404	79.78291151
NH27	1545950	1545850	D	R1	4.3	2.7	3.5	55	10/Dec/2022	26.16855417	79.78233839
NH27	1545850	1545750	D	R1	2.9	4.3	3.6	48	10/Dec/2022	26.16780781	79.78177608
NH27	1545750	1545650	D	R1	2.7	3.3	3	39	10/Dec/2022	26.16705023	79.78123346

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1545650	1545550	D	R1	2.8	4	3.4	37	10/Dec/2022	26.16629039	79.78069579
NH27	1545550	1545450	D	R1	4.1	3.6	3.9	36	10/Dec/2022	26.16553142	79.78015703
NH27	1545450	1545350	D	R1	4.4	3	3.7	41	10/Dec/2022	26.16476958	79.77962487
NH27	1545350	1545250	D	R1	5.1	2.3	3.7	43	10/Dec/2022	26.16400942	79.77908878
NH27	1545250	1545150	D	R1	3.3	4.3	3.8	32	10/Dec/2022	26.16324795	79.77855231
NH27	1545150	1545050	D	R1	3.9	3.4	3.7	10	10/Dec/2022	26.16249977	79.77801924
NH27	1545050	1544950	D	R1	3.7	4.2	4	39	10/Dec/2022	26.16178034	79.77742366
NH27	1544950	1544850	D	R1	3.2	3.9	3.6	50	10/Dec/2022	26.16109723	79.77677573
NH27	1544850	1544750	D	R1	2.6	3.3	3	52	10/Dec/2022	26.16042059	79.77611747
NH27	1544750	1544650	D	R1	2.8	2.9	2.9	40	10/Dec/2022	26.15974484	79.77545433
NH27	1544650	1544550	D	R1	3.7	3.3	3.5	37	10/Dec/2022	26.1590682	79.7747956
NH27	1544550	1544450	D	R1	3.4	4	3.7	52	10/Dec/2022	26.15838513	79.77414902
NH27	1544450	1544350	D	R1	3.2	3.5	3.4	55	10/Dec/2022	26.15771213	79.77348549
NH27	1544350	1544250	D	R1	2.9	3.6	3.3	54	10/Dec/2022	26.15704563	79.7728147
NH27	1544250	1544150	D	R1	3.3	3.2	3.3	58	10/Dec/2022	26.15635847	79.77216993
NH27	1544150	1544050	D	R1	3.2	3.9	3.6	51	10/Dec/2022	26.15568805	79.77149994
NH27	1544050	1543950	D	R1	3.3	4.3	3.8	58	10/Dec/2022	26.1549982	79.77085943
NH27	1543950	1543850	D	R1	3.2	4.4	3.8	63	10/Dec/2022	26.15432131	79.77020091
NH27	1543850	1543750	D	R1	2.3	4.2	3.3	65	10/Dec/2022	26.15364468	79.76954204
NH27	1543750	1543650	D	R1	3.6	3.7	3.7	61	10/Dec/2022	26.15296735	79.76888148
NH27	1543650	1543550	D	R1	3.4	3.9	3.7	52	10/Dec/2022	26.15228875	79.76822271
NH27	1543550	1543450	D	R1	3.6	4.7	4.2	58	10/Dec/2022	26.15160944	79.76756834
NH27	1543450	1543350	D	R1	3.6	4.5	4.1	63	10/Dec/2022	26.15093137	79.76691207
NH27	1543350	1543250	D	R1	3.7	6.8	5.3	67	10/Dec/2022	26.15025306	79.7662556
NH27	1543250	1543150	D	R1	5.4	5.9	5.7	69	10/Dec/2022	26.14957544	79.76559658
NH27	1543150	1543050	D	R1	4.4	5	4.7	69	10/Dec/2022	26.14889413	79.76494213
NH27	1543050	1542950	D	R1	3.4	3.7	3.6	69	10/Dec/2022	26.14821852	79.76428162
NH27	1542950	1542850	D	R1	3.1	3.3	3.2	64	10/Dec/2022	26.14753806	79.76362535
NH27	1542850	1542750	D	R1	4.6	3.4	4	59	10/Dec/2022	26.14686445	79.76296066
NH27	1542750	1542650	D	R1	5.1	5.1	5.1	63	10/Dec/2022	26.14614552	79.76236223
NH27	1542650	1542550	D	R1	4.7	5.2	5	65	10/Dec/2022	26.14537842	79.76184041
NH27	1542550	1542450	D	R1	4.7	3.6	4.2	63	10/Dec/2022	26.14457552	79.76138701
NH27	1542450	1542350	D	R1	2.8	2.6	2.7	54	10/Dec/2022	26.1437691	79.76093744
NH27	1542350	1542250	D	R1	4.1	3.4	3.8	57	10/Dec/2022	26.14296545	79.7604889
NH27	1542250	1542150	D	R1	4.8	1.9	3.4	60	10/Dec/2022	26.14215234	79.76005891
NH27	1542150	1542050	D	R1	4.5	4	4.3	54	10/Dec/2022	26.14134393	79.75961667
NH27	1542050	1541950	D	R1	4.5	5	4.8	50	10/Dec/2022	26.14053606	79.75917265
NH27	1541950	1541850	D	R1	4.2	5.5	4.9	53	10/Dec/2022	26.13973029	79.75872768
NH27	1541850	1541750	D	R1	3.5	4.2	3.9	56	10/Dec/2022	26.13891807	79.75829771
NH27	1541750	1541650	D	R1	4.5	4.8	4.7	55	10/Dec/2022	26.13811808	79.75784133

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1541650	1541550	D	R1	4.3	6.6	5.5	60	10/Dec/2022	26.13730418	79.75741723
NH27	1541550	1541450	D	R1	6	6.6	6.3	62	10/Dec/2022	26.13649757	79.75697494
NH27	1541450	1541350	D	R1	5.9	5.7	5.8	63	10/Dec/2022	26.13568946	79.75653336
NH27	1541350	1541250	D	R1	5.7	3.2	4.5	49	10/Dec/2022	26.13487959	79.75609052
NH27	1541250	1541150	D	R1	13.3	6.8	10.1	55	10/Dec/2022	26.13407335	79.75564815
NH27	1541150	1541050	D	R1	15.6	7.2	11.4	59	10/Dec/2022	26.13326627	79.75520612
NH27	1541050	1540950	D	R1	16.2	7.7	12	60	10/Dec/2022	26.13245773	79.75476634
NH27	1540950	1540850	D	R1	14.5	7.2	10.9	57	10/Dec/2022	26.13164881	79.75432506
NH27	1540850	1540750	D	R1	9.2	13.4	11.3	57	10/Dec/2022	26.130842	79.75388093
NH27	1540750	1540650	D	R1	11.9	14.8	13.4	49	10/Dec/2022	26.13003593	79.75343233
NH27	1540650	1540550	D	R1	8.2	11	9.6	55	10/Dec/2022	26.12922495	79.75300106
NH27	1540550	1540450	D	R1	4.8	5.5	5.2	45	10/Dec/2022	26.12841513	79.75256062
NH27	1540450	1540350	D	R1	5.9	5.5	5.7	55	10/Dec/2022	26.12760865	79.75211991
NH27	1540350	1540250	D	R1	6.1	5.5	5.8	56	10/Dec/2022	26.12680086	79.7516785
NH27	1540250	1540150	D	R1	4.1	6.1	5.1	48	10/Dec/2022	26.12603258	79.75116109
NH27	1540150	1540050	D	R1	4.5	6.6	5.6	12	10/Dec/2022	26.12528678	79.75060416
NH27	1540050	1539950	D	R1	3.6	8.5	6.1	43	10/Dec/2022	26.12447523	79.75018147
NH27	1539950	1539850	D	R1	4.8	4.6	4.7	53	10/Dec/2022	26.12372293	79.74963784
NH27	1539850	1539750	D	R1	6.3	4.5	5.4	61	10/Dec/2022	26.12300717	79.74903523
NH27	1539750	1539650	D	R1	4	4.2	4.1	65	10/Dec/2022	26.12231798	79.74839477
NH27	1539650	1539550	D	R1	6.5	4.9	5.7	55	10/Dec/2022	26.12168433	79.74768352
NH27	1539550	1539450	D	R1	9.7	4.2	7	57	10/Dec/2022	26.12113909	79.74689021
NH27	1539450	1539350	D	R1	8.8	4	6.4	51	10/Dec/2022	26.12072212	79.74600397
NH27	1539350	1539250	D	R1	5.1	4.6	4.9	59	10/Dec/2022	26.1202874	79.7451316
NH27	1539250	1539150	D	R1	4	4.3	4.2	58	10/Dec/2022	26.1198597	79.74425183
NH27	1539150	1539050	D	R1	7.8	4.7	6.3	56	10/Dec/2022	26.11935108	79.74342983
NH27	1539050	1538950	D	R1	5.2	3.3	4.3	50	10/Dec/2022	26.11867356	79.74277989
NH27	1538950	1538850	D	R1	6.3	5.9	6.1	34	10/Dec/2022	26.11791726	79.74223762
NH27	1538850	1538750	D	R1	6.1	7.4	6.8	51	10/Dec/2022	26.1171368	79.74174478
NH27	1538750	1538650	D	R1	3.7	8.2	6	55	10/Dec/2022	26.11636937	79.741224
NH27	1538650	1538550	D	R1	4.2	4.7	4.5	58	10/Dec/2022	26.11560199	79.74070234
NH27	1538550	1538450	D	R1	3.8	4.1	4	58	10/Dec/2022	26.11483552	79.74017848
NH27	1538450	1538350	D	R1	3.5	6.4	5	58	10/Dec/2022	26.11411934	79.73957521
NH27	1538350	1538250	D	R1	3.5	5.2	4.4	57	10/Dec/2022	26.11355734	79.73879775
NH27	1538250	1538150	D	R1	3.4	3.7	3.6	52	10/Dec/2022	26.11319901	79.73788426
NH27	1538150	1538050	D	R1	2.7	1.7	2.2	49	10/Dec/2022	26.11307789	79.73689809
NH27	1538050	1537950	D	R1	4	4.2	4.1	55	10/Dec/2022	26.11318975	79.73591019
NH27	1537950	1537850	D	R1	5.4	4.3	4.9	59	10/Dec/2022	26.11340543	79.73494208
NH27	1537850	1537750	D	R1	6.9	3	5	61	10/Dec/2022	26.11360255	79.73396928
NH27	1537750	1537650	D	R1	5	4.5	4.8	60	10/Dec/2022	26.11365335	79.73297636

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1537650	1537550	D	R1	3.2	3.9	3.6	59	10/Dec/2022	26.11352807	79.7319902
NH27	1537550	1537450	D	R1	5.2	5.9	5.6	58	10/Dec/2022	26.11336479	79.73100935
NH27	1537450	1537350	D	R1	5.2	8.9	7.1	59	10/Dec/2022	26.11325621	79.7300195
NH27	1537350	1537250	D	R1	6.9	5.2	6.1	61	10/Dec/2022	26.1132009	79.72902409
NH27	1537250	1537150	D	R1	6.3	5.6	6	59	10/Dec/2022	26.11314389	79.72802804
NH27	1537150	1537050	D	R1	5.1	4.4	4.8	54	10/Dec/2022	26.11304904	79.72703594
NH27	1537050	1536950	D	R1	4.3	7.1	5.7	58	10/Dec/2022	26.11278892	79.72608369
NH27	1536950	1536850	D	R1	2.5	4.8	3.7	62	10/Dec/2022	26.11236635	79.72520615
NH27	1536850	1536750	D	R1	2.8	5.5	4.2	64	10/Dec/2022	26.11185907	79.72438185
NH27	1536750	1536650	D	R1	3.2	5.4	4.3	65	10/Dec/2022	26.11134673	79.72356088
NH27	1536650	1536550	D	R1	3.3	4.8	4.1	66	10/Dec/2022	26.11083389	79.72274
NH27	1536550	1536450	D	R1	3	4.7	3.9	67	10/Dec/2022	26.11032262	79.72191787
NH27	1536450	1536350	D	R1	3.6	5.5	4.6	67	10/Dec/2022	26.10981145	79.72109558
NH27	1536350	1536250	D	R1	3.6	4.7	4.2	68	10/Dec/2022	26.10929698	79.72027569
NH27	1536250	1536150	D	R1	3.7	5.1	4.4	66	10/Dec/2022	26.1087765	79.71946147
NH27	1536150	1536050	D	R1	2.9	4.3	3.6	64	10/Dec/2022	26.10822274	79.7186746
NH27	1536050	1535950	D	R1	2.9	4	3.5	63	10/Dec/2022	26.10769221	79.71786851
NH27	1535950	1535850	D	R1	2.8	4.5	3.7	64	10/Dec/2022	26.10720111	79.71703243
NH27	1535850	1535750	D	R1	3	4.8	3.9	65	10/Dec/2022	26.10671304	79.71619284
NH27	1535750	1535650	D	R1	2.8	4.2	3.5	63	10/Dec/2022	26.10622439	79.71535294
NH27	1535650	1535550	D	R1	1.8	3	2.4	64	10/Dec/2022	26.10571973	79.71452653
NH27	1535550	1535450	D	R1	2.2	3.7	3	62	10/Dec/2022	26.10517566	79.7137301
NH27	1535450	1535350	D	R1	2.5	3.8	3.2	62	10/Dec/2022	26.10462055	79.71294527
NH27	1535350	1535250	D	R1	2.6	2.9	2.8	62	10/Dec/2022	26.10406123	79.71216354
NH27	1535250	1535150	D	R1	2.5	2.1	2.3	63	10/Dec/2022	26.10350557	79.71137864
NH27	1535150	1535050	D	R1	2.7	2.5	2.6	64	10/Dec/2022	26.10294852	79.71059424
NH27	1535050	1534950	D	R1	2.8	3.4	3.1	64	10/Dec/2022	26.10239688	79.70980515
NH27	1534950	1534850	D	R1	2.9	3.1	3	64	10/Dec/2022	26.10184191	79.70901875
NH27	1534850	1534750	D	R1	2.5	3.1	2.8	64	10/Dec/2022	26.10128801	79.70823153
NH27	1534750	1534650	D	R1	2.1	2.5	2.3	62	10/Dec/2022	26.10073156	79.70744535
NH27	1534650	1534550	D	R1	2.5	2.3	2.4	59	10/Dec/2022	26.10017998	79.70665516
NH27	1534550	1534450	D	R1	2.8	2.9	2.9	61	10/Dec/2022	26.09961567	79.70586446
NH27	1534450	1534350	D	R1	2.8	3.1	3	38	10/Dec/2022	26.09906825	79.70506841
NH27	1534350	1534250	D	R1	3.9	3.7	3.8	46	10/Dec/2022	26.09850647	79.70428901
NH27	1534250	1534150	D	R1	4.1	4.8	4.5	41	10/Dec/2022	26.09797951	79.70347895
NH27	1534150	1534050	D	R1	2.6	3.3	3	46	10/Dec/2022	26.09742325	79.70269512
NH27	1534050	1533950	D	R1	4.5	5.5	5	54	10/Dec/2022	26.09687321	79.70190738
NH27	1533950	1533850	D	R1	3.5	5.3	4.4	61	10/Dec/2022	26.09633135	79.70111186
NH27	1533850	1533750	D	R1	3.2	3.9	3.6	63	10/Dec/2022	26.09579179	79.7003132
NH27	1533750	1533650	D	R1	3.3	4.3	3.8	65	10/Dec/2022	26.0952544	79.69951305

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1533650	1533550	D	R1	3.6	5.2	4.4	65	10/Dec/2022	26.09470883	79.69871869
NH27	1533550	1533450	D	R1	4.2	5.1	4.7	65	10/Dec/2022	26.09416823	79.69792023
NH27	1533450	1533350	D	R1	3.3	3.9	3.6	65	10/Dec/2022	26.09363282	79.69711756
NH27	1533350	1533250	D	R1	3.1	4.7	3.9	65	10/Dec/2022	26.09311313	79.69630208
NH27	1533250	1533150	D	R1	3.4	4.7	4.1	66	10/Dec/2022	26.09260515	79.69547755
NH27	1533150	1533050	D	R1	2.9	5	4	66	10/Dec/2022	26.09212076	79.69463559
NH27	1533050	1532950	D	R1	3.1	2.2	2.7	65	10/Dec/2022	26.09164823	79.69378554
NH27	1532950	1532850	D	R1	3.2	3.9	3.6	65	10/Dec/2022	26.0911943	79.69292291
NH27	1532850	1532750	D	R1	2.6	5	3.8	65	10/Dec/2022	26.09076079	79.69204773
NH27	1532750	1532650	D	R1	4	3.1	3.6	65	10/Dec/2022	26.09034461	79.69116222
NH27	1532650	1532550	D	R1	3.2	2.4	2.8	64	10/Dec/2022	26.08993722	79.69027127
NH27	1532550	1532450	D	R1	3.9	3.5	3.7	24	10/Dec/2022	26.08952689	79.68937138
NH27	1532450	1532350	D	R1	3.9	4.1	4	24	10/Dec/2022	26.08912101	79.68847938
NH27	1532350	1532250	D	R1	5.7	5.6	5.6	24	10/Dec/2022	26.08871513	79.68758737
NH27	1532250	1532150	D	R1	4.7	4.6	4.7	24	10/Dec/2022	26.08830925	79.68669537
NH27	1532150	1532050	D	R1	3.5	6.2	4.8	40	10/Dec/2022	26.08792402	79.6858368
NH27	1532050	1531950	D	R1	3.1	5.8	4.5	44	10/Dec/2022	26.08751879	79.68494648
NH27	1531950	1531850	D	R1	3.4	5.2	4.3	48	10/Dec/2022	26.08711367	79.68405638
NH27	1531850	1531750	D	R1	2.7	5.2	4	52	10/Dec/2022	26.08671167	79.68316464
NH27	1531750	1531650	D	R1	2.8	4.8	3.8	55	10/Dec/2022	26.08630792	79.68227355
NH27	1531650	1531550	D	R1	3.1	4.5	3.8	56	10/Dec/2022	26.08590305	79.68138263
NH27	1531550	1531450	D	R1	3	5.1	4	57	10/Dec/2022	26.08549737	79.68049175
NH27	1531450	1531350	D	R1	4.3	4.9	4.6	56	10/Dec/2022	26.08508964	79.67960206
NH27	1531350	1531250	D	R1	2.9	5.6	4.2	54	10/Dec/2022	26.08468438	79.67871044
NH27	1531250	1531150	D	R1	3.7	4.7	4.2	54	10/Dec/2022	26.08428118	79.67781827
NH27	1531150	1531050	D	R1	4.3	4.5	4.4	54	10/Dec/2022	26.08387198	79.67692923
NH27	1531050	1530950	D	R1	5.1	4.7	4.9	52	10/Dec/2022	26.0834699	79.67603611
NH27	1530950	1530850	D	R1	4.9	5.2	5	52	10/Dec/2022	26.08306108	79.67514697
NH27	1530850	1530750	D	R1	3.1	4.3	3.7	52	10/Dec/2022	26.08266034	79.67425386
NH27	1530750	1530650	D	R1	2.9	3.1	3	52	10/Dec/2022	26.08225993	79.67336005
NH27	1530650	1530550	D	R1	2.9	4.9	3.9	52	10/Dec/2022	26.08185437	79.67247077
NH27	1530550	1530450	D	R1	2.7	4.8	3.8	53	10/Dec/2022	26.08144403	79.67158266
NH27	1530450	1530350	D	R1	5.2	4.9	5	53	10/Dec/2022	26.08103893	79.67069141
NH27	1530350	1530250	D	R1	3.8	4.2	4	52	10/Dec/2022	26.08062944	79.66980269
NH27	1530250	1530150	D	R1	3	5.3	4.2	53	10/Dec/2022	26.08021124	79.66891918
NH27	1530150	1530050	D	R1	3.5	5.2	4.4	54	10/Dec/2022	26.07980755	79.66802769
NH27	1530050	1529950	D	R1	4.1	4.7	4.4	56	10/Dec/2022	26.079375	79.66715306
NH27	1529950	1529850	D	R1	3.7	5.4	4.5	57	10/Dec/2022	26.07895737	79.66626903
NH27	1529850	1529750	D	R1	5.5	5.3	5.4	58	10/Dec/2022	26.07853787	79.66538633
NH27	1529750	1529650	D	R1	3	4.8	3.9	58	10/Dec/2022	26.07811791	79.66450366

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1529650	1529550	D	R1	2.8	4.9	3.8	58	10/Dec/2022	26.07770216	79.66361868
NH27	1529550	1529450	D	R1	2.4	4.8	3.6	57	10/Dec/2022	26.07728529	79.66273404
NH27	1529450	1529350	D	R1	2.6	3.5	3	57	10/Dec/2022	26.07686985	79.66184869
NH27	1529350	1529250	D	R1	2.5	3.3	2.9	58	10/Dec/2022	26.07645312	79.66096418
NH27	1529250	1529150	D	R1	2.3	4.8	3.6	59	10/Dec/2022	26.07603497	79.6600811
NH27	1529150	1529050	D	R1	2.3	5.6	3.9	61	10/Dec/2022	26.07561572	79.65919855
NH27	1529050	1528950	D	R1	2.6	6	4.3	62	10/Dec/2022	26.0751978	79.6583149
NH27	1528950	1528850	D	R1	3	3.8	3.4	61	10/Dec/2022	26.07478059	79.65743038
NH27	1528850	1528750	D	R1	2.4	3.1	2.7	61	10/Dec/2022	26.07436517	79.65654536
NH27	1528750	1528650	D	R1	2.4	4.5	3.5	61	10/Dec/2022	26.07393669	79.65566759
NH27	1528650	1528550	D	R1	3.1	4.2	3.7	61	10/Dec/2022	26.07352445	79.65478071
NH27	1528550	1528450	D	R1	2.9	4.2	3.5	60	10/Dec/2022	26.07309789	79.65390188
NH27	1528450	1528350	D	R1	2.2	5.5	3.8	60	10/Dec/2022	26.07266825	79.65302497
NH27	1528350	1528250	D	R1	3	5.7	4.3	61	10/Dec/2022	26.07223419	79.65215107
NH27	1528250	1528150	D	R1	2.9	5.3	4.1	61	10/Dec/2022	26.07179843	79.65127757
NH27	1528150	1528050	D	R1	3.1	5.7	4.4	60	10/Dec/2022	26.07136296	79.65040394
NH27	1528050	1527950	D	R1	3	6	4.5	59	10/Dec/2022	26.07092633	79.64953097
NH27	1527950	1527850	D	R1	2.6	4.9	3.7	60	10/Dec/2022	26.07049501	79.64865491
NH27	1527850	1527750	D	R1	2.7	3.4	3	60	10/Dec/2022	26.07006003	79.64778115
NH27	1527750	1527650	D	R1	3.2	4.6	3.9	61	10/Dec/2022	26.069625	79.64690787
NH27	1527650	1527550	D	R1	3.4	4.8	4.1	61	10/Dec/2022	26.06918937	79.64603462
NH27	1527550	1527450	D	R1	3.3	5	4.1	60	10/Dec/2022	26.06875545	79.64515985
NH27	1527450	1527350	D	R1	2.6	4.8	3.7	60	10/Dec/2022	26.06832063	79.64428592
NH27	1527350	1527250	D	R1	2.7	4.9	3.8	59	10/Dec/2022	26.06788385	79.64341299
NH27	1527250	1527150	D	R1	3.2	5.3	4.3	59	10/Dec/2022	26.06745016	79.64253846
NH27	1527150	1527050	D	R1	3.3	5.4	4.3	60	10/Dec/2022	26.06701474	79.64166517
NH27	1527050	1526950	D	R1	2.5	4.9	3.7	60	10/Dec/2022	26.06658074	79.64079098
NH27	1526950	1526850	D	R1	2.9	5	3.9	62	10/Dec/2022	26.06614572	79.6399176
NH27	1526850	1526750	D	R1	2.7	4.9	3.8	63	10/Dec/2022	26.06571142	79.63904352
NH27	1526750	1526650	D	R1	3.2	5.3	4.2	65	10/Dec/2022	26.06527631	79.63817055
NH27	1526650	1526550	D	R1	4.1	4.3	4.2	66	10/Dec/2022	26.06484141	79.63729705
NH27	1526550	1526450	D	R1	3.9	5.9	4.9	66	10/Dec/2022	26.06440369	79.63642509
NH27	1526450	1526350	D	R1	3.5	5.6	4.6	66	10/Dec/2022	26.0639709	79.63555028
NH27	1526350	1526250	D	R1	3.3	5.3	4.3	67	10/Dec/2022	26.06353527	79.63467715
NH27	1526250	1526150	D	R1	3.5	5.2	4.3	67	10/Dec/2022	26.06310167	79.63380279
NH27	1526150	1526050	D	R1	4.3	5	4.6	67	10/Dec/2022	26.06266221	79.63293172
NH27	1526050	1525950	D	R1	2.3	5.3	3.8	67	10/Dec/2022	26.06222566	79.6320589
NH27	1525950	1525850	D	R1	2.8	5	3.9	66	10/Dec/2022	26.06178816	79.63118664
NH27	1525850	1525750	D	R1	2.6	4.8	3.7	65	10/Dec/2022	26.06134863	79.63031545
NH27	1525750	1525650	D	R1	2.3	4.2	3.3	64	10/Dec/2022	26.06091103	79.62944342

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1525650	1525550	D	R1	2.4	5.1	3.7	64	10/Dec/2022	26.0604711	79.6285726
NH27	1525550	1525450	D	R1	3.7	3.8	3.7	63	10/Dec/2022	26.06003181	79.6277012
NH27	1525450	1525350	D	R1	2.7	4.4	3.6	63	10/Dec/2022	26.05959213	79.62682996
NH27	1525350	1525250	D	R1	3.3	7.8	5.6	61	10/Dec/2022	26.05918015	79.62594181
NH27	1525250	1525150	D	R1	3.2	4	3.6	65	10/Dec/2022	26.05872455	79.62508265
NH27	1525150	1525050	D	R1	3.4	5.4	4.4	66	10/Dec/2022	26.05827782	79.62421598
NH27	1525050	1524950	D	R1	3.1	3.4	3.3	66	10/Dec/2022	26.05784078	79.62334337
NH27	1524950	1524850	D	R1	2.6	3.6	3.1	66	10/Dec/2022	26.05740267	79.62247127
NH27	1524850	1524750	D	R1	2.5	5.1	3.8	65	10/Dec/2022	26.05696418	79.6215994
NH27	1524750	1524650	D	R1	3.8	3.9	3.8	65	10/Dec/2022	26.05652445	79.62072827
NH27	1524650	1524550	D	R1	3.5	4.2	3.9	65	10/Dec/2022	26.0560845	79.61985738
NH27	1524550	1524450	D	R1	2.3	3.2	2.8	65	10/Dec/2022	26.05565041	79.61898313
NH27	1524450	1524350	D	R1	2.4	2.2	2.3	65	10/Dec/2022	26.05524369	79.61809231
NH27	1524350	1524250	D	R1	2.9	2.9	2.9	61	10/Dec/2022	26.05487645	79.61717949
NH27	1524250	1524150	D	R1	2.2	3.1	2.7	56	10/Dec/2022	26.05455174	79.61624799
NH27	1524150	1524050	D	R1	2.1	4.3	3.2	60	10/Dec/2022	26.05423228	79.61531574
NH27	1524050	1523950	D	R1	3.5	3.9	3.7	62	10/Dec/2022	26.05392218	79.61437942
NH27	1523950	1523850	D	R1	4.1	3.6	3.8	64	10/Dec/2022	26.05358401	79.61345583
NH27	1523850	1523750	D	R1	3	4.4	3.7	65	10/Dec/2022	26.05316285	79.61257502
NH27	1523750	1523650	D	R1	3	4.5	3.8	65	10/Dec/2022	26.05266344	79.61174507
NH27	1523650	1523550	D	R1	3	4.5	3.8	65	10/Dec/2022	26.05214792	79.61092652
NH27	1523550	1523450	D	R1	2.3	4.2	3.2	66	10/Dec/2022	26.05163133	79.61010886
NH27	1523450	1523350	D	R1	2.1	4.2	3.1	66	10/Dec/2022	26.05111568	79.60929043
NH27	1523350	1523250	D	R1	2.6	4.5	3.6	65	10/Dec/2022	26.05059941	79.60847225
NH27	1523250	1523150	D	R1	3.7	3.9	3.8	65	10/Dec/2022	26.05008046	79.60765642
NH27	1523150	1523050	D	R1	4.3	3.7	4	65	10/Dec/2022	26.0495638	79.60683917
NH27	1523050	1522950	D	R1	4.2	3.4	3.8	66	10/Dec/2022	26.04904562	79.60602298
NH27	1522950	1522850	D	R1	3.8	3.8	3.8	66	10/Dec/2022	26.04852856	79.60520585
NH27	1522850	1522750	D	R1	2.9	5.2	4.1	66	10/Dec/2022	26.04802294	79.60437972
NH27	1522750	1522650	D	R1	2.8	5.2	4	66	10/Dec/2022	26.04754309	79.60353499
NH27	1522650	1522550	D	R1	2.9	3.1	3	62	10/Dec/2022	26.0470616	79.60269034
NH27	1522550	1522450	D	R1	5.5	5.2	5.4	52	10/Dec/2022	26.04658536	79.60184088
NH27	1522450	1522350	D	R1	3.2	3.7	3.4	9	10/Dec/2022	26.04608988	79.60100417
NH27	1522350	1522250	D	R1	3.3	5.1	4.2	38	10/Dec/2022	26.04563454	79.60014718
NH27	1522250	1522150	D	R1	4.3	4.9	4.6	53	10/Dec/2022	26.04517146	79.59929443
NH27	1522150	1522050	D	R1	4	5.4	4.7	48	10/Dec/2022	26.04469453	79.59844675
NH27	1522050	1521950	D	R1	3.2	4.4	3.8	49	10/Dec/2022	26.04421294	79.59759148
NH27	1521950	1521850	D	R1	1.8	3.4	2.6	52	10/Dec/2022	26.04375638	79.59673182
NH27	1521850	1521750	D	R1	2.1	3.8	2.9	55	10/Dec/2022	26.0433272	79.59585521
NH27	1521750	1521650	D	R1	1.7	4.2	2.9	61	10/Dec/2022	26.04292887	79.59496206

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1521650	1521550	D	R1	1.8	4.2	3	62	10/Dec/2022	26.04255892	79.59405243
NH27	1521550	1521450	D	R1	1.8	4.3	3	60	10/Dec/2022	26.04221067	79.59313164
NH27	1521450	1521350	D	R1	2.5	5.3	3.9	60	10/Dec/2022	26.04186154	79.59221205
NH27	1521350	1521250	D	R1	2.2	4.9	3.6	62	10/Dec/2022	26.04151399	79.59129246
NH27	1521250	1521150	D	R1	2.1	4	3.1	64	10/Dec/2022	26.04116401	79.5903732
NH27	1521150	1521050	D	R1	1.6	4.1	2.8	65	10/Dec/2022	26.04081913	79.58945134
NH27	1521050	1520950	D	R1	2.3	5	3.6	65	10/Dec/2022	26.04046839	79.58853196
NH27	1520950	1520850	D	R1	2	3.5	2.7	65	10/Dec/2022	26.04011882	79.58761231
NH27	1520850	1520750	D	R1	1.9	2.8	2.3	65	10/Dec/2022	26.0397719	79.58669108
NH27	1520750	1520650	D	R1	3.3	3.2	3.3	61	10/Dec/2022	26.03942804	79.58576769
NH27	1520650	1520550	D	R1	2.9	3.4	3.2	66	10/Dec/2022	26.03909041	79.58484423
NH27	1520550	1520450	D	R1	1.4	2.4	1.9	69	10/Dec/2022	26.0387326	79.58392931
NH27	1520450	1520350	D	R1	2.1	3.3	2.7	69	10/Dec/2022	26.03837957	79.58301132
NH27	1520350	1520250	D	R1	2.4	4.4	3.4	69	10/Dec/2022	26.03803235	79.58208987
NH27	1520250	1520150	D	R1	1.5	3.7	2.6	65	10/Dec/2022	26.03769865	79.58116193
NH27	1520150	1520050	D	R1	2.4	3.6	3	60	10/Dec/2022	26.03736196	79.58023496
NH27	1520050	1519950	D	R1	6.5	7.5	7	56	10/Dec/2022	26.03700855	79.57931606
NH27	1519950	1519850	D	R1	7.8	7.5	7.6	22	10/Dec/2022	26.03664378	79.57840042
NH27	1519850	1519750	D	R1	4.2	8.5	6.4	32	10/Dec/2022	26.03633378	79.5774659
NH27	1519750	1519650	D	R1	2.5	4.5	3.5	46	10/Dec/2022	26.0360188	79.57653422
NH27	1519650	1519550	D	R1	1.8	4.4	3.1	57	10/Dec/2022	26.03569281	79.57560678
NH27	1519550	1519450	D	R1	2.4	5.4	3.9	64	10/Dec/2022	26.0353581	79.57468295
NH27	1519450	1519350	D	R1	2.3	6.4	4.4	66	10/Dec/2022	26.03502404	79.57375673
NH27	1519350	1519250	D	R1	2.4	5.7	4	69	10/Dec/2022	26.03468841	79.57283175
NH27	1519250	1519150	D	R1	2.9	4.8	3.8	71	10/Dec/2022	26.03435464	79.57190555
NH27	1519150	1519050	D	R1	2.3	5.7	4	72	10/Dec/2022	26.03402192	79.57097893
NH27	1519050	1518950	D	R1	3.2	5.2	4.2	73	10/Dec/2022	26.03368538	79.57005351
NH27	1518950	1518850	D	R1	2.7	5.2	4	73	10/Dec/2022	26.0333523	79.56912638
NH27	1518850	1518750	D	R1	2.5	5	3.7	72	10/Dec/2022	26.03301741	79.56820001
NH27	1518750	1518650	D	R1	2.4	5.3	3.8	72	10/Dec/2022	26.03268209	79.56727346
NH27	1518650	1518550	D	R1	2.1	4.1	3.1	71	10/Dec/2022	26.0323496	79.5663458
NH27	1518550	1518450	D	R1	2.9	6.2	4.6	71	10/Dec/2022	26.03201452	79.56541934
NH27	1518450	1518350	D	R1	3.5	4.9	4.2	71	10/Dec/2022	26.03167332	79.56449592
NH27	1518350	1518250	D	R1	2.5	4.1	3.3	71	10/Dec/2022	26.03133536	79.56357062
NH27	1518250	1518150	D	R1	2.4	3.7	3.1	73	10/Dec/2022	26.03099433	79.56264687
NH27	1518150	1518050	D	R1	2.7	4.2	3.4	75	10/Dec/2022	26.03065137	79.56172393
NH27	1518050	1517950	D	R1	2.4	4.1	3.2	75	10/Dec/2022	26.03030982	79.56079973
NH27	1517950	1517850	D	R1	2.9	4.7	3.8	73	10/Dec/2022	26.02996724	79.55987611
NH27	1517850	1517750	D	R1	3.3	4.8	4.1	69	10/Dec/2022	26.02962139	79.5589531
NH27	1517750	1517650	D	R1	3.9	4.2	4.1	64	10/Dec/2022	26.0292947	79.55802175

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1517650	1517550	D	R1	3.4	4	3.7	64	10/Dec/2022	26.02897097	79.5570909
NH27	1517550	1517450	D	R1	2.8	4.2	3.5	54	10/Dec/2022	26.02865223	79.55615603
NH27	1517450	1517350	D	R1	3.8	4.8	4.3	51	10/Dec/2022	26.02833128	79.55522341
NH27	1517350	1517250	D	R1	3.8	4.8	4.3	60	10/Dec/2022	26.02798628	79.55430492
NH27	1517250	1517150	D	R1	3.6	5.4	4.5	63	10/Dec/2022	26.02766214	79.55337633
NH27	1517150	1517050	D	R1	3.4	5.2	4.3	65	10/Dec/2022	26.02730432	79.55246257
NH27	1517050	1516950	D	R1	3.2	4.3	3.7	65	10/Dec/2022	26.02696357	79.5515403
NH27	1516950	1516850	D	R1	2.8	4.7	3.7	69	10/Dec/2022	26.0266206	79.55061892
NH27	1516850	1516750	D	R1	2.4	5.2	3.8	71	10/Dec/2022	26.02627844	79.54969623
NH27	1516750	1516650	D	R1	2.8	4.7	3.8	71	10/Dec/2022	26.02593714	79.54877268
NH27	1516650	1516550	D	R1	2.7	4.2	3.5	70	10/Dec/2022	26.02559438	79.54784973
NH27	1516550	1516450	D	R1	2.7	4.6	3.7	70	10/Dec/2022	26.02525284	79.54692612
NH27	1516450	1516350	D	R1	2.2	5.1	3.6	69	10/Dec/2022	26.02491245	79.54600212
NH27	1516350	1516250	D	R1	2.5	5.2	3.8	68	10/Dec/2022	26.02457765	79.54507553
NH27	1516250	1516150	D	R1	3	5	4	67	10/Dec/2022	26.02424006	79.54415024
NH27	1516150	1516050	D	R1	3.1	5.5	4.3	67	10/Dec/2022	26.02390226	79.54322557
NH27	1516050	1515950	D	R1	2.7	4.4	3.6	63	10/Dec/2022	26.0235674	79.54229777
NH27	1515950	1515850	D	R1	3	3.9	3.4	57	10/Dec/2022	26.02323558	79.54136833
NH27	1515850	1515750	D	R1	2.9	3.6	3.2	48	10/Dec/2022	26.02290099	79.54043977
NH27	1515750	1515713	D	R1	2.7	4.6	3.7	28	10/Dec/2022	26.02256563	79.53951195
NH27	1578530	1578450	D	R2	2.9	2.3	2.6	10	10/Dec/2022	26.37877324	79.998663
NH27	1578450	1578350	D	R2	1.7	2.7	2.2	29	10/Dec/2022	26.37833486	79.99803618
NH27	1578350	1578250	D	R2	3.3	3.8	3.5	38	10/Dec/2022	26.37765301	79.99738546
NH27	1578250	1578150	D	R2	3.1	2.9	3	25	10/Dec/2022	26.37692844	79.99679256
NH27	1578150	1578050	D	R2	3.9	3.7	3.8	12	10/Dec/2022	26.37614501	79.99629916
NH27	1578050	1577950	D	R2	4.1	3	3.6	34	10/Dec/2022	26.37531095	79.99579345
NH27	1577950	1577850	D	R2	3.8	4.9	4.4	43	10/Dec/2022	26.37451901	79.99532089
NH27	1577850	1577750	D	R2	2.2	2.5	2.4	44	10/Dec/2022	26.37373104	79.99483785
NH27	1577750	1577650	D	R2	2.9	4.6	3.8	51	10/Dec/2022	26.3729523	79.99433807
NH27	1577650	1577550	D	R2	2.2	4.6	3.4	55	10/Dec/2022	26.37216286	79.99385851
NH27	1577550	1577450	D	R2	2.6	5	3.8	53	10/Dec/2022	26.37137105	79.99338181
NH27	1577450	1577350	D	R2	2.9	2.4	2.7	55	10/Dec/2022	26.37058042	79.99290384
NH27	1577350	1577250	D	R2	2.3	3.8	3.1	55	10/Dec/2022	26.36978929	79.99242616
NH27	1577250	1577150	D	R2	3.3	2.2	2.8	54	10/Dec/2022	26.36899782	79.9919493
NH27	1577150	1577050	D	R2	2.9	2	2.5	54	10/Dec/2022	26.36820427	79.99147639
NH27	1577050	1576950	D	R2	3	3.3	3.2	51	10/Dec/2022	26.36740938	79.99100456
NH27	1576950	1576850	D	R2	2.8	3.1	3	53	10/Dec/2022	26.36659942	79.99056991
NH27	1576850	1576750	D	R2	3	2.4	2.7	56	10/Dec/2022	26.3658048	79.9901008
NH27	1576750	1576650	D	R2	2.9	4.4	3.7	57	10/Dec/2022	26.36501396	79.98962324

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1576650	1576550	D	R2	2.2	4.2	3.2	58	10/Dec/2022	26.36422164	79.98914776
NH27	1576550	1576450	D	R2	2.5	2.9	2.7	58	10/Dec/2022	26.36342975	79.98867169
NH27	1576450	1576350	D	R2	3.1	2.5	2.8	59	10/Dec/2022	26.36263854	79.98819422
NH27	1576350	1576250	D	R2	3.3	2.1	2.7	56	10/Dec/2022	26.36184735	79.98771457
NH27	1576250	1576150	D	R2	3.2	2.1	2.7	54	10/Dec/2022	26.3610555	79.98723801
NH27	1576150	1576050	D	R2	2.5	4.1	3.3	53	10/Dec/2022	26.36026238	79.98676392
NH27	1576050	1575950	D	R2	2.7	2.3	2.5	47	10/Dec/2022	26.35946841	79.98628977
NH27	1575950	1575850	D	R2	2.3	2.4	2.4	48	10/Dec/2022	26.35867859	79.98581047
NH27	1575850	1575750	D	R2	2.2	3.1	2.7	59	10/Dec/2022	26.35788554	79.98534136
NH27	1575750	1575650	D	R2	3.1	2.3	2.7	65	10/Dec/2022	26.35709788	79.98485991
NH27	1575650	1575550	D	R2	2.9	2.7	2.8	66	10/Dec/2022	26.35632788	79.98434162
NH27	1575550	1575450	D	R2	2.7	2.2	2.5	69	10/Dec/2022	26.35560758	79.98374255
NH27	1575450	1575350	D	R2	2.9	3.2	3.1	69	10/Dec/2022	26.3549349	79.9830784
NH27	1575350	1575250	D	R2	2.2	4.1	3.2	70	10/Dec/2022	26.35431435	79.98235414
NH27	1575250	1575150	D	R2	3	3.4	3.2	69	10/Dec/2022	26.35370882	79.98161392
NH27	1575150	1575050	D	R2	2.9	3.8	3.4	66	10/Dec/2022	26.35310535	79.98087058
NH27	1575050	1574950	D	R2	2.9	3.1	3	29	10/Dec/2022	26.35250783	79.98011811
NH27	1574950	1574850	D	R2	1.9	4.3	3.1	40	10/Dec/2022	26.35188972	79.97939646
NH27	1574850	1574750	D	R2	2.3	3.6	3	43	10/Dec/2022	26.35128466	79.97865551
NH27	1574750	1574650	D	R2	2.2	2.4	2.3	45	10/Dec/2022	26.35067729	79.97791932
NH27	1574650	1574550	D	R2	1.8	4.2	3	54	10/Dec/2022	26.35007121	79.97718192
NH27	1574550	1574450	D	R2	3.7	2.6	3.2	56	10/Dec/2022	26.34946359	79.97644445
NH27	1574450	1574350	D	R2	5.9	4	5	51	10/Dec/2022	26.34886005	79.97570111
NH27	1574350	1574250	D	R2	2.4	3.9	3.2	53	10/Dec/2022	26.34825192	79.97496529
NH27	1574250	1574150	D	R2	2.6	2.7	2.7	59	10/Dec/2022	26.34763894	79.97423456
NH27	1574150	1574050	D	R2	2	3.2	2.6	60	10/Dec/2022	26.34703371	79.97349433
NH27	1574050	1573950	D	R2	2	2.9	2.5	61	10/Dec/2022	26.34641653	79.97276658
NH27	1573950	1573850	D	R2	2.4	3.4	2.9	60	10/Dec/2022	26.34579465	79.97204413
NH27	1573850	1573750	D	R2	2.2	2.9	2.6	56	10/Dec/2022	26.34518305	79.97131114
NH27	1573750	1573650	D	R2	3.6	3.9	3.8	54	10/Dec/2022	26.34457895	79.97057104
NH27	1573650	1573550	D	R2	3.7	3.7	3.7	55	10/Dec/2022	26.34397361	79.96983192
NH27	1573550	1573450	D	R2	3.5	4.2	3.9	60	10/Dec/2022	26.34336448	79.96909567
NH27	1573450	1573350	D	R2	2.4	3.2	2.8	66	10/Dec/2022	26.34275942	79.96835542
NH27	1573350	1573250	D	R2	2.6	3	2.8	67	10/Dec/2022	26.34214943	79.96761893
NH27	1573250	1573150	D	R2	2.2	3.1	2.7	66	10/Dec/2022	26.34153503	79.96688716
NH27	1573150	1573050	D	R2	2.5	2.4	2.5	64	10/Dec/2022	26.34092655	79.96614913
NH27	1573050	1572950	D	R2	2.4	2	2.2	59	10/Dec/2022	26.3403204	79.96540774
NH27	1572950	1572850	D	R2	3.2	2.6	2.9	42	10/Dec/2022	26.33971606	79.96466377
NH27	1572850	1572750	D	R2	2.9	2.5	2.7	42	10/Dec/2022	26.33907416	79.96396732
NH27	1572750	1572650	D	R2	2.8	3.3	3.1	49	10/Dec/2022	26.33833017	79.96340718

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1572650	1572550	D	R2	5.1	3.2	4.2	55	10/Dec/2022	26.33755745	79.96289571
NH27	1572550	1572450	D	R2	4	2.4	3.2	59	10/Dec/2022	26.33681188	79.96233565
NH27	1572450	1572350	D	R2	3.5	3.2	3.4	60	10/Dec/2022	26.33607397	79.96176269
NH27	1572350	1572250	D	R2	2.4	3.2	2.8	59	10/Dec/2022	26.33533552	79.9611902
NH27	1572250	1572150	D	R2	3.7	2.4	3.1	58	10/Dec/2022	26.33459111	79.96062679
NH27	1572150	1572050	D	R2	3.2	2	2.6	56	10/Dec/2022	26.33383652	79.96008014
NH27	1572050	1571950	D	R2	3.3	2.3	2.8	54	10/Dec/2022	26.33309711	79.95950815
NH27	1571950	1571850	D	R2	3	3.1	3.1	55	10/Dec/2022	26.33236728	79.95892223
NH27	1571850	1571750	D	R2	2.6	4.5	3.6	56	10/Dec/2022	26.33165744	79.95830807
NH27	1571750	1571650	D	R2	3.5	2.4	3	54	10/Dec/2022	26.33095246	79.9576867
NH27	1571650	1571550	D	R2	4.2	3.7	4	54	10/Dec/2022	26.33024451	79.95706829
NH27	1571550	1571450	D	R2	3.3	4	3.7	54	10/Dec/2022	26.32953783	79.95644723
NH27	1571450	1571350	D	R2	3.2	4.3	3.8	56	10/Dec/2022	26.32883108	79.95582736
NH27	1571350	1571250	D	R2	2.4	3.8	3.1	55	10/Dec/2022	26.32812727	79.95520276
NH27	1571250	1571150	D	R2	2.3	2.6	2.5	55	10/Dec/2022	26.32744256	79.95455312
NH27	1571150	1571050	D	R2	3.3	3.5	3.4	56	10/Dec/2022	26.32673539	79.95393441
NH27	1571050	1570950	D	R2	2	3.2	2.6	56	10/Dec/2022	26.32602605	79.95331824
NH27	1570950	1570850	D	R2	2.3	3.6	3	57	10/Dec/2022	26.32532787	79.95268684
NH27	1570850	1570750	D	R2	4.3	3.5	3.9	58	10/Dec/2022	26.32468406	79.95198767
NH27	1570750	1570650	D	R2	3.5	3.2	3.4	59	10/Dec/2022	26.32407507	79.95125111
NH27	1570650	1570550	D	R2	5	3.6	4.3	57	10/Dec/2022	26.32346541	79.95051508
NH27	1570550	1570450	D	R2	5	3.2	4.1	56	10/Dec/2022	26.3229064	79.94973115
NH27	1570450	1570350	D	R2	4.2	3.2	3.7	55	10/Dec/2022	26.32243245	79.94888129
NH27	1570350	1570250	D	R2	3.9	2.5	3.2	55	10/Dec/2022	26.32203064	79.9479866
NH27	1570250	1570150	D	R2	2.5	2.9	2.7	55	10/Dec/2022	26.32165441	79.94707871
NH27	1570150	1570050	D	R2	2.3	2.2	2.3	57	10/Dec/2022	26.3212752	79.94617229
NH27	1570050	1569950	D	R2	2.4	2.6	2.5	58	10/Dec/2022	26.32087252	79.94527854
NH27	1569950	1569850	D	R2	3.4	3.4	3.4	58	10/Dec/2022	26.32042818	79.94440905
NH27	1569850	1569750	D	R2	2.7	3.4	3.1	57	10/Dec/2022	26.3199295	79.94357707
NH27	1569750	1569650	D	R2	3	3.9	3.5	57	10/Dec/2022	26.31939775	79.94276968
NH27	1569650	1569550	D	R2	4.7	2.3	3.5	54	10/Dec/2022	26.31886571	79.94196192
NH27	1569550	1569450	D	R2	3.7	3.5	3.6	55	10/Dec/2022	26.31833379	79.94115537
NH27	1569450	1569350	D	R2	2.3	2.8	2.6	53	10/Dec/2022	26.31785733	79.94030679
NH27	1569350	1569250	D	R2	2.7	3.9	3.3	55	10/Dec/2022	26.31745003	79.93941551
NH27	1569250	1569150	D	R2	2.4	3	2.7	54	10/Dec/2022	26.3170764	79.93850524
NH27	1569150	1569050	D	R2	4.3	2.2	3.3	57	10/Dec/2022	26.31670946	79.93759303
NH27	1569050	1568950	D	R2	3	3.5	3.3	60	10/Dec/2022	26.3163399	79.93668144
NH27	1568950	1568850	D	R2	2.4	3.8	3.1	60	10/Dec/2022	26.31595384	79.93577882
NH27	1568850	1568750	D	R2	2.6	2.2	2.4	59	10/Dec/2022	26.3155033	79.93491246
NH27	1568750	1568650	D	R2	3.1	2	2.6	59	10/Dec/2022	26.31504764	79.93404879

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1568650	1568550	D	R2	2.8	3.1	3	60	10/Dec/2022	26.3145899	79.93318661
NH27	1568550	1568450	D	R2	2.6	2	2.3	57	10/Dec/2022	26.31413596	79.93232215
NH27	1568450	1568350	D	R2	2.1	4.3	3.2	45	10/Dec/2022	26.31368734	79.93142827
NH27	1568350	1568250	D	R2	2.6	2	2.3	50	10/Dec/2022	26.31320154	79.93059021
NH27	1568250	1568150	D	R2	2.4	3.1	2.8	55	10/Dec/2022	26.31261111	79.92983984
NH27	1568150	1568050	D	R2	3	2.5	2.8	56	10/Dec/2022	26.3119458	79.92916699
NH27	1568050	1567950	D	R2	2.8	3	2.9	56	10/Dec/2022	26.31127936	79.92849469
NH27	1567950	1567850	D	R2	2.8	2.7	2.8	56	10/Dec/2022	26.31061269	79.92782216
NH27	1567850	1567750	D	R2	2.9	2.6	2.8	56	10/Dec/2022	26.30994535	79.9271511
NH27	1567750	1567650	D	R2	3.5	4.4	4	55	10/Dec/2022	26.30927587	79.92648197
NH27	1567650	1567550	D	R2	2.8	4.1	3.5	56	10/Dec/2022	26.30860557	79.92581453
NH27	1567550	1567450	D	R2	2.8	2.8	2.8	58	10/Dec/2022	26.30794023	79.92514062
NH27	1567450	1567350	D	R2	2.8	2.3	2.6	58	10/Dec/2022	26.30727354	79.9244677
NH27	1567350	1567250	D	R2	2.5	2.8	2.7	54	10/Dec/2022	26.30658231	79.92383063
NH27	1567250	1567150	D	R2	2.9	3.2	3.1	53	10/Dec/2022	26.30577477	79.92339551
NH27	1567150	1567050	D	R2	2.7	3	2.9	51	10/Dec/2022	26.30491234	79.92310837
NH27	1567050	1566950	D	R2	4.3	3	3.7	53	10/Dec/2022	26.30410763	79.92266726
NH27	1566950	1566850	D	R2	3.4	2.3	2.9	54	10/Dec/2022	26.30342936	79.92201153
NH27	1566850	1566750	D	R2	3.9	3.1	3.5	53	10/Dec/2022	26.30291189	79.92119486
NH27	1566750	1566650	D	R2	2.5	4.4	3.5	54	10/Dec/2022	26.30243949	79.920345
NH27	1566650	1566550	D	R2	3.5	2.8	3.2	53	10/Dec/2022	26.30195477	79.91950363
NH27	1566550	1566450	D	R2	3.1	3.5	3.3	54	10/Dec/2022	26.301396	79.9187223
NH27	1566450	1566350	D	R2	3.5	2.9	3.2	53	10/Dec/2022	26.3007862	79.91798841
NH27	1566350	1566250	D	R2	2.7	3.5	3.1	49	10/Dec/2022	26.30015922	79.91727098
NH27	1566250	1566150	D	R2	4.3	4.4	4.4	51	10/Dec/2022	26.29955743	79.91652946
NH27	1566150	1566050	D	R2	3.2	2.4	2.8	58	10/Dec/2022	26.29892397	79.91582144
NH27	1566050	1565950	D	R2	3.2	2.6	2.9	61	10/Dec/2022	26.2982931	79.91510957
NH27	1565950	1565850	D	R2	3.7	2.8	3.3	59	10/Dec/2022	26.29766167	79.91439626
NH27	1565850	1565750	D	R2	2.4	4.4	3.4	58	10/Dec/2022	26.2970688	79.91364378
NH27	1565750	1565650	D	R2	2.5	2.3	2.4	58	10/Dec/2022	26.29650228	79.91286719
NH27	1565650	1565550	D	R2	3.9	2	3	58	10/Dec/2022	26.29593667	79.91208996
NH27	1565550	1565450	D	R2	2.7	2.5	2.6	58	10/Dec/2022	26.29536668	79.9113164
NH27	1565450	1565350	D	R2	3.2	4.4	3.8	58	10/Dec/2022	26.29479867	79.91054111
NH27	1565350	1565250	D	R2	2.8	4.1	3.5	61	10/Dec/2022	26.29423255	79.90976473
NH27	1565250	1565150	D	R2	3.2	4.4	3.8	60	10/Dec/2022	26.29366618	79.9089876
NH27	1565150	1565050	D	R2	3.3	4.2	3.8	63	10/Dec/2022	26.29309772	79.90821324
NH27	1565050	1564950	D	R2	4.3	3.7	4	64	10/Dec/2022	26.29253293	79.9074353
NH27	1564950	1564850	D	R2	5.1	2.3	3.7	64	10/Dec/2022	26.29196559	79.90665949
NH27	1564850	1564750	D	R2	5.6	3.9	4.8	64	10/Dec/2022	26.29139969	79.90588232
NH27	1564750	1564650	D	R2	6.4	2.5	4.5	64	10/Dec/2022	26.29084418	79.90509558

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1564650	1564550	D	R2	8.3	4.2	6.3	65	10/Dec/2022	26.29037403	79.90424382
NH27	1564550	1564450	D	R2	5	2.7	3.9	56	10/Dec/2022	26.28997921	79.90334455
NH27	1564450	1564350	D	R2	6.2	3.8	5	53	10/Dec/2022	26.289594	79.90244235
NH27	1564350	1564250	D	R2	5.9	2.6	4.3	58	10/Dec/2022	26.28921205	79.90154004
NH27	1564250	1564150	D	R2	3.8	2	2.9	57	10/Dec/2022	26.2888142	79.90064279
NH27	1564150	1564050	D	R2	2.8	3.3	3.1	64	10/Dec/2022	26.28835335	79.89978592
NH27	1564050	1563950	D	R2	6.4	2.1	4.3	68	10/Dec/2022	26.28782117	79.89898066
NH27	1563950	1563850	D	R2	9.2	3.4	6.3	71	10/Dec/2022	26.28723269	79.89822411
NH27	1563850	1563750	D	R2	4.6	4.5	4.6	69	10/Dec/2022	26.28663301	79.89747779
NH27	1563750	1563650	D	R2	3.7	2.9	3.3	67	10/Dec/2022	26.28603502	79.89672954
NH27	1563650	1563550	D	R2	3.2	3.4	3.3	65	10/Dec/2022	26.28543582	79.89598277
NH27	1563550	1563450	D	R2	2.5	4.3	3.4	65	10/Dec/2022	26.28481387	79.89525987
NH27	1563450	1563350	D	R2	3.1	4.2	3.7	65	10/Dec/2022	26.2842035	79.8945244
NH27	1563350	1563250	D	R2	2.9	3	3	64	10/Dec/2022	26.28359924	79.89378305
NH27	1563250	1563150	D	R2	2.7	3.3	3	66	10/Dec/2022	26.28297402	79.89306465
NH27	1563150	1563050	D	R2	2.9	3.1	3	68	10/Dec/2022	26.28228876	79.89241966
NH27	1563050	1562950	D	R2	3.5	2.6	3.1	69	10/Dec/2022	26.28152922	79.89188542
NH27	1562950	1562850	D	R2	3.4	3.2	3.3	68	10/Dec/2022	26.2807421	79.8913998
NH27	1562850	1562750	D	R2	4.5	4.3	4.4	68	10/Dec/2022	26.28003305	79.89078447
NH27	1562750	1562650	D	R2	3.7	2.6	3.2	68	10/Dec/2022	26.27938129	79.89009447
NH27	1562650	1562550	D	R2	4.4	2.6	3.5	68	10/Dec/2022	26.2787305	79.88940334
NH27	1562550	1562450	D	R2	4.2	2.4	3.3	68	10/Dec/2022	26.27808002	79.888712
NH27	1562450	1562350	D	R2	4.1	3.1	3.6	68	10/Dec/2022	26.27742942	79.88802061
NH27	1562350	1562250	D	R2	3.9	2.2	3.1	68	10/Dec/2022	26.27677955	79.88732842
NH27	1562250	1562150	D	R2	3.3	4.4	3.9	69	10/Dec/2022	26.27613063	79.88663512
NH27	1562150	1562050	D	R2	4	2.3	3.2	69	10/Dec/2022	26.27547845	79.88594568
NH27	1562050	1561950	D	R2	4.1	3.3	3.7	69	10/Dec/2022	26.27482634	79.88525621
NH27	1561950	1561850	D	R2	2.9	4.4	3.7	69	10/Dec/2022	26.27417276	79.88456829
NH27	1561850	1561750	D	R2	3.9	4.5	4.2	69	10/Dec/2022	26.27351857	79.88388104
NH27	1561750	1561650	D	R2	3.8	3.5	3.7	69	10/Dec/2022	26.2728651	79.88319281
NH27	1561650	1561550	D	R2	2.5	3.3	2.9	69	10/Dec/2022	26.27221062	79.88250603
NH27	1561550	1561450	D	R2	2.6	3.4	3	70	10/Dec/2022	26.27155463	79.88182138
NH27	1561450	1561350	D	R2	2.4	3.8	3.1	69	10/Dec/2022	26.27089721	79.88113706
NH27	1561350	1561250	D	R2	2.5	4.1	3.3	64	10/Dec/2022	26.27023942	79.8804523
NH27	1561250	1561150	D	R2	2.8	3.5	3.2	65	10/Dec/2022	26.26957915	79.87977265
NH27	1561150	1561050	D	R2	3.5	3.7	3.6	66	10/Dec/2022	26.26889864	79.87911919
NH27	1561050	1560950	D	R2	3	3.7	3.4	70	10/Dec/2022	26.2681633	79.87854393
NH27	1560950	1560850	D	R2	3.2	4.2	3.7	71	10/Dec/2022	26.26742248	79.87797559
NH27	1560850	1560750	D	R2	3	4.8	3.9	67	10/Dec/2022	26.26668007	79.87740733
NH27	1560750	1560650	D	R2	3.4	3	3.2	67	10/Dec/2022	26.26593268	79.87684964

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1560650	1560550	D	R2	4.6	3.6	4.1	68	10/Dec/2022	26.26518879	79.87628602
NH27	1560550	1560450	D	R2	4.4	3.5	4	67	10/Dec/2022	26.26444713	79.87571784
NH27	1560450	1560350	D	R2	3.5	2.5	3	55	10/Dec/2022	26.2637124	79.87513641
NH27	1560350	1560250	D	R2	3	2.9	3	61	10/Dec/2022	26.26295865	79.87459124
NH27	1560250	1560150	D	R2	2.7	3.9	3.3	66	10/Dec/2022	26.26221651	79.87402662
NH27	1560150	1560050	D	R2	2.4	2.3	2.4	69	10/Dec/2022	26.26147304	79.87346335
NH27	1560050	1559950	D	R2	3.2	2.6	2.9	64	10/Dec/2022	26.26073317	79.87289013
NH27	1559950	1559850	D	R2	3.6	3.8	3.7	65	10/Dec/2022	26.25998496	79.87233501
NH27	1559850	1559750	D	R2	2.8	2	2.4	65	10/Dec/2022	26.25924279	79.87176844
NH27	1559750	1559650	D	R2	2.8	2.2	2.5	66	10/Dec/2022	26.25849878	79.87120529
NH27	1559650	1559550	D	R2	3.5	2.4	3	67	10/Dec/2022	26.25775441	79.87064305
NH27	1559550	1559450	D	R2	3.6	2	2.8	68	10/Dec/2022	26.25702355	79.87005878
NH27	1559450	1559350	D	R2	11.8	2.6	7.2	68	10/Dec/2022	26.25633527	79.86941409
NH27	1559350	1559250	D	R2	5.5	4.3	4.9	65	10/Dec/2022	26.25572109	79.86868165
NH27	1559250	1559150	D	R2	2.6	4	3.3	66	10/Dec/2022	26.25513369	79.8679237
NH27	1559150	1559050	D	R2	3.3	2.8	3.1	65	10/Dec/2022	26.25455494	79.86715693
NH27	1559050	1558950	D	R2	3	2.7	2.9	64	10/Dec/2022	26.25398211	79.8663848
NH27	1558950	1558850	D	R2	3.4	3.1	3.3	65	10/Dec/2022	26.25339144	79.86563023
NH27	1558850	1558750	D	R2	2.5	3.4	3	63	10/Dec/2022	26.25281704	79.86485968
NH27	1558750	1558650	D	R2	2.7	4.1	3.4	63	10/Dec/2022	26.25223355	79.86409909
NH27	1558650	1558550	D	R2	2.8	3.2	3	64	10/Dec/2022	26.25165051	79.86333687
NH27	1558550	1558450	D	R2	3.6	2.2	2.9	64	10/Dec/2022	26.25107113	79.86257155
NH27	1558450	1558350	D	R2	2.7	4.4	3.6	64	10/Dec/2022	26.2504908	79.86180664
NH27	1558350	1558250	D	R2	2.6	3	2.8	66	10/Dec/2022	26.24991062	79.86104291
NH27	1558250	1558150	D	R2	3	2.3	2.7	67	10/Dec/2022	26.24932587	79.86028269
NH27	1558150	1558050	D	R2	4.3	4.2	4.3	66	10/Dec/2022	26.24874524	79.85951741
NH27	1558050	1557950	D	R2	5.8	3	4.4	51	10/Dec/2022	26.24814778	79.85875486
NH27	1557950	1557850	D	R2	4.2	4.2	4.2	56	10/Dec/2022	26.24745243	79.85812359
NH27	1557850	1557750	D	R2	2.5	2.9	2.7	64	10/Dec/2022	26.2466972	79.85758284
NH27	1557750	1557650	D	R2	2.2	3.8	3	62	10/Dec/2022	26.24593676	79.85704519
NH27	1557650	1557550	D	R2	4.1	2.7	3.4	62	10/Dec/2022	26.24516537	79.85652958
NH27	1557550	1557450	D	R2	3.4	3.8	3.6	60	10/Dec/2022	26.24439755	79.85600477
NH27	1557450	1557350	D	R2	3.4	3.9	3.7	60	10/Dec/2022	26.24363119	79.85547898
NH27	1557350	1557250	D	R2	2.9	2.3	2.6	61	10/Dec/2022	26.24286251	79.85495759
NH27	1557250	1557150	D	R2	2.8	2.7	2.8	63	10/Dec/2022	26.2420981	79.85442946
NH27	1557150	1557050	D	R2	2.9	2.7	2.8	64	10/Dec/2022	26.24132966	79.85390732
NH27	1557050	1556950	D	R2	2.9	3.4	3.2	63	10/Dec/2022	26.24056256	79.8533824
NH27	1556950	1556850	D	R2	2.8	2.3	2.6	63	10/Dec/2022	26.23979507	79.85285853
NH27	1556850	1556750	D	R2	3.2	2.7	3	63	10/Dec/2022	26.23902999	79.85233099
NH27	1556750	1556650	D	R2	2.8	3.9	3.4	62	10/Dec/2022	26.23827125	79.85179152

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1556650	1556550	D	R2	3.8	2.4	3.1	62	10/Dec/2022	26.23755937	79.85117969
NH27	1556550	1556450	D	R2	3.5	3.8	3.7	63	10/Dec/2022	26.23690734	79.85049034
NH27	1556450	1556350	D	R2	4.2	4	4.1	59	10/Dec/2022	26.23631732	79.84973412
NH27	1556350	1556250	D	R2	3.5	4	3.8	35	10/Dec/2022	26.23580581	79.84891002
NH27	1556250	1556150	D	R2	5.1	2.1	3.6	52	10/Dec/2022	26.23536848	79.84803997
NH27	1556150	1556050	D	R2	3.6	4.1	3.9	61	10/Dec/2022	26.23501284	79.84712445
NH27	1556050	1555950	D	R2	2.8	4.4	3.6	65	10/Dec/2022	26.23474378	79.84617174
NH27	1555950	1555850	D	R2	3.5	5	4.3	47	10/Dec/2022	26.2345109	79.84520402
NH27	1555850	1555750	D	R2	2.7	3.4	3.1	54	10/Dec/2022	26.23426292	79.84424572
NH27	1555750	1555650	D	R2	3	4	3.5	58	10/Dec/2022	26.23402093	79.84328405
NH27	1555650	1555550	D	R2	2.6	3.2	2.9	58	10/Dec/2022	26.23378487	79.84231979
NH27	1555550	1555450	D	R2	3	4.6	3.8	57	10/Dec/2022	26.23354546	79.84135573
NH27	1555450	1555350	D	R2	3.1	4.9	4	58	10/Dec/2022	26.23331108	79.84039122
NH27	1555350	1555250	D	R2	2.7	4.8	3.8	60	10/Dec/2022	26.2330708	79.8394288
NH27	1555250	1555150	D	R2	2.5	3.4	3	65	10/Dec/2022	26.23283073	79.83846683
NH27	1555150	1555050	D	R2	2.7	3.5	3.1	67	10/Dec/2022	26.23258634	79.83750606
NH27	1555050	1554950	D	R2	3.3	2.4	2.9	71	10/Dec/2022	26.23229069	79.83656453
NH27	1554950	1554850	D	R2	3.6	2.6	3.1	67	10/Dec/2022	26.23190911	79.83565887
NH27	1554850	1554750	D	R2	4.4	3.4	3.9	65	10/Dec/2022	26.23142852	79.83481583
NH27	1554750	1554650	D	R2	3.6	3.6	3.6	66	10/Dec/2022	26.2308699	79.83403417
NH27	1554650	1554550	D	R2	4.6	3.3	4	68	10/Dec/2022	26.23024061	79.83332225
NH27	1554550	1554450	D	R2	4.3	3.5	3.9	71	10/Dec/2022	26.22954384	79.83269079
NH27	1554450	1554350	D	R2	4.4	3.5	4	73	10/Dec/2022	26.22878784	79.8321486
NH27	1554350	1554250	D	R2	4.1	4.1	4.1	72	10/Dec/2022	26.22798225	79.83170238
NH27	1554250	1554150	D	R2	3.9	3.6	3.8	70	10/Dec/2022	26.22713737	79.83135698
NH27	1554150	1554050	D	R2	3.7	3.8	3.8	69	10/Dec/2022	26.22627318	79.8310731
NH27	1554050	1553950	D	R2	4.2	5	4.6	67	10/Dec/2022	26.22540761	79.83079129
NH27	1553950	1553850	D	R2	2.8	3.9	3.4	62	10/Dec/2022	26.22453948	79.83052287
NH27	1553850	1553750	D	R2	2.3	3.5	2.9	66	10/Dec/2022	26.22367348	79.83024847
NH27	1553750	1553650	D	R2	2.5	3.9	3.2	67	10/Dec/2022	26.2228089	79.82996802
NH27	1553650	1553550	D	R2	2.6	3.6	3.1	69	10/Dec/2022	26.22194555	79.82968258
NH27	1553550	1553450	D	R2	3.1	3.9	3.5	70	10/Dec/2022	26.22107754	79.82941479
NH27	1553450	1553350	D	R2	2.9	2.3	2.6	68	10/Dec/2022	26.22021182	79.82913602
NH27	1553350	1553250	D	R2	3.1	2.4	2.8	66	10/Dec/2022	26.21934612	79.8288567
NH27	1553250	1553150	D	R2	2.6	3.4	3	68	10/Dec/2022	26.21848	79.82858264
NH27	1553150	1553050	D	R2	2.1	3.9	3	70	10/Dec/2022	26.21761441	79.82830617
NH27	1553050	1552950	D	R2	3.4	3.7	3.6	70	10/Dec/2022	26.21674904	79.82802814
NH27	1552950	1552850	D	R2	4.7	4.7	4.7	69	10/Dec/2022	26.21588335	79.82774972
NH27	1552850	1552750	D	R2	4.8	3.9	4.4	69	10/Dec/2022	26.21502709	79.82743789
NH27	1552750	1552650	D	R2	3.8	4.1	4	70	10/Dec/2022	26.21420362	79.827033

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1552650	1552550	D	R2	3.7	3.4	3.6	64	10/Dec/2022	26.21340961	79.82655733
NH27	1552550	1552450	D	R2	4.2	3.7	4	43	10/Dec/2022	26.21266807	79.82598852
NH27	1552450	1552350	D	R2	5.8	3.7	4.8	56	10/Dec/2022	26.21200333	79.82531817
NH27	1552350	1552250	D	R2	3.9	4.8	4.4	61	10/Dec/2022	26.21142275	79.82455528
NH27	1552250	1552150	D	R2	2.9	3	3	63	10/Dec/2022	26.21086627	79.82376972
NH27	1552150	1552050	D	R2	3.4	3.1	3.3	40	10/Dec/2022	26.21033244	79.82296113
NH27	1552050	1551950	D	R2	3.3	3.7	3.5	51	10/Dec/2022	26.20978975	79.82216835
NH27	1551950	1551850	D	R2	4.5	3.2	3.9	61	10/Dec/2022	26.20921095	79.8214055
NH27	1551850	1551750	D	R2	2.4	3.2	2.8	62	10/Dec/2022	26.20865395	79.82062027
NH27	1551750	1551650	D	R2	4.1	4.2	4.2	60	10/Dec/2022	26.20809001	79.81984018
NH27	1551650	1551550	D	R2	3.7	9.6	6.7	48	10/Dec/2022	26.20750764	79.81907723
NH27	1551550	1551450	D	R2	6.8	7.8	7.3	56	10/Dec/2022	26.20688477	79.81835743
NH27	1551450	1551350	D	R2	3.9	7.8	5.9	56	10/Dec/2022	26.20628407	79.81761245
NH27	1551350	1551250	D	R2	3.4	6	4.7	30	10/Dec/2022	26.20568066	79.81686671
NH27	1551250	1551150	D	R2	3.5	7.3	5.4	37	10/Dec/2022	26.20506909	79.81614061
NH27	1551150	1551050	D	R2	4.2	4.5	4.4	53	10/Dec/2022	26.2044282	79.81544541
NH27	1551050	1550950	D	R2	4.6	9.6	7.1	58	10/Dec/2022	26.20374346	79.81480033
NH27	1550950	1550850	D	R2	5.2	9	7.1	61	10/Dec/2022	26.20303006	79.81419214
NH27	1550850	1550750	D	R2	4.7	9.1	6.9	62	10/Dec/2022	26.20230658	79.81359658
NH27	1550750	1550650	D	R2	4.6	6.8	5.7	61	10/Dec/2022	26.20158591	79.81299583
NH27	1550650	1550550	D	R2	4.1	6.8	5.5	56	10/Dec/2022	26.20086444	79.81239478
NH27	1550550	1550450	D	R2	3.2	6.7	5	61	10/Dec/2022	26.20014357	79.81179617
NH27	1550450	1550350	D	R2	4	5	4.5	63	10/Dec/2022	26.19943569	79.81117726
NH27	1550350	1550250	D	R2	3.1	7.1	5.1	55	10/Dec/2022	26.19879111	79.81047569
NH27	1550250	1550150	D	R2	3.3	6.8	5.1	19	10/Dec/2022	26.19817434	79.80974842
NH27	1550150	1550050	D	R2	2.7	3.3	3	36	10/Dec/2022	26.19754	79.80904323
NH27	1550050	1549950	D	R2	2.9	8.1	5.5	44	10/Dec/2022	26.19690934	79.80833237
NH27	1549950	1549850	D	R2	3.5	7	5.3	28	10/Dec/2022	26.1962801	79.8076153
NH27	1549850	1549750	D	R2	3.2	9.7	6.5	36	10/Dec/2022	26.19564914	79.80690385
NH27	1549750	1549650	D	R2	4	12	8	47	10/Dec/2022	26.19502288	79.80618811
NH27	1549650	1549550	D	R2	3.7	10.4	7.1	39	10/Dec/2022	26.1943974	79.80546854
NH27	1549550	1549450	D	R2	3	8.1	5.6	43	10/Dec/2022	26.19378367	79.80473923
NH27	1549450	1549350	D	R2	3.7	10.2	7	47	10/Dec/2022	26.19314233	79.80403894
NH27	1549350	1549250	D	R2	3.4	9.5	6.5	59	10/Dec/2022	26.19252199	79.80331826
NH27	1549250	1549150	D	R2	3.4	9.2	6.3	66	10/Dec/2022	26.19189486	79.80260302
NH27	1549150	1549050	D	R2	3.7	10	6.9	69	10/Dec/2022	26.1912672	79.80188718
NH27	1549050	1548950	D	R2	3.1	5	4.1	68	10/Dec/2022	26.19064054	79.80116853
NH27	1548950	1548850	D	R2	3.1	3.1	3.1	68	10/Dec/2022	26.19001204	79.80045172
NH27	1548850	1548750	D	R2	3	4	3.5	66	10/Dec/2022	26.18938612	79.79973206
NH27	1548750	1548650	D	R2	4.1	11	7.6	65	10/Dec/2022	26.18875662	79.79901634

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1548650	1548550	D	R2	3.6	8	5.8	59	10/Dec/2022	26.18812958	79.79829637
NH27	1548550	1548450	D	R2	3.2	8.2	5.7	54	10/Dec/2022	26.18750092	79.79757909
NH27	1548450	1548350	D	R2	2.7	4.5	3.6	56	10/Dec/2022	26.18687358	79.79686242
NH27	1548350	1548250	D	R2	2.3	3.4	2.9	57	10/Dec/2022	26.18622012	79.79617536
NH27	1548250	1548150	D	R2	2.8	4.6	3.7	45	10/Dec/2022	26.18552697	79.79553613
NH27	1548150	1548050	D	R2	4.6	7.7	6.2	37	10/Dec/2022	26.18479599	79.79495152
NH27	1548050	1547950	D	R2	5.4	8.7	7.1	56	10/Dec/2022	26.18405495	79.79438895
NH27	1547950	1547850	D	R2	6.2	9	7.6	64	10/Dec/2022	26.1833181	79.79381667
NH27	1547850	1547750	D	R2	5	9.5	7.3	67	10/Dec/2022	26.18258009	79.79324465
NH27	1547750	1547650	D	R2	5	8	6.5	68	10/Dec/2022	26.18184403	79.79266768
NH27	1547650	1547550	D	R2	4.8	9.2	7	68	10/Dec/2022	26.18110747	79.79209224
NH27	1547550	1547450	D	R2	3.9	5.7	4.8	67	10/Dec/2022	26.18036844	79.79152017
NH27	1547450	1547350	D	R2	3.8	4.8	4.3	67	10/Dec/2022	26.17963199	79.79094425
NH27	1547350	1547250	D	R2	3.8	6.9	5.4	65	10/Dec/2022	26.1788984	79.79036358
NH27	1547250	1547150	D	R2	5.4	7.9	6.7	65	10/Dec/2022	26.17816059	79.78978995
NH27	1547150	1547050	D	R2	3.9	7.8	5.9	43	10/Dec/2022	26.17742087	79.78921427
NH27	1547050	1546950	D	R2	4.9	6.7	5.8	47	10/Dec/2022	26.17668153	79.78864524
NH27	1546950	1546850	D	R2	4.6	5.2	4.9	59	10/Dec/2022	26.17594186	79.78807918
NH27	1546850	1546750	D	R2	4.3	7.2	5.8	62	10/Dec/2022	26.17520247	79.78750923
NH27	1546750	1546650	D	R2	5.4	6.2	5.8	67	10/Dec/2022	26.17445867	79.78693033
NH27	1546650	1546550	D	R2	4.1	3.8	4	70	10/Dec/2022	26.17372209	79.7863558
NH27	1546550	1546450	D	R2	4.3	2.4	3.4	71	10/Dec/2022	26.17298403	79.78578294
NH27	1546450	1546350	D	R2	3.5	3.5	3.5	71	10/Dec/2022	26.17224612	79.78520906
NH27	1546350	1546250	D	R2	3.7	3.2	3.5	70	10/Dec/2022	26.17150878	79.78463399
NH27	1546250	1546150	D	R2	3	2.1	2.6	68	10/Dec/2022	26.17077127	79.78405886
NH27	1546150	1546050	D	R2	3	3.3	3.2	67	10/Dec/2022	26.17003194	79.78348656
NH27	1546050	1545950	D	R2	2.6	3.3	3	64	10/Dec/2022	26.16929404	79.78291151
NH27	1545950	1545850	D	R2	3.5	8.3	5.9	55	10/Dec/2022	26.16855417	79.78233839
NH27	1545850	1545750	D	R2	3.9	8.6	6.3	48	10/Dec/2022	26.16780781	79.78177608
NH27	1545750	1545650	D	R2	4.5	7	5.8	39	10/Dec/2022	26.16705023	79.78123346
NH27	1545650	1545550	D	R2	5.2	6.2	5.7	37	10/Dec/2022	26.16629039	79.78069579
NH27	1545550	1545450	D	R2	4.5	8.7	6.6	36	10/Dec/2022	26.16553142	79.78015703
NH27	1545450	1545350	D	R2	3.4	4.2	3.8	41	10/Dec/2022	26.16476958	79.77962487
NH27	1545350	1545250	D	R2	3.1	3	3.1	43	10/Dec/2022	26.16400942	79.77908878
NH27	1545250	1545150	D	R2	2.9	3.7	3.3	32	10/Dec/2022	26.16324795	79.77855231
NH27	1545150	1545050	D	R2	5.2	10.4	7.8	10	10/Dec/2022	26.16249977	79.77801924
NH27	1545050	1544950	D	R2	4.9	9	7	39	10/Dec/2022	26.16178034	79.77742366
NH27	1544950	1544850	D	R2	5.2	6.6	5.9	50	10/Dec/2022	26.16109723	79.77677573
NH27	1544850	1544750	D	R2	3.3	5.9	4.6	52	10/Dec/2022	26.16042059	79.77611747
NH27	1544750	1544650	D	R2	2.5	6.5	4.5	40	10/Dec/2022	26.15974484	79.77545433

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1544650	1544550	D	R2	5.1	5.4	5.3	37	10/Dec/2022	26.1590682	79.7747956
NH27	1544550	1544450	D	R2	3.8	4	3.9	52	10/Dec/2022	26.15838513	79.77414902
NH27	1544450	1544350	D	R2	3.7	5.3	4.5	55	10/Dec/2022	26.15771213	79.77348549
NH27	1544350	1544250	D	R2	3.1	4	3.6	54	10/Dec/2022	26.15704563	79.7728147
NH27	1544250	1544150	D	R2	2.7	4.2	3.5	58	10/Dec/2022	26.15635847	79.77216993
NH27	1544150	1544050	D	R2	3.3	4.9	4.1	51	10/Dec/2022	26.15568805	79.77149994
NH27	1544050	1543950	D	R2	3.7	6.7	5.2	58	10/Dec/2022	26.1549982	79.77085943
NH27	1543950	1543850	D	R2	3.2	4.9	4.1	63	10/Dec/2022	26.15432131	79.77020091
NH27	1543850	1543750	D	R2	3.8	9.9	6.9	65	10/Dec/2022	26.15364468	79.76954204
NH27	1543750	1543650	D	R2	3.6	9.9	6.8	61	10/Dec/2022	26.15296735	79.76888148
NH27	1543650	1543550	D	R2	2.4	5.1	3.8	52	10/Dec/2022	26.15228875	79.76822271
NH27	1543550	1543450	D	R2	3.8	6.1	5	58	10/Dec/2022	26.15160944	79.76756834
NH27	1543450	1543350	D	R2	3.8	8.8	6.3	63	10/Dec/2022	26.15093137	79.76691207
NH27	1543350	1543250	D	R2	4.5	7.1	5.8	67	10/Dec/2022	26.15025306	79.7662556
NH27	1543250	1543150	D	R2	4.3	4.6	4.5	69	10/Dec/2022	26.14957544	79.76559658
NH27	1543150	1543050	D	R2	2.7	4.3	3.5	69	10/Dec/2022	26.14889413	79.76494213
NH27	1543050	1542950	D	R2	2.9	3.6	3.3	69	10/Dec/2022	26.14821852	79.76428162
NH27	1542950	1542850	D	R2	5	7.3	6.2	64	10/Dec/2022	26.14753806	79.76362535
NH27	1542850	1542750	D	R2	3.1	4.1	3.6	59	10/Dec/2022	26.14686445	79.76296066
NH27	1542750	1542650	D	R2	4.4	3.9	4.2	63	10/Dec/2022	26.14614552	79.76236223
NH27	1542650	1542550	D	R2	2.7	4	3.4	65	10/Dec/2022	26.14537842	79.76184041
NH27	1542550	1542450	D	R2	2.4	2.5	2.5	63	10/Dec/2022	26.14457552	79.76138701
NH27	1542450	1542350	D	R2	2.2	3	2.6	54	10/Dec/2022	26.1437691	79.76093744
NH27	1542350	1542250	D	R2	3	5.2	4.1	57	10/Dec/2022	26.14296545	79.7604889
NH27	1542250	1542150	D	R2	3.4	6	4.7	60	10/Dec/2022	26.14215234	79.76005891
NH27	1542150	1542050	D	R2	3.9	5.6	4.8	54	10/Dec/2022	26.14134393	79.75961667
NH27	1542050	1541950	D	R2	4.2	5.4	4.8	50	10/Dec/2022	26.14053606	79.75917265
NH27	1541950	1541850	D	R2	3.2	5.2	4.2	53	10/Dec/2022	26.13973029	79.75872768
NH27	1541850	1541750	D	R2	5	5.7	5.4	56	10/Dec/2022	26.13891807	79.75829771
NH27	1541750	1541650	D	R2	5.5	5.5	5.5	55	10/Dec/2022	26.13811808	79.75784133
NH27	1541650	1541550	D	R2	4.4	5.2	4.8	60	10/Dec/2022	26.13730418	79.75741723
NH27	1541550	1541450	D	R2	3.7	4.5	4.1	62	10/Dec/2022	26.13649757	79.75697494
NH27	1541450	1541350	D	R2	4.4	4.8	4.6	63	10/Dec/2022	26.13568946	79.75653336
NH27	1541350	1541250	D	R2	8.4	9.9	9.2	49	10/Dec/2022	26.13487959	79.75609052
NH27	1541250	1541150	D	R2	10.1	9	9.6	55	10/Dec/2022	26.13407335	79.75564815
NH27	1541150	1541050	D	R2	8.5	10.3	9.4	59	10/Dec/2022	26.13326627	79.75520612
NH27	1541050	1540950	D	R2	11	8.8	9.9	60	10/Dec/2022	26.13245773	79.75476634
NH27	1540950	1540850	D	R2	10.9	8.7	9.8	57	10/Dec/2022	26.13164881	79.75432506
NH27	1540850	1540750	D	R2	9	9.1	9.1	57	10/Dec/2022	26.130842	79.75388093
NH27	1540750	1540650	D	R2	9.1	9.9	9.5	49	10/Dec/2022	26.13003593	79.75343233

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1540650	1540550	D	R2	3.6	4.3	4	55	10/Dec/2022	26.12922495	79.75300106
NH27	1540550	1540450	D	R2	4.1	2.5	3.3	45	10/Dec/2022	26.12841513	79.75256062
NH27	1540450	1540350	D	R2	2.6	3.9	3.3	55	10/Dec/2022	26.12760865	79.75211991
NH27	1540350	1540250	D	R2	3.5	3	3.3	56	10/Dec/2022	26.12680086	79.7516785
NH27	1540250	1540150	D	R2	5.1	3.9	4.5	48	10/Dec/2022	26.12603258	79.75116109
NH27	1540150	1540050	D	R2	12.1	7.5	9.8	12	10/Dec/2022	26.12528678	79.75060416
NH27	1540050	1539950	D	R2	5.2	8	6.6	43	10/Dec/2022	26.12447523	79.75018147
NH27	1539950	1539850	D	R2	7.7	5.7	6.7	53	10/Dec/2022	26.12372293	79.74963784
NH27	1539850	1539750	D	R2	6.9	2.7	4.8	61	10/Dec/2022	26.12300717	79.74903523
NH27	1539750	1539650	D	R2	6.6	5.4	6	65	10/Dec/2022	26.12231798	79.74839477
NH27	1539650	1539550	D	R2	4.1	2	3.1	55	10/Dec/2022	26.12168433	79.74768352
NH27	1539550	1539450	D	R2	2.2	3.5	2.9	57	10/Dec/2022	26.12113909	79.74689021
NH27	1539450	1539350	D	R2	4	4.4	4.2	51	10/Dec/2022	26.12072212	79.74600397
NH27	1539350	1539250	D	R2	2.7	4.6	3.7	59	10/Dec/2022	26.1202874	79.7451316
NH27	1539250	1539150	D	R2	3.6	3	3.3	58	10/Dec/2022	26.1198597	79.74425183
NH27	1539150	1539050	D	R2	6	4.7	5.4	56	10/Dec/2022	26.11935108	79.74342983
NH27	1539050	1538950	D	R2	7.2	3	5.1	50	10/Dec/2022	26.11867356	79.74277989
NH27	1538950	1538850	D	R2	6.6	5.4	6	34	10/Dec/2022	26.11791726	79.74223762
NH27	1538850	1538750	D	R2	7.2	3.8	5.5	51	10/Dec/2022	26.1171368	79.74174478
NH27	1538750	1538650	D	R2	8.8	5.9	7.4	55	10/Dec/2022	26.11636937	79.741224
NH27	1538650	1538550	D	R2	7.2	9.1	8.2	58	10/Dec/2022	26.11560199	79.74070234
NH27	1538550	1538450	D	R2	4.4	8.9	6.7	58	10/Dec/2022	26.11483552	79.74017848
NH27	1538450	1538350	D	R2	3.5	9.2	6.4	58	10/Dec/2022	26.11411934	79.73957521
NH27	1538350	1538250	D	R2	5.7	10.7	8.2	57	10/Dec/2022	26.11355734	79.73879775
NH27	1538250	1538150	D	R2	4.6	7.9	6.3	52	10/Dec/2022	26.11319901	79.73788426
NH27	1538150	1538050	D	R2	5.5	9	7.3	49	10/Dec/2022	26.11307789	79.73689809
NH27	1538050	1537950	D	R2	3.5	7.2	5.4	55	10/Dec/2022	26.11318975	79.73591019
NH27	1537950	1537850	D	R2	4	6.6	5.3	59	10/Dec/2022	26.11340543	79.73494208
NH27	1537850	1537750	D	R2	4	3.5	3.8	61	10/Dec/2022	26.11360255	79.73396928
NH27	1537750	1537650	D	R2	6.1	6.5	6.3	60	10/Dec/2022	26.11365335	79.73297636
NH27	1537650	1537550	D	R2	4	5.4	4.7	59	10/Dec/2022	26.11352807	79.7319902
NH27	1537550	1537450	D	R2	4.8	6.9	5.9	58	10/Dec/2022	26.11336479	79.73100935
NH27	1537450	1537350	D	R2	4.8	7.1	6	59	10/Dec/2022	26.11325621	79.7300195
NH27	1537350	1537250	D	R2	3.6	5.1	4.4	61	10/Dec/2022	26.1132009	79.72902409
NH27	1537250	1537150	D	R2	3.9	4.5	4.2	59	10/Dec/2022	26.11314389	79.72802804
NH27	1537150	1537050	D	R2	3.9	4.9	4.4	54	10/Dec/2022	26.11304904	79.72703594
NH27	1537050	1536950	D	R2	3.4	5	4.2	58	10/Dec/2022	26.11278892	79.72608369
NH27	1536950	1536850	D	R2	4.8	7.6	6.2	62	10/Dec/2022	26.11236635	79.72520615
NH27	1536850	1536750	D	R2	5.3	8.8	7.1	64	10/Dec/2022	26.11185907	79.72438185
NH27	1536750	1536650	D	R2	4.9	8.6	6.8	65	10/Dec/2022	26.11134673	79.72356088

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1536650	1536550	D	R2	4.8	7.4	6.1	66	10/Dec/2022	26.11083389	79.72274
NH27	1536550	1536450	D	R2	4	8.9	6.5	67	10/Dec/2022	26.11032262	79.72191787
NH27	1536450	1536350	D	R2	4.1	8.8	6.5	67	10/Dec/2022	26.10981145	79.72109558
NH27	1536350	1536250	D	R2	5.8	8.3	7.1	68	10/Dec/2022	26.10929698	79.72027569
NH27	1536250	1536150	D	R2	6.4	7.1	6.8	66	10/Dec/2022	26.1087765	79.71946147
NH27	1536150	1536050	D	R2	6.1	8.2	7.2	64	10/Dec/2022	26.10822274	79.7186746
NH27	1536050	1535950	D	R2	6.2	7.7	7	63	10/Dec/2022	26.10769221	79.71786851
NH27	1535950	1535850	D	R2	5.3	6.5	5.9	64	10/Dec/2022	26.10720111	79.71703243
NH27	1535850	1535750	D	R2	5.2	6.9	6.1	65	10/Dec/2022	26.10671304	79.71619284
NH27	1535750	1535650	D	R2	4.8	8.7	6.8	63	10/Dec/2022	26.10622439	79.71535294
NH27	1535650	1535550	D	R2	4.6	7.8	6.2	64	10/Dec/2022	26.10571973	79.71452653
NH27	1535550	1535450	D	R2	4.2	6.3	5.3	62	10/Dec/2022	26.10517566	79.7137301
NH27	1535450	1535350	D	R2	3.8	4.7	4.3	62	10/Dec/2022	26.10462055	79.71294527
NH27	1535350	1535250	D	R2	3.9	9.2	6.6	62	10/Dec/2022	26.10406123	79.71216354
NH27	1535250	1535150	D	R2	4.6	8.7	6.7	63	10/Dec/2022	26.10350557	79.71137864
NH27	1535150	1535050	D	R2	4.6	7	5.8	64	10/Dec/2022	26.10294852	79.71059424
NH27	1535050	1534950	D	R2	4.2	6.2	5.2	64	10/Dec/2022	26.10239688	79.70980515
NH27	1534950	1534850	D	R2	4.4	5.9	5.2	64	10/Dec/2022	26.10184191	79.70901875
NH27	1534850	1534750	D	R2	4.5	7.9	6.2	64	10/Dec/2022	26.10128801	79.70823153
NH27	1534750	1534650	D	R2	4.5	9.3	6.9	62	10/Dec/2022	26.10073156	79.70744535
NH27	1534650	1534550	D	R2	5	11.5	8.3	59	10/Dec/2022	26.10017998	79.70665516
NH27	1534550	1534450	D	R2	4.8	11.5	8.2	61	10/Dec/2022	26.09961567	79.70586446
NH27	1534450	1534350	D	R2	4.6	11	7.8	38	10/Dec/2022	26.09906825	79.70506841
NH27	1534350	1534250	D	R2	4.4	5.7	5.1	46	10/Dec/2022	26.09850647	79.70428901
NH27	1534250	1534150	D	R2	3.8	6.2	5	41	10/Dec/2022	26.09797951	79.70347895
NH27	1534150	1534050	D	R2	5	11.8	8.4	46	10/Dec/2022	26.09742325	79.70269512
NH27	1534050	1533950	D	R2	3.6	7.4	5.5	54	10/Dec/2022	26.09687321	79.70190738
NH27	1533950	1533850	D	R2	2.9	9.9	6.4	61	10/Dec/2022	26.09633135	79.70111186
NH27	1533850	1533750	D	R2	2.9	3.7	3.3	63	10/Dec/2022	26.09579179	79.7003132
NH27	1533750	1533650	D	R2	4.4	8.2	6.3	65	10/Dec/2022	26.0952544	79.69951305
NH27	1533650	1533550	D	R2	4.7	8.7	6.7	65	10/Dec/2022	26.09470883	79.69871869
NH27	1533550	1533450	D	R2	5.6	11.5	8.6	65	10/Dec/2022	26.09416823	79.69792023
NH27	1533450	1533350	D	R2	3.7	9.9	6.8	65	10/Dec/2022	26.09363282	79.69711756
NH27	1533350	1533250	D	R2	4	7.5	5.8	65	10/Dec/2022	26.09311313	79.69630208
NH27	1533250	1533150	D	R2	3.8	12	7.9	66	10/Dec/2022	26.09260515	79.69547755
NH27	1533150	1533050	D	R2	3.7	11.4	7.6	66	10/Dec/2022	26.09212076	79.69463559
NH27	1533050	1532950	D	R2	4.3	11	7.7	65	10/Dec/2022	26.09164823	79.69378554
NH27	1532950	1532850	D	R2	3.9	11.8	7.9	65	10/Dec/2022	26.0911943	79.69292291
NH27	1532850	1532750	D	R2	3.6	9	6.3	65	10/Dec/2022	26.09076079	79.69204773
NH27	1532750	1532650	D	R2	2.6	9.1	5.9	65	10/Dec/2022	26.09034461	79.69116222

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1532650	1532550	D	R2	3	6.2	4.6	64	10/Dec/2022	26.08993722	79.69027127
NH27	1532550	1532450	D	R2	2.9	4.4	3.7	24	10/Dec/2022	26.08952689	79.68937138
NH27	1532450	1532350	D	R2	3.3	7	5.2	24	10/Dec/2022	26.08912101	79.68847938
NH27	1532350	1532250	D	R2	6.3	7.9	7.1	24	10/Dec/2022	26.08871513	79.68758737
NH27	1532250	1532150	D	R2	5.5	9.1	7.3	24	10/Dec/2022	26.08830925	79.68669537
NH27	1532150	1532050	D	R2	2.6	10.2	6.4	40	10/Dec/2022	26.08792402	79.6858368
NH27	1532050	1531950	D	R2	2	7.5	4.8	44	10/Dec/2022	26.08751879	79.68494648
NH27	1531950	1531850	D	R2	2.2	9.1	5.7	48	10/Dec/2022	26.08711367	79.68405638
NH27	1531850	1531750	D	R2	1.7	10.9	6.3	52	10/Dec/2022	26.08671167	79.68316464
NH27	1531750	1531650	D	R2	1.5	10.1	5.8	55	10/Dec/2022	26.08630792	79.68227355
NH27	1531650	1531550	D	R2	2.5	8	5.3	56	10/Dec/2022	26.08590305	79.68138263
NH27	1531550	1531450	D	R2	3.7	6.7	5.2	57	10/Dec/2022	26.08549737	79.68049175
NH27	1531450	1531350	D	R2	6.2	6.3	6.3	56	10/Dec/2022	26.08508964	79.67960206
NH27	1531350	1531250	D	R2	3.2	4.8	4	54	10/Dec/2022	26.08468438	79.67871044
NH27	1531250	1531150	D	R2	3.3	8.3	5.8	54	10/Dec/2022	26.08428118	79.67781827
NH27	1531150	1531050	D	R2	3.7	13.8	8.8	54	10/Dec/2022	26.08387198	79.67692923
NH27	1531050	1530950	D	R2	5.6	12.1	8.9	52	10/Dec/2022	26.0834699	79.67603611
NH27	1530950	1530850	D	R2	5.1	7.9	6.5	52	10/Dec/2022	26.08306108	79.67514697
NH27	1530850	1530750	D	R2	3.4	3.9	3.7	52	10/Dec/2022	26.08266034	79.67425386
NH27	1530750	1530650	D	R2	2.8	4.9	3.9	52	10/Dec/2022	26.08225993	79.67336005
NH27	1530650	1530550	D	R2	3.7	13.3	8.5	52	10/Dec/2022	26.08185437	79.67247077
NH27	1530550	1530450	D	R2	3.1	12.2	7.7	53	10/Dec/2022	26.08144403	79.67158266
NH27	1530450	1530350	D	R2	5.7	10.7	8.2	53	10/Dec/2022	26.08103893	79.67069141
NH27	1530350	1530250	D	R2	5.3	12.4	8.9	52	10/Dec/2022	26.08062944	79.66980269
NH27	1530250	1530150	D	R2	5.5	5.9	5.7	53	10/Dec/2022	26.08021124	79.66891918
NH27	1530150	1530050	D	R2	3.4	4.9	4.2	54	10/Dec/2022	26.07980755	79.66802769
NH27	1530050	1529950	D	R2	4.8	6.6	5.7	56	10/Dec/2022	26.079375	79.66715306
NH27	1529950	1529850	D	R2	6.3	8.9	7.6	57	10/Dec/2022	26.07895737	79.66626903
NH27	1529850	1529750	D	R2	5.4	8.7	7.1	58	10/Dec/2022	26.07853787	79.66538633
NH27	1529750	1529650	D	R2	4.3	7.4	5.9	58	10/Dec/2022	26.07811791	79.66450366
NH27	1529650	1529550	D	R2	5.2	8.5	6.9	58	10/Dec/2022	26.07770216	79.66361868
NH27	1529550	1529450	D	R2	2.8	7.4	5.1	57	10/Dec/2022	26.07728529	79.66273404
NH27	1529450	1529350	D	R2	8.3	8.5	8.4	57	10/Dec/2022	26.07686985	79.66184869
NH27	1529350	1529250	D	R2	7.7	8.2	8	58	10/Dec/2022	26.07645312	79.66096418
NH27	1529250	1529150	D	R2	3.4	8.3	5.9	59	10/Dec/2022	26.07603497	79.6600811
NH27	1529150	1529050	D	R2	3.4	3.9	3.7	61	10/Dec/2022	26.07561572	79.65919855
NH27	1529050	1528950	D	R2	3.2	4.8	4	62	10/Dec/2022	26.0751978	79.6583149
NH27	1528950	1528850	D	R2	3.9	9.4	6.7	61	10/Dec/2022	26.07478059	79.65743038
NH27	1528850	1528750	D	R2	4.9	7.5	6.2	61	10/Dec/2022	26.07436517	79.65654536
NH27	1528750	1528650	D	R2	3.4	7.5	5.5	61	10/Dec/2022	26.07393669	79.65566759

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1528650	1528550	D	R2	3.1	7.6	5.4	61	10/Dec/2022	26.07352445	79.65478071
NH27	1528550	1528450	D	R2	3.7	5.3	4.5	60	10/Dec/2022	26.07309789	79.65390188
NH27	1528450	1528350	D	R2	2.8	4.5	3.7	60	10/Dec/2022	26.07266825	79.65302497
NH27	1528350	1528250	D	R2	2.9	5.6	4.3	61	10/Dec/2022	26.07223419	79.65215107
NH27	1528250	1528150	D	R2	4.7	7.6	6.2	61	10/Dec/2022	26.07179843	79.65127757
NH27	1528150	1528050	D	R2	4	5.2	4.6	60	10/Dec/2022	26.07136296	79.65040394
NH27	1528050	1527950	D	R2	3	4.4	3.7	59	10/Dec/2022	26.07092633	79.64953097
NH27	1527950	1527850	D	R2	4.5	6.6	5.6	60	10/Dec/2022	26.07049501	79.64865491
NH27	1527850	1527750	D	R2	5.5	9.1	7.3	60	10/Dec/2022	26.07006003	79.64778115
NH27	1527750	1527650	D	R2	4	6.3	5.2	61	10/Dec/2022	26.069625	79.64690787
NH27	1527650	1527550	D	R2	2.5	6.5	4.5	61	10/Dec/2022	26.06918937	79.64603462
NH27	1527550	1527450	D	R2	3.8	7.2	5.5	60	10/Dec/2022	26.06875545	79.64515985
NH27	1527450	1527350	D	R2	3.4	8.4	5.9	60	10/Dec/2022	26.06832063	79.64428592
NH27	1527350	1527250	D	R2	3.1	5	4.1	59	10/Dec/2022	26.06788385	79.64341299
NH27	1527250	1527150	D	R2	3.9	8.7	6.3	59	10/Dec/2022	26.06745016	79.64253846
NH27	1527150	1527050	D	R2	3.6	8.2	5.9	60	10/Dec/2022	26.06701474	79.64166517
NH27	1527050	1526950	D	R2	4	5.3	4.7	60	10/Dec/2022	26.06658074	79.64079098
NH27	1526950	1526850	D	R2	2.1	8.9	5.5	62	10/Dec/2022	26.06614572	79.6399176
NH27	1526850	1526750	D	R2	3.7	5.4	4.6	63	10/Dec/2022	26.06571142	79.63904352
NH27	1526750	1526650	D	R2	3.9	9.9	6.9	65	10/Dec/2022	26.06527631	79.63817055
NH27	1526650	1526550	D	R2	2.6	7	4.8	66	10/Dec/2022	26.06484141	79.63729705
NH27	1526550	1526450	D	R2	4	6.7	5.4	66	10/Dec/2022	26.06440369	79.63642509
NH27	1526450	1526350	D	R2	2.6	7.7	5.2	66	10/Dec/2022	26.0639709	79.63555028
NH27	1526350	1526250	D	R2	2.7	6.3	4.5	67	10/Dec/2022	26.06353527	79.63467715
NH27	1526250	1526150	D	R2	2.7	5.1	3.9	67	10/Dec/2022	26.06310167	79.63380279
NH27	1526150	1526050	D	R2	6	9.4	7.7	67	10/Dec/2022	26.06266221	79.63293172
NH27	1526050	1525950	D	R2	2.3	5.2	3.8	67	10/Dec/2022	26.06222566	79.6320589
NH27	1525950	1525850	D	R2	4.3	7.5	5.9	66	10/Dec/2022	26.06178816	79.63118664
NH27	1525850	1525750	D	R2	3.1	7.7	5.4	65	10/Dec/2022	26.06134863	79.63031545
NH27	1525750	1525650	D	R2	2.2	6.1	4.2	64	10/Dec/2022	26.06091103	79.62944342
NH27	1525650	1525550	D	R2	6.1	9.3	7.7	64	10/Dec/2022	26.0604711	79.6285726
NH27	1525550	1525450	D	R2	2.2	5.3	3.8	63	10/Dec/2022	26.06003181	79.6277012
NH27	1525450	1525350	D	R2	2.2	7.1	4.7	63	10/Dec/2022	26.05959213	79.62682996
NH27	1525350	1525250	D	R2	3.4	5.1	4.3	61	10/Dec/2022	26.05918015	79.62594181
NH27	1525250	1525150	D	R2	2.1	8	5.1	65	10/Dec/2022	26.05872455	79.62508265
NH27	1525150	1525050	D	R2	3.4	5.9	4.7	66	10/Dec/2022	26.05827782	79.62421598
NH27	1525050	1524950	D	R2	7.8	8	7.9	66	10/Dec/2022	26.05784078	79.62334337
NH27	1524950	1524850	D	R2	4	5.2	4.6	66	10/Dec/2022	26.05740267	79.62247127
NH27	1524850	1524750	D	R2	2.6	6.3	4.5	65	10/Dec/2022	26.05696418	79.6215994
NH27	1524750	1524650	D	R2	2	6.6	4.3	65	10/Dec/2022	26.05652445	79.62072827

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1524650	1524550	D	R2	2.1	7.9	5	65	10/Dec/2022	26.0560845	79.61985738
NH27	1524550	1524450	D	R2	3.4	5.2	4.3	65	10/Dec/2022	26.05565041	79.61898313
NH27	1524450	1524350	D	R2	2.5	9	5.8	65	10/Dec/2022	26.05524369	79.61809231
NH27	1524350	1524250	D	R2	6.1	6	6.1	61	10/Dec/2022	26.05487645	79.61717949
NH27	1524250	1524150	D	R2	2	8.9	5.5	56	10/Dec/2022	26.05455174	79.61624799
NH27	1524150	1524050	D	R2	2.3	7.4	4.9	60	10/Dec/2022	26.05423228	79.61531574
NH27	1524050	1523950	D	R2	2.3	9.7	6	62	10/Dec/2022	26.05392218	79.61437942
NH27	1523950	1523850	D	R2	2.8	9.2	6	64	10/Dec/2022	26.05358401	79.61345583
NH27	1523850	1523750	D	R2	3	10	6.5	65	10/Dec/2022	26.05316285	79.61257502
NH27	1523750	1523650	D	R2	5.2	9	7.1	65	10/Dec/2022	26.05266344	79.61174507
NH27	1523650	1523550	D	R2	3.2	9.8	6.5	65	10/Dec/2022	26.05214792	79.61092652
NH27	1523550	1523450	D	R2	5	7.8	6.4	66	10/Dec/2022	26.05163133	79.61010886
NH27	1523450	1523350	D	R2	2.8	5.8	4.3	66	10/Dec/2022	26.05111568	79.60929043
NH27	1523350	1523250	D	R2	4.6	9.3	7	65	10/Dec/2022	26.05059941	79.60847225
NH27	1523250	1523150	D	R2	1.4	9.9	5.7	65	10/Dec/2022	26.05008046	79.60765642
NH27	1523150	1523050	D	R2	2	6.2	4.1	65	10/Dec/2022	26.0495638	79.60683917
NH27	1523050	1522950	D	R2	1.7	7.5	4.6	66	10/Dec/2022	26.04904562	79.60602298
NH27	1522950	1522850	D	R2	3	6	4.5	66	10/Dec/2022	26.04852856	79.60520585
NH27	1522850	1522750	D	R2	4.3	7.6	6	66	10/Dec/2022	26.04802294	79.60437972
NH27	1522750	1522650	D	R2	5.2	6.3	5.7	66	10/Dec/2022	26.04754309	79.60353499
NH27	1522650	1522550	D	R2	7.2	8.8	8	62	10/Dec/2022	26.0470616	79.60269034
NH27	1522550	1522450	D	R2	6.6	9.5	8.1	52	10/Dec/2022	26.04658536	79.60184088
NH27	1522450	1522350	D	R2	5.4	9	7.2	9	10/Dec/2022	26.04608988	79.60100417
NH27	1522350	1522250	D	R2	4.8	5.7	5.3	38	10/Dec/2022	26.04563454	79.60014718
NH27	1522250	1522150	D	R2	4.8	6.3	5.6	53	10/Dec/2022	26.04517146	79.59929443
NH27	1522150	1522050	D	R2	5.8	9.1	7.5	48	10/Dec/2022	26.04469453	79.59844675
NH27	1522050	1521950	D	R2	4.1	8.5	6.3	49	10/Dec/2022	26.04421294	79.59759148
NH27	1521950	1521850	D	R2	4.5	7.5	6	52	10/Dec/2022	26.04375638	79.59673182
NH27	1521850	1521750	D	R2	2.1	8	5.1	55	10/Dec/2022	26.0433272	79.59585521
NH27	1521750	1521650	D	R2	2.6	8.5	5.6	61	10/Dec/2022	26.04292887	79.59496206
NH27	1521650	1521550	D	R2	2.9	9.9	6.4	62	10/Dec/2022	26.04255892	79.59405243
NH27	1521550	1521450	D	R2	2.5	7.8	5.2	60	10/Dec/2022	26.04221067	79.59313164
NH27	1521450	1521350	D	R2	3.5	8.8	6.2	60	10/Dec/2022	26.04186154	79.59221205
NH27	1521350	1521250	D	R2	5.8	9.6	7.7	62	10/Dec/2022	26.04151399	79.59129246
NH27	1521250	1521150	D	R2	2.8	7.3	5.1	64	10/Dec/2022	26.04116401	79.5903732
NH27	1521150	1521050	D	R2	3.5	6.9	5.2	65	10/Dec/2022	26.04081913	79.58945134
NH27	1521050	1520950	D	R2	2.4	8.7	5.6	65	10/Dec/2022	26.04046839	79.58853196
NH27	1520950	1520850	D	R2	3	9.5	6.3	65	10/Dec/2022	26.04011882	79.58761231
NH27	1520850	1520750	D	R2	5.3	5.4	5.4	65	10/Dec/2022	26.0397719	79.58669108
NH27	1520750	1520650	D	R2	4.4	6.9	5.7	61	10/Dec/2022	26.03942804	79.58576769

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1520650	1520550	D	R2	2.2	7.3	4.8	66	10/Dec/2022	26.03909041	79.58484423
NH27	1520550	1520450	D	R2	2.9	5.9	4.4	69	10/Dec/2022	26.0387326	79.58392931
NH27	1520450	1520350	D	R2	3.5	6.2	4.9	69	10/Dec/2022	26.03837957	79.58301132
NH27	1520350	1520250	D	R2	3.1	5.1	4.1	69	10/Dec/2022	26.03803235	79.58208987
NH27	1520250	1520150	D	R2	6.7	5.1	5.9	65	10/Dec/2022	26.03769865	79.58116193
NH27	1520150	1520050	D	R2	5.2	5.8	5.5	60	10/Dec/2022	26.03736196	79.58023496
NH27	1520050	1519950	D	R2	3.8	5.5	4.7	56	10/Dec/2022	26.03700855	79.57931606
NH27	1519950	1519850	D	R2	5.4	7.5	6.5	22	10/Dec/2022	26.03664378	79.57840042
NH27	1519850	1519750	D	R2	2.6	4.6	3.6	32	10/Dec/2022	26.03633378	79.5774659
NH27	1519750	1519650	D	R2	2.5	6.9	4.7	46	10/Dec/2022	26.0360188	79.57653422
NH27	1519650	1519550	D	R2	2.9	9.4	6.2	57	10/Dec/2022	26.03569281	79.57560678
NH27	1519550	1519450	D	R2	3.3	9.5	6.4	64	10/Dec/2022	26.0353581	79.57468295
NH27	1519450	1519350	D	R2	4.6	11.2	7.9	66	10/Dec/2022	26.03502404	79.57375673
NH27	1519350	1519250	D	R2	3.5	8.9	6.2	69	10/Dec/2022	26.03468841	79.57283175
NH27	1519250	1519150	D	R2	3.8	11	7.4	71	10/Dec/2022	26.03435464	79.57190555
NH27	1519150	1519050	D	R2	3.2	9.3	6.3	72	10/Dec/2022	26.03402192	79.57097893
NH27	1519050	1518950	D	R2	3.3	5.6	4.5	73	10/Dec/2022	26.03368538	79.57005351
NH27	1518950	1518850	D	R2	2.6	4.9	3.8	73	10/Dec/2022	26.0333523	79.56912638
NH27	1518850	1518750	D	R2	3.2	6.5	4.9	72	10/Dec/2022	26.03301741	79.56820001
NH27	1518750	1518650	D	R2	3.5	8.6	6.1	72	10/Dec/2022	26.03268209	79.56727346
NH27	1518650	1518550	D	R2	3.6	12.8	8.2	71	10/Dec/2022	26.0323496	79.5663458
NH27	1518550	1518450	D	R2	8.2	8.1	8.2	71	10/Dec/2022	26.03201452	79.56541934
NH27	1518450	1518350	D	R2	5.2	8.2	6.7	71	10/Dec/2022	26.03167332	79.56449592
NH27	1518350	1518250	D	R2	1.9	9.2	5.6	71	10/Dec/2022	26.03133536	79.56357062
NH27	1518250	1518150	D	R2	1.6	9	5.3	73	10/Dec/2022	26.03099433	79.56264687
NH27	1518150	1518050	D	R2	3	8.9	6	75	10/Dec/2022	26.03065137	79.56172393
NH27	1518050	1517950	D	R2	3.4	5.9	4.7	75	10/Dec/2022	26.03030982	79.56079973
NH27	1517950	1517850	D	R2	3	5.1	4.1	73	10/Dec/2022	26.02996724	79.55987611
NH27	1517850	1517750	D	R2	4.1	5.7	4.9	69	10/Dec/2022	26.02962139	79.5589531
NH27	1517750	1517650	D	R2	3.8	8.1	6	64	10/Dec/2022	26.0292947	79.55802175
NH27	1517650	1517550	D	R2	3.5	5.2	4.4	64	10/Dec/2022	26.02897097	79.5570909
NH27	1517550	1517450	D	R2	6.3	6.9	6.6	54	10/Dec/2022	26.02865223	79.55615603
NH27	1517450	1517350	D	R2	3.9	8	6	51	10/Dec/2022	26.02833128	79.55522341
NH27	1517350	1517250	D	R2	3.6	9	6.3	60	10/Dec/2022	26.02798628	79.55430492
NH27	1517250	1517150	D	R2	3.1	7.7	5.4	63	10/Dec/2022	26.02766214	79.55337633
NH27	1517150	1517050	D	R2	3	5.1	4.1	65	10/Dec/2022	26.02730432	79.55246257
NH27	1517050	1516950	D	R2	6.6	8.8	7.7	65	10/Dec/2022	26.02696357	79.5515403
NH27	1516950	1516850	D	R2	4.9	8.4	6.7	69	10/Dec/2022	26.0266206	79.55061892
NH27	1516850	1516750	D	R2	3	4.4	3.7	71	10/Dec/2022	26.02627844	79.54969623
NH27	1516750	1516650	D	R2	3.7	6.8	5.3	71	10/Dec/2022	26.02593714	79.54877268

NH Number	Start Chainage	End Chainage	Direction	Lane Number	Rutting Left	Rutting Right	Rutting Avg	Speed	Survey Date	Latitude	Longitude
NH27	1516650	1516550	D	R2	6.8	10.2	8.5	70	10/Dec/2022	26.02559438	79.54784973
NH27	1516550	1516450	D	R2	7.6	11.5	9.6	70	10/Dec/2022	26.02525284	79.54692612
NH27	1516450	1516350	D	R2	5	8	6.5	69	10/Dec/2022	26.02491245	79.54600212
NH27	1516350	1516250	D	R2	5	9.1	7.1	68	10/Dec/2022	26.02457765	79.54507553
NH27	1516250	1516150	D	R2	3.9	9.2	6.6	67	10/Dec/2022	26.02424006	79.54415024
NH27	1516150	1516050	D	R2	3.7	8.9	6.3	67	10/Dec/2022	26.02390226	79.54322557
NH27	1516050	1515950	D	R2	4.5	9.2	6.9	63	10/Dec/2022	26.0235674	79.54229777
NH27	1515950	1515850	D	R2	3.7	8.5	6.1	57	10/Dec/2022	26.02323558	79.54136833
NH27	1515850	1515750	D	R2	4.4	9.4	6.9	48	10/Dec/2022	26.02290099	79.54043977
NH27	1515750	1515713	D	R2	4.1	5.6	4.9	28	10/Dec/2022	26.02256563	79.53951195

Annexure – 4.5

Axle Load Data Analysis

AXLE LOAD SURVEY DATA & VDF ANALYSIS

Road Name:	NH-27_Axle Load_Ukasa Toll Plaza_Km 1520+000	**Location:**	1520+000
Direction:	Both The Directions	**Date:**	02 December 2022

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
14	Orai-Kanpur	UP92T9231	Jasi	Kanpur	Bus	1.2	Passengers	Yes	2880	3960					0.869	0.971			0.571	0.890			1.461	
25	Orai-Kanpur	UP780072	Surat	Kanpur	Bus	1.2	Passengers	Yes	3010	4510					0.909	1.106			0.681	1.497			2.178	
29	Orai-Kanpur	UP226406	Orai	Kadaura	Bus	1.2	Passengers	Yes	2560	3490					0.773	0.856			0.357	0.537			0.893	
32	Orai-Kanpur	UP789291	Ahmedabad	Kanpur	Bus	1.2	Passengers	Yes	2810	3250					0.848	0.797			0.518	0.404			0.921	
54	Orai-Kanpur	UP920185	Orai	Aata	Bus	1.2	Passengers	Yes	2860	3210					0.863	0.787			0.555	0.384			0.939	
67	Orai-Kanpur	UP89467	Gujarat	Kanpur	Bus	1.2	Passengers	Yes	2260	3210					0.682	0.787			0.217	0.384			0.601	
87	Orai-Kanpur	UP93BT8227	Jhansi	Lucknow	Bus	1.2	Passengers	Yes	2580	3560					0.779	0.873			0.368	0.581			0.949	
131	Orai-Kanpur	UP787398	Gujarat	Kanpur	Bus	1.2	Passengers	Yes	2680	3870					0.809	0.949			0.428	0.811			1.240	
135	Orai-Kanpur	MP078988	Indore	Kanpur	Bus	1.2	Passengers	Yes	2410	4440					0.727	1.089			0.280	1.406			1.686	**1.451**
170	Orai-Kanpur	RJ055377	Gujarat	Kanpur	Bus	1.2	Passengers	Yes	3210	4710					0.969	1.155			0.881	1.780			2.662	
201	Orai-Kanpur	UP781785	Orai	Kanpur	Bus	1.2	Passengers	Yes	2660	4290					0.803	1.052			0.416	1.225			1.641	
236	Orai-Kanpur	UP92T8504	Jhansi	Lucknow	Bus	1.2	Passengers	Yes	2880	3960					0.869	0.971			0.571	0.890			1.461	
246	Orai-Kanpur	UP934115	Jhansi	Kanpur	Bus	1.2	Passengers	Yes	2970	4385					0.896	1.075			0.646	1.338			1.983	
305	Orai-Kanpur	UP936312	Jasi	Lucknow	Bus	1.2	Passengers	Yes	2450	4280					0.740	1.050			0.299	1.214			1.513	
353	Orai-Kanpur	UP930058	Orai	Kanpur	Bus	1.2	Passengers	Yes	2710	4290					0.818	1.052			0.448	1.225			1.673	
380	Orai-Kanpur	UP831276	Jhansi	Kanpur	Bus	1.2	Passengers	Yes	2570	4050					0.776	0.993			0.362	0.973			1.335	
405	Orai-Kanpur	UP926036	Orai	Kanpur	Bus	1.2	Passengers	Yes	2960	3960					0.893	0.971			0.637	0.890			1.527	
4	Orai-Kanpur	UP77A0867	Orai	Kanpur	LCV	1.2	Pipe	Yes	3170	5450					0.957	1.337			0.838	3.192			4.030	
5	Orai-Kanpur	UP78DT4436	Orai	Kanpur	LCV	1.2	Pipe	Yes	3275	5140					0.989	1.261			0.955	2.525			3.480	
6	Orai-Kanpur	UP36DT9041	Orai	Kanpur	LCV	1.2	Parcel	Yes	3035	4985					0.916	1.223			0.704	2.234			2.938	
9	Orai-Kanpur	UP03ST7037	Indore	Bihar	LCV	1.2	Parcel	Yes	3540	5210					1.069	1.278			1.304	2.665			3.969	
22	Orai-Kanpur	MH481592	Mumbai	Guwahati	LCV	1.2	Machine Parts	Yes	4010	5275					1.210	1.294			2.146	2.801			4.947	
27	Orai-Kanpur	RJ082756	Delhi	Patna	LCV	1.2	Empty	Yes	2202	1610					0.665	0.395			0.195	0.024			0.219	
34	Orai-Kanpur	UP32KN0741	Jhansi	Kanpur	LCV	1.2	Empty	Yes	2210	2010					0.667	0.493			0.198	0.059			0.257	
35	Orai-Kanpur	GJ167504	Gujarat	Varanasi	LCV	1.2	Salt	Yes	2490	3890					0.752	0.954			0.319	0.828			1.147	
43	Orai-Kanpur	UP516801	Jasi	Gorakhpur	LCV	1.2	Empty	Yes	1972	1850					0.595	0.454			0.126	0.042			0.168	
50	Orai-Kanpur	UP923230	Guna	Gorakhpur	LCV	1.2	Food	Yes	2600	5290					0.785	1.297			0.379	2.833			3.212	
52	Orai-Kanpur	UP923859	Jasi	Kanpur	LCV	1.2	Ground nuts	Yes	2690	5290					0.812	1.297			0.435	2.833			3.268	
60	Orai-Kanpur	UP3L6677	Orai	Lucknow	LCV	1.2	Sand	Yes	3940	5240					1.189	1.285			2.000	2.727			4.728	
92	Orai-Kanpur	MP332263	Shivpuri	Kanpur	LCV	1.2	Food	Yes	3290	5390					0.993	1.322			0.973	3.053			4.026	
94	Orai-Kanpur	DL7CA5896	Ujjain	Raebareli	LCV	1.2	Pipe	No	4040	2565					1.219	0.629			2.211	0.157			2.368	**2.574**
101	Orai-Kanpur	NL016628	Jasi	Kanpur	LCV	1.2	Empty	No	2210	2130					0.667	0.522			0.198	0.074			0.272	
138	Orai-Kanpur	GJ064753	Gujarat	Kanpur	LCV	1.2	Pipe	Yes	3810	6060					1.150	1.486			1.749	4.879			6.628	
148	Orai-Kanpur	MP331368	Mumbai	Kanpur	LCV	1.2	Parcel	Yes	3690	5810					1.114	1.425			1.539	4.122			5.661	
153	Orai-Kanpur	UP922504	Jhansi	Barabanki	LCV	1.2	Empty	Yes	2210	1910					0.667	0.468			0.198	0.048			0.246	
162	Orai-Kanpur	UP587814	Jhansi	Barabanki	LCV	1.2	Empty	Yes	2460	2310					0.743	0.567			0.304	0.103			0.407	
164	Orai-Kanpur	UP935378	Jhansi	Kanpur	LCV	1.2	Empty	Yes	2290	2010					0.691	0.493			0.228	0.059			0.287	
168	Orai-Kanpur	UP932255	Gujarat	Lucknow	LCV	1.2	Empty	Yes	2210	1910					0.667	0.468			0.198	0.048			0.246	
181	Orai-Kanpur	RJ111295	Bhusawal	Kanpur	LCV	1.2	Banana	Yes	3210	5210					0.969	1.278			0.881	2.665			3.547	
190	Orai-Kanpur	UP21AT8997	Pune	Kanpur	LCV	1.2	Groceries	Yes	3781	5820					1.141	1.427			1.696	4.151			5.847	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
219	Orai-Kanpur	UP783610	Orai	Basti	LCV	1.2	Empty	Yes	1910	1960					0.577	0.481			0.110	0.053			0.164	
346	Orai-Kanpur	OD936137	Jhansi	Bihar	LCV	1.2	Parcel	Yes	3310	5610					0.999	1.376			0.996	3.583			4.580	
351	Orai-Kanpur	UP780148	Jhansi	Lucknow	LCV	1.2	Parcel	Yes	3810	5490					1.150	1.346			1.749	3.286			5.035	
382	Orai-Kanpur	UP779712	Orai	Kanpur	LCV	1.1	Empty	Yes	2040	1820					0.616	0.549			0.144	0.091			0.235	
386	Orai-Kanpur	MH44866	Indore	Kanpur	LCV	1.2	Empty	No	1980	1700					0.598	0.417			0.128	0.030			0.158	
1	Orai-Kanpur	HR55M5606	Jhansi	Lucknow	2Axle	1.2	Parcel	Yes	2900	5280					0.875	1.295			0.587	2.812			3.399	
33	Orai-Kanpur	GJ255943	Gujarat	Kolkata	2Axle	1.2	Fish	Yes	3190	5610					0.963	1.376			0.860	3.583			4.443	
37	Orai-Kanpur	HR556764	Ahmedabad	Kanpur	2Axle	1.2	Salt	Yes	2610	5160					0.788	1.265			0.385	2.565			2.950	
41	Orai-Kanpur	GJ034183	Indore	Lakhimpur	2Axle	1.2	Empty	Yes	2290	1890					0.691	0.464			0.228	0.046			0.274	
47	Orai-Kanpur	RJ194878	Indore	Gorakhpur	2Axle	1.2	Parcel	Yes	3090	5290					0.933	1.297			0.757	2.833			3.590	
53	Orai-Kanpur	GJ064536	Gujarat	Bihar	2Axle	1.2	Chemical	Yes	3210	5915					0.969	1.451			0.881	4.428			5.310	
74	Orai-Kanpur	UP78FN4336	Jhansi	Kanpur	2Axle	1.2	Onion	Yes	3840	5160					1.159	1.265			1.805	2.565			4.369	
86	Orai-Kanpur	MH25MK9347	Jhansi	Kanpur	2Axle	1.2	Paper	Yes	3310	6140					0.999	1.506			0.996	5.142			6.138	
88	Orai-Kanpur	UP30T9533	Indore	Lucknow	2Axle	1.2	Onion	Yes	3750	5690					1.132	1.395			1.641	3.792			5.434	
103	Orai-Kanpur	UP789201	Jhansi	Kanpur	2Axle	1.2	Parcel	Yes	3210	5960					0.969	1.462			0.881	4.565			5.446	
108	Orai-Kanpur	UP212269	Mumbai	Lucknow	2Axle	1.2	Parcel	Yes	3315	6010					1.001	1.474			1.002	4.720			5.722	
123	Orai-Kanpur	UP783363	Orai	Kanpur	2Axle	1.2	Milk	Yes	3160	4900					0.954	1.202			0.828	2.085			2.913	
126	Orai-Kanpur	GJ39153	Gujarat	Lucknow	2Axle	1.2	Parcel	Yes	3580	4140					1.081	1.015			1.363	1.063			2.426	
143	Orai-Kanpur	KA019663	Indore	Kanpur	2Axle	1.2	Parcel	Yes	3390	5695					1.023	1.397			1.096	3.805			4.902	
145	Orai-Kanpur	UP785391	Ahmedabad	Siliguri	2Axle	1.2	Groceries	Yes	3530	5010					1.065	1.229			1.289	2.279			3.568	
163	Orai-Kanpur	HR555130	Jhansi	Kanpur	2Axle	1.2	Parcel	No	3205	4310					0.967	1.057			0.876	1.248			2.124	
176	Orai-Kanpur	UP782191	Orai	Kanpur	2Axle	1.2	Parcel	Yes	3310	5010					0.999	1.229			0.996	2.279			3.276	
179	Orai-Kanpur	UK069377	Ahmedabad	Jolhupur Mod	2Axle	1.2	Machine Parts	Yes	2480	5710					0.749	1.400			0.314	3.846			4.160	3.009
180	Orai-Kanpur	UP839274	Orai	Kalpi	2Axle	1.2	Empty	No	1910	1760					0.577	0.432			0.110	0.035			0.145	
189	Orai-Kanpur	UP52AT0971	Jhansi	Kanpur	2Axle	1.2	Gas	Yes	2340	5240					0.706	1.285			0.249	2.727			2.976	
207	Orai-Kanpur	NL010141	Orai	Bihar	2Axle	1.2	Empty	No	1910	1870					0.577	0.459			0.110	0.044			0.155	
217	Orai-Kanpur	UP329743	Jhansi	Kanpur	2Axle	1.2	Empty	Yes	2160	1910					0.652	0.468			0.181	0.048			0.229	
222	Orai-Kanpur	GJ18AZ3662	Ahmedabad	Kolkata	2Axle	1.2	Parcel	Yes	3840	4950					1.159	1.214			1.805	2.172			3.977	
228	Orai-Kanpur	GJ039147	Mumbai	Kanpur	2Axle	1.2	Empty	Yes	1880	1690					0.567	0.414			0.104	0.030			0.133	
234	Orai-Kanpur	UP83BT5241	Jhansi	Kanpur	2Axle	1.2	Clothes	Yes	3840	4720					1.159	1.158			1.805	1.796			3.600	
241	Orai-Kanpur	UP92T3792	Jhansi	Kanpur	2Axle	1.2	Cylinder	Yes	3450	4850					1.041	1.189			1.176	2.002			3.178	
257	Orai-Kanpur	UP21CT1223	Mumbai	Lucknow	2Axle	1.2	Empty	Yes	2180	1860					0.658	0.456			0.187	0.043			0.231	
283	Orai-Kanpur	HR85AE1719	Mumbai	Lucknow	2Axle	1.2	Empty	Yes	2150	1890					0.649	0.464			0.177	0.046			0.224	
344	Orai-Kanpur	UP58AT1004	Mumbai	Kanpur	2Axle	1.2	Ground nuts	Yes	3840	5110					1.159	1.253			1.805	2.467			4.271	
347	Orai-Kanpur	HR476468	Orai	Kanpur	2Axle	1.2	Parcel	Yes	3210	5690					0.969	1.395			0.881	3.792			4.673	
354	Orai-Kanpur	RJ141027	kota	Bihar	2Axle	1.2	Parcel	Yes	3210	5615					0.969	1.377			0.881	3.596			4.477	
376	Orai-Kanpur	NL012847	Pune	Kanpur	2Axle	1.2	Empty	No	2210	1915					0.667	0.470			0.198	0.049			0.247	
385	Orai-Kanpur	UP335935	Jhansi	Kanpur	2Axle	1.2	Gas	Yes	3210	5210					0.969	1.278			0.881	2.665			3.547	
389	Orai-Kanpur	GJ276900	Gujarat	Bihar	2Axle	1.2	Empty	Yes	2160	1890					0.652	0.464			0.181	0.046			0.227	
394	Orai-Kanpur	UP93BT2141	Jhansi	Kanpur	2Axle	1.2	Gas	Yes	3010	5400					0.909	1.324			0.681	3.076			3.757	
400	Orai-Kanpur	MP13GN7244	Bina	Barabanki	2Axle	1.2	Parcel	Yes	3020	4210					0.912	1.032			0.690	1.136			1.827	
2	Orai-Kanpur	RJ40GA1468	Jhansi	Lucknow	3Axle	1.22	Empty	Yes	2540	2230	1955				0.767		0.555		0.346		0.095		0.440	
13	Orai-Kanpur	UP21BP0291	Gujarat	Bihar	3Axle	1.22	Clothes	No	3240	4480	4080				0.978		1.135		0.915		1.659		2.573	
21	Orai-Kanpur	NL01G2689	Gujarat	Burdwan	3Axle	1.22	Parcel	Yes	3190	5110	4890				0.963		1.326		0.860		3.089		3.949	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
26	Orai-Kanpur	NL010904	Mumbai	Guwahati	3Axle	1.22	Parcel	Yes	3510	5160	5090				1.059		1.359		1.260		3.410		4.670	
31	Orai-Kanpur	NL01AA7319	Ahmedabad	Kolkata	3Axle	1.22	Groceries	Yes	3610	5210	5010				1.090		1.355		1.410		3.370		4.780	
36	Orai-Kanpur	HR557785	Ahmedabad	Kolkata	3Axle	1.22	Parcel	Yes	3210	5210	5090				0.969		1.366		0.881		3.477		4.358	
42	Orai-Kanpur	UP786464	Orai	Bhognipur	3Axle	1.22	Sand	Yes	4160	7040	6210				1.256		1.757		2.486		9.521		12.007	
63	Orai-Kanpur	HR557990	Mumbai	Varanasi	3Axle	1.22	Parcel	Yes	3090	5210	5090				0.933		1.366		0.757		3.477		4.233	
70	Orai-Kanpur	HR464857	Ahmedabad	Kolkata	3Axle	1.22	Empty	Yes	4590	6050	5410				1.385		1.519		3.684		5.328		9.012	
71	Orai-Kanpur	RJ274073	Rajasthan	Varanasi	3Axle	1.22	Parcel	No	3010	6210	6030				0.909		1.623		0.681		6.933		7.615	
79	Orai-Kanpur	WB01AB5340	Orai	Agra	3Axle	1.22	Iron	No	3190	5870	4890				0.963		1.426		0.860		4.141		5.000	
114	Orai-Kanpur	UP783272	Gujarat	Kanpur	3Axle	1.22	Clothes	Yes	2860	5210	5040				0.863		1.359		0.555		3.410		3.965	
116	Orai-Kanpur	UP785517	Surat	Varanasi	3Axle	1.22	Empty	Yes	4370	6910	6040				1.319		1.717		3.027		8.688		11.715	
119	Orai-Kanpur	RJ111733	Pune	Lucknow	3Axle	1.22	Machine Parts	No	3680	7510	6890				1.111		1.909		1.522		13.282		14.805	
147	Orai-Kanpur	UP931720	Jhansi	Basti	3Axle	1.22	Gas	No	3210	6140	6040				0.969		1.615		0.881		6.798		7.680	
150	Orai-Kanpur	TS085749	Hyderabad	Lucknow	3Axle	1.22	Paper	Yes	3160	5590	5070				0.954		1.413		0.828		3.989		4.817	
160	Orai-Kanpur	UP784328	Jhansi	Kanpur	3Axle	1.22	Parcel	Yes	3090	5210	5030				0.933		1.358		0.757		3.396		4.153	
161	Orai-Kanpur	UP530315	Jhansi	Kanpur	3Axle	1.22	Empty	Yes	3210	5310	5090				0.969		1.379		0.881		3.614		4.495	
184	Orai-Kanpur	RJ322619	Gujarat	Lucknow	3Axle	1.22	Pipe	No	3210	6110	6010				0.969		1.607		0.881		6.666		7.547	
187	Orai-Kanpur	GJ445562	Pune	Malda	3Axle	1.22	Fish	Yes	3110	6410	6040				0.939		1.651		0.777		7.422		8.198	
193	Orai-Kanpur	RJ116367	Kota	Lucknow	3Axle	1.22	Empty	No	4010	5310	5090				1.210		1.379		2.146		3.614		5.760	
200	Orai-Kanpur	UP227770	Jhansi	Kanpur	3Axle	1.22	Gas	No	4010	6910	6040				1.210		1.717		2.146		8.688		10.834	
202	Orai-Kanpur	UP786919	Orai	Lucknow	3Axle	1.22	Rice	No	3290	6490	5530				0.993		1.594		0.973		6.448		7.421	
208	Orai-Kanpur	UP212419	Jhansi	Etawah	3Axle	1.22	Empty	Yes	1800	2140	1950				0.543		0.542		0.087		0.086		0.174	
209	Orai-Kanpur	UP778922	Mumbai	Lucknow	3Axle	1.22	Oil	Yes	4520	5740	5230				1.364		1.454		3.465		4.474		7.938	
212	Orai-Kanpur	GJ05MU0870	Indore	Kanpur	3Axle	1.22	Clothes	Yes	3340	5080	4450				1.008		1.263		1.033		2.548		3.581	**5.664**
214	Orai-Kanpur	AR477757	Orai	Lucknow	3Axle	1.22	Parcel	Yes	3010	5590	4700				0.909		1.364		0.681		3.463		4.145	
215	Orai-Kanpur	NL16758	Indore	Raebareli	3Axle	1.22	Parcel	Yes	3210	5110	4910				0.969		1.328		0.881		3.114		3.995	
218	Orai-Kanpur	NL013436	Jhansi	Lucknow	3Axle	1.22	Empty	No	2190	2040	1915				0.661		0.524		0.191		0.076		0.267	
237	Orai-Kanpur	UP93T8753	Jhansi	Lucknow	3Axle	1.22	Pipe	No	3870	4850	4475				1.168		1.236		1.862		2.336		4.198	
239	Orai-Kanpur	UP41AT6057	Nashik	Kanpur	3Axle	1.22	Onion	No	2670	5820	5470				0.806		1.497		0.422		5.019		5.441	
279	Orai-Kanpur	UP32M3246	Jhansi	Basti	3Axle	1.22	Empty	No	2140	1870	1760				0.646		0.481		0.174		0.054		0.228	
289	Orai-Kanpur	NL010822	Gujarat	Nagaland	3Axle	1.22	Onion	No	3820	5760	5240				1.153		1.458		1.768		4.523		6.290	
290	Orai-Kanpur	UP78BH7452	Jhansi	Kanpur	3Axle	1.22	Groceries	No	3390	4970	4420				1.023		1.245		1.096		2.402		3.498	
298	Orai-Kanpur	JH02R5311	Jasi	Ranchi	3Axle	1.22	Dust	No	3570	4810	4410				1.078		1.222		1.348		2.232		3.581	
302	Orai-Kanpur	RJ11GA6397	Nashik	Lucknow	3Axle	1.22	Onion	Yes	3250	5670	5050				0.981		1.421		0.926		4.079		5.006	
306	Orai-Kanpur	UP09HG6029	Jasi	Kanpur	3Axle	1.22	Empty	Yes	4170	5890	5410				1.259		1.498		2.510		5.037		7.547	
337	Orai-Kanpur	UP77AN4341	Jhansi	Basti	3Axle	1.22	Iron	Yes	3450	6190	5650				1.041		1.570		1.176		6.071		7.247	
339	Orai-Kanpur	UP78BN7735	Jhansi	Kanpur	3Axle	1.22	Medicine	Yes	3350	4460	4110				1.011		1.136		1.045		1.666		2.712	
341	Orai-Kanpur	UP93CT8760	Jhansi	Kanpur	3Axle	1.22	Oil	Yes	3340	4890	4650				1.008		1.265		1.033		2.559		3.592	
363	Orai-Kanpur	MP09HH7658	Nashik	Kanpur	3Axle	1.22	Empty	Yes	2110	1955	1770				0.637		0.494		0.165		0.059		0.224	
368	Orai-Kanpur	UP17AT3987	Jhansi	Unnao	3Axle	1.22	Gas	yes	3210	6160	6090				0.969		1.624		0.881		6.956		7.837	
369	Orai-Kanpur	UP82AT4184	Jhansi	Raebareli	3Axle	1.22	Gas	yes	3360	5910	5290				1.014		1.485		1.058		4.861		5.919	
371	Orai-Kanpur	UP78BT1001	Shivpuri	Kanpur	3Axle	1.22	Gas	Yes	3210	6410	6090				0.969		1.657		0.881		7.542		8.423	
374	Orai-Kanpur	HR46E8387	Gujarat	Varanasi	3Axle	1.22	Parcel	Yes	3910	6910	6570				1.180		1.787		1.940		10.200		12.140	
391	Orai-Kanpur	HR39E9809	Gujarat	Unnao	3Axle	1.22	Parcel	Yes	3210	5510	5040				0.969		1.399		0.881		3.827		4.708	
393	Orai-Kanpur	UP83T7341	kota	Bihar	3Axle	1.22	Empty	Yes	3040	6410	6020				0.918		1.648		0.709		7.374		8.083	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
396	Orai-Kanpur	GJ23T6322	Gujarat	Kanpur	3Axle	1.22	Empty	Yes	3010	6310	6040				0.909		1.637		0.681		7.186		7.867	
398	Orai-Kanpur	NL02N5400	Mumbai	Guwahati	3Axle	1.22	Parcel	Yes	3010	6210	5610				0.909		1.567		0.681		6.030		6.711	
401	Orai-Kanpur	UP92T7881	Orai	Prayagraj	3Axle	1.22	Oil	Yes	3110	6110	5910				0.939		1.594		0.777		6.448		7.225	
402	Orai-Kanpur	UP75AT5555	Gujarat	Lucknow	3Axle	1.22	Empty	Yes	2210	1990	1835				0.667		0.507		0.198		0.066		0.264	
142	Orai-Kanpur	JH123612	Nashik	Kanpur	MAV	1.1.12	Onion	No	2815	3650	5590	4885			0.850	1.102	1.389		0.521	1.473	3.719		5.714	
144	Orai-Kanpur	UP787979	Gujarat	Kanpur	MAV	1.1.12	Clothes	No	3210	4090	6040	5145			0.969	1.235	1.483		0.881	2.323	4.835		8.039	
146	Orai-Kanpur	UP274173	Orai	Kanpur	MAV	1.1.12	Stone	No	3690	5290	6570	5590			1.114	1.597	1.612		1.539	6.500	6.754		14.793	
149	Orai-Kanpur	PB135185	Pune	Bihar	MAV	1.1.12	Powder	No	3490	3910	5360	4885			1.053	1.180	1.358		1.231	1.940	3.403		6.575	
191	Orai-Kanpur	UP785624	Jhansi	Raebareli	MAV	1.1.12	Empty	No	2510	2290	2010	1890			0.758	0.691	0.517		0.329	0.228	0.071		0.629	
3	Orai-Kanpur	GJ01CY2898	Orai	Kanpur	MAV	1.1.22	Sand	No	4150	4910	7180	6250			1.253	1.482	1.780		2.462	4.824	10.049		17.336	
10	Orai-Kanpur	RJ14GJ7660	Indore	Bihar	MAV	1.1.22	Empty	No	2160	2015	1955	1545			0.652	0.608	0.464		0.181	0.137	0.046		0.364	
12	Orai-Kanpur	UP3ST9856	Guna	Bihar	MAV	1.1.22	Onion	No	3100	4255	5615	4700			0.936	1.284	1.367		0.767	2.721	3.497		6.985	
15	Orai-Kanpur	UP7Z1911	Jhansi	Kanpur	MAV	1.1.22	Oil	No	3675	4120	8710	8090			1.109	1.244	2.227		1.514	2.392	24.607		28.513	
17	Orai-Kanpur	UP78PY2177	Orai	Saharanpur	MAV	1.1.22	Garlic	No	3015	3950	5450	4750			0.910	1.192	1.352		0.686	2.021	3.344		6.050	
28	Orai-Kanpur	RJ01GB9278	Bhopal	Lucknow	MAV	1.1.22	Iron	No	3410	4590	8475	7105			1.029	1.385	2.065		1.122	3.684	18.201		23.008	
39	Orai-Kanpur	UP328166	Orai	Lucknow	MAV	1.1.22	Stone	No	4290	5010	6910	6020			1.295	1.512	1.714		2.812	5.230	8.634		16.675	
44	Orai-Kanpur	UP32JN4034	Nashik	Kanpur	MAV	1.1.22	Onion	No	2590	4120	5910	5240			0.782	1.244	1.478		0.374	2.392	4.774		7.540	
45	Orai-Kanpur	UP350551	Indore	Bihar	MAV	1.1.22	Onion	No	2915	3255	5975	5240			0.880	0.982	1.487		0.599	0.932	4.887		6.418	
46	Orai-Kanpur	UP932917	Nashik	Bihar	MAV	1.1.22	Onion	No	2995	3955	5495	5095			0.904	1.194	1.404		0.668	2.031	3.885		6.584	
48	Orai-Kanpur	MH43T3471	Orai	Kanpur	MAV	1.1.22	Parcel	No	3210	4560	5110	4580			0.969	1.376	1.285		0.881	3.589	2.723		7.194	
51	Orai-Kanpur	UP780342	Bhopal	Kanpur	MAV	1.1.22	Onion	No	3210	4795	6910	6570			0.969	1.447	1.787		0.881	4.388	10.200		15.469	
56	Orai-Kanpur	UP40T6882	Orai	Kanpur	MAV	1.1.22	Sand	No	3590	4325	6890	6125			1.084	1.305	1.725		1.379	2.904	8.863		13.147	
66	Orai-Kanpur	UP735377	Indore	Kanpur	MAV	1.1.22	Onion	No	3210	4040	6890	6000			0.969	1.219	1.709		0.881	2.211	8.528		11.620	
68	Orai-Kanpur	UP938373	Orai	Kanpur	MAV	1.1.22	Stone	No	4090	4650	8195	9560			1.235	1.404	2.354		2.323	3.881	30.698		36.901	
69	Orai-Kanpur	HR383005	Orai	Lucknow	MAV	1.1.22	Parcel	No	3560	4210	5545	4960			1.075	1.271	1.393		1.333	2.608	3.762		7.703	
72	Orai-Kanpur	UP64A3995	Orai	Kanpur	MAV	1.1.22	Empty	No	2050	1850	1755	1650			0.619	0.558	0.451		0.147	0.097	0.042		0.285	
81	Orai-Kanpur	MH46BB5302	Indore	Kanpur	MAV	1.1.22	Onion	No	2980	3920	5695	4985			0.899	1.183	1.416		0.655	1.960	4.019		6.634	
83	Orai-Kanpur	UP53ET5182	Jhansi	Lucknow	MAV	1.1.22	Stone	No	3960	4890	7470	6845			1.195	1.476	1.898		2.041	4.746	12.971		19.759	
84	Orai-Kanpur	UP51BT2632	Jhansi	Lucknow	MAV	1.1.22	Dust	No	3790	4120	7890	7260			1.144	1.244	2.008		1.713	2.392	16.273		20.378	
85	Orai-Kanpur	UP93CT9112	Jhansi	Lucknow	MAV	1.1.22	Stone	No	3390	4870	6480	6240			1.023	1.470	1.686		1.096	4.669	8.087		13.852	
90	Orai-Kanpur	RJ11GA8510	Jhansi	Kanpur	MAV	1.1.22	Glass	No	3560	4570	5170	4920			1.075	1.379	1.338		1.333	3.621	3.202		8.156	
97	Orai-Kanpur	RJ090395	Jasi	Rampura Jalaun	MAV	1.1.22	Coal	No	3250	5310	7490	6650			0.981	1.603	1.875		0.926	6.599	12.349		19.874	
104	Orai-Kanpur	UP564331	Orai	Kanpur	MAV	1.1.22	Stone	No	3690	5160	7210	6590			1.114	1.558	1.830		1.539	5.885	11.203		18.627	
105	Orai-Kanpur	UP325669	Indore	Kanpur	MAV	1.1.22	Onion	No	3290	4095	5810	5140			0.993	1.236	1.452		0.973	2.334	4.441		7.748	
106	Orai-Kanpur	UP929699	Indore	Kanpur	MAV	1.1.22	Onion	No	3210	4290	5410	4970			0.969	1.295	1.376		0.881	2.812	3.586		7.279	
117	Orai-Kanpur	MH283578	Mumbai	Barabanki	MAV	1.1.22	Banana	No	2910	3850	5595	5095			0.878	1.162	1.417		0.595	1.824	4.034		6.453	
118	Orai-Kanpur	UP5L1808	Orai	Basti	MAV	1.1.22	Stone	No	3210	5210	7290	6175			0.969	1.573	1.785		0.881	6.116	10.154		17.152	
122	Orai-Kanpur	JH127613	Indore	Varanasi	MAV	1.1.22	Onion	No	2690	4290	6210	5540			0.812	1.295	1.558		0.435	2.812	5.888		9.134	
129	Orai-Kanpur	NL02L2011	Orai	Kanpur	MAV	1.1.22	Iron	No	2545	3715	6650	5451			0.768	1.121	1.604		0.348	1.581	6.624		8.553	
132	Orai-Kanpur	UP923673	Orai	Kanpur	MAV	1.1.22	Stone	No	3290	4290	8810	9570			0.993	1.295	2.437		0.973	2.812	35.254		39.038	
133	Orai-Kanpur	UP350924	Indore	Kanpur	MAV	1.1.22	Onion	No	3290	4110	5545	4840			0.993	1.241	1.377		0.973	2.369	3.593		6.934	
134	Orai-Kanpur	MH464776	Nashik	Lucknow	MAV	1.1.22	Oil	No	4160	5095	7810	6040			1.256	1.538	1.836		2.486	5.594	11.366		19.446	
156	Orai-Kanpur	UP782776	Jhansi	Kanpur	MAV	1.1.22	Soap	No	2955	3885	4950	4210			0.892	1.173	1.214		0.633	1.891	2.175		4.699	
157	Orai-Kanpur	JH022498	Indore	Lucknow	MAV	1.1.22	Onion	No	3010	4110	6010	5045			0.909	1.241	1.466		0.681	2.369	4.614		7.664	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
167	Orai-Kanpur	UP781891	Jhansi	Azamgarh	MAV	1.1.22	Groceries	No	3210	4290	6410	5840			0.969	1.295	1.624		0.881	2.812	6.956		10.649	
194	Orai-Kanpur	MH4C2655	Nashik	Kanpur	MAV	1.1.22	Chemical	No	4290	5010	6910	6325			1.295	1.512	1.755		2.812	5.230	9.478		17.519	
199	Orai-Kanpur	AP972863	Nashik	Kolkata	MAV	1.1.22	Onion	No	3160	4295	5910	5170			0.954	1.296	1.469		0.828	2.825	4.656		8.308	
203	Orai-Kanpur	UP512458	Orai	Raebareli	MAV	1.1.22	Stone	No	3910	6160	7910	7195			1.180	1.859	2.003		1.940	11.952	16.081		29.973	
204	Orai-Kanpur	UP789558	Indore	Raebareli	MAV	1.1.22	Onion	No	3210	4865	6910	6370			0.969	1.468	1.761		0.881	4.650	9.608		15.139	
211	Orai-Kanpur	UP53ST4259	Jhansi	Gorakhpur	MAV	1.1.22	Stone	No	3280	5100	9480	8210			0.990	1.539	2.345		0.961	5.616	30.251		36.827	
220	Orai-Kanpur	UP78T2268	Orai	Basti	MAV	1.1.22	Sand	No	3840	4570	8010	7060			1.159	1.379	1.998		1.805	3.621	15.932		21.358	
229	Orai-Kanpur	RJ11GC1417	Orai	Basti	MAV	1.1.22	Ply wood	No	4170	4570	5160	4795			1.259	1.379	1.320		2.510	3.621	3.034		9.164	
231	Orai-Kanpur	UP83CT8836	Jhansi	Gorakhpur	MAV	1.1.22	Dust	No	2870	3855	7500	6855			0.866	1.164	1.903		0.563	1.833	13.117		15.513	
232	Orai-Kanpur	WB234359	Nashik	Kanpur	MAV	1.1.22	Onion	No	2850	3870	5240	4760			0.860	1.168	1.326		0.548	1.862	3.089		5.499	
235	Orai-Kanpur	RJ422545	Nashik	Etawah	MAV	1.1.22	Empty	No	2120	1890	1755	1600			0.640	0.570	0.445		0.168	0.106	0.039		0.313	
238	Orai-Kanpur	JH026643	Nashik	Basti	MAV	1.1.22	Onion	No	3065	4260	6550	5865			0.925	1.286	1.646		0.733	2.734	7.339		10.805	
240	Orai-Kanpur	UP784727	Jhansi	Basti	MAV	1.1.22	Dust	No	2870	3950	7850	7540			0.866	1.192	2.040		0.563	2.021	17.329		19.913	
247	Orai-Kanpur	MH33H6414	Jhansi	Kanpur	MAV	1.1.22	Onion	No	2950	4225	5085	4520			0.890	1.275	1.273		0.629	2.645	2.629		5.903	
248	Orai-Kanpur	UP93C7290	Nashik	Basti	MAV	1.1.22	Onion	No	3255	4195	5325	4985			0.982	1.266	1.367		0.932	2.571	3.490		6.993	
252	Orai-Kanpur	MH467175	Jhansi	Lucknow	MAV	1.1.22	Chemical	No	4170	5450	7290	6740			1.259	1.645	1.860		2.510	7.323	11.969		21.802	
253	Orai-Kanpur	GJ01JT7133	Nashik	Kanpur	MAV	1.1.22	Onion	No	2890	4140	6250	5610			0.872	1.250	1.572		0.579	2.438	6.112		9.129	
255	Orai-Kanpur	UP78GN5115	Nashik	Lucknow	MAV	1.1.22	Onion	No	2870	3750	6490	5875			0.866	1.132	1.639		0.563	1.641	7.221		9.426	
258	Orai-Kanpur	MP092786	Nashik	Basti	MAV	1.1.22	Onion	No	2890	3440	6170	5560			0.872	1.038	1.555		0.579	1.162	5.848		7.590	
259	Orai-Kanpur	UP58T7075	Jhansi	Etawah	MAV	1.1.22	Dust	No	4290	5140	8195	7650			1.295	1.551	2.101		2.812	5.794	19.471		28.077	
260	Orai-Kanpur	UP47T6969	Jhansi	Balrampur	MAV	1.1.22	Empty	No	2170	1890	1805	1750			0.655	0.570	0.471		0.184	0.106	0.049		0.339	
261	Orai-Kanpur	UP783354	Jhansi	Kanpur	MAV	1.1.22	Stone	No	3795	5640	8550	7420			1.145	1.702	2.117		1.722	8.399	20.093		30.214	
263	Orai-Kanpur	MH18PT9325	Jhansi	Basti	MAV	1.1.22	Empty	No	1970	1985	1900	1795			0.595	0.599	0.490		0.125	0.129	0.058		0.311	
264	Orai-Kanpur	UP92BT4992	Nashik	Lucknow	MAV	1.1.22	Onion	No	3170	4270	6130	5590			0.957	1.289	1.554		0.838	2.759	5.828		9.426	
265	Orai-Kanpur	JH09AU6438	Nashik	Kanpur	MAV	1.1.22	Garlic	No	2870	3655	5095	4265			0.866	1.103	1.241		0.563	1.481	2.371		4.416	
271	Orai-Kanpur	UP92AT2386	Orai	Kanpur	MAV	1.1.22	Stone	No	4250	4870	8460	7590			1.283	1.470	2.128		2.708	4.669	20.499		27.876	
272	Orai-Kanpur	HR55AL1510	Jhansi	Kanpur	MAV	1.1.22	Machine Parts	No	3870	4850	5970	5470			1.168	1.464	1.517		1.862	4.593	5.291		11.746	
278	Orai-Kanpur	GJ02AT2587	Gujarat	Kanpur	MAV	1.1.22	Garlic	No	2855	3755	6240	5585			0.862	1.133	1.568		0.551	1.650	6.040		8.242	
288	Orai-Kanpur	UP32N00324	Jhansi	Lucknow	MAV	1.1.22	Cotton	No	3410	5170	5860	5265			1.029	1.561	1.475		1.122	5.930	4.732		11.784	
291	Orai-Kanpur	MH04AU3123	Jhansi	Gorakhpur	MAV	1.1.22	Pipe	No	3890	4450	5170	4920			1.174	1.343	1.338		1.901	3.255	3.202		8.357	
292	Orai-Kanpur	UP92RT1741	Jhansi	Unnao	MAV	1.1.22	Empty	No	2445	2100	1995	1890			0.738	0.634	0.515		0.297	0.161	0.070		0.528	
293	Orai-Kanpur	UP38BT8446	Jasi	Lucknow	MAV	1.1.22	Dust	No	4270	5140	8440	7860			1.289	1.551	2.161		2.759	5.794	21.806		30.359	
304	Orai-Kanpur	UP53AT4747	Jhansi	Gorakhpur	MAV	1.1.22	Stone	No	3990	5320	9120	8250			1.204	1.606	2.303		2.104	6.649	28.120		36.873	
309	Orai-Kanpur	HR45C0182	Jhansi	Kanpur	MAV	1.1.22	Gas	No	3140	4510	7050	6450			0.948	1.361	1.790		0.807	3.434	10.260		14.501	
318	Orai-Kanpur	UP75M4195	Jhansi	Kanpur	MAV	1.1.22	Biscuit	No	2985	3840	5470	5145			0.901	1.159	1.407		0.659	1.805	3.922		6.386	
321	Orai-Kanpur	MH15F9684	Nashik	Lucknow	MAV	1.1.22	Empty	No	1920	1855	1805	1725			0.580	0.560	0.468		0.113	0.098	0.048		0.259	
323	Orai-Kanpur	UP51BT4111	Jhansi	Unnao	MAV	1.1.22	Empty	No	2190	1820	1745	1650			0.661	0.549	0.450		0.191	0.091	0.041		0.323	
325	Orai-Kanpur	GJ78A3202	Jhansi	Unnao	MAV	1.1.22	Stone	No	4010	5210	7790	6640			1.210	1.573	1.913		2.146	6.116	13.393		21.656	
326	Orai-Kanpur	UP93BT4523	Jhansi	Barabanki	MAV	1.1.22	Stone	No	3655	4640	7460	6890			1.103	1.401	1.902		1.481	3.848	13.099		18.428	
328	Orai-Kanpur	UP77AN6483	Nashik	Kanpur	MAV	1.1.22	Onion	No	3060	4490	6090	4910			0.924	1.355	1.458		0.728	3.374	4.523		8.624	
331	Orai-Kanpur	UP78FN6116	Nashik	Kanpur	MAV	1.1.22	Onion	No	2655	4240	5850	5130			0.801	1.280	1.456		0.412	2.683	4.490		7.585	
333	Orai-Kanpur	UP78CN4955	Nashik	Gorakhpur	MAV	1.1.22	Onion	No	3130	3990	5270	4370			0.945	1.204	1.278		0.797	2.104	2.668		5.568	
342	Orai-Kanpur	UP51BT4750	Jhansi	Kanpur	MAV	1.1.22	Clothes	No	3850	4670	5650	5210			1.162	1.410	1.440		1.824	3.948	4.297		10.069	
343	Orai-Kanpur	UP78BT6379	Jhansi	Kanpur	MAV	1.1.22	Groceries	No	3350	4190	5560	4970			1.011	1.265	1.396		1.045	2.558	3.798		7.402	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
355	Orai-Kanpur	MH492299	Nashik	Basti	MAV	1.1.22	Cream	No	3210	4250	5910	4970			0.969	1.283	1.442		0.881	2.708	4.329		7.918	
357	Orai-Kanpur	MP09GH9873	Shivpuri	Kanpur	MAV	1.1.22	Sand	No	4250	4655	8015	7160			1.283	1.405	2.012		2.708	3.898	16.381		22.987	
358	Orai-Kanpur	UP92T3515	Orai	Gorakhpur	MAV	1.1.22	Empty	No	2262	2115	2095	1855			0.683	0.638	0.524		0.217	0.166	0.075		0.459	
361	Orai-Kanpur	MH06NH1660	Mumbai	Guwahati	MAV	1.1.22	Parcel	No	3015	4655	5620	5105			0.910	1.405	1.422		0.686	3.898	4.087		8.671	
362	Orai-Kanpur	UP72AT3500	Indore	Varanasi	MAV	1.1.22	Empty	No	2210	2030	1920	1685			0.667	0.613	0.478		0.198	0.141	0.052		0.391	
370	Orai-Kanpur	MH40BL4897	Mumbai	Kanpur	MAV	1.1.22	Parcel	No	3160	4225	5490	4900			0.954	1.275	1.377		0.828	2.645	3.600		7.073	
373	Orai-Kanpur	UP53GT5663	Orai	Gonda - Bahraich	MAV	1.1.22	Sand	No	3915	4510	8565	7645			1.182	1.361	2.149		1.950	3.434	21.328		26.712	
378	Orai-Kanpur	UP363398	Indore	Varanasi	MAV	1.1.22	Onion	No	3210	5010	7040	6085			0.969	1.512	1.740		0.881	5.230	9.167		15.278	
379	Orai-Kanpur	UP533765	Jhansi	Basti	MAV	1.1.22	Empty	No	2270	2165	2075	1950			0.685	0.653	0.534		0.220	0.182	0.081		0.484	
381	Orai-Kanpur	UP923620	Jhansi	Kanpur	MAV	1.1.22	Urea	No	3890	4115	7400	6090			1.174	1.242	1.788		1.901	2.380	10.230		14.511	
390	Orai-Kanpur	UP610515	Orai	Kanpur	MAV	1.1.22	Empty	No	2360	2015	1995	1750			0.712	0.608	0.496		0.257	0.137	0.061		0.455	
395	Orai-Kanpur	UP93T4034	Jhansi	Gorakhpur	MAV	1.1.22	Stone	No	3915	4440	8510	8410			1.182	1.340	2.243		1.950	3.226	25.318		30.494	
397	Orai-Kanpur	UP93T3948	Jhansi	Barabanki	MAV	1.1.22	Stone	No	3660	4710	8590	8460			1.105	1.422	2.260		1.489	4.085	26.105		31.679	
399	Orai-Kanpur	UP78CN2262	Indore	Kanpur	MAV	1.1.22	Onion	No	2610	3800	6040	5210			0.788	1.147	1.491		0.385	1.731	4.948		7.064	
404	Orai-Kanpur	RJ11GB7711	Nashik	Lucknow	MAV	1.1.22	Onion	No	2750	3695	5590	5000			0.830	1.115	1.404		0.475	1.547	3.885		5.907	
49	Orai-Kanpur	NL010369	Gujarat	Kolkata	MAV	1.2.11	Car	No	3295	4910	4410	4090			0.995	1.204	1.127		0.978	2.103	1.612		4.694	
55	Orai-Kanpur	NL011157	Orai	Basti	MAV	1.2.11	Empty	No	2200	2010	1985	1755			0.664	0.493	0.496		0.194	0.059	0.060		0.314	
80	Orai-Kanpur	WB01AA5060	Jhansi	Kanpur	MAV	1.2.11	Bikes	No	3040	4870	4390	4170			0.918	1.194	1.135		0.709	2.035	1.659		4.402	
91	Orai-Kanpur	RJ140847	Pune	Gonda	MAV	1.2.11	Car	No	3210	5215	4890	4410			0.969	1.279	1.233		0.881	2.676	2.311		5.868	
130	Orai-Kanpur	MH040375	Guna	Sitapur	MAV	1.2.11	Car	No	2840	4210	4910	4410			0.857	1.032	1.236		0.540	1.136	2.331		4.007	
151	Orai-Kanpur	RJ149421	Pune	Kanpur	MAV	1.2.11	Car	No	3910	5490	4910	4130			1.180	1.346	1.198		1.940	3.286	2.063		7.289	
165	Orai-Kanpur	HR550905	Pune	Lucknow	MAV	1.2.11	Car	No	3510	4490	4100	4090			1.059	1.101	1.086		1.260	1.470	1.390		4.120	
198	Orai-Kanpur	UP327485	Pune	Lucknow	MAV	1.2.11	Car	No	4210	4590	4210	4130			1.271	1.126	1.106		2.608	1.606	1.494		5.708	
242	Orai-Kanpur	NL01N6150	Mumbai	Kanpur	MAV	1.2.11	Car	No	4150	5070	5460	4210			1.253	1.243	1.282		2.462	2.390	2.701		7.553	
243	Orai-Kanpur	NL01AF3011	Mumbai	Kanpur	MAV	1.2.11	Car	No	4390	5150	5210	5020			1.325	1.263	1.356		3.083	2.545	3.383		9.011	
245	Orai-Kanpur	NL01N1008	Guna	Sitapur	MAV	1.2.11	Bikes	No	4350	5090	5170	4940			1.313	1.248	1.340		2.972	2.428	3.227		8.628	
280	Orai-Kanpur	UP53GJ6828	Mumbai	Lucknow	MAV	1.2.11	Car	No	3890	4670	5020	4900			1.174	1.145	1.315		1.901	1.721	2.991		6.613	
375	Orai-Kanpur	NL01A1083	Pune	Malda	MAV	1.2.11	Car	No	3910	5210	4990	4530			1.180	1.278	1.262		1.940	2.665	2.537		7.143	
95	Orai-Kanpur	UP53HT3766	Jhansi	Kanpur	MAV	1.2.22	Stone	No	4210	4910	8265	7420			1.271	1.204	2.079		2.608	2.103	18.697		23.407	
96	Orai-Kanpur	UP538727	Jhansi	Gorakhpur	MAV	1.2.22	Stone	No	3440	4365	9040	7750			1.038	1.071	2.226		1.162	1.313	24.549		27.024	
120	Orai-Kanpur	MH464899	Pune	Barabanki	MAV	1.2.22	Chemical	No	2610	3710	6000	5410			0.788	0.910	1.513		0.385	0.685	5.236		6.306	
171	Orai-Kanpur	MP099161	Indore	Kanpur	MAV	1.2.22	Onion	No	2290	3040	6160	5150			0.691	0.746	1.499		0.228	0.309	5.054		5.592	
174	Orai-Kanpur	ML011049	Jhansi	Kanpur	MAV	1.2.22	Iron	No	3210	4410	7070	6290			0.969	1.082	1.771		0.881	1.368	9.841		12.091	
267	Orai-Kanpur	UP92CT7990	Nashik	Basti	MAV	1.2.22	Onion	No	2540	3870	6460	5410			0.767	0.949	1.574		0.346	0.811	6.132		7.289	
270	Orai-Kanpur	UP555127	Jhansi	Basti	MAV	1.2.22	Stone	No	3795	4290	8850	8015			1.145	1.052	2.236		1.722	1.225	24.990		27.937	
273	Orai-Kanpur	UP77AT6432	Jhansi	Unnao	MAV	1.2.22	Stone	No	4140	4790	8425	7070			1.250	1.175	2.054		2.438	1.904	17.807		22.150	
275	Orai-Kanpur	MH46B4076	Jhansi	Basti	MAV	1.2.22	Stone	No	4270	4490	6105	5210			1.289	1.101	1.500		2.759	1.470	5.063		9.293	
276	Orai-Kanpur	UP78GT8715	Nashik	Lucknow	MAV	1.2.22	Onion	No	2865	3890	6450	5630			0.865	0.954	1.601		0.559	0.828	6.578		7.966	
277	Orai-Kanpur	UP78BT3287	Jhansi	Barabanki	MAV	1.2.22	Dust	No	3890	4740	8170	7490			1.174	1.162	2.076		1.901	1.826	18.578		22.304	
281	Orai-Kanpur	UP42BT7956	Jasi	Lucknow	MAV	1.2.22	Stone	No	3790	4650	8480	7290			1.144	1.140	2.091		1.713	1.691	19.105		22.509	
284	Orai-Kanpur	UP93BT4172	Jhansi	Lucknow	MAV	1.2.22	Stone	No	3780	4240	7790	6650			1.141	1.040	1.914		1.695	1.169	13.431		16.294	
287	Orai-Kanpur	UP17AT0179	Jhansi	Kanpur	MAV	1.2.22	Dust	No	4210	4690	8920	7440			1.271	1.150	2.169		2.608	1.750	22.129		26.487	
300	Orai-Kanpur	MP09HH3868	Indore	Lucknow	MAV	1.2.22	Onion	No	2115	3670	6140	5510			0.638	0.900	1.544		0.166	0.656	5.690		6.513	
307	Orai-Kanpur	RJ66AG0106	Jhansi	Kanpur	MAV	1.2.22	Machine Parts	No	3960	4620	6970	5220			1.195	1.133	1.616		2.041	1.648	6.821		10.510	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
311	Orai-Kanpur	GJ04MH5526	Gujarat	Patna	MAV	1.2.22	Onion	No	2470	3870	6470	5650			0.746	0.949	1.607		0.309	0.811	6.666		7.786	
312	Orai-Kanpur	UP75Y2545	Shivpuri	Kanpur	MAV	1.2.22	Wheat	No	3080	3450	7640	7390			0.930	0.846	1.993		0.747	0.513	15.764		17.023	
315	Orai-Kanpur	UP51AT6538	Orai	Kanpur	MAV	1.2.22	Dust	No	4585	4660	6980	6105			1.384	1.143	1.735		3.668	1.706	9.056		14.430	
317	Orai-Kanpur	UP78DT6279	Jhansi	Gorakhpur	MAV	1.2.22	Dust	No	2855	4455	8650	8095			0.862	1.093	2.220		0.551	1.425	24.286		26.263	
320	Orai-Kanpur	RJ026584	Orai	Kanpur	MAV	1.2.22	Groceries	No	3840	4710	5190	4920			1.159	1.155	1.340		1.805	1.780	3.227		6.812	
322	Orai-Kanpur	MH406025	Nashik	Kanpur	MAV	1.2.22	Onion	No	2350	3890	6470	5420			0.709	0.954	1.576		0.253	0.828	6.174		7.255	
329	Orai-Kanpur	MH43BX5973	Jhansi	Kanpur	MAV	1.2.22	Iron	No	3880	4870	5890	5640			1.171	1.194	1.529		1.881	2.035	5.459		9.375	
330	Orai-Kanpur	UP75M1741	Jhansi	Kanpur	MAV	1.2.22	Iron	No	3590	4650	5510	5410			1.084	1.140	1.448		1.379	1.691	4.393		7.463	
332	Orai-Kanpur	UP77AN6177	Nashik	Lucknow	MAV	1.2.22	Onion	No	2250	3120	5810	5050			0.679	0.765	1.440		0.213	0.343	4.297		4.852	
334	Orai-Kanpur	MH05DK1958	Nashik	Unnao	MAV	1.2.22	Onion	No	2845	3890	6140	5220			0.859	0.954	1.506		0.544	0.828	5.144		6.517	14.580
377	Orai-Kanpur	HR470182	Jhansi	Gorakhpur	MAV	1.2.22	Gas	No	3490	4310	7210	7040			1.053	1.057	1.889		1.231	1.248	12.737		15.217	
383	Orai-Kanpur	UP932824	Indore	Kanpur	MAV	1.2.22	Cement	No	3710	4340	8245	7090			1.120	1.064	2.033		1.573	1.283	17.083		19.939	
8	Orai-Kanpur	UP35AT2543	Indore	Bihar	MAV	1.1.122	Onion	No	2850	3650	4560	6240	5960		0.860	1.102		1.467986336	0.548	1.473		4.643955537	6.665	
16	Orai-Kanpur	UP416092	Orai	Barabanki	MAV	1.1.122	Soil	No	3780	5210	5540	8410	8090		1.141	1.573		1.930454585	1.695	6.116		13.88795679	21.699	
20	Orai-Kanpur	UP72AM3926	Nashik	Kolkata	MAV	1.1.122	Food	No	3890	4910	5120	8310	7010		1.174	1.482		1.790312692	1.901	4.824		10.27343226	16.998	
30	Orai-Kanpur	UP321471	Orai	Kanpur	MAV	1.1.122	Sand	No	3210	5210	5680	8510	7040		0.969	1.573		1.859507752	0.881	6.116		11.956167	18.953	
38	Orai-Kanpur	UP834260	Nashik	Kanpur	MAV	1.1.122	Food	No	4180	5210	5320	7790	8100		1.262	1.573		1.857755978	2.534	6.116		11.91117677	20.561	
61	Orai-Kanpur	NL019611	Jamnagar	Kolkata	MAV	1.1.122	Powder	No	3760	4010	4210	5210	5010		1.135	1.210		1.263904704	1.659	2.146		2.551862795	6.357	
73	Orai-Kanpur	UP93B3664	Orai	Kanpur	MAV	1.1.122	Dust	No	3680	4815	5560	8290	7885		1.111	1.453		1.903740037	1.522	4.462		13.13501502	19.119	
111	Orai-Kanpur	UP423933	Orai	Kadaura	MAV	1.1.122	Empty	No	2215	2050	1985	1850	1655		0.669	0.619		0.480861873	0.200	0.147		0.053466453	0.400	
112	Orai-Kanpur	UP935108	Orai	Basti	MAV	1.1.122	Empty	No	2470	2210	2040	1910	1810		0.746	0.667		0.504510817	0.309	0.198		0.064786114	0.572	
139	Orai-Kanpur	UP535916	Indore	Kanpur	MAV	1.1.122	Onion	No	2910	4855		6610	6125		0.878	1.465	1.688320297		0.595	4.612	8.125		13.332	
152	Orai-Kanpur	UP440783	Orai	Kanpur	MAV	1.1.122	Stone	No	4290	5085	6910	8210	7040		1.295	1.535		1.940965227	2.812	5.550		14.19289599	22.554	
154	Orai-Kanpur	UP920250	Jhansi	Kanpur	MAV	1.1.122	Stone	No	4090	5050	7010	8210	7030		1.235	1.524		1.948848209	2.323	5.399		14.42487495	22.146	
159	Orai-Kanpur	UP564615	Jhansi	Gorakhpur	MAV	1.1.122	Stone	No	4240	4915	7910	8820	7520		1.280	1.484		2.124025576	2.683	4.844		20.35349372	27.880	
172	Orai-Kanpur	GJ060329	Indore	Kanpur	MAV	1.1.122	Onion	No	3610	4420	5295	6210	5645		1.090	1.334		1.502145923	1.410	3.168		5.091532184	9.669	
173	Orai-Kanpur	UP774839	Indore	Burdwan	MAV	1.1.122	Onion	No	3210	4560	5045	7310	6710		0.969	1.376		1.669878252	0.881	3.589		7.775695306	12.246	
175	Orai-Kanpur	UP932266	Jhansi	Lucknow	MAV	1.1.122	Empty	No	2015	1940	1850	1740	1595		0.608	0.586		0.454147324	0.137	0.118		0.042538977	0.297	
177	Orai-Kanpur	RJ705243	Jhansi	Raebareli	MAV	1.1.122	Onion	No	2890	3580	4655	7040	6610		0.872	1.081		1.603310852	0.579	1.363		6.608013608	8.551	
178	Orai-Kanpur	UP039434	Jhansi	Kanpur	MAV	1.1.122	Stone	No	4410	4160	4365	5560	5210		1.331	1.256		1.325654725	3.140	2.486		3.088315755	8.714	
182	Orai-Kanpur	UP787957	Jhansi	Raebareli	MAV	1.1.122	Empty	No	2265	2015	1900	1810	1730		0.684	0.608		0.476482438	0.218	0.137		0.051545125	0.407	
183	Orai-Kanpur	JH127624	Jhansi	Kanpur	MAV	1.1.122	Stone	No	3490	5520	6410	8160	7010		1.053	1.666		1.890163791	1.231	7.707		12.76432217	21.703	
188	Orai-Kanpur	MH46BB2568	Mumbai	Kanpur	MAV	1.1.122	Empty	No	1715	1700	1655	1585	1430		0.518	0.513		0.409039152	0.072	0.069		0.027993649	0.169	
192	Orai-Kanpur	UP197778	Kota	Kanpur	MAV	1.1.122	Stone	No	4010	5010	6610	7910	7590		1.210	1.512		1.936585793	2.146	5.230		14.06523414	21.441	
195	Orai-Kanpur	UP458433	Orai	Kanpur	MAV	1.1.122	Sand	No	4160	5150	5450	8210	7020		1.256	1.554		1.811333976	2.486	5.839		10.76450673	19.089	
197	Orai-Kanpur	UP221577	Indore	Faizabad	MAV	1.1.122	Onion	No	2745	3655	5405	6510	5540		0.829	1.103		1.528860471	0.471	1.481		5.463505799	7.416	
205	Orai-Kanpur	UP785068	Jhansi	Kanpur	MAV	1.1.122	Stone	No	3810	4290	7255	7960	8130		1.150	1.295		2.044757817	1.749	2.812		17.48104975	22.042	
206	Orai-Kanpur	UP473800	Jhansi	Kanpur	MAV	1.1.122	Stone	No	3700	4210	8050	8510	9090		1.117	1.271		2.246649733	1.556	2.608		25.4766003	29.640	
210	Orai-Kanpur	UP32SN0076	Jhansi	Lucknow	MAV	1.1.122	Stone	No	4220	3940		7800	6940		1.274	1.189	1.954129657		2.632	2.000	14.582		19.215	
213	Orai-Kanpur	UP75T9862	Indore	Kanpur	MAV	1.1.122	Stone	No	4150	5170		8160	7270		1.253	1.561	2.045605197		2.462	5.930	17.510		25.902	
216	Orai-Kanpur	UP328244	Jhansi	Kanpur	MAV	1.1.122	Stone	No	4210	4160	7455	7915	7210		1.271	1.256		1.977752474	2.608	2.486		15.29987019	20.393	
225	Orai-Kanpur	UP78DN7125	Orai	Kanpur	MAV	1.1.122	Washing powder	No	3890	4670	6520	8470	5850		1.174	1.410		1.825348165	1.901	3.948		11.10153045	16.950	
227	Orai-Kanpur	UP77AV4786	Jhansi	Kanpur	MAV	1.1.122	Dust	No	4050	4295		8575	7895		1.222	1.296	2.183481373		2.233	2.825	22.730		27.788	
230	Orai-Kanpur	UP362372	Jhansi	Kanpur	MAV	1.1.122	Dust	No	4480	5170		7820	6640		1.352	1.561	1.917009148		3.344	5.930	13.505		22.779	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
244	Orai-Kanpur	MP062278	Bengaluru	Lucknow	MAV	1.1.122	Fish	No	4450	4690	5695	7050	6890		1.343	1.416		1.719803801	3.255	4.016		8.748137857	16.019	
250	Orai-Kanpur	UP70FT8995	Ujjain	Kanpur	MAV	1.1.122	Chemical	No	3890	4470	6050	6420	6310		1.174	1.349		1.644915477	1.901	3.314		7.321066429	12.536	
256	Orai-Kanpur	UP41AT8041	Jhansi	Kolkata	MAV	1.1.122	Dust	No	4190	5450	6075	8480	7770		1.265	1.645		1.95541736	2.558	7.323		14.62035325	24.502	
268	Orai-Kanpur	UP53E5725	Jhansi	Gorakhpur	MAV	1.1.122	Dust	No	4740	5590	5785	8780	7450		1.431	1.687		1.928264868	4.190	8.105		13.82505141	26.120	
269	Orai-Kanpur	GJ12AY6847	Jhansi	Unnao	MAV	1.1.122	Dust	No	4140	5370		8855	7650		1.250	1.621	2.188121437		2.438	6.903	22.924		32.265	
285	Orai-Kanpur	UP90CT8901	Jhansi	Barabanki	MAV	1.1.122	Cotton	No	4450	5190	6125	6310	6240		1.343	1.567		1.635718665	3.255	6.023		7.158704532	16.436	
295	Orai-Kanpur	HR55AT6914	Jasi	Kanpur	MAV	1.1.122	Empty	No	2340	2050	1985	1840	1720		0.706	0.619		0.48567925	0.249	0.147		0.055641419	0.451	
296	Orai-Kanpur	MH46H1046	Mumbai	Lucknow	MAV	1.1.122	Parcel	No	3370	4650	5010	7540	7010		1.017	1.404		1.71323465	1.071	3.881		8.615240342	13.567	
313	Orai-Kanpur	NL01BT2297	Gujarat	Guwahati	MAV	1.1.122	Wheat	No	4140	5370	6470	8470	7510		1.250	1.621		1.966365946	2.438	6.903		14.95055714	24.292	
319	Orai-Kanpur	UP32M9580	Jhansi	Barabanki	MAV	1.1.122	Dust	No	4470	5390	6125	8680	7450		1.349	1.627		1.949286152	3.314	7.006		14.43784551	24.758	
327	Orai-Kanpur	UP3BT7130	Jhansi	Gorakhpur	MAV	1.1.122	Dust	No	3780	5050	5855	8780	7460		1.141	1.524		1.935271963	1.695	5.399		14.02710408	21.120	
348	Orai-Kanpur	UP01FT7218	Indore	Bihar	MAV	1.1.122	Onion	No	2910	3910	4985	6510	6045		0.878	1.180		1.536305509	0.595	1.940		5.570707452	8.106	
356	Orai-Kanpur	NL01AD8427	Mumbai	Guwahati	MAV	1.1.122	Stone	No	3915	3210		8040	7245		1.182	0.969	2.026382076		1.950	0.881	16.861		19.692	
359	Orai-Kanpur	UP53AT5064	Jhansi	Basti	MAV	1.1.122	Empty	No	2040	1910	1720	1655	1585		0.616	0.577		0.43443987	0.144	0.110		0.035622033	0.290	
360	Orai-Kanpur	UP53AT3361	Jhansi	Basti	MAV	1.1.122	Stone	No	4165	5215	6910	8870	7740		1.257	1.574		2.060085837	2.498	6.139		18.01114263	26.649	
364	Orai-Kanpur	UP58BT1716	Jhansi	Barabanki	MAV	1.1.122	Stone	No	3910	4960	7810	7400	7120		1.180	1.497		1.955855303	1.940	5.024		14.63345539	21.597	
365	Orai-Kanpur	UP93AT0423	Jhansi	Kanpur	MAV	1.1.122	Stone	No	4215	5260	6040	8210	7715		1.272	1.588		1.923885434	2.620	6.354		13.69988199	22.674	
366	Orai-Kanpur	UP53GT1705	Jhansi	Unnao	MAV	1.1.122	Empty	No	2095	1915	1795	1685	1590		0.632	0.578		0.444074626	0.160	0.112		0.038888737	0.310	
367	Orai-Kanpur	UP73T2892	Bhopal	Lucknow	MAV	1.1.122	Potatoes	No	2360	5010	6570	7090	7530		0.712	1.512		1.856004204	0.257	5.230		11.86631363	17.353	
372	Orai-Kanpur	MP09AJ5619	Bhopal	Kanpur	MAV	1.1.122	Empty	No	2210	2160	1945	1840	1770		0.667	0.652		0.486555137	0.198	0.181		0.056043887	0.435	
387	Orai-Kanpur	UP771888	Nashik	Kolkata	MAV	1.1.122	Onion	No	2650	4255	5040	6910	6125		0.800	1.284		1.583165455	0.409	2.721		6.282105415	9.412	
388	Orai-Kanpur	UP783764	Indore	Bihar	MAV	1.1.122	Onion	No	2955	3975		6540	5645		0.892	1.200	1.615405011		0.633	2.072	6.810		9.515	
392	Orai-Kanpur	MH42BH2186	Jhansi	Lucknow	MAV	1.1.122	Stone	No	4210	5440	6420	8310	7040		1.271	1.642		1.906805641	2.608	7.270		13.21982518	23.097	
11	Orai-Kanpur	GJ06BT8627	Ujjain	Rajbandh	MAV	1.1.222	Chemical	No	3440	4000	5420	7800	7210		1.038	1.207		1.789436805	1.162	2.125		10.25334244	13.541	
75	Orai-Kanpur	UP78GT6310	Jhansi	Kanpur	MAV	1.1.222	Dust	No	3560	4010	5560	6520	6345		1.075	1.210		1.613821494	1.333	2.146		6.783002575	10.263	
82	Orai-Kanpur	UP92AT9091	Jhansi	Lucknow	MAV	1.1.222	Dust	No	4190	4870	6440	7170	6990		1.265	1.470		1.804326881	2.558	4.669		10.59890202	17.826	
121	Orai-Kanpur	JH209138	Nashik	Kolkata	MAV	1.1.222	Onion	No	3260	4290	6940	7290	7040		0.984	1.295		1.863011299	0.938	2.812		12.04652969	15.796	
169	Orai-Kanpur	JH102173	Ahmedabad	Bihar	MAV	1.1.222	Paper	No	3290	4810	7910	7590	7040		0.993	1.452		1.974248927	0.973	4.443		15.19174432	20.607	
223	Orai-Kanpur	GJ06BT7087	Guna	Sitapur	MAV	1.1.222	Chemical	No	2055	3390	3870	5560	5150		0.620	1.023		1.277043006	0.148	1.096		2.65963532	3.904	
233	Orai-Kanpur	GJ277583	Jhansi	Basti	MAV	1.1.222	Dust	No	4090	5650	5865	9470	8500		1.235	1.705		2.087676272	2.323	8.459		18.99558272	29.777	
249	Orai-Kanpur	UP53HT4216	Jhansi	Basti	MAV	1.1.222	Dust	No	3660	5270	5540	8795	7465		1.105	1.591		1.909433301	1.489	6.403		13.2928459	21.185	
251	Orai-Kanpur	UP25CT3041	Jhansi	Gorakhpur	MAV	1.1.222	Dust	No	3840	5190	6500	8590	7440		1.159	1.567		1.97337304	1.805	6.023		15.16480264	22.992	
254	Orai-Kanpur	UP93BT4390	Jhansi	Basti	MAV	1.1.222	Dust	No	3890	5650	6755	8850	7550		1.174	1.705		2.028115967	1.901	8.459		16.91886157	27.278	
274	Orai-Kanpur	UP53BT8335	Jhansi	Basti	MAV	1.1.222	Dust	No	4010	5690	6140	7450	6570		1.210	1.717		1.76578786	2.146	8.701		9.721966201	20.569	
282	Orai-Kanpur	MP35H8391	Indore	Kanpur	MAV	1.1.222	Rice	No	4080	5740	6180	7540	7025		1.232	1.733		1.81702724	2.300	9.011		10.90048326	22.211	
297	Orai-Kanpur	MP09H1382	Indore	Lucknow	MAV	1.1.222	Rice	No	3870	5890	5740	6120	5820		1.168	1.778		1.548567925	1.862	9.990		5.750704322	17.603	
308	Orai-Kanpur	NL016601	Ujjain	Lucknow	MAV	1.1.222	Iron	No	4160	5820	6050	8555	7810		1.256	1.757		1.963300342	2.486	9.524		14.85754207	26.867	
324	Orai-Kanpur	UP530179	Jhansi	Gorakhpur	MAV	1.1.222	Dust	No	4055	5140	6050	8080	7490		1.224	1.551		1.893667338	2.244	5.794		12.85922378	20.897	
335	Orai-Kanpur	NH012207	Orai	Kanpur	MAV	1.1.222	Pipe	No	3840	4790	5040	5890	5650		1.159	1.446		1.452220373	1.805	4.370		4.447644846	10.622	
336	Orai-Kanpur	NH027624	Jhansi	Basti	MAV	1.1.222	Pipe	No	4150	4810	5120	5470	5140		1.253	1.452		1.377769992	2.462	4.443		3.603353636	10.509	
338	Orai-Kanpur	UP93CT7770	Jhansi	Kanpur	MAV	1.1.222	Dust	No	4190	5690	6050	7055	6585		1.265	1.717		1.724621179	2.558	8.701		8.846568819	20.106	
340	Orai-Kanpur	UP03CT4225	Mumbai	Gonda - Bahraich	MAV	1.1.222	Cement	No	4050	5170	5095	7640	7210		1.222	1.561		1.746956293	2.233	5.930		9.313826818	17.477	
345	Orai-Kanpur	UP78AN6734	Jhansi	Kanpur	MAV	1.1.222	Sand	No	3790	5650	5230	7555	6845		1.144	1.705		1.719365858	1.713	8.459		8.739230501	18.911	
403	Orai-Kanpur	RJ11GB9500	Rajasthan	Varanasi	MAV	1.1.222	Stone	No	3910	5570	5245	9470	8740		1.180	1.681		2.054392572	1.940	7.990		17.8128637	27.743	
24	Orai-Kanpur	GJ169196	Gujarat	Kanpur	MAV	1.2.222	Powder	No	3590	5145	5600	7210	6910		1.084	1.262		1.727248839	1.379	2.535		8.90060726	12.814	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
57	Orai-Kanpur	NL014333	Guna	Sitapur	MAV	1.2.222	Machine Parts	No	3160	4290	5025	6590	6030		0.954	1.052		1.545502321	0.828	1.225		5.705302113	7.758	
58	Orai-Kanpur	NL014737	Guna	Sitapur	MAV	1.2.222	Machine Parts	No	2890	4020	5565	6210	6140		0.872	0.986		1.569151266	0.579	0.945		6.062604615	7.586	
59	Orai-Kanpur	GJ16AU5008	Gujarat	Kanpur	MAV	1.2.222	Clothes	No	2805	3990	8040	5890	5300		0.847	0.979		1.684330385	0.514	0.917		8.048392223	9.479	
76	Orai-Kanpur	UP93BT5595	Jhansi	Kanpur	MAV	1.2.222	Stone	No	3830	3480	4650	6450	5980		1.156	0.853		1.496014715	1.786	0.531		5.008912685	7.326	
98	Orai-Kanpur	UP580821	Jasi	Basti	MAV	1.2.222	Stone	No	4340	5110	5610	8200	7585		1.310	1.253		1.873959884	2.945	2.467		12.33221703	17.744	
110	Orai-Kanpur	UP479205	Orai	Faizabad	MAV	1.2.222	Stone	No	3900	5210	6400	8410	7540		1.177	1.278		1.957607077	1.920	2.665		14.68595204	19.272	
124	Orai-Kanpur	NL015744	Indore	Kanpur	MAV	1.2.222	JCB	No	3160	4910	5210	6015	5410		0.954	1.204		1.457037751	0.828	2.103		4.506954946	7.437	
125	Orai-Kanpur	NL015424	Indore	Kanpur	MAV	1.2.222	JCB	No	2910	4190	6310	6090	5930		0.878	1.028		1.605500569	0.595	1.115		6.64418713	8.354	
136	Orai-Kanpur	UP174789	Delhi	Kanpur	MAV	1.2.222	Gas	No	3210	5210	5910	7040	6590		0.969	1.278		1.711482876	0.881	2.665		8.580058191	12.127	
137	Orai-Kanpur	UP537697	Orai	Basti	MAV	1.2.222	Stone	No	4590	5210	6215	9040	8140		1.385	1.278		2.049137251	3.684	2.665		17.63129427	23.981	
140	Orai-Kanpur	UP537077	Orai	Basti	MAV	1.2.222	Empty	No	2550	2210	2000	1855	1740		0.770	0.542		0.490058684	0.351	0.086		0.057675632	0.495	
155	Orai-Kanpur	MH463274	Mumbai	Barabanki	MAV	1.2.222	Food	No	3290	3910	4560	6110	5740		0.993	0.959		1.437330297	0.973	0.846		4.268018763	6.086	
158	Orai-Kanpur	RJ056555	Kota	Patna	MAV	1.2.222	Soyabean	No	3090	3610	4755	6910	6510		0.933	0.885		1.591924323	0.757	0.614		6.422286474	7.793	
185	Orai-Kanpur	UP440907	Orai	Kanpur	MAV	1.2.222	Empty	No	2100	2040	1410	1870	1700		0.634	0.500		0.436191644	0.161	0.063		0.036200066	0.260	
196	Orai-Kanpur	UP515991	Jhansi	Basti	MAV	1.2.222	Stone	No	3210	4625	5855	8490	7545		0.969	1.134		1.917316283	0.881	1.655		13.51372391	16.050	
221	Orai-Kanpur	UP539183	Jhansi	Ayodhya	MAV	1.2.222	Stone	No	4215	5045	6415	8210	7560		1.272	1.237		1.943154944	2.620	2.344		14.25705182	19.221	
224	Orai-Kanpur	UP53GT5958	Jhansi	Gorakhpur	MAV	1.2.222	Stone	No	4010	5070	8120	9460	3050		1.210	1.243		1.806954541	2.146	2.390		10.6607782	15.197	
7	Orai-Kanpur	UP32GF4210	Orai	Kanpur	MAV	1.22.222	Sand	No	3530	4540	5480	6005	6600	6210	1.065		1.328	1.648	1.289		3.114	7.376	11.779	
18	Orai-Kanpur	RJ01GB5451	Ujjain	Raebareli	MAV	1.22.222	Iron	No	3010	5045	5110	5510	9375	8710	0.909		1.346	2.067	0.681		3.285	18.242	22.208	
19	Orai-Kanpur	RJ01GB4292	Ujjain	Raebareli	MAV	1.22.222	Iron	No	3610	5065	6595	7955	8490	7500	1.090		1.546	2.097	1.410		5.710	19.349	26.468	
23	Orai-Kanpur	UP478639	Orai	Kanpur	MAV	1.22.222	Sand	No	3210	4210	6090	7110	8510	8010	0.969		1.366	2.070	0.881		3.477	18.350	22.709	
40	Orai-Kanpur	UP775419	Kota	Lucknow	MAV	1.22.222	Stone	No	3890	4490	7090	7250	9370	8560	1.174		1.535	2.205	1.901		5.555	23.660	31.115	
62	Orai-Kanpur	UP4L8211	Jasi	Kanpur	MAV	1.22.222	Stone	No	4195	5210	5970	6255	7585	6295	1.266		1.482	1.764	2.571		4.826	9.674	17.071	
64	Orai-Kanpur	UP789744	Orai	Kanpur	MAV	1.22.222	Empty	No	2110	2040	1915	1850	1750	1655	0.637		0.524	0.460	0.165		0.076	0.045	0.285	
65	Orai-Kanpur	UP512957	Orai	Basti	MAV	1.22.222	Stone	No	4140	4410	6910	7085	8910	8030	1.250		1.501	2.104	2.438		5.072	19.609	27.119	
77	Orai-Kanpur	UP92T9860	Jhansi	Kanpur	MAV	1.22.222	Sand	No	4170	5440	6610	7255	7970	7025	1.259		1.598	1.949	2.510		6.513	14.425	23.448	
78	Orai-Kanpur	RJ09GC3891	Jhansi	Kanpur	MAV	1.22.222	Empty	No	2250	2110	2085	1920	1750	1545	0.679		0.556	0.457	0.213		0.096	0.044	0.352	
89	Orai-Kanpur	UP78GV6509	Jhansi	Balrampur	MAV	1.22.222	Dust	No	4370	5440	6490	6945	7170	6960	1.319		1.582	1.846	3.027		6.257	11.611	20.895	
93	Orai-Kanpur	UP42BT6599	Orai	Kanpur	MAV	1.22.222	Empty	No	2100	1900	1855	1750	1520	1445	0.634		0.498	0.413	0.161		0.061	0.029	0.252	
99	Orai-Kanpur	UP757850	Jasi	Kanpur	MAV	1.22.222	Sand	No	3490	4290	5100	5560	9110	8545	1.053		1.245	2.033	1.231		2.402	17.095	20.728	
100	Orai-Kanpur	UP455966	Jasi	Ayodhya	MAV	1.22.222	Stone	No	4100	4490	5310	5855	7920	7040	1.238		1.299	1.823	2.346		2.849	11.048	16.243	
102	Orai-Kanpur	UP512764	Orai	Basti	MAV	1.22.222	Stone	No	3590	4140	5610	5690	7760	6530	1.084		1.293	1.750	1.379		2.792	9.379	13.550	
107	Orai-Kanpur	UP434688	Jhansi	Raebareli	MAV	1.22.222	Stone	No	3160	4140	5610	5685	7210	6400	0.954		1.293	1.690	0.828		2.792	8.158	11.777	
109	Orai-Kanpur	UP928177	Orai	Lucknow	MAV	1.22.222	Stone	No	3250	4940	5660	5480	7710	6740	0.981		1.405	1.746	0.926		3.900	9.286	14.112	
113	Orai-Kanpur	UP477575	Jhansi	Balrampur	MAV	1.22.222	Stone	No	3810	4910	7210	7450	9160	8750	1.150		1.607	2.221	1.749		6.666	24.344	32.758	
115	Orai-Kanpur	UP934249	Orai	Kanpur	MAV	1.22.222	Stone	No	3290	4910	7290	7555	9210	8495	0.993		1.617	2.212	0.973		6.843	23.962	31.778	
127	Orai-Kanpur	RJ118687	Guna	Sitapur	MAV	1.22.222	Oil	No	3290	5010	7170	7650	7590	7210	0.993		1.615	1.966	0.973		6.798	14.951	22.722	
128	Orai-Kanpur	UP537035	Indore	Burdwan	MAV	1.22.222	Onion	No	2675	3225	4050	5740	6075	5465	0.807		0.964	1.514	0.425		0.865	5.248	6.538	
141	Orai-Kanpur	UP786541	Jhansi	Faizabad	MAV	1.22.222	Sand	No	3900	5040	5540	7960	9090	8510	1.177		1.403	2.239	1.920		3.870	25.121	30.912	
166	Orai-Kanpur	UP539168	Jhansi	Kanpur	MAV	1.22.222	Stone	No	3910	4810	6050	7210	8310	7415	1.180		1.440	2.009	1.940		4.297	16.285	22.522	
186	Orai-Kanpur	UP531627	Orai	Kanpur	MAV	1.22.222	Stone	No	3140	4490	7210	6480	9010	8530	0.948		1.551	2.104	0.807		5.789	19.592	26.188	
226	Orai-Kanpur	UP53HT7627	Jhansi	Kanpur	MAV	1.22.222	Dust	No	4290	5050	5560	7500	8450	7440	1.295		1.407	2.049	2.812		3.915	17.616	24.342	
262	Orai-Kanpur	UP93BT5294	Jhansi	Lucknow	MAV	1.22.222	Stone	No	3050	4050	5820	7065	8780	8045	0.921		1.308	2.092	0.718		2.932	19.172	22.821	
266	Orai-Kanpur	UP53BT4223	Jhansi	Barabanki	MAV	1.22.222	Stone	No	3790	5140	6450	5780	7870	6680	1.144		1.537	1.781	1.713		5.574	10.054	17.341	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
286	Orai-Kanpur	NL012260	Orai	Kanpur	MAV	1.22.222	Machine Parts	No	4050	5020	5245	6170	6555	5455	1.222		1.361	1.592	2.233		3.430	6.429	12.092	
294	Orai-Kanpur	UP64N3218	Jasi	Basti	MAV	1.22.222	Stone	No	4190	5050	6225	6950	8480	7120	1.265		1.495	1.975	2.558		4.992	15.219	22.769	
299	Orai-Kanpur	MP09HS7390	Jhansi	Kanpur	MAV	1.22.222	Potatoes	No	3870	5490	6050	6240	7080	6625	1.168		1.530	1.747	1.862		5.478	9.314	16.654	
301	Orai-Kanpur	UP53FT8226	Jhansi	Basti	MAV	1.22.222	Dust	No	3890	5440	6210	7050	7920	6840	1.174		1.544	1.910	1.901		5.690	13.317	20.908	
303	Orai-Kanpur	UP40AT5580	Jasi	Unnao	MAV	1.22.222	Dust	No	4120	4490	6050	7450	8870	8420	1.244		1.397	2.167	2.392		3.812	22.049	28.253	
310	Orai-Kanpur	UP51BT1134	Jhansi	Basti	MAV	1.22.222	Stone	No	3890	5450	5820	6050	7870	7105	1.174		1.494	1.842	1.901		4.983	11.501	18.385	
314	Orai-Kanpur	UP78CN8073	Jhansi	Lucknow	MAV	1.22.222	Stone	No	3870	4440	5750	6255	8895	8030	1.168		1.351	2.030	1.862		3.331	16.992	22.185	
316	Orai-Kanpur	UP32L5259	Orai	Kanpur	MAV	1.22.222	Groceries	No	4050	5380	5850	6695	7215	6580	1.222		1.489	1.795	2.233		4.913	10.374	17.521	
349	Orai-Kanpur	RJ099998	kota	Raebareli	MAV	1.22.222	Powder	No	3230	4490	5110	6125	7970	7000	0.975		1.273	1.848	0.903		2.624	11.655	15.182	
350	Orai-Kanpur	RJ473741	Guna	Sitapur	MAV	1.22.222	Iron	No	3920	4110	5040	5475	9210	8645	1.183		1.213	2.043	1.960		2.165	17.436	21.561	
352	Orai-Kanpur	UP530225	Orai	Basti	MAV	1.22.222	Stone	No	3210	4910	5460	5895	8910	8310	0.969		1.375	2.025	0.881		3.572	16.802	21.256	
384	Orai-Kanpur	UP538802	Jhansi	Raebareli	MAV	1.22.222	Stone	No	3910	5350	6110	6050	9210	8560	1.180		1.519	2.086	1.940		5.328	18.948	26.216	
406	Orai-Kanpur	RJ364938	Ratlam	Bihar	MAV	1.22.222	Cement	No	3690	4490	6290	6550	9160	8540	1.114		1.429	2.124	1.539		4.172	20.353	26.064	
71	Kanpur-Orai	UP33T6589	Kanpur	Orai	Bus	1.2	Passengers	Yes	2890	4255					0.872	1.044			0.579	1.186			1.765	
77	Kanpur-Orai	UP93AT2225	Kanpur	Jhansi	Bus	1.2	Passengers	Yes	2870	4010					0.866	0.983			0.563	0.935			1.499	
82	Kanpur-Orai	UP93BT1520	Rania	Kota	Bus	1.2	Passengers	Yes	2710	3990					0.818	0.979			0.448	0.917			1.365	
107	Kanpur-Orai	UP93AT4717	Lucknow	Jhansi	Bus	1.2	Passengers	Yes	2480	3740					0.749	0.917			0.314	0.708			1.022	
108	Kanpur-Orai	UP78FT7135	Kanpur	Jhansi	Bus	1.2	Passengers	Yes	2310	3640					0.697	0.893			0.236	0.635			0.871	
110	Kanpur-Orai	UP926036	Kanpur	Jhansi	Bus	1.2	Passengers	Yes	2170	3640					0.655	0.893			0.184	0.635			0.819	**1.207**
126	Kanpur-Orai	UP93BT7616	Kanpur	Jhansi	Bus	1.2	Passengers	Yes	2390	3830					0.721	0.939			0.271	0.778			1.049	
149	Kanpur-Orai	UP78CT5621	Lucknow	Jhansi	Bus	1.2	Passengers	Yes	2280	4560					0.688	1.118			0.224	1.564			1.788	
167	Kanpur-Orai	UP13T4713	Lucknow	Jhansi	Bus	1.2	Passengers	Yes	2380	3645					0.718	0.894			0.266	0.639			0.905	
223	Kanpur-Orai	UP93E8983	Lucknow	Jhansi	Bus	1.2	Passengers	Yes	2770	3670					0.836	0.900			0.489	0.656			1.145	
226	Kanpur-Orai	UP78CT9750	Kanpur	Jhansi	Bus	1.2	Passengers	Yes	2460	3790					0.743	0.929			0.304	0.746			1.050	
144	Kanpur-Orai	MH46BH9152	Gorakhpur	Orai	LCV	1.2	Fruits	No	2525	4500					0.762	1.104			0.337	1.483			1.821	
151	Kanpur-Orai	CG046137	Kanpur	Orai	LCV	1.2	Empty	No	1405	1350					0.424	0.331			0.032	0.012			0.044	
164	Kanpur-Orai	UP93T9995	Kanpur	Orai	LCV	1.2	Empty	No	1980	1755					0.598	0.430			0.128	0.034			0.162	
170	Kanpur-Orai	DL1LV8117	Etawah	Jhansi	LCV	1.2	Medicine	Yes	2890	4575					0.872	1.122			0.579	1.585			2.164	
174	Kanpur-Orai	MP063814	Kanpur	Orai	LCV	1.2	Onion	Yes	3800	4970					1.147	1.219			1.731	2.207			3.938	
196	Kanpur-Orai	UP71T4196	Kanpur	Orai	LCV	1.2	Eggs	Yes	2870	4210					0.866	1.032			0.563	1.136			1.700	
198	Kanpur-Orai	UP32MN2868	Kanpur	Orai	LCV	1.2	Empty	Yes	1880	1440					0.567	0.353			0.104	0.016			0.119	
252	Kanpur-Orai	UP78T3441	Kalpi	Orai	LCV	1.2	Vegetables	Yes	2940	3955					0.887	0.970			0.620	0.885			1.505	
254	Kanpur-Orai	UP92T3482	Kanpur	Orai	LCV	1.2	Parcel	Yes	3020	5060					0.912	1.241			0.690	2.372			3.062	
258	Kanpur-Orai	UP92T4223	Kanpur	Orai	LCV	1.2	Empty	Yes	2085	1955					0.629	0.479			0.157	0.053			0.210	
265	Kanpur-Orai	UP77N9712	Kalpi	Orai	LCV	1.2	Empty	Yes	1350	1120					0.407	0.275			0.028	0.006			0.033	
273	Kanpur-Orai	UP77AT2098	Kanpur	Orai	LCV	1.2	Milk	Yes	2860	3755					0.863	0.921			0.555	0.719			1.275	**1.686**
275	Kanpur-Orai	MH04JK1322	Kanpur	Orai	LCV	1.2	Fruits	Yes	2470	4260					0.746	1.045			0.309	1.191			1.500	
280	Kanpur-Orai	UP78GT6951	Kalpi	Orai	LCV	1.2	Ice cream	Yes	2450	3500					0.740	0.858			0.299	0.543			0.842	
283	Kanpur-Orai	UP77A0299	Kalpi	Orai	LCV	1.2	Milk	Yes	2670	4755					0.806	1.166			0.422	1.849			2.271	
287	Kanpur-Orai	MP04CG6832	Auraiya	Jhansi	LCV	1.2	Sand	Yes	3450	5655					1.041	1.387			1.176	3.700			4.876	
289	Kanpur-Orai	UP33BT7583	Kanpur	Orai	LCV	1.2	Milk	Yes	2920	3655					0.881	0.896			0.603	0.646			1.249	
294	Kanpur-Orai	UP78DT0589	Kalpi	Orai	LCV	1.2	Fruits	Yes	2540	4010					0.767	0.983			0.346	0.935			1.281	
298	Kanpur-Orai	UP63BT1536	Kanpur	Orai	LCV	1.2	Plastic	Yes	3245	4955					0.979	1.215			0.920	2.181			3.101	
314	Kanpur-Orai	UP30T9530	Kalpi	Orai	LCV	1.2	Sand	Yes	3440	5455					1.038	1.338			1.162	3.203			4.366	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
324	Kanpur-Orai	UP92AT3141	Kanpur	Orai	LCV	1.2	Empty	Yes	1760	1565					0.531	0.384			0.080	0.022			0.101	
329	Kanpur-Orai	UP78TS7520	Kalpi	Orai	LCV	1.2	Empty	Yes	1455	1750					0.439	0.429			0.037	0.034			0.071	
367	Kanpur-Orai	UP93AT9329	Kalpi	Jhansi	LCV	1.2	Groceries	Yes	2980	5095					0.899	1.250			0.655	2.438			3.092	
5	Kanpur-Orai	MH04JU1615	Kanpur	Mumbai	2Axle	1.2	Iron	Yes	2840	5690					0.857	1.395			0.540	3.792			4.332	
11	Kanpur-Orai	JH14GP6057	Kanpur	Orai	2Axle	1.2	Empty	Yes	2390	1710					0.721	0.419			0.271	0.031			0.302	
13	Kanpur-Orai	UP32RN3803	Kanpur	Orai	2Axle	1.2	Empty	Yes	2170	1720					0.655	0.422			0.184	0.032			0.216	
30	Kanpur-Orai	RJ2GA2380	Kanpur	Orai	2Axle	1.2	Empty	Yes	2420	2045					0.730	0.502			0.285	0.063			0.348	
33	Kanpur-Orai	NL01AC6344	Lucknow	Orai	2Axle	1.2	Plastic	Yes	3470	5640					1.047	1.383			1.203	3.661			4.864	
38	Kanpur-Orai	UP92T9257	Kanpur	Orai	2Axle	1.2	Oil	Yes	2870	4460					0.866	1.094			0.563	1.431			1.995	
78	Kanpur-Orai	HR64E6400	Guwahati	Ahmedabad	2Axle	1.2	Potatoes	Yes	2870	5690					0.866	1.395			0.563	3.792			4.355	
89	Kanpur-Orai	NL01AC4492	Kanpur	Indore	2Axle	1.2	Empty	Yes	2470	1710					0.746	0.419			0.309	0.031			0.340	
112	Kanpur-Orai	GJ03BM9119	Unnao	Jhansi	2Axle	1.2	Empty	Yes	2055	1810					0.620	0.444			0.148	0.039			0.187	
114	Kanpur-Orai	UP78F6625	Gorakhpur	Jhansi	2Axle	1.2	Parcel	Yes	2550	3620					0.770	0.888			0.351	0.621			0.972	
124	Kanpur-Orai	RJ20GB1573	Kanpur	Jhansi	2Axle	1.2	Empty	Yes	2360	1740					0.712	0.427			0.257	0.033			0.291	
141	Kanpur-Orai	GJ03BU103	Kanpur	Orai	2Axle	1.2	Empty	Yes	1440	1900					0.435	0.466			0.036	0.047			0.083	
188	Kanpur-Orai	UP85T7885	Kanpur	Orai	2Axle	1.2	Empty	Yes	2340	1970					0.706	0.483			0.249	0.054			0.303	
199	Kanpur-Orai	UP79T9656	Kanpur	Jhansi	2Axle	1.2	Parcel	Yes	2170	1620					0.655	0.397			0.184	0.025			0.209	
200	Kanpur-Orai	UP93CT4994	Kanpur	Jhansi	2Axle	1.2	Onion	Yes	3170	5820					0.957	1.427			0.838	4.151			4.989	
205	Kanpur-Orai	UP78N0794	Kalpi	Orai	2Axle	1.2	Parcel	Yes	2940	3265					0.887	0.801			0.620	0.411			1.031	
214	Kanpur-Orai	HR550968	Kalpi	Orai	2Axle	1.2	Eggs	Yes	2470	3170					0.746	0.777			0.309	0.365			0.674	**1.134**
222	Kanpur-Orai	MH044493	Kanpur	Jhansi	2Axle	1.2	Parcel	Yes	2840	3870					0.857	0.949			0.540	0.811			1.351	
231	Kanpur-Orai	MH48CB2937	Kanpur	Bhusawal	2Axle	1.2	Iron	Yes	1743	3120					0.526	0.765			0.077	0.343			0.419	
242	Kanpur-Orai	MH04SU3676	Kanpur	Jhansi	2Axle	1.2	Iron	Yes	2250	1930					0.679	0.473			0.213	0.050			0.263	
281	Kanpur-Orai	UP24TZ2225	Kalpi	Jhansi	2Axle	1.2	Onion	Yes	2060	3700					0.622	0.907			0.149	0.678			0.827	
291	Kanpur-Orai	GJ18BT8509	Auraiya	Jhansi	2Axle	1.2	Courier	Yes	2125	1960					0.641	0.481			0.169	0.053			0.223	
301	Kanpur-Orai	HR55G0542	Kanpur	Jhansi	2Axle	1.2	Courier	Yes	2005	1995					0.605	0.489			0.134	0.057			0.191	
304	Kanpur-Orai	GJ039211	Kanpur	Indore	2Axle	1.2	Iron	Yes	2070	3460					0.625	0.849			0.152	0.518			0.671	
308	Kanpur-Orai	UP21BN3416	Kanpur	Dewas	2Axle	1.2	Iron	Yes	2260	2565					0.682	0.629			0.217	0.157			0.373	
320	Kanpur-Orai	UP30T9533	Kanpur	Orai	2Axle	1.2	Furniture	Yes	2260	2370					0.682	0.581			0.217	0.114			0.331	
340	Kanpur-Orai	GJ033103	Kanpur	Jhansi	2Axle	1.2	Eggs	Yes	3310	4190					0.999	1.028			0.996	1.115			2.111	
349	Kanpur-Orai	UP774419	Kolkata	Aata	2Axle	1.2	Empty	Yes	2250	2045					0.679	0.502			0.213	0.063			0.276	
350	Kanpur-Orai	HR55AK8719	Guwahati	Orai	2Axle	1.2	Empty	Yes	1950	1745					0.589	0.428			0.120	0.034			0.154	
368	Kanpur-Orai	NL01AE3932	Kanpur	Bombay	2Axle	1.2	Furniture	Yes	2490	5045					0.752	1.237			0.319	2.344			2.663	
369	Kanpur-Orai	UP32JN9498	Lucknow	Pama	2Axle	1.2	Plastic	No	2090	4570					0.631	1.121			0.158	1.578			1.736	
370	Kanpur-Orai	HR55AH8889	Guwahati	Surat	2Axle	1.2	Courier	No	1420	2150					0.429	0.527			0.034	0.077			0.111	
375	Kanpur-Orai	MP09GG5795	Kanpur	Indore	2Axle	1.2	Courier	No	2170	1950					0.655	0.478			0.184	0.052			0.236	
17	Kanpur-Orai	UP22AT3456	Guwahati	Mumbai	3Axle	1.22	Parcel	No	2155	3720	3345				0.650		0.937		0.179		0.770		0.949	
22	Kanpur-Orai	RJ14GK9296	Lucknow	Orai	3Axle	1.22	Empty	No	2170	2085	1755				0.655		0.509		0.184		0.067		0.251	
25	Kanpur-Orai	MH01AA4220	Kanpur	Orai	3Axle	1.22	Eggs	Yes	2410	4430	3955				0.727		1.112		0.280		1.527		1.807	
27	Kanpur-Orai	UP78CN3748	Kanpur	Orai	3Axle	1.22	Parcel	Yes	2170	5215	4755				0.655		1.322		0.184		3.052		3.236	
37	Kanpur-Orai	UP21CN0955	Guwahati	Ahmedabad	3Axle	1.22	Iron	Yes	2840	5820	5440				0.857		1.493		0.540		4.966		5.506	
44	Kanpur-Orai	BR01GL4669	Kanpur	Orai	3Axle	1.22	Stick	Yes	3790	5720	5540				1.144		1.493		1.713		4.966		6.678	
52	Kanpur-Orai	HR38AD1135	kanpur	Ahmedabad	3Axle	1.22	Groceries	Yes	3750	5670	5290				1.132		1.453		1.641		4.457		6.099	
61	Kanpur-Orai	UP96T9430	Kanpur	Orai	3Axle	1.22	Parcel	Yes	2770	5565	4985				0.836		1.399		0.489		3.827		4.315	

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			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
62	Kanpur-Orai	WB23D6303	Kanpur	Jhansi	3Axle	1.22	Aluminium	Yes	3380	5780	5460				1.020		1.490		1.083		4.930		6.014	
74	Kanpur-Orai	RJ32GB3883	Kanpur	Orai	3Axle	1.22	Empty	Yes	2390	1780	1545				0.721		0.441		0.271		0.038		0.309	
76	Kanpur-Orai	GJ011251	Kanpur	Indore	3Axle	1.22	Iron	Yes	3870	5890	5470				1.168		1.506		1.862		5.144		7.006	
87	Kanpur-Orai	UP77AN3289	Kanpur	Jhansi	3Axle	1.22	Petrol	Yes	3870	5160	4980				1.168		1.344		1.862		3.266		5.128	
96	Kanpur-Orai	NL01AD0516	Kanpur	Ujjain	3Axle	1.22	Empty	Yes	2120	2255	2155				0.640		0.585		0.168		0.117		0.285	
100	Kanpur-Orai	MH41B4286	Kanpur	Orai	3Axle	1.22	Empty	Yes	2260	2105	1955				0.682		0.538		0.217		0.084		0.300	
109	Kanpur-Orai	MP46H0691	Kanpur	Jhansi	3Axle	1.22	Medicine	Yes	2760	3740	3650				0.833		0.980		0.482		0.921		1.403	
125	Kanpur-Orai	UP93CT7990	Kanpur	Jhansi	3Axle	1.22	Empty	Yes	2260	2060	1875				0.682		0.522		0.217		0.074		0.291	
130	Kanpur-Orai	NL01AT6381	Etawah	Jhansi	3Axle	1.22	Empty	Yes	1870	1750	1655				0.564		0.451		0.102		0.042		0.143	
131	Kanpur-Orai	NL01A8752	Etawah	Jhansi	3Axle	1.22	Empty	Yes	2170	2250	2145				0.655		0.583		0.184		0.115		0.299	
134	Kanpur-Orai	HR55AL7270	Unnao	Ujjain	3Axle	1.22	Groceries	Yes	2470	4560	4255				0.746		1.169		0.309		1.865		2.174	
142	Kanpur-Orai	GJ039102	Unnao	Jhansi	3Axle	1.22	Medicine	Yes	3085	3970	3750				0.931		1.023		0.752		1.097		1.849	
145	Kanpur-Orai	HR74A4992	Unnao	Jhansi	3Axle	1.22	Plastic	Yes	3090	4905	4020				0.933		1.183		0.757		1.960		2.717	
180	Kanpur-Orai	RJ414941	Kanpur	Jhansi	3Axle	1.22	Empty	Yes	1890	1955	1755				0.570		0.492		0.106		0.059		0.164	
183	Kanpur-Orai	UP780364	Kanpur	Jhansi	3Axle	1.22	Empty	Yes	1890	1605	1570				0.570		0.421		0.106		0.031		0.137	
186	Kanpur-Orai	UP39BT3056	Kanpur	Orai	3Axle	1.22	Oil	Yes	3920	4460	4380				1.183		1.172		1.960		1.886		3.846	
193	Kanpur-Orai	MH04AA3328	Gorakhpur	Ujjain	3Axle	1.22	Empty	Yes	2170	2245	2145				0.655		0.582		0.184		0.115		0.299	
237	Kanpur-Orai	UP78BT0531	Kanpur	Lalitpur	3Axle	1.22	Stone	Yes	2160	6085	5500				0.652		1.536		0.181		5.564		5.745	**2.591**
241	Kanpur-Orai	UP93CT9103	Kanpur	Orai	3Axle	1.22	Eggs	Yes	2505	4480	3965				0.756		1.120		0.327		1.571		1.898	
251	Kanpur-Orai	NL01E5128	Etawah	Orai	3Axle	1.22	Empty	Yes	2065	2155	2075				0.623		0.561		0.151		0.099		0.250	
253	Kanpur-Orai	UP35AT237	Kanpur	Dewas	3Axle	1.22	Parcel	Yes	2680	6120	5540				0.809		1.546		0.428		5.710		6.138	
256	Kanpur-Orai	UP78GT7929	Kanpur	Jhansi	3Axle	1.22	Empty	Yes	1860	1755	1425				0.561		0.422		0.099		0.032		0.131	
257	Kanpur-Orai	UP78CN3749	Tundla	Bhojpur	3Axle	1.22	Cement	Yes	2245	5565	5085				0.678		1.412		0.211		3.974		4.185	
267	Kanpur-Orai	TS08UF8475	Auraiya	Jhansi	3Axle	1.22	Cement	Yes	2900	6270	5860				0.875		1.608		0.587		6.688		7.275	
272	Kanpur-Orai	UP78GT0147	Kanpur	Jhansi	3Axle	1.22	Powder	Yes	2340	4460	4050				0.706		1.128		0.249		1.620		1.869	
277	Kanpur-Orai	UP22AT9032	Kanpur	Indore	3Axle	1.22	Empty	No	2120	2065	1775				0.640		0.509		0.168		0.067		0.235	
278	Kanpur-Orai	MH049534	Kanpur	Nagpur	3Axle	1.22	Parcel	No	3030	4960	4565				0.915		1.263		0.700		2.543		3.242	
282	Kanpur-Orai	KA25C7089	Auraiya	Dewas	3Axle	1.22	Empty	No	2330	2215	1975				0.703		0.555		0.245		0.095		0.340	
290	Kanpur-Orai	RJ52GA8461	Kanpur	Orai	3Axle	1.22	Empty	No	2220	2015	1655				0.670		0.487		0.202		0.056		0.258	
296	Kanpur-Orai	AS25DC0694	Kanpur	Orai	3Axle	1.22	Oil	No	3140	5125	4675				0.948		1.299		0.807		2.849		3.656	
297	Kanpur-Orai	UP77N9972	Gorakhpur	Jhansi	3Axle	1.22	Powder	No	2245	4390	4115				0.678		1.128		0.211		1.616		1.827	
300	Kanpur-Orai	UP92T9337	Etawah	Jhansi	3Axle	1.22	Iron	No	3350	5125	4990				1.011		1.341		1.045		3.234		4.279	
303	Kanpur-Orai	GJ18BT6440	Lucknow	Ahmedabad	3Axle	1.22	Cement	No	2505	6050	5475				0.756		1.528		0.327		5.450		5.777	
313	Kanpur-Orai	UP93BT6154	Kanpur	Jhansi	3Axle	1.22	Cement	No	2535	6520	6050				0.765		1.666		0.343		7.712		8.055	
319	Kanpur-Orai	UP77AN3322	Kanpur	Jhansi	3Axle	1.22	Vegetables	No	3160	4590	3905				0.954		1.126		0.828		1.609		2.436	
322	Kanpur-Orai	UP92AT9847	Kanpur	Jhansi	3Axle	1.22	Groceries	No	3005	4820	4350				0.907		1.216		0.677		2.184		2.861	
327	Kanpur-Orai	UP22AT9192	Lucknow	Jhansi	3Axle	1.22	Empty	No	1955	2075	1855				0.590		0.521		0.121		0.074		0.195	
333	Kanpur-Orai	UP42BT5705	Prayagraj	Kalpi	3Axle	1.22	Medicine	No	2160	3890	3360				0.652		0.961		0.181		0.853		1.034	
335	Kanpur-Orai	UP21CT9712	Kanpur	Jhansi	3Axle	1.22	Powder	No	2180	4585	4060				0.658		1.146		0.187		1.725		1.913	
344	Kanpur-Orai	MH40FT8876	Kanpur	Orai	3Axle	1.22	Petrol	Yes	3370	4850	4290				1.017		1.212		1.071		2.156		3.226	
351	Kanpur-Orai	UP21CT5373	Kanpur	Nagpur	3Axle	1.22	Empty	Yes	2180	2085	1725				0.658		0.505		0.187		0.065		0.253	
355	Kanpur-Orai	JH02AB6542	Kanpur	Jhansi	3Axle	1.22	Eggs	Yes	3890	4450	4160				1.174		1.141		1.901		1.698		3.598	
358	Kanpur-Orai	UP78BT4443	Bhognipur	Jhansi	3Axle	1.22	Empty	Yes	2150	2050	1945				0.649		0.530		0.177		0.079		0.256	
15	Kanpur-Orai	UP72AT2561	Prayagraj	Delhi	MAV	1.1.22	Coal	No	3075	3255	6025	5895			0.928	0.982	1.580		0.742	0.932	6.236		7.910	

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			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
24	Kanpur-Orai	UP78CN5925	Kanpur	Orai	MAV	1.1.22	Empty	No	2310	2050	1670	1610			0.697	0.619	0.435		0.236	0.147	0.036		0.419	
35	Kanpur-Orai	UP92T9602	Bhokla Par	Orai	MAV	1.1.22	Iron	No	3430	4785	7450	7210			1.035	1.444	1.944		1.149	4.352	14.268		19.768	
36	Kanpur-Orai	UP92T8729	Kanpur	Jhansi	MAV	1.1.22	Empty	No	2370	2160	1970	1840			0.715	0.652	0.505		0.262	0.181	0.065		0.508	
39	Kanpur-Orai	UP55T3840	Kanpur	Jhansi	MAV	1.1.22	Cement	No	3710	5120	6490	6220			1.120	1.545	1.685		1.573	5.704	8.061		15.338	
41	Kanpur-Orai	UP77AN5558	Kanpur	Jhansi	MAV	1.1.22	Steel	No	3820	5880	6470	6220			1.153	1.775	1.682		1.768	9.923	8.011		19.701	
43	Kanpur-Orai	UP32JN93330	Kanpur	Jhansi	MAV	1.1.22	Clothes	No	2370	3160	4560	4230			0.715	0.954	1.165		0.262	0.828	1.844		2.934	
47	Kanpur-Orai	RJ01GA8470	Kanpur	Orai	MAV	1.1.22	Coal	No	2985	3050	6255	6045			0.901	0.921	1.631		0.659	0.718	7.070		8.448	
55	Kanpur-Orai	MH04GR2780	Nagpura	Jhansi	MAV	1.1.22	Coarse aggregate	No	3410	4250	5890	5685			1.029	1.283	1.535		1.122	2.708	5.545		9.376	
56	Kanpur-Orai	UP93BT3588	Kanpur	Orai	MAV	1.1.22	Powder	No	2780	3050	4585	4255			0.839	0.921	1.172		0.496	0.718	1.886		3.100	
63	Kanpur-Orai	UP95T3068	Lucknow	Jhansi	MAV	1.1.22	Coarse aggregate	No	3315	4050	6255	6075			1.001	1.222	1.635		1.002	2.233	7.140		10.375	
72	Kanpur-Orai	UP93T4430	Lucknow	Orai	MAV	1.1.22	Empty	No	2410	2320	1970	1910			0.727	0.700	0.514		0.280	0.240	0.070		0.590	
80	Kanpur-Orai	UP78AN4103	Kanpur	Ahmedabad	MAV	1.1.22	Aggregate	No	2480	2750	6050	5850			0.749	0.830	1.578		0.314	0.475	6.195		6.983	
81	Kanpur-Orai	UP78BT1001	Kanpur	Jhansi	MAV	1.1.22	Oil	No	3170	4450	6470	5670			0.957	1.343	1.609		0.838	3.255	6.710		10.803	
86	Kanpur-Orai	UP75AT1187	Bhognipur	Orai	MAV	1.1.22	Brick	No	4190	5870	6490	6210			1.265	1.772	1.684		2.558	9.855	8.036		20.450	
128	Kanpur-Orai	UP93AT8048	Kanpur	Jhansi	MAV	1.1.22	Coarse aggregate	No	3340	3325	6450	6155			1.008	1.004	1.671		1.033	1.015	7.798		9.846	
143	Kanpur-Orai	UP92T9806	Kanpur	Jhansi	MAV	1.1.22	Empty	No	2180	2015	1990	1705			0.658	0.608	0.490		0.187	0.137	0.058		0.382	
146	Kanpur-Orai	UP32JN1922	Kanpur	Orai	MAV	1.1.22	Gas	No	2050	2565	4250	4050			0.619	0.774	1.100		0.147	0.359	1.466		1.972	
147	Kanpur-Orai	UP50CT4449	Nepanyan	Shivpuri	MAV	1.1.22	Machinary	No	3940	5070	7540	7050			1.189	1.530	1.934		2.000	5.485	13.997		21.482	
150	Kanpur-Orai	UP15AT1724	Noida	Jhansi	MAV	1.1.22	Machinary	No	3870	4820	7215	6985			1.168	1.455	1.883		1.862	4.480	12.560		18.902	
163	Kanpur-Orai	UP78FM3846	Kanpur	Jhansi	MAV	1.1.22	Powder	No	2280	2950	4365	3955			0.688	0.890	1.103		0.224	0.629	1.480		2.333	
169	Kanpur-Orai	MH6BB4483	Kanpur	Jhansi	MAV	1.1.22	Coal	No	3050	3155	7055	6585			0.921	0.952	1.808		0.718	0.822	10.693		12.233	
173	Kanpur-Orai	MH18AA8669	Kanpur	Orai	MAV	1.1.22	Cement	No	4240	6120	6905	6480			1.280	1.847	1.774		2.683	11.644	9.915		24.242	
175	Kanpur-Orai	KA06AX5066	Kanpur	Jhansi	MAV	1.1.22	Aggregate	No	2470	2565	6125	6010			0.746	0.774	1.609		0.309	0.359	6.699		7.367	
179	Kanpur-Orai	NL14G5893	Kanpur	Orai	MAV	1.1.22	Powder	No	2570	3155	4855	4565			0.776	0.952	1.249		0.362	0.822	2.432		3.617	
187	Kanpur-Orai	MP09NS7305	Kanpur	Jhansi	MAV	1.1.22	Empty	No	2125	1985	1755	1565			0.641	0.599	0.440		0.169	0.129	0.038		0.336	
194	Kanpur-Orai	MH041964	Kanpur	Jhansi	MAV	1.1.22	Wheat	No	3340	4020	5810	5540			1.008	1.213	1.505		1.033	2.168	5.126		8.327	
197	Kanpur-Orai	UP02AF8782	Kanpur	Jhansi	MAV	1.1.22	Empty	No	2470	2060	1820	1640			0.746	0.622	0.459		0.309	0.149	0.044		0.503	
201	Kanpur-Orai	UP77AT1719	Kanpur	Jhansi	MAV	1.1.22	Coarse aggregate	No	3440	3085	5080	4985			1.038	0.931	1.334		1.162	0.752	3.170		5.084	
208	Kanpur-Orai	UP78GN0218	Unnao	Ujjain	MAV	1.1.22	Coal	No	3355	3085	7120	6695			1.013	0.931	1.831		1.052	0.752	11.252		13.055	
209	Kanpur-Orai	UP81T8381	Kanpur	Jhansi	MAV	1.1.22	Empty	No	2160	1820	1745	1620			0.652	0.549	0.446		0.181	0.091	0.040		0.311	
216	Kanpur-Orai	UP93BT6127	Hawaspur	Ujjain	MAV	1.1.22	Wheat	No	3370	4450	5890	5370			1.017	1.343	1.493		1.071	3.255	4.966		9.291	
217	Kanpur-Orai	UP93BT4471	Hawaspur	Ujjain	MAV	1.1.22	Wheat	No	3845	4670	5820	5160			1.161	1.410	1.456		1.814	3.948	4.490		10.252	
232	Kanpur-Orai	UP92T8552	Kanpur	Orai	MAV	1.1.22	Coal	No	3295	3455	6955	6525			0.995	1.043	1.787		0.978	1.183	10.200		12.361	
240	Kanpur-Orai	UP32CN3216	Kanpur	Jhansi	MAV	1.1.22	Machinary	No	3420	4330	7320	6350			1.032	1.307	1.812		1.136	2.918	10.787		14.840	
243	Kanpur-Orai	UP32JM9735	Lucknow	Jhansi	MAV	1.1.22	Stone	No	3240	4450	6975	6510			0.978	1.343	1.788		0.915	3.255	10.215		14.384	
245	Kanpur-Orai	UP82T6892	Lucknow	Indore	MAV	1.1.22	Cement	No	3790	5400	7085	6090			1.144	1.630	1.747		1.713	7.058	9.307		18.078	
248	Kanpur-Orai	UP78CN2259	Kalpi	Jhansi	MAV	1.1.22	Stone	No	3040	5210	7095	6820			0.918	1.573	1.845		0.709	6.116	11.581		18.406	
249	Kanpur-Orai	UP35AT1823	Kanpur	Jhansi	MAV	1.1.22	Machinary	No	3650	4110	6955	6555			1.102	1.241	1.791		1.473	2.369	10.291		14.133	
263	Kanpur-Orai	UP344574	Kanpur	Gwalior	MAV	1.1.22	Stone	No	3540	5055	7895	7500			1.069	1.526	2.041		1.304	5.420	17.352		24.075	
268	Kanpur-Orai	UP78BT2139	Gorakhpur	Orai	MAV	1.1.22	Groceries	No	2540	3120	4850	4585			0.767	0.942	1.251		0.346	0.787	2.448		3.580	
269	Kanpur-Orai	UP789186	Kanpur	Orai	MAV	1.1.22	Gas	No	2760	3050	4155	4095			0.833	0.921	1.094		0.482	0.718	1.431		2.631	
270	Kanpur-Orai	UP779630	Kanpur	Orai	MAV	1.1.22	Machinary	No	3600	5095	7045	6800			1.087	1.538	1.835		1.394	5.594	11.350		18.338	
276	Kanpur-Orai	UP78DN3798	Kanpur	Mumbai	MAV	1.1.22	Stone	No	2960	5310	7545	6840			0.893	1.603	1.907		0.637	6.599	13.227		20.463	
286	Kanpur-Orai	UP32LN2192	Kanpur	Orai	MAV	1.1.22	Groceries	No	2670	3010	4965	4685			0.806	0.909	1.279		0.422	0.681	2.679		3.782	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
299	Kanpur-Orai	UP51BT3932	Kalpi	Jhansi	MAV	1.1.22	Gas	No	2265	2565	3955	3785			0.684	0.774	1.026		0.218	0.359	1.109		1.686	
315	Kanpur-Orai	UP32MN9269	Auraiya	Dewas	MAV	1.1.22	Groceries	No	2450	2870	4775	4705			0.740	0.866	1.257		0.299	0.563	2.495		3.357	
328	Kanpur-Orai	UP78CT1627	Unnao	Orai	MAV	1.1.22	Jute	No	2670	2850	4565	4250			0.806	0.860	1.169		0.422	0.548	1.865		2.835	
330	Kanpur-Orai	UP78CT5692	Kalpi	Kota	MAV	1.1.22	Coarse aggregate	No	3310	3545	6355	6125			0.999	1.070	1.655		0.996	1.311	7.493		9.801	
334	Kanpur-Orai	MH18AG7318	Kanpur	Mumbai	MAV	1.1.22	Gas	No	2240	3025	4085	3655			0.676	0.913	1.026		0.209	0.695	1.109		2.013	
341	Kanpur-Orai	UP326931	Gorakhpur	Jhansi	MAV	1.1.22	Sand	No	3480	4240	6780	6100			1.050	1.280	1.708		1.217	2.683	8.501		12.401	
342	Kanpur-Orai	AP6PT6359	Basti	Jhansi	MAV	1.1.22	Aggregate	No	2570	2850	5985	5785			0.776	0.860	1.560		0.362	0.548	5.928		6.838	
343	Kanpur-Orai	UP53HT4737	Unnao	Jhansi	MAV	1.1.22	Aggregate	No	2170	2950	5755	5685			0.655	0.890	1.517		0.184	0.629	5.291		6.104	
352	Kanpur-Orai	WB57C0807	Kolkata	Aata	MAV	1.1.22	Wheat	No	3250	4120	6450	6040			0.981	1.244	1.656		0.926	2.392	7.517		10.835	
356	Kanpur-Orai	HR38Z0736	Kanpur	Orai	MAV	1.1.22	Wheat	No	3650	4350	6050	5910			1.102	1.313	1.586		1.473	2.972	6.320		10.766	
21	Kanpur-Orai	MH01AF7505	Kanpur	Orai	MAV	1.2.11	Bike	No	3360	3950	6050	5560			1.014	0.969	1.539		1.058	0.881	5.612		7.551	
171	Kanpur-Orai	WB11F1917	Kanpur	Orai	MAV	1.2.11	Car	No	3890	4750	6555	6045			1.174	1.165	1.670		1.901	1.842	7.786		11.528	
353	Kanpur-Orai	NL01N5313	Kolkata	Aata	MAV	1.2.11	Bike	No	3290	4205	6115	5420			0.993	1.031	1.529		0.973	1.131	5.469		7.572	
3	Kanpur-Orai	GJ06AT4640	Khadara	Pune	MAV	1.2.22	Iron	No	3490	4560	6930	6545			1.053	1.118	1.786		1.231	1.564	10.184		12.980	
18	Kanpur-Orai	UP53GT5156	Gorakhpur	Jhansi	MAV	1.2.22	Aggregate	No	2255	3325	6450	5665			0.681	0.815	1.606		0.215	0.442	6.655		7.311	
106	Kanpur-Orai	RJ28GA3055	Unnao	Jhansi	MAV	1.2.22	Potatoes	No	2710	3050	4750	4225			0.818	0.748	1.190		0.448	0.313	2.004		2.765	
117	Kanpur-Orai	GJ12Z0637	Etawah	Orai	MAV	1.2.22	Iron	No	3470	4950	7085	6850			1.047	1.214	1.847		1.203	2.172	11.648		15.023	
127	Kanpur-Orai	UP40T9715	Unnao	Jhansi	MAV	1.2.22	Groceries	No	3260	3390	5570	5210			0.984	0.831	1.429		0.938	0.478	4.172		5.587	
133	Kanpur-Orai	WB159767	Kolkata	Kalpi	MAV	1.2.22	Powder	No	2370	3255	4125	4095			0.715	0.798	1.090		0.262	0.406	1.410		2.078	
218	Kanpur-Orai	UP78GT4088	Kanpur	Orai	MAV	1.2.22	Sand	No	3370	4060	6930	5575			1.017	0.996	1.658		1.071	0.983	7.554		9.607	
250	Kanpur-Orai	GJ36T7185	Varanasi	Kalpi	MAV	1.2.22	Sand	No	3540	4440	6360	5930			1.069	1.089	1.629		1.304	1.406	7.047		9.757	
260	Kanpur-Orai	UP78DN0779	Unnao	Jhansi	MAV	1.2.22	Stone	No	3280	5565	7340	7050			0.990	1.365	1.908		0.961	3.470	13.245		17.676	
285	Kanpur-Orai	GJ02ZZ7255	Kanpur	Orai	MAV	1.2.22	Steel	No	3160	4005	6850	5965			0.954	0.982	1.699		0.828	0.931	8.331		10.089	
302	Kanpur-Orai	HR74A8785	Kanpur	Indore	MAV	1.2.22	Empty	No	2295	2100	1900	1695			0.693	0.515	0.477		0.230	0.070	0.052		0.352	
365	Kanpur-Orai	NL01AA1625	Kanpur	Jhansi	MAV	1.2.22	Sand	No	3980	4560	6295	5465			1.201	1.118	1.559		2.083	1.564	5.908		9.555	
366	Kanpur-Orai	UP78DT5055	Gorakhpur	Orai	MAV	1.2.22	Bambo	No	3135	4250	5695	5325			0.946	1.042	1.461		0.802	1.180	4.556		6.538	
6	Kanpur-Orai	UP93CT5383	Kanpur	Devari	MAV	1.1.122	Courier	No	2560	2230	6260	7440	7060		0.773	0.673		1.81834107	0.357	0.205		10.93204454	11.494	
90	Kanpur-Orai	JH05A2399	Unnao	Jhansi	MAV	1.1.122	Cement	No	3480	5180	7585	6950	6450		1.050	1.564		1.838048524	1.217	5.976		11.41373776	18.607	
91	Kanpur-Orai	MP09HJ4759	Kanpur	Shivpuri	MAV	1.1.122	Brick	No	3870	4490	5850	7670	7390		1.168	1.355		1.831479373	1.862	3.374		11.25144048	16.487	
92	Kanpur-Orai	UP74T5015	Kanpur	Orai	MAV	1.1.122	Empty	No	2390	2040	1995	1780	1650		0.721	0.616		0.475168608	0.271	0.144		0.050978959	0.466	
119	Kanpur-Orai	UP42BT2305	Kanpur	Budaun	MAV	1.1.122	Empty	No	2170	1970	1900	1860	1710		0.655	0.595		0.479110099	0.184	0.125		0.05269159	0.362	
120	Kanpur-Orai	UP42B2307	Kanpur	Budaun	MAV	1.1.122	Cement	No	3350	5245	7690	7255	7055		1.011	1.583		1.926951038	1.045	6.282		13.78741091	21.115	
122	Kanpur-Orai	UP75AT2685	Kanpur	Jhansi	MAV	1.1.122	Sand	No	2670	4320	6520	7450	6785		0.806	1.304		1.817903127	0.422	2.891		10.92151651	14.234	
129	Kanpur-Orai	UP93BT7753	Unnao	Jhansi	MAV	1.1.122	Cement	No	3560	5320	7780	7150	6850		1.075	1.606		1.907681528	1.333	6.649		13.24413191	21.226	
132	Kanpur-Orai	UP974841	Kanpur	Ujjain	MAV	1.1.122	Empty	No	2450	2060	1945	1745	1620		0.740	0.622		0.46509591	0.299	0.149		0.046791835	0.495	
135	Kanpur-Orai	MH12SF6520	Kolkata	kalpi	MAV	1.1.122	Stone	No	3470	4890	6170	8920	8120		1.047	1.476		2.032933345	1.203	4.746		17.0801845	23.030	
154	Kanpur-Orai	UP77AN4898	Rania	Orai	MAV	1.1.122	Empty	No	2170	2040	1970	1940	1760		0.655	0.616		0.496627836	0.184	0.144		0.060830899	0.389	
158	Kanpur-Orai	UP93BT6233	Gorakhpur	Jhansi	MAV	1.1.122	Aggregate	No	3380	4870	5985	5745	5540		1.020	1.470		1.512656565	1.083	4.669		5.235538361	10.988	
159	Kanpur-Orai	UP93BT9460	Kanpur	Jhansi	MAV	1.1.122	Oil	No	3125	4425	5370	5785	5650		0.943	1.336		1.471927827	0.792	3.182		4.694032185	8.668	
161	Kanpur-Orai	UP41BT3778	Kanpur	Ujjain	MAV	1.1.122	Powder	No	2355	4860	6850	7255	6850		0.711	1.467		1.835420864	0.255	4.631		11.34860961	16.235	
191	Kanpur-Orai	UP93CT9110	Kanpur	Jhansi	MAV	1.1.122	Aggregate	No	3540	5560	5635	5425	5125		1.069	1.678		1.417622843	1.304	7.933		4.038711311	13.275	
202	Kanpur-Orai	UP78ET5734	Kanpur	Jhansi	MAV	1.1.122	Parcel	No	2840	4450	8255	8750	8540		0.857	1.343		2.237452921	0.540	3.255		25.06199413	28.857	
215	Kanpur-Orai	UP93ET5219	Kanpur	Jhansi	MAV	1.1.122	Courier	No	2640	3920	6875	7465	6950		0.797	1.183		1.864763073	0.403	1.960		12.09190263	14.455	
261	Kanpur-Orai	UP81CT0260	Gorakhpur	Jhansi	MAV	1.1.122	Empty	No	2480	2005	1915	1805	1650		0.749	0.605		0.470351231	0.314	0.134		0.048942837	0.497	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
262	Kanpur-Orai	NL016504	Gorakhpur	Orai	MAV	1.1.122	Empty	No	2505	2450	2330	2270	2185		0.756	0.740		0.594289218	0.327	0.299		0.124735882	0.751	
271	Kanpur-Orai	UP81BT9221	Kanpur	Jhansi	MAV	1.1.122	Aggregate	No	3560	5010	6155	6110	5745		1.075	1.512		1.577472191	1.333	5.230		6.192226691	12.755	
279	Kanpur-Orai	UP78DT2039	Kanpur	Orai	MAV	1.1.122	Courier	No	2350	2870	5565	6400	5980		0.709	0.866		1.571778926	0.253	0.563		6.103315863	6.920	
284	Kanpur-Orai	UP30AT3794	Gorakhpur	Jhansi	MAV	1.1.122	Parcel	No	3210	3685	5450	6250	5885		0.969	1.112		1.540247	0.881	1.531		5.628095866	8.040	
309	Kanpur-Orai	UP45T8431	Kanpur	Jhansi	MAV	1.1.122	Cement	No	3455	5505	8065	7195	6745		1.043	1.662		1.927388981	1.183	7.623		13.79994919	22.606	
310	Kanpur-Orai	JH10PE2850	Etawah	Orai	MAV	1.1.122	Machinery	No	2560	2230	6260	7440	7060		0.773	0.673		1.81834107	0.357	0.205		10.93204454	11.494	
317	Kanpur-Orai	RJ02GC3282	Kanpur	Kota	MAV	1.1.122	Groceries	No	3250	3090	4560	5450	5220		0.981	0.933		1.33397565	0.926	0.757		3.166588346	4.849	
331	Kanpur-Orai	UP53AT8737	Gorakhpur	Jhansi	MAV	1.1.122	Courier	No	2670	4985	6695	7015	6565		0.806	1.505		1.775860559	0.422	5.126		9.945702111	15.494	
347	Kanpur-Orai	UP42BT5142	Kanpur	Jhansi	MAV	1.1.122	Empty	No	2380	2190	2090	1970	1910		0.718	0.661		0.522904441	0.266	0.191		0.074763448	0.532	
361	Kanpur-Orai	MP09FT1578	Kanpur	Jhansi	MAV	1.1.122	Aggregate	No	3490	5440	6075	5785	5420		1.053	1.642		1.513532452	1.231	7.270		5.247675217	13.749	
362	Kanpur-Orai	NL01AA9350	Kanpur	Orai	MAV	1.1.122	Empty	No	2150	2085	1925	1890	1720		0.649	0.629		0.484803363	0.177	0.157		0.055241123	0.389	
380	Kanpur-Orai	UP47T3404	Hawaspur	Jhansi	MAV	1.1.122	Courier	No	2440	3690	5790	6125	5880		0.736	1.114		1.558640624	0.294	1.539		5.901792894	7.735	
42	Kanpur-Orai	UP92AT2099	Kanpur	Jhansi	MAV	1.1.222	Empty	No	2490	2110	2050	1950	1755		0.752	0.637		0.504072874	0.319	0.165		0.064561455	0.548	
50	Kanpur-Orai	UP32SN0076	Lucknow	Jhansi	MAV	1.1.222	Coal	No	3780	5040	8560	8890	8445		1.141	1.521		2.26810896	1.695	5.356		26.46401032	33.515	
64	Kanpur-Orai	UP93CT4824	Kanpur	Jhansi	MAV	1.1.222	Empty	No	2370	2160	1955	1890	1840		0.715	0.652		0.497941666	0.262	0.181		0.061477171	0.504	
65	Kanpur-Orai	UP56AT4639	Gorakhpur	Jhansi	MAV	1.1.222	Aggregate	No	3170	5060	6325	6075	5745		0.957	1.527		1.589296663	0.838	5.441		6.379988353	12.660	
66	Kanpur-Orai	UP56AT5630	Gorakhpur	Jhansi	MAV	1.1.222	Empty	No	2280	2010	1980	1750	1655		0.688	0.607		0.471665061	0.224	0.135		0.04949198	0.409	
68	Kanpur-Orai	UP93CT7072	Kanpur	Jhansi	MAV	1.1.222	Iron	No	2460	5590	6550	7120	6980		0.743	1.687		1.808706315	0.304	8.105		10.70217923	19.111	
69	Kanpur-Orai	UP02AH2948	Kolkata	Gujaini	MAV	1.1.222	Iron	No	3025	5790	6580	6855	6450		0.913	1.748		1.741700972	0.695	9.329		9.202257403	19.226	
70	Kanpur-Orai	UP77AN9780	Kanpur	Jhansi	MAV	1.1.222	Clothes	No	2780	2970	4950	5260	5010		0.839	0.896		1.333099764	0.496	0.646		3.158279821	4.300	
84	Kanpur-Orai	UP78CT0759	Kanpur	Jhansi	MAV	1.1.222	Powder	No	4120	4550	7540	8270	8040		1.244	1.373		2.088990102	2.392	3.558		19.04344558	24.993	
85	Kanpur-Orai	UP93CT2670	Lucknow	Jhansi	MAV	1.1.222	Empty	No	2260	2070	1985	1855	1760		0.682	0.625		0.490496628	0.217	0.152		0.057882077	0.427	
93	Kanpur-Orai	UP53ET3990	Kunda	Jhansi	MAV	1.1.222	Gas	No	2560	2950	5045	7865	7420		0.773	0.890		1.780677936	0.357	0.629		10.05406087	11.039	
94	Kanpur-Orai	UP93BT7697	Gorakhpur	Shivpuri	MAV	1.1.222	Brick	No	3840	4650	6025	6120	5980		1.159	1.404		1.587544889	1.805	3.881		6.351905916	12.038	
97	Kanpur-Orai	UP92AT5192	Kanpur	Ujjain	MAV	1.1.222	Aggregate	No	3470	5340	5865	6125	6010		1.047	1.612		1.576596304	1.203	6.750		6.178485278	14.132	
98	Kanpur-Orai	UP92AT6481	Rasulla	Jhansi	MAV	1.1.222	Empty	No	2380	2060	1950	1750	1555		0.718	0.622		0.460278532	0.266	0.149		0.044883103	0.461	
99	Kanpur-Orai	UP92AT0029	Unnao	Jhansi	MAV	1.1.222	Powder	No	3640	4570	6985	7445	7125		1.099	1.379		1.887974074	1.457	3.621		12.70527602	17.783	
111	Kanpur-Orai	UP02BJ8143	Kanpur	Indore	MAV	1.1.222	Iron	No	2470	5120	6255	6525	5785		0.746	1.545		1.62608391	0.309	5.704		6.991523311	13.005	
136	Kanpur-Orai	UP78HN9149	Kanpur	Gursarai	MAV	1.1.222	Potatoes	No	2480	3440	4520	4985	4750		0.749	1.038		1.248576684	0.314	1.162		2.430305571	3.907	
137	Kanpur-Orai	UP78HN9148	Kanpur	Gursarai	MAV	1.1.222	Aggregate	No	3370	5400	6305	6000	5685		1.017	1.630		1.575720417	1.071	7.058		6.164766748	14.294	
138	Kanpur-Orai	UP783379	Unnao	Jhansi	MAV	1.1.222	Coal	No	3480	4595	8330	8740	8335		1.050	1.387		2.225190505	1.217	3.700		24.51708274	29.435	
139	Kanpur-Orai	UP78AH7529	Unnao	Jhansi	MAV	1.1.222	Coal	No	3380	4955	7850	8350	8050		1.020	1.496		2.124025576	1.083	5.004		20.35349372	26.441	
152	Kanpur-Orai	UP74T9192	Kanpur	Dewas	MAV	1.1.222	Aggregate	No	3340	5460	5785	5855	5255		1.008	1.648		1.479810808	1.033	7.377		4.795399352	13.205	
153	Kanpur-Orai	RJ02GR0977	Varanasi	Kalpi	MAV	1.1.222	Empty	No	2410	2260	2110	1879	1765		0.727	0.682		0.503985285	0.280	0.217		0.064516593	0.561	
155	Kanpur-Orai	UP33AT2780	Kanpur	Jhansi	MAV	1.1.222	Empty	No	2143	2050	1985	1650	1555		0.647	0.619		0.454585268	0.175	0.147		0.042703299	0.364	
165	Kanpur-Orai	UP53T1739	Kanpur	Jhansi	MAV	1.1.222	Coarse aggregate	No	2570	1940	5380	6855	6420		0.776	0.586		1.633966891	0.362	0.118		7.128087288	7.608	
166	Kanpur-Orai	RJ29J5524	Kanpur	Orai	MAV	1.1.222	Groceries	No	3870	4450	5220	6050	5745		1.168	1.343		1.49032145	1.862	3.255		4.933098754	10.050	
168	Kanpur-Orai	WB15B7054	Kanpur	Orai	MAV	1.1.222	Empty	No	2470	2180	2110	2090	1960		0.746	0.658		0.539546291	0.309	0.187		0.084745148	0.581	
172	Kanpur-Orai	UP32NN8597	Kanpur	Orai	MAV	1.1.222	Cement	No	3070	5820	9050	9170	8920		0.927	1.757		2.377156871	0.737	9.524		31.9323859	42.193	
176	Kanpur-Orai	UP77AN6941	Kanpur	Orai	MAV	1.1.222	Empty	No	2480	2180	2090	1920	1860		0.749	0.658		0.514145572	0.314	0.187		0.069878633	0.571	**8.872**
177	Kanpur-Orai	UP61A0515	Kanpur	Ujjain	MAV	1.1.222	Clothes	No	2570	3020	5215	5115	4855		0.776	0.912		1.33003416	0.362	0.690		3.129328683	4.182	
178	Kanpur-Orai	UP77AT3905	Gorakhpur	Ujjain	MAV	1.1.222	Rice	No	1840	3020	6560	7040	6350		0.555	0.912		1.747394237	0.095	0.690		9.323169841	10.109	
181	Kanpur-Orai	UP32J8787	Kanpur	Orai	MAV	1.1.222	Empty	No	2470	2105	1960	1705	1640		0.746	0.635		0.464657966	0.309	0.163		0.046615844	0.519	
184	Kanpur-Orai	UP57BT0216	Gorakhpur	Jhansi	MAV	1.1.222	Empty	No	2205	2340	2250	2160	1970		0.666	0.706		0.558815801	0.196	0.249		0.097515738	0.543	
185	Kanpur-Orai	UP770699	Unnao	Jhansi	MAV	1.1.222	Empty	No	2170	1870	1620	1545	1420		0.655	0.564		0.401594114	0.184	0.102		0.026010539	0.312	
189	Kanpur-Orai	NL338973	Unnao	Jhansi	MAV	1.1.222	Sand	No	2640	3740	8450	8850	8710		0.797	1.129		2.278181659	0.403	1.624		26.93725916	28.965	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
190	Kanpur-Orai	UP77AM7145	Kanpur	Jhansi	MAV	1.1.222	Empty	No	2280	2060	1950	1745	1555		0.688	0.622		0.459840589	0.224	0.149		0.044712526	0.419	
192	Kanpur-Orai	UP74T5910	Kanpur	Orai	MAV	1.1.222	Empty	No	2370	2180	2075	1910	1880		0.715	0.658		0.513707629	0.262	0.187		0.06964085	0.519	
195	Kanpur-Orai	UP784165	Kanpur	Jhansi	MAV	1.1.222	Gas	No	2370	2750	5545	7050	6850		0.715	0.830		1.703161951	0.262	0.475		8.41441225	9.151	
203	Kanpur-Orai	UP78FT4542	Kanpur	Ujjain	MAV	1.1.222	Coarse aggregate	No	2855	3240	7450	8065	7185		0.862	0.978		1.988263116	0.551	0.915		15.62771292	17.094	
204	Kanpur-Orai	RJ27GC6142	Kanpur	Jhansi	MAV	1.1.222	Onion	No	3450	5350	6050	6430	6210		1.041	1.615		1.637032495	1.176	6.800		7.181732111	15.158	
210	Kanpur-Orai	HR47B3935	Kanpur	Jhansi	MAV	1.1.222	Empty	No	2270	2540	2480	1980	1840		0.685	0.767		0.551808706	0.220	0.346		0.092715895	0.659	
211	Kanpur-Orai	UP93B6139	Gorakhpur	Jhansi	MAV	1.1.222	Empty	No	2440	2060	1975	1660	1525		0.736	0.622		0.451957607	0.294	0.149		0.041724467	0.485	
212	Kanpur-Orai	UP02BA2613	Kanpur	Jhansi	MAV	1.1.222	Empty	No	2120	1740	1700	1620	1560		0.640	0.525		0.427432776	0.168	0.076		0.033378843	0.277	
219	Kanpur-Orai	MP09MJ2907	Hawaspur	Orai	MAV	1.1.222	Empty	No	2160	1940	1850	1760	1420		0.652	0.586		0.440571078	0.181	0.118		0.037675926	0.336	
224	Kanpur-Orai	UP329911	Kalpi	Jhansi	MAV	1.1.222	Aggregate	No	3440	5070	5950	5825	5425		1.038	1.530		1.506525357	1.162	5.485		5.151168821	11.798	
227	Kanpur-Orai	UP36T3580	Hawaspur	Jhansi	MAV	1.1.222	Aggregate	No	3740	4950	6085	6020	5565		1.129	1.494		1.547692038	1.624	4.984		5.737704713	12.345	
244	Kanpur-Orai	UP39BT4917	Kalpi	Jhansi	MAV	1.1.222	Stone	No	2415	3925	6080	7878	7215		0.729	1.185		1.854515197	0.282	1.970		11.82827971	14.081	
246	Kanpur-Orai	UP78DN3545	Varanasi	Kalpi	MAV	1.1.222	Empty	No	2240	2120	2045	1900	1720		0.676	0.640		0.496189892	0.209	0.168		0.060616611	0.437	
264	Kanpur-Orai	MH09HH7450	Kalpi	Bhopal	MAV	1.1.222	Sand	No	2855	4215	5045	7865	7420		0.862	1.272		1.780677936	0.551	2.620		10.05406087	13.226	
266	Kanpur-Orai	UP70N6403	Auraiya	Jhansi	MAV	1.1.222	Iron	No	3260	5060	6075	6745	6145		0.984	1.527		1.661119383	0.938	5.441		7.61383365	13.993	
274	Kanpur-Orai	UP93BT6092	Gorakhpur	Dewas	MAV	1.1.222	Potatoes	No	3450	5466	5580	6430	6210		1.041	1.650		1.595865814	1.176	7.410		6.486127572	15.072	
288	Kanpur-Orai	UP77AT1652	Kanpur	Jhansi	MAV	1.1.222	Aggregate	No	3570	5360	6295	6095	5685		1.078	1.618		1.583165455	1.348	6.851		6.282105415	14.482	
305	Kanpur-Orai	UP70GT1820	Kanpur	Bhopal	MAV	1.1.222	Iron	No	3295	5550	6450	6985	6280		0.995	1.675		1.726810896	0.978	7.876		8.891583708	17.746	
306	Kanpur-Orai	UP78GT9813	Kanpur	Jhansi	MAV	1.1.222	Empty	No	2340	2160	2085	2005	1980		0.706	0.652		0.531663309	0.249	0.181		0.079899996	0.509	
311	Kanpur-Orai	JH10N1572	Auraiya	Indore	MAV	1.1.222	Iron	No	3105	5795	6255	7185	6890		0.937	1.749		1.780677936	0.772	9.361		10.05406087	20.187	
316	Kanpur-Orai	NL01AF6582	Kanpur	Nagpur	MAV	1.1.222	Sand	No	2415	3920	6520	7155	6625		0.729	1.183		1.778050276	0.282	1.960		9.994846932	12.237	
336	Kanpur-Orai	UP51BT2644	Kanpur	Jhansi	MAV	1.1.222	Coarse aggregate	No	2415	3920	6520	7155	6625		0.729	1.183		1.778050276	0.282	1.960		9.994846932	12.237	
337	Kanpur-Orai	UP93BT3049	Kanpur	Orai	MAV	1.1.222	Coal	No	3490	4755	7620	8095	7585		1.053	1.435		2.040816327	1.231	4.243		17.34665256	22.822	
338	Kanpur-Orai	AP07TG2779	Unnao	Ujjain	MAV	1.1.222	Empty	No	2160	2050	1985	1850	1780		0.652	0.619		0.491810458	0.181	0.147		0.058504738	0.386	
339	Kanpur-Orai	UP93BT9731	Gorakhpur	Jhansi	MAV	1.1.222	Empty	No	2450	2160	2075	1980	1720		0.740	0.652		0.505824647	0.299	0.181		0.06546361	0.545	
345	Kanpur-Orai	UP47C7383	Kanpur	Jhansi	MAV	1.1.222	Empty	No	2350	2160	2095	1950	1710		0.709	0.652		0.504072874	0.253	0.181		0.064561455	0.498	
346	Kanpur-Orai	UP50CT0697	Kanpur	Jhansi	MAV	1.1.222	Clothes	No	2840	3085	5265	5095	4650		0.857	0.931		1.31470614	0.540	0.752		2.987547127	4.279	
348	Kanpur-Orai	UP53HT1731	Kanpur	Orai	MAV	1.1.222	Aggregate	No	3450	5470	6455	6115	5575		1.041	1.651		1.589296663	1.176	7.431		6.379988353	14.987	
359	Kanpur-Orai	RJ144716	Kalpi	Ujjain	MAV	1.1.222	Empty	No	2450	2190	2005	1980	1890		0.740	0.661		0.514583516	0.299	0.191		0.070117025	0.560	
360	Kanpur-Orai	RJ09GB3760	Kanpur	Orai	MAV	1.1.222	Coarse aggregate	No	2890	4250	6585	7420	6985		0.872	1.283		1.838486468	0.579	2.708		11.42461964	14.712	
363	Kanpur-Orai	UP42BT5188	Gorakhpur	Jhansi	MAV	1.1.222	Empty	No	2340	2250	1950	1850	1770		0.706	0.679		0.487868967	0.249	0.213		0.056651678	0.518	
371	Kanpur-Orai	PB10GJ9411	Guwahati	Jhansi	MAV	1.1.222	Clothes	No	2560	2855	5055	5425	4520		0.773	0.862		1.313830253	0.357	0.551		2.979593595	3.888	
372	Kanpur-Orai	UP47T8123	Kanpur	Orai	MAV	1.1.222	Potatoes	No	2345	3960	4590	6875	6410		0.708	1.195		1.565647718	0.251	2.041		6.008640181	8.301	
373	Kanpur-Orai	UP40A3782	Gorakhpur	Jhansi	MAV	1.1.222	Sand	No	2645	3925	7085	7950	6545		0.798	1.185		1.890163791	0.406	1.970		12.76432217	15.141	
31	Kanpur-Orai	UP58T7075	Siddharthnagar	Orai	MAV	1.2.122	Aggregate	No	3190	5040	6125	6050	5865		0.963	1.236		1.580099851	0.860	2.334		6.233588485	9.427	
48	Kanpur-Orai	UP32RN2263	Lucknow	Jhansi	MAV	1.2.122	Empty	No	2380	1960	1850	1800	1780		0.718	0.481		0.475606552	0.266	0.053		0.05116716	0.371	
238	Kanpur-Orai	UP92T8140	Kanpur	Jhansi	MAV	1.2.122	Wood	No	2415	3925	6080	7878	7215		0.729	0.963		1.854515197	0.282	0.859		11.82827971	12.969	
239	Kanpur-Orai	RJ148083	Kalpi	Orai	MAV	1.2.122	Stone	No	2455	3260	6350	7980	7425		0.741	0.800		1.90549181	0.302	0.409		13.18342784	13.894	
2	Kanpur-Orai	UP77AT4373	Bhognipur	Dakore	MAV	1.2.222	Gas	No	2240	2530	5985	6575	6120		0.676	0.620		1.636156609	0.209	0.148		7.166374229	7.524	
7	Kanpur-Orai	MH08BD0975	Bihar	Bombay	MAV	1.2.222	Empty	No	2180	1870	1700	1680	1660		0.658	0.459		0.441446965	0.187	0.044		0.03797643	0.270	
8	Kanpur-Orai	UP93BT7586	Kanpur	Jhansi	MAV	1.2.222	Aggregate	No	3330	4780	6050	6150	6050		1.005	1.172		1.598493475	1.021	1.889		6.528951928	9.438	
9	Kanpur-Orai	UP93CT4530	Kanpur	Orai	MAV	1.2.222	Clothes	No	2470	3190	4850	5060	4955		0.746	0.782		1.302005781	0.309	0.375		2.873767639	3.557	
10	Kanpur-Orai	UP53GT6283	Bihar	Orai	MAV	1.2.222	Empty	No	2280	1970	1825	1740	1710		0.688	0.483		0.462030306	0.224	0.054		0.045570296	0.324	
12	Kanpur-Orai	UP56AT4637	Kalpi	Jhansi	MAV	1.2.222	Iron	No	3170	5490	7045	7855	7445		0.957	1.346		1.957169134	0.838	3.286		14.67281466	18.797	
14	Kanpur-Orai	NL01N4247	Bihar	Agara	MAV	1.2.222	Coarse aggregate	No	3625	4255	3985	7840	7210		1.094	1.044		1.667250591	1.433	1.186		7.726868485	10.346	
19	Kanpur-Orai	UP92T9070	Kalpi	Jhansi	MAV	1.2.222	Powder	No	3350	4050	6550	7050	6855		1.011	0.993		1.791626522	1.045	0.973		10.30362232	12.322	
20	Kanpur-Orai	UP83GT8150	Gorakhpur	Jhansi	MAV	1.2.222	Iron	No	2370	5370	6555	7045	6750		0.715	1.317		1.78242971	0.262	3.008		10.09368274	13.364	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)						ESWL				Axle Damage Factor				VDF	Avg. VDF
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
46	Kanpur-Orai	UP76T3612	Kanpur	Jhansi	MAV	1.2.222	Empty	No	2130	2320	2150	1870	1790		0.643	0.569		0.508890251	0.171	0.105		0.067065092	0.343	
49	Kanpur-Orai	UP56AT3331	Gorakhpur	Jhansi	MAV	1.2.222	Empty	No	2490	2160	2050	1955	1780		0.752	0.530		0.506700534	0.319	0.079		0.065918217	0.464	
53	Kanpur-Orai	UP8T8851	Bhognipur	Jhansi	MAV	1.2.222	Empty	No	2160	2470	2250	1970	1720		0.652	0.606		0.52027678	0.181	0.135		0.073271954	0.389	
57	Kanpur-Orai	UP97BT7071	Kanpur	Jhansi	MAV	1.2.222	Aggregate	No	3490	5350	6445	6255	6005		1.053	1.312		1.638346326	1.231	2.964		7.204815201	11.400	
59	Kanpur-Orai	NL21T5548	Gorakhpur	Jhansi	MAV	1.2.222	Empty	No	2260	2160	2015	1920	1870		0.682	0.530		0.508452308	0.217	0.079		0.066834529	0.362	
60	Kanpur-Orai	UP93CT4952	Kanpur	Orai	MAV	1.2.222	Iron	No	2575	5170	6085	6555	6320		0.777	1.268		1.66068144	0.365	2.585		7.605807472	10.555	
67	Kanpur-Orai	UP93CT8816	Kanpur	Jhansi	MAV	1.2.222	Empty	No	2380	2660	2450	2215	2160		0.718	0.652		0.597792765	0.266	0.181		0.127703447	0.575	
75	Kanpur-Orai	UP32W8459	Kanpur	Jhansi	MAV	1.2.222	Aggregate	No	3680	5340	5955	5785	5585		1.111	1.310		1.517473942	1.522	2.942		5.3025524	9.767	
83	Kanpur-Orai	UP93BT7742	Kanpur	Jhansi	MAV	1.2.222	Coal	No	3340	5655	8450	8650	8225		1.008	1.387		2.218183411	1.033	3.700		24.20972253	28.942	
88	Kanpur-Orai	MP09HJ6142	Kanpur	Indore	MAV	1.2.222	Empty	No	2170	2050	1975	1855	1760		0.655	0.503		0.489620741	0.184	0.064		0.057469739	0.305	
95	Kanpur-Orai	UP77AP3292	Kanpur	Ujjain	MAV	1.2.222	Ash	No	3470	5870	6050	7460	7240		1.047	1.440		1.817465183	1.203	4.295		10.91099609	16.410	
101	Kanpur-Orai	UP92BT9553	Kanpur	Jhansi	MAV	1.2.222	Empty	No	2380	2170	2075	1965	1720		0.718	0.532		0.504510817	0.266	0.080		0.064786114	0.411	
102	Kanpur-Orai	NL01D8943	Bihar	Bombay	MAV	1.2.222	Iron	No	3110	5890	6255	6755	5820		0.939	1.445		1.649294911	0.777	4.354		7.399344979	12.530	
103	Kanpur-Orai	NL01AC8983	Bihar	Orai	MAV	1.2.222	Iron	No	3060	5260	6120	6310	5870		0.924	1.290		1.602872909	0.728	2.769		6.600796665	10.098	
104	Kanpur-Orai	NL01AB5456	Etawah	Orai	MAV	1.2.222	Iron	No	2870	4820	5870	6020	5910		0.866	1.182		1.559078567	0.563	1.953		5.908428781	8.424	
105	Kanpur-Orai	UP57AT0367	Kanpur	Jhansi	MAV	1.2.222	Clothes	No	2570	3195	4555	5045	4950		0.776	0.784		1.274415346	0.362	0.377		2.637812786	3.377	
113	Kanpur-Orai	JH02AT3724	Kanpur	Jhansi	MAV	1.2.222	Coal	No	3470	5855	8250	8540	8150		1.047	1.436		2.184461768	1.203	4.251		22.77077397	28.226	
115	Kanpur-Orai	UP93T6552	Kanpur	Ujjain	MAV	1.2.222	Aggregate	No	3640	5045	6255	6010	5785		1.099	1.237		1.580975738	1.457	2.344		6.247421686	10.048	
116	Kanpur-Orai	UP53GT8788	Gorakhpur	Jhansi	MAV	1.2.222	Empty	No	2480	2040	1955	1755	1485		0.749	0.500		0.455023211	0.314	0.063		0.042868097	0.420	
118	Kanpur-Orai	UP93CT3311	Kanpur	Jhansi	MAV	1.2.222	Wood	No	2670	3480	4500	5210	5045		0.806	0.853		1.292371026	0.422	0.531		2.789644429	3.742	
121	Kanpur-Orai	UP77AT3910	Kanpur	Jhansi	MAV	1.2.222	Empty	No	2205	2070	1925	1885	1545		0.666	0.508		0.4690374	0.196	0.066		0.048398277	0.311	
123	Kanpur-Orai	NL02K3805	Bhokla Par	Jhansi	MAV	1.2.222	Iron	No	3370	5750	6050	6230	5660		1.017	1.410		1.571340983	1.071	3.955		6.096516459	11.122	
140	Kanpur-Orai	UP93CT7951	Kanpur	Ujjain	MAV	1.2.222	Clothes	No	2440	3560	5045	5215	5110		0.736	0.873		1.346238066	0.294	0.581		3.284637643	4.160	
148	Kanpur-Orai	UP93BT7901	Lucknow	Jhansi	MAV	1.2.222	Wood	No	3255	4750	5060	6085	5975		0.982	1.165		1.499518262	0.932	1.842		5.055999673	7.829	
157	Kanpur-Orai	RJ26GB0922	Kanpur	Rath	MAV	1.2.222	Empty	No	2470	2190	2065	1990	1740		0.746	0.537		0.507576421	0.309	0.083		0.066375187	0.459	
160	Kanpur-Orai	UP78F9132	Unnao	Ujjain	MAV	1.2.222	Rice	No	4170	5555	6460	8890	6320		1.259	1.362		1.898046772	2.510	3.445		12.97859382	18.933	
162	Kanpur-Orai	UP92T6452	Kanpur	Jhansi	MAV	1.2.222	Potatoes	No	3765	4210	6840	7455	6765		1.136	1.032		1.844617675	1.668	1.136		11.57778454	14.382	
182	Kanpur-Orai	UP77AT8871	Kanpur	Jhansi	MAV	1.2.222	Empty	No	2390	1905	1900	1890	1840		0.721	0.467		0.493124288	0.271	0.048		0.059132409	0.378	
206	Kanpur-Orai	UP02BJ5425	Kanpur	Jhansi	MAV	1.2.222	Empty	No	2470	2260	2140	2015	1970		0.746	0.554		0.536480687	0.309	0.094		0.082835475	0.486	
207	Kanpur-Orai	UP92T9924	Kalpi	Ujjain	MAV	1.2.222	Empty	No	2270	1980	1840	1720	1700		0.685	0.486		0.460716475	0.220	0.056		0.045054168	0.321	
213	Kanpur-Orai	UP85BT1222	Bahraich	Jhansi	MAV	1.2.222	Sand	No	3210	4940	7240	7740	7210		0.969	1.212		1.943592888	0.881	2.154		14.26990904	17.306	
220	Kanpur-Orai	UP53GT7072	Gorakhpur	Jhansi	MAV	1.2.222	Clothes	No	2470	3390	5365	5330	5210		0.746	0.831		1.393098012	0.309	0.478		3.766402154	4.553	
221	Kanpur-Orai	UP77AN5467	Gorakhpur	Jhansi	MAV	1.2.222	Coarse aggregate	No	2355	4860	6850	7255	6850		0.711	1.192		1.835420864	0.255	2.018		11.34860961	13.622	
225	Kanpur-Orai	RJ11GG5711	Kanpur	Jhansi	MAV	1.2.222	Coarse aggregate	No	2420	3210	5040	6515	6240		0.730	0.787		1.558640624	0.285	0.384		5.901792894	6.571	
228	Kanpur-Orai	UP92A2558	Kanpur	Orai	MAV	1.2.222	Wheat	No	2540	4540	8210	8670	8040		0.767	1.113		2.182709994	0.346	1.537		22.69782001	24.580	
229	Kanpur-Orai	UP74T8925	Kanpur	Jhansi	MAV	1.2.222	Coarse aggregate	No	2345	3960	4590	6875	6410		0.708	0.971		1.565647718	0.251	0.890		6.008640181	7.149	
230	Kanpur-Orai	MP33H8673	Kanpur	Jhansi	MAV	1.2.222	Empty	No	2125	1930	1825	1710	1665		0.641	0.473		0.455461154	0.169	0.050		0.043033371	0.262	
235	Kanpur-Orai	UP53FT1771	Kanpur	Jhansi	MAV	1.2.222	Gas	No	2165	2445	5850	7225	7005		0.653	0.600		1.758780766	0.182	0.129		9.568565402	9.880	
236	Kanpur-Orai	UP78BT0052	Lucknow	Jhansi	MAV	1.2.222	Maida	No	2455	3260	6350	7980	7425		0.741	0.800		1.90549181	0.302	0.409		13.18342784	13.894	
255	Kanpur-Orai	MP090872	Kanpur	Orai	MAV	1.2.222	Empty	No	2355	1860	1745	1855	1650		0.711	0.456		0.459840589	0.255	0.043		0.044712526	0.343	
259	Kanpur-Orai	UP42BT2203	Etawah	Orai	MAV	1.2.222	Coarse aggregate	No	3210	4940	7240	7740	7210		0.969	1.212		1.943592888	0.881	2.154		14.26990904	17.306	
307	Kanpur-Orai	UP32HN7678	Auraiya	Jhansi	MAV	1.2.222	Powder	No	2675	3695	4825	6575	6125		0.807	0.906		1.534991679	0.425	0.674		5.551675871	6.651	
323	Kanpur-Orai	UP51BT0519	Kalpi	Jhansi	MAV	1.2.222	Clothes	No	2460	3340	5095	5145	4755		0.743	0.819		1.31339231	0.304	0.450		2.975622789	3.730	
325	Kanpur-Orai	WB61B3991	Kanpur	Orai	MAV	1.2.222	Aggregate	No	3560	5385	6085	5785	5585		1.075	1.321		1.528860471	1.333	3.042		5.463505799	9.839	
332	Kanpur-Orai	UP51AT9142	Basti	Jhansi	MAV	1.2.222	Clothes	No	2370	3980	5085	5225	5000		0.715	0.976		1.340982745	0.262	0.908		3.233648117	4.403	
354	Kanpur-Orai	RJ09GC1620	Gorakhpur	Orai	MAV	1.2.222	Iron	No	4270	5650	6650	7190	6450		1.289	1.386		1.777174389	2.759	3.687		9.9751672	16.421	
374	Kanpur-Orai	UP32RN6123	Guwahati	Orai	MAV	1.2.222	Empty	No	2555	2415	2215	2085	1875		0.771	0.592		0.540860121	0.354	0.123		0.085573608	0.562	

S.No	Direction	Vehicle Reg. No.	Trip Details		Vehicle Type	Axle Configaration	Commodity Type	SpaciNog betweeNo froNot & froNot rear (< 4.5m or > 4.5m)	Wheel Load (kg)					
			Origion	Destination					Front Axle	Rear 1st Axle	2nd Axle	3rd Axle	4th Axle	5th Axle
376	Kanpur-Orai	UP53GT9098	Gorakhpur	Jhansi	MAV	1.2.222	Gas	No	2270	2650	5665	7115	6855	
377	Kanpur-Orai	UP43AT6201	Balrampur	Jhansi	MAV	1.2.222	Aggregate	No	3305	4750	6155	6000	5620	
379	Kanpur-Orai	UP52AT5166	Kanpur	Orai	MAV	1.2.222	Clothes	No	2050	3920	5020	5665	5230	
34	Kanpur-Orai	UP93CT7256	Kanpur	Gursarai	MAV	1.22.122	Wood	No	2840	3365	3855	4065	5855	5745
292	Kanpur-Orai	UP55AT2854	Gorakhpur	Orai	MAV	1.22.122	Coal	No	3295	3855	4165	4065	6255	5895
293	Kanpur-Orai	UP51BT1835	Gorakhpur	Orai	MAV	1.22.122	Coarse aggregate	No	2830	3650	4220	4110	6105	5970
326	Kanpur-Orai	UP47T8628	Kanpur	Jhansi	MAV	1.22.122	Powder	No	2670	3435	3665	5330	6190	5945
1	Kanpur-Orai	UP53ET8477	Gorakhpur	Jhansi	MAV	1.22.222	Powder	No	2545	3860	4050	5470	5675	5410
4	Kanpur-Orai	RJ08GA4334	Kanpur	Orai	MAV	1.22.222	Coal	No	2870	3055	4210	4420	6050	5865
16	Kanpur-Orai	UP83ET7475	Gorakhpur	Jhansi	MAV	1.22.222	Gas	No	2655	3840	4115	5620	6015	5785
23	Kanpur-Orai	UP93JT3740	Kanpur	Jhansi	MAV	1.22.222	Empty	No	2370	2215	1960	1855	1770	1730
26	Kanpur-Orai	UP93CT5015	Kanpur	Jhansi	MAV	1.22.222	Coal	No	2790	3245	4085	4210	6220	6020
28	Kanpur-Orai	UP93CT6456	Kalpi	Jhansi	MAV	1.22.222	Potatoes	No	2590	3590	3755	5080	5525	4710
29	Kanpur-Orai	UP53ET9307	Kanpur	Orai	MAV	1.22.222	Coal	No	2410	3155	4110	4350	6630	6150
32	Kanpur-Orai	UP53HT7327	Kanpur	Orai	MAV	1.22.222	Wheat	No	2710	3490	3850	4855	5325	5110
40	Kanpur-Orai	UP93CT8093	Lucknow	Jhansi	MAV	1.22.222	Powder	No	2810	3970	4275	5060	5445	5095
45	Kanpur-Orai	UP53ET6050	Bihar	Orai	MAV	1.22.222	Plastic	No	3070	3455	4205	4105	5460	5185
51	Kanpur-Orai	UP93CT4320	Kanpur	Jhansi	MAV	1.22.222	Powder	No	2470	3360	3660	4955	5295	4960
54	Kanpur-Orai	UP93BT8256	Kanpur	Jhansi	MAV	1.22.222	Coarse aggregate	No	2755	3185	4110	4050	5210	5070
58	Kanpur-Orai	UP93CT4489	Vanpurwa	Jhansi	MAV	1.22.222	Potatoes	No	2380	3360	3950	4785	5095	4710
73	Kanpur-Orai	UP53ET1455	kanpur	Jhansi	MAV	1.22.222	Powder	No	2480	3340	3785	5095	5365	4910
79	Kanpur-Orai	UP53FT3435	Gorakhpur	Jhansi	MAV	1.22.222	Potatoes	No	2610	3970	4365	5365	5800	5720
156	Kanpur-Orai	RJ26GA4059	Kanpur	Jhansi	MAV	1.22.222	Parcel	No	3480	4470	5060	5210	6155	5670
233	Kanpur-Orai	UP32KN8142	Lucknow	Jhansi	MAV	1.22.222	Powder	No	2395	3360	4005	5320	5740	5480
234	Kanpur-Orai	UP32KN8143	Lucknow	Jhansi	MAV	1.22.222	Coarse aggregate	No	3260	4050	4425	4520	5095	4390
247	Kanpur-Orai	RJ09CN1578	Kanpur	Orai	MAV	1.22.222	Coarse aggregate	No	2930	3255	3955	4120	5995	5680
295	Kanpur-Orai	UP56AT3069	Kanpur	Jhansi	MAV	1.22.222	Aggregate	No	2960	3740	4200	4265	5745	5475
312	Kanpur-Orai	RJ06GC6347	Nepanyan	Nasik	MAV	1.22.222	Jute	No	3050	3955	4560	5450	5690	5500
318	Kanpur-Orai	UP47T8241	Etawah	Orai	MAV	1.22.222	Potatoes	No	2560	3390	3865	5120	6025	5590
321	Kanpur-Orai	UP42BT3670	Kanpur	Kota	MAV	1.22.222	Coal	No	3080	3750	4165	4060	5660	5520
357	Kanpur-Orai	UP53FT1677	Kanpur	Jhansi	MAV	1.22.222	Potatoes	No	2470	3390	3715	5415	5980	5650
364	Kanpur-Orai	UP53HT3137	Kanpur	Orai	MAV	1.22.222	Coal	No	3490	4630	5320	5120	6505	6120
378	Kanpur-Orai	UP53GT0371	Gorakhpur	Jhansi	MAV	1.22.222	Coal	No	3270	4130	5095	5110	6740	6350

ESWL				Axle Damage Factor				VDF	Avg. VDF
Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle	Front Stering axle	Rear Single Axle	Tandem Axle	Tridam Axle		
0.685	0.650		1.719803801	0.220	0.178		8.748137857	9.147	
0.998	1.165		1.55688885	0.990	1.842		5.875305226	8.707	
0.619	0.961		1.393973899	0.147	0.854		3.775883338	4.777	
0.857		0.957	1.372	0.540		0.839	3.544	4.924	
0.995		1.063	1.420	0.978		1.278	4.069	6.325	
0.854		1.043	1.418	0.532		1.185	4.039	5.756	
0.806		0.941	1.530	0.422		0.785	5.476	6.683	
0.768		1.049	1.450	0.348		1.209	4.421	5.978	
0.866		0.963	1.431	0.563		0.861	4.191	5.614	
0.801		1.055	1.526	0.412		1.237	5.420	7.069	
0.715		0.553	0.469	0.262		0.094	0.048	0.404	
0.842		0.972	1.441	0.503		0.892	4.310	5.704	
0.782		0.974	1.341	0.374		0.899	3.238	4.510	
0.727		0.963	1.500	0.280		0.861	5.068	6.208	
0.818		0.973	1.339	0.448		0.897	3.217	4.561	
0.848		1.093	1.366	0.518		1.428	3.486	5.431	
0.927		1.016	1.292	0.737		1.064	2.786	4.587	
0.746		0.931	1.332	0.309		0.750	3.150	4.209	
0.832		0.967	1.255	0.478		0.875	2.482	3.835	
0.718		0.969	1.278	0.266		0.882	2.667	3.815	
0.749		0.945	1.346	0.314		0.796	3.285	4.395	
0.788		1.105	1.479	0.385		1.491	4.784	6.660	
1.050		1.263	1.492	1.217		2.548	4.956	8.722	
0.723		0.976	1.449	0.273		0.909	4.405	5.587	
0.984		1.124	1.227	0.938		1.594	2.264	4.795	
0.884		0.956	1.383	0.612		0.835	3.663	5.110	
0.893		1.053	1.356	0.637		1.228	3.384	5.249	
0.921		1.129	1.457	0.718		1.624	4.512	6.855	
0.773		0.962	1.466	0.357		0.856	4.616	5.829	
0.930		1.049	1.335	0.747		1.212	3.175	5.134	
0.746		0.942	1.493	0.309		0.787	4.968	6.064	
1.053		1.319	1.554	1.231		3.028	5.836	10.095	
0.987		1.223	1.594	0.949		2.237	6.458	9.644	

Annexure – 4.6

Methodology of FWD

1 PRINCIPLE OF FLEXIBLE PAVEMENT EVALUATION USING FWD

Performance of flexible pavements can be evaluated by applying loads on the pavements that simulate the traffic loading, recording the response to such loading by measuring the elastic deflection under such loads, and analyzing these data duly considering the factors influencing the performance such as subgrade strength, thickness and quality of each of the pavement layers, drainage conditions, pavement surface temperature etc.

Among the equipment available for structural evaluation of pavements, the Falling Weight Deflectometer (FWD) is extensively used world-wide because it simulates, to a large extent, the actual loading conditions of the pavement. When a moving wheel load passes over the pavement it produces load pulses. Normal stresses (vertical as well as horizontal) at a location in the pavement will increase in magnitude from zero to a peak value as the moving wheel load approaches the location. The time taken for the stress pulse to vary from zero to peak value is termed as 'rise time of the pulse'. As the wheel moves away from the location, magnitude of stress reduces from peak value to zero. The time period during which the magnitude of stress pulse varies from 'zero-to-peak-to-zero' is the pulse duration. Peak load and the corresponding pavement responses are of interest for pavement evaluation.

The resulting load-deflection data can be interpreted through appropriate analytical techniques, such as back calculation technique, to estimate the elastic moduli of the pavement layers. The computed moduli are, in turn, used for (i) the strength evaluation of different layers of in-service pavements (ii) the estimation of the remaining life of in-service pavement (iii) determination of strengthening requirement, if any and (iv) evaluation of different rehabilitation alternatives (overlay, recycling, partial reconstruction, etc.)

2 BRIEF DISCRIPTION OF FALLING WEIGHT DEFLECTOMETER (FWD)

Falling Weight Deflectometer is an impulse-generating device with a guide system. This device allows a variable weight to be dropped from a variable height. The apparatus has a loading plate which is used for uniform force distribution on the test layer. When the weight affects this plate, this loading plate ensures that the resulting force is applied perpendicularly to the test layer’s surface. It also has a load cell for measuring the actual applied impulse. It also has one or more deflection sensors. (Note: Deflection basin tests require at least seven sensors.) It also has a system for collecting, processing, and storing deflection data. Structural evaluation of pavements involves application of a standard load to the pavement and measuring its response in terms of stress, strain or deflection.

Benkelman beam has been among the earliest equipment used for measuring deflection and structural evaluation of pavements. In this technique, a static load is applied to the pavement surface and rebound deflections are measured at one or more locations. Measurement of deflection under a static load does not simulate the loading conditions produced in pavements by a moving vehicle. The evaluation of pavements by such methods is labor-intensive and, in general, time consuming. Impulse loading equipment commonly known as Falling Weight Deflectometer (FWD) have been developed, which closely simulates the duration and amplitude of the load pulses produced by moving wheel loads.

The basic working principle of the impulse loading equipment is to drop a mass on the pavement to produce an impulse load and measure the surface deflections. The mass is dropped on a spring system, which in turn transmits the load to the pavement through a loading plate. The

resulting deflection bowl characteristics are observed and used in the back calculation of pavement material properties. The principle is illustrated in **Figure-1.**

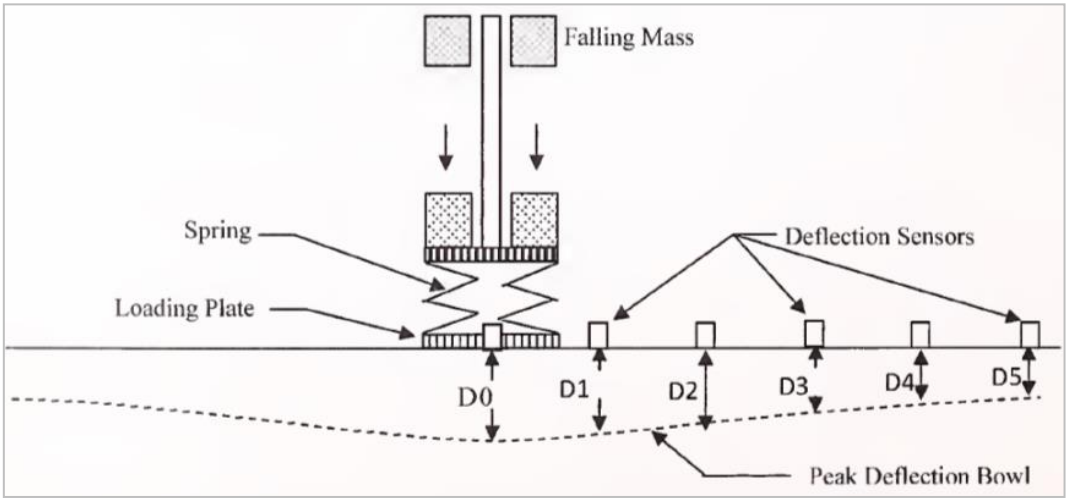

FIGURE 1 : WORKING PRINCIPLE OF FWD

2.1 FWD INSTRUMENT USED FOR THE DEFLECTION SURVEY: ERAY-FWD

For the purpose of conducting FWD survey on the project road **ERAY** TEST FWD Fully-Automatic Vehicle-mounted FWD was used. **ERAY FWD** developed by **ERAY** Machinery. The FWD can apply a loading in the range of 12-150 KN, enabling it to simulate all type of vehicle loads on pavement surface. This model is complete with back-up battery and with all other accessories for evaluation of pavements.

Main Components of the system

The main components of the **ERAY FWD** system are described in the following paragraphs

i. The Vehicle

A vehicle is suitably modified for housing the entire FWD system including hydraulic and electronic circuits. Modifications are made in the vehicle to accommodate necessary furniture for personal computer, electronic circuits and for working personnel. An alternator was used to draw power from the engine of the vehicle for charging the batteries. Sine wave inverter is used to supply power to the computer and the electronic circuit. A 550 mm diameter hole is made in the floor of the vehicle to allow the loading plate and the falling mass to pass through it. The vehicle is equipped with flashing lights to caution the road users during the test and it is very useful during the night time.

ii. Supporting Frame

A rectangular frame is fabricated and fixed to the floor of the machine vehicle to protect from weathering actions.

iii. Mass and Rubber Pad Arrangement

The base of a two-stage cylinder is attached to the top horizontal member of the supporting frame. The loading plate assembly is connected to the bottom flange of the cylinder. A load sensor (Strain Impact Sensor) of 150 KN capacity is placed on the loading plate assembly. The loading plate assembly consists of a bottom plate of 300 mm diameter with a rubber sole fixed to its bottom for uniform distribution of load.

iv. Loading Plate Assembly

A universal joint is fixed at the bottom of top plate of the assembly to provide flexibility and to ensure that the loading plate rests evenly on the pavement surface. A casing is made to hold the central geophone.

v. Geophone Arrangement

Nine geophones are arranged in a geophone frame at radial distances of 0, 200, 300, 450, 600, 900, 1500 from the centre of the loading plate to measure the pavement surface deflections. The first geophone is located in the loading plate assembly. Straightening/ folding and vertical movements of the geophone frame are performed by the hydraulic system. More over this particular instrument mostly exceeds or matches all the criteria given in the IRC: 115-2014. Following table summarizes the technical specifications of the instrument against the specifications of FWD mentioned by IRC: 115-2014.

TABLE 1: COMPARISON BETWEEN IRC AND ERAY FWD SPECIFICATIONS

S. No.	FWD Components	IRC Recommended Specifications for FWD	ERAY's FWD Specifications	Remarks
1	Plate Diameter	300/450 mm	300 mm	In IRC:115-2014, 300 mm dia plate is recommended
2	Mass System	Single Mass	Single Mass	Matched
3	Falling Weight Mass	50 to 700 Kg	50 to 350 Kg	Matched
4	Height of fall	100 to 600 mm	Variable	Matched
5	Target Peak Load	40 KN	40-150 KN	Matched
6	Load Cell Accuracy	+ 2 %	+ 1 %	Matched
7	Number of Deflection Transducers	6 to 9	9	Matched
8	Deflection Sensor Types	Geophones	Geophones	Matched
9	Reading Resolution of Deflection Transducers	Min 1 um	1 um	Matched
10	Deflection Transducers Accuracy	+ 2 %	+ 1 %	Matched

2.2 TESTING PROCEDURE AND METHODOLOGY

The detailed test methodology and procedure was described in IRC: 115-2014 "Guidelines for Structural Evaluation and Strengthening of Flexible Road Pavements Using Falling Weight Deflectometer (FWD) Technique". However, as per the client's requirement the sampling procedure was customized in this project. In adherence to the same, structural evaluation of the existing 'pavement and subgrade system' by measuring its response in terms of deflection was carried out using FWD for the project road **on the 2nd Dec-2022.**

Evaluation of pavement structural strength would be carried out in accordance with requirements of TOR and IRC: 115-2014.

(a) Testing Equipment

The equipment used for the testing is:

- **ERAY TEST FWD** Vehicle Mounted Falling Weight Deflectometer with 1 loading plate and 9 numbers of geophones placed at the spacing of 0,200, 300, 450, 600, 900, 1200, 1500 and 1800mm from the centre of the loading plate.
- GPS, Air Temperature and Pavement Surface Temperature sensors as part of the FWD instrument.
- Glycerol and digital thermometer.
- Red flags and red cones and flashing lamps for traffic arrangement.

(b) Testing Frequency – as per IRC:115-2014

The entire length has been classified into section of uniform performance. As it is inexpedient to change the sample size for deflection measurement at frequent intervals, the minimum length of uniform section has been kept as 1.0km. The interval at which deflection measurements has been carried out was calculated by using the following formula of equation 1 of IRC: 115-2014 and the same is extracted below for ready reference.

$$\boldsymbol{n = (z * CV)^2 / ME^2}$$

Where,

n = sample size
z = standard normal deviate, 1.285 corresponding to 90 per cent (two-sided) confidence level

ME = 10 percent acceptable margin of error (as percentage of mean)

CV = Coefficient of variation of deflection (standard deviation/mean) expressed as percentage; 15 percent, 30 percent and 45 percent for good, fair and poor condition respectively.

Though the length of uniform section divided by calculated sample size results the interval of FWD test, however the deflection measurement scheme depends upon the type of carriageway, number of lanes and the measurement along a lane is given in Table 2 of IRC 115-2014 and the same has been followed and the same is presented in **Table** below.

TABLE 2 : GUIDELINES FOR SELECTION OF DEFLECTION MEASUREMENT SCHEME FOR 4-LANE DUAL (DIVIDED) CARRIAGEWAY

Recommended Measurement Scheme	Maximum Spacing(m) for test points along selected wheel path for pavements of different classification		
	Poor	Fair	Good
(i)measure along outer wheel paths of outer lanes	30	65	250
(ii) measure along the outer wheel path of inner lane	60	130	500
(iii)measure along the centre line of paved shoulder (in case of widening projects)	120	260	500

Courtesy: Table 2 of IRC: 115-2014

Also, during survey, pavement temperature of bituminous layer has been recorded as per the procedure specified in section 5.4.7 of IRC: 115-2014.

The following steps are carried out for measuring deflections at a test point:

i. Mark the test point on the pavement

ii. Centre the load plate over the test point

iii. Lower the loading plate onto the pavement ensuring there should be no standing water on the pavement surface. The loading plate should be in proper contact with pavement surface. The longitudinal and transverse slope of the pavement should not exceed 10 percent at the test location.

iv. Lower the frame holding the geophones so that the transducers are in contact with pavement surface.

v. Raise the mass to a pre-determined height required for producing a target load of 40 kN (+10%).

vi. Drop one seating load, load and deflection data for which need not be recorded.

vii. Raise the mass and drop. Record the load and deflection data into the computer through data acquisition system. While peak load and peak deflections at different selected radial positions must be recorded. At least 2 drops should be made at one location for precision.

viii. If, during previous 2 steps, the deflections measured are giving variations or the deflections/load pulses are not proper, repeat the drop.

ix. Raise the geophone frame and load plate and move to the next test location

x. Deflection measurements should not be made when the pavement temperature is more than 45°C.

2.3 STRUCTURAL EVALUATION OF RIGID PAVEMENTS USING FWD

The structural evaluation and analysis of remaining life of project was carried out in conformity with IRC: 117-2015, “Guidelines for The Structural Evaluation of Rigid Pavement by Falling Weight Deflectometer (FWD)”.

2.3.1 PRINCIPLE OF RIGID PAVEMENT EVALUATION USING FWD

Performance of Rigid pavements can be evaluated by applying loads on the pavements that simulate the traffic loading, recording the response to such loading by measuring the deflection under such loads, and analyzing these data duly considering the factors influencing the performance such as PQC thickness and Load on the pavement.

Among the equipment available for structural evaluation of pavements, the Falling Weight Deflectometer (FWD) is extensively used worldwide because it simulates, to a large extent, the actual loading conditions of pavement.

The resulting load-deflection data can be interpreted through appropriate analytical techniques, to estimate the Subgrade modulus. The computed moduli are, in turn used for (i) the Elastic Modulus of Concrete and the Strength of Concrete (ii) the Flexural strength of the concrete slab of in-service pavements (iii) determination of Strengthening requirement, in the presence of voids if the deflections are much higher than normal and (iv) evaluation of different rehabilitation alternatives (Slab replacement etc.)

Structural evaluation exercise also includes Load transfer Efficiency at the transverse and longitudinal joints, (i) determination of Strengthening requirement, if any and (ii) evaluation of different rehabilitation alternatives (Retrofitting of Joints etc.)

2.3.2 TESTING PROCEDURE AND METHODOLOGY FOR RIGID PAVEMENTS

The detailed test methodology and procedure was described in IRC: 117-2015, “Guidelines for Structural Evaluation of Rigid Pavement by Falling Weight Deflectometer (FWD) Technique”.

Deflection measurement points were taken as per the existing pavement condition. In adherence to the same, structural evaluation of the existing 'pavement and subgrade system' by measuring its response in terms of deflection was carried out by using FWD. Evaluation of pavement structural strength would be carried out in accordance with requirements of TOR and IRC: 117-2015.

(a) Testing Equipment

The equipment used for the testing is:

- **ERAY TEST FWD** Vehicle Mounted Falling Weight Deflectometer with 1 loading plate and 9 numbers of geophones placed at the spacing of 0,200, 300, 450, 600, 900, and 1500 from the centre of the loading plate.
- GPS, Air Temperature and Pavement Surface Temperature sensors as part of the FWD instrument.
- Glycerol and digital thermometer.
- Red flags and red cones and flashing lamps for traffic arrangement

(b) Testing Frequency – as per IRC:117-2015

FWD deflection data may be collected at interiors, corners, transverse joints, and longitudinal joints, in the outer lane at intervals of 500 m. Heavy loads travel mostly in outer lanes and very often greater distresses also are found in the outer lanes. If there are distresses in the inner lanes also FWD test should be done in those lanes.

(c) Loading Positions – as per IRC:117-2015

The loading positions are presented in **Figure 2.**

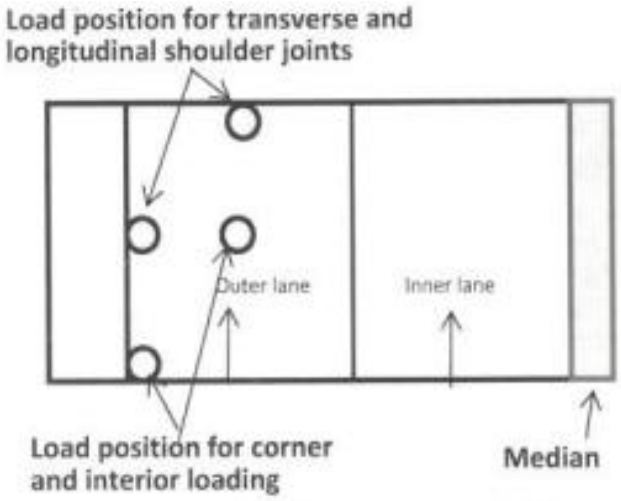

FIGURE 2 : LOAD POSITIONS FOR CORNER, INTERIOR, TRANSVERSE AND LONGITUDINAL SHOULDER JOINTS

FWD DEFLECTION TESTING POINTS & MEASUREMENT-RIGID PAVEMENT

As it is specified in IRC:117-2015 FWD deflection measurement has carried out for Corner, Interior, Transverse Joint and Longitudinal joint in the outer lane at an interval of 500 m. At every

measurement location, four drops were made, such that the first drop was the ‘seating drop’ and with the remaining three drops deflections were recorded.

Photographs of FWD test under progress at some locations were shown in **Figure 3.**

FIGURE 3 : PHOTOGRAPHS SHOWING FWD SURVEY UNDER PROGRESS -RIGID PAVEMENT

The following steps are carried out for measuring deflections at a test point:

i. Mark the test point on the pavement

ii. Centre the load plate over the test point

iii. Lower the loading plate onto the pavement ensuring there should be no standing water on the pavement surface. The loading plate should be in proper contact with pavement surface. The longitudinal and transverse slope of the pavement should not exceed 10 percent at the test location.

iv. Lower the frame holding the geophones so that the transducers are in contact with pavement surface.

v. Raise the mass to a pre-determined height required for producing a target load of 70 kN (+5%).

vi. Drop one seating load, load and deflection data for which need not be recorded.

vii. Raise the mass and drop. Record the load and deflection data into the computer through data acquisition system. While peak load and peak deflections at different selected radial positions must be recorded. At least 2 drops should be made at one location for precision.

viii. If, during previous 2 steps, the deflections measured are giving variations or the deflections/load pulses are not proper, repeat the drop.

ix. Raise the geophone frame and load plate and move to the next test location.

x. Deflection measurements should not be made when the pavement temperature is more than 40°C.

2.4 RIGID PAVEMENT COMPOSITION DETAILS

Adopted PQC crust thickness during construction was 300mm and same is considered for analysis

2.5 INPUT DATA FOR RIGID PAVEMENT ANALYSIS

a) Processing of Area and Deflection data.

The FWD test should be done at 0mm, 300mm, 600mm, 900mm radial distances from the center of loading point should be measured.

The area of Deflection basin is calculated by

$$A=6(1+2(D_1/D_0)+2(D_2/D_0)+(D_3/D_0))$$

Where,

A=Area parameter of the deflection basin

D_0=Deflection at center of the loading plate in mm

D_1= Deflection in mm at 300mm from center of the loading plate

D_2= Deflection in mm at 600mm from center of the loading plate

D_3= Deflection in mm at 900mm from center of the loading plate

From the area of deflection basin, Radius of relativeness (l) can be evaluated from the charts given in IRC: 117 (Appendix V) and the normalized deflections are found.

b) Evaluation of Subgrade Modulus, Elastic Modulus of concrete, Strength of concrete, Flexural Strength of concrete.

Subgrade moduli value can be found for normalized deflections and average of all should be taken as subgrade modulus.

$$k_i=Pd_i/l^2D_i$$

Where,

i=1,2,3,4

l=Radius of relative stiffness, mm

P=Load in kN

D_i=Measured deflections in mm at various radial distance

d_i=Normalized deflections in mm at various radial distances

Elastic Modulus (MPa) of concrete can be found by using the formulae

$$E_c=12(1-\mu_c)\, kl^4/1000h^3$$

Where,

μ_c= Poisson's Ratio of Concrete

h= Thickness of concrete layer in mm

l= Radius of relative stiffness in mm

k=modulus of subgrade reaction in MPa/m

E= Elastic modulus of concrete, MPa

Strength of concrete can be determined from the E_C from the following

$$f_c= (E_C /5000)0.50$$

Flexural strength can be determined from the f_c of the concrete slab as given below:

$$f_{mr}=0.7(f_c)0.50$$

Poisson's ratio for different layers i.e., 0.15 for concrete and 0.45 for subgrade.

c) Evaluation of Load Transfer Efficiency of Joints

Transverse as well as longitudinal joints deteriorate with traffic due to continuous loading. For a new pavement, the joint efficiency is nearly 100 percent since the deflections on either side of the joint under a wheel load are almost equal and the ratio decreases as the joints deteriorate under repeated loading.

When deflection sensors are the either side of a joint with deflections D_1 and D_2 on the loaded and unloaded sides. Deflections on the Loaded and Unloaded side at a Joint is presented in **Figure 4.**

$$LTE=100(D_2/D_1)$$

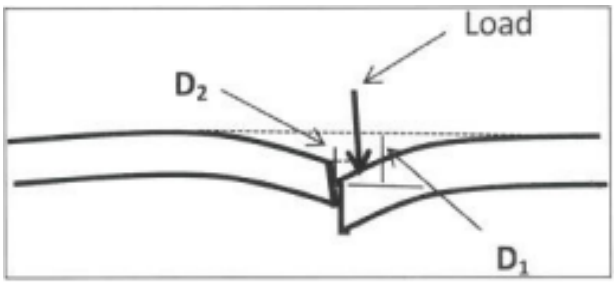

FIGURE 4 : DEFLECTIONS ON THE LOADED AND UNLOADED SIDE AT A JOINT

For a new pavement, $D_1 = D_2$ but D_2 becomes less and less as the joints deteriorate.

If $D_2/D_1 < 0.5$ transverse joints in critical condition

If $D_2/D_1 < 0.4$ longitudinal joints in critical condition

Where,

D_1 is the deflection on the loaded side of the slab

& D_2 is the deflection on the unloaded side of the slab

Annexure – 4.7

Summary of Back Calculation of E Values

E-Values & Remaining Life Analysis:																
S.No	Chainage (km)	Date & Time	Lane	KN	0 (mm)	200 (mm)	300 (mm)	450 (mm)	600 (mm)	900 (mm)	1500 (mm)	Temperatures (oC)		Pavement Condition	4-Days Soaked CBR (%)
				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air		
1	1515.750	02/12/2022 13:17	Outer lane_LHS	40	0.12678	0.10450	0.09761	0.08793	0.08066	0.06144	0.04978	32.7	29.6	Good	8
2	1516.000	02/12/2022 13:21	Outer lane_LHS	40	0.22638	0.18938	0.17027	0.14293	0.12353	0.08664	0.05892	32.7	29.9	Good	8
3	1516.101	03/12/2022 08:30	Inner lane_LHS	40	0.57531	0.45198	0.38554	0.28654	0.20731	0.09451	0.07821	17.5	17.1	Good	8
4	1516.265	02/12/2022 13:22	Outer lane_LHS	40	0.25720	0.19803	0.16759	0.13251	0.11408	0.07301	0.04471	32.7	30.0	Good	8
5	1516.603	03/12/2022 08:32	Inner lane_LHS	40	0.46491	0.36837	0.31068	0.24047	0.16862	0.09494	0.08441	17.4	17.0	Good	8
6	1516.758	02/12/2022 13:24	Outer lane_LHS	40	0.28359	0.23459	0.20451	0.16897	0.12937	0.08177	0.06031	32.7	30.2	Good	8
7	1517.085	02/12/2022 13:25	Outer lane_LHS	40	0.25152	0.20719	0.18134	0.14651	0.10168	0.06549	0.04824	32.7	30.3	Good	8
8	1517.108	03/12/2022 08:34	Inner lane_LHS	40	0.30464	0.25633	0.22676	0.18111	0.12541	0.07631	0.06137	17.4	17.2	Good	8
9	1517.260	02/12/2022 13:29	Outer lane_LHS	40	0.37670	0.31873	0.27936	0.22709	0.15644	0.09734	0.07658	32.7	30.7	Good	8
10	1517.605	03/12/2022 08:36	Inner lane_LHS	40	0.13594	0.11298	0.10915	0.09639	0.08221	0.06082	0.05354	17.5	17.4	Good	8
11	1517.755	02/12/2022 13:31	Outer lane_LHS	40	0.22120	0.18156	0.15579	0.12640	0.08925	0.06077	0.04882	32.7	30.8	Good	8
12	1517.993	02/12/2022 13:32	Outer lane_LHS	40	0.40349	0.33223	0.29090	0.22757	0.14655	0.08495	0.06654	32.7	30.9	Good	8
13	1518.104	03/12/2022 08:38	Inner lane_LHS	40	0.23563	0.19485	0.18394	0.15727	0.13255	0.09228	0.06401	19.7	17.6	Good	8
14	1518.256	02/12/2022 13:34	Outer lane_LHS	40	0.24595	0.18927	0.16756	0.13986	0.10754	0.06750	0.06057	32.7	31.0	Good	8
15	1518.596	03/12/2022 08:40	Inner lane_LHS	40	0.19580	0.16324	0.14191	0.12605	0.10122	0.07363	0.05809	19.7	17.8	Good	8
16	1518.759	02/12/2022 13:35	Outer lane_LHS	40	0.30567	0.24361	0.21851	0.18292	0.12275	0.07390	0.05887	32.7	31.0	Good	8
17	1519.011	02/12/2022 13:36	Outer lane_LHS	40	0.31786	0.25159	0.21605	0.17304	0.12737	0.08472	0.06634	32.7	31.4	Good	8
18	1519.102	03/12/2022 08:42	Inner lane_LHS	40	0.27071	0.21287	0.18224	0.14834	0.12952	0.09217	0.06807	19.7	18.1	Good	8
19	1519.250	02/12/2022 13:38	Outer lane_LHS	40	0.25259	0.19081	0.16677	0.13620	0.10390	0.06226	0.04879	32.7	31.3	Good	8
20	1519.607	03/12/2022 08:43	Inner lane_LHS	40	0.26490	0.21902	0.19550	0.16320	0.13652	0.08812	0.06514	19.7	18.1	Good	8
21	1519.751	02/12/2022 13:39	Outer lane_LHS	40	0.24298	0.20642	0.18496	0.16013	0.10404	0.07694	0.06750	32.7	31.5	Good	8
22	1520.001	02/12/2022 13:42	Outer lane_LHS	40	0.19574	0.16138	0.14610	0.12498	0.09416	0.06188	0.05571	32.7	31.7	Good	8
23	1520.104	03/12/2022 08:44	Inner lane_LHS	40	0.23929	0.19635	0.17535	0.14891	0.12186	0.08475	0.07864	19.7	18.3	Good	8
24	1520.256	02/12/2022 13:44	Outer lane_LHS	40	0.32304	0.24321	0.20492	0.16881	0.11631	0.08031	0.06845	32.7	31.7	Good	8
25	1520.601	03/12/2022 09:20	Inner lane_LHS	40	0.20585	0.14807	0.13188	0.11205	0.10302	0.07258	0.05560	23.4	20.7	Good	8
26	1520.758	02/12/2022 13:46	Outer lane_LHS	40	0.22054	0.17928	0.16401	0.14583	0.11158	0.07123	0.06119	32.7	32.1	Good	8
27	1521.004	02/12/2022 13:47	Outer lane_LHS	40	0.35942	0.29521	0.25664	0.20690	0.15849	0.10338	0.08224	32.7	31.9	Good	8

E-Values & Remaining Life Analysis:															
S.No	Chainage (km)	Date & Time	Lane	KN	0 (mm)	200 (mm)	300 (mm)	450 (mm)	600 (mm)	900 (mm)	1500 (mm)	Temperatures (oC)		Pavement Condition	4-Days Soaked CBR (%)
				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air		
28	1521.126	03/12/2022 09:22	Inner lane_LHS	40	0.17916	0.13917	0.12156	0.09861	0.08928	0.06341	0.05095	23.4	20.8	Good	8
29	1521.259	02/12/2022 13:49	Outer lane_LHS	40	0.21250	0.16401	0.14135	0.11490	0.09180	0.06317	0.05235	32.7	32.1	Good	8
30	1521.614	03/12/2022 09:24	Inner lane_LHS	40	0.19436	0.14070	0.13018	0.10656	0.08463	0.05818	0.05155	23.4	21.0	Good	8
31	1521.759	02/12/2022 14:31	Outer lane_LHS	40	0.30182	0.24112	0.20980	0.17081	0.12145	0.07675	0.07343	36.7	32.4	Good	8
32	1522.001	02/12/2022 14:32	Outer lane_LHS	40	0.24155	0.21348	0.19655	0.14545	0.11576	0.10007	0.07679	36.7	32.3	Good	8
33	1522.134	03/12/2022 09:25	Inner lane_LHS	40	0.18871	0.15295	0.13815	0.11696	0.09843	0.06869	0.05344	23.4	20.9	Good	8
34	1522.253	02/12/2022 14:34	Outer lane_LHS	40	0.23445	0.18228	0.15201	0.09124	0.06582	0.05582	0.04672	36.7	32.0	Good	8
35	1522.622	03/12/2022 09:27	Inner lane_LHS	40	0.28279	0.23393	0.20825	0.17056	0.14590	0.09267	0.06295	23.4	21.4	Good	8
36	1522.748	02/12/2022 14:36	Outer lane_LHS	40	0.21522	0.13997	0.11678	0.09149	0.05715	0.04291	0.03716	36.7	32.3	Good	8
37	1522.998	02/12/2022 14:37	Outer lane_LHS	40	0.39670	0.29905	0.25031	0.19310	0.14864	0.09227	0.07414	36.7	32.3	Good	8
38	1523.122	03/12/2022 09:31	Inner lane_LHS	40	0.31498	0.23089	0.19368	0.14513	0.13169	0.08062	0.05310	27.6	21.8	Good	8
39	1523.122	03/12/2022 09:40	Inner lane_LHS	40	0.31264	0.20835	0.17838	0.13399	0.13087	0.08224	0.05012	26.4	22.3	Good	8
40	1523.122	03/12/2022 10:00	Inner lane_LHS	40	0.29576	0.21409	0.18642	0.13468	0.12731	0.07989	0.04804	26.7	23.2	Good	8
41	1523.271	02/12/2022 14:38	Outer lane_LHS	40	0.18362	0.13726	0.12243	0.09311	0.07203	0.05657	0.05000	36.7	32.3	Good	8
42	1523.613	03/12/2022 10:01	Inner lane_LHS	40	0.30296	0.21114	0.18323	0.13953	0.13750	0.08696	0.04650	26.7	23.0	Good	8
43	1523.755	02/12/2022 14:40	Outer lane_LHS	40	0.21458	0.18139	0.16162	0.13808	0.09846	0.07247	0.06258	36.7	32.4	Good	8
44	1523.999	02/12/2022 14:41	Outer lane_LHS	40	0.22211	0.17380	0.15270	0.12706	0.10133	0.07025	0.05705	36.7	32.4	Good	8
45	1524.103	03/12/2022 10:10	Inner lane_LHS	40	0.15171	0.12613	0.11800	0.10750	0.08321	0.06364	0.05784	27.6	23.5	Good	8
46	1524.264	02/12/2022 14:43	Outer lane_LHS	40	0.29470	0.23705	0.20192	0.16734	0.11890	0.07808	0.05902	36.7	32.5	Good	8
47	1524.603	03/12/2022 10:13	Inner lane_LHS	40	0.24125	0.17961	0.15799	0.13061	0.11951	0.08602	0.06062	27.6	23.9	Good	8
48	1524.757	02/12/2022 14:44	Outer lane_LHS	40	0.18119	0.13807	0.12420	0.10514	0.08577	0.06141	0.04646	36.7	32.5	Good	8
49	1525.002	02/12/2022 14:46	Outer lane_LHS	40	0.21725	0.14788	0.12897	0.10321	0.09345	0.06539	0.04870	36.7	32.5	Good	8
50	1525.124	03/12/2022 10:15	Inner lane_LHS	40	0.22869	0.18143	0.15990	0.13371	0.11494	0.08584	0.05921	27.6	24.3	Good	8
51	1525.259	02/12/2022 14:47	Outer lane_LHS	40	0.28045	0.21398	0.17810	0.13787	0.09771	0.06180	0.04978	36.7	32.7	Good	8
52	1525.596	03/12/2022 10:17	Inner lane_LHS	40	0.28320	0.21617	0.18398	0.14799	0.12447	0.08588	0.06736	27.6	24.2	Good	8
53	1525.757	02/12/2022 14:49	Outer lane_LHS	40	0.30242	0.23454	0.20352	0.16557	0.12769	0.08705	0.07619	36.7	32.8	Good	8
54	1526.013	02/12/2022 14:50	Outer lane_LHS	40	0.37220	0.30855	0.25616	0.20451	0.14960	0.09502	0.07621	36.7	32.7	Good	8

E-Values & Remaining Life Analysis:															
S.No	Chainage (km)	Date & Time	Lane	KN	0 (mm)	200 (mm)	300 (mm)	450 (mm)	600 (mm)	900 (mm)	1500 (mm)	Temperatures (oC)		Pavement Condition	4-Days Soaked CBR (%)
				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air		
55	1526.132	03/12/2022 10:19	Inner lane_LHS	40	0.24079	0.18829	0.16135	0.14070	0.12169	0.08317	0.06146	27.6	24.4	Good	8
56	1526.299	02/12/2022 14:51	Outer lane_LHS	40	0.26005	0.22852	0.21199	0.18114	0.12620	0.08171	0.08035	36.7	32.9	Good	8
57	1526.621	03/12/2022 10:20	Inner lane_LHS	40	0.23218	0.17633	0.15625	0.13445	0.13078	0.09450	0.06225	27.6	24.7	Good	8
58	1526.762	02/12/2022 14:53	Outer lane_LHS	40	0.27228	0.21418	0.18434	0.15784	0.10591	0.07116	0.05728	36.7	33.0	Good	8
59	1527.009	02/12/2022 14:54	Outer lane_LHS	40	0.28021	0.20422	0.17300	0.13245	0.10269	0.06846	0.05645	36.7	33.1	Good	8
60	1527.120	03/12/2022 10:22	Inner lane_LHS	40	0.14529	0.12016	0.11028	0.09914	0.08198	0.06126	0.05700	27.6	24.9	Good	8
61	1527.254	02/12/2022 14:55	Outer lane_LHS	40	0.41464	0.32676	0.27586	0.21127	0.15589	0.09372	0.06782	36.7	33.1	Good	8
62	1527.606	03/12/2022 10:23	Inner lane_LHS	40	0.33941	0.26493	0.21608	0.17067	0.14368	0.09068	0.05949	27.6	25.0	Good	8
63	1527.779	02/12/2022 14:57	Outer lane_LHS	40	0.41564	0.33755	0.28411	0.22776	0.16084	0.08366	0.07341	36.7	33.2	Good	8
64	1528.017	02/12/2022 14:58	Outer lane_LHS	40	0.41451	0.32347	0.27216	0.20872	0.15771	0.10140	0.07233	36.7	33.3	Good	8
65	1528.130	03/12/2022 10:25	Inner lane_LHS	40	0.27099	0.20309	0.17089	0.14343	0.10994	0.06882	0.05489	27.6	25.2	Good	8
66	1528.261	02/12/2022 15:00	Outer lane_LHS	40	0.44721	0.38459	0.31322	0.23588	0.16209	0.10560	0.09313	36.7	33.3	Good	8
67	1528.590	03/12/2022 10:27	Inner lane_LHS	40	0.24325	0.18744	0.15574	0.12615	0.10953	0.07299	0.05407	27.6	25.5	Good	8
68	1528.764	02/12/2022 15:01	Outer lane_LHS	40	0.18663	0.16186	0.14493	0.12817	0.09726	0.07413	0.06014	36.7	33.3	Good	8
69	1529.000	02/12/2022 15:03	Outer lane_LHS	40	0.22380	0.17121	0.16149	0.13634	0.12001	0.07577	0.06295	36.7	33.4	Good	8
70	1529.145	03/12/2022 10:29	Inner lane_LHS	40	0.45644	0.39141	0.33892	0.27796	0.19300	0.11654	0.09186	27.6	25.6	Good	8
71	1529.249	02/12/2022 15:05	Outer lane_LHS	40	0.32722	0.26267	0.23937	0.19425	0.14760	0.10049	0.08008	36.7	33.4	Good	8
72	1529.603	03/12/2022 10:30	Inner lane_LHS	40	0.23374	0.18894	0.16577	0.13842	0.09725	0.06849	0.05696	27.6	25.1	Good	8
73	1529.751	02/12/2022 15:06	Outer lane_LHS	40	0.47030	0.35623	0.29999	0.23028	0.17577	0.10655	0.07842	36.7	33.6	Good	8
74	1530.104	02/12/2022 15:08	Outer lane_LHS	40	0.26121	0.20899	0.18475	0.14828	0.10107	0.06395	0.04702	36.7	33.6	Good	8
75	1530.124	03/12/2022 10:32	Inner lane_LHS	40	0.23764	0.18075	0.15474	0.11757	0.09368	0.05870	0.04868	27.6	25.9	Good	8
76	1530.260	02/12/2022 15:09	Outer lane_LHS	40	0.20196	0.13877	0.12653	0.10293	0.09670	0.06968	0.05289	36.7	33.8	Good	8
77	1530.598	03/12/2022 10:33	Inner lane_LHS	40	0.30455	0.25301	0.20663	0.16949	0.14257	0.08841	0.07361	27.6	26.1	Good	8
78	1530.766	02/12/2022 15:10	Outer lane_LHS	40	0.41084	0.36304	0.34115	0.27823	0.19315	0.11399	0.09127	36.7	33.7	Good	8
79	1531.020	02/12/2022 15:12	Outer lane_LHS	40	0.32652	0.27135	0.24888	0.21483	0.13838	0.09799	0.08930	36.7	33.8	Good	8
80	1531.127	03/12/2022 10:35	Inner lane_LHS	40	0.47467	0.37555	0.33373	0.25361	0.21814	0.13188	0.07715	27.6	26.3	Good	8
81	1531.263	02/12/2022 15:13	Outer lane_LHS	40	0.41680	0.34453	0.29726	0.23132	0.17647	0.10781	0.07891	36.7	33.9	Good	8

E-Values & Remaining Life Analysis:																
S.No	Chainage (km)	Date & Time	Lane	KN	0 (mm)	200 (mm)	300 (mm)	450 (mm)	600 (mm)	900 (mm)	1500 (mm)	Temperatures (oC)		Pavement Condition	4-Days Soaked CBR (%)
				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air		
82	1531.601	03/12/2022 10:36	Inner lane_LHS	40	0.23123	0.17658	0.16472	0.13784	0.13151	0.09062	0.07055	27.6	26.4	Good	8
83	1531.761	02/12/2022 15:15	Outer lane_LHS	40	0.28153	0.22899	0.19998	0.16338	0.11536	0.07470	0.06705	36.7	33.9	Good	8
84	1532.007	02/12/2022 15:16	Outer lane_LHS	40	0.22184	0.18353	0.15889	0.13109	0.09748	0.06852	0.05554	36.7	34.0	Good	8
85	1532.135	03/12/2022 10:38	Inner lane_LHS	40	0.25179	0.20891	0.18476	0.15740	0.12184	0.08787	0.06628	27.6	26.9	Good	8
86	1532.251	02/12/2022 15:17	Outer lane_LHS	40	0.30001	0.24290	0.21465	0.16126	0.11379	0.08291	0.07070	36.7	34.1	Good	8
87	1532.628	03/12/2022 10:39	Inner lane_LHS	40	0.20427	0.17641	0.15421	0.12957	0.10543	0.06625	0.05663	27.6	26.8	Good	8
88	1532.754	02/12/2022 15:19	Outer lane_LHS	40	0.25260	0.20852	0.18818	0.15506	0.13544	0.09685	0.06746	36.7	34.0	Good	8
89	1533.006	02/12/2022 15:20	Outer lane_LHS	40	0.24172	0.18477	0.16368	0.12928	0.11363	0.07536	0.05543	36.7	33.9	Good	8
90	1533.117	03/12/2022 10:41	Inner lane_LHS	40	0.37126	0.28858	0.25074	0.19435	0.16241	0.10944	0.07962	27.6	26.7	Good	8
91	1533.413	02/12/2022 15:22	Outer lane_LHS	40	0.22610	0.17828	0.15347	0.12843	0.10168	0.07148	0.06165	36.7	34.1	Good	8
92	1533.594	03/12/2022 10:42	Inner lane_LHS	40	0.24174	0.19249	0.17048	0.13241	0.11115	0.07524	0.06253	27.6	27.0	Good	8
93	1533.757	02/12/2022 15:23	Outer lane_LHS	40	0.19446	0.16132	0.14096	0.11729	0.10709	0.07938	0.05713	36.7	34.1	Good	8
94	1534.000	02/12/2022 15:25	Outer lane_LHS	40	0.17659	0.14919	0.13731	0.10552	0.07989	0.05839	0.04872	36.7	34.1	Good	8
95	1534.141	03/12/2022 10:44	Inner lane_LHS	40	0.21486	0.17362	0.16307	0.14022	0.10753	0.07863	0.07070	27.6	27.1	Good	8
96	1534.263	02/12/2022 15:26	Outer lane_LHS	40	0.15978	0.13937	0.12403	0.09354	0.06509	0.05511	0.04243	36.7	34.1	Good	8
97	1534.598	03/12/2022 10:46	Inner lane_LHS	40	0.19933	0.14417	0.12942	0.11172	0.10147	0.06747	0.05477	27.6	27.1	Good	8
98	1534.747	02/12/2022 15:28	Outer lane_LHS	40	0.20840	0.16582	0.14638	0.11565	0.10257	0.07496	0.05584	36.7	34.2	Good	8
99	1535.000	02/12/2022 15:29	Outer lane_LHS	40	0.22247	0.16169	0.13844	0.09125	0.06989	0.05282	0.04411	36.7	34.3	Good	8
100	1535.089	03/12/2022 10:47	Inner lane_LHS	40	0.18868	0.14818	0.13123	0.10950	0.08767	0.05714	0.04301	27.6	27.4	Good	8
101	1535.251	02/12/2022 15:31	Outer lane_LHS	40	0.27848	0.20701	0.17352	0.12520	0.09633	0.06430	0.05425	36.7	34.2	Good	8
102	1535.622	03/12/2022 10:49	Inner lane_LHS	40	0.16732	0.15485	0.14554	0.12666	0.06220	0.05943	0.05325	27.6	27.5	Good	8
103	1535.758	02/12/2022 15:32	Outer lane_LHS	40	0.28621	0.23702	0.20982	0.17009	0.10877	0.06762	0.05590	36.7	34.2	Good	8
104	1536.000	04/12/2022 08:46	Outer lane_LHS	40	0.13251	0.09952	0.08977	0.08027	0.06844	0.04342	0.04107	20.1	17.1	Good	8
105	1536.128	03/12/2022 10:51	Inner lane_LHS	40	0.34993	0.30087	0.26992	0.22099	0.18292	0.11680	0.08228	27.7	27.6	Good	8
106	1536.251	04/12/2022 08:47	Outer lane_LHS	40	0.29467	0.23012	0.20559	0.16331	0.13702	0.09246	0.06698	20.1	17.2	Good	8
107	1536.566	03/12/2022 10:52	Inner lane_LHS	40	0.20675	0.16680	0.15063	0.12869	0.10609	0.07333	0.06390	27.7	27.6	Good	8
108	1536.762	04/12/2022 08:49	Outer lane_LHS	40	0.15007	0.12151	0.10977	0.09182	0.07939	0.05454	0.04159	20.1	17.4	Good	8

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				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air		
109	1537.005	04/12/2022 08:50	Outer lane_LHS	40	0.26196	0.22729	0.19571	0.16104	0.12265	0.07808	0.05690	20.1	17.8	Good	8
110	1537.100	03/12/2022 10:54	Inner lane_LHS	40	0.23543	0.19393	0.18225	0.15901	0.12141	0.08902	0.07300	27.8	27.6	Good	8
111	1537.278	04/12/2022 08:51	Outer lane_LHS	40	0.16668	0.13688	0.11775	0.10244	0.07918	0.05676	0.04693	20.1	17.8	Good	8
112	1537.615	03/12/2022 10:56	Inner lane_LHS	40	0.25220	0.23714	0.22404	0.09425	0.06160	0.03445	0.03174	28.1	27.6	Good	8
113	1537.744	04/12/2022 08:53	Outer lane_LHS	40	0.18346	0.14797	0.13011	0.11060	0.08165	0.05555	0.04877	20.1	18.2	Good	8
114	1538.001	04/12/2022 08:55	Outer lane_LHS	40	0.36827	0.29898	0.24937	0.20661	0.15455	0.10045	0.07492	20.1	18.3	Good	8
115	1538.112	03/12/2022 10:58	Inner lane_LHS	40	0.25274	0.19816	0.17130	0.12953	0.09770	0.04907	0.03607	28.1	27.6	Good	8
116	1538.252	04/12/2022 08:56	Outer lane_LHS	40	0.27448	0.20708	0.17587	0.13529	0.11738	0.06876	0.06210	20.1	18.5	Good	8
117	1538.609	03/12/2022 11:00	Inner lane_LHS	40	0.30505	0.22413	0.18402	0.13639	0.10930	0.06671	0.05658	28.4	27.6	Good	8
118	1538.752	04/12/2022 08:57	Outer lane_LHS	40	0.31201	0.23551	0.19434	0.14631	0.12270	0.07807	0.06560	20.1	18.7	Good	8
119	1539.003	04/12/2022 08:59	Outer lane_LHS	40	0.43035	0.34445	0.28035	0.20957	0.14161	0.08360	0.06966	20.1	18.9	Good	8
120	1539.073	03/12/2022 11:01	Inner lane_LHS	40	0.28951	0.25714	0.22223	0.18102	0.08500	0.06401	0.03411	28.4	27.6	Good	8
121	1540.010	04/12/2022 09:01	Outer lane_LHS	40	0.27470	0.18957	0.14323	0.09599	0.06217	0.02922	0.02471	20.1	19.3	Good	8
122	1540.101	03/12/2022 11:04	Inner lane_LHS	40	0.29854	0.21770	0.19729	0.12025	0.08221	0.05646	0.02717	28.3	27.6	Good	8
123	1540.248	04/12/2022 09:03	Outer lane_LHS	40	0.14425	0.12068	0.10931	0.09646	0.07410	0.05669	0.05018	20.1	19.6	Good	8
124	1540.511	03/12/2022 11:06	Inner lane_LHS	40	0.22648	0.18992	0.15863	0.12886	0.09520	0.06141	0.04966	28.6	27.6	Good	8
125	1541.363	03/12/2022 11:09	Inner lane_LHS	40	0.27900	0.23350	0.20128	0.15887	0.14757	0.08879	0.05717	28.8	27.6	Good	8
126	1541.398	04/12/2022 09:05	Outer lane_LHS	40	0.18271	0.15350	0.13937	0.11723	0.09021	0.05855	0.05429	20.1	19.9	Good	8
127	1541.750	04/12/2022 09:07	Outer lane_LHS	40	0.27882	0.23203	0.20125	0.16624	0.12820	0.08424	0.06715	20.2	20.1	Good	8
128	1541.807	03/12/2022 11:10	Inner lane_LHS	40	0.22087	0.17640	0.15385	0.13042	0.10715	0.06543	0.04956	28.8	27.6	Good	8
129	1542.006	04/12/2022 09:08	Outer lane_LHS	40	0.31797	0.27862	0.23591	0.18999	0.14357	0.08876	0.07192	20.3	20.1	Good	8
130	1542.143	03/12/2022 11:14	Inner lane_LHS	40	0.42162	0.33665	0.28940	0.22655	0.17695	0.09745	0.06376	29.0	27.6	Good	8
131	1542.279	04/12/2022 09:09	Outer lane_LHS	40	0.49193	0.42052	0.37028	0.28008	0.19569	0.11407	0.08353	20.5	20.1	Good	8
132	1542.618	03/12/2022 11:16	Inner lane_LHS	40	0.43895	0.40190	0.36667	0.28492	0.22417	0.12938	0.09336	29.1	27.6	Good	8
133	1542.753	04/12/2022 09:11	Outer lane_LHS	40	0.25587	0.19045	0.16843	0.13922	0.10876	0.06469	0.05450	20.7	20.1	Good	8
134	1543.002	04/12/2022 09:12	Outer lane_LHS	40	0.41279	0.35127	0.28696	0.23034	0.17093	0.10559	0.07729	23.6	20.9	Good	8
135	1543.119	03/12/2022 11:18	Inner lane_LHS	40	0.33007	0.27396	0.24034	0.19398	0.15624	0.08237	0.06891	29.2	27.6	Good	8

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				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air		
136	1543.246	04/12/2022 09:14	Outer lane_LHS	40	0.33846	0.27202	0.24008	0.19552	0.16163	0.10853	0.08263	23.6	21.0	Good	8
137	1543.601	03/12/2022 11:19	Inner lane_LHS	40	0.16122	0.14315	0.12760	0.10642	0.06557	0.04074	0.03659	29.3	27.6	Good	8
138	1543.747	04/12/2022 09:16	Outer lane_LHS	40	0.40536	0.34168	0.29214	0.24021	0.19527	0.12478	0.09415	23.6	21.4	Good	8
139	1543.996	04/12/2022 09:17	Outer lane_LHS	40	0.23571	0.20039	0.17690	0.14963	0.11322	0.06984	0.06600	23.6	21.5	Good	8
140	1544.135	03/12/2022 11:21	Inner lane_LHS	40	0.18124	0.13465	0.11210	0.09167	0.07951	0.04902	0.03674	34.5	29.4	Good	8
141	1544.255	04/12/2022 09:18	Outer lane_LHS	40	0.11653	0.09996	0.09206	0.08414	0.06896	0.04892	0.04295	23.6	21.6	Good	8
142	1544.642	03/12/2022 11:23	Inner lane_LHS	40	0.12929	0.08909	0.08190	0.07260	0.05545	0.04259	0.03778	34.5	29.6	Good	8
143	1544.748	04/12/2022 09:20	Outer lane_LHS	40	0.10305	0.08740	0.07810	0.06880	0.05820	0.04041	0.03226	23.6	21.8	Good	8
144	1544.996	04/12/2022 09:21	Outer lane_LHS	40	0.19004	0.14077	0.12458	0.10234	0.08127	0.05017	0.04217	23.6	22.1	Good	8
145	1545.119	03/12/2022 11:25	Inner lane_LHS	40	0.23135	0.17499	0.16159	0.13559	0.12507	0.08485	0.07215	34.5	29.6	Good	8
146	1545.251	04/12/2022 09:22	Outer lane_LHS	40	0.22784	0.18103	0.15302	0.12588	0.09725	0.06353	0.05235	23.6	22.2	Good	8
147	1545.653	03/12/2022 11:26	Inner lane_LHS	40	0.21096	0.15888	0.13561	0.11271	0.08684	0.05236	0.05089	34.5	29.8	Good	8
148	1545.758	04/12/2022 09:24	Outer lane_LHS	40	0.11907	0.10297	0.09303	0.08443	0.06597	0.05037	0.04342	23.6	22.5	Good	8
149	1545.989	04/12/2022 09:25	Outer lane_LHS	40	0.13935	0.10496	0.09094	0.07904	0.06447	0.04695	0.03746	23.6	22.6	Good	8
150	1546.130	03/12/2022 11:28	Inner lane_LHS	40	0.15734	0.12091	0.10591	0.08886	0.07545	0.05122	0.04355	34.5	29.9	Good	8
151	1546.254	04/12/2022 09:26	Outer lane_LHS	40	0.25513	0.20521	0.17519	0.14112	0.11718	0.07311	0.05638	23.6	22.8	Good	8
152	1546.619	03/12/2022 11:30	Inner lane_LHS	40	0.24490	0.18399	0.16352	0.13413	0.12896	0.08371	0.06338	34.5	30.0	Good	8
153	1546.737	04/12/2022 09:28	Outer lane_LHS	40	0.24882	0.19662	0.17118	0.14041	0.10144	0.06356	0.05953	23.6	23.2	Good	8
154	1546.992	04/12/2022 09:30	Outer lane_LHS	40	0.17045	0.11720	0.10276	0.08660	0.07845	0.05009	0.04162	23.6	23.2	Good	8
155	1547.104	03/12/2022 11:32	Inner lane_LHS	40	0.19962	0.15688	0.14141	0.11841	0.10069	0.07080	0.05768	34.5	30.1	Good	8
156	1547.279	04/12/2022 09:31	Outer lane_LHS	40	0.22048	0.16896	0.14307	0.11383	0.09531	0.06675	0.05242	23.6	23.5	Good	8
157	1547.604	03/12/2022 11:33	Inner lane_LHS	40	0.17220	0.13429	0.11870	0.11197	0.09312	0.06647	0.05913	34.5	30.3	Good	8
158	1547.750	04/12/2022 09:33	Outer lane_LHS	40	0.29692	0.24774	0.21790	0.17985	0.14077	0.09106	0.07840	23.6	23.5	Good	8
159	1548.002	04/12/2022 09:34	Outer lane_LHS	40	0.35468	0.29519	0.26014	0.21670	0.16890	0.09938	0.08705	23.7	23.6	Good	8
160	1548.136	03/12/2022 11:35	Inner lane_LHS	40	0.31463	0.25692	0.23289	0.19360	0.14963	0.09278	0.07751	34.5	30.3	Good	8
161	1548.250	04/12/2022 09:36	Outer lane_LHS	40	0.47733	0.39055	0.32281	0.23793	0.15378	0.08734	0.07130	24.0	23.6	Good	8
162	1548.634	03/12/2022 11:37	Inner lane_LHS	40	0.17503	0.13837	0.12448	0.10856	0.08770	0.06419	0.05565	34.5	30.4	Good	8

E-Values & Remaining Life Analysis:															
S.No	Chainage (km)	Date & Time	Lane	KN	0 (mm)	200 (mm)	300 (mm)	450 (mm)	600 (mm)	900 (mm)	1500 (mm)	Temperatures (oC)		Pavement Condition	4-Days Soaked CBR (%)
				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air		
163	1548.756	04/12/2022 09:37	Outer lane_LHS	40	0.14302	0.11414	0.10087	0.08596	0.07110	0.04823	0.04270	24.0	23.6	Good	8
164	1548.975	04/12/2022 09:38	Outer lane_LHS	40	0.17753	0.13449	0.11580	0.09535	0.07767	0.05429	0.04529	24.2	23.6	Good	8
165	1549.131	03/12/2022 11:39	Inner lane_LHS	40	0.17489	0.14227	0.12815	0.11189	0.09142	0.06820	0.05720	34.5	30.5	Good	8
166	1549.275	04/12/2022 09:40	Outer lane_LHS	40	0.11857	0.10146	0.09327	0.08260	0.06055	0.04356	0.03635	24.3	23.6	Good	8
167	1549.599	03/12/2022 11:41	Inner lane_LHS	40	0.17234	0.13233	0.11820	0.10101	0.08592	0.06390	0.04896	34.5	30.6	Good	8
168	1549.778	04/12/2022 09:42	Outer lane_LHS	40	0.22790	0.18197	0.16796	0.14767	0.12840	0.09036	0.07895	24.6	23.6	Good	8
169	1549.971	04/12/2022 09:43	Outer lane_LHS	40	0.18716	0.15140	0.13343	0.11488	0.09276	0.05955	0.05494	26.9	24.6	Good	8
170	1550.058	03/12/2022 11:43	Inner lane_LHS	40	0.16565	0.13441	0.12601	0.11104	0.08703	0.06517	0.05957	34.5	30.8	Good	8
171	1551.177	03/12/2022 11:45	Inner lane_LHS	40	0.47995	0.38979	0.33066	0.23774	0.17761	0.09664	0.05909	34.5	30.9	Good	8
172	1551.263	04/12/2022 09:46	Outer lane_LHS	40	0.11717	0.10191	0.09387	0.08650	0.07551	0.05749	0.04505	26.9	24.9	Good	8
173	1551.638	03/12/2022 11:47	Inner lane_LHS	40	0.29579	0.22359	0.19258	0.15460	0.13766	0.08272	0.06250	34.5	30.9	Good	8
174	1551.786	04/12/2022 09:47	Outer lane_LHS	40	0.18799	0.15750	0.14276	0.12420	0.11090	0.07623	0.05908	26.9	25.1	Good	8
175	1552.028	04/12/2022 09:49	Outer lane_LHS	40	0.12068	0.11267	0.10877	0.10037	0.07588	0.06126	0.05518	26.9	25.1	Good	8
176	1552.158	03/12/2022 11:49	Inner lane_LHS	40	0.17277	0.13911	0.12713	0.11168	0.10436	0.07965	0.05836	34.5	31.0	Good	8
177	1552.250	04/12/2022 09:50	Outer lane_LHS	40	0.22491	0.18859	0.17212	0.15469	0.13778	0.09924	0.07514	26.9	25.3	Good	8
178	1552.594	03/12/2022 11:50	Inner lane_LHS	40	0.16953	0.14243	0.13248	0.12186	0.10424	0.07801	0.06323	34.5	31.2	Good	8
179	1552.753	04/12/2022 09:52	Outer lane_LHS	40	0.10774	0.09680	0.09306	0.08781	0.07019	0.04997	0.04714	26.9	25.5	Good	8
180	1552.972	04/12/2022 09:53	Outer lane_LHS	40	0.15634	0.11244	0.09679	0.08544	0.07716	0.05546	0.04614	26.9	25.5	Good	8
181	1553.102	03/12/2022 11:52	Inner lane_LHS	40	0.11273	0.09239	0.08630	0.07551	0.06514	0.04526	0.03759	34.5	31.2	Good	8
182	1553.256	04/12/2022 09:54	Outer lane_LHS	40	0.17514	0.13970	0.13025	0.11517	0.09188	0.06609	0.06005	26.9	25.7	Good	8
183	1553.613	03/12/2022 11:53	Inner lane_LHS	40	0.18826	0.14460	0.13005	0.10882	0.10578	0.07369	0.04491	34.5	31.3	Good	8
184	1553.763	04/12/2022 09:56	Outer lane_LHS	40	0.39851	0.32723	0.28459	0.23348	0.17851	0.11838	0.10198	26.9	25.9	Good	8
185	1554.027	04/12/2022 09:57	Outer lane_LHS	40	0.19365	0.17637	0.16341	0.15264	0.11422	0.08285	0.07671	26.9	25.9	Good	8
186	1554.101	03/12/2022 11:55	Inner lane_LHS	40	0.17591	0.13890	0.13149	0.12572	0.09813	0.07136	0.05683	34.5	31.4	Good	8
187	1554.217	04/12/2022 09:58	Outer lane_LHS	40	0.14317	0.13048	0.12248	0.10932	0.08633	0.06340	0.05319	26.9	26.1	Good	8
188	1554.695	03/12/2022 11:56	Inner lane_LHS	40	0.15391	0.12170	0.11396	0.09239	0.08919	0.05713	0.04771	34.5	31.4	Good	8
189	1554.749	04/12/2022 10:00	Outer lane_LHS	40	0.25741	0.21685	0.18834	0.16101	0.12050	0.08094	0.06801	26.9	26.2	Good	8

E-Values & Remaining Life Analysis:															
S.No	Chainage (km)	Date & Time	Lane	KN	0 (mm)	200 (mm)	300 (mm)	450 (mm)	600 (mm)	900 (mm)	1500 (mm)	Temperatures (oC)		Pavement Condition	4-Days Soaked CBR (%)
				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air		
190	1554.998	04/12/2022 10:01	Outer lane_LHS	40	0.16649	0.15483	0.14759	0.13304	0.11138	0.08750	0.06997	26.9	26.5	Good	8
191	1555.122	03/12/2022 11:58	Inner lane_LHS	40	0.12344	0.10547	0.10127	0.08853	0.08522	0.06599	0.05133	34.5	31.5	Good	8
192	1555.260	04/12/2022 10:02	Outer lane_LHS	40	0.13306	0.10732	0.10114	0.09922	0.08692	0.07082	0.05786	26.9	26.6	Good	8
193	1555.606	03/12/2022 11:59	Inner lane_LHS	40	0.11704	0.09601	0.09468	0.09101	0.06469	0.04957	0.04406	34.5	31.6	Good	8
194	1555.753	04/12/2022 10:08	Outer lane_LHS	40	0.11714	0.09793	0.09100	0.07920	0.06805	0.04850	0.03619	27.0	26.9	Good	8
195	1556.002	04/12/2022 10:09	Outer lane_LHS	40	0.11325	0.09961	0.09247	0.08553	0.07376	0.05411	0.04412	27.1	26.9	Good	8
196	1556.116	03/12/2022 12:01	Inner lane_LHS	40	0.14306	0.12035	0.11706	0.11200	0.09806	0.07502	0.06209	34.5	31.7	Good	8
197	1556.276	04/12/2022 10:10	Outer lane_LHS	40	0.13482	0.11051	0.10815	0.09054	0.08899	0.06482	0.04892	27.2	26.9	Good	8
198	1556.618	03/12/2022 12:03	Inner lane_LHS	40	0.17549	0.13793	0.12251	0.10071	0.08746	0.05781	0.04839	34.5	31.8	Good	8
199	1556.792	04/12/2022 10:12	Outer lane_LHS	40	0.10651	0.08429	0.07557	0.07227	0.06731	0.05251	0.04163	27.3	26.9	Good	8
200	1556.951	04/12/2022 10:13	Outer lane_LHS	40	0.15569	0.13140	0.12074	0.10862	0.08517	0.05760	0.05612	27.3	26.9	Good	8
201	1557.113	03/12/2022 12:04	Inner lane_LHS	40	0.08769	0.06549	0.06237	0.05572	0.05197	0.03826	0.03309	34.5	31.9	Good	8
202	1557.257	04/12/2022 10:14	Outer lane_LHS	40	0.10029	0.09212	0.08862	0.08178	0.06512	0.04982	0.04603	27.4	26.9	Good	8
203	1557.596	03/12/2022 12:06	Inner lane_LHS	40	0.13196	0.10403	0.09182	0.08125	0.06578	0.04288	0.03218	34.5	32.0	Good	8
204	1557.769	04/12/2022 10:16	Outer lane_LHS	40	0.11577	0.10019	0.09258	0.08386	0.08057	0.05089	0.04954	27.6	26.9	Good	8
205	1558.010	04/12/2022 10:17	Outer lane_LHS	40	0.11629	0.09390	0.08263	0.06781	0.05639	0.04026	0.03017	27.8	26.9	Good	8
206	1558.113	03/12/2022 12:07	Inner lane_LHS	40	0.10031	0.07965	0.07175	0.06473	0.05641	0.03779	0.03315	34.5	32.0	Good	8
207	1558.246	04/12/2022 10:18	Outer lane_LHS	40	0.10048	0.07945	0.07336	0.06701	0.06490	0.04509	0.03380	27.9	26.9	Good	8
208	1558.614	03/12/2022 12:09	Inner lane_LHS	40	0.10481	0.08380	0.07869	0.06881	0.06159	0.03847	0.03214	34.5	31.9	Good	8
209	1558.756	04/12/2022 10:20	Outer lane_LHS	40	0.11508	0.10077	0.08914	0.08433	0.07173	0.05049	0.04908	32.7	28.0	Good	8
210	1558.997	04/12/2022 10:22	Outer lane_LHS	40	0.14549	0.11404	0.10418	0.09058	0.08445	0.06051	0.04973	32.7	28.2	Good	8
211	1559.114	03/12/2022 12:11	Inner lane_LHS	40	0.19187	0.15326	0.13253	0.11365	0.08696	0.05772	0.05082	34.5	32.1	Good	8
212	1559.270	04/12/2022 10:23	Outer lane_LHS	40	0.10138	0.08243	0.07939	0.07418	0.06544	0.04619	0.04098	32.7	28.4	Good	8
213	1559.602	03/12/2022 12:12	Inner lane_LHS	40	0.20896	0.17597	0.16023	0.13067	0.10897	0.07078	0.05515	34.5	32.2	Good	8
214	1559.760	04/12/2022 10:25	Outer lane_LHS	40	0.12368	0.09579	0.09368	0.08400	0.07883	0.06036	0.04394	32.7	28.5	Good	8
215	1559.988	04/12/2022 10:26	Outer lane_LHS	40	0.11295	0.09935	0.09057	0.08763	0.07304	0.05822	0.05274	32.7	28.6	Good	8
216	1560.110	03/12/2022 12:14	Inner lane_LHS	40	0.18875	0.13474	0.11824	0.10164	0.09636	0.06378	0.04771	34.5	32.2	Good	8

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S.No	Chainage (km)	Date & Time	Lane	KN	0 (mm)	200 (mm)	300 (mm)	450 (mm)	600 (mm)	900 (mm)	1500 (mm)	Temperatures (oC)		Pavement Condition	4-Days Soaked CBR (%)
				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air		
217	1560.248	04/12/2022 10:27	Outer lane_LHS	40	0.18770	0.14442	0.12998	0.11246	0.10175	0.07089	0.05870	32.7	29.0	Good	8
218	1560.615	03/12/2022 12:15	Inner lane_LHS	40	0.25463	0.19668	0.17627	0.14925	0.13292	0.09035	0.06139	34.5	32.2	Good	8
219	1560.758	04/12/2022 10:29	Outer lane_LHS	40	0.23341	0.18169	0.15847	0.13439	0.12037	0.08089	0.06545	32.7	28.5	Good	8
220	1560.977	04/12/2022 10:30	Outer lane_LHS	40	0.15616	0.13003	0.11573	0.09682	0.07308	0.05213	0.04327	32.7	29.0	Good	8
221	1561.117	03/12/2022 12:17	Inner lane_LHS	40	0.20680	0.16419	0.13540	0.11198	0.08942	0.05717	0.04291	34.5	32.6	Good	8
222	1561.259	04/12/2022 10:32	Outer lane_LHS	40	0.24624	0.20942	0.18740	0.15877	0.13270	0.08650	0.06882	32.7	29.2	Good	8
223	1561.617	03/12/2022 12:18	Inner lane_LHS	40	0.16214	0.12172	0.10872	0.09094	0.08214	0.06032	0.05038	34.5	32.3	Good	8
224	1561.753	04/12/2022 10:33	Outer lane_LHS	40	0.21060	0.18843	0.17862	0.15151	0.11005	0.07437	0.06454	32.7	29.3	Good	8
225	1561.981	04/12/2022 10:35	Outer lane_LHS	40	0.12466	0.10134	0.09954	0.08788	0.08502	0.05734	0.04030	32.7	29.5	Good	8
226	1562.106	03/12/2022 12:20	Inner lane_LHS	40	0.17243	0.14413	0.13402	0.11887	0.09882	0.07401	0.05741	34.5	32.5	Good	8
227	1562.248	04/12/2022 10:36	Outer lane_LHS	40	0.09905	0.07630	0.07254	0.06775	0.06367	0.05601	0.04187	32.7	29.5	Good	8
228	1562.600	03/12/2022 12:21	Inner lane_LHS	40	0.29837	0.23978	0.20984	0.17405	0.14340	0.09965	0.07937	34.5	32.6	Good	8
229	1562.756	04/12/2022 10:38	Outer lane_LHS	40	0.47361	0.41730	0.36964	0.28917	0.21185	0.12905	0.09874	32.7	29.6	Good	8
230	1562.986	04/12/2022 10:39	Outer lane_LHS	40	0.11623	0.10480	0.10059	0.09026	0.06399	0.05375	0.04756	32.7	29.8	Good	8
231	1563.120	03/12/2022 12:23	Inner lane_LHS	40	0.11994	0.09354	0.08882	0.08364	0.07819	0.05111	0.04213	34.5	32.5	Good	8
232	1563.261	04/12/2022 10:40	Outer lane_LHS	40	0.25113	0.20169	0.17913	0.15122	0.13601	0.08672	0.07017	32.7	29.9	Good	8
233	1563.611	03/12/2022 12:25	Inner lane_LHS	40	0.47499	0.39597	0.34371	0.28122	0.22315	0.13619	0.09788	34.5	32.7	Good	8
234	1563.761	04/12/2022 10:42	Outer lane_LHS	40	0.44510	0.37469	0.31741	0.23510	0.16712	0.09129	0.07053	32.7	30.1	Good	8
235	1564.418	03/12/2022 12:27	Inner lane_LHS	40	0.31746	0.24031	0.20371	0.15736	0.13199	0.08158	0.05896	34.5	32.8	Good	8
236	1564.757	04/12/2022 10:45	Outer lane_LHS	40	0.19690	0.17149	0.15709	0.14015	0.11124	0.07593	0.06941	32.7	30.2	Good	8
237	1564.960	04/12/2022 10:46	Outer lane_LHS	40	0.32742	0.26788	0.22700	0.16416	0.13827	0.09126	0.07910	32.7	30.4	Good	8
238	1565.106	03/12/2022 12:29	Inner lane_LHS	40	0.21886	0.17994	0.16358	0.14061	0.11513	0.07974	0.06530	34.5	32.8	Good	8
239	1565.267	04/12/2022 10:47	Outer lane_LHS	40	0.11447	0.09723	0.09060	0.07951	0.06726	0.05006	0.03922	32.7	30.4	Good	8
240	1565.604	03/12/2022 12:30	Inner lane_LHS	40	0.31332	0.26009	0.23199	0.20229	0.16383	0.11271	0.08510	34.5	32.9	Good	8
241	1565.758	04/12/2022 10:50	Outer lane_LHS	40	0.19803	0.16722	0.15245	0.13175	0.11567	0.08505	0.06170	32.7	30.6	Good	8
242	1566.003	04/12/2022 10:51	Outer lane_LHS	40	0.10659	0.08790	0.08260	0.07666	0.06991	0.05669	0.04143	32.7	30.8	Good	8
243	1566.109	03/12/2022 12:32	Inner lane_LHS	40	0.17434	0.15474	0.14472	0.12779	0.10559	0.07560	0.06243	34.5	33.0	Good	8

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				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air		
244	1566.267	04/12/2022 10:52	Outer lane_LHS	40	0.12910	0.10570	0.10275	0.09550	0.08974	0.06768	0.05633	32.7	30.7	Good	8
245	1566.601	03/12/2022 12:33	Inner lane_LHS	40	0.46191	0.36362	0.31635	0.24975	0.19473	0.11723	0.08435	34.5	33.0	Good	8
246	1566.757	04/12/2022 10:54	Outer lane_LHS	40	0.22538	0.20903	0.18863	0.16542	0.14391	0.10455	0.07225	32.7	30.8	Good	8
247	1566.969	04/12/2022 10:55	Outer lane_LHS	40	0.36872	0.33057	0.28714	0.25700	0.19363	0.12388	0.11338	32.7	31.0	Good	8
248	1567.153	03/12/2022 12:35	Inner lane_LHS	40	0.30067	0.25558	0.22642	0.19416	0.12663	0.09751	0.05867	34.5	33.0	Good	8
249	1567.249	04/12/2022 10:56	Outer lane_LHS	40	0.24953	0.22551	0.20094	0.17734	0.13180	0.08783	0.07214	32.7	31.1	Good	8
250	1567.602	03/12/2022 12:37	Inner lane_LHS	40	0.16733	0.13736	0.13064	0.11783	0.10220	0.07102	0.06129	34.5	33.1	Good	8
251	1567.765	04/12/2022 10:58	Outer lane_LHS	40	0.10857	0.09090	0.08464	0.07433	0.06395	0.04492	0.03570	32.7	31.4	Good	8
252	1567.944	04/12/2022 10:59	Outer lane_LHS	40	0.13628	0.10619	0.09575	0.08687	0.06908	0.04944	0.04582	32.7	31.2	Good	8
253	1568.119	03/12/2022 12:38	Inner lane_LHS	40	0.24171	0.20415	0.18714	0.16606	0.14796	0.10757	0.08069	34.5	33.2	Good	8
254	1568.256	04/12/2022 11:00	Outer lane_LHS	40	0.12903	0.11806	0.11347	0.10762	0.09142	0.07235	0.06014	32.7	31.2	Good	8
255	1568.593	03/12/2022 12:40	Inner lane_LHS	40	0.60740	0.49316	0.41174	0.29866	0.21514	0.11653	0.08558	34.5	33.2	Good	8
256	1568.756	04/12/2022 11:02	Outer lane_LHS	40	0.08762	0.08116	0.07717	0.07111	0.06181	0.04919	0.04628	32.7	31.3	Good	8
257	1568.980	04/12/2022 11:03	Outer lane_LHS	40	0.14875	0.11541	0.10347	0.09307	0.07610	0.05297	0.04252	32.7	31.4	Good	8
258	1569.113	03/12/2022 12:41	Inner lane_LHS	40	0.20988	0.15545	0.13675	0.11055	0.09231	0.05430	0.04651	34.5	33.3	Good	8
259	1569.251	04/12/2022 11:04	Outer lane_LHS	40	0.31687	0.26327	0.22964	0.19081	0.15586	0.10026	0.07602	32.7	31.4	Good	8
260	1569.608	03/12/2022 12:43	Inner lane_LHS	40	0.48613	0.40524	0.34662	0.26033	0.21623	0.13975	0.09417	34.5	33.4	Good	8
261	1569.755	04/12/2022 11:06	Outer lane_LHS	40	0.11614	0.10262	0.09962	0.08831	0.07079	0.05149	0.04493	32.7	31.5	Good	8
262	1570.001	04/12/2022 11:07	Outer lane_LHS	40	0.10795	0.08526	0.08266	0.07525	0.07203	0.05448	0.03950	32.7	31.6	Good	8
263	1570.102	03/12/2022 12:44	Inner lane_LHS	40	0.22129	0.17359	0.14843	0.11980	0.07941	0.05255	0.04627	34.5	33.4	Good	8
264	1570.251	04/12/2022 11:08	Outer lane_LHS	40	0.10275	0.09167	0.08733	0.07929	0.05688	0.04144	0.03633	32.7	31.7	Good	8
265	1570.604	03/12/2022 12:46	Inner lane_LHS	40	0.30194	0.23444	0.19268	0.14392	0.10232	0.05787	0.04776	34.5	33.5	Good	8
266	1570.754	04/12/2022 11:10	Outer lane_LHS	40	0.15571	0.12621	0.11378	0.09336	0.06712	0.04410	0.03927	32.7	31.8	Good	8
267	1571.005	04/12/2022 11:11	Outer lane_LHS	40	0.29970	0.24940	0.21048	0.17247	0.12874	0.07960	0.06737	32.7	31.9	Good	8
268	1571.126	03/12/2022 12:48	Inner lane_LHS	40	0.15403	0.11889	0.10839	0.09503	0.08764	0.06326	0.04870	34.5	33.5	Good	8
269	1571.267	04/12/2022 11:13	Outer lane_LHS	40	0.16234	0.12768	0.11956	0.10825	0.08257	0.05662	0.04789	32.7	32.0	Good	8
270	1571.797	04/12/2022 11:14	Outer lane_LHS	40	0.21659	0.16793	0.13718	0.12311	0.09711	0.07124	0.05576	32.7	32.0	Good	8

E-Values & Remaining Life Analysis:																
S.No	Chainage (km)	Date & Time	Lane	KN	0 (mm)	200 (mm)	300 (mm)	450 (mm)	600 (mm)	900 (mm)	1500 (mm)	Temperatures (oC)		Pavement Condition	4-Days Soaked CBR (%)
				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air		
271	1571.856	03/12/2022 12:50	Inner lane_LHS	40	0.19629	0.13406	0.10121	0.07135	0.06175	0.03698	0.02909	34.5	33.5	Good	8
272	1571.994	04/12/2022 11:15	Outer lane_LHS	40	0.21207	0.17006	0.14865	0.12155	0.09239	0.06356	0.05494	32.7	32.0	Good	8
273	1572.115	03/12/2022 12:51	Inner lane_LHS	40	0.25255	0.18483	0.15363	0.11514	0.10255	0.06261	0.04750	34.5	33.6	Good	8
274	1572.253	04/12/2022 11:17	Outer lane_LHS	40	0.27197	0.21096	0.17629	0.13632	0.10803	0.06898	0.05029	32.7	32.1	Good	8
275	1572.605	03/12/2022 12:52	Inner lane_LHS	40	0.21371	0.16160	0.14269	0.11924	0.10510	0.07713	0.05735	34.5	33.7	Good	8
276	1572.749	04/12/2022 11:18	Outer lane_LHS	40	0.29863	0.23534	0.20004	0.15804	0.11586	0.07272	0.05393	32.7	32.2	Good	8
277	1572.984	04/12/2022 11:20	Outer lane_LHS	40	0.21208	0.18239	0.16250	0.14317	0.10227	0.07341	0.06952	32.7	32.2	Good	8
278	1573.101	03/12/2022 12:55	Inner lane_LHS	40	0.23797	0.17848	0.15033	0.11623	0.09558	0.05857	0.04686	34.5	33.8	Good	8
279	1573.904	04/12/2022 11:22	Outer lane_LHS	40	0.34172	0.27180	0.24312	0.19489	0.15424	0.09154	0.07049	32.8	32.4	Good	8
280	1574.004	04/12/2022 11:23	Outer lane_LHS	40	0.33077	0.26946	0.23641	0.19393	0.15388	0.09262	0.07171	32.7	32.4	Good	8
281	1574.097	03/12/2022 12:57	Inner lane_LHS	40	0.29703	0.24566	0.21034	0.16950	0.13228	0.09286	0.07486	34.5	33.9	Good	8
282	1574.275	04/12/2022 11:24	Outer lane_LHS	40	0.21415	0.17373	0.15130	0.12870	0.10408	0.06884	0.05396	32.7	32.4	Good	8
283	1574.624	03/12/2022 12:59	Inner lane_LHS	40	0.36787	0.30251	0.26701	0.21869	0.18136	0.11903	0.08765	34.5	33.9	Good	8
284	1574.739	04/12/2022 11:26	Outer lane_LHS	40	0.12345	0.10798	0.10184	0.09168	0.07348	0.05340	0.05051	36.2	32.4	Good	8
285	1575.002	04/12/2022 11:28	Outer lane_LHS	40	0.15307	0.13688	0.12730	0.12179	0.10825	0.08023	0.06869	36.2	32.5	Good	8
286	1575.105	03/12/2022 13:01	Inner lane_LHS	40	0.30971	0.25475	0.22599	0.19148	0.15053	0.10525	0.08177	34.5	33.9	Good	8
287	1575.253	04/12/2022 11:29	Outer lane_LHS	40	0.17589	0.14997	0.14131	0.12839	0.11081	0.08040	0.07611	36.2	32.6	Good	8
288	1575.602	03/12/2022 13:02	Inner lane_LHS	40	0.21735	0.16279	0.14443	0.11479	0.09222	0.05445	0.04261	34.5	33.9	Good	8
289	1575.754	04/12/2022 11:31	Outer lane_LHS	40	0.27282	0.22502	0.20064	0.17408	0.13995	0.09410	0.07590	36.2	32.6	Good	8
290	1575.977	04/12/2022 11:32	Outer lane_LHS	40	0.30616	0.24764	0.21145	0.18111	0.14096	0.09503	0.08489	36.2	32.6	Good	8
291	1576.124	03/12/2022 13:04	Inner lane_LHS	40	0.26797	0.19635	0.16047	0.12258	0.08385	0.04731	0.04138	34.5	33.8	Good	8
292	1576.249	04/12/2022 11:33	Outer lane_LHS	40	0.14631	0.13063	0.12142	0.11684	0.08981	0.06369	0.06087	36.2	32.8	Good	8
293	1576.601	03/12/2022 13:05	Inner lane_LHS	40	0.25979	0.21228	0.17618	0.15078	0.11475	0.07611	0.06424	34.5	33.9	Good	8
294	1576.746	04/12/2022 11:35	Outer lane_LHS	40	0.21095	0.16880	0.15424	0.13742	0.10922	0.07064	0.06135	36.2	32.9	Good	8
295	1576.979	04/12/2022 11:36	Outer lane_LHS	40	0.50325	0.43763	0.39651	0.32734	0.23428	0.13986	0.11712	36.2	32.9	Good	8
296	1577.100	03/12/2022 13:07	Inner lane_LHS	40	0.36851	0.28958	0.25301	0.20546	0.17338	0.09645	0.05848	34.5	33.8	Good	8
297	1577.236	04/12/2022 11:38	Outer lane_LHS	40	0.16534	0.12221	0.10888	0.10277	0.09886	0.06795	0.05590	36.2	33.0	Good	8

E-Values & Remaining Life Analysis:															
S.No	Chainage (km)	Date & Time	Lane	KN	0 (mm)	200 (mm)	300 (mm)	450 (mm)	600 (mm)	900 (mm)	1500 (mm)	Temperatures (oC)		Pavement Condition	4-Days Soaked CBR (%)
				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air		
298	1577.597	03/12/2022 13:09	Inner lane_LHS	40	0.44414	0.35560	0.29987	0.23394	0.18874	0.12484	0.08481	34.5	34.0	Good	8
299	1577.761	04/12/2022 11:39	Outer lane_LHS	40	0.35090	0.27347	0.23316	0.18391	0.15293	0.08368	0.06018	36.2	33.0	Good	8
300	1578.009	04/12/2022 11:41	Outer lane_LHS	40	0.24358	0.17574	0.14290	0.11106	0.09798	0.05522	0.03623	36.2	33.1	Good	8

E-Values & Remaining Life Analysis:																		
S.No	Chainage (km)	Date & Time	Lane	BT E Modulli Ranges (Mpa)		Granual E Modulli (Mpa)		Subgrade E Modulli (Mpa)		Crust Thickness (mm)		Field Moduli (Mpa)			Lemda	Field Moduli After Temp. & Winter Seasonal Correction		
				lower Bound	Upper Bound	lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
1	1515.750	02/12/2022 13:17	Outer lane_LHS	750	3000	100	500	40	160	260	450	2997.8	493.0	159.9	0.90	2712.5	391.6	136.9
2	1516.000	02/12/2022 13:21	Outer lane_LHS	750	3000	100	500	40	160	260	450	2826.2	232.6	133.5	0.90	2557.3	202.5	115.4
3	1516.101	03/12/2022 08:30	Inner lane_LHS	750	3000	100	500	40	160	260	450	769.8	105.5	98.4	0.48	370.9	79.3	85.2
4	1516.265	02/12/2022 13:22	Outer lane_LHS	750	3000	100	500	40	160	260	450	1574.8	232.9	160.0	0.90	1424.9	202.7	136.9
5	1516.603	03/12/2022 08:32	Inner lane_LHS	750	3000	100	500	40	160	260	450	750.0	110.9	112.3	0.48	360.4	85.4	97.4
6	1516.758	02/12/2022 13:24	Outer lane_LHS	750	3000	100	500	40	160	260	450	1570.4	175.9	138.4	0.90	1421.0	151.8	119.4
7	1517.085	02/12/2022 13:25	Outer lane_LHS	750	3000	100	500	40	160	260	450	1475.8	241.5	159.8	0.90	1335.4	210.0	136.8
8	1517.108	03/12/2022 08:34	Inner lane_LHS	750	3000	100	500	40	160	260	450	1354.8	150.4	145.6	0.48	650.9	127.1	125.3
9	1517.260	02/12/2022 13:29	Outer lane_LHS	750	3000	100	500	40	160	260	450	1044.7	126.6	114.8	0.90	945.3	102.5	99.6
10	1517.605	03/12/2022 08:36	Inner lane_LHS	750	3000	100	500	40	160	260	450	2989.0	499.6	159.2	0.48	1444.3	395.8	136.3
11	1517.755	02/12/2022 13:31	Outer lane_LHS	750	3000	100	500	40	160	260	450	1566.0	373.7	159.8	0.90	1417.0	311.4	136.8
12	1517.993	02/12/2022 13:32	Outer lane_LHS	750	3000	100	500	40	160	260	450	833.6	111.3	132.8	0.90	754.3	85.8	114.8
13	1518.104	03/12/2022 08:38	Inner lane_LHS	750	3000	100	500	40	160	260	450	2843.8	224.7	122.8	0.53	1505.3	195.7	106.4
14	1518.256	02/12/2022 13:34	Outer lane_LHS	750	3000	100	500	40	160	260	450	1603.4	285.7	151.6	0.90	1450.8	245.8	130.2
15	1518.596	03/12/2022 08:40	Inner lane_LHS	750	3000	100	500	40	160	260	450	2571.1	424.9	141.5	0.53	1360.9	346.8	122.0
16	1518.759	02/12/2022 13:35	Outer lane_LHS	750	3000	100	500	40	160	260	450	1280.1	155.5	150.7	0.90	1158.3	132.2	129.5
17	1519.011	02/12/2022 13:36	Outer lane_LHS	750	3000	100	500	40	160	260	450	1154.7	198.5	130.9	0.90	1044.8	172.7	113.2
18	1519.102	03/12/2022 08:42	Inner lane_LHS	750	3000	100	500	40	160	260	450	1524.2	337.7	116.4	0.53	806.8	285.3	101.0
19	1519.250	02/12/2022 13:38	Outer lane_LHS	750	3000	100	500	40	160	260	450	1295.5	300.2	160.0	0.90	1172.2	257.0	136.9
20	1519.607	03/12/2022 08:43	Inner lane_LHS	750	3000	100	500	40	160	260	450	1977.3	212.2	124.1	0.53	1046.6	184.8	107.5
21	1519.751	02/12/2022 13:39	Outer lane_LHS	750	3000	100	500	40	160	260	450	1627.6	292.4	135.2	0.90	1472.7	251.0	116.8
22	1520.001	02/12/2022 13:42	Outer lane_LHS	750	3000	100	500	40	160	260	450	2357.8	375.7	159.9	0.90	2133.4	312.8	136.9
23	1520.104	03/12/2022 08:44	Inner lane_LHS	750	3000	100	500	40	160	260	450	1825.5	421.0	114.0	0.53	966.3	344.2	98.9
24	1520.256	02/12/2022 13:44	Outer lane_LHS	750	3000	100	500	40	160	260	450	945.7	243.5	133.4	0.90	855.7	211.6	115.3
25	1520.601	03/12/2022 09:20	Inner lane_LHS	750	3000	100	500	40	160	260	450	2195.0	498.0	146.0	0.62	1352.5	394.8	125.7
26	1520.758	02/12/2022 13:46	Outer lane_LHS	750	3000	100	500	40	160	260	450	2298.4	284.6	144.6	0.91	2082.7	244.9	124.5
27	1521.004	02/12/2022 13:47	Outer lane_LHS	750	3000	100	500	40	160	260	450	1152.5	167.6	105.6	0.90	1042.8	143.9	91.6

E-Values & Remaining Life Analysis:																			
S.No	Chainage (km)	Date & Time	Lane	BT E Modulli Ranges (Mpa)		Granual E Modulli (Mpa)		Subgrade E Modulli (Mpa)		Crust Thickness (mm)		Field Moduli (Mpa)			Lemda	Field Moduli After Temp. & Winter Seasonal Correction		
				lower Bound	Upper Bound	lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
28	1521.126	03/12/2022 09:22	Inner lane_LHS	750	3000	100	500	40	160	260	450	2986.8	496.5	159.8	0.62	1840.4	393.8	136.8
29	1521.259	02/12/2022 13:49	Outer lane_LHS	750	3000	100	500	40	160	260	450	1632.0	453.1	159.8	0.90	1476.7	365.7	136.8
30	1521.614	03/12/2022 09:24	Inner lane_LHS	750	3000	100	500	40	160	260	450	2368.8	496.1	160.0	0.62	1459.6	393.6	136.9
31	1521.759	02/12/2022 14:31	Outer lane_LHS	750	3000	100	500	40	160	260	450	1165.7	227.5	133.0	1.08	1258.0	198.1	115.0
32	1522.001	02/12/2022 14:32	Outer lane_LHS	750	3000	100	500	40	160	260	450	1838.7	410.9	107.8	1.08	1984.3	337.3	93.5
33	1522.134	03/12/2022 09:25	Inner lane_LHS	750	3000	100	500	40	160	260	450	2571.1	423.0	152.8	0.62	1584.2	345.5	131.2
34	1522.253	02/12/2022 14:34	Outer lane_LHS	750	3000	100	500	40	160	260	450	1438.4	497.3	160.0	1.08	1552.3	394.3	136.9
35	1522.622	03/12/2022 09:27	Inner lane_LHS	750	3000	100	500	40	160	260	450	1994.9	159.8	127.2	0.62	1229.2	136.4	110.1
36	1522.748	02/12/2022 14:36	Outer lane_LHS	750	3000	100	500	40	160	260	450	2857.0	500.0	160.0	1.08	3083.3	396.1	136.9
37	1522.998	02/12/2022 14:37	Outer lane_LHS	750	3000	100	500	40	160	260	450	809.4	169.2	118.1	1.08	873.5	145.5	102.4
38	1523.122	03/12/2022 09:31	Inner lane_LHS	750	3000	100	500	40	160	260	450	1227.3	195.0	146.9	0.73	897.5	169.5	126.4
39	1523.122	03/12/2022 09:40	Inner lane_LHS	750	3000	100	500	40	160	260	450	1130.5	243.9	149.0	0.70	787.1	212.0	128.1
40	1523.122	03/12/2022 10:00	Inner lane_LHS	750	3000	100	500	40	160	260	450	1462.6	193.1	156.0	0.70	1030.9	167.8	133.7
41	1523.271	02/12/2022 14:38	Outer lane_LHS	750	3000	100	500	40	160	260	450	2942.8	499.6	160.0	1.08	3175.8	395.8	136.9
42	1523.613	03/12/2022 10:01	Inner lane_LHS	750	3000	100	500	40	160	260	450	1647.4	158.7	158.9	0.70	1161.1	135.3	136.1
43	1523.755	02/12/2022 14:40	Outer lane_LHS	750	3000	100	500	40	160	260	450	2021.3	363.5	142.4	1.08	2181.4	304.1	122.7
44	1523.999	02/12/2022 14:41	Outer lane_LHS	750	3000	100	500	40	160	260	450	1759.5	386.2	148.2	1.08	1898.8	320.2	127.5
45	1524.103	03/12/2022 10:10	Inner lane_LHS	750	3000	100	500	40	160	260	450	2973.6	500.0	159.4	0.73	2174.5	396.1	136.5
46	1524.264	02/12/2022 14:43	Outer lane_LHS	750	3000	100	500	40	160	260	450	1308.7	193.8	143.1	1.08	1412.3	168.4	123.3
47	1524.603	03/12/2022 10:13	Inner lane_LHS	750	3000	100	500	40	160	260	450	1744.1	426.5	127.0	0.73	1275.4	347.9	110.0
48	1524.757	02/12/2022 14:44	Outer lane_LHS	750	3000	100	500	40	160	260	450	2874.6	500.0	159.8	1.08	3102.2	396.1	136.8
49	1525.002	02/12/2022 14:46	Outer lane_LHS	750	3000	100	500	40	160	260	450	1722.1	497.3	159.9	1.08	1858.5	394.3	136.9
50	1525.124	03/12/2022 10:15	Inner lane_LHS	750	3000	100	500	40	160	260	450	2058.7	366.3	129.9	0.73	1505.4	306.1	112.4
51	1525.259	02/12/2022 14:47	Outer lane_LHS	750	3000	100	500	40	160	260	450	1013.9	295.5	159.6	1.08	1094.2	253.4	136.6
52	1525.596	03/12/2022 10:17	Inner lane_LHS	750	3000	100	500	40	160	260	450	1330.6	310.8	123.9	0.73	973.0	265.2	107.3
53	1525.757	02/12/2022 14:49	Outer lane_LHS	750	3000	100	500	40	160	260	450	1242.7	267.0	118.9	1.08	1341.1	230.9	103.1
54	1526.013	02/12/2022 14:50	Outer lane_LHS	750	3000	100	500	40	160	260	450	1031.5	149.3	116.2	1.08	1113.2	126.0	100.8

E-Values & Remaining Life Analysis:																		
S.No	Chainage (km)	Date & Time	Lane	BT E Modulli Ranges (Mpa)		Granual E Modulli (Mpa)		Subgrade E Modulli (Mpa)		Crust Thickness (mm)		Field Moduli (Mpa)			Lemda	Field Moduli After Temp. & Winter Seasonal Correction		
				lower Bound	Upper Bound	lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
55	1526.132	03/12/2022 10:19	Inner lane_LHS	750	3000	100	500	40	160	260	450	1878.3	345.6	129.3	0.73	1373.5	291.1	111.9
56	1526.299	02/12/2022 14:51	Outer lane_LHS	750	3000	100	500	40	160	260	450	1845.3	225.5	122.0	1.08	1991.4	196.4	105.7
57	1526.621	03/12/2022 10:20	Inner lane_LHS	750	3000	100	500	40	160	260	450	2256.6	401.1	119.3	0.73	1650.2	330.5	103.4
58	1526.762	02/12/2022 14:53	Outer lane_LHS	750	3000	100	500	40	160	260	450	1434.0	229.4	153.0	1.08	1547.6	199.7	131.3
59	1527.009	02/12/2022 14:54	Outer lane_LHS	750	3000	100	500	40	160	260	450	1117.3	287.3	157.7	1.08	1205.8	247.0	135.1
60	1527.120	03/12/2022 10:22	Inner lane_LHS	750	3000	100	500	40	160	260	450	2997.8	496.1	158.2	0.73	2192.2	393.6	135.5
61	1527.254	02/12/2022 14:55	Outer lane_LHS	750	3000	100	500	40	160	260	450	886.4	118.4	122.9	1.08	956.6	93.7	106.5
62	1527.606	03/12/2022 10:23	Inner lane_LHS	750	3000	100	500	40	160	260	450	1154.7	164.5	133.8	0.73	844.4	141.0	115.6
63	1527.779	02/12/2022 14:57	Outer lane_LHS	750	3000	100	500	40	160	260	450	835.8	112.5	126.3	1.08	902.0	87.2	109.4
64	1528.017	02/12/2022 14:58	Outer lane_LHS	750	3000	100	500	40	160	260	450	904.0	129.7	114.8	1.08	975.6	105.8	99.6
65	1528.130	03/12/2022 10:25	Inner lane_LHS	750	3000	100	500	40	160	260	450	1354.8	246.2	156.1	0.73	990.7	213.9	133.8
66	1528.261	02/12/2022 15:00	Outer lane_LHS	750	3000	100	500	40	160	260	450	754.4	142.2	98.5	1.08	814.1	118.8	85.3
67	1528.590	03/12/2022 10:27	Inner lane_LHS	750	3000	100	500	40	160	260	450	1546.2	342.0	149.2	0.73	1130.7	288.5	128.3
68	1528.764	02/12/2022 15:01	Outer lane_LHS	750	3000	100	500	40	160	260	450	2991.2	408.9	140.6	1.08	3228.1	335.9	121.3
69	1529.000	02/12/2022 15:03	Outer lane_LHS	750	3000	100	500	40	160	260	450	2184.0	354.5	133.6	1.08	2357.0	297.6	115.5
70	1529.145	03/12/2022 10:29	Inner lane_LHS	750	3000	100	500	40	160	260	450	904.0	102.0	95.4	0.73	661.1	75.3	82.5
71	1529.249	02/12/2022 15:05	Outer lane_LHS	750	3000	100	500	40	160	260	450	1304.3	207.5	106.9	1.08	1407.6	180.7	92.7
72	1529.603	03/12/2022 10:30	Inner lane_LHS	750	3000	100	500	40	160	260	450	1618.8	307.6	155.5	0.73	1183.8	262.7	133.3
73	1529.751	02/12/2022 15:06	Outer lane_LHS	750	3000	100	500	40	160	260	450	802.8	123.5	99.7	1.08	866.4	99.2	86.4
74	1530.104	02/12/2022 15:08	Outer lane_LHS	750	3000	100	500	40	160	260	450	1475.8	239.2	160.0	1.08	1592.7	208.0	136.9
75	1530.124	03/12/2022 10:32	Inner lane_LHS	750	3000	100	500	40	160	260	450	1346.0	409.7	160.0	0.73	984.3	336.5	136.9
76	1530.260	02/12/2022 15:09	Outer lane_LHS	750	3000	100	500	40	160	260	450	2179.6	500.0	158.1	1.08	2352.2	396.1	135.4
77	1530.598	03/12/2022 10:33	Inner lane_LHS	750	3000	100	500	40	160	260	450	1370.2	230.2	117.7	0.73	1002.0	200.4	102.1
78	1530.766	02/12/2022 15:10	Outer lane_LHS	750	3000	100	500	40	160	260	450	1077.7	102.0	94.0	1.08	1163.0	75.3	81.3
79	1531.020	02/12/2022 15:12	Outer lane_LHS	750	3000	100	500	40	160	260	450	1330.6	196.6	105.7	1.08	1436.0	170.9	91.7
80	1531.127	03/12/2022 10:35	Inner lane_LHS	750	3000	100	500	40	160	260	450	851.2	102.7	94.8	0.73	622.4	76.1	82.0
81	1531.263	02/12/2022 15:13	Outer lane_LHS	750	3000	100	500	40	160	260	450	928.2	116.8	107.1	1.08	1001.7	91.9	92.9

E-Values & Remaining Life Analysis:																			
S.No	Chainage (km)	Date & Time	Lane	BT E Modulli Ranges (Mpa)		Granual E Modulli (Mpa)		Subgrade E Modulli (Mpa)		Crust Thickness (mm)		Field Moduli (Mpa)			Lemda	Field Moduli After Temp. & Winter Seasonal Correction		
				lower Bound	Upper Bound	lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
82	1531.601	03/12/2022 10:36	Inner lane_LHS	750	3000	100	500	40	160	260	450	2100.4	469.1	112.1	0.73	1535.9	376.2	97.3
83	1531.761	02/12/2022 15:15	Outer lane_LHS	750	3000	100	500	40	160	260	450	1319.6	229.4	139.5	1.08	1424.1	199.7	120.4
84	1532.007	02/12/2022 15:16	Outer lane_LHS	750	3000	100	500	40	160	260	450	1818.9	325.2	155.0	1.08	1962.9	276.0	132.9
85	1532.135	03/12/2022 10:38	Inner lane_LHS	750	3000	100	500	40	160	260	450	1915.7	277.5	123.4	0.73	1400.9	239.3	106.9
86	1532.251	02/12/2022 15:17	Outer lane_LHS	750	3000	100	500	40	160	260	450	1159.1	247.0	131.7	1.08	1250.9	214.5	113.9
87	1532.628	03/12/2022 10:39	Inner lane_LHS	750	3000	100	500	40	160	260	450	2406.2	299.0	156.0	0.73	1759.6	256.1	133.7
88	1532.754	02/12/2022 15:19	Outer lane_LHS	750	3000	100	500	40	160	260	450	2236.8	250.9	117.0	1.08	2413.9	217.8	101.5
89	1533.006	02/12/2022 15:20	Outer lane_LHS	750	3000	100	500	40	160	260	450	1763.9	294.3	146.9	1.08	1903.6	252.5	126.4
90	1533.117	03/12/2022 10:41	Inner lane_LHS	750	3000	100	500	40	160	260	450	1060.1	187.2	102.5	0.73	775.2	162.4	88.9
91	1533.413	02/12/2022 15:22	Outer lane_LHS	750	3000	100	500	40	160	260	450	1730.9	396.4	143.8	1.08	1868.0	327.3	123.9
92	1533.594	03/12/2022 10:42	Inner lane_LHS	750	3000	100	500	40	160	260	450	1541.8	358.5	138.2	0.73	1127.5	300.5	119.3
93	1533.757	02/12/2022 15:23	Outer lane_LHS	750	3000	100	500	40	160	260	450	2700.9	454.3	137.2	1.08	2914.8	366.5	118.5
94	1534.000	02/12/2022 15:25	Outer lane_LHS	750	3000	100	500	40	160	260	450	2705.3	497.3	160.0	1.08	2919.5	394.3	136.9
95	1534.141	03/12/2022 10:44	Inner lane_LHS	750	3000	100	500	40	160	260	450	2228.0	455.4	123.9	0.73	1629.2	367.2	107.3
96	1534.263	02/12/2022 15:26	Outer lane_LHS	750	3000	100	500	40	160	260	450	2969.2	498.0	160.0	1.08	3204.3	394.8	136.9
97	1534.598	03/12/2022 10:46	Inner lane_LHS	750	3000	100	500	40	160	260	450	2285.2	498.4	151.6	0.73	1671.1	395.0	130.2
98	1534.747	02/12/2022 15:28	Outer lane_LHS	750	3000	100	500	40	160	260	450	2071.8	439.0	145.1	1.08	2235.9	356.3	124.9
99	1535.000	02/12/2022 15:29	Outer lane_LHS	750	3000	100	500	40	160	260	450	1755.1	500.0	160.0	1.08	1894.1	396.1	136.9
100	1535.089	03/12/2022 10:47	Inner lane_LHS	750	3000	100	500	40	160	260	450	2509.5	495.3	160.0	0.73	1835.1	393.1	136.9
101	1535.251	02/12/2022 15:31	Outer lane_LHS	750	3000	100	500	40	160	250	440	1097.5	331.9	159.8	1.08	1184.4	281.0	136.8
102	1535.622	03/12/2022 10:49	Inner lane_LHS	750	3000	100	500	40	160	250	440	2964.8	498.4	160.0	0.73	2168.0	395.0	136.9
103	1535.758	02/12/2022 15:32	Outer lane_LHS	750	3000	100	500	40	160	250	440	1387.8	179.0	159.8	1.08	1497.7	154.8	136.8
104	1536.000	04/12/2022 08:46	Outer lane_LHS	750	3000	100	500	40	160	250	440	2993.4	493.7	159.8	0.54	1611.0	392.0	136.8
105	1536.128	03/12/2022 10:51	Inner lane_LHS	750	3000	100	500	40	160	250	440	1726.5	132.8	98.2	0.73	1267.7	109.1	85.0
106	1536.251	04/12/2022 08:47	Outer lane_LHS	750	3000	100	500	40	160	250	440	1629.8	231.4	121.1	0.54	877.1	201.4	105.0
107	1536.566	03/12/2022 10:52	Inner lane_LHS	750	3000	100	500	40	160	250	440	2379.8	459.7	135.0	0.74	1749.8	370.0	116.6
108	1536.762	04/12/2022 08:49	Outer lane_LHS	750	3000	100	500	40	160	250	440	2898.8	493.7	160.0	0.54	1560.1	392.0	136.9

E-Values & Remaining Life Analysis:																		
S.No	Chainage (km)	Date & Time	Lane	BT E Modulli Ranges (Mpa)		Granual E Modulli (Mpa)		Subgrade E Modulli (Mpa)		Crust Thickness (mm)		Field Moduli (Mpa)			Lemda	Field Moduli After Temp. & Winter Seasonal Correction		
				lower Bound	Upper Bound	lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
109	1537.005	04/12/2022 08:50	Outer lane_LHS	750	3000	100	500	40	160	250	440	1891.5	186.4	145.3	0.54	1018.0	161.6	125.1
110	1537.100	03/12/2022 10:54	Inner lane_LHS	750	3000	100	500	40	160	250	440	2445.7	346.7	115.8	0.74	1805.6	291.9	100.4
111	1537.278	04/12/2022 08:51	Outer lane_LHS	750	3000	100	500	40	160	250	440	2839.4	496.9	160.0	0.54	1528.1	394.1	136.9
112	1537.615	03/12/2022 10:56	Inner lane_LHS	750	3000	100	500	40	160	250	440	1618.8	495.7	160.0	0.75	1208.3	393.3	136.9
113	1537.744	04/12/2022 08:53	Outer lane_LHS	750	3000	100	500	40	160	250	440	2804.3	488.3	160.0	0.54	1509.2	388.6	136.9
114	1538.001	04/12/2022 08:55	Outer lane_LHS	750	3000	100	500	40	160	250	440	1132.7	155.5	113.1	0.54	609.6	132.2	98.1
115	1538.112	03/12/2022 10:58	Inner lane_LHS	750	3000	100	500	40	160	250	440	1253.7	386.2	160.0	0.75	937.1	320.2	136.9
116	1538.252	04/12/2022 08:56	Outer lane_LHS	750	3000	100	500	40	160	250	440	1304.3	284.6	148.5	0.54	701.9	244.9	127.7
117	1538.609	03/12/2022 11:00	Inner lane_LHS	750	3000	100	500	40	160	250	440	1009.5	247.8	159.4	0.76	762.9	215.2	136.5
118	1538.752	04/12/2022 08:57	Outer lane_LHS	750	3000	100	500	40	160	250	440	967.7	278.3	134.7	0.54	520.8	239.9	116.4
119	1539.003	04/12/2022 08:59	Outer lane_LHS	750	3000	100	500	40	160	250	440	776.4	125.8	130.7	0.54	417.8	101.7	113.1
120	1539.073	03/12/2022 11:01	Inner lane_LHS	750	3000	100	500	40	160	250	440	1108.5	216.1	160.0	0.76	838.8	188.3	136.9
121	1540.010	04/12/2022 09:01	Outer lane_LHS	750	3000	100	500	40	160	250	440	2958.2	486.3	160.0	0.54	1592.0	387.3	136.9
122	1540.101	03/12/2022 11:04	Inner lane_LHS	750	3000	100	500	40	160	250	440	890.8	358.1	160.0	0.75	671.3	300.2	136.9
123	1540.248	04/12/2022 09:03	Outer lane_LHS	750	3000	100	500	40	160	250	440	2997.8	499.6	159.6	0.54	1613.4	395.8	136.6
124	1540.511	03/12/2022 11:06	Inner lane_LHS	750	3000	100	500	40	160	250	440	1643.0	347.1	159.9	0.76	1253.6	292.2	136.9
125	1541.363	03/12/2022 11:09	Inner lane_LHS	750	3000	100	500	40	160	250	440	2164.2	149.7	139.5	0.77	1662.6	126.4	120.4
126	1541.398	04/12/2022 09:05	Outer lane_LHS	750	3000	100	500	40	160	250	440	2524.9	484.4	159.8	0.54	1358.8	386.1	136.8
127	1541.750	04/12/2022 09:07	Outer lane_LHS	750	3000	100	500	40	160	250	440	1621.0	227.5	127.9	0.54	874.8	198.1	110.7
128	1541.807	03/12/2022 11:10	Inner lane_LHS	750	3000	100	500	40	160	250	440	2001.5	315.1	160.0	0.77	1539.8	268.4	136.9
129	1542.006	04/12/2022 09:08	Outer lane_LHS	750	3000	100	500	40	160	250	440	1440.6	164.1	122.0	0.54	780.7	140.6	105.7
130	1542.143	03/12/2022 11:14	Inner lane_LHS	750	3000	100	500	40	160	250	440	976.5	100.4	124.6	0.77	756.4	73.4	107.9
131	1542.279	04/12/2022 09:09	Outer lane_LHS	750	3000	100	500	40	160	250	440	833.6	100.8	95.5	0.55	456.1	73.9	82.6
132	1542.618	03/12/2022 11:16	Inner lane_LHS	750	3000	100	500	40	160	250	440	1027.1	102.3	86.1	0.78	800.0	75.6	74.1
133	1542.753	04/12/2022 09:11	Outer lane_LHS	750	3000	100	500	40	160	250	440	1612.2	272.8	158.7	0.55	888.2	235.5	135.9
134	1543.002	04/12/2022 09:12	Outer lane_LHS	750	3000	100	500	40	160	250	440	974.3	117.6	111.0	0.62	605.2	92.8	96.3
135	1543.119	03/12/2022 11:18	Inner lane_LHS	750	3000	100	500	40	160	250	440	1390.0	142.6	129.4	0.78	1085.7	119.2	112.0

E-Values & Remaining Life Analysis:																		
S.No	Chainage (km)	Date & Time	Lane	BT E Modulli Ranges (Mpa)		Granual E Modulli (Mpa)		Subgrade E Modulli (Mpa)		Crust Thickness (mm)		Field Moduli (Mpa)			Lemda	Field Moduli After Temp. & Winter Seasonal Correction		
				lower Bound	Upper Bound	lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
136	1543.246	04/12/2022 09:14	Outer lane_LHS	750	3000	100	500	40	160	250	440	1392.2	215.7	99.6	0.62	864.9	187.9	86.3
137	1543.601	03/12/2022 11:19	Inner lane_LHS	750	3000	100	500	40	160	250	440	2973.6	498.8	159.9	0.78	2329.0	395.3	136.9
138	1543.747	04/12/2022 09:16	Outer lane_LHS	750	3000	100	500	40	160	250	440	1183.3	139.5	89.3	0.62	735.1	116.1	77.0
139	1543.996	04/12/2022 09:17	Outer lane_LHS	750	3000	100	500	40	160	250	440	1900.3	286.5	142.3	0.62	1180.5	246.4	122.7
140	1544.135	03/12/2022 11:21	Inner lane_LHS	750	3000	100	500	40	160	250	440	2986.8	495.7	159.5	0.98	2921.8	393.3	136.5
141	1544.255	04/12/2022 09:18	Outer lane_LHS	750	3000	100	500	40	160	250	440	2945.0	494.1	159.8	0.62	1829.5	392.3	136.8
142	1544.642	03/12/2022 11:23	Inner lane_LHS	750	3000	100	500	40	160	250	440	2997.8	496.9	160.0	0.98	2932.5	394.1	136.9
143	1544.748	04/12/2022 09:20	Outer lane_LHS	750	3000	100	500	40	160	250	440	2997.8	491.0	160.0	0.62	1862.3	390.3	136.9
144	1544.996	04/12/2022 09:21	Outer lane_LHS	750	3000	100	500	40	160	250	440	2949.4	499.2	159.8	0.62	1832.2	395.6	136.8
145	1545.119	03/12/2022 11:25	Inner lane_LHS	750	3000	100	500	40	160	250	440	2076.2	495.3	116.7	0.98	2031.0	393.1	101.2
146	1545.251	04/12/2022 09:22	Outer lane_LHS	750	3000	100	500	40	160	250	440	1612.2	368.6	160.0	0.62	1001.5	307.7	136.9
147	1545.653	03/12/2022 11:26	Inner lane_LHS	750	3000	100	500	40	160	250	440	1968.5	495.3	159.9	0.98	1925.6	393.1	136.9
148	1545.758	04/12/2022 09:24	Outer lane_LHS	750	3000	100	500	40	160	250	440	2980.2	497.3	159.9	0.62	1851.3	394.3	136.9
149	1545.989	04/12/2022 09:25	Outer lane_LHS	750	3000	100	500	40	160	250	440	2936.2	497.3	159.9	0.62	1824.0	394.3	136.9
150	1546.130	03/12/2022 11:28	Inner lane_LHS	750	3000	100	500	40	160	250	440	2995.6	499.2	159.5	0.98	2930.4	395.6	136.5
151	1546.254	04/12/2022 09:26	Outer lane_LHS	750	3000	100	500	40	160	250	440	1678.2	258.0	148.7	0.62	1042.5	223.6	127.9
152	1546.619	03/12/2022 11:30	Inner lane_LHS	750	3000	100	500	40	160	250	440	1816.7	411.6	125.2	0.98	1777.1	337.8	108.4
153	1546.737	04/12/2022 09:28	Outer lane_LHS	750	3000	100	500	40	160	250	440	1445.0	309.2	157.4	0.62	898.9	263.9	134.9
154	1546.992	04/12/2022 09:30	Outer lane_LHS	750	3000	100	500	40	160	250	440	3000.0	500.0	160.0	0.62	1863.6	396.1	136.9
155	1547.104	03/12/2022 11:32	Inner lane_LHS	750	3000	100	500	40	160	250	440	2401.8	488.7	145.1	0.98	2349.5	388.8	124.9
156	1547.279	04/12/2022 09:31	Outer lane_LHS	750	3000	100	500	40	160	250	440	1612.2	457.8	159.8	0.62	1001.5	368.8	136.8
157	1547.604	03/12/2022 11:33	Inner lane_LHS	750	3000	100	500	40	160	250	440	2995.6	498.8	158.8	0.98	2930.4	395.3	136.0
158	1547.750	04/12/2022 09:33	Outer lane_LHS	750	3000	100	500	40	160	250	440	1583.6	244.7	112.1	0.62	985.1	212.6	97.3
159	1548.002	04/12/2022 09:34	Outer lane_LHS	750	3000	100	500	40	160	250	440	1297.7	177.8	102.4	0.62	810.5	153.6	88.8
160	1548.136	03/12/2022 11:35	Inner lane_LHS	750	3000	100	500	40	160	250	440	1574.8	186.8	113.4	0.98	1540.5	162.0	98.4
161	1548.250	04/12/2022 09:36	Outer lane_LHS	750	3000	100	500	40	160	250	440	776.4	103.5	124.1	0.63	489.6	77.0	107.5
162	1548.634	03/12/2022 11:37	Inner lane_LHS	750	3000	100	500	40	160	250	440	2956.0	498.4	159.1	0.98	2891.6	395.0	136.2

E-Values & Remaining Life Analysis:																		
S.No	Chainage (km)	Date & Time	Lane	BT E Modulli Ranges (Mpa)		Granual E Modulli (Mpa)		Subgrade E Modulli (Mpa)		Crust Thickness (mm)		Field Moduli (Mpa)			Lemda	Field Moduli After Temp. & Winter Seasonal Correction		
				lower Bound	Upper Bound	lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
163	1548.756	04/12/2022 09:37	Outer lane_LHS	750	3000	100	500	40	160	250	440	2982.4	493.0	159.8	0.63	1885.7	391.6	136.8
164	1548.975	04/12/2022 09:38	Outer lane_LHS	750	3000	100	500	40	160	250	440	2975.8	487.5	160.0	0.64	1891.8	388.1	136.9
165	1549.131	03/12/2022 11:39	Inner lane_LHS	750	3000	100	500	40	160	280	490	2795.5	487.5	144.9	0.98	2734.6	388.1	124.8
166	1549.275	04/12/2022 09:40	Outer lane_LHS	750	3000	100	500	40	160	280	490	2997.8	494.5	159.5	0.64	1916.1	392.6	136.5
167	1549.599	03/12/2022 11:41	Inner lane_LHS	750	3000	100	500	40	160	280	490	2738.3	497.7	159.6	0.98	2678.7	394.6	136.6
168	1549.778	04/12/2022 09:42	Outer lane_LHS	750	3000	100	500	40	160	280	490	2142.2	432.4	104.0	0.65	1387.9	351.9	90.2
169	1549.971	04/12/2022 09:43	Outer lane_LHS	750	3000	100	500	40	160	280	490	2159.8	421.4	159.6	0.71	1534.8	344.5	136.6
170	1550.058	03/12/2022 11:43	Inner lane_LHS	750	3000	100	500	40	160	280	490	3000.0	500.0	150.0	0.98	2934.7	396.1	128.9
171	1551.177	03/12/2022 11:45	Inner lane_LHS	750	3000	100	500	40	160	280	490	758.8	100.8	121.4	0.98	742.3	73.9	105.2
172	1551.263	04/12/2022 09:46	Outer lane_LHS	750	3000	100	500	40	160	280	490	3000.0	497.7	159.6	0.71	2131.8	394.6	136.6
173	1551.638	03/12/2022 11:47	Inner lane_LHS	750	3000	100	500	40	160	280	490	1324.0	200.9	132.0	0.98	1295.2	174.8	114.1
174	1551.786	04/12/2022 09:47	Outer lane_LHS	750	3000	100	500	40	160	280	490	2969.2	355.3	134.8	0.71	2109.9	298.2	116.5
175	1552.028	04/12/2022 09:49	Outer lane_LHS	750	3000	100	500	40	160	280	490	2975.8	487.9	160.0	0.71	2114.6	388.3	136.9
176	1552.158	03/12/2022 11:49	Inner lane_LHS	750	3000	100	500	40	160	280	490	2936.2	500.0	134.9	0.98	2872.3	396.1	116.6
177	1552.250	04/12/2022 09:50	Outer lane_LHS	750	3000	100	500	40	160	280	490	2892.2	314.3	102.8	0.71	2055.2	267.8	89.1
178	1552.594	03/12/2022 11:50	Inner lane_LHS	750	3000	100	500	40	160	280	490	2993.4	492.2	130.7	0.98	2928.2	391.1	113.1
179	1552.753	04/12/2022 09:52	Outer lane_LHS	750	3000	100	500	40	160	280	490	2982.4	497.3	159.6	0.71	2119.3	394.3	136.6
180	1552.972	04/12/2022 09:53	Outer lane_LHS	750	3000	100	500	40	160	280	490	2978.0	498.4	159.3	0.71	2116.2	395.0	136.4
181	1553.102	03/12/2022 11:52	Inner lane_LHS	750	3000	100	500	40	160	280	490	2997.8	497.3	160.0	0.98	2932.5	394.3	136.9
182	1553.256	04/12/2022 09:54	Outer lane_LHS	750	3000	100	500	40	160	280	490	2659.1	500.0	144.9	0.71	1889.6	396.1	124.8
183	1553.613	03/12/2022 11:53	Inner lane_LHS	750	3000	100	500	40	160	280	490	2879.0	325.2	159.9	0.98	2816.3	276.0	136.9
184	1553.763	04/12/2022 09:56	Outer lane_LHS	750	3000	100	500	40	160	280	490	972.1	163.7	86.7	0.71	690.8	140.2	74.6
185	1554.027	04/12/2022 09:57	Outer lane_LHS	750	3000	100	500	40	160	280	490	2989.0	363.1	113.3	0.71	2124.0	303.8	98.3
186	1554.101	03/12/2022 11:55	Inner lane_LHS	750	3000	100	500	40	160	280	490	2991.2	462.9	139.8	0.98	2926.1	372.1	120.6
187	1554.217	04/12/2022 09:58	Outer lane_LHS	750	3000	100	500	40	160	280	490	2997.8	498.8	158.6	0.71	2130.2	395.3	135.8
188	1554.695	03/12/2022 11:56	Inner lane_LHS	750	3000	100	500	40	160	280	490	2907.6	499.6	159.2	0.98	2844.3	395.8	136.3
189	1554.749	04/12/2022 10:00	Outer lane_LHS	750	3000	100	500	40	160	280	490	1566.0	249.8	126.3	0.71	1112.8	216.9	109.4

E-Values & Remaining Life Analysis:																		
S.No	Chainage (km)	Date & Time	Lane	BT E Modulli Ranges (Mpa)		Granual E Modulli (Mpa)		Subgrade E Modulli (Mpa)		Crust Thickness (mm)		Field Moduli (Mpa)			Lemda	Field Moduli After Temp. & Winter Seasonal Correction		
				lower Bound	Upper Bound	lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
190	1554.998	04/12/2022 10:01	Outer lane_LHS	750	3000	100	500	40	160	280	490	2995.6	495.7	113.5	0.71	2128.7	393.3	98.5
191	1555.122	03/12/2022 11:58	Inner lane_LHS	750	3000	100	500	40	160	280	490	2991.2	499.6	158.7	0.98	2926.1	395.8	135.9
192	1555.260	04/12/2022 10:02	Outer lane_LHS	750	3000	100	500	40	160	280	490	2971.4	495.7	160.0	0.71	2111.5	393.3	136.9
193	1555.606	03/12/2022 11:59	Inner lane_LHS	750	3000	100	500	40	160	280	490	2984.6	496.5	159.5	0.98	2919.6	393.8	136.5
194	1555.753	04/12/2022 10:08	Outer lane_LHS	750	3000	100	500	40	160	280	490	2929.6	499.6	160.0	0.71	2093.2	395.8	136.9
195	1556.002	04/12/2022 10:09	Outer lane_LHS	750	3000	100	500	40	160	280	490	2989.0	496.9	159.6	0.72	2138.5	394.1	136.6
196	1556.116	03/12/2022 12:01	Inner lane_LHS	750	3000	100	500	40	160	280	490	2993.4	499.2	147.7	0.98	2928.2	395.6	127.1
197	1556.276	04/12/2022 10:10	Outer lane_LHS	750	3000	100	500	40	160	280	490	2995.6	498.0	159.8	0.72	2157.9	394.8	136.8
198	1556.618	03/12/2022 12:03	Inner lane_LHS	750	3000	100	500	40	160	280	490	2656.9	494.1	159.8	0.98	2599.0	392.3	136.8
199	1556.792	04/12/2022 10:12	Outer lane_LHS	750	3000	100	500	40	160	280	490	2995.6	496.1	159.8	0.72	2163.8	393.6	136.8
200	1556.951	04/12/2022 10:13	Outer lane_LHS	750	3000	100	500	40	160	280	490	2993.4	487.1	159.1	0.72	2165.2	387.8	136.2
201	1557.113	03/12/2022 12:04	Inner lane_LHS	750	3000	100	500	40	160	280	490	2986.8	499.2	159.2	0.98	2921.8	395.6	136.3
202	1557.257	04/12/2022 10:14	Outer lane_LHS	750	3000	100	500	40	160	280	490	2896.6	500.0	159.4	0.73	2103.7	396.1	136.5
203	1557.596	03/12/2022 12:06	Inner lane_LHS	750	3000	100	500	40	160	280	490	2938.4	494.1	159.9	0.98	2874.4	392.3	136.9
204	1557.769	04/12/2022 10:16	Outer lane_LHS	750	3000	100	500	40	160	280	490	2936.2	497.7	160.0	0.73	2147.1	394.6	136.9
205	1558.010	04/12/2022 10:17	Outer lane_LHS	750	3000	100	500	40	160	280	490	2989.0	498.8	159.5	0.74	2203.7	395.3	136.5
206	1558.113	03/12/2022 12:07	Inner lane_LHS	750	3000	100	500	40	160	280	490	2949.4	496.9	159.2	0.98	2885.2	394.1	136.3
207	1558.246	04/12/2022 10:18	Outer lane_LHS	750	3000	100	500	40	160	280	490	3000.0	498.8	159.6	0.74	2224.0	395.3	136.6
208	1558.614	03/12/2022 12:09	Inner lane_LHS	750	3000	100	500	40	160	280	490	2973.6	498.8	159.3	0.98	2908.8	395.3	136.4
209	1558.756	04/12/2022 10:20	Outer lane_LHS	750	3000	100	500	40	160	280	490	2969.2	498.8	159.1	0.90	2686.7	395.3	136.2
210	1558.997	04/12/2022 10:22	Outer lane_LHS	750	3000	100	500	40	160	280	490	2953.8	497.3	160.0	0.90	2672.7	394.3	136.9
211	1559.114	03/12/2022 12:11	Inner lane_LHS	750	3000	100	500	40	160	280	490	1937.7	458.2	160.0	0.98	1895.5	369.0	136.9
212	1559.270	04/12/2022 10:23	Outer lane_LHS	750	3000	100	500	40	160	280	490	2982.4	496.1	159.8	0.90	2698.6	393.6	136.8
213	1559.602	03/12/2022 12:12	Inner lane_LHS	750	3000	100	500	40	160	280	490	2362.2	245.5	151.9	0.98	2310.8	213.3	130.5
214	1559.760	04/12/2022 10:25	Outer lane_LHS	750	3000	100	500	40	160	280	490	2995.6	494.9	159.9	0.90	2710.5	392.8	136.9
215	1559.988	04/12/2022 10:26	Outer lane_LHS	750	3000	100	500	40	160	280	490	2991.2	498.8	159.4	0.90	2706.6	395.3	136.5
216	1560.110	03/12/2022 12:14	Inner lane_LHS	750	3000	100	500	40	160	300	450	2175.2	493.0	159.6	0.98	2127.8	391.6	136.6

E-Values & Remaining Life Analysis:																		
S.No	Chainage (km)	Date & Time	Lane	BT E Modulli Ranges (Mpa)		Granual E Modulli (Mpa)		Subgrade E Modulli (Mpa)		Crust Thickness (mm)		Field Moduli (Mpa)			Lemda	Field Moduli After Temp. & Winter Seasonal Correction		
				lower Bound	Upper Bound	lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
217	1560.248	04/12/2022 10:27	Outer lane_LHS	750	3000	100	500	40	160	300	450	2324.8	491.4	140.3	0.90	2103.6	390.6	121.0
218	1560.615	03/12/2022 12:15	Inner lane_LHS	750	3000	100	500	40	160	300	450	1891.5	201.7	128.4	0.98	1850.3	175.5	111.1
219	1560.758	04/12/2022 10:29	Outer lane_LHS	750	3000	100	500	40	160	300	450	1627.6	361.6	126.1	0.90	1472.7	302.7	109.2
220	1560.977	04/12/2022 10:30	Outer lane_LHS	750	3000	100	500	40	160	300	450	2874.6	494.5	160.0	0.90	2601.1	392.6	136.9
221	1561.117	03/12/2022 12:17	Inner lane_LHS	750	3000	100	500	40	160	300	450	1500.0	449.2	160.0	0.98	1467.3	363.1	136.9
222	1561.259	04/12/2022 10:32	Outer lane_LHS	750	3000	100	500	40	160	300	450	1856.3	210.7	123.9	0.90	1679.7	183.5	107.3
223	1561.617	03/12/2022 12:18	Inner lane_LHS	750	3000	100	500	40	160	300	450	2997.8	492.6	159.5	0.98	2932.5	391.3	136.5
224	1561.753	04/12/2022 10:33	Outer lane_LHS	750	3000	100	500	40	160	300	450	2155.4	241.9	137.1	0.90	1950.3	210.3	118.4
225	1561.981	04/12/2022 10:35	Outer lane_LHS	750	3000	100	500	40	160	300	450	2934.0	499.2	159.8	0.90	2654.8	395.6	136.8
226	1562.106	03/12/2022 12:20	Inner lane_LHS	750	3000	100	500	40	160	300	450	2986.8	424.9	139.1	0.98	2921.8	346.8	120.0
227	1562.248	04/12/2022 10:36	Outer lane_LHS	750	3000	100	500	40	160	300	450	3000.0	498.4	159.6	0.90	2714.5	395.0	136.6
228	1562.600	03/12/2022 12:21	Inner lane_LHS	750	3000	100	500	40	160	300	450	1308.7	237.2	104.8	0.98	1280.2	206.3	90.9
229	1562.756	04/12/2022 10:38	Outer lane_LHS	750	3000	100	500	40	160	300	450	758.8	103.9	83.2	0.90	686.6	77.4	71.4
230	1562.986	04/12/2022 10:39	Outer lane_LHS	750	3000	100	500	40	160	300	450	2962.6	499.6	159.6	0.90	2680.7	395.8	136.6
231	1563.120	03/12/2022 12:23	Inner lane_LHS	750	3000	100	500	40	160	300	450	2947.2	497.3	160.0	0.98	2883.0	394.3	136.9
232	1563.261	04/12/2022 10:40	Outer lane_LHS	750	3000	100	500	40	160	300	450	1618.8	271.7	118.7	0.90	1464.8	234.7	102.9
233	1563.611	03/12/2022 12:25	Inner lane_LHS	750	3000	100	500	40	160	300	450	765.4	105.9	80.0	0.98	748.7	79.7	68.4
234	1563.761	04/12/2022 10:42	Outer lane_LHS	750	3000	100	500	40	160	300	450	756.6	100.0	119.1	0.90	684.6	72.9	103.3
235	1564.418	03/12/2022 12:27	Inner lane_LHS	750	3000	100	500	40	160	300	450	998.5	175.1	138.7	0.98	976.8	151.1	119.7
236	1564.757	04/12/2022 10:45	Outer lane_LHS	750	3000	100	500	40	160	300	450	2421.6	360.8	125.7	0.90	2191.2	302.1	108.9
237	1564.960	04/12/2022 10:46	Outer lane_LHS	750	3000	100	500	40	160	300	450	952.3	214.2	114.6	0.90	861.7	186.6	99.4
238	1565.106	03/12/2022 12:29	Inner lane_LHS	750	3000	100	500	40	160	300	450	2056.5	309.6	127.7	0.98	2011.7	264.2	110.5
239	1565.267	04/12/2022 10:47	Outer lane_LHS	750	3000	100	500	40	160	300	450	3000.0	497.3	160.0	0.90	2714.5	394.3	136.9
240	1565.604	03/12/2022 12:30	Inner lane_LHS	750	3000	100	500	40	160	300	450	1548.4	167.6	96.7	0.98	1514.7	143.9	83.7
241	1565.758	04/12/2022 10:50	Outer lane_LHS	750	3000	100	500	40	160	300	450	2898.8	296.7	127.5	0.90	2623.0	254.3	110.4
242	1566.003	04/12/2022 10:51	Outer lane_LHS	750	3000	100	500	40	160	300	450	2991.2	498.8	159.3	0.90	2706.6	395.3	136.4
243	1566.109	03/12/2022 12:32	Inner lane_LHS	750	3000	100	500	40	160	300	450	2980.2	399.9	131.4	0.98	2915.3	329.7	113.6

E-Values & Remaining Life Analysis:																		
S.No	Chainage (km)	Date & Time	Lane	BT E Modulli Ranges (Mpa)		Granual E Modulli (Mpa)		Subgrade E Modulli (Mpa)		Crust Thickness (mm)		Field Moduli (Mpa)			Lemda	Field Moduli After Temp. & Winter Seasonal Correction		
				lower Bound	Upper Bound	lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
244	1566.267	04/12/2022 10:52	Outer lane_LHS	750	3000	100	500	40	160	300	450	3000.0	494.1	159.1	0.90	2714.5	392.3	136.2
245	1566.601	03/12/2022 12:33	Inner lane_LHS	750	3000	100	500	40	160	300	450	769.8	102.3	96.7	0.98	753.0	75.6	83.7
246	1566.757	04/12/2022 10:54	Outer lane_LHS	750	3000	100	500	40	160	300	450	2971.4	165.7	111.3	0.90	2688.6	142.1	96.6
247	1566.969	04/12/2022 10:55	Outer lane_LHS	750	3000	100	500	40	160	300	450	1218.5	139.1	81.3	0.90	1102.5	115.6	69.6
248	1567.153	03/12/2022 12:35	Inner lane_LHS	750	3000	100	500	40	160	300	450	1423.0	110.9	138.5	0.98	1392.0	85.4	119.5
249	1567.249	04/12/2022 10:56	Outer lane_LHS	750	3000	100	500	40	160	300	450	1977.3	172.7	121.2	0.90	1789.1	148.8	105.1
250	1567.602	03/12/2022 12:37	Inner lane_LHS	750	3000	100	500	40	160	300	450	2995.6	497.7	136.4	0.98	2930.4	394.6	117.8
251	1567.765	04/12/2022 10:58	Outer lane_LHS	750	3000	100	500	40	160	300	450	2971.4	498.0	159.6	0.90	2688.6	394.8	136.6
252	1567.944	04/12/2022 10:59	Outer lane_LHS	750	3000	100	500	40	160	300	450	2973.6	499.6	160.0	0.90	2690.6	395.8	136.9
253	1568.119	03/12/2022 12:38	Inner lane_LHS	750	3000	100	500	40	160	300	450	2762.5	222.0	100.3	0.98	2702.3	193.4	86.9
254	1568.256	04/12/2022 11:00	Outer lane_LHS	750	3000	100	500	40	160	300	450	2991.2	494.5	154.3	0.90	2706.6	392.6	132.4
255	1568.593	03/12/2022 12:40	Inner lane_LHS	750	3000	100	500	40	160	300	450	761.0	100.4	85.4	0.98	744.4	73.4	73.4
256	1568.756	04/12/2022 11:02	Outer lane_LHS	750	3000	100	500	40	160	300	450	2973.6	500.0	158.6	0.90	2690.6	396.1	135.8
257	1568.980	04/12/2022 11:03	Outer lane_LHS	750	3000	100	500	40	160	300	450	2929.6	493.0	159.6	0.90	2650.8	391.6	136.6
258	1569.113	03/12/2022 12:41	Inner lane_LHS	750	3000	100	500	40	160	300	450	1515.4	470.3	160.0	0.98	1482.4	376.9	136.9
259	1569.251	04/12/2022 11:04	Outer lane_LHS	750	3000	100	500	40	160	300	450	1335.0	154.3	110.6	0.90	1208.0	131.0	96.0
260	1569.608	03/12/2022 12:43	Inner lane_LHS	750	3000	100	500	40	160	280	450	763.2	100.4	84.7	0.98	746.6	73.4	72.8
261	1569.755	04/12/2022 11:06	Outer lane_LHS	750	3000	100	500	40	160	280	450	2980.2	495.3	160.0	0.90	2696.6	393.1	136.9
262	1570.001	04/12/2022 11:07	Outer lane_LHS	750	3000	100	500	40	160	280	450	2993.4	495.7	159.6	0.90	2708.5	393.3	136.6
263	1570.102	03/12/2022 12:44	Inner lane_LHS	750	3000	100	500	40	160	280	450	1315.2	490.6	160.0	0.98	1286.6	390.1	136.9
264	1570.251	04/12/2022 11:08	Outer lane_LHS	750	3000	100	500	40	160	280	450	2971.4	493.4	160.0	0.90	2688.6	391.9	136.9
265	1570.604	03/12/2022 12:46	Inner lane_LHS	750	3000	100	500	40	160	280	450	862.2	245.8	159.9	0.98	843.4	213.5	136.9
266	1570.754	04/12/2022 11:10	Outer lane_LHS	750	3000	100	500	40	160	280	450	2953.8	500.0	159.8	0.90	2672.7	396.1	136.8
267	1571.005	04/12/2022 11:11	Outer lane_LHS	750	3000	100	500	40	160	280	450	1255.9	174.3	135.6	0.90	1136.4	150.3	117.1
268	1571.126	03/12/2022 12:48	Inner lane_LHS	750	3000	100	500	40	160	280	450	2969.2	491.8	159.8	0.98	2904.5	390.8	136.8
269	1571.267	04/12/2022 11:13	Outer lane_LHS	750	3000	100	500	40	160	280	450	2993.4	497.3	159.4	0.90	2708.5	394.3	136.5
270	1571.797	04/12/2022 11:14	Outer lane_LHS	750	3000	100	500	40	160	280	450	1629.8	425.3	148.2	0.90	1474.7	347.1	127.5

E-Values & Remaining Life Analysis:																		
S.No	Chainage (km)	Date & Time	Lane	BT E Modulli Ranges (Mpa)		Granual E Modulli (Mpa)		Subgrade E Modulli (Mpa)		Crust Thickness (mm)		Field Moduli (Mpa)			Lemda	Field Moduli After Temp. & Winter Seasonal Correction		
				lower Bound	Upper Bound	lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
271	1571.856	03/12/2022 12:50	Inner lane_LHS	750	3000	100	500	40	160	280	450	2940.6	500.0	160.0	0.98	2876.6	396.1	136.9
272	1571.994	04/12/2022 11:15	Outer lane_LHS	750	3000	100	500	40	160	280	450	1706.7	372.5	159.8	0.90	1544.3	310.5	136.8
273	1572.115	03/12/2022 12:51	Inner lane_LHS	750	3000	100	500	40	160	280	450	1156.9	371.7	159.8	0.98	1131.7	309.9	136.8
274	1572.253	04/12/2022 11:17	Outer lane_LHS	750	3000	100	500	40	160	280	450	1200.9	231.8	159.8	0.90	1086.6	201.8	136.8
275	1572.605	03/12/2022 12:52	Inner lane_LHS	750	3000	100	500	40	160	280	450	1867.3	460.1	138.9	0.98	1826.6	370.3	119.9
276	1572.749	04/12/2022 11:18	Outer lane_LHS	750	3000	100	500	40	160	280	450	1143.7	171.6	155.9	0.90	1034.9	147.8	133.7
277	1572.984	04/12/2022 11:20	Outer lane_LHS	750	3000	100	500	40	160	280	450	2060.9	364.3	132.6	0.90	1864.8	304.6	114.6
278	1573.101	03/12/2022 12:55	Inner lane_LHS	750	3000	100	500	40	160	280	450	1211.9	433.1	159.9	0.98	1185.5	352.3	136.9
279	1573.904	04/12/2022 11:22	Outer lane_LHS	750	3000	100	500	40	160	280	450	1154.7	141.8	120.8	0.91	1050.8	118.4	104.7
280	1574.004	04/12/2022 11:23	Outer lane_LHS	750	3000	100	500	40	160	280	450	1277.9	140.7	120.0	0.90	1156.3	117.3	104.0
281	1574.097	03/12/2022 12:57	Inner lane_LHS	750	3000	100	500	40	160	280	450	1313.0	234.9	114.1	0.98	1284.4	204.4	99.0
282	1574.275	04/12/2022 11:24	Outer lane_LHS	750	3000	100	500	40	160	280	450	2021.3	290.0	155.7	0.90	1829.0	249.1	133.5
283	1574.624	03/12/2022 12:59	Inner lane_LHS	750	3000	100	500	40	160	280	450	1264.7	147.3	93.5	0.98	1237.2	124.0	80.8
284	1574.739	04/12/2022 11:26	Outer lane_LHS	750	3000	100	500	40	160	280	450	2978.0	499.2	159.3	1.06	3141.9	395.6	136.4
285	1575.002	04/12/2022 11:28	Outer lane_LHS	750	3000	100	500	40	160	280	450	2995.6	498.4	131.1	1.06	3160.4	395.0	113.4
286	1575.105	03/12/2022 13:01	Inner lane_LHS	750	3000	100	500	40	160	280	450	1440.6	213.4	101.3	0.98	1409.2	185.9	87.8
287	1575.253	04/12/2022 11:29	Outer lane_LHS	750	3000	100	500	40	160	280	450	2986.8	494.1	120.4	1.06	3151.2	392.3	104.4
288	1575.602	03/12/2022 13:02	Inner lane_LHS	750	3000	100	500	40	160	280	450	1370.2	478.1	160.0	0.98	1340.4	382.0	136.9
289	1575.754	04/12/2022 11:31	Outer lane_LHS	750	3000	100	500	40	160	280	450	1687.0	246.6	110.0	1.06	1779.8	214.2	95.4
290	1575.977	04/12/2022 11:32	Outer lane_LHS	750	3000	100	500	40	160	280	450	1242.7	260.7	104.5	1.06	1311.1	225.8	90.6
291	1576.124	03/12/2022 13:04	Inner lane_LHS	750	3000	100	500	40	160	280	450	857.8	482.0	160.0	0.98	839.1	384.5	136.9
292	1576.249	04/12/2022 11:33	Outer lane_LHS	750	3000	100	500	40	160	280	450	2991.2	499.6	156.8	1.06	3155.8	395.8	134.4
293	1576.601	03/12/2022 13:05	Inner lane_LHS	750	3000	100	500	40	160	280	450	1467.0	258.4	137.9	0.98	1435.1	223.9	119.0
294	1576.746	04/12/2022 11:35	Outer lane_LHS	750	3000	100	500	40	160	280	450	2188.4	319.7	142.2	1.06	2308.8	271.9	122.6
295	1576.979	04/12/2022 11:36	Outer lane_LHS	750	3000	100	500	40	160	280	450	794.0	107.8	73.2	1.06	837.7	81.9	62.0
296	1577.100	03/12/2022 13:07	Inner lane_LHS	750	3000	100	500	40	160	280	450	1077.7	102.7	129.4	0.98	1054.2	76.1	112.0
297	1577.236	04/12/2022 11:38	Outer lane_LHS	750	3000	100	500	40	160	280	450	2991.2	499.2	159.3	1.06	3155.8	395.6	136.4

E-Values & Remaining Life Analysis:																			
S.No	Chainage (km)	Date & Time	Lane	BT E Modulli Ranges (Mpa)		Granual E Modulli (Mpa)		Subgrade E Modulli (Mpa)		Crust Thickness (mm)		Field Moduli (Mpa)			Lemda	Field Moduli After Temp. & Winter Seasonal Correction		
				lower Bound	Upper Bound	lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
298	1577.597	03/12/2022 13:09	Inner lane_LHS	750	3000	100	500	40	160	280	450	860.0	119.2	95.1	0.98	841.3	94.6	82.3
299	1577.761	04/12/2022 11:39	Outer lane_LHS	750	3000	100	500	40	160	280	450	1068.9	122.7	138.7	1.06	1127.7	98.4	119.7
300	1578.009	04/12/2022 11:41	Outer lane_LHS	750	3000	100	500	40	160	280	450	1216.3	423.4	160.0	1.06	1283.2	345.8	136.9

S.No	Chainage (km)	Date & Time	Lane	KN	0 (mm)	200 (mm)	300 (mm)	450 (mm)	600 (mm)	900 (mm)	1500 (mm)	Temperatures (oC)		Pavement Condition	4-Days Soaked CBR (%)	BT E Modulli Ranges (Mpa)	
				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air			lower Bound	Upper Bound
1	1578.250	04/12/2022 11:48	Outer lane_RHS	40	0.22595	0.13773	0.10433	0.08144	0.05817	0.03877	0.03804	32.3	32.0	Good	8	750	3000
2	1578.100	03/12/2022 13:21	Inner lane_RHS	40	0.28550	0.03545	0.20288	0.16318	0.12727	0.07384	0.04947	32.3	31.1	Good	8	750	3000
3	1578.000	04/12/2022 11:52	Outer lane_RHS	40	0.25091	0.18917	0.16453	0.13289	0.10670	0.06683	0.04212	32.3	30.4	Good	8	750	3000
4	1577.753	04/12/2022 11:53	Outer lane_RHS	40	0.25882	0.10109	0.15062	0.11229	0.08942	0.05539	0.03675	32.3	30.3	Good	8	750	3000
5	1577.618	03/12/2022 13:23	Inner lane_RHS	40	0.28272	0.21194	0.16935	0.12265	0.08666	0.04348	0.02447	32.3	30.3	Good	8	750	3000
6	1577.250	04/12/2022 11:55	Outer lane_RHS	40	0.22580	0.17381	0.15456	0.13165	0.10398	0.08006	0.06025	32.3	32.0	Good	8	750	3000
7	1577.102	03/12/2022 13:25	Inner lane_RHS	40	0.22114	0.18179	0.15810	0.13754	0.11113	0.07326	0.05367	32.3	30.2	Good	8	750	3000
8	1577.008	04/12/2022 11:56	Outer lane_RHS	40	0.25712	0.17338	0.12914	0.09979	0.07138	0.04000	0.02757	32.3	30.8	Good	8	750	3000
9	1576.713	04/12/2022 11:58	Outer lane_RHS	40	0.22595	0.13773	0.10433	0.08144	0.05817	0.03877	0.03804	32.3	32.1	Good	8	750	3000
10	1576.631	03/12/2022 13:38	Inner lane_RHS	40	0.23726	0.17627	0.14480	0.11495	0.09071	0.05764	0.03733	32.3	30.8	Good	8	750	3000
11	1576.236	04/12/2022 11:59	Outer lane_RHS	40	0.22580	0.17381	0.15456	0.13165	0.10398	0.08006	0.06025	32.3	30.5	Good	8	750	3000
12	1576.100	03/12/2022 13:40	Inner lane_RHS	40	0.22114	0.18179	0.15810	0.13754	0.11113	0.07326	0.05367	32.3	30.8	Good	8	750	3000
13	1576.014	04/12/2022 12:01	Outer lane_RHS	40	0.23193	0.18894	0.15492	0.11590	0.09070	0.05683	0.04312	32.3	32.0	Good	8	750	3000
14	1575.749	04/12/2022 12:02	Outer lane_RHS	40	0.24348	0.19468	0.16689	0.13902	0.10477	0.07166	0.06607	32.3	32.1	Good	8	750	3000
15	1575.603	03/12/2022 14:26	Inner lane_RHS	40	0.20752	0.16965	0.15015	0.13054	0.08317	0.06059	0.05565	32.3	30.9	Good	8	750	3000
16	1575.254	04/12/2022 12:04	Outer lane_RHS	40	0.08997	0.06907	0.06498	0.05420	0.04476	0.02801	0.02224	32.3	30.5	Good	8	750	3000
17	1575.107	03/12/2022 14:28	Inner lane_RHS	40	0.13464	0.10677	0.09549	0.08368	0.06384	0.03785	0.03577	32.3	30.9	Good	8	750	3000
18	1575.004	04/12/2022 12:05	Outer lane_RHS	40	0.22040	0.17135	0.14659	0.11961	0.10007	0.06829	0.05046	32.3	30.5	Good	8	750	3000
19	1574.749	04/12/2022 12:06	Outer lane_RHS	40	0.21599	0.17739	0.15216	0.12549	0.09682	0.05827	0.03861	32.3	30.8	Good	8	750	3000
20	1574.613	03/12/2022 14:30	Inner lane_RHS	40	0.25774	0.21028	0.18468	0.15411	0.12003	0.07287	0.04542	32.3	30.9	Good	8	750	3000
21	1574.254	04/12/2022 12:08	Outer lane_RHS	40	0.24054	0.17767	0.14197	0.10786	0.08381	0.05453	0.03706	32.3	30.8	Good	8	750	3000
22	1574.099	03/12/2022 14:32	Inner lane_RHS	40	0.24531	0.18193	0.15651	0.12649	0.10081	0.06138	0.04825	32.5	30.8	Good	8	750	3000
23	1573.994	04/12/2022 12:09	Outer lane_RHS	40	0.23044	0.18511	0.15991	0.12227	0.09421	0.05466	0.02963	31.6	30.3	Good	8	750	3000
24	1573.234	04/12/2022 12:11	Outer lane_RHS	40	0.22497	0.18715	0.16265	0.13068	0.10893	0.07127	0.03975	31.6	30.9	Good	8	750	3000
25	1573.099	03/12/2022 14:35	Inner lane_RHS	40	0.22970	0.19458	0.17173	0.14529	0.12089	0.08318	0.05854	32.5	30.4	Good	8	750	3000
26	1573.027	04/12/2022 12:12	Outer lane_RHS	40	0.22459	0.16627	0.13755	0.09809	0.07390	0.03758	0.02136	31.6	30.9	Good	8	750	3000
27	1572.734	04/12/2022 12:14	Outer lane_RHS	40	0.26411	0.21719	0.19292	0.16035	0.14120	0.09946	0.07784	31.6	30.8	Good	8	750	3000
28	1572.596	03/12/2022 14:37	Inner lane_RHS	40	0.24273	0.17291	0.13747	0.08954	0.06341	0.04360	0.01888	32.5	30.8	Good	8	750	3000

S.No	Chainage (km)	Date & Time	Lane	KN	0 (mm)	200 (mm)	300 (mm)	450 (mm)	600 (mm)	900 (mm)	1500 (mm)	Temperatures (oC)		Pavement Condition	4-Days Soaked CBR (%)	BT E Modulli Ranges (Mpa)	
				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air			lower Bound	Upper Bound
29	1572.248	04/12/2022 12:15	Outer lane_RHS	40	0.25372	0.20768	0.17628	0.13849	0.11281	0.07720	0.05008	31.6	30.8	Good	8	750	3000
30	1572.087	03/12/2022 14:38	Inner lane_RHS	40	0.24713	0.18207	0.15472	0.10957	0.08769	0.05100	0.03084	32.5	30.9	Good	8	750	3000
31	1572.004	04/12/2022 12:16	Outer lane_RHS	40	0.14967	0.13176	0.12215	0.10675	0.09043	0.06218	0.05772	31.6	30.2	Good	8	750	3000
32	1571.273	04/12/2022 12:18	Outer lane_RHS	40	0.13758	0.11587	0.11002	0.09819	0.07870	0.05604	0.04792	31.6	30.3	Good	8	750	3000
33	1571.097	03/12/2022 14:41	Inner lane_RHS	40	0.14361	0.11288	0.10224	0.09034	0.07012	0.04505	0.04039	32.5	30.2	Good	8	750	3000
34	1571.043	04/12/2022 12:20	Outer lane_RHS	40	0.10583	0.08145	0.07852	0.07107	0.05714	0.04085	0.03967	31.6	30.3	Good	8	750	3000
35	1570.749	04/12/2022 12:21	Outer lane_RHS	40	0.18123	0.15770	0.13950	0.12263	0.10249	0.07583	0.06310	31.6	31.0	Good	8	750	3000
36	1570.604	03/12/2022 14:43	Inner lane_RHS	40	0.21219	0.17493	0.15268	0.12573	0.08571	0.05481	0.04504	32.5	30.8	Good	8	750	3000
37	1570.243	04/12/2022 12:23	Outer lane_RHS	40	0.14579	0.12839	0.12330	0.10922	0.09217	0.07171	0.06614	31.6	31.1	Good	8	750	3000
38	1570.085	03/12/2022 14:44	Inner lane_RHS	40	0.13996	0.11151	0.10468	0.10058	0.09653	0.06884	0.05480	32.5	30.8	Good	8	750	3000
39	1570.030	04/12/2022 12:24	Outer lane_RHS	40	0.18737	0.15276	0.14140	0.12091	0.10026	0.07190	0.05874	31.6	31.1	Good	8	750	3000
40	1569.743	04/12/2022 12:25	Outer lane_RHS	40	0.23632	0.20184	0.17901	0.14799	0.12363	0.08283	0.05565	31.6	31.2	Good	8	750	3000
41	1569.606	03/12/2022 14:46	Inner lane_RHS	40	0.20856	0.15014	0.12293	0.08493	0.07356	0.05145	0.04826	32.5	30.3	Good	8	750	3000
42	1569.252	04/12/2022 12:27	Outer lane_RHS	40	0.19009	0.01354	0.13557	0.10892	0.09094	0.05886	0.03805	31.6	31.3	Good	8	750	3000
43	1569.104	03/12/2022 14:47	Inner lane_RHS	40	0.29565	0.25419	0.21697	0.17008	0.13090	0.08529	0.06153	32.5	30.3	Good	8	750	3000
44	1569.000	04/12/2022 12:28	Outer lane_RHS	40	0.20208	0.14922	0.12607	0.10151	0.08382	0.05671	0.04285	31.6	31.4	Good	8	750	3000
45	1568.752	04/12/2022 12:29	Outer lane_RHS	40	0.28686	0.19636	0.16201	0.10937	0.08345	0.05919	0.03077	31.6	30.5	Good	8	750	3000
46	1568.591	03/12/2022 14:49	Inner lane_RHS	40	0.30515	0.22767	0.16623	0.12483	0.09611	0.05661	0.04040	32.5	30.3	Good	8	750	3000
47	1568.255	04/12/2022 12:31	Outer lane_RHS	40	0.28686	0.19636	0.16201	0.10937	0.08345	0.05919	0.03077	31.6	31.4	Good	8	750	3000
48	1568.094	03/12/2022 14:51	Inner lane_RHS	40	0.30515	0.22767	0.16623	0.12483	0.09611	0.05661	0.04040	32.5	30.4	Good	8	750	3000
49	1568.038	04/12/2022 12:32	Outer lane_RHS	40	0.20231	0.15293	0.13063	0.10872	0.09034	0.06623	0.04592	31.6	31.5	Good	8	750	3000
50	1567.754	04/12/2022 12:33	Outer lane_RHS	40	0.20208	0.14922	0.12607	0.10151	0.08382	0.05671	0.04285	31.6	30.8	Good	8	750	3000
51	1567.594	03/12/2022 14:53	Inner lane_RHS	40	0.28589	0.22477	0.18105	0.13485	0.10393	0.06504	0.04257	32.5	30.8	Good	8	750	3000
52	1567.232	04/12/2022 12:35	Outer lane_RHS	40	0.19377	0.14542	0.12700	0.09813	0.07675	0.04722	0.02976	31.6	30.6	Good	8	750	3000
53	1567.063	03/12/2022 14:55	Inner lane_RHS	40	0.22014	0.16016	0.13300	0.09782	0.08395	0.05883	0.04467	32.5	30.8	Good	8	750	3000
54	1566.927	04/12/2022 12:36	Outer lane_RHS	40	0.23719	0.19631	0.16757	0.12462	0.10701	0.06205	0.05038	31.6	30.5	Good	8	750	3000
55	1566.752	04/12/2022 12:37	Outer lane_RHS	40	0.22722	0.19256	0.16102	0.12221	0.10741	0.07455	0.06150	31.6	30.7	Good	8	750	3000
56	1566.602	03/12/2022 14:56	Inner lane_RHS	40	0.19708	0.16027	0.14593	0.12806	0.10764	0.07587	0.05982	32.5	30.2	Good	8	750	3000

S.No	Chainage (km)	Date & Time	Lane	KN	0 (mm)	200 (mm)	300 (mm)	450 (mm)	600 (mm)	900 (mm)	1500 (mm)	Temperatures (oC)		Pavement Condition	4-Days Soaked CBR (%)	BT E Modulli Ranges (Mpa)	
				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air			lower Bound	Upper Bound
57	1566.257	04/12/2022 12:39	Outer lane_RHS	40	0.13522	0.10358	0.09344	0.07925	0.06828	0.04817	0.03876	31.6	30.6	Good	8	750	3000
58	1566.082	03/12/2022 14:58	Inner lane_RHS	40	0.16033	0.12853	0.11697	0.09847	0.08267	0.05365	0.03904	32.5	30.3	Good	8	750	3000
59	1566.022	04/12/2022 12:40	Outer lane_RHS	40	0.13691	0.11262	0.10651	0.09544	0.08409	0.05852	0.04963	31.6	30.4	Good	8	750	3000
60	1565.751	04/12/2022 12:42	Outer lane_RHS	40	0.08301	0.06461	0.06105	0.05521	0.04429	0.03037	0.02675	31.6	30.2	Good	8	750	3000
61	1565.526	03/12/2022 15:00	Inner lane_RHS	40	0.19824	0.15636	0.13786	0.11585	0.08776	0.05900	0.05080	32.5	30.4	Good	8	750	3000
62	1565.264	04/12/2022 12:43	Outer lane_RHS	40	0.09504	0.07786	0.07120	0.06453	0.05392	0.03913	0.03313	31.6	30.2	Good	8	750	3000
63	1565.074	03/12/2022 15:02	Inner lane_RHS	40	0.19932	0.15755	0.13773	0.11535	0.08865	0.06022	0.04692	32.5	30.3	Good	8	750	3000
64	1565.008	04/12/2022 13:27	Outer lane_RHS	40	0.17687	0.14266	0.12440	0.10638	0.08112	0.05521	0.04488	31.6	31.1	Good	8	750	3000
65	1564.753	04/12/2022 13:28	Outer lane_RHS	40	0.24412	0.20090	0.17902	0.15167	0.12168	0.08413	0.06724	31.1	30.9	Good	8	750	3000
66	1564.614	03/12/2022 15:04	Inner lane_RHS	40	0.30957	0.25222	0.22068	0.18196	0.12487	0.07649	0.05721	32.3	30.5	Good	8	750	3000
67	1563.842	04/12/2022 13:31	Outer lane_RHS	40	0.30963	0.25278	0.21870	0.18274	0.14231	0.09159	0.06727	31.1	30.3	Good	8	750	3000
68	1563.615	03/12/2022 15:06	Inner lane_RHS	40	0.21746	0.17249	0.15809	0.14241	0.13203	0.09993	0.07758	32.3	31.0	Good	8	750	3000
69	1563.259	04/12/2022 13:33	Outer lane_RHS	40	0.07956	0.06191	0.05616	0.05045	0.04339	0.03055	0.02329	31.1	30.3	Good	8	750	3000
70	1563.090	03/12/2022 15:08	Inner lane_RHS	40	0.20079	0.16939	0.15967	0.14527	0.13173	0.09526	0.07489	32.3	31.0	Good	8	750	3000
71	1563.006	04/12/2022 13:34	Outer lane_RHS	40	0.14081	0.12026	0.11413	0.10258	0.09497	0.07567	0.05850	31.1	30.3	Good	8	750	3000
72	1562.754	04/12/2022 13:36	Outer lane_RHS	40	0.12655	0.10178	0.09319	0.08044	0.06895	0.04737	0.03944	31.1	31.0	Good	8	750	3000
73	1562.604	03/12/2022 15:09	Inner lane_RHS	40	0.19963	0.15072	0.13082	0.10561	0.08656	0.05401	0.03475	32.3	31.2	Good	8	750	3000
74	1562.237	04/12/2022 13:37	Outer lane_RHS	40	0.09930	0.07656	0.07333	0.06445	0.05557	0.03607	0.02911	31.1	30.3	Good	8	750	3000
75	1562.085	03/12/2022 15:11	Inner lane_RHS	40	0.12177	0.08910	0.08255	0.07280	0.06276	0.04230	0.03433	32.3	31.1	Good	8	750	3000
76	1562.030	04/12/2022 13:38	Outer lane_RHS	40	0.08808	0.06459	0.06040	0.05141	0.04759	0.03116	0.02457	31.1	30.3	Good	8	750	3000
77	1561.737	04/12/2022 13:39	Outer lane_RHS	40	0.14915	0.10751	0.08688	0.07098	0.04552	0.03119	0.02506	31.1	31.0	Good	8	750	3000
78	1561.609	03/12/2022 15:13	Inner lane_RHS	40	0.17175	0.13078	0.11490	0.09456	0.07491	0.04491	0.03770	31.3	30.5	Good	8	750	3000
79	1561.256	04/12/2022 13:41	Outer lane_RHS	40	0.10234	0.08412	0.08281	0.07388	0.05835	0.04417	0.03907	31.1	30.4	Good	8	750	3000
80	1561.097	03/12/2022 15:14	Inner lane_RHS	40	0.09432	0.08087	0.07607	0.07342	0.05963	0.04336	0.03830	31.3	31.1	Good	8	750	3000
81	1561.027	04/12/2022 13:43	Outer lane_RHS	40	0.11408	0.09460	0.08676	0.08160	0.06676	0.04916	0.04189	31.1	30.4	Good	8	750	3000
82	1560.737	04/12/2022 13:44	Outer lane_RHS	40	0.15697	0.11777	0.10095	0.08470	0.06493	0.04331	0.03930	31.1	30.8	Good	8	750	3000
83	1560.618	03/12/2022 15:16	Inner lane_RHS	40	0.13216	0.10643	0.09905	0.08767	0.07542	0.05236	0.04053	31.3	31.1	Good	8	750	3000
84	1560.250	04/12/2022 13:46	Outer lane_RHS	40	0.10672	0.07710	0.07180	0.06285	0.05755	0.04105	0.03439	31.1	30.4	Good	8	750	3000

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				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air			lower Bound	Upper Bound
85	1560.112	03/12/2022 15:17	Inner lane_RHS	40	0.23108	0.18146	0.15803	0.13246	0.09812	0.06815	0.05256	31.3	31.2	Good	8	750	3000
86	1560.021	04/12/2022 13:47	Outer lane_RHS	40	0.15954	0.13063	0.11645	0.10074	0.07635	0.05125	0.04188	31.1	30.2	Good	8	750	3000
87	1559.603	03/12/2022 15:19	Inner lane_RHS	40	0.23045	0.18445	0.16489	0.13956	0.11635	0.07931	0.06057	31.3	31.2	Good	8	750	3000
88	1559.247	04/12/2022 13:49	Outer lane_RHS	40	0.16681	0.13095	0.11993	0.10861	0.09495	0.06914	0.05232	31.1	30.4	Good	8	750	3000
89	1559.095	03/12/2022 15:21	Inner lane_RHS	40	0.12742	0.10014	0.09133	0.07738	0.06485	0.04283	0.03700	31.3	31.2	Good	8	750	3000
90	1559.033	04/12/2022 13:50	Outer lane_RHS	40	0.14140	0.12148	0.11280	0.09929	0.07587	0.05751	0.05322	31.1	30.3	Good	8	750	3000
91	1558.751	04/12/2022 13:52	Outer lane_RHS	40	0.18589	0.15075	0.13316	0.10950	0.08761	0.06059	0.04858	32.7	30.8	Good	8	750	3000
92	1558.604	03/12/2022 15:22	Inner lane_RHS	40	0.20148	0.15111	0.11738	0.09255	0.07345	0.05512	0.04059	31.9	31.3	Good	8	750	3000
93	1558.256	04/12/2022 13:53	Outer lane_RHS	40	0.25508	0.20631	0.17495	0.14005	0.11733	0.07967	0.05064	32.7	30.9	Good	8	750	3000
94	1558.107	03/12/2022 15:24	Inner lane_RHS	40	0.24961	0.20356	0.17456	0.13769	0.11033	0.07763	0.05744	31.9	30.4	Good	8	750	3000
95	1558.055	04/12/2022 13:54	Outer lane_RHS	40	0.21335	0.18251	0.15896	0.12561	0.10874	0.07785	0.06091	32.7	30.2	Good	8	750	3000
96	1557.737	04/12/2022 13:56	Outer lane_RHS	40	0.23585	0.15449	0.11178	0.07204	0.05436	0.04094	0.03495	32.7	30.2	Good	8	750	3000
97	1557.594	03/12/2022 15:26	Inner lane_RHS	40	0.25022	0.17723	0.16752	0.14003	0.11298	0.06842	0.04736	31.9	31.3	Good	8	750	3000
98	1557.248	04/12/2022 13:57	Outer lane_RHS	40	0.25107	0.20803	0.18173	0.15364	0.12196	0.08460	0.05981	32.7	31.0	Good	8	750	3000
99	1557.098	03/12/2022 15:27	Inner lane_RHS	40	0.20869	0.16739	0.14426	0.11622	0.08300	0.04908	0.04421	31.9	31.3	Good	8	750	3000
100	1557.000	04/12/2022 13:59	Outer lane_RHS	40	0.20715	0.15179	0.11942	0.08909	0.06824	0.04315	0.03039	32.7	31.0	Good	8	750	3000
101	1556.739	04/12/2022 14:00	Outer lane_RHS	40	0.20762	0.17252	0.15215	0.12332	0.10453	0.07035	0.05228	32.7	31.1	Good	8	750	3000
102	1556.602	03/12/2022 15:29	Inner lane_RHS	40	0.25051	0.17915	0.12605	0.07359	0.05344	0.02989	0.02243	31.9	31.3	Good	8	750	3000
103	1556.223	04/12/2022 14:02	Outer lane_RHS	40	0.22520	0.15909	0.12806	0.09032	0.07608	0.04494	0.03418	32.7	31.2	Good	8	750	3000
104	1556.094	03/12/2022 15:31	Inner lane_RHS	40	0.26125	0.22168	0.19207	0.16431	0.12937	0.09228	0.07364	31.9	31.4	Good	8	750	3000
105	1555.928	04/12/2022 14:03	Outer lane_RHS	40	0.25229	0.16994	0.13244	0.09515	0.06896	0.04233	0.02944	32.7	31.2	Good	8	750	3000
106	1555.692	04/12/2022 14:04	Outer lane_RHS	40	0.24229	0.16935	0.13245	0.09525	0.06896	0.04232	0.02945	32.7	31.3	Good	8	750	3000
107	1555.605	03/12/2022 15:32	Inner lane_RHS	40	0.19192	0.16234	0.14811	0.12955	0.09633	0.06581	0.05421	31.9	31.4	Good	8	750	3000
108	1555.255	04/12/2022 14:06	Outer lane_RHS	40	0.20298	0.16114	0.12963	0.09364	0.07056	0.04215	0.03549	32.7	31.6	Good	8	750	3000
109	1555.097	03/12/2022 15:34	Inner lane_RHS	40	0.23207	0.12369	0.09744	0.07297	0.05037	0.04154	0.00965	31.9	31.5	Good	8	750	3000
110	1555.007	04/12/2022 14:07	Outer lane_RHS	40	0.24432	0.19550	0.15775	0.11261	0.08023	0.03882	0.02306	32.7	31.2	Good	8	750	3000
111	1554.793	04/12/2022 14:08	Outer lane_RHS	40	0.22408	0.18229	0.15618	0.10933	0.09983	0.06691	0.05398	32.7	31.3	Good	8	750	3000
112	1554.247	04/12/2022 14:10	Outer lane_RHS	40	0.22119	0.15980	0.12343	0.08386	0.06102	0.03760	0.02316	32.7	31.4	Good	8	750	3000

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				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air			lower Bound	Upper Bound
113	1554.111	03/12/2022 15:37	Inner lane_RHS	40	0.20715	0.16106	0.13837	0.11392	0.09316	0.06692	0.04718	31.9	31.5	Good	8	750	3000
114	1554.004	04/12/2022 14:11	Outer lane_RHS	40	0.23967	0.19878	0.17202	0.14356	0.11139	0.06816	0.04695	32.7	31.4	Good	8	750	3000
115	1553.750	04/12/2022 14:12	Outer lane_RHS	40	0.20964	0.15127	0.11825	0.08092	0.06743	0.04507	0.03750	32.7	31.5	Good	8	750	3000
116	1553.604	03/12/2022 15:39	Inner lane_RHS	40	0.22508	0.16967	0.12579	0.10361	0.07598	0.04208	0.01852	31.9	31.6	Good	8	750	3000
117	1553.252	04/12/2022 14:14	Outer lane_RHS	40	0.21217	0.17715	0.15562	0.13139	0.10766	0.07623	0.04599	32.7	31.6	Good	8	750	3000
118	1553.104	03/12/2022 15:41	Inner lane_RHS	40	0.23179	0.18833	0.15109	0.11205	0.08753	0.05398	0.03401	31.9	31.2	Good	8	750	3000
119	1553.026	04/12/2022 14:15	Outer lane_RHS	40	0.23353	0.17991	0.14574	0.10429	0.07489	0.03927	0.01465	32.7	31.7	Good	8	750	3000
120	1552.753	04/12/2022 14:16	Outer lane_RHS	40	0.21167	0.18596	0.16793	0.14285	0.11870	0.07915	0.05178	32.7	31.7	Good	8	750	3000
121	1552.599	03/12/2022 15:42	Inner lane_RHS	40	0.21608	0.16887	0.13973	0.10623	0.08100	0.04692	0.02338	31.9	31.5	Good	8	750	3000
122	1552.230	04/12/2022 14:18	Outer lane_RHS	40	0.22071	0.15003	0.11474	0.08784	0.06020	0.03635	0.01577	32.7	31.7	Good	8	750	3000
123	1552.102	03/12/2022 15:44	Inner lane_RHS	40	0.23373	0.19526	0.17796	0.15598	0.12451	0.09055	0.06311	31.9	31.5	Good	8	750	3000
124	1552.069	04/12/2022 14:19	Outer lane_RHS	40	0.21424	0.15435	0.11314	0.09363	0.08234	0.06036	0.03721	32.7	31.8	Good	8	750	3000
125	1551.727	04/12/2022 14:21	Outer lane_RHS	40	0.21571	0.15145	0.11573	0.08750	0.06503	0.03681	0.01727	32.7	31.8	Good	8	750	3000
126	1551.600	03/12/2022 15:46	Inner lane_RHS	40	0.22579	0.15740	0.11930	0.09742	0.07202	0.04758	0.03412	31.9	31.5	Good	8	750	3000
127	1551.270	04/12/2022 14:22	Outer lane_RHS	40	0.22141	0.18171	0.16083	0.13374	0.10289	0.06157	0.03895	32.7	31.9	Good	8	750	3000
128	1551.263	03/12/2022 15:48	Inner lane_RHS	40	0.22240	0.16379	0.12826	0.09266	0.06772	0.03805	0.01453	31.9	31.5	Good	8	750	3000
129	1550.232	04/12/2022 14:25	Outer lane_RHS	40	0.17705	0.14018	0.12501	0.10874	0.08750	0.06348	0.05777	32.7	32.0	Good	8	750	3000
130	1550.101	03/12/2022 15:50	Inner lane_RHS	40	0.17302	0.12197	0.10067	0.08207	0.07089	0.04946	0.03628	31.9	31.7	Good	8	750	3000
131	1550.031	04/12/2022 14:26	Outer lane_RHS	40	0.10683	0.08065	0.07335	0.06490	0.05002	0.03332	0.03172	32.7	32.0	Good	8	750	3000
132	1549.745	04/12/2022 14:28	Outer lane_RHS	40	0.18327	0.13808	0.11965	0.09773	0.08524	0.05188	0.04547	32.7	32.1	Good	8	750	3000
133	1549.597	03/12/2022 15:52	Inner lane_RHS	40	0.26772	0.19535	0.16389	0.13013	0.11591	0.07104	0.05672	31.9	31.6	Good	8	750	3000
134	1549.245	04/12/2022 14:30	Outer lane_RHS	40	0.11360	0.07851	0.07417	0.06900	0.05487	0.04129	0.03700	32.7	32.1	Good	8	750	3000
135	1549.080	03/12/2022 15:53	Inner lane_RHS	40	0.20527	0.16302	0.14923	0.13366	0.10797	0.07616	0.06884	31.9	31.7	Good	8	750	3000
136	1549.038	04/12/2022 14:31	Outer lane_RHS	40	0.11030	0.09252	0.08392	0.07704	0.06496	0.04442	0.03943	32.7	30.5	Good	8	750	3000
137	1548.745	04/12/2022 14:32	Outer lane_RHS	40	0.12705	0.09850	0.09615	0.08604	0.07501	0.04875	0.04196	32.7	32.1	Good	8	750	3000
138	1548.604	03/12/2022 15:55	Inner lane_RHS	40	0.18508	0.15386	0.14423	0.12745	0.11324	0.07864	0.06587	31.9	31.6	Good	8	750	3000
139	1548.232	04/12/2022 14:34	Outer lane_RHS	40	0.15881	0.13345	0.12261	0.11097	0.09111	0.06382	0.04916	32.7	30.9	Good	8	750	3000
140	1548.093	03/12/2022 15:57	Inner lane_RHS	40	0.14213	0.10967	0.09776	0.07804	0.06367	0.04252	0.03088	31.9	31.6	Good	8	750	3000

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				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air			lower Bound	Upper Bound
141	1548.034	04/12/2022 14:35	Outer lane_RHS	40	0.21147	0.17374	0.16314	0.14248	0.12557	0.09045	0.06795	32.7	32.3	Good	8	750	3000
142	1547.751	04/12/2022 14:36	Outer lane_RHS	40	0.11660	0.10444	0.09698	0.09007	0.07542	0.05797	0.05019	32.7	30.5	Good	8	750	3000
143	1547.604	03/12/2022 15:58	Inner lane_RHS	40	0.16215	0.13240	0.12367	0.11640	0.10411	0.07790	0.06098	31.9	31.7	Good	8	750	3000
144	1547.249	04/12/2022 14:38	Outer lane_RHS	40	0.14280	0.12574	0.11478	0.11019	0.08857	0.06230	0.05397	32.7	30.3	Good	8	750	3000
145	1547.102	03/12/2022 16:00	Inner lane_RHS	40	0.20356	0.16452	0.14905	0.13114	0.10730	0.08162	0.06703	31.9	31.6	Good	8	750	3000
146	1546.984	04/12/2022 14:39	Outer lane_RHS	40	0.15248	0.12776	0.11875	0.10832	0.09346	0.06762	0.05626	32.7	30.4	Good	8	750	3000
147	1546.727	04/12/2022 14:41	Outer lane_RHS	40	0.11917	0.09350	0.08443	0.07632	0.06948	0.04991	0.03692	32.7	30.2	Good	8	750	3000
148	1546.602	03/12/2022 16:02	Inner lane_RHS	40	0.20221	0.16537	0.15038	0.13403	0.11802	0.08648	0.07005	31.9	31.7	Good	8	750	3000
149	1546.255	04/12/2022 14:42	Outer lane_RHS	40	0.10371	0.07935	0.07701	0.06752	0.05911	0.04107	0.03622	32.7	32.7	Good	8	750	3000
150	1546.089	03/12/2022 16:03	Inner lane_RHS	40	0.11840	0.09558	0.09031	0.07916	0.07211	0.04930	0.03839	31.9	31.7	Good	8	750	3000
151	1546.041	04/12/2022 14:44	Outer lane_RHS	40	0.13305	0.10622	0.09635	0.08744	0.06698	0.04716	0.04191	32.7	30.8	Good	8	750	3000
152	1545.753	04/12/2022 14:45	Outer lane_RHS	40	0.15354	0.13362	0.12621	0.11398	0.09609	0.06967	0.05237	32.7	32.6	Good	8	750	3000
153	1545.603	03/12/2022 16:05	Inner lane_RHS	40	0.43626	0.34764	0.29666	0.24068	0.18684	0.11337	0.08264	31.9	31.7	Good	8	750	3000
154	1545.254	04/12/2022 14:47	Outer lane_RHS	40	0.16484	0.14905	0.13970	0.12622	0.10202	0.07432	0.06069	32.7	32.6	Good	8	750	3000
155	1545.086	03/12/2022 16:06	Inner lane_RHS	40	0.21959	0.18086	0.16840	0.14559	0.13087	0.09804	0.07904	31.9	31.7	Good	8	750	3000
156	1545.033	04/12/2022 14:48	Outer lane_RHS	40	0.22594	0.14932	0.11721	0.08135	0.06205	0.03928	0.01933	31.1	30.3	Good	8	750	3000
157	1544.738	04/12/2022 14:49	Outer lane_RHS	40	0.22548	0.17785	0.16277	0.13222	0.11026	0.07366	0.04739	31.1	30.8	Good	8	750	3000
158	1544.586	03/12/2022 16:08	Inner lane_RHS	40	0.21847	0.14962	0.12653	0.09890	0.07764	0.04725	0.02363	31.9	31.7	Good	8	750	3000
159	1544.215	04/12/2022 14:51	Outer lane_RHS	40	0.22680	0.17756	0.15491	0.12254	0.09450	0.05588	0.02633	31.1	30.8	Good	8	750	3000
160	1544.063	03/12/2022 16:10	Inner lane_RHS	40	0.21561	0.17516	0.14204	0.12065	0.09787	0.06046	0.03962	31.9	31.7	Good	8	750	3000
161	1544.045	04/12/2022 14:52	Outer lane_RHS	40	0.21833	0.15784	0.12454	0.09130	0.06581	0.03777	0.01753	31.1	30.8	Good	8	750	3000
162	1543.744	04/12/2022 14:54	Outer lane_RHS	40	0.21518	0.17116	0.14492	0.11222	0.08595	0.05655	0.03536	31.1	30.8	Good	8	750	3000
163	1543.603	03/12/2022 16:11	Inner lane_RHS	40	0.11298	0.09660	0.08995	0.07777	0.06813	0.04732	0.03790	31.9	31.6	Good	8	750	3000
164	1543.257	04/12/2022 14:55	Outer lane_RHS	40	0.12868	0.09999	0.09457	0.08930	0.08494	0.06129	0.05251	31.1	30.8	Good	8	750	3000
165	1543.098	03/12/2022 16:13	Inner lane_RHS	40	0.17708	0.13740	0.11682	0.10178	0.08865	0.06389	0.05339	31.9	31.6	Good	8	750	3000
166	1543.050	04/12/2022 14:57	Outer lane_RHS	40	0.13601	0.11654	0.10851	0.09768	0.08379	0.06118	0.05214	31.1	30.8	Good	8	750	3000
167	1542.652	04/12/2022 14:58	Outer lane_RHS	40	0.15424	0.12786	0.11380	0.10693	0.09074	0.06695	0.06195	31.1	30.8	Good	8	750	3000
168	1542.600	03/12/2022 16:14	Inner lane_RHS	40	0.17620	0.12752	0.11312	0.09403	0.07552	0.05333	0.04277	31.9	31.7	Good	8	750	3000

S.No	Chainage (km)	Date & Time	Lane	KN	0 (mm)	200 (mm)	300 (mm)	450 (mm)	600 (mm)	900 (mm)	1500 (mm)	Temperatures (oC)		Pavement Condition	4-Days Soaked CBR (%)	BT E Modulli Ranges (Mpa)	
				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air			lower Bound	Upper Bound
169	1542.256	04/12/2022 15:00	Outer lane_RHS	40	0.18450	0.15802	0.14250	0.12520	0.10084	0.07185	0.06571	31.1	30.9	Good	8	750	3000
170	1542.090	03/12/2022 16:16	Inner lane_RHS	40	0.20076	0.14732	0.12693	0.10620	0.08537	0.05774	0.04593	31.9	31.7	Good	8	750	3000
171	1541.981	04/12/2022 15:01	Outer lane_RHS	40	0.25947	0.20046	0.17323	0.14744	0.12303	0.08597	0.06661	31.1	30.9	Good	8	750	3000
172	1541.614	03/12/2022 16:17	Inner lane_RHS	40	0.38982	0.31125	0.26320	0.20873	0.17478	0.11499	0.08142	31.9	31.5	Good	8	750	3000
173	1541.601	04/12/2022 15:02	Outer lane_RHS	40	0.22639	0.19639	0.17807	0.15694	0.13057	0.09615	0.07726	31.1	30.2	Good	8	750	3000
174	1540.513	03/12/2022 16:20	Inner lane_RHS	40	0.13462	0.10594	0.09329	0.08320	0.07149	0.05364	0.04633	31.9	31.7	Good	8	750	3000
175	1540.247	04/12/2022 15:06	Outer lane_RHS	40	0.31479	0.25442	0.22201	0.18624	0.15903	0.11103	0.07927	31.1	30.4	Good	8	750	3000
176	1540.108	03/12/2022 16:22	Inner lane_RHS	40	0.18972	0.14232	0.11390	0.10208	0.09692	0.05750	0.04761	31.9	31.6	Good	8	750	3000
177	1539.189	04/12/2022 15:09	Outer lane_RHS	40	0.24495	0.18826	0.15427	0.11814	0.08449	0.05170	0.03843	31.1	30.9	Good	8	750	3000
178	1539.087	03/12/2022 16:25	Inner lane_RHS	40	0.30926	0.23225	0.18606	0.13330	0.09030	0.05476	0.04820	31.9	31.6	Good	8	750	3000
179	1539.000	04/12/2022 15:10	Outer lane_RHS	40	0.26212	0.21478	0.18326	0.14996	0.11795	0.08867	0.07417	31.1	30.9	Good	8	750	3000
180	1538.685	04/12/2022 15:12	Outer lane_RHS	40	0.35495	0.27883	0.22717	0.16600	0.11700	0.07081	0.05029	31.1	30.3	Good	8	750	3000
181	1538.600	03/12/2022 16:26	Inner lane_RHS	40	0.39961	0.30422	0.25143	0.19470	0.14594	0.08215	0.06233	31.9	31.5	Good	8	750	3000
182	1538.259	04/12/2022 15:14	Outer lane_RHS	40	0.14636	0.12476	0.11455	0.09964	0.08382	0.05856	0.04454	31.1	30.3	Good	8	750	3000
183	1538.063	03/12/2022 16:28	Inner lane_RHS	40	0.26822	0.21878	0.20126	0.17451	0.15046	0.10306	0.07899	31.9	31.5	Good	8	750	3000
184	1538.031	04/12/2022 15:15	Outer lane_RHS	40	0.11233	0.09868	0.09423	0.08487	0.07245	0.05633	0.04458	31.1	30.3	Good	8	750	3000
185	1537.691	04/12/2022 15:16	Outer lane_RHS	40	0.14018	0.11287	0.10412	0.09231	0.07888	0.05792	0.04741	31.1	30.4	Good	8	750	3000
186	1537.625	03/12/2022 16:30	Inner lane_RHS	40	0.18919	0.14889	0.13670	0.11643	0.10430	0.06902	0.05605	31.9	31.6	Good	8	750	3000
187	1537.242	04/12/2022 15:18	Outer lane_RHS	40	0.22126	0.18910	0.17413	0.14989	0.12161	0.08532	0.06660	31.1	30.4	Good	8	750	3000
188	1537.100	03/12/2022 16:32	Inner lane_RHS	40	0.17600	0.14225	0.12688	0.11425	0.10562	0.07299	0.04735	31.9	31.5	Good	8	750	3000
189	1536.955	04/12/2022 15:20	Outer lane_RHS	40	0.17420	0.15045	0.14026	0.12785	0.11572	0.08716	0.06902	31.1	30.9	Good	8	750	3000
190	1536.731	04/12/2022 15:21	Outer lane_RHS	40	0.12222	0.09893	0.09250	0.08160	0.07446	0.05256	0.03998	31.1	30.4	Good	8	750	3000
191	1536.577	03/12/2022 16:33	Inner lane_RHS	40	0.19776	0.15514	0.14053	0.12317	0.10824	0.07441	0.06330	31.9	31.5	Good	8	750	3000
192	1536.251	04/12/2022 15:23	Outer lane_RHS	40	0.18920	0.16039	0.15076	0.13707	0.12521	0.09454	0.07469	31.1	30.8	Good	8	750	3000
193	1536.106	03/12/2022 16:35	Inner lane_RHS	40	0.16927	0.14066	0.13527	0.12034	0.10594	0.07940	0.06440	31.9	31.6	Good	8	750	3000
194	1536.000	04/12/2022 15:24	Outer lane_RHS	40	0.12245	0.10937	0.10253	0.09174	0.06858	0.04866	0.04075	31.1	29.8	Good	8	750	3000
195	1535.752	02/12/2022 15:38	Outer lane_RHS	40	0.11615	0.10345	0.09833	0.06278	0.04450	0.04224	0.03237	32.4	32.3	Good	8	750	3000
196	1535.736	04/12/2022 15:25	Outer lane_RHS	40	0.10511	0.08468	0.07107	0.06761	0.05410	0.03706	0.03265	31.1	30.9	Good	8	750	3000

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				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air			lower Bound	Upper Bound
197	1535.596	03/12/2022 16:37	Inner lane_RHS	40	0.24674	0.19260	0.17179	0.14388	0.12641	0.08587	0.06461	31.3	30.2	Good	8	750	3000
198	1535.250	02/12/2022 15:40	Outer lane_RHS	40	0.10879	0.09615	0.08683	0.06903	0.05198	0.03884	0.03417	32.4	30.3	Good	8	750	3000
199	1535.090	03/12/2022 16:38	Inner lane_RHS	40	0.14971	0.12351	0.11165	0.09665	0.08069	0.05717	0.04240	31.3	30.1	Good	8	750	3000
200	1535.001	02/12/2022 15:41	Outer lane_RHS	40	0.12115	0.09987	0.09404	0.08990	0.04732	0.03914	0.03484	32.4	30.4	Good	8	750	3000
201	1534.754	02/12/2022 15:43	Outer lane_RHS	40	0.13632	0.11870	0.10839	0.09632	0.06966	0.05211	0.04605	32.4	30.4	Good	8	750	3000
202	1534.666	03/12/2022 16:40	Inner lane_RHS	40	0.27181	0.22165	0.19234	0.16173	0.14693	0.09819	0.07133	31.3	30.2	Good	8	750	3000
203	1534.248	02/12/2022 15:44	Outer lane_RHS	40	0.14947	0.10990	0.10276	0.07888	0.05985	0.04057	0.03787	32.4	30.3	Good	8	750	3000
204	1533.995	02/12/2022 15:46	Outer lane_RHS	40	0.10821	0.09368	0.08792	0.08034	0.06144	0.04254	0.03954	32.4	30.4	Good	8	750	3000
205	1533.992	03/12/2022 16:46	Inner lane_RHS	40	0.21307	0.16934	0.15560	0.13581	0.12069	0.08564	0.06486	31.3	31.2	Good	8	750	3000
206	1533.722	02/12/2022 15:47	Outer lane_RHS	40	0.11125	0.09346	0.08114	0.07416	0.05863	0.04195	0.03265	32.4	32.3	Good	8	750	3000
207	1533.620	03/12/2022 16:47	Inner lane_RHS	40	0.14091	0.11229	0.10506	0.09312	0.08835	0.06455	0.05625	31.3	31.0	Good	8	750	3000
208	1533.258	02/12/2022 15:49	Outer lane_RHS	40	0.12298	0.10352	0.09277	0.08228	0.06441	0.04464	0.03831	32.4	30.8	Good	8	750	3000
209	1533.101	03/12/2022 16:49	Inner lane_RHS	40	0.22196	0.16406	0.14131	0.11932	0.09904	0.06468	0.05854	31.3	31.2	Good	8	750	3000
210	1532.999	02/12/2022 15:50	Outer lane_RHS	40	0.11960	0.10231	0.09625	0.08784	0.07243	0.05225	0.04845	32.4	32.4	Good	8	750	3000
211	1532.745	02/12/2022 15:51	Outer lane_RHS	40	0.14267	0.11871	0.10861	0.09380	0.08722	0.06243	0.04135	32.4	32.3	Good	8	750	3000
212	1532.603	03/12/2022 16:50	Inner lane_RHS	40	0.26741	0.21036	0.18859	0.16046	0.14264	0.09836	0.06652	31.3	31.1	Good	8	750	3000
213	1532.202	02/12/2022 15:53	Outer lane_RHS	40	0.14060	0.13016	0.12430	0.11327	0.08803	0.07102	0.06222	32.4	30.8	Good	8	750	3000
214	1532.094	03/12/2022 16:52	Inner lane_RHS	40	0.20361	0.15428	0.13363	0.11425	0.09596	0.06687	0.05391	31.3	31.1	Good	8	750	3000
215	1531.999	02/12/2022 15:54	Outer lane_RHS	40	0.14634	0.12979	0.12766	0.11332	0.09405	0.06638	0.05594	32.4	30.8	Good	8	750	3000
216	1531.701	02/12/2022 15:56	Outer lane_RHS	40	0.13516	0.11799	0.11134	0.10171	0.09434	0.06902	0.05616	32.4	30.4	Good	8	750	3000
217	1531.609	03/12/2022 16:53	Inner lane_RHS	40	0.27827	0.22640	0.20084	0.16920	0.13845	0.09371	0.07454	31.3	31.2	Good	8	750	3000
218	1531.178	02/12/2022 15:57	Outer lane_RHS	40	0.15160	0.10814	0.09134	0.07636	0.06285	0.04606	0.03952	32.4	30.4	Good	8	750	3000
219	1531.089	03/12/2022 16:55	Inner lane_RHS	40	0.23009	0.16141	0.14181	0.11616	0.10791	0.07282	0.05679	31.3	31.2	Good	8	750	3000
220	1531.003	02/12/2022 15:58	Outer lane_RHS	40	0.22010	0.17238	0.14939	0.12001	0.08759	0.06450	0.05318	32.4	30.8	Good	8	750	3000
221	1530.752	02/12/2022 15:59	Outer lane_RHS	40	0.18040	0.13161	0.11085	0.09427	0.07622	0.05030	0.04371	32.4	30.8	Good	8	750	3000
222	1530.611	03/12/2022 16:57	Inner lane_RHS	40	0.18923	0.12837	0.11169	0.09267	0.08651	0.05674	0.04678	31.3	31.1	Good	8	750	3000
223	1530.248	02/12/2022 16:01	Outer lane_RHS	40	0.15977	0.12816	0.11457	0.10086	0.07919	0.05682	0.04755	32.3	30.8	Good	8	750	3000
224	1530.105	03/12/2022 16:58	Inner lane_RHS	40	0.15509	0.12046	0.10648	0.09059	0.07386	0.04812	0.04359	31.3	31.1	Good	8	750	3000

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				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air			lower Bound	Upper Bound
225	1529.994	02/12/2022 16:02	Outer lane_RHS	40	0.12178	0.10536	0.09859	0.08784	0.06366	0.04894	0.04443	32.3	30.8	Good	8	750	3000
226	1529.730	02/12/2022 16:04	Outer lane_RHS	40	0.19547	0.16777	0.15277	0.13511	0.10194	0.07939	0.06641	32.3	30.8	Good	8	750	3000
227	1529.601	03/12/2022 17:00	Inner lane_RHS	40	0.25914	0.22514	0.19688	0.17109	0.14150	0.10737	0.08441	31.3	31.1	Good	8	750	3000
228	1529.250	02/12/2022 16:06	Outer lane_RHS	40	0.12100	0.11052	0.10339	0.09010	0.07254	0.05763	0.04870	32.3	30.8	Good	8	750	3000
229	1529.101	03/12/2022 17:01	Inner lane_RHS	40	0.18508	0.16790	0.15597	0.13822	0.10727	0.07198	0.06376	31.3	31.1	Good	8	750	3000
230	1529.014	02/12/2022 16:07	Outer lane_RHS	40	0.12508	0.10918	0.10458	0.09269	0.07655	0.04875	0.04500	32.3	30.9	Good	8	750	3000
231	1528.746	02/12/2022 16:08	Outer lane_RHS	40	0.14167	0.11030	0.10270	0.09076	0.07460	0.05150	0.04472	32.3	30.8	Good	8	750	3000
232	1528.601	03/12/2022 17:03	Inner lane_RHS	40	0.18212	0.14068	0.13002	0.11059	0.10343	0.07083	0.05844	31.3	30.4	Good	8	750	3000
233	1528.245	02/12/2022 16:10	Outer lane_RHS	40	0.27031	0.22573	0.19443	0.16870	0.12748	0.08842	0.07564	32.3	30.3	Good	8	750	3000
234	1528.100	03/12/2022 17:05	Inner lane_RHS	40	0.28774	0.21463	0.19164	0.16231	0.14630	0.09497	0.07612	31.3	31.0	Good	8	750	3000
235	1528.019	02/12/2022 16:11	Outer lane_RHS	40	0.20550	0.16377	0.14402	0.12539	0.09937	0.06769	0.05886	32.3	30.9	Good	8	750	3000
236	1527.746	02/12/2022 16:12	Outer lane_RHS	40	0.28293	0.22902	0.20382	0.17195	0.13296	0.08997	0.06749	32.3	30.3	Good	8	750	3000
237	1527.603	03/12/2022 17:06	Inner lane_RHS	40	0.40516	0.32304	0.28200	0.22851	0.19575	0.12989	0.08856	31.3	30.5	Good	8	750	3000
238	1527.246	02/12/2022 16:13	Outer lane_RHS	40	0.12730	0.10948	0.10363	0.09431	0.07328	0.05484	0.04830	32.3	30.3	Good	8	750	3000
239	1527.084	03/12/2022 17:08	Inner lane_RHS	40	0.32291	0.26690	0.22731	0.17948	0.13796	0.08434	0.05592	31.3	31.0	Good	8	750	3000
240	1527.026	02/12/2022 16:14	Outer lane_RHS	40	0.21910	0.18342	0.16624	0.14445	0.11887	0.08590	0.06735	32.3	30.3	Good	8	750	3000
241	1526.754	02/12/2022 16:16	Outer lane_RHS	40	0.22555	0.19917	0.18182	0.15806	0.12265	0.08800	0.07327	32.3	30.3	Good	8	750	3000
242	1526.610	03/12/2022 17:10	Inner lane_RHS	40	0.23401	0.19058	0.16888	0.14091	0.12368	0.08481	0.06400	31.3	30.4	Good	8	750	3000
243	1526.221	02/12/2022 16:17	Outer lane_RHS	40	0.36115	0.30087	0.26142	0.21238	0.15729	0.09978	0.08290	32.3	30.3	Good	8	750	3000
244	1526.106	03/12/2022 17:11	Inner lane_RHS	40	0.15026	0.12691	0.12138	0.10617	0.09436	0.06861	0.05168	31.3	31.1	Good	8	750	3000
245	1526.016	02/12/2022 16:18	Outer lane_RHS	40	0.10402	0.08338	0.07766	0.07041	0.06160	0.04556	0.03976	32.3	30.3	Good	8	750	3000
246	1525.669	02/12/2022 16:19	Outer lane_RHS	40	0.15098	0.13414	0.12606	0.10628	0.08754	0.06334	0.04622	32.3	30.3	Good	8	750	3000
247	1525.607	03/12/2022 17:13	Inner lane_RHS	40	0.27073	0.20566	0.17453	0.13966	0.11419	0.07314	0.05917	31.3	30.5	Good	8	750	3000
248	1525.265	02/12/2022 16:21	Outer lane_RHS	40	0.12713	0.11950	0.10431	0.09219	0.07014	0.04756	0.04479	32.3	30.3	Good	8	750	3000
249	1525.090	03/12/2022 17:14	Inner lane_RHS	40	0.24225	0.19871	0.17115	0.14277	0.12082	0.08412	0.06373	31.3	30.4	Good	8	750	3000
250	1525.025	02/12/2022 16:22	Outer lane_RHS	40	0.08976	0.08296	0.07935	0.07188	0.04265	0.04134	0.03224	32.3	30.3	Good	8	750	3000
251	1524.744	02/12/2022 16:25	Outer lane_RHS	40	0.17875	0.16512	0.15622	0.14151	0.10926	0.07907	0.07182	32.3	30.8	Good	8	750	3000
252	1524.593	03/12/2022 17:16	Inner lane_RHS	40	0.15412	0.13469	0.12199	0.10949	0.09585	0.06884	0.05303	31.3	30.4	Good	8	750	3000

S.No	Chainage (km)	Date & Time	Lane	KN	0 (mm)	200 (mm)	300 (mm)	450 (mm)	600 (mm)	900 (mm)	1500 (mm)	Temperatures (oC)		Pavement Condition	4-Days Soaked CBR (%)	BT E Modulli Ranges (Mpa)	
				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air			lower Bound	Upper Bound
253	1524.220	02/12/2022 16:26	Outer lane_RHS	40	0.19279	0.16309	0.14727	0.13479	0.10818	0.08439	0.07091	32.3	30.9	Good	8	750	3000
254	1524.110	03/12/2022 17:17	Inner lane_RHS	40	0.36114	0.29681	0.24683	0.19878	0.17379	0.11613	0.08332	31.3	30.5	Good	8	750	3000
255	1523.995	02/12/2022 16:27	Outer lane_RHS	40	0.32629	0.27645	0.25065	0.21129	0.17447	0.12339	0.09871	32.3	30.2	Good	8	750	3000
256	1523.739	02/12/2022 16:29	Outer lane_RHS	40	0.37581	0.31274	0.27591	0.22825	0.16096	0.09670	0.08776	32.3	30.4	Good	8	750	3000
257	1523.599	03/12/2022 17:19	Inner lane_RHS	40	0.26979	0.21695	0.18608	0.15044	0.12657	0.08746	0.06006	31.3	30.9	Good	8	750	3000
258	1523.221	02/12/2022 16:30	Outer lane_RHS	40	0.30310	0.25346	0.22188	0.18139	0.13175	0.08639	0.07493	32.3	30.4	Good	8	750	3000
259	1523.100	03/12/2022 17:21	Inner lane_RHS	40	0.29346	0.23949	0.20876	0.16893	0.13165	0.08064	0.06989	31.3	30.2	Good	8	750	3000
260	1523.004	02/12/2022 16:31	Outer lane_RHS	40	0.25927	0.20943	0.18404	0.15195	0.11467	0.07940	0.06744	32.3	32.1	Good	8	750	3000
261	1522.728	02/12/2022 16:33	Outer lane_RHS	40	0.11774	0.09581	0.08777	0.07734	0.06567	0.04654	0.03951	32.3	30.5	Good	8	750	3000
262	1522.617	03/12/2022 17:22	Inner lane_RHS	40	0.20336	0.16049	0.14105	0.12269	0.11723	0.08189	0.05100	31.3	30.8	Good	8	750	3000
263	1522.252	02/12/2022 16:35	Outer lane_RHS	40	0.12034	0.09834	0.09030	0.08246	0.06594	0.04801	0.04222	32.3	30.1	Good	8	750	3000
264	1522.126	03/12/2022 17:23	Inner lane_RHS	40	0.18619	0.14743	0.13236	0.11279	0.09729	0.06208	0.05172	31.3	30.4	Good	8	750	3000
265	1522.012	02/12/2022 16:36	Outer lane_RHS	40	0.20465	0.16814	0.15752	0.14655	0.12191	0.08575	0.08099	32.3	30.6	Good	8	750	3000
266	1521.754	02/12/2022 16:37	Outer lane_RHS	40	0.12894	0.10890	0.10122	0.09077	0.07249	0.05693	0.04574	32.3	32.2	Good	8	750	3000
267	1521.608	03/12/2022 17:25	Inner lane_RHS	40	0.15904	0.12214	0.11186	0.09675	0.08646	0.05655	0.04837	31.3	30.8	Good	8	750	3000
268	1521.248	02/12/2022 16:39	Outer lane_RHS	40	0.17322	0.14903	0.13738	0.11801	0.09716	0.06623	0.05112	32.3	30.5	Good	8	750	3000
269	1521.084	03/12/2022 17:26	Inner lane_RHS	40	0.13263	0.10631	0.10069	0.09110	0.08598	0.06436	0.04796	31.3	30.1	Good	8	750	3000
270	1521.014	02/12/2022 16:40	Outer lane_RHS	40	0.18475	0.15839	0.13995	0.12200	0.10496	0.07409	0.06224	32.3	32.2	Good	8	750	3000
271	1520.757	02/12/2022 16:41	Outer lane_RHS	40	0.22048	0.17924	0.15825	0.13442	0.10321	0.07659	0.06261	32.3	30.5	Good	8	750	3000
272	1520.610	03/12/2022 17:28	Inner lane_RHS	40	0.26909	0.21240	0.17892	0.15293	0.12718	0.08042	0.06081	31.3	30.3	Good	8	750	3000
273	1520.253	02/12/2022 16:44	Outer lane_RHS	40	0.20836	0.18471	0.16969	0.15140	0.12595	0.08999	0.07748	32.3	32.1	Good	8	750	3000
274	1520.151	03/12/2022 17:31	Inner lane_RHS	40	0.17044	0.12125	0.11163	0.10500	0.09939	0.06045	0.05167	31.3	30.4	Good	8	750	3000
275	1520.047	02/12/2022 16:45	Outer lane_RHS	40	0.17888	0.15191	0.14062	0.11747	0.07767	0.05469	0.04283	32.3	32.1	Good	8	750	3000
276	1519.760	02/12/2022 16:50	Outer lane_RHS	40	0.14112	0.11216	0.10161	0.09112	0.07450	0.05227	0.04767	32.3	31.9	Good	8	750	3000
277	1519.596	03/12/2022 17:35	Inner lane_RHS	40	0.21467	0.17349	0.15801	0.13544	0.11645	0.08727	0.06838	31.3	30.2	Good	8	750	3000
278	1519.231	02/12/2022 16:54	Outer lane_RHS	40	0.23035	0.18778	0.17500	0.15094	0.12982	0.09415	0.07186	32.3	31.7	Good	8	750	3000
279	1519.121	03/12/2022 17:36	Inner lane_RHS	40	0.18104	0.14869	0.13925	0.12358	0.10923	0.06602	0.05856	31.3	30.1	Good	8	750	3000
280	1519.020	02/12/2022 16:55	Outer lane_RHS	40	0.18283	0.16098	0.15006	0.13553	0.11165	0.07555	0.06689	32.3	31.7	Good	8	750	3000

S.No	Chainage (km)	Date & Time	Lane	KN	0 (mm)	200 (mm)	300 (mm)	450 (mm)	600 (mm)	900 (mm)	1500 (mm)	Temperatures (oC)		Pavement Condition	4-Days Soaked CBR (%)	BT E Modulli Ranges (Mpa)	
				Load	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	D5 (mm)	D6 (mm)	D7 (mm)	Asphalt	Air			lower Bound	Upper Bound
281	1518.742	02/12/2022 16:56	Outer lane_RHS	40	0.23621	0.18927	0.17243	0.14866	0.12275	0.08554	0.06426	32.3	31.8	Good	8	750	3000
282	1518.591	03/12/2022 17:38	Inner lane_RHS	40	0.22436	0.18957	0.16808	0.14617	0.11579	0.06629	0.05956	31.3	30.5	Good	8	750	3000
283	1518.250	02/12/2022 16:58	Outer lane_RHS	40	0.12138	0.10637	0.09981	0.09191	0.07289	0.05067	0.04496	32.3	31.7	Good	8	750	3000
284	1518.063	03/12/2022 17:39	Inner lane_RHS	40	0.21017	0.16698	0.15431	0.13239	0.11891	0.08278	0.06393	31.3	29.8	Good	8	750	3000
285	1518.013	02/12/2022 16:59	Outer lane_RHS	40	0.14133	0.12505	0.11168	0.10516	0.08170	0.06122	0.05125	32.3	31.6	Good	8	750	3000
286	1517.728	02/12/2022 17:00	Outer lane_RHS	40	0.20002	0.17719	0.16449	0.14743	0.12124	0.09371	0.08629	32.3	31.6	Good	8	750	3000
287	1517.625	03/12/2022 17:41	Inner lane_RHS	40	0.14309	0.12511	0.11241	0.10621	0.09054	0.06757	0.05667	31.3	30.5	Good	8	750	3000
288	1517.249	02/12/2022 17:02	Outer lane_RHS	40	0.12846	0.11259	0.10531	0.09570	0.07636	0.05415	0.04654	32.3	31.5	Good	8	750	3000
289	1517.111	03/12/2022 17:42	Inner lane_RHS	40	0.18754	0.17236	0.16890	0.15537	0.11913	0.09253	0.08141	31.3	29.7	Good	8	750	3000
290	1517.022	02/12/2022 17:03	Outer lane_RHS	40	0.20681	0.17848	0.16602	0.15553	0.14060	0.10732	0.08445	32.3	31.8	Good	8	750	3000
291	1516.756	02/12/2022 17:05	Outer lane_RHS	40	0.17961	0.15046	0.14284	0.12076	0.10330	0.07493	0.06281	32.3	31.9	Good	8	750	3000
292	1516.614	03/12/2022 17:44	Inner lane_RHS	40	0.20266	0.15945	0.14425	0.12450	0.10913	0.07837	0.06271	31.3	30.6	Good	8	750	3000
293	1516.242	02/12/2022 17:06	Outer lane_RHS	40	0.14887	0.11769	0.10514	0.09574	0.07045	0.05000	0.04458	32.3	31.5	Good	8	750	3000
294	1516.170	03/12/2022 17:45	Inner lane_RHS	40	0.14703	0.12377	0.11061	0.10148	0.07940	0.05226	0.04714	31.3	30.5	Good	8	750	3000
295	1516.024	02/12/2022 17:07	Outer lane_RHS	40	0.25975	0.22297	0.20420	0.18174	0.14662	0.10118	0.08242	32.3	31.4	Good	8	750	3000
296	1515.750	02/12/2022 17:09	Outer lane_RHS	40	0.15912	0.13641	0.12889	0.11838	0.09180	0.06582	0.05871	32.3	31.5	Good	8	750	3000

S.No	Chainage (km)	Date & Time	Lane	Granual E Modulli (Mpa)		Subgrade E Modulli (Mpa)		Crust Thickness (mm)		Field Moduli (Mpa)			Lemda	Field Moduli After Temp. & Winter Seasonal Correction		
				lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
1	1578.250	04/12/2022 11:48	Outer lane_RHS	100	500	40	160	300	450	2984.6	498.8	159.9	0.89	2654.8	395.3	136.9
2	1578.100	03/12/2022 13:21	Inner lane_RHS	100	500	40	160	300	450	2956.0	484.4	159.9	0.89	2629.4	386.1	136.9
3	1578.000	04/12/2022 11:52	Outer lane_RHS	100	500	40	160	300	450	1352.6	245.8	159.6	0.89	1203.2	213.5	136.6
4	1577.753	04/12/2022 11:53	Outer lane_RHS	100	500	40	160	300	450	1955.3	495.7	160.0	0.89	1739.3	393.3	136.9
5	1577.618	03/12/2022 13:23	Inner lane_RHS	100	500	40	160	300	450	2672.3	406.9	160.0	0.89	2377.0	334.5	136.9
6	1577.250	04/12/2022 11:55	Outer lane_RHS	100	500	40	160	300	450	1625.4	382.7	134.3	0.89	1445.8	317.7	116.1
7	1577.102	03/12/2022 13:25	Inner lane_RHS	100	500	40	160	300	450	2236.8	336.6	160.0	0.89	1989.7	284.5	136.9
8	1577.008	04/12/2022 11:56	Outer lane_RHS	100	500	40	160	300	450	1324.0	498.0	159.8	0.89	1177.7	394.8	136.8
9	1576.713	04/12/2022 11:58	Outer lane_RHS	100	500	40	160	300	450	2984.6	498.8	159.9	0.89	2654.8	395.3	136.9
10	1576.631	03/12/2022 13:38	Inner lane_RHS	100	500	40	160	300	450	1082.1	451.9	160.0	0.89	962.5	364.9	136.9
11	1576.236	04/12/2022 11:59	Outer lane_RHS	100	500	40	160	300	450	1625.4	382.7	134.3	0.89	1445.8	317.7	116.1
12	1576.100	03/12/2022 13:40	Inner lane_RHS	100	500	40	160	300	450	2014.7	207.1	155.4	0.89	1792.1	180.3	133.3
13	1576.014	04/12/2022 12:01	Outer lane_RHS	100	500	40	160	300	450	1178.9	394.4	160.0	0.89	1048.6	325.9	136.9
14	1575.749	04/12/2022 12:02	Outer lane_RHS	100	500	40	160	300	450	1431.8	297.1	141.0	0.89	1273.6	254.6	121.6
15	1575.603	03/12/2022 14:26	Inner lane_RHS	100	500	40	160	300	450	1583.6	378.8	160.0	0.89	1408.6	315.0	136.9
16	1575.254	04/12/2022 12:04	Outer lane_RHS	100	500	40	160	290	450	2978.0	496.1	159.9	0.89	2649.0	393.6	136.9
17	1575.107	03/12/2022 14:28	Inner lane_RHS	100	500	40	160	290	450	2848.2	498.8	159.6	0.89	2533.5	395.3	136.6
18	1575.004	04/12/2022 12:05	Outer lane_RHS	100	500	40	160	290	450	1618.8	329.5	160.0	0.89	1439.9	279.2	136.9
19	1574.749	04/12/2022 12:06	Outer lane_RHS	100	500	40	160	290	450	1581.4	353.4	160.0	0.89	1406.7	296.8	136.9
20	1574.613	03/12/2022 14:30	Inner lane_RHS	100	500	40	160	290	450	1601.2	155.1	159.9	0.89	1424.3	131.8	136.9
21	1574.254	04/12/2022 12:08	Outer lane_RHS	100	500	40	160	290	450	1185.5	493.0	160.0	0.89	1054.5	391.6	136.9
22	1574.099	03/12/2022 14:32	Inner lane_RHS	100	500	40	160	290	450	1227.3	336.6	159.9	0.90	1101.1	284.5	136.9
23	1573.994	04/12/2022 12:09	Outer lane_RHS	100	500	40	160	290	450	1372.4	320.9	159.9	0.86	1185.0	272.8	136.9
24	1573.234	04/12/2022 12:11	Outer lane_RHS	100	500	40	160	290	450	1880.5	221.6	159.6	0.86	1623.8	193.0	136.6
25	1573.099	03/12/2022 14:35	Inner lane_RHS	100	500	40	160	290	450	2201.6	202.8	138.4	0.90	1975.1	176.5	119.4
26	1573.027	04/12/2022 12:12	Outer lane_RHS	100	500	40	160	290	450	2054.3	493.7	160.0	0.86	1773.8	392.0	136.9
27	1572.734	04/12/2022 12:14	Outer lane_RHS	100	500	40	160	290	450	1750.7	277.1	106.2	0.86	1511.7	239.0	92.1
28	1572.596	03/12/2022 14:37	Inner lane_RHS	100	500	40	160	290	450	2736.1	498.0	160.0	0.90	2454.7	394.8	136.9

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				lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
29	1572.248	04/12/2022 12:15	Outer lane_RHS	100	500	40	160	290	450	1599.0	189.1	156.4	0.86	1380.7	164.1	134.1
30	1572.087	03/12/2022 14:38	Inner lane_RHS	100	500	40	160	290	450	1381.2	186.4	160.0	0.90	1239.1	161.6	136.9
31	1572.004	04/12/2022 12:16	Outer lane_RHS	100	500	40	160	290	450	2986.8	498.0	158.5	0.86	2579.0	394.8	135.7
32	1571.273	04/12/2022 12:18	Outer lane_RHS	100	500	40	160	290	450	2938.4	492.6	159.5	0.86	2537.2	391.3	136.5
33	1571.097	03/12/2022 14:41	Inner lane_RHS	100	500	40	160	290	450	2927.4	498.8	159.8	0.90	2626.3	395.3	136.8
34	1571.043	04/12/2022 12:20	Outer lane_RHS	100	500	40	160	290	450	2986.8	498.8	159.8	0.86	2579.0	395.3	136.8
35	1570.749	04/12/2022 12:21	Outer lane_RHS	100	500	40	160	290	450	2975.8	430.4	131.7	0.86	2569.5	350.5	113.9
36	1570.604	03/12/2022 14:43	Inner lane_RHS	100	500	40	160	290	450	1423.0	433.1	160.0	0.90	1276.6	352.3	136.9
37	1570.243	04/12/2022 12:23	Outer lane_RHS	100	500	40	160	290	450	2978.0	496.9	148.5	0.86	2571.4	394.1	127.7
38	1570.085	03/12/2022 14:44	Inner lane_RHS	100	500	40	160	290	450	2989.0	491.0	159.2	0.90	2681.5	390.3	136.3
39	1570.030	04/12/2022 12:24	Outer lane_RHS	100	500	40	160	290	450	2511.7	418.3	140.9	0.86	2168.8	342.3	121.5
40	1569.743	04/12/2022 12:25	Outer lane_RHS	100	500	40	160	290	450	2173.0	166.5	144.0	0.86	1876.3	142.9	124.0
41	1569.606	03/12/2022 14:46	Inner lane_RHS	100	500	40	160	290	450	2335.8	497.7	160.0	0.90	2095.5	394.6	136.9
42	1569.252	04/12/2022 12:27	Outer lane_RHS	100	500	40	160	290	450	2993.4	493.4	159.9	0.86	2584.7	391.9	136.9
43	1569.104	03/12/2022 14:47	Inner lane_RHS	100	500	40	160	290	450	1317.4	154.7	134.0	0.90	1181.9	131.4	115.8
44	1569.000	04/12/2022 12:28	Outer lane_RHS	100	500	40	160	290	450	1898.1	489.8	160.0	0.86	1639.0	389.5	136.9
45	1568.752	04/12/2022 12:29	Outer lane_RHS	100	500	40	160	290	450	864.4	419.8	160.0	0.86	746.4	343.4	136.9
46	1568.591	03/12/2022 14:49	Inner lane_RHS	100	500	40	160	290	450	761.0	345.2	160.0	0.90	682.7	290.8	136.9
47	1568.255	04/12/2022 12:31	Outer lane_RHS	100	500	40	160	290	450	864.4	419.8	160.0	0.86	746.4	343.4	136.9
48	1568.094	03/12/2022 14:51	Inner lane_RHS	100	500	40	160	290	450	761.0	345.2	160.0	0.90	682.7	290.8	136.9
49	1568.038	04/12/2022 12:32	Outer lane_RHS	100	500	40	160	290	450	1768.3	469.9	159.9	0.86	1526.9	376.7	136.9
50	1567.754	04/12/2022 12:33	Outer lane_RHS	100	500	40	160	290	450	1898.1	489.8	160.0	0.86	1639.0	389.5	136.9
51	1567.594	03/12/2022 14:53	Inner lane_RHS	100	500	40	160	290	450	954.5	243.1	159.9	0.90	856.3	211.3	136.9
52	1567.232	04/12/2022 12:35	Outer lane_RHS	100	500	40	160	290	450	2153.2	496.1	159.9	0.86	1859.2	393.6	136.9
53	1567.063	03/12/2022 14:55	Inner lane_RHS	100	500	40	160	290	450	1398.8	497.7	159.8	0.90	1254.9	394.6	136.8
54	1566.927	04/12/2022 12:36	Outer lane_RHS	100	500	40	160	290	450	1387.8	287.3	159.9	0.86	1198.3	247.0	136.9
55	1566.752	04/12/2022 12:37	Outer lane_RHS	100	500	40	160	290	450	1616.6	338.5	139.5	0.86	1395.9	285.9	120.4
56	1566.602	03/12/2022 14:56	Inner lane_RHS	100	500	40	160	290	450	2485.3	367.1	136.7	0.90	2229.7	306.6	118.0

S.No	Chainage (km)	Date & Time	Lane	Granual E Modulli (Mpa)		Subgrade E Modulli (Mpa)		Crust Thickness (mm)		Field Moduli (Mpa)			Lemda	Field Moduli After Temp. & Winter Seasonal Correction		
				lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
57	1566.257	04/12/2022 12:39	Outer lane_RHS	100	500	40	160	290	450	2949.4	497.7	160.0	0.86	2546.7	394.6	136.9
58	1566.082	03/12/2022 14:58	Inner lane_RHS	100	500	40	160	290	450	2942.8	496.1	159.6	0.90	2640.1	393.6	136.6
59	1566.022	04/12/2022 12:40	Outer lane_RHS	100	500	40	160	290	450	3000.0	495.7	160.0	0.86	2590.4	393.3	136.9
60	1565.751	04/12/2022 12:42	Outer lane_RHS	100	500	40	160	290	450	2982.4	488.3	160.0	0.86	2575.2	388.6	136.9
61	1565.526	03/12/2022 15:00	Inner lane_RHS	100	500	40	160	290	450	1741.9	454.3	159.9	0.90	1562.7	366.5	136.9
62	1565.264	04/12/2022 12:43	Outer lane_RHS	100	500	40	160	290	450	2997.8	492.6	159.5	0.86	2588.5	391.3	136.5
63	1565.074	03/12/2022 15:02	Inner lane_RHS	100	500	40	160	290	450	1821.1	421.4	160.0	0.90	1633.8	344.5	136.9
64	1565.008	04/12/2022 13:27	Outer lane_RHS	100	500	40	160	290	450	2311.6	493.7	160.0	0.86	1996.0	392.0	136.9
65	1564.753	04/12/2022 13:28	Outer lane_RHS	100	500	40	160	300	450	1735.3	259.1	124.2	0.85	1467.1	224.5	107.6
66	1564.614	03/12/2022 15:04	Inner lane_RHS	100	500	40	160	300	450	1108.5	127.8	152.6	0.89	986.0	103.8	131.0
67	1563.842	04/12/2022 13:31	Outer lane_RHS	100	500	40	160	300	450	1315.2	141.4	124.5	0.85	1112.0	118.0	107.9
68	1563.615	03/12/2022 15:06	Inner lane_RHS	100	500	40	160	300	450	2329.2	493.7	100.2	0.89	2071.9	392.0	86.8
69	1563.259	04/12/2022 13:33	Outer lane_RHS	100	500	40	160	300	450	2973.6	498.8	159.8	0.85	2514.1	395.3	136.8
70	1563.090	03/12/2022 15:08	Inner lane_RHS	100	500	40	160	300	450	2951.6	406.9	103.8	0.89	2625.5	334.5	90.0
71	1563.006	04/12/2022 13:34	Outer lane_RHS	100	500	40	160	300	450	3000.0	491.4	151.3	0.85	2536.4	390.6	130.0
72	1562.754	04/12/2022 13:36	Outer lane_RHS	100	500	40	160	300	450	2982.4	499.2	159.4	0.85	2521.5	395.6	136.5
73	1562.604	03/12/2022 15:09	Inner lane_RHS	100	500	40	160	300	450	1851.9	496.9	160.0	0.89	1647.3	394.1	136.9
74	1562.237	04/12/2022 13:37	Outer lane_RHS	100	500	40	160	300	450	2995.6	500.0	159.8	0.85	2532.7	396.1	136.8
75	1562.085	03/12/2022 15:11	Inner lane_RHS	100	500	40	160	300	450	2949.4	496.5	159.8	0.89	2623.5	393.8	136.8
76	1562.030	04/12/2022 13:38	Outer lane_RHS	100	500	40	160	300	450	2951.6	498.4	159.9	0.85	2495.5	395.0	136.9
77	1561.737	04/12/2022 13:39	Outer lane_RHS	100	500	40	160	300	450	2964.8	495.3	159.8	0.85	2506.6	393.1	136.8
78	1561.609	03/12/2022 15:13	Inner lane_RHS	100	500	40	160	300	450	2938.4	496.5	159.5	0.85	2505.3	393.8	136.5
79	1561.256	04/12/2022 13:41	Outer lane_RHS	100	500	40	160	300	450	2956.0	499.6	159.9	0.85	2499.2	395.8	136.9
80	1561.097	03/12/2022 15:14	Inner lane_RHS	100	500	40	160	300	450	2980.2	497.3	160.0	0.85	2541.0	394.3	136.9
81	1561.027	04/12/2022 13:43	Outer lane_RHS	100	500	40	160	300	450	2982.4	498.4	159.9	0.85	2521.5	395.0	136.9
82	1560.737	04/12/2022 13:44	Outer lane_RHS	100	500	40	160	300	450	2890.0	497.7	159.8	0.85	2443.4	394.6	136.8
83	1560.618	03/12/2022 15:16	Inner lane_RHS	100	500	40	160	300	450	2931.8	499.2	159.6	0.85	2499.7	395.6	136.6
84	1560.250	04/12/2022 13:46	Outer lane_RHS	100	500	40	160	300	450	2993.4	489.8	159.9	0.85	2530.8	389.5	136.9

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				lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
85	1560.112	03/12/2022 15:17	Inner lane_RHS	100	500	40	160	300	450	1539.6	273.2	157.3	0.85	1312.7	235.9	134.8
86	1560.021	04/12/2022 13:47	Outer lane_RHS	100	500	40	160	300	450	2914.2	499.6	159.9	0.85	2463.8	395.8	136.9
87	1559.603	03/12/2022 15:19	Inner lane_RHS	100	500	40	160	300	450	1836.5	270.1	134.9	0.85	1565.8	233.4	116.6
88	1559.247	04/12/2022 13:49	Outer lane_RHS	100	500	40	160	300	450	2997.8	482.0	150.1	0.85	2534.5	384.5	129.0
89	1559.095	03/12/2022 15:21	Inner lane_RHS	100	500	40	160	300	450	2991.2	487.9	159.8	0.85	2550.3	388.3	136.8
90	1559.033	04/12/2022 13:50	Outer lane_RHS	100	500	40	160	300	450	2997.8	492.6	159.5	0.85	2534.5	391.3	136.5
91	1558.751	04/12/2022 13:52	Outer lane_RHS	100	500	40	160	300	450	1968.5	453.5	160.0	0.90	1781.2	365.9	136.9
92	1558.604	03/12/2022 15:22	Inner lane_RHS	100	500	40	160	300	450	1968.5	495.3	159.9	0.87	1721.5	393.1	136.9
93	1558.256	04/12/2022 13:53	Outer lane_RHS	100	500	40	160	300	450	1643.0	164.1	156.5	0.90	1486.7	140.6	134.1
94	1558.107	03/12/2022 15:24	Inner lane_RHS	100	500	40	160	300	450	1438.4	237.6	145.1	0.87	1257.9	206.7	124.9
95	1558.055	04/12/2022 13:54	Outer lane_RHS	100	500	40	160	300	450	1955.3	327.2	136.2	0.90	1769.2	277.5	117.6
96	1557.737	04/12/2022 13:56	Outer lane_RHS	100	500	40	160	300	450	2771.3	500.0	160.0	0.90	2507.6	396.1	136.9
97	1557.594	03/12/2022 15:26	Inner lane_RHS	100	500	40	160	300	450	1561.6	209.5	159.6	0.87	1365.6	182.5	136.6
98	1557.248	04/12/2022 13:57	Outer lane_RHS	100	500	40	160	300	450	1741.9	197.8	134.2	0.90	1576.1	172.0	116.0
99	1557.098	03/12/2022 15:27	Inner lane_RHS	100	500	40	160	300	450	1464.8	497.3	159.8	0.87	1281.0	394.3	136.8
100	1557.000	04/12/2022 13:59	Outer lane_RHS	100	500	40	160	300	450	2302.8	499.6	160.0	0.90	2083.7	395.8	136.9
101	1556.739	04/12/2022 14:00	Outer lane_RHS	100	500	40	160	300	450	2027.9	261.1	157.1	0.90	1834.9	226.1	134.6
102	1556.602	03/12/2022 15:29	Inner lane_RHS	100	500	40	160	300	450	2949.4	487.1	160.0	0.87	2579.3	387.8	136.9
103	1556.223	04/12/2022 14:02	Outer lane_RHS	100	500	40	160	300	450	1671.6	492.2	160.0	0.90	1512.5	391.1	136.9
104	1556.094	03/12/2022 15:31	Inner lane_RHS	100	500	40	160	300	450	1603.4	237.2	115.0	0.87	1402.2	206.3	99.8
105	1555.928	04/12/2022 14:03	Outer lane_RHS	100	500	40	160	270	460	1376.8	500.0	115.0	0.90	1245.8	396.1	99.8
106	1555.692	04/12/2022 14:04	Outer lane_RHS	100	500	40	160	270	460	1378.8	498.9	113.0	0.90	1247.6	395.4	98.0
107	1555.605	03/12/2022 15:32	Inner lane_RHS	100	500	40	160	270	460	2575.5	315.4	158.1	0.87	2252.3	268.6	135.4
108	1555.255	04/12/2022 14:06	Outer lane_RHS	100	500	40	160	270	460	2439.1	493.4	160.0	0.90	2207.0	391.9	136.9
109	1555.097	03/12/2022 15:34	Inner lane_RHS	100	500	40	160	270	460	2870.2	488.3	159.9	0.87	2510.0	388.6	136.9
110	1555.007	04/12/2022 14:07	Outer lane_RHS	100	500	40	160	270	460	1401.0	487.5	160.0	0.90	1267.7	388.1	136.9
111	1554.793	04/12/2022 14:08	Outer lane_RHS	100	500	40	160	270	460	1568.2	368.2	158.5	0.90	1419.0	307.4	135.7
112	1554.247	04/12/2022 14:10	Outer lane_RHS	100	500	40	160	270	460	2861.4	494.5	160.0	0.90	2589.1	392.6	136.9

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				lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
113	1554.111	03/12/2022 15:37	Inner lane_RHS	100	500	40	160	270	460	1902.5	405.0	159.9	0.87	1663.8	333.2	136.9
114	1554.004	04/12/2022 14:11	Outer lane_RHS	100	500	40	160	270	460	1733.1	226.7	159.8	0.90	1568.2	197.4	136.8
115	1553.750	04/12/2022 14:12	Outer lane_RHS	100	500	40	160	270	460	2923.0	500.0	159.6	0.90	2644.8	396.1	136.6
116	1553.604	03/12/2022 15:39	Inner lane_RHS	100	500	40	160	270	460	2780.1	499.2	160.0	0.87	2431.2	395.6	136.9
117	1553.252	04/12/2022 14:14	Outer lane_RHS	100	500	40	160	270	460	2606.3	214.6	159.8	0.90	2358.3	186.9	136.8
118	1553.104	03/12/2022 15:41	Inner lane_RHS	100	500	40	160	270	460	1260.3	457.4	160.0	0.87	1102.2	368.5	136.9
119	1553.026	04/12/2022 14:15	Outer lane_RHS	100	500	40	160	270	460	2630.5	498.8	160.0	0.90	2380.2	395.3	136.9
120	1552.753	04/12/2022 14:16	Outer lane_RHS	100	500	40	160	270	460	2978.0	167.6	155.1	0.90	2694.6	143.9	133.0
121	1552.599	03/12/2022 15:42	Inner lane_RHS	100	500	40	160	270	460	1942.1	499.2	160.0	0.87	1698.4	395.6	136.9
122	1552.230	04/12/2022 14:18	Outer lane_RHS	100	500	40	160	270	460	2940.6	497.3	159.8	0.90	2660.8	394.3	136.8
123	1552.102	03/12/2022 15:44	Inner lane_RHS	100	500	40	160	270	460	2487.5	231.0	126.0	0.87	2175.4	201.1	109.1
124	1552.069	04/12/2022 14:19	Outer lane_RHS	100	500	40	160	270	460	1939.9	493.0	160.0	0.90	1755.3	391.6	136.9
125	1551.727	04/12/2022 14:21	Outer lane_RHS	100	500	40	160	270	460	2975.8	499.2	159.9	0.90	2692.6	395.6	136.9
126	1551.600	03/12/2022 15:46	Inner lane_RHS	100	500	40	160	270	460	1792.5	496.1	160.0	0.87	1567.6	393.6	136.9
127	1551.270	04/12/2022 14:22	Outer lane_RHS	100	500	40	160	270	460	1704.5	291.6	160.0	0.90	1542.3	250.4	136.9
128	1551.263	03/12/2022 15:48	Inner lane_RHS	100	500	40	160	270	460	2782.3	491.0	160.0	0.87	2433.2	390.3	136.9
129	1550.232	04/12/2022 14:25	Outer lane_RHS	100	500	40	160	270	460	2630.5	499.2	157.3	0.90	2380.2	395.6	134.8
130	1550.101	03/12/2022 15:50	Inner lane_RHS	100	500	40	160	270	460	2905.4	498.8	159.8	0.87	2540.8	395.3	136.8
131	1550.031	04/12/2022 14:26	Outer lane_RHS	100	500	40	160	270	460	2964.8	492.6	160.0	0.90	2682.7	391.3	136.9
132	1549.745	04/12/2022 14:28	Outer lane_RHS	100	500	40	160	270	460	2859.2	498.0	160.0	0.90	2587.1	394.8	136.9
133	1549.597	03/12/2022 15:52	Inner lane_RHS	100	500	40	160	270	460	1236.1	308.8	148.4	0.87	1081.0	263.6	127.6
134	1549.245	04/12/2022 14:30	Outer lane_RHS	100	500	40	160	270	460	2907.6	500.0	159.8	0.90	2630.9	396.1	136.8
135	1549.080	03/12/2022 15:53	Inner lane_RHS	100	500	40	160	270	460	2311.6	499.2	124.3	0.87	2021.5	395.6	107.7
136	1549.038	04/12/2022 14:31	Outer lane_RHS	100	500	40	160	270	460	2960.4	498.8	158.7	0.90	2678.7	395.3	135.9
137	1548.745	04/12/2022 14:32	Outer lane_RHS	100	500	40	160	270	460	2953.8	495.3	159.8	0.90	2672.7	393.1	136.8
138	1548.604	03/12/2022 15:55	Inner lane_RHS	100	500	40	160	270	460	2865.8	496.9	123.8	0.87	2506.2	394.1	107.3
139	1548.232	04/12/2022 14:34	Outer lane_RHS	100	500	40	160	270	460	2995.6	496.5	159.6	0.90	2710.5	393.8	136.6
140	1548.093	03/12/2022 15:57	Inner lane_RHS	100	500	40	160	270	460	2964.8	499.6	160.0	0.87	2592.8	395.8	136.9

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				lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
141	1548.034	04/12/2022 14:35	Outer lane_RHS	100	500	40	160	270	460	3000.0	335.0	117.0	0.90	2714.5	283.3	101.5
142	1547.751	04/12/2022 14:36	Outer lane_RHS	100	500	40	160	270	460	2997.8	493.7	159.5	0.90	2712.5	392.0	136.5
143	1547.604	03/12/2022 15:58	Inner lane_RHS	100	500	40	160	270	460	2993.4	500.0	139.5	0.87	2617.8	396.1	120.4
144	1547.249	04/12/2022 14:38	Outer lane_RHS	100	500	40	160	270	460	2978.0	498.4	159.4	0.90	2694.6	395.0	136.5
145	1547.102	03/12/2022 16:00	Inner lane_RHS	100	500	40	160	270	460	2395.2	498.4	122.2	0.87	2094.6	395.0	105.9
146	1546.984	04/12/2022 14:39	Outer lane_RHS	100	500	40	160	270	460	2975.8	498.8	157.7	0.90	2692.6	395.3	135.1
147	1546.727	04/12/2022 14:41	Outer lane_RHS	100	500	40	160	270	460	2993.4	494.5	160.0	0.90	2708.5	392.6	136.9
148	1546.602	03/12/2022 16:02	Inner lane_RHS	100	500	40	160	270	460	2698.7	498.8	113.7	0.87	2360.1	395.3	98.6
149	1546.255	04/12/2022 14:42	Outer lane_RHS	100	500	40	160	270	460	2984.6	497.7	160.0	0.90	2700.6	394.6	136.9
150	1546.089	03/12/2022 16:03	Inner lane_RHS	100	500	40	160	270	460	2936.2	498.0	159.9	0.87	2567.8	394.8	136.9
151	1546.041	04/12/2022 14:44	Outer lane_RHS	100	500	40	160	270	460	2934.0	496.9	159.9	0.90	2654.8	394.1	136.9
152	1545.753	04/12/2022 14:45	Outer lane_RHS	100	500	40	160	270	460	3000.0	496.1	152.4	0.90	2714.5	393.6	130.9
153	1545.603	03/12/2022 16:05	Inner lane_RHS	100	500	40	160	270	460	904.0	116.0	99.1	0.87	790.6	91.1	85.9
154	1545.254	04/12/2022 14:47	Outer lane_RHS	100	500	40	160	270	460	2993.4	493.7	134.4	0.90	2708.5	392.0	116.1
155	1545.086	03/12/2022 16:06	Inner lane_RHS	100	500	40	160	270	460	2590.9	476.9	100.2	0.87	2265.8	381.2	86.8
156	1545.033	04/12/2022 14:48	Outer lane_RHS	100	500	40	160	270	460	2826.2	499.6	100.2	0.85	2389.4	395.8	86.8
157	1544.738	04/12/2022 14:49	Outer lane_RHS	100	500	40	160	270	460	2329.2	214.6	160.0	0.85	1969.2	186.9	136.9
158	1544.586	03/12/2022 16:08	Inner lane_RHS	100	500	40	160	270	460	2406.2	499.2	160.0	0.87	2104.3	395.6	136.9
159	1544.215	04/12/2022 14:51	Outer lane_RHS	100	500	40	160	270	460	1825.5	333.0	160.0	0.85	1543.4	281.8	136.9
160	1544.063	03/12/2022 16:10	Inner lane_RHS	100	500	40	160	270	460	1821.1	368.6	160.0	0.87	1592.6	307.7	136.9
161	1544.045	04/12/2022 14:52	Outer lane_RHS	100	500	40	160	270	460	2929.6	491.0	160.0	0.85	2476.9	390.3	136.9
162	1543.744	04/12/2022 14:54	Outer lane_RHS	100	500	40	160	270	450	1607.8	447.6	160.0	0.85	1359.3	362.0	136.9
163	1543.603	03/12/2022 16:11	Inner lane_RHS	100	500	40	160	270	450	2991.2	497.3	159.8	0.87	2615.9	394.3	136.8
164	1543.257	04/12/2022 14:55	Outer lane_RHS	100	500	40	160	270	450	2980.2	499.6	158.7	0.85	2519.6	395.8	135.9
165	1543.098	03/12/2022 16:13	Inner lane_RHS	100	500	40	160	270	450	2929.6	498.8	159.9	0.87	2562.0	395.3	136.9
166	1543.050	04/12/2022 14:57	Outer lane_RHS	100	500	40	160	270	450	2993.4	499.6	159.4	0.85	2530.8	395.8	136.5
167	1542.652	04/12/2022 14:58	Outer lane_RHS	100	500	40	160	270	450	2993.4	497.3	160.0	0.85	2530.8	394.3	136.9
168	1542.600	03/12/2022 16:14	Inner lane_RHS	100	500	40	160	270	450	2947.2	496.9	159.9	0.87	2577.4	394.1	136.9

S.No	Chainage (km)	Date & Time	Lane	Granual E Modulli (Mpa)		Subgrade E Modulli (Mpa)		Crust Thickness (mm)		Field Moduli (Mpa)			Lemda	Field Moduli After Temp. & Winter Seasonal Correction		
				lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
169	1542.256	04/12/2022 15:00	Outer lane_RHS	100	500	40	160	270	450	2819.6	492.6	133.0	0.85	2383.9	391.3	115.0
170	1542.090	03/12/2022 16:16	Inner lane_RHS	100	500	40	160	270	450	1977.3	491.8	159.9	0.87	1729.2	390.8	136.9
171	1541.981	04/12/2022 15:01	Outer lane_RHS	100	500	40	160	270	450	1526.4	346.3	121.5	0.85	1290.5	291.6	105.3
172	1541.614	03/12/2022 16:17	Inner lane_RHS	100	500	40	160	270	450	1005.1	158.7	97.9	0.87	879.0	135.3	84.8
173	1541.601	04/12/2022 15:02	Outer lane_RHS	100	500	40	160	270	450	2595.3	347.9	105.6	0.85	2194.2	292.8	91.6
174	1540.513	03/12/2022 16:20	Inner lane_RHS	100	500	40	160	270	450	2995.6	500.0	159.3	0.87	2619.7	396.1	136.4
175	1540.247	04/12/2022 15:06	Outer lane_RHS	100	500	40	160	270	450	1489.0	213.8	100.2	0.85	1258.9	186.2	86.8
176	1540.108	03/12/2022 16:22	Inner lane_RHS	100	500	40	160	270	450	2542.5	495.7	159.6	0.87	2223.5	393.3	136.6
177	1539.189	04/12/2022 15:09	Outer lane_RHS	100	500	40	160	270	450	1152.5	492.2	160.0	0.85	974.4	391.1	136.9
178	1539.087	03/12/2022 16:25	Inner lane_RHS	100	500	40	160	270	450	818.2	320.5	159.8	0.87	715.5	272.5	136.8
179	1539.000	04/12/2022 15:10	Outer lane_RHS	100	500	40	160	270	450	1436.2	366.3	116.8	0.85	1214.3	306.1	101.3
180	1538.685	04/12/2022 15:12	Outer lane_RHS	100	500	40	160	270	450	840.2	150.0	159.6	0.85	710.4	126.7	136.6
181	1538.600	03/12/2022 16:26	Inner lane_RHS	100	500	40	160	270	450	802.8	125.0	138.2	0.87	702.1	100.8	119.3
182	1538.259	04/12/2022 15:14	Outer lane_RHS	100	500	40	160	270	450	2973.6	496.9	160.0	0.85	2514.1	394.1	136.9
183	1538.063	03/12/2022 16:28	Inner lane_RHS	100	500	40	160	270	450	2126.8	254.1	102.5	0.87	1859.9	220.4	88.9
184	1538.031	04/12/2022 15:15	Outer lane_RHS	100	500	40	160	270	450	2995.6	496.9	159.6	0.85	2532.7	394.1	136.6
185	1537.691	04/12/2022 15:16	Outer lane_RHS	100	500	40	160	270	450	2953.8	498.8	159.9	0.85	2497.3	395.3	136.9
186	1537.625	03/12/2022 16:30	Inner lane_RHS	100	500	40	160	270	450	2584.3	455.8	145.9	0.87	2260.0	367.5	125.6
187	1537.242	04/12/2022 15:18	Outer lane_RHS	100	500	40	160	270	450	2678.9	274.0	123.6	0.85	2264.9	236.5	107.1
188	1537.100	03/12/2022 16:32	Inner lane_RHS	100	500	40	160	270	450	2986.8	396.4	157.0	0.87	2612.0	327.3	134.5
189	1536.955	04/12/2022 15:20	Outer lane_RHS	100	500	40	160	270	450	2995.6	499.6	118.8	0.85	2532.7	395.8	103.0
190	1536.731	04/12/2022 15:21	Outer lane_RHS	100	500	40	160	270	450	2991.2	497.7	159.9	0.85	2528.9	394.6	136.9
191	1536.577	03/12/2022 16:33	Inner lane_RHS	100	500	40	160	270	450	2434.8	499.2	131.7	0.87	2129.3	395.6	113.9
192	1536.251	04/12/2022 15:23	Outer lane_RHS	100	500	40	160	270	450	2982.4	494.9	107.7	0.85	2521.5	392.8	93.4
193	1536.106	03/12/2022 16:35	Inner lane_RHS	100	500	40	160	270	450	2982.4	500.0	131.6	0.87	2608.2	396.1	113.8
194	1536.000	04/12/2022 15:24	Outer lane_RHS	100	500	40	160	270	450	2984.6	491.0	160.0	0.85	2523.4	390.3	136.9
195	1535.752	02/12/2022 15:38	Outer lane_RHS	100	500	40	160	270	450	2956.0	496.5	159.6	0.89	2640.6	393.8	136.6
196	1535.736	04/12/2022 15:25	Outer lane_RHS	100	500	40	160	270	450	2971.4	499.2	160.0	0.85	2512.2	395.6	136.9

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				lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
197	1535.596	03/12/2022 16:37	Inner lane_RHS	100	500	40	160	270	450	1746.3	322.1	125.7	0.85	1488.9	273.7	108.9
198	1535.250	02/12/2022 15:40	Outer lane_RHS	100	500	40	160	270	450	2975.8	494.1	159.5	0.89	2658.3	392.3	136.5
199	1535.090	03/12/2022 16:38	Inner lane_RHS	100	500	40	160	270	450	2995.6	498.4	159.9	0.85	2554.1	395.0	136.9
200	1535.001	02/12/2022 15:41	Outer lane_RHS	100	500	40	160	270	450	2938.4	500.0	159.4	0.89	2624.9	396.1	136.5
201	1534.754	02/12/2022 15:43	Outer lane_RHS	100	500	40	160	270	450	2975.8	498.4	160.0	0.89	2658.3	395.0	136.9
202	1534.666	03/12/2022 16:40	Inner lane_RHS	100	500	40	160	270	450	1884.9	246.2	111.8	0.85	1607.1	213.9	97.0
203	1534.248	02/12/2022 15:44	Outer lane_RHS	100	500	40	160	270	450	2986.8	499.2	159.9	0.89	2668.2	395.6	136.9
204	1533.995	02/12/2022 15:46	Outer lane_RHS	100	500	40	160	270	450	2975.8	494.5	159.8	0.89	2658.3	392.6	136.8
205	1533.992	03/12/2022 16:46	Inner lane_RHS	100	500	40	160	270	450	2617.3	386.6	121.8	0.85	2231.5	320.5	105.6
206	1533.722	02/12/2022 15:47	Outer lane_RHS	100	500	40	160	270	450	2907.6	492.2	160.0	0.89	2597.4	391.1	136.9
207	1533.620	03/12/2022 16:47	Inner lane_RHS	100	500	40	160	270	450	2945.0	496.5	159.5	0.85	2510.9	393.8	136.5
208	1533.258	02/12/2022 15:49	Outer lane_RHS	100	500	40	160	270	450	2984.6	494.1	159.9	0.89	2666.2	392.3	136.9
209	1533.101	03/12/2022 16:49	Inner lane_RHS	100	500	40	160	270	450	1596.8	448.0	153.8	0.85	1361.4	362.3	132.0
210	1532.999	02/12/2022 15:50	Outer lane_RHS	100	500	40	160	270	450	2949.4	497.7	160.0	0.89	2634.7	394.6	136.9
211	1532.745	02/12/2022 15:51	Outer lane_RHS	100	500	40	160	270	450	2971.4	497.7	160.0	0.89	2654.4	394.6	136.9
212	1532.603	03/12/2022 16:50	Inner lane_RHS	100	500	40	160	270	450	2052.1	227.5	116.6	0.85	1749.6	198.1	101.1
213	1532.202	02/12/2022 15:53	Outer lane_RHS	100	500	40	160	270	450	2995.6	497.3	153.7	0.89	2676.0	394.3	131.9
214	1532.094	03/12/2022 16:52	Inner lane_RHS	100	500	40	160	270	450	1865.1	475.0	154.4	0.85	1590.2	380.0	132.5
215	1531.999	02/12/2022 15:54	Outer lane_RHS	100	500	40	160	270	450	2989.0	496.5	157.9	0.89	2670.1	393.8	135.3
216	1531.701	02/12/2022 15:56	Outer lane_RHS	100	500	40	160	270	450	2969.2	494.5	160.0	0.89	2652.4	392.6	136.9
217	1531.609	03/12/2022 16:53	Inner lane_RHS	100	500	40	160	270	450	1766.1	227.9	112.4	0.85	1505.8	198.4	97.5
218	1531.178	02/12/2022 15:57	Outer lane_RHS	100	500	40	160	270	450	2978.0	497.7	159.6	0.89	2660.3	394.6	136.6
219	1531.089	03/12/2022 16:55	Inner lane_RHS	100	500	40	160	270	450	1484.6	491.4	143.1	0.85	1265.8	390.6	123.3
220	1531.003	02/12/2022 15:58	Outer lane_RHS	100	500	40	160	270	450	1482.4	409.7	160.0	0.89	1324.2	336.5	136.9
221	1530.752	02/12/2022 15:59	Outer lane_RHS	100	500	40	160	270	450	2951.6	498.8	159.8	0.89	2636.7	395.3	136.8
222	1530.611	03/12/2022 16:57	Inner lane_RHS	100	500	40	160	270	450	2938.4	495.7	160.0	0.85	2505.3	393.3	136.9
223	1530.248	02/12/2022 16:01	Outer lane_RHS	100	500	40	160	270	450	2925.2	498.0	159.9	0.89	2602.0	394.8	136.9
224	1530.105	03/12/2022 16:58	Inner lane_RHS	100	500	40	160	270	450	2929.6	498.8	159.6	0.85	2497.8	395.3	136.6

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				lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
225	1529.994	02/12/2022 16:02	Outer lane_RHS	100	500	40	160	260	420	2964.8	494.9	159.8	0.89	2637.2	392.8	136.8
226	1529.730	02/12/2022 16:04	Outer lane_RHS	100	500	40	160	260	420	2659.1	495.7	129.3	0.89	2365.3	393.3	111.9
227	1529.601	03/12/2022 17:00	Inner lane_RHS	100	500	40	160	260	420	2129.0	360.8	96.2	0.85	1815.2	302.1	83.3
228	1529.250	02/12/2022 16:06	Outer lane_RHS	100	500	40	160	260	420	2929.6	498.4	159.9	0.89	2605.9	395.0	136.9
229	1529.101	03/12/2022 17:01	Inner lane_RHS	100	500	40	160	260	420	3000.0	390.1	137.2	0.85	2557.8	322.9	118.5
230	1529.014	02/12/2022 16:07	Outer lane_RHS	100	500	40	160	260	420	2997.8	492.6	159.5	0.89	2666.6	391.3	136.5
231	1528.746	02/12/2022 16:08	Outer lane_RHS	100	500	40	160	260	420	2984.6	498.8	159.9	0.89	2654.8	395.3	136.9
232	1528.601	03/12/2022 17:03	Inner lane_RHS	100	500	40	160	260	420	2982.4	498.8	145.5	0.85	2542.8	395.3	125.3
233	1528.245	02/12/2022 16:10	Outer lane_RHS	100	500	40	160	260	420	1614.4	287.3	116.8	0.89	1436.0	247.0	101.3
234	1528.100	03/12/2022 17:05	Inner lane_RHS	100	500	40	160	260	420	1513.2	333.8	110.0	0.85	1290.2	282.4	95.4
235	1528.019	02/12/2022 16:11	Outer lane_RHS	100	500	40	160	260	420	2122.4	431.2	150.1	0.89	1887.9	351.1	129.0
236	1527.746	02/12/2022 16:12	Outer lane_RHS	100	500	40	160	260	420	1623.2	226.7	122.7	0.89	1443.9	197.4	106.3
237	1527.603	03/12/2022 17:06	Inner lane_RHS	100	500	40	160	260	420	1247.1	137.1	89.5	0.85	1063.3	113.6	77.2
238	1527.246	02/12/2022 16:13	Outer lane_RHS	100	500	40	160	260	420	2989.0	497.3	159.6	0.89	2658.8	394.3	136.6
239	1527.084	03/12/2022 17:08	Inner lane_RHS	100	500	40	160	260	420	1317.4	130.5	143.7	0.85	1123.2	106.7	123.8
240	1527.026	02/12/2022 16:14	Outer lane_RHS	100	500	40	160	260	420	2412.8	396.0	120.9	0.89	2146.2	327.0	104.8
241	1526.754	02/12/2022 16:16	Outer lane_RHS	100	500	40	160	260	420	2566.7	329.9	116.1	0.89	2283.1	279.5	100.7
242	1526.610	03/12/2022 17:10	Inner lane_RHS	100	500	40	160	260	420	2102.6	343.6	126.7	0.85	1792.7	289.6	109.7
243	1526.221	02/12/2022 16:17	Outer lane_RHS	100	500	40	160	260	420	1086.5	161.8	108.0	0.89	966.5	138.3	93.7
244	1526.106	03/12/2022 17:11	Inner lane_RHS	100	500	40	160	260	420	2973.6	496.9	159.4	0.85	2535.3	394.1	136.5
245	1526.016	02/12/2022 16:18	Outer lane_RHS	100	500	40	160	260	420	2903.2	500.0	159.9	0.89	2582.4	396.1	136.9
246	1525.669	02/12/2022 16:19	Outer lane_RHS	100	500	40	160	260	420	2918.6	499.2	160.0	0.89	2596.1	395.6	136.9
247	1525.607	03/12/2022 17:13	Inner lane_RHS	100	500	40	160	260	420	1306.5	293.5	145.8	0.85	1113.9	251.9	125.5
248	1525.265	02/12/2022 16:21	Outer lane_RHS	100	500	40	160	260	420	2885.6	500.0	160.0	0.89	2566.8	396.1	136.9
249	1525.090	03/12/2022 17:14	Inner lane_RHS	100	500	40	160	260	420	1898.1	315.8	131.4	0.85	1618.3	269.0	113.6
250	1525.025	02/12/2022 16:22	Outer lane_RHS	100	500	40	160	260	420	2997.8	492.6	159.5	0.89	2666.6	391.3	136.5
251	1524.744	02/12/2022 16:25	Outer lane_RHS	100	500	40	160	260	420	2780.1	486.3	125.6	0.89	2472.9	387.3	108.8
252	1524.593	03/12/2022 17:16	Inner lane_RHS	100	500	40	160	260	420	2980.2	495.3	158.5	0.85	2541.0	393.1	135.7

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				lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
253	1524.220	02/12/2022 16:26	Outer lane_RHS	100	500	40	160	260	420	2986.8	496.1	120.6	0.89	2656.8	393.6	104.5
254	1524.110	03/12/2022 17:17	Inner lane_RHS	100	500	40	160	260	420	1194.3	194.2	96.5	0.85	1018.3	168.8	83.5
255	1523.995	02/12/2022 16:27	Outer lane_RHS	100	500	40	160	260	420	1590.2	241.2	84.5	0.89	1414.5	209.7	72.6
256	1523.739	02/12/2022 16:29	Outer lane_RHS	100	500	40	160	260	420	1060.1	148.5	107.1	0.89	943.0	125.2	92.9
257	1523.599	03/12/2022 17:19	Inner lane_RHS	100	500	40	160	260	420	1588.0	247.4	131.8	0.85	1353.9	214.9	114.0
258	1523.221	02/12/2022 16:30	Outer lane_RHS	100	500	40	160	260	420	1385.6	205.6	122.6	0.89	1232.5	179.0	106.2
259	1523.100	03/12/2022 17:21	Inner lane_RHS	100	500	40	160	260	420	1462.6	197.8	131.4	0.85	1247.0	172.0	113.6
260	1523.004	02/12/2022 16:31	Outer lane_RHS	100	500	40	160	260	420	1579.2	298.2	130.9	0.89	1404.7	255.5	113.2
261	1522.728	02/12/2022 16:33	Outer lane_RHS	100	500	40	160	260	420	2934.0	500.0	159.9	0.89	2609.8	396.1	136.9
262	1522.617	03/12/2022 17:22	Inner lane_RHS	100	500	40	160	260	420	2975.8	329.1	146.2	0.85	2537.2	278.9	125.8
263	1522.252	02/12/2022 16:35	Outer lane_RHS	100	500	40	160	260	420	2971.4	493.0	159.9	0.89	2643.1	391.6	136.9
264	1522.126	03/12/2022 17:23	Inner lane_RHS	100	500	40	160	260	420	2443.5	486.3	160.0	0.85	2083.4	387.3	136.9
265	1522.012	02/12/2022 16:36	Outer lane_RHS	100	500	40	160	260	420	2969.2	499.6	111.2	0.89	2641.1	395.8	96.5
266	1521.754	02/12/2022 16:37	Outer lane_RHS	100	500	40	160	260	420	2993.4	498.8	159.9	0.89	2662.7	395.3	136.9
267	1521.608	03/12/2022 17:25	Inner lane_RHS	100	500	40	160	260	420	2978.0	498.4	159.8	0.85	2539.1	395.0	136.8
268	1521.248	02/12/2022 16:39	Outer lane_RHS	100	500	40	160	260	420	2982.4	408.9	159.8	0.89	2652.9	335.9	136.8
269	1521.084	03/12/2022 17:26	Inner lane_RHS	100	500	40	160	260	420	2986.8	497.7	159.6	0.85	2546.6	394.6	136.6
270	1521.014	02/12/2022 16:40	Outer lane_RHS	100	500	40	160	260	420	2991.2	487.9	136.4	0.89	2660.7	388.3	117.8
271	1520.757	02/12/2022 16:41	Outer lane_RHS	100	500	40	160	260	420	1957.5	424.9	136.4	0.89	1741.2	346.8	117.8
272	1520.610	03/12/2022 17:28	Inner lane_RHS	100	500	40	160	260	420	1616.6	248.6	135.7	0.85	1378.3	215.9	117.2
273	1520.253	02/12/2022 16:44	Outer lane_RHS	100	500	40	160	260	420	2984.6	447.6	109.1	0.89	2654.8	362.0	94.7
274	1520.151	03/12/2022 17:31	Inner lane_RHS	100	500	40	160	260	420	2934.0	498.8	159.9	0.85	2501.6	395.3	136.9
275	1520.047	02/12/2022 16:45	Outer lane_RHS	100	500	40	160	260	420	2641.5	493.7	160.0	0.89	2349.7	392.0	136.9
276	1519.760	02/12/2022 16:50	Outer lane_RHS	100	500	40	160	260	420	2956.0	498.0	159.6	0.89	2629.4	394.8	136.6
277	1519.596	03/12/2022 17:35	Inner lane_RHS	100	500	40	160	260	420	2384.2	493.7	118.8	0.85	2032.8	392.0	103.0
278	1519.231	02/12/2022 16:54	Outer lane_RHS	100	500	40	160	260	420	2566.7	382.3	111.4	0.89	2283.1	317.4	96.7
279	1519.121	03/12/2022 17:36	Inner lane_RHS	100	500	40	160	260	420	2997.8	443.3	146.9	0.85	2556.0	359.2	126.4
280	1519.020	02/12/2022 16:55	Outer lane_RHS	100	500	40	160	260	420	2986.8	463.6	131.6	0.89	2656.8	372.6	113.8

S.No	Chainage (km)	Date & Time	Lane	Granual E Modulli (Mpa)		Subgrade E Modulli (Mpa)		Crust Thickness (mm)		Field Moduli (Mpa)			Lemda	Field Moduli After Temp. & Winter Seasonal Correction		
				lower Bound	Upper Bound	lower Bound	Upper Bound	Bituminous layer	Granular Layer	E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)		E1 (Bituminous Layer)	E2 (Granular Layer)	E3 (Subgrade)
281	1518.742	02/12/2022 16:56	Outer lane_RHS	100	500	40	160	260	420	2320.4	293.9	126.6	0.89	2064.0	252.2	109.6
282	1518.591	03/12/2022 17:38	Inner lane_RHS	100	500	40	160	260	420	2124.6	249.0	153.0	0.85	1811.5	216.2	131.3
283	1518.250	02/12/2022 16:58	Outer lane_RHS	100	500	40	160	260	420	3000.0	493.4	159.9	0.89	2668.5	391.9	136.9
284	1518.063	03/12/2022 17:39	Inner lane_RHS	100	500	40	160	260	420	2555.7	447.2	126.2	0.85	2179.0	361.8	109.3
285	1518.013	02/12/2022 16:59	Outer lane_RHS	100	500	40	160	260	420	2969.2	500.0	159.5	0.89	2641.1	396.1	136.5
286	1517.728	02/12/2022 17:00	Outer lane_RHS	100	500	40	160	260	420	2964.8	500.0	105.5	0.89	2637.2	396.1	91.5
287	1517.625	03/12/2022 17:41	Inner lane_RHS	100	500	40	160	260	420	2978.0	498.8	159.9	0.85	2539.1	395.3	136.9
288	1517.249	02/12/2022 17:02	Outer lane_RHS	100	500	40	160	260	420	2991.2	496.9	160.0	0.89	2660.7	394.1	136.9
289	1517.111	03/12/2022 17:42	Inner lane_RHS	100	500	40	160	260	420	2989.0	496.9	107.7	0.85	2548.5	394.1	93.4
290	1517.022	02/12/2022 17:03	Outer lane_RHS	100	500	40	160	260	420	2997.8	482.0	96.5	0.89	2666.6	384.5	83.5
291	1516.756	02/12/2022 17:05	Outer lane_RHS	100	500	40	160	260	420	2958.2	496.1	136.7	0.89	2631.4	393.6	118.0
292	1516.614	03/12/2022 17:44	Inner lane_RHS	100	500	40	160	260	420	2489.7	499.6	132.1	0.85	2122.7	395.8	114.2
293	1516.242	02/12/2022 17:06	Outer lane_RHS	100	500	40	160	260	420	2971.4	490.6	159.5	0.89	2643.1	390.1	136.5
294	1516.170	03/12/2022 17:45	Inner lane_RHS	100	500	40	160	260	420	2986.8	493.0	160.0	0.85	2546.6	391.6	136.9
295	1516.024	02/12/2022 17:07	Outer lane_RHS	100	500	40	160	260	420	2300.6	266.6	102.5	0.89	2046.4	230.6	88.9
296	1515.750	02/12/2022 17:09	Outer lane_RHS	100	500	40	160	260	420	2997.8	498.8	158.1	0.89	2666.6	395.3	135.4

Annexure – 4.8

Mobile Bridge Inspection Unit (MBIU)

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Orai-Barah Section
1	State	UP
2	Category of Road	NH
3	Road No	NH-27
4	Section	Orai-Barah
5	Location Chainage	1540800
6	Structure Number	Data not avalible
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Major bridge/ Yamuna Revier
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Kalpi
12	Year of Construction	Data not avalible
13	Overall Bridge Length	784.00 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	No
31	Overall Deck Width in m	11.00 m
32	Approach Roadway Width including Shoulders in m	7.50 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	Data not avalible
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	11
40	Maximum Span	766.60 m
41	Type of Superstructure	Box girder
42	Peir Type	RCC Counterfort wall
43	Abutment Type	RCC Coloumn
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	Not applicble
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Not applicble

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Orai-Barah Section
49	Type of Railing	Steel Hand rail
50	Corrosion Protection	No
51	Bank Protection Type	No
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	No
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	Data not avalible
62	Any other Observation/Data	No

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: ORAI-BARAH**

CHAINAGE : KM 1540+800 (RHS) **DATE OF INSPECTION: 13-12-2022**

TYPE OF STRUCTURE: MAJOR BRIDGE

STRUCTURE NO:

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Major bridge/ Yamuna Revier
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.50 m
1.6	Overall Deck width (m)	11.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	7 x 85.00 + 2 x 80.80 + 2 x 5.00 m
1.10	Total length of the bridge (m)	766.60 m
1.11	Vertical Clearance (m)	4.50 m
1.12	Whether meadian, if yes its width (m)	No
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	3.50 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	Steel Hand rail & Length - 800.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	2 x 5.00 m

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	Cracks are observed
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No damages
2.8	Approach slab (Check settlement, cracks,movement etc.)	No
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Retaining wall is in fair condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	No
2.12	Approach Geometry (Check whether it satisfies the standard in force)	No
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	No
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitching, growth of vegitation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	No
	b) For Piers	No
3.4	Bank Protection & Type	No
3.5	Floor Protection & Type	Not visible
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	No
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	Uniform. No change in flow, erosion of banks

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Not visible	
4.5	Check the adequacy of waterway	Not visible	
4.6	Check the errosion of bank	Not visible	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Well foundation	
5.2	Material	RCC	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Counterfort wall	Counterfort wall
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No cracks, settlement, sour, exposed steel	No cracks, settlement, sour, exposed steel
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No	No
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not applicable	
6.1.9	Check damage of protective coating of painting.	Not visible	

6.2	Pier	09 Nos.	
6.2.1	Type	Coloumn type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No cracks, settlement, sour, exposed steel	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not applicable	
6.2.6	Check damage of protective coating of painting.	Not visible	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not applicable	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not applicable	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	No bearings	No bearings
8.2	No. per Pier	No bearings	No bearings
8.3	Type and allowable movements	Not applicable	Not applicable
8.4	Material	Not applicable	Not applicable
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Not applicable	Not applicable
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Not applicable	Not applicable
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	11 Nos. & 7 x 85.00 + 2 x 80.80 + 2 x 5.00	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab +Box Girder	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Balance catilever
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC + PSC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	No
9.7	Check exposed reinforcement, if any	No
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	Not applicable
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	No
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Not applicable
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not applicable
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not applicable
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not applicable
9.22	Check peeling off of protective coat or paint	Not applicable
9.23	Check steel members	Not applicable
9.24	Check condition of protective system	Not applicable
9.25	Check corrosion, if any	Not applicable
9.26	Check excessive vibrations, if any	Not applicable
9.27	Check alignment of members	Not applicable
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not applicable
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not applicable
9.30	Check buckling, kinking, warping and waviness	Not applicable

9.31	Check apparent fracture if any	Not applicable
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not applicable
9.33	Check conditions inside the closed members	Not applicable
9.34	Check masonry arches	Not applicable
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not applicable
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not applicable
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not applicable
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not applicable
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not applicable
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not applicable
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not applicable
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	Misalignment of joints and debris are accmulated.
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Fair condition

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	All expansion joints sealing materials are damaged
10.5	Check secureness of the joints	No
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	Yes
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	No
10.8	Check for debris in joints	Yes
10.9	Report rattling, if any	Yes
10.10	Check drainage from expansion joint	No
10.11	Check alignment and clearance	Yes
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Fair condition
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Drainage spouts are clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Drain pipes are not provided, no structural members are affected
12.3	Check adequacy thereof	Adequated
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not applicable
12.5	For submersible bridges, report on functioning	Not applicable
12.6	Report absence of Drainage Spouts	Drainage spouts are provided

12.7	Check choking of drainage holes provided in the bottom booms	No
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Hand rail
13.2	Material	Steel
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	Yes
14.2	Material	RCC
14.3	Condition	Fair condition
14.4	Check missing footpath slab	No
14.5	Cleanless of ducts along with footpath	No
15.UTILITIES		
15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cables
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes	Remove of vegetation and cleaning is required
2	Pavement surface	Cracks are observed
3	Expansion joints	All expansion joints sealing materials are damaged and Cleaning is required

17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of pavement

Approaches pavement

17.2 Expansion Joints (If any)

View of expansion joints

Sealing material damaged

17.3 Bearings (if any)

View of drainage spouts

View of drainage spouts

17.4 Abutment

View of abutment

View of abutment

17.5 Piers

View of pier

View of pier

17.6 Superstructure

View of Superstructure

View of Superstructure

17.7 Retaining wall

View of Side slopes

View of Side slopes

17.8 Overall Bridge

View of Overall bridge

View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Orai-Barah Section
1	State	UP
2	Category of Road	NH
3	Road No	NH-27
4	Section	Orai-Barah
5	Location Chainage	1540800
6	Structure Number	Data not avalible
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Major bridge/ Yamuna Revier
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Kalpi
12	Year of Construction	Data not avalible
13	Overall Bridge Length	784.00 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	No
31	Overall Deck Width in m	10.00 m
32	Approach Roadway Width including Shoulders in m	7.50 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	Data not avalible
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	10
40	Maximum Span	784.00 m
41	Type of Superstructure	Segmental Box girder
42	Peir Type	RCC wall
43	Abutment Type	RCC wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	Not applicble
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Not applicble

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Orai-Barah Section
49	Type of Railing	RCC Crash barrier + Hand rail
50	Corrosion Protection	No
51	Bank Protection Type	No
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	No
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	Data not avalible
62	Any other Observation/Data	No

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: ORAI-BARAH**

CHAINAGE : KM 1540+800 (RHS) **DATE OF INSPECTION: 13-12-2022**

TYPE OF STRUCTURE: MAJOR BRIDGE

STRUCTURE NO:

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Major bridge/ Yamuna Revier
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.50 m
1.6	Overall Deck width (m)	10.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	8 x 85.00 + 2 x 52.00 m
1.10	Total length of the bridge (m)	784.00 m
1.11	Vertical Clearance (m)	4.50 m
1.12	Whether meadian, if yes its width (m)	No
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	3.50 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Crash barrier + Hand rail & Length - 800.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	No spans

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	Cracks are observed
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No damages
2.8	Approach slab (Check settlement, cracks,movement etc.)	No
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Retaining wall is in fair condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	No
2.12	Approach Geometry (Check whether it satisfies the standard in force)	No
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	No
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitching, growth of vegitation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	No
	b) For Piers	No
3.4	Bank Protection & Type	No
3.5	Floor Protection & Type	Not visible
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	No
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	Uniform. No change in flow, erosion of banks

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Not visible	
4.5	Check the adequacy of waterway	Not visible	
4.6	Check the errosion of bank	Not visible	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Well foundation	
5.2	Material	RCC	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No cracks, settlement, sour, exposed steel	No cracks, settlement, sour, exposed steel
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No	No
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not applicable	
6.1.9	Check damage of protective coating of painting.	Not visible	

6.2	Pier	09 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No cracks, settlement, sour, exposed steel	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not applicable	
6.2.6	Check damage of protective coating of painting.	Not visible	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not applicable	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not applicable	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 2 Nos.	02 x 2 Nos.
8.2	No. per Pier	08 x 2 Nos. + 1 x 04 Nos.	09 x 2 Nos. + 1 x 04 Nos.
8.3	Type and allowable movements	POT cum PTFE	Square
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Fair condition	Fair condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Proper functioning	Proper functioning
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	10 Nos. & 8 x 85.00 + 2 x 52.00 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab +Segmentel box Girder	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Balance catilever
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC + PSC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	No
9.7	Check exposed reinforcement, if any	No
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	Not applicable
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	No
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Not applicable
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not applicable
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not applicable
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not applicable
9.22	Check peeling off of protective coat or paint	Not applicable
9.23	Check steel members	Not applicable
9.24	Check condition of protective system	Not applicable
9.25	Check corrosion, if any	Not applicable
9.26	Check excessive vibrations, if any	Not applicable
9.27	Check alignment of members	Not applicable
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not applicable
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not applicable
9.30	Check buckling, kinking, warping and waviness	Not applicable

9.31	Check apparent fracture if any	Not applicable
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not applicable
9.33	Check conditions inside the closed members	Not applicable
9.34	Check masonry arches	Not applicable
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not applicable
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not applicable
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not applicable
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not applicable
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not applicable
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not applicable
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not applicable
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Modular strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	Fair condition, No Misalignment of joints and debris are accmulated.
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Fair condition

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	Not visible as it is covered with bituminous
10.5	Check secureness of the joints	No
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	Yes
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	No
10.8	Check for debris in joints	Yes
10.9	Report rattling, if any	Yes
10.10	Check drainage from expansion joint	No
10.11	Check alignment and clearance	Yes
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Fair condition
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Drainage spouts are clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Drain pipes are provided, no structural members are affected
12.3	Check adequacy thereof	Adequated
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not applicable
12.5	For submersible bridges, report on functioning	Not applicable
12.6	Report absence of Drainage Spouts	Drainage spouts are provided

12.7	Check choking of drainage holes provided in the bottom booms	No
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Crash barrier + Hand rail
13.2	Material	RCC + Steel
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	Yes
14.2	Material	RCC
14.3	Condition	Fair condition
14.4	Check missing footpath slab	No
14.5	Cleanless of ducts along with footpath	No
15.UTILITIES		
15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cables
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes	Remove of vegetation and cleaning is required
2	Drainage spouts	Cleaning is required
3	Expansion joints	Cleaning is required
4	Pavement surface	Cracks are observed

17.PHOTOGRAPHS

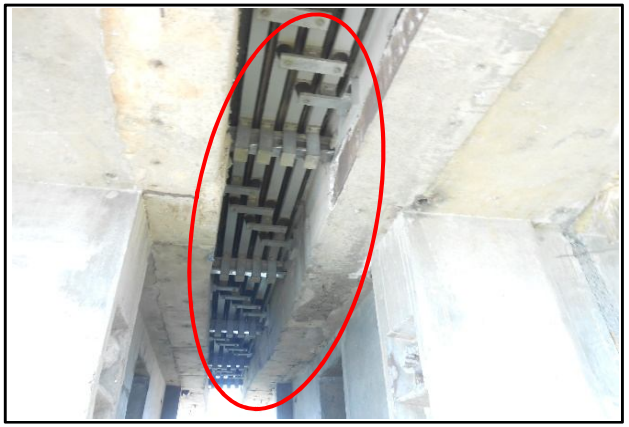
17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit

View of Mobile Bridge Inspection Unit

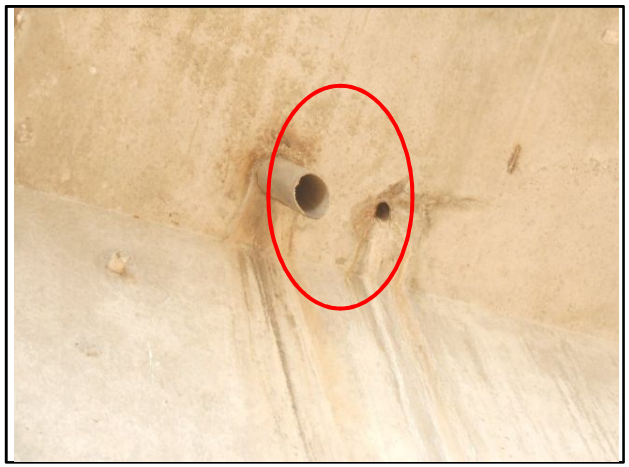
17.2 Expansion Joints (If any)

View of Sealing material



View of expansion joint inside

17.3 Spout (If any)



View of drainage spouts

View of drainage spouts

17.4 Bearings (if any)

View of POT cum PTFE bearing

View of POT cum PTFE bearing

17.5 Abutment

View of abutment

View of abutment

17.6 Piers

View of pier

View of pier

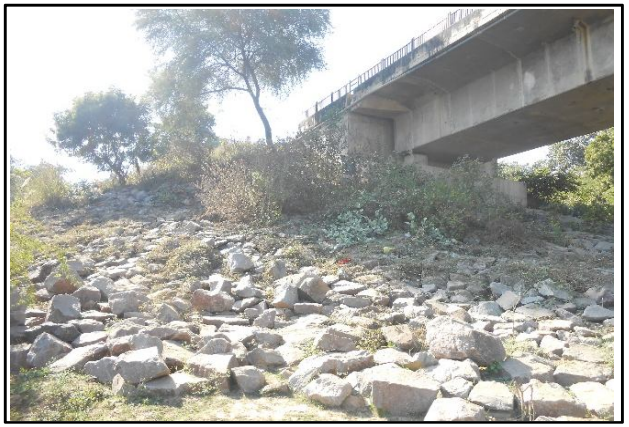
17.7 Superstructure

View of Superstructure

View of box girder inside

17.8 Retaining wall

View of side slopes pitching



View of side slopes pitching

17.8 Overall Bridge

View of Overall bridge

View of Overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Flyover on NH-27 Orai-Barah Section
1	State	UP
2	Category of Road	NH
3	Road No	NH-27
4	Section	Orai-Barah
5	Location Chainage	1550700
6	Structure Number	Data not avalible
7	Features Intersected	Vehicule crossing
8	Type of Structure	Flyover
9	Popular/Official Name	Flyover/Bhoginpur
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Akbarpur
12	Year of Construction	2008
13	Overall Bridge Length	62.450 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Not applicable
23	OFL	Not applicable
24	LWL	Not applicable
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	No
31	Overall Deck Width in m	9.00 m
32	Approach Roadway Width including Shoulders in m	7.50 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	5.50 and 24.80 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	11
40	Maximum Span	26.20 m
41	Type of Superstructure	PSC Girder
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	POT cum PTFE
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Flyover on NH-27 Orai-Barah Section
49	Type of Railing	RCC Crash barrier
50	Corrosion Protection	No
51	Bank Protection Type	No
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	No
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	Data not avalible
62	Any other Observation/Data	No

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: ORAI-BARAH**

CHAINAGE : KM 1540+700 (MCW) **DATE OF INSPECTION: 13-12-2022**

TYPE OF STRUCTURE: FLYOVER

STRUCTURE NO:

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Flyover/Bhoginpur flyover
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	Not applicable
1.4	(a) H.F.L	Not applicable
	(b) Inadequacy of waterway	Not applicable
	(c) Erosion of Banks as evident	Not applicable
1.5	Clear Carriageway width(m)	7.50 m
1.6	Overall Deck width (m)	9.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	11 x 26.20 m
1.10	Total length of the bridge (m)	288.20 m
1.11	Vertical Clearance (m)	5.50 m
1.12	Whether meadian, if yes its width (m)	No
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	7.80 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Crash barrier & Length - 400.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	RE wall
2.4	if Approches Having any Span then provide Span details	No spans

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	Cracks and unevenness settlements are observed
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Not applicable
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No damages
2.8	Approach slab (Check settlement, cracks,movement etc.)	No
2.9	Retaining / RE Wall /toe walls type and height (m)	RE wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	RE wall is in fair condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	No
2.12	Approach Geometry (Check whether it satisfies the standard in force)	No
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	Not applicable
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Not applicable
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	Not applicable
	b) For Piers	Not applicable
3.4	Bank Protection & Type	Not applicable
3.5	Floor Protection & Type	Not applicable
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	Not applicable
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	Not applicable

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Not applicable	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Not applicable	
4.5	Check the adequacy of waterway	Not applicable	
4.6	Check the errosion of bank	Not applicable	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Data not avalibale	
5.2	Material	Data not avalibale	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	Not applicable	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Pier abutment	Pier abutment
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No cracks, settlement, sour, exposed steel	No cracks, settlement, sour, exposed steel
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	Not applicable	Not applicable
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	No	
6.1.9	Check damage of protective coating of painting.	Not visible	

6.2	Pier	10 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No cracks, settlement, sour, exposed steel	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	No	
6.2.6	Check damage of protective coating of painting.	Not visible	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not applicable	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	No	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 4 Nos.	02 x 4 Nos.
8.2	No. per Pier	10 x 8 Nos.	10 x 8 Nos.
8.3	Type and allowable movements	POT cum PTFE	Square
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Fair condition	Fair condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Proper functioning	Proper functioning
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	11 Nos. & 11 x 26.20 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab + Girder	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Continous
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC + PSC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	No
9.7	Check exposed reinforcement, if any	No
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	Not applicable
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	No
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Not applicable
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not applicable
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not applicable
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not applicable
9.22	Check peeling off of protective coat or paint	Not applicable
9.23	Check steel members	Not applicable
9.24	Check condition of protective system	Not applicable
9.25	Check corrosion, if any	Not applicable
9.26	Check excessive vibrations, if any	Not applicable
9.27	Check alignment of members	Not applicable
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not applicable
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not applicable
9.30	Check buckling, kinking, warping and waviness	Not applicable

9.31	Check apparent fracture if any	Not applicable
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not applicable
9.33	Check conditions inside the closed members	Not applicable
9.34	Check masonry arches	Not applicable
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not applicable
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not applicable
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not applicable
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not applicable
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not applicable
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not applicable
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not applicable
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	Misalignment of joints and debris is accmulated
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Crcaks are observed on expansion joint edge beam

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	All expansion joint sealing materials are damaged
10.5	Check secureness of the joints	No
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	Yes
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	No
10.8	Check for debris in joints	Yes
10.9	Report rattling, if any	No
10.10	Check drainage from expansion joint	No
10.11	Check alignment and clearance	Not visible as it is filled with bituminous
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Cracks and unevenness settlements are observed
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Drainage spouts are clear
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Drain pipes are provided, no structural members are affected
12.3	Check adequacy thereof	Adequated
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not applicable
12.5	For submersible bridges, report on functioning	Not applicable
12.6	Report absence of Drainage Spouts	Drainage spouts are provided

12.7	Check choking of drainage holes provided in the bottom booms	Yes
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Crash barrier
13.2	Material	RCC
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	No
14.2	Material	Not applicable
14.3	Condition	Not applicable
14.4	Check missing footpath slab	Not applicable
14.5	Cleanless of ducts along with footpath	Not applicable
15.UTILITIES		
15.1	Present (Yes/No)	Yes
15.2	Type of Utility	Cable
15.3	Report damage due to Utility if any	No
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Expansion joints	All expansion joint sealing materials to be replaced and cleaning is required
2	Drainage spouts	Cleaning is required
3	Pavement surface	Cracks and unevenness settlements are observed

17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit

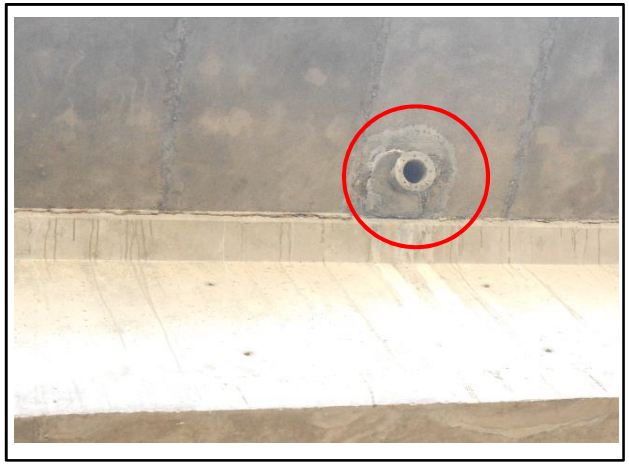
View of pavement surface

17.2 Expansion Joints (If any)

View of expansion joint

View of expansion joint

17.3 Spout (If any)



View of drainage spouts

View of drainage spouts

17.4 Bearings (if any)

View of POT cum PTFE bearing

View of POT cum PTFE bearing

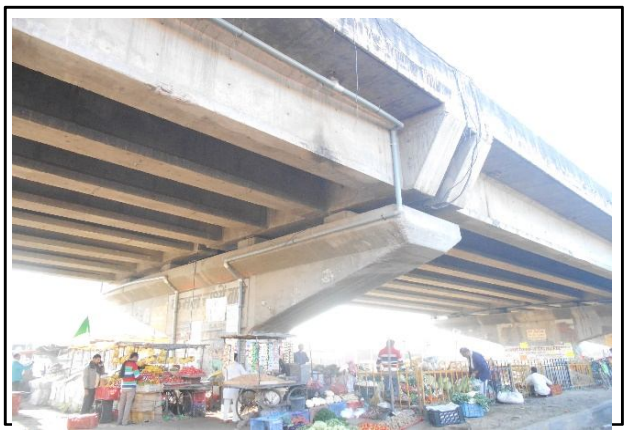
17.5 Abutment

View of abutment

View of abutment

17.6 Piers

View of pier



View of pier

17.7 Superstructure

View of Superstructure

View of Superstructure

17.8 Retaining wall

View of RE wall

View of RE wall

17.8 Floor Protection

Not applicable	Not applicable

17.09 Overall Bridge

View of Overall bridge	**View of Overall bridge**

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Orai-Barah Section
1	State	UP
2	Category of Road	NH
3	Road No	NH-27
4	Section	Orai-Barah
5	Location Chainage	1567060
6	Structure Number	Data not avalible
7	Features Intersected	Nalla
8	Type of Structure	Major bridge
9	Popular/Official Name	Major bridge/ Sengar Revier
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Pukhrayan
12	Year of Construction	Data not avalible
13	Overall Bridge Length	72.80 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Data not avalible
23	OFL	Data not avalible
24	LWL	Nil
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	No
31	Overall Deck Width in m	8.50 m
32	Approach Roadway Width including Shoulders in m	7.50 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	5.50 m and 11.50 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	4
40	Maximum Span	13.70 m
41	Type of Superstructure	Arch type
42	Peir Type	Brick masonry Wall
43	Abutment Type	Brick masonry Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	Not applicble
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Not applicble

S.No	Information of Item	Information of Major bridge-Nala on NH-27 Orai-Barah Section
49	Type of Railing	RCC Crash barrier + Hand rail
50	Corrosion Protection	No
51	Bank Protection Type	No
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	No
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	Data not avalible
62	Any other Observation/Data	No

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: ORAI-BARAH**

CHAINAGE : KM 1567+060 (LHS) **DATE OF INSPECTION: 13-12-2022**

TYPE OF STRUCTURE: MAJOR BRIDGE

STRUCTURE NO:

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Major bridge/ Sengar Revier
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.50 m
1.6	Overall Deck width (m)	10.00 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	03 x 28.450 m
1.10	Total length of the bridge (m)	85.350 m
1.11	Vertical Clearance (m)	4.50 m
1.12	Whether meadian, if yes its width (m)	6.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	2.50 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Crash barrier + Hand rail & Length - 91.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	No spans

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	Cracks are observed
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No damages
2.8	Approach slab (Check settlement, cracks,movement etc.)	No
2.9	Retaining / RE Wall /toe walls type and height (m)	RCC Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Retaining wall is in fair condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	No
2.12	Approach Geometry (Check whether it satisfies the standard in force)	No
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	No
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitching damaged due to growth of vegitation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	No
	b) For Piers	No
3.4	Bank Protection & Type	No
3.5	Floor Protection & Type	Not visible
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	No
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	Uniform. No change in flow, erosion of banks

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Not visible	
4.5	Check the adequacy of waterway	Not visible	
4.6	Check the errosion of bank	Not visible	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Data not avalibale	
5.2	Material	Data not avalibale	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No cracks, settlement, sour, exposed steel	No cracks, settlement, sour, exposed steel
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No	No
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not applicable	
6.1.9	Check damage of protective coating of painting.	Not visible	
6.2	Pier	02 Nos.	
6.2.1	Type	Wall type	

6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No cracks, settlement, sour, exposed steel	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not applicable	
6.2.6	Check damage of protective coating of painting.	Not visible	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not applicable	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not applicable	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 2 Nos.	02 x 2 Nos.
8.2	No. per Pier	02 x 4 Nos.	02 x 4 Nos.
8.3	Type and allowable movements	POT cum PTFE	Square
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Seizing of plates siliting on abument A1 at Girder G1	Fair condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Proper functioning	Proper functioning
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	03 Nos. & 3 x 28.450 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab + Girder	
9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported	
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC + PSC	

9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	No
9.7	Check exposed reinforcement, if any	No
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	Not applicable
9.16	Check excessive vibrations, if any	No
9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	No
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Not applicable

9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not applicable
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not applicable
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not applicable
9.22	Check peeling off of protective coat or paint	Not applicable
9.23	Check steel members	Not applicable
9.24	Check condition of protective system	Not applicable
9.25	Check corrosion, if any	Not applicable
9.26	Check excessive vibrations, if any	Not applicable
9.27	Check alignment of members	Not applicable
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not applicable
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not applicable
9.30	Check buckling, kinking, warping and waviness	Not applicable
9.31	Check apparent fracture if any	Not applicable
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not applicable

9.33	Check conditions inside the closed members	Not applicable
9.34	Check masonry arches	Not applicable
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not applicable
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not applicable
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not applicable
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not applicable
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not applicable
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not applicable
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not applicable
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	Misalignment of joints and debris are accmulated.
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Cracks are observed on expansion joint edge beam
10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	Sealing material is damaged at Abutmtnt A1 & A2 and filled with bituminous at Pier P1 & P2
10.5	Check secureness of the joints	No

10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	Yes
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	No
10.8	Check for debris in joints	Yes
10.9	Report rattling, if any	Yes
10.10	Check drainage from expansion joint	No
10.11	Check alignment and clearance	Yes
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Fair condition
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Drainage spouts are clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Drain pipes are provided, no structural members are affected
12.3	Check adequacy thereof	Adequated
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not applicable
12.5	For submersible bridges, report on functioning	Not applicable
12.6	Report absence of Drainage Spouts	Drainage spouts are provided
12.7	Check choking of drainage holes provided in the bottom booms	No
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Crash barrier + Hand rail

13.2	Material	RCC + Steel
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	Yes
14.2	Material	RCC
14.3	Condition	Fair condition
14.4	Check missing footpath slab	No
14.5	Cleanless of ducts along with footpath	No
15.UTILITIES		
15.1	Present (Yes/No)	No
15.2	Type of Utility	Not applicable
15.3	Report damage due to Utility if any	Not applicable
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes	Remove of vegetation and cleaning is required
2	Drainage spouts	Cleaning is required
3	Expansion joints	Sealing material is damaged at Abutmtnt A1 & A2 and filled with bituminous at Pier P1 & P2 and Cleaning is required
4	Pavement surface	Cracks are observed

17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit

View of Mobile Bridge Inspection Unit

17.2 Expansion Joints (If any)

Damage of sealing material

Filled with bituminous

17.3 Spout (If any)

View of drainage spouts

View of drainage spouts

17.4 Bearings (if any)

Seizing of plates siliting on abument A1 at

View of POT cum PTFE bearing

17.5 Abutment

View of abutment

View of abutment

17.6 Piers

View of pier

View of pier

17.7 Superstructure

View of Superstructure

View of Superstructure

17.8 Retaining wall

View of side slopes pitching

View of side slopes pitching

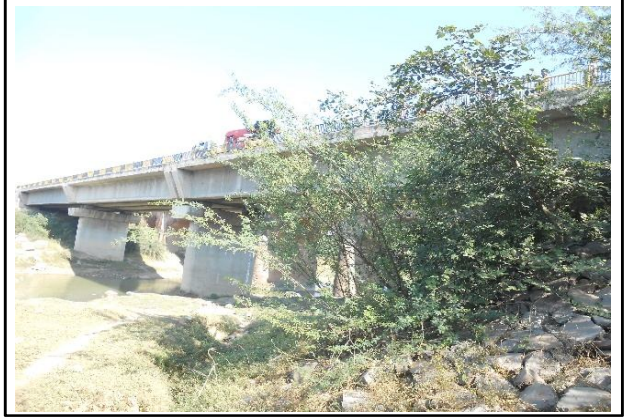
17.8 Floor Protection

Not visble

Not visble

17.09 Overall Bridge

View of Overall bridge



View of Overall bridge

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: ORAI-BARAH**

CHAINAGE : KM 1567+060 (RHS) **DATE OF INSPECTION: 12-12-2022**

TYPE OF STRUCTURE: MAJOR BRIDGE

STRUCTURE NO:

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Major bridge/ Sengar Revier
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	High Level
1.4	(a) H.F.L	Data not available
	(b) Inadequacy of waterway	No
	(c) Erosion of Banks as evident	No
1.5	Clear Carriageway width(m)	7.50 m
1.6	Overall Deck width (m)	8.50 m
1.7	Average skew angle	No
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	04 x 13.70 + 2 x 9.00 m
1.10	Total length of the bridge (m)	72.80 m
1.11	Vertical Clearance (m)	7.50 m
1.12	Whether meadian, if yes its width (m)	6.00 m
1.13	Shoulder width (m) and material	No
1.14	Height of Approach Embankment (m)	3.00 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Crash barrier + Hand rail & Length - 60.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	Soil
2.4	if Approches Having any Span then provide Span details	2 x 9.00 m

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	Pavement surface is in fair condition
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Un pitched, growth of vegitation on side slopes
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No damages
2.8	Approach slab (Check settlement, cracks,movement etc.)	No
2.9	Retaining / RE Wall /toe walls type and height (m)	Brick masonry Retaining wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	Retaining wall is in fair condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	No
2.12	Approach Geometry (Check whether it satisfies the standard in force)	No
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	No
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Stone pitching, growth of vegitation on side slopes
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	No
	b) For Piers	No
3.4	Bank Protection & Type	No
3.5	Floor Protection & Type	Not visible
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	No
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	Uniform. No change in flow, erosion of banks

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Data not avalible	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Not visible	
4.5	Check the adequacy of waterway	Not visible	
4.6	Check the errosion of bank	Not visible	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Data not avalibale	
5.2	Material	Data not avalibale	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No damages	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Wall type	Wall type
6.1.2	Material	Brick masonry	Brick masonry
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No cracks, settlement, sour, exposed steel	No cracks, settlement, sour, exposed steel
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	No	No
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	Not applicable	
6.1.9	Check damage of protective coating of painting.	Not visible	

6.2	Pier	03 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	Brick masonry	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No cracks, settlement, sour, exposed steel	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	Not applicable	
6.2.6	Check damage of protective coating of painting.	Not visible	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not applicable	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	Not applicable	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	No bearings	No bearings
8.2	No. per Pier	No bearings	No bearings
8.3	Type and allowable movements	Not applicable	Not applicable
8.4	Material	Not applicable	Not applicable
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Not applicable	Not applicable
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Not applicable	Not applicable
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	04 Nos. & 4 x 13.70 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	Arch type	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Continuous
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	Brick masonry
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	No
9.7	Check exposed reinforcement, if any	No
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	Not applicable
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	No
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Not applicable
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not applicable
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not applicable
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not applicable
9.22	Check peeling off of protective coat or paint	Not applicable
9.23	Check steel members	Not applicable
9.24	Check condition of protective system	Not applicable
9.25	Check corrosion, if any	Not applicable
9.26	Check excessive vibrations, if any	Not applicable
9.27	Check alignment of members	Not applicable
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not applicable
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not applicable
9.30	Check buckling, kinking, warping and waviness	Not applicable

9.31	Check apparent fracture if any	Not applicable
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not applicable
9.33	Check conditions inside the closed members	Not applicable
9.34	Check masonry arches	Not applicable
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not applicable
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not applicable
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not applicable
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not applicable
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not applicable
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not applicable
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not applicable
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	No
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	Not applicable
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Not applicable

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	Not applicable
10.5	Check secureness of the joints	Not applicable
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	Not applicable
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	Not applicable
10.8	Check for debris in joints	Not applicable
10.9	Report rattling, if any	Not applicable
10.10	Check drainage from expansion joint	Not applicable
10.11	Check alignment and clearance	Not applicable
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Fair condition
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Drainage spouts are clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Drain pipes are not provided, no structural members are affected
12.3	Check adequacy thereof	Adequated
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not applicable
12.5	For submersible bridges, report on functioning	Not applicable
12.6	Report absence of Drainage Spouts	Drainage spouts are provided

12.7	Check choking of drainage holes provided in the bottom booms	No
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Crash barrier + Hand rail
13.2	Material	RCC + Steel
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	No
14.2	Material	Not applicable
14.3	Condition	Not applicable
14.4	Check missing footpath slab	Not applicable
14.5	Cleanless of ducts along with footpath	Not applicable
15.UTILITIES		
15.1	Present (Yes/No)	No
15.2	Type of Utility	Not applicable
15.3	Report damage due to Utility if any	Not applicable
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Approaches and side slopes	Remove of vegetation and cleaning is required
2	Drainage spouts	Cleaning is required

17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of pavement surface

View of pavement surface

17.2 Abutment

View of abutment

View of abutment

17.3 Piers

View of pier

View of pier

17.4 Superstructure

View of pier of superstructure

View of pier of superstructure

17.5 Retaining wall

View of rataininng wall

View of rataininng wall

17.6 Overall Bridge

View of overall bridge

View of overall bridge

Appendix-2

INVENTORY OF ROAD BRIDGES

S.No	Information of Item	Information of Flyover on NH-27 Orai-Barah Section
1	State	UP
2	Category of Road	NH
3	Road No	NH-27
4	Section	Orai-Barah
5	Location Chainage	1578360
6	Structure Number	Data not avalible
7	Features Intersected	Vehicule crossing
8	Type of Structure	Flyover
9	Popular/Official Name	Flyover/Barazor flyover
10	Highway/Cicle/Division	NH-27
11	Nearest City/Town	Akbarpur
12	Year of Construction	2008
13	Overall Bridge Length	62.450 m
14	No of Lanes	2 Lanes
15	Load Rating	Data not avalible
16	Design Loading	Class A 70 R or 2Lane of Class A
17	Year of Inventory	2022
18	Design velocity in m/sec	Data not avalible
19	Design Discharge in cumecs	Data not avalible
20	HTL	Nil
21	LTL	Nil
22	Design HFL	Not applicable
23	OFL	Not applicable
24	LWL	Not applicable
25	Design Scour Level at peir	Data not avalible
26	Design Scour Level at Abutment	Data not avalible
27	Founding Strata	Data not avalible
28	Whether Bridge has any Gradient	No
29	Road level in m	Data not avalible
30	Foot path Width in m	No
31	Overall Deck Width in m	10.00 m
32	Approach Roadway Width including Shoulders in m	8.80 m
33	Average Skew	No
34	Conditions of Exposure	Severe
35	Whether Navigable	No
36	Vertical and Horizantal Clearence	5.50 and 28.50 m
37	Soffit Level at Centre of Bridge	Data not avalible
38	Importance Factor	1.2
39	Total Number of Spans	2
40	Maximum Span	31.70 m
41	Type of Superstructure	PSC Girder
42	Peir Type	RCC Wall
43	Abutment Type	RCC Wall
44	Peir Foundation Type	Data not avalible
45	Abutment Foundation Type	Data not avalible
46	Type of Bearings	POT cum PTFE
47	Type of Wearing Coat	Bituminous
48	Type of Expansion Joint	Strip seal expansion joints

S.No	Information of Item	Information of Flyover on NH-27 Orai-Barah Section
49	Type of Railing	RCC Crash barrier
50	Corrosion Protection	No
51	Bank Protection Type	No
52	Floor Protection Type	Not visible
53	Suspension of Traffic	Data not avalible
54	Erosion of Banks/Bunds	No
55	Abnormal Scour Level Around Peirs	Not visible
56	Abnormal Scour Level Around Abutments	Not visible
57	Abnormal Floor Level in m	Not visible
58	Distress and Repairs in Foundation	Data not avalible
59	Distress and Repairs in Guide Bunds	No
60	Distress and Repairs in Substructure	Data not avalible
61	Distress and Repairs in Superstructure	Data not avalible
62	Any other Observation/Data	No

INSPECTION AND CONDITION SURVEY OF BRIDGES (AS PER IRC SP-35 CODE)

ROAD NAME: NH-27 **DIRECTION: ORAI-BARAH**

CHAINAGE : KM 1567+060 (LHS) **DATE OF INSPECTION: 12-12-2022**

TYPE OF STRUCTURE: FLYOVER

STRUCTURE NO:

S.NO	DESCRIPTION	OBSERVATIONS
	1.STRUCTURE DATA	
1.1	Name of Bridge/No.of Bridge/Name of River	Flyover/Barazor flyover
1.2	Name of Highway/location of Bridge	NH-27
1.3	Type of Bridge High level/submersible	Not applicable
1.4	(a) H.F.L	Not applicable
	(b) Inadequacy of waterway	Not applicable
	(c) Erosion of Banks as evident	Not applicable
1.5	Clear Carriageway width(m)	8.80 m
1.6	Overall Deck width (m)	10.00 m
1.7	Average skew angle	60°
1.8	Whether Navigable	No
1.9	Span Arrangement (Nos. x Length in m)	1 x 31.70 + 1 x 30.75 m
1.10	Total length of the bridge (m)	62.450 m
1.11	Vertical Clearance (m)	5.50 m
1.12	Whether meadian, if yes its width (m)	No
1.13	Shoulder width (m) and material	1.20 m
1.14	Height of Approach Embankment (m)	7.80 m
1.15	Is the Bridge Located in back water (Marine) or chemical affected water body	No
1.16	Whether guard rail/Crash barrier, if yes their length/details	RCC Crash barrier & Length - 200.00 m
	2.APPROACHES	
2.1	Type of Terrain	Plain
2.2	Type of Approach	Embankment
2.3	Material of Approach	RE wall
2.4	if Approches Having any Span then provide Span details	No spans

2.5	Pavement surface (Check unevenness settlement, cracking,potholes etc.)	Pavement surface is in fair condition
2.6	Side slopes (Check pitched or un-pitched, condition of pitchong/turfing, any signs of slope failure etc.)	Not applicable
2.7	Erosion of Embankment by cuts or any other damage to Embankment.	No damages
2.8	Approach slab (Check settlement, cracks,movement etc.)	No
2.9	Retaining / RE Wall /toe walls type and height (m)	RE wall
2.10	Retaining wall condition (Check subsidence, tilting, condition of weep-holes, guard-stone and railing etc.)	RE wall is in fair condition
2.11	Silt and Debris (Check Accumulation of silt and debris on submersible approaches in cutting and embankment.)	No
2.12	Approach Geometry (Check whether it satisfies the standard in force)	No
3.PROTECTION WORKS		
3.1	Type of protection (Mention whether guide-bund or protection around abutments or spurs.)	Not applicable
3.2	Slope pitching, apron, and toe walls (Check for proper slopes, thickness of pitching in the slope, erosion of toe wall and indicating the nature of damage if any etc.)	Not applicable
3.3	Scour (Check any abnormal scour noticed.)	
	a) For Abutments	Not applicable
	b) For Piers	Not applicable
3.4	Bank Protection & Type	Not applicable
3.5	Floor Protection & Type	Not applicable
4.WATERWAY		
4.1	Check presence of obstruction in flow and its impact on flow, island formation, Vegetation growth etc.	Not applicable
4.2	Flow pattern (Check any abnormal change in Meandering inflow and erosion of banks)	Not applicable

4.3	Check maximum flood level observed during the year and mark the same of the pier/ abutment both on the U/S and D/S (Local enquiry if necessary)	Not applicable	
4.4	Check signs of abnormal aflux from U/S and D/S watermarks on piers if any	Not applicable	
4.5	Check the adequacy of waterway	Not applicable	
4.6	Check the errosion of bank	Not applicable	
5.FOUNDATION			
5.1	Type of Foundation (Main bridge and approach spans if any)	Data not avalibale	
5.2	Material	Data not avalibale	
5.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	Not visible	
5.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	Not applicable	
6.SUBSTRUCTURE			
6.1	**Abutment (A1 & A2)**	**A1**	**A2**
6.1.1	Type	Pier abutment	Pier abutment
6.1.2	Material	RCC	RCC
6.1.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No cracks, settlement, sour, exposed steel	No cracks, settlement, sour, exposed steel
6.1.4	Floating bodies, boulders etc (Check damage due to impact of floating bodies, boulders etc)	Not applicable	Not applicable
6.1.6	Check condition of side retaining wall like cracking, disintegration, and seepage is any.	No	
6.1.7	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.1.8	Check damage of protective measures to abutments (For Flyover/ Viaducts/ROB etc.	No	
6.1.9	Check damage of protective coating of painting.	Not visible	

6.2	Pier	01 Nos.	
6.2.1	Type	Wall type	
6.2.2	Material	RCC	
6.2.3	Condition (Crack, Settlement, Scour, Tilting, Rusting in exposed Steel, Strains and other damages etc)	No cracks, settlement, sour, exposed steel	
6.2.4	Check large excavations done in the road below in the vicinity of flyover or road over bridge of Viaduct.	No	
6.2.5	Check damage of protective measures to piers (For Flyover/ Viaducts/ROB etc.	No	
6.2.6	Check damage of protective coating of painting.	Not visible	
7.For Subways			
7.1	Check condition of side retaining wall like cracking, disintegration and seepage, if any	Not applicable	
7.2	check damages to protective measures to pier and abutments (For Viaducts,Flyover and ROBs)	No	
8. Bearing & Pedestal			
		Bearings	**Pedestals**
8.1	No. per Abutment	02 x 4 Nos.	02 x 4 Nos.
8.2	No. per Pier	01 x 8 Nos.	01 x 8 Nos.
8.3	Type and allowable movements	POT cum PTFE	Square
8.4	Material	Steel	RCC
8.5	General condition (Check rusting, cleanliness,seizing of plates silting, accumulations of dirt in case of submersible bridges)	Fair condition	Fair condition
8.6	Functioning (Check excessive movement, tilting, jumping off guides)	Proper functioning	Proper functioning
9.SUPERSTRUCTURE			
9.1	Total number of Spans & Arrangement	02 Nos. & 1 x 31.70 + 1 x 30.75 m	
9.2	Type of Span (T-beam, slab/box-girder etc.)	RCC Deck slab + Girder	

9.3	Structural System (Simply supported/continuous/Continuous overhang/balance cantilever etc.)	Simply supported
9.4	Type of Material (RCC/PSC/Steel/Timer/Masonry etc)	RCC + PSC
9.5	Check spalling, disintegration or honey combing, (special attention: to be given at points of bearings)	No
9.6	Check cracks (Pattern, location, explain preferably by photograph and plotting on sketch. A map of cracking should be produced. The size and distribution of cracks and their penetration should be noted)	No
9.7	Check exposed reinforcement, if any	No
9.8	Check wear of deck surface	Not visible as it is covered with bituminous wearing coat
9.9	Check scaling (This is gradual and continuous loss of surface mortar and aggregate over irregular areas.)	No scaling
9.10	Check surface stains and rust stains along with the locations	No stains
9.11	Check leaching (Effects are most usually evident on the soffits of decks)	No
9.12	Check corrosion of reinforcements, sheathing and tendon if visible	No
9.13	Check leakage (Leakage of water can take place through concrete decks, construction joints or thin component sections of the deck viz.., kerbs, etc.)	No
9.14	Check damages if any due to moving vehicle	No
9.15	Check condition of articulation (Cracks, exposed reinforcement if any)	Not applicable
9.16	Check excessive vibrations, if any	No

9.17	Check excessive deflections(sag) or loss of camber if any at same point each time	No
9.18	Check cracks, if any, around anchorage zone for pre-stressed concrete members	Not applicable
9.19	Check excessive deflection (sag) at central hinge, tip, of cantilever for cantilever bridge	Not applicable
9.20	In box girders, the interior faces of flanges and webs need to be examined for signs of cracking and report excessive accumulation of water or debris. Interior diaphragms will also require examination, particularly for any signs of cracking at their junction to the webs	Not applicable
9.21	Check accumulation of slit and debris on surface of deck (for submersible bridges)	Not applicable
9.22	Check peeling off of protective coat or paint	Not applicable
9.23	Check steel members	Not applicable
9.24	Check condition of protective system	Not applicable
9.25	Check corrosion, if any	Not applicable
9.26	Check excessive vibrations, if any	Not applicable
9.27	Check alignment of members	Not applicable
9.28	Check condition for Steel Superstructure (Adequacy, looseness of rivets, bolts or worn-out welds, especially on connection of stringers to cross girders, cross girders to main girders, gussets or splices, condition of hinges, splices, etc.)	Not applicable
9.29	Check excessive loss of camber and excessive deflections and deformations, if any	Not applicable
9.30	Check buckling, kinking, warping and waviness	Not applicable

9.31	Check apparent fracture if any	Not applicable
9.32	Check excessive wear (such as in pins in joints of truss) and their locations requiring close monitoring	Not applicable
9.33	Check conditions inside the closed members	Not applicable
9.34	Check masonry arches	Not applicable
9.35	Check condition of joints mortar, pointing, masonry, etc.	Not applicable
9.36	Check profile, report flattening by observing rise of the arch at centre and quarter points	Not applicable
9.37	Check cracks (indicate location, pattern, extent, depth; explain by sketches)	Not applicable
9.38	Check drainage of spandrel fillings (check bulging of spandrel walls, if any)	Not applicable
9.39	Check growth of vegetation	No
9.40	Check all cast iron/wrought iron components	Not applicable
9.41	In case of steel bridges (Corrosion/painting/loose rivet joints)	Not applicable
9.42	In case of masonry bridges (Pointing/joints mortar and bulging of spandrel)	Not applicable
9.43	Vegetation (Yes/No)	No
10. EXPANSION JOINT		
10.1	Type	Strip seal expansion joints
10.2	Condition i.e. Misalignment of Joints, Debris, Accumulation etc.	Not visible as it is filled with bituminous
10.3	Functioning i.e. Cracks in wearing course, existence of normal gap, excessive noise, etc.	Not visible as it is filled with bituminous

10.4	Sealing material i.e. For neoprene sealing material, check for splitting, oxidation, creep, flattening, bulging and for bitumen filler., check hardening, cracking, etc.	Not visible as it is filled with bituminous
10.5	Check secureness of the joints	Not visible as it is filled with bituminous
10.6	Top sliding plate i.e. check corrosion, damage to welds, etc.	Not visible as it is filled with bituminous
10.7	Locking of joints i.e. Check locking of joints especially for finger type expansion joints.	Not visible as it is filled with bituminous
10.8	Check for debris in joints	Not visible as it is filled with bituminous
10.9	Report rattling, if any	Not visible as it is filled with bituminous
10.10	Check drainage from expansion joint	Not visible as it is filled with bituminous
10.11	Check alignment and clearance	Not visible as it is filled with bituminous
11. WEARING COAT		
11.1	Material	Bituminous
11.2	Surface condition i.e. Cracks / potholes / Bulges, spalling, disintegration, etc.	Fair condition
11.3	Details of water proofing system, if any	Data not available
12. DRAINAGE SPOUTS AND VENT HOLES		
12.1	Check clogging, deterioration and damage, if any	Drainage spouts are clogged
12.2	Check the projection of the spout on the underside (see whether structural members are being affected)	Drain pipes are provided, no structural members are affected
12.3	Check adequacy thereof	Adequated
12.4	For subways report about adequacy of drainage and pumping arrangements etc.	Not applicable
12.5	For submersible bridges, report on functioning	Not applicable
12.6	Report absence of Drainage Spouts	Drainage spouts are provided

12.7	Check choking of drainage holes provided in the bottom booms	No
13. HANDRAILS, PARAPETS, CRASH BARRIERS		
13.1	Present (Yes/No)	Yes, Crash barrier
13.2	Material	RCC
13.3	Condition	Fair condition
13.4	Expansion joint gap in hand rail / parapets/Crash barriers	Yes
13.5	Present of additional safety measures	No
13.6	Inspection Galley / ladder platform etc.	No
14.FOOTPATHS		
14.1	Present (Yes/No)	No
14.2	Material	Not applicable
14.3	Condition	Not applicable
14.4	Check missing footpath slab	Not applicable
14.5	Cleanless of ducts along with footpath	Not applicable
15.UTILITIES		
15.1	Present (Yes/No)	No
15.2	Type of Utility	Not applicable
15.3	Report damage due to Utility if any	Not applicable
15.4	Any type of Encroachment under the bridge	No
MAINTENANCE AND IMPROVEMENT RECOMMENDATION		
Sl No.	**Item Needing Attention**	**Action recommended**
1	Expansion joints	Cleaning is required
2	Drainage spouts	Cleaning is required

17.PHOTOGRAPHS

17.1 Mobile Bridge Inspection Unit Picture (if required)

View of Mobile Bridge Inspection Unit

View of pavement surface

17.2 Expansion Joints (If any)

Filled with bituminous

Filled with bituminous

17.3 Spout (If any)

View of drainage spouts

View of drainage spouts

17.4 Bearings (if any)

View of POT cum PTFE bearing

View of POT cum PTFE bearing

17.5 Abutment

View of abutment

View of abutment

17.6 Piers

View of pier

View of pier

17.7 Superstructure

View of Superstructure

View of Superstructure

17.8 Retaining wall

View of RE wall

View of RE wall

17.8 Floor Protection

Not applicable	Not applicable

17.09 Overall Bridge

View of Overall bridge	**View of Overall bridge**

SUPPLEMENTARY REPORT OF THE FINAL TECHNICAL DUE-DILIGENCE REPORT

Technical Consultant Services for National Highways Infra Trust

Orai to Barah Section of NH-27 in the State of Uttar Pradesh

February 2024

egis India
Consulting engineers pvt. ltd.

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Section 1: Supplementary Report

1.1 Background

Technical Consultant submitted the Final TDD Report for Orai – Barah section of NH-27 in the state of Uttar Pradesh in October – 2023. Later a strategy is formed to optimise the cost of toll collection operation which has impact on the operation cost presented in the final TDD report. This Supplementary Report is submitted with respect to updated operation cost and shall be read in conjunction with the Final TDD Report submitted in October – 2023.

1.2 Strategy for Toll Operation

It is understood that requirement of man-powers for toll operation shall reduce with time. Revised strategy in this regard is presented below:

S. No.	Financial Year	Toll Collector	Lane Assitant	Traffic Marshal
1	Appointed Date (First year)	Each per Lane per shift + No. of Lanes x 3/6	Each per Two Lanes per shift	Each per Two Lanes per shift
2	2nd Year	Each per Lane per shift + No. of Lanes x 3/6	Each per Two Lanes per shift	Each per Two Lanes per shift
3	3rd Year	Two per Three Lane per shift + No. of Lanes x 2/3 x 3/6	Each per Three Lanes per shift	Each per Three Lanes per shift
4	4th Year	Two per Three Lane per shift + No. of Lanes x 2/3 x 3/6	Each per Three Lanes per shift	Each per Three Lanes per shift
5	5th Year to 20th year	Two per Four Lane per shift + No. of Lanes x 1/2 x 3/6	Each per Four Lanes per shift	Each per Four Lanes per shift

1.3 Updated O&M Cost

As per the strategy explained in above section, O&M cost for the entire concession period (excluding escalation) is updated which is presented below:

Updated Estimate - CapEx and O&M ***(excluding escalation, Figures in INR Crore)***

Year of Concession	O & M Year	Capex							Major Maintenance			Operation & Maintenance					Admin Expenses	Insurance	Estimated O&M Cost (Rs.)
						Immediate Maintenance						Operations			Maintenance				
		New Construction (Sch B)	Electrical work	ATMS	TCMS	Road works-Flex	Road works-Rigid	Structure works	Structure & Roadwork	Equipment replacement cost	Equipment replacement cost	Tolling Operations	Incident Management	Routine Maintenance	Repairs	ATMS			
1	2024-25	3.37			3.18							5.05	2.23	2.33	1.84		3.45	1.20	22.65
2	2025-26	5.06										5.05	2.23	2.33	1.84		3.45	1.20	21.16
3	2026-27											4.31	2.23	2.33	1.84		3.45	1.20	15.36
4	**2027-28**								**84.98**			4.31	2.23	2.33	1.84		3.45	1.20	100.34
5	2028-29											4.02	2.23	2.33	1.84		3.45	1.20	15.07
6	2029-30											4.02	2.23	2.33	1.84		3.45	1.20	15.07
7	2030-31									1.59		4.02	Capacity augmentation construction				3.45	1.20	10.26
8	2031-32											4.02	Capacity augmentation construction				3.45	1.20	8.67
9	**2032-33**								**72.31**			4.02	Capacity augmentation maintenance period				3.45	1.20	80.98
10	2033-34											4.02	Capacity augmentation maintenance period				3.45	1.20	8.67
11	2034-35											4.02	Capacity augmentation maintenance period				3.45	1.20	8.67
12	2035-36											4.02	Capacity augmentation maintenance period				3.45	1.20	8.67
13	2036-37											4.02	Capacity augmentation maintenance period				3.45	1.20	8.67
14	2037-38									3.18		4.02	2.23	2.91	2.5		3.45	1.20	19.49
15	2038-39											4.02	2.23	2.91	2.5		3.45	1.20	16.31
16	**2039-40**								**81.05**			4.02	2.23	2.91	2.5		3.45	1.20	97.36
17	2040-41											4.02	2.23	2.91	2.5		3.45	1.20	16.31
18	2041-42											4.02	2.23	2.91	2.5		3.45	1.20	16.31
19	2042-43											4.02	2.23	2.91	2.5		3.45	1.20	16.31
20	2043-44											4.02	2.23	2.91	2.5		3.45	1.20	16.31
Total		**8.43**	**0**	**-**	**3.18**	**-**	**-**	**-**	**238.34**	**4.77**	**0**	**83.04**	**28.99**	**34.35**	**28.54**		**69.00**	**24.00**	**522.64**

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SIX LANE CHITRADURGA – DAVANGERE – HAVERI - HUBLI SECTION OF NH-48, LENGTH 214.50 KM, IN THE STATE OF KARNATAKA

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TECHNICAL DUE DILIGENCE REPORT

SIX LANE CHITRADURGA – DAVANGERE – HAVERI - HUBLI SECTION OF NH-48, LENGTH 214.50 KM, IN THE STATE OF KARNATAKA

Project name	**SIX LANE CHITRADURGA – DAVANGERE – HAVERI - HUBLI SECTION OF NH-48, LENGTH 214.50 KM, IN THE STATE OF KARNATAKA**
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Acronyms and Abbreviations

BBD	Benkelman Beam Deflection	LCV	Light Commercial Vehicle
BOQ	Bill of Quantities	LHS	Left hand side
BC	Bituminous Concrete	LIE	Lenders' Independent Engineer
BOT	Build, Operate and Transfer	LT	Low Tension
CA	Concession Agreement	MOEF	Ministry of Environment and Forest
CAPEX	Capital Expenditure	MORT&H	Ministry of Road Transport & Highways
COD	Commercial Operation Date	MPRDC	Madhya Pradesh Road Development Corporation
CRPF	Central Reserve Police Force	MSA	Million Standard Axle
C & G	Clearing and grubbing	NCR	Non-Compliance Report
CRMB	Crumb Rubber Modified Bitumen	NH	National Highways
CUP	Cattle Under Pass	NHAI	National Highways Authority of India
DBM	Dense Bitumen Macadam	NHDP	National Highway Development Programme
DLC	Dense Lean Concrete	NRMB	Natural Rubber Modified Bitumen
DFO	Divisional Forest Office	NOC	No Objection Certificate
DG	Diesel Generator	OFC	Optical Fibre Cable
DLP	Defect liability period	OPEX	Operation Expenditure
DPR	Detailed Project Report	O&M	Operation and Maintenance
EIA	Environment Impact Assessment	PPE	Personal Protection Equipment
EMP	Environment Management Plan	PPP	Public-Private/Public Sector Partnership
EPC	Engineering Procurement & Construction	PQC	Pavement Quality Concrete
FCI	Food Corporation of India	PUP	Pedestrian Under pass
FRL	Formation Road Level	PWD	Public Works Department

FWD	Falling Weight Deflectometer	PCC	Plain Cement Concrete
GAD	General Arrangement Drawing	PD	Project Director
GFC	Good for Construction	PIU	Project Implementation Unit
GOI	Government of India	PLR	Prime lending rate
GSB	Granular Subbase	PMB	Polymer Modified Bitumen
HT	High Tension	PMC	Project Management Consultant
HMP	Hot Mix Plant	PUP	Pedestrian Under Pass
HDM	Highway Development & Management	QA/QC	Quality Assurance / Quality Control
IC	Independent Consultant	SDBC	Semi-dense Bitumen Concrete
IE	Independent Engineer	SPV	Special Purpose Vehicle
IPC	Interim Payment Certification	VDF	Vehicle Damage Factor
IRC	Indian Road Congress		

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1. EXECUTIVE SUMMARY

1.1 Ramboll Scope

NATIONAL HIGHWAYS INFRA INVESTMENT MANAGERS PRIVATE LIMITED have entrusted Ramboll India Private Limited for technical due diligence study of 214.50 km long six lane section of NH-48 between Chitradurga – Davangere – Haveri - Hubli in the State of Karnataka. Accordingly, Ramboll team has undertaken the work of preparing advisory report based on study of project related reports and documents, visual inspections, and field investigations.

1.2 Project Introduction

The Government of India had entrusted to National Highways Authority of India (NHAI) the development, maintenance, and management of National Highway No. 48 (Old NH-4) including Design Chainage Km 0+000 to Km 20+700 & Km 208+000 to Km 260+000 (approx. 72.70 Km) on the Chitradurga Davanagere section (*hereinafter called 'Package 1'*); Design Chainage Km 260.000 to Km 338.923) (approx. 79 Km) on the Davanagere Haveri section (*hereinafter called 'Package 2'*) and chainage from km 340.000 to km 403.400 (approx. 63.4 km) on the Haveri Hubli section (*hereinafter called 'Package 3'*). The Authority had resolved to augment this existing road of Chitradurga Davanagere Haveri Hubli section of National Highway No. 48 (Old NH-4) (hereinafter called the "NH 48") in the State of Karnataka by Six Laning thereof (the "Project") on Hybrid Annuity Mode, which shall be partly financed by the Concessionaire who shall recover its investment and costs through payments to be made by the Authority, in accordance with the terms and conditions to be set forth in a concession agreement.

The Authority had invited proposals by its Request for Proposal for Package 1, 2 & 3 for qualification and short listing of bidders for construction, operation, and maintenance of these Packages on Hybrid Annuity basis. After evaluation of the bids received, the Authority had technically qualified certain bidders including, inter alia, the selected bidder, and accepted the financial bid of the selected bidder and issued Letter of Award to the selected bidder requiring, the execution of the respective Concession Agreement of three packages.

Particulars	Package -1	Package -2	Package -3
Project Name	Six-Laning of Chitradurga - Davanagere including Chitradurga bypass km 189+000 to km 260+000 (Design chainage Km 0+000 to Km 20+700 & Km 208+000 to Km 260+000) of NH-48 (Old NH-4) in the state of Karnataka	Six Laning of Davanagere - Haveri from Km 260.000 to Km 338.923 of NH-48 (Old NH-4) in state of Karnataka	Six Laning & Strengthening of Km 340+000 to Km 403+400 of Hubli - Haveri section of NH-48 (old NH-4) in the state of Karnataka
Mode of the Execution (BOT Toll/ BOT Annuity/ EPC/ HAM/ Others)	Hybrid Annuity Mode under NHDP Phase - V	Hybrid Annuity Mode under NHDP Phase - V	Hybrid Annuity Mode under NHDP Phase - V
Project Phase	Tolling, Operation, Maintenance and Transfer	Tolling, Operation, Maintenance and Transfer	Tolling, Operation, Maintenance and Transfer
No. of Lanes/	6 Lane divided carriageway	6 Lane divided	6 Lane divided

Particulars	Package -1	Package -2	Package -3
Configuration		carriageway	carriageway
Length of the Project (in Km)	72.68 km	78.913 km	62.877 km
Client		NHAI	
NH No.	NH-48 (Old NH-4)	NH-48 (Old NH-4)	NH-48 (Old NH-4)
Concessionaire	PNC Chitradurga Highways Pvt Ltd	IRCON Davangere Haveri Highways Ltd	Montecarlo Hubli Haveri Highways Pvt Ltd
Total Project Cost	INR 1434 Crores	INR 1177 Crores	INR 1200 Crores
EPC Contractor	PNC Infratech Ltd.	Ircon International Limited	Montecarlo Hubli-Haveri Highway Pvt. Ltd & Montecarlo Limited
Independent Engineer (O&M Phase)	URS Scott Wilson India Pvt Ltd in association with G-Eng Advisory Services Pvt Ltd.	URS Scott Wilson India Pvt Ltd in association with G-Eng Advisory Services Pvt Ltd.	L.N. Malviya Infra Projects Pvt. Ltd
LOA	31-Mar-17	29-Mar-17	23-Mar-17
Date of Signing of CA	14-Jun-17	19-Jun-17	5-Jun-17
Appointed Date	27-Dec-17	24-Jan-18	22-Feb-18
Concession Period	Construction period of 912 days and Operation period of 15 years commencing from COD.		
Provisional Certificate of Completion	24-Jun-21	28-May-21	23-Sep-20
Completion Certificate	14-Feb-23	-	27-Apr-22
End Date of Concession period	23-Jun-36	24-May-36	22-Sep-35
HAM Handover date	24-Jun-36	28-May-36	23-Sep-35
No. of Toll Plazas (Number and Location)	Toll Plaza 1: Hebbalu Toll Plaza Ch. 286+000	Toll Plaza 2: Chalageri Toll Plaza at Km 286+160	Toll Plaza 3: Bankapur Toll Plaza Ch. 352+550

Settlement agreement for Rescoping of		25.04.2023	

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Particulars	Package -1	Package -2	Package -3
Descoped work awarded			
Scheduled Date of Completion for re-scoped works		31.10.2024	
Cost of Rescoped work		INR 171.42 crores	

The location map of the project road.

1.3 Project Description

The project road is 214.50 km long and is in the administrative location of three districts namely Chitradurga, Davangere and Haveri in the state of Karnataka. The project traverse's major settlement areas such as Chitradurga, Kolahal, Emmahatti, Golarahatti, Chikbennur, Hunsukatte, Bharmasagara, Davangere, Anagodu, Harihar, Ranibennur, Haveri and Hubli.

Package 1 - The project starts at Km 0.00 of Chitradurga bypass which is 20.7 km long and ends at km 261.680 of NH-48.

Package 2 - The project starts at Km 261.680 and ends at km 340.593 of NH-48.

Package 3 - The project starts at Km 340.593 and ends at km 403.470 of NH-48.

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1.4 Scope of work

Broadly the Scope of services encompasses the following:

- Review of available documents and site visit
- Field inspection, investigations, and Analysis
- Operations and Maintenance assessment
- Major Maintenance strategy and assessment
- Other CapEx (to include balance works and immediate repairs, if any).

1.5 Assessment of Project Assets

Projects asset inventory and their condition assessment is prepared through visual inspection during site visits, review of reports shared by the client, field investigations and analysis, by NSV survey. All the elements and components pertaining to project asset are reported in subsequent Chapter 5, 6 & 7 and their assessment is used to prepare the strategy for preventive, routine, and periodic maintenance. The overall condition of the project and its assets are satisfactory.

S.No.	Item - Features	Units	Package 1	Package 2	Package 3	Total
1	**Service Road**	km	127.087	127.893	117.4	372.380
2	**Bypasses**	km	27.900	31.02	0.000	58.920
3	**Major Intersections**	Nos.	17	10	8	35
4	**Minor Intersection**	Nos.	66	82	76	224
5	**Bus bay & Bus Shelters**	Nos.	22	0	16	38
6	**Truck Lay Bye**	Nos.	1	0	2	3
7	**Rest Area**	Nos.	1	0	1	2
8	**Toll Plaza**	Nos.	1	1	1	3
	Toll Plaza lane	Nos.	16	12	14	42
9	**Median Opening**	Nos.	9	11	12	32
10	**Entry Exit**	Nos.	50	61	98	209
11	**Avenue Plantation**	km	5.107	1.169	2.82	9.096
12	**Median Plantation**	km	60.563	45.693	48.489	154.745
13	**Chain Link Fence**	km	42.459	43.980	-	86.439
14	**Drainage**					
	MCW Longitudinal Drain	km	57.730	88.110	64.710	210.550
	Service Road Longitudinal Drain	km	65.010	74.590	32.920	172.520
	Median Longitudinal Drain	km	1.755	0.240	11.391	13.386

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S.No.	Item - Features	Units	Package 1	Package 2	Package 3	Total
15	**Gantry Sign Board**	Nos.	19	33	15	67
16	**High mast Lights**	Nos.	11	5	19	35
17	**Street Light Poles**	Nos.	2159	1269	1498	4926
18	**Pedestrian Guard Rail**	km	2.158	0.893	4.617	7.668
19	**Rigid Concrete Barrier**	km	53.559	32.29	30.679	116.528
20	**W Beam Crash Barrier**	km	36.276	46.682	29.993	112.951
21	**Interchange Ramp & Loops**	km	4.170	-	-	4.170
22	**CCTV**	Nos.	39	13	65	117
23	**VMS**	Nos.	4	3	8	15
24	**Blinkers**	Nos.	60	8	4	72
25	**Sign Boards**	Nos.	736	717	579	2032
26	**Delineators**	Nos.	-	310	766	1076
27	**Object Hazard Marking**	Nos.	343	182	299	824
28	**Fuel station**	Nos.	13	5	19	37

1.6 Assessment of Structures

The collection and analysis of Major bridges, ROBs and Grade separators condition and inventory data is done using the Mobile Bridge Inspection Unit (MBIU) and comprehensive visual inspection is carried out for assessing the minor bridges, underpasses, overpasses and culverts of the entire project stretch of 214.50 kms. During the inspection and condition survey no major failure/Distresses is observed however minor cracks, exposed reinforcement at parapet, honeycombing repairs at structural components, clogged drainage spout, debris found under culvert and waterways and vegetation found on superstructures with unwanted material found around the bearings.

Total nos. of structures on the Project Highway is given in the table below

Sl. No.	Item	Package-1	Package-2	Package-3	Total
1	Major Bridges	1	2	1	4
2	Minor Bridges	18	7	11	36
3	Flyovers	3	10	2	15
4	ROB	2	2	0	4
5	Overpass	2	0	0	2
6	VUP	13	14	12	39
7	LVUP	21	8	7	36
8	PUP/CUP	16	13	25	54

Sl. No.	Item	Package-1	Package-2	Package-3	Total
9	FOB	1	0	0	1
10	Culvert	101	142	133	376

1.7 Toll Management System (TMS)

The project has 3 toll plazas (as given the table of Project Introduction) comprising of hybrid ETC lane infrastructure in 42 lanes. Bankapur Toll Plaza is the only toll plaza which has Weigh-In-Motion systems installed in each lane and at remaining two toll plazas (Chelagiri & Hebbalu) two Weigh-In-Motion systems are found installed in each direction but with no sensors for vehicle separation and no island for lane discipline.

Further it is also found that the Static Weigh Bridges are installed at only two toll plazas i.e., Bankapur and Chelagiri. It may be pertinent to note that none of the Weigh-In-Motion and Static Weigh Bridge systems are functional and no stamping certificates (which is a mandatory requirement) has been found at any site.

With regards to the TMS functionality, it is pertinent to mention that they are in a poor state of functioning and none of the AVC equipment was found functional. As per the supplementary agreement requirement, a hot-standby server is required at each toll plaza to maintain the business continuity in case of any failure in the primary server which is also not complied with.

1.8 Soil and Material investigation

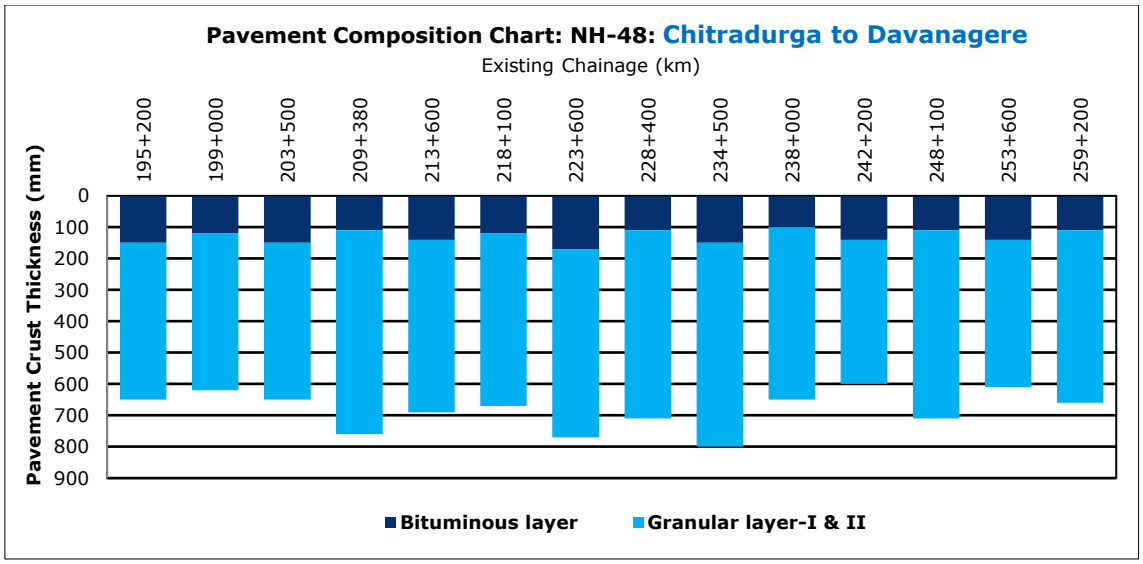
Soil and Material investigation are done with the samples collected from pit investigation and the results are narrated in Chapter 9.

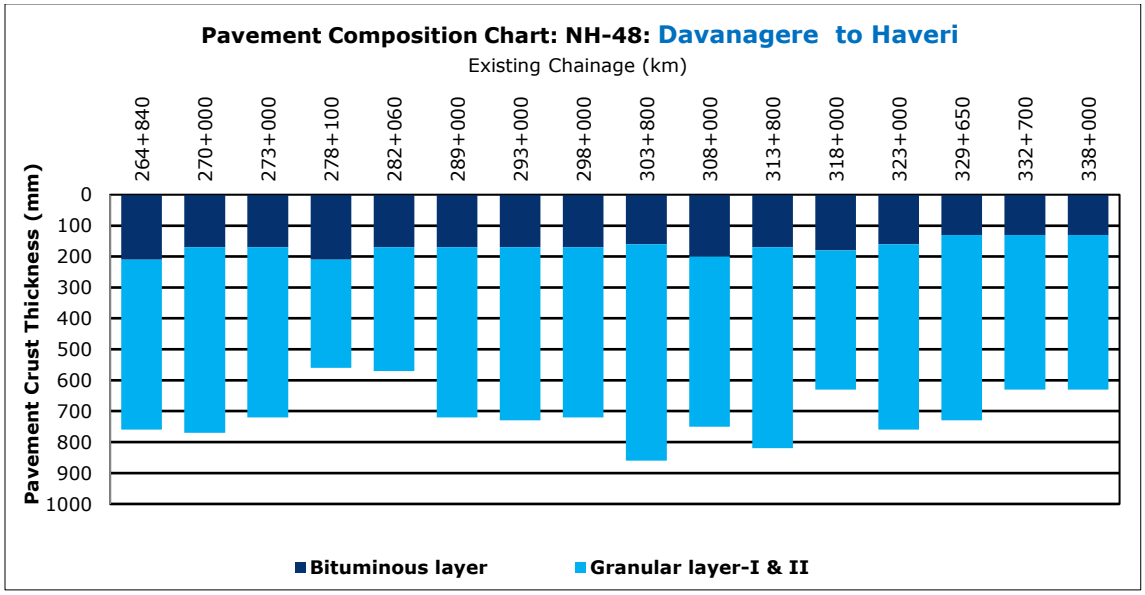
The subsoil is consistent throughout the project road and is predominantly sandy in nature from Chitradurga to Davanagere and Gravel and Sandy in nature from Davanagere to Haveri and Haveri to Hubli. The degree of compaction of subgrade along the project corridor is ranging between 96.1% - 99.0%. Obtained 4-days soaked CBR is ranging from 6.8% to 23.2%.

The existing granular layer material is tested, and the observations are given below.

The Liquid limit and Plasticity Index for all the granular materials is within the LL Limit (Max 25%), PI (Max 6%) as per MoRTH Specifications.

The Aggregate Impact Value of Granular material is within the limit (Max 30% for WMM and Max 40% for GSB) as per MoRTH Specifications. The summary of existing pavement crust thickness is graphically present below:





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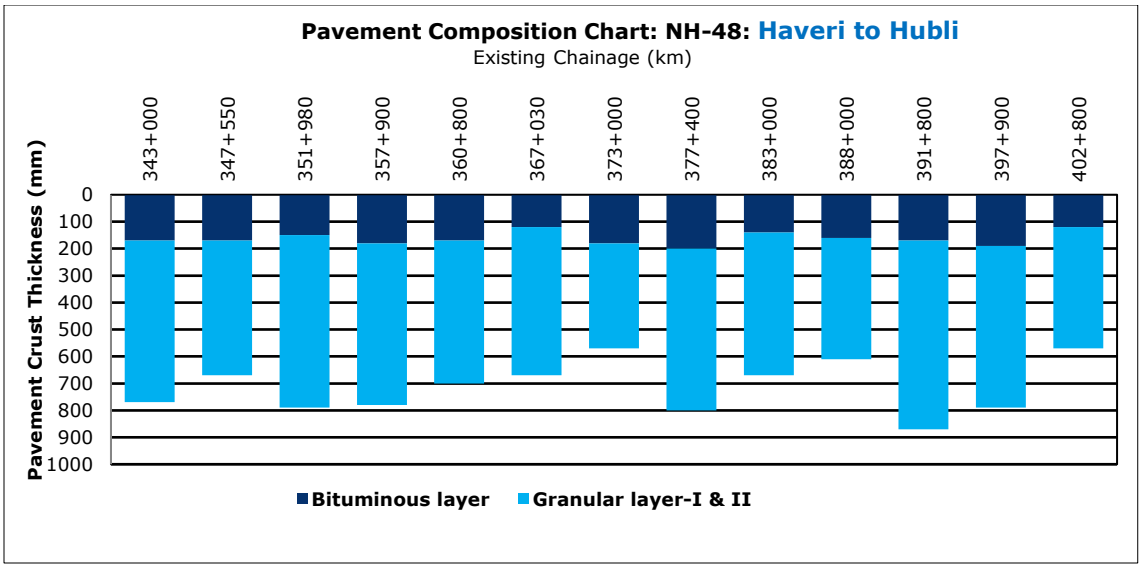


The existing pavement along the project corridor is flexible in nature except at Toll Plaza's. The flexible pavement composition comprises of bituminous layer, granular base over the granular sub-base.

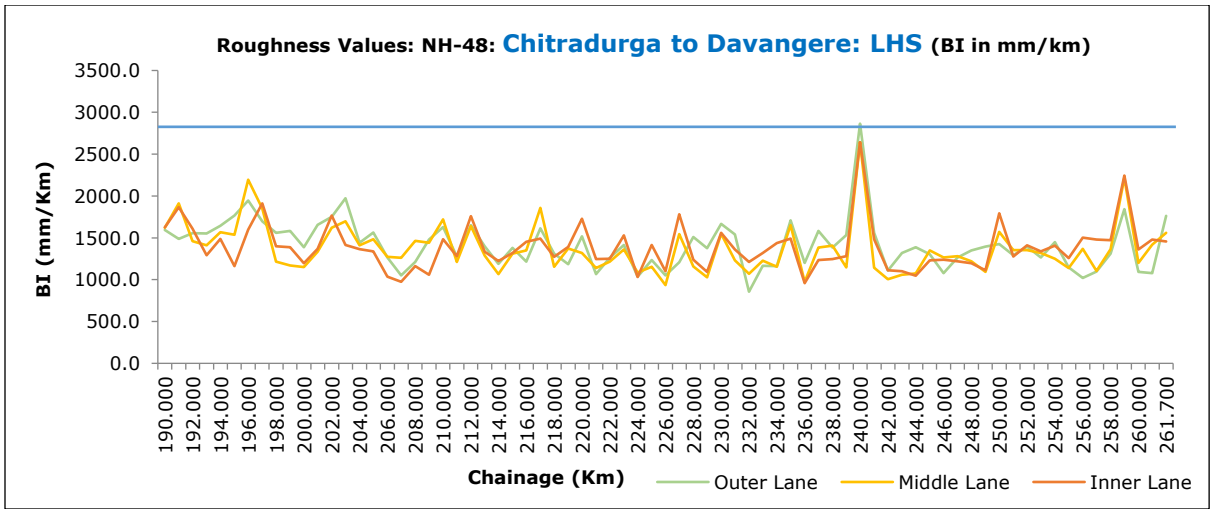
Chitradurga to Davanagere section - Throughout the project road it possesses consistent bituminous/ granular layer thickness with an average of 130mm bituminous layer over 552mm of granular layer.

Davanagere to Haveri section - Throughout the project road it possesses consistent bituminous/ granular layer thickness with an average of 169mm bituminous layer over 541mm of granular layer.

Haveri to Hubli section - Throughout the project road it possesses consistent bituminous/ granular layer thickness with an average of 163mm bituminous layer over 549mm of granular layer.

1.9 Pavement Evaluation

Pavement condition survey was carried out on each lane of each carriage way with NSV. The obtained lane wise Roughness summary in terms of BI (mm/km) is illustrated below and in Chapter 10 for Main carriage way LHS and RHS respectively for Chitradurga to Davangere to Haveri to Hubli.



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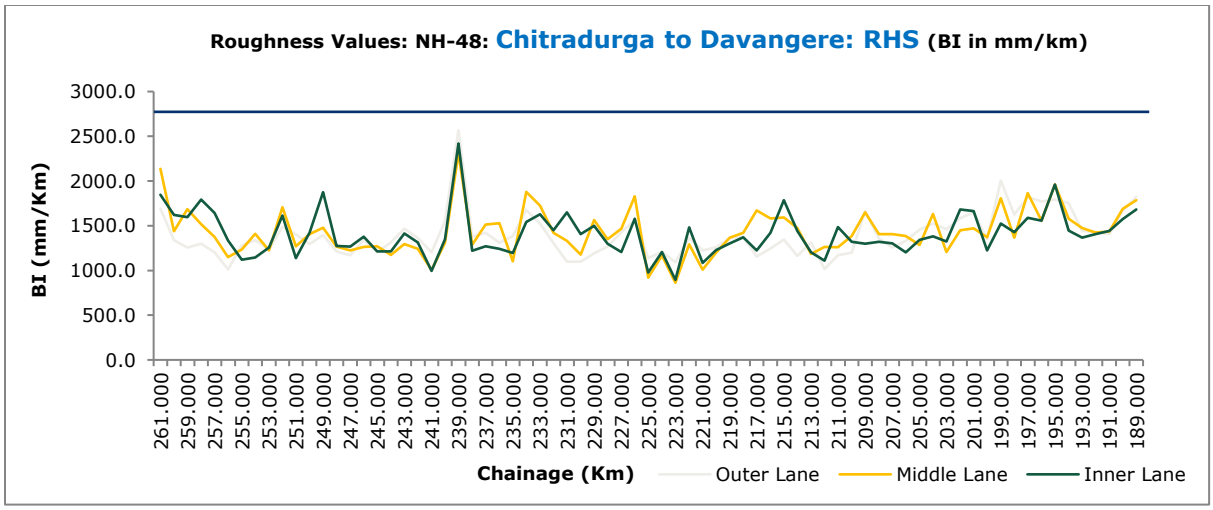

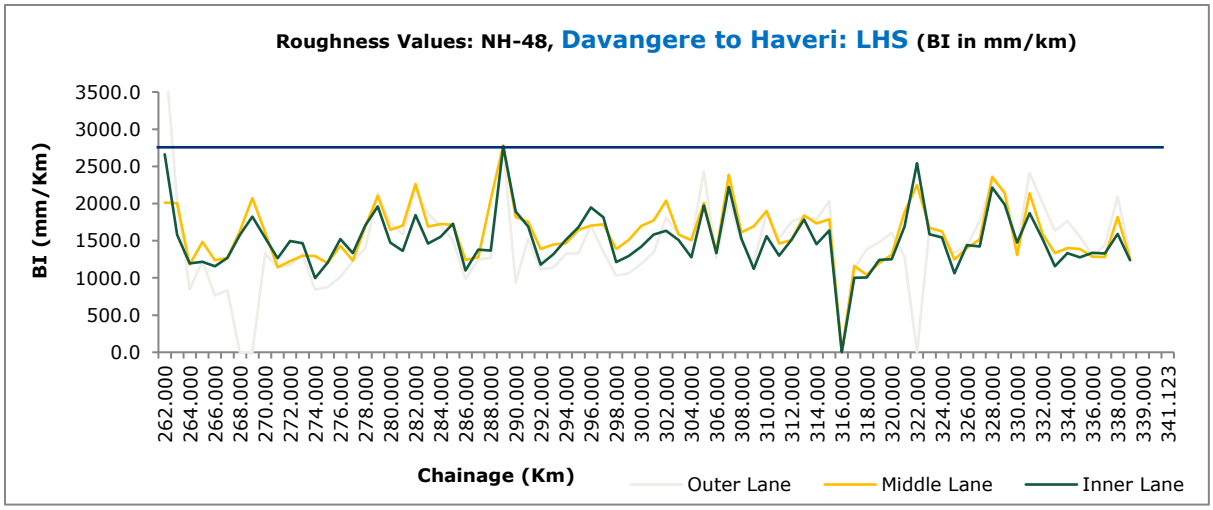

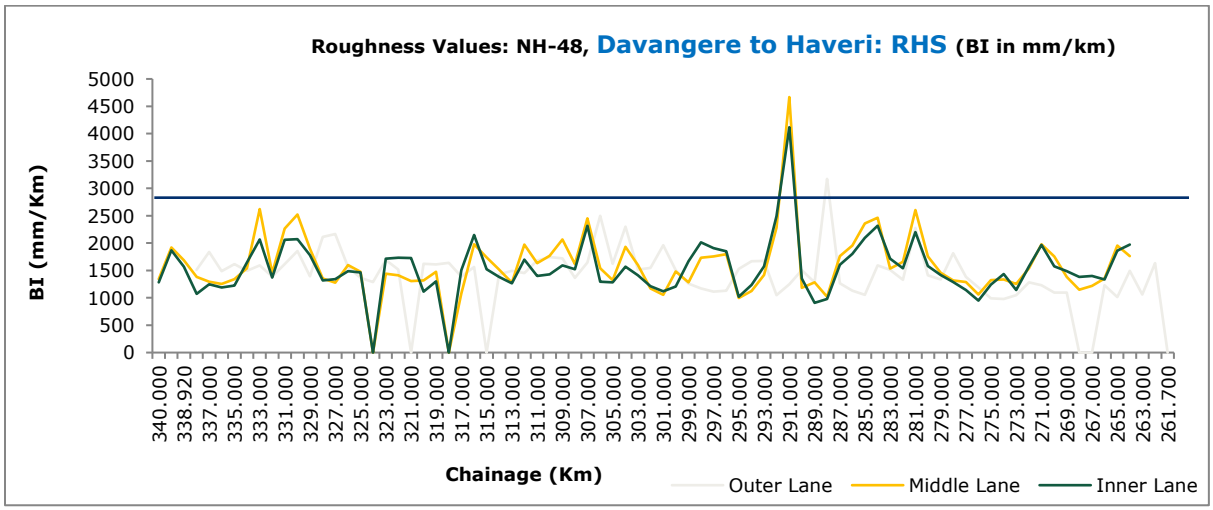

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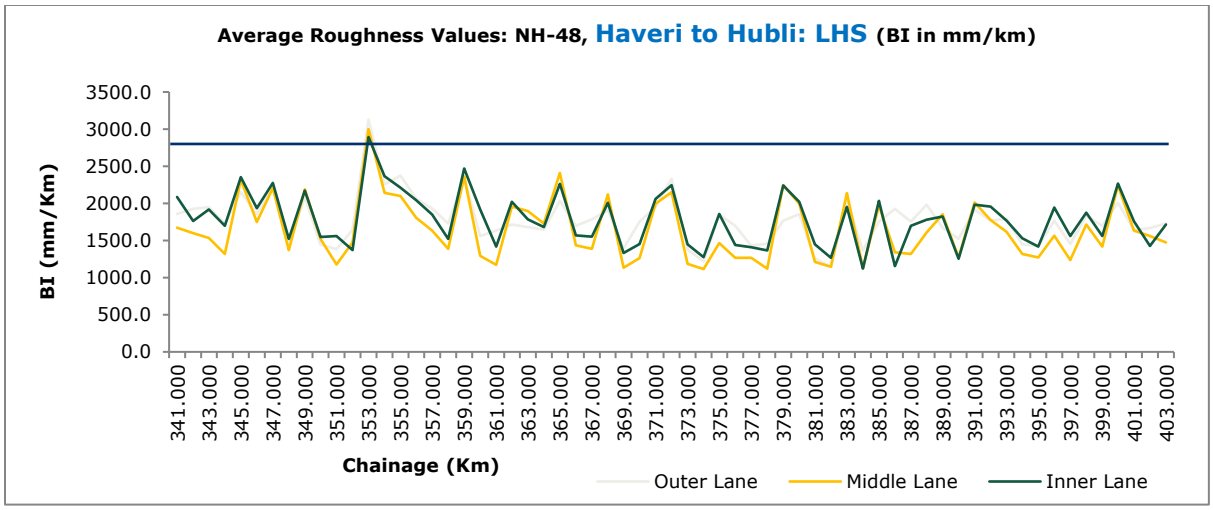
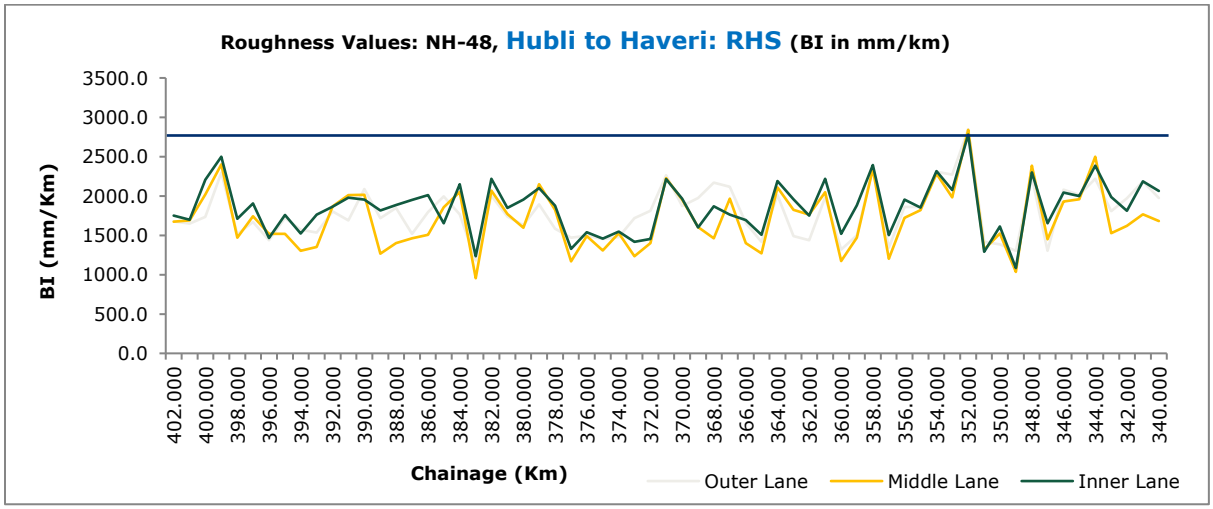
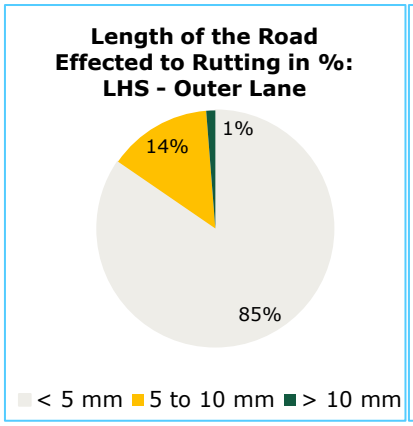


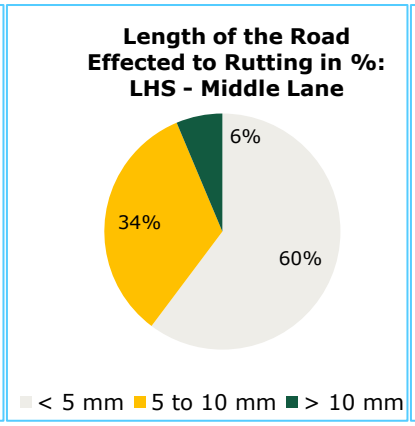


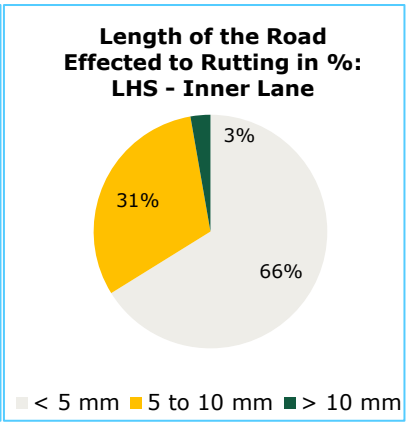
As per Schedule-K of HAM Concession Agreement, limiting value of roughness is 2,750 mm/km. If, the roughness value exceeds more than this during operational period, treatment / rectification has to be done within 180 days. After handover of project stretch to InvIT, the InvIT concessionaire shall maintain the roughness level at 2750mm however after any functional overlay (Roughness exceeding 2750mm) or structural overlay (FWD Test) is provided in a particular stretch length then that particular length shall be maintained at a roughness level mentioned in Schedule-F of TOT Agreement after overlay.

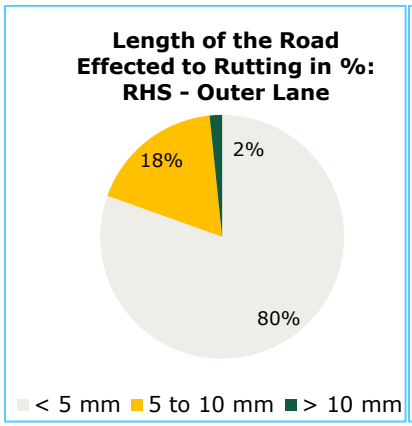
Rutting data of flexible pavement of MCW is also collected through Digital Laser Profilers System (DLP). The obtained lane wise rutting summary is illustrated for LHS and RHS side of the project road as below and presented in Chapter 10. Middle and Inner Lanes of both LHS & RHS direction are having more rutting compared to the other lanes. Rectifications have to be done in the locations whose rut depth is exceeding 10mm within 30 days as per schedule-K and F of HAM and TOT Agreement respectively.

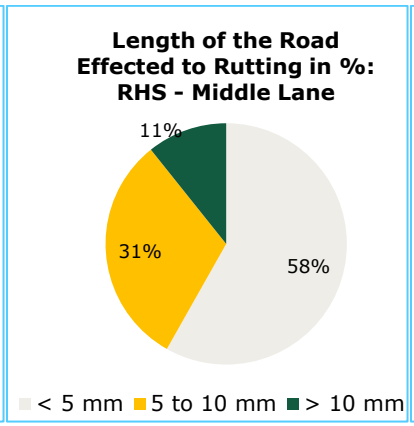
Chitradurga - Davanagere Section:

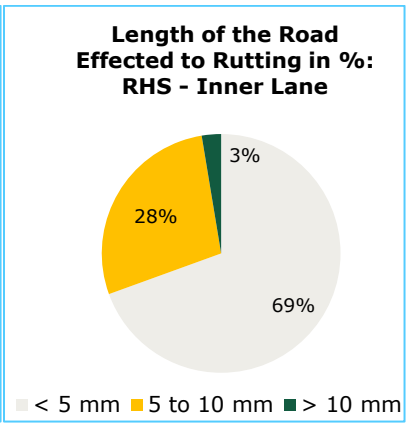




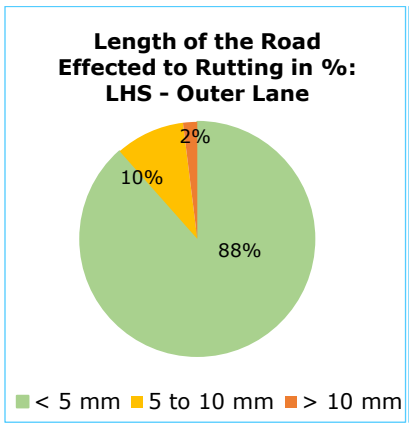


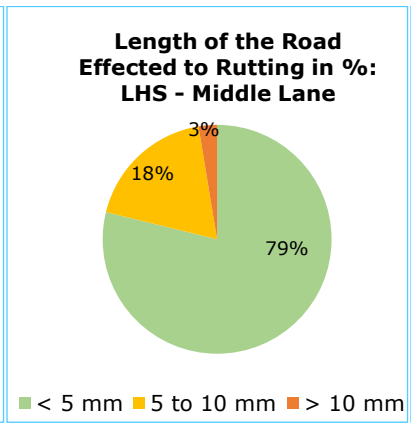


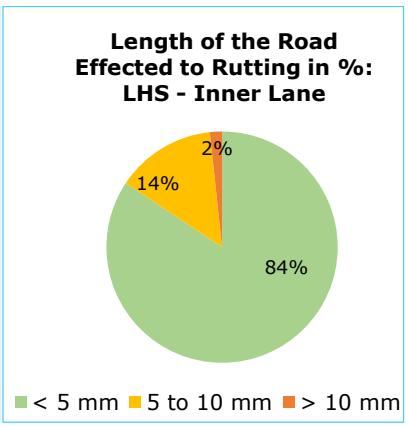




Davanagere -Haveri Section:







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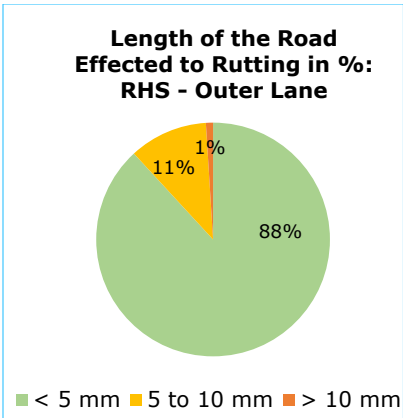
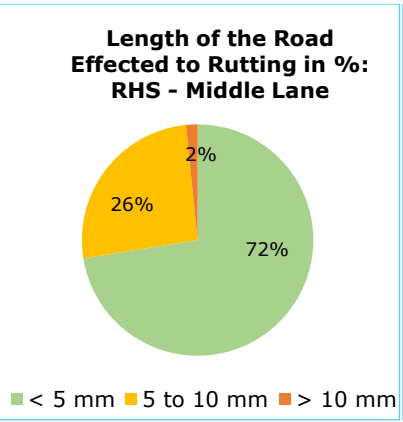
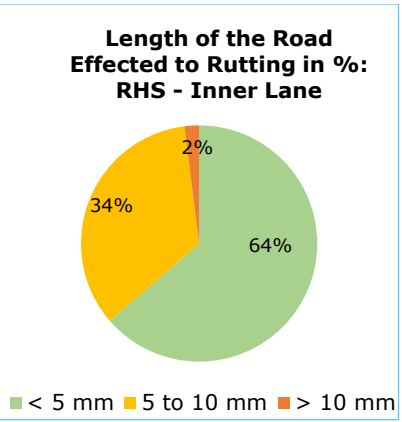
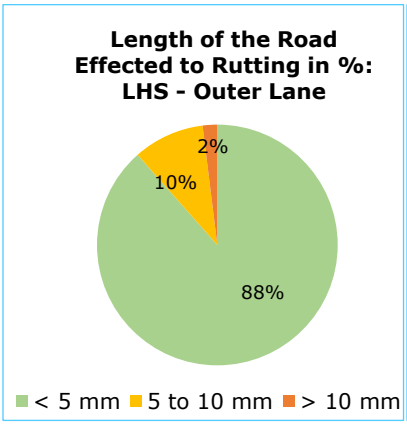
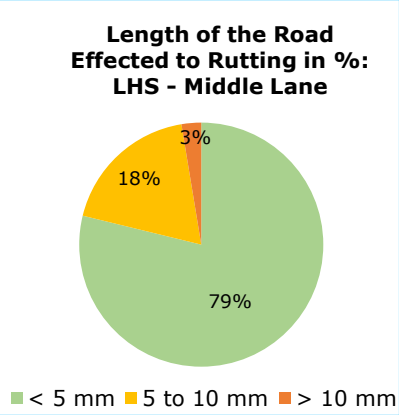


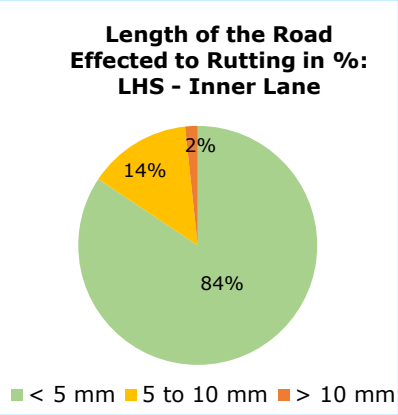


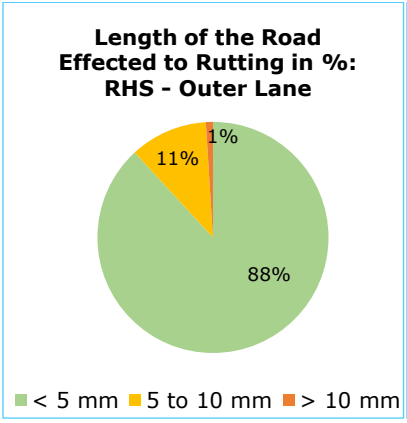


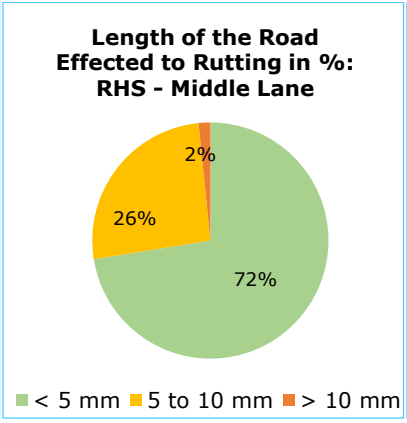
Haveri – Hubli Section:

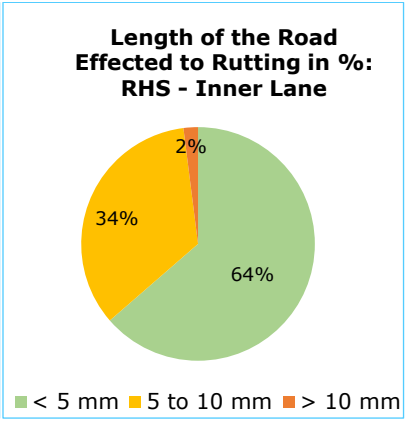








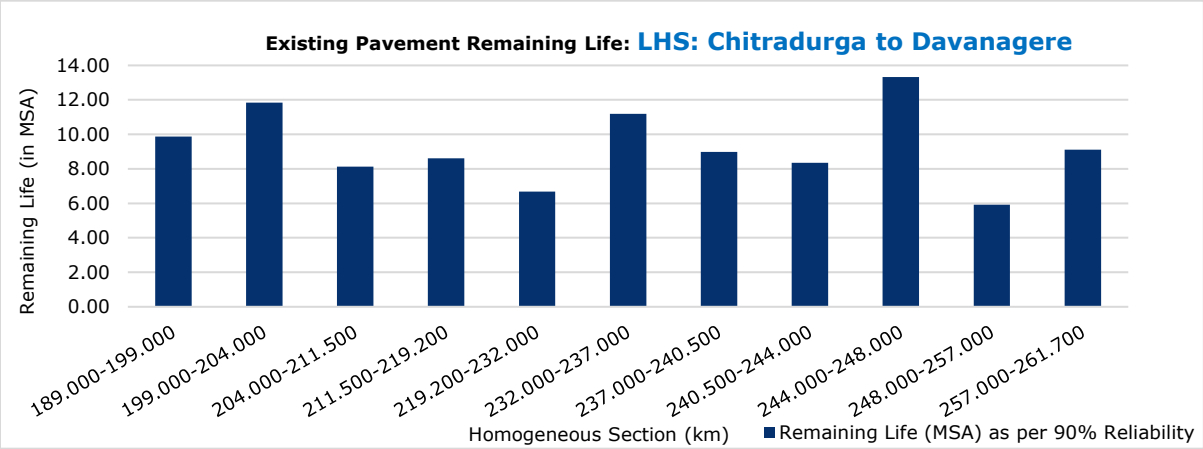


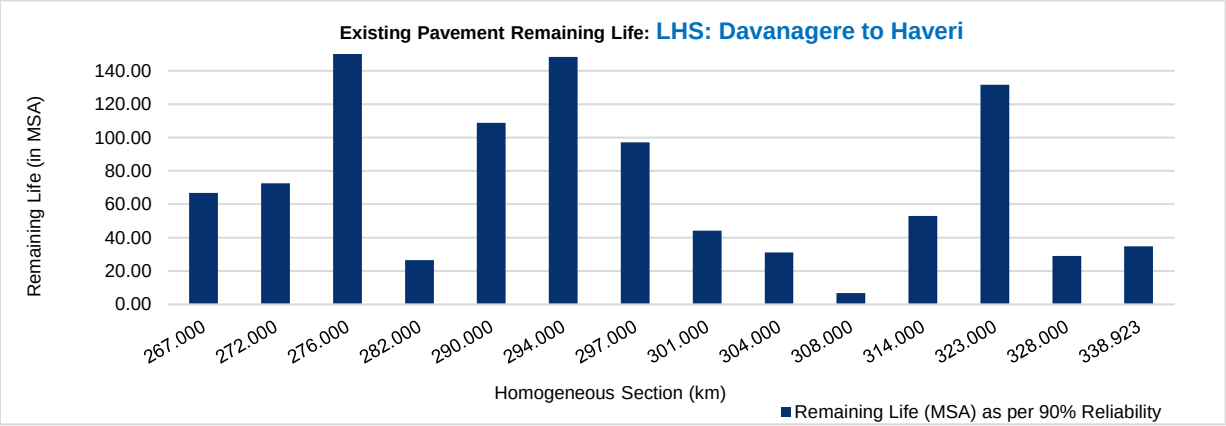


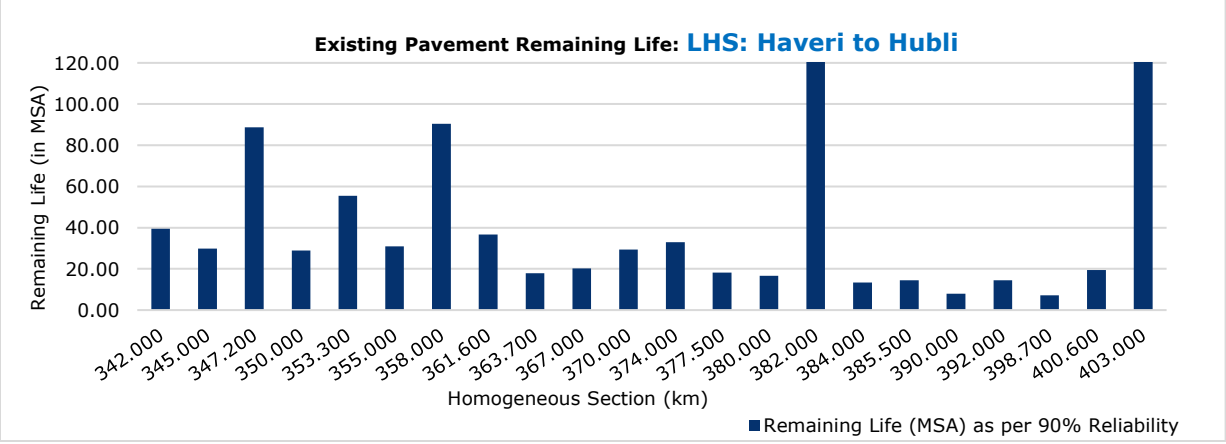
Pavement distresses are considered for assessing the flexible pavement condition as per IRC: 82-2015. There are no major surface distresses observed along the project stretch except cracks. Un-acceptable surface distress locations are summarised along with appropriate rehabilitation techniques in Chapter 10.

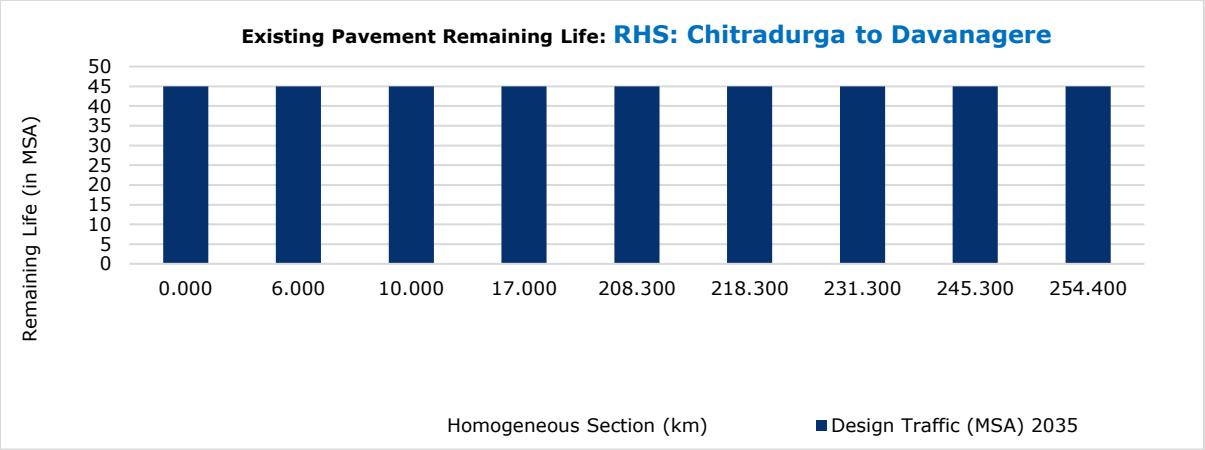
FWD deflection measurement has been carried out for each carriageway to evaluate the pavement structural strength and analysis of remaining life of project is carried out in conformity with IRC: 115-2014. The in-service three-layer pavement system has been analysed with the back-calculated corrected

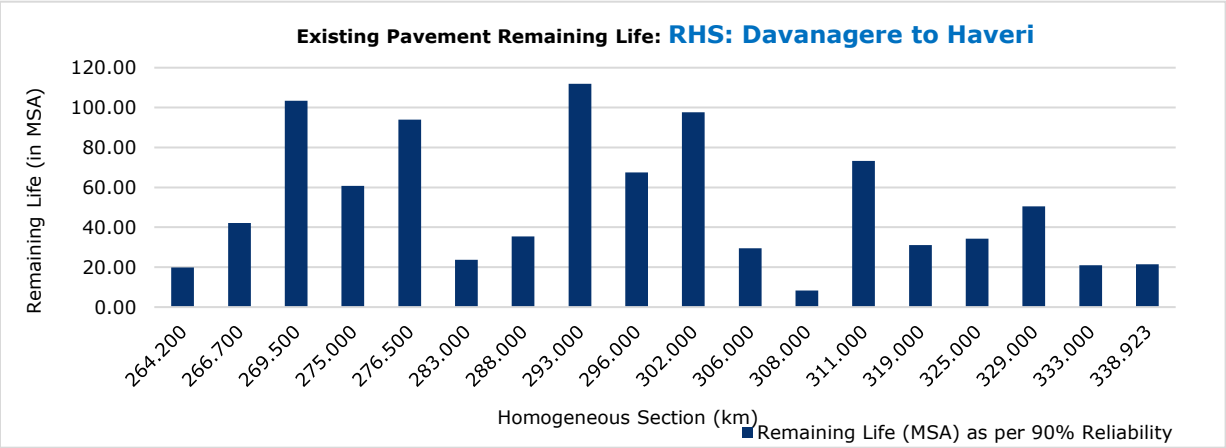
layer moduli and layer thicknesses. From the performance criteria equations, the residual/remaining rutting and fatigue life have been estimated. Remaining life and required overlay are calculated as per 90% reliability. The detailed analysis is presented direction wise in Chapter 10 and the obtained remaining life are graphically presented below:

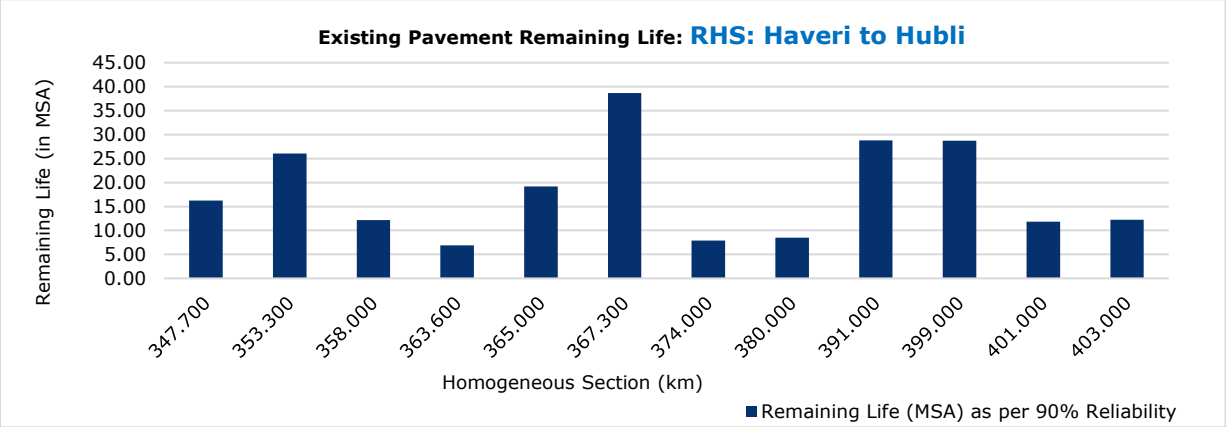




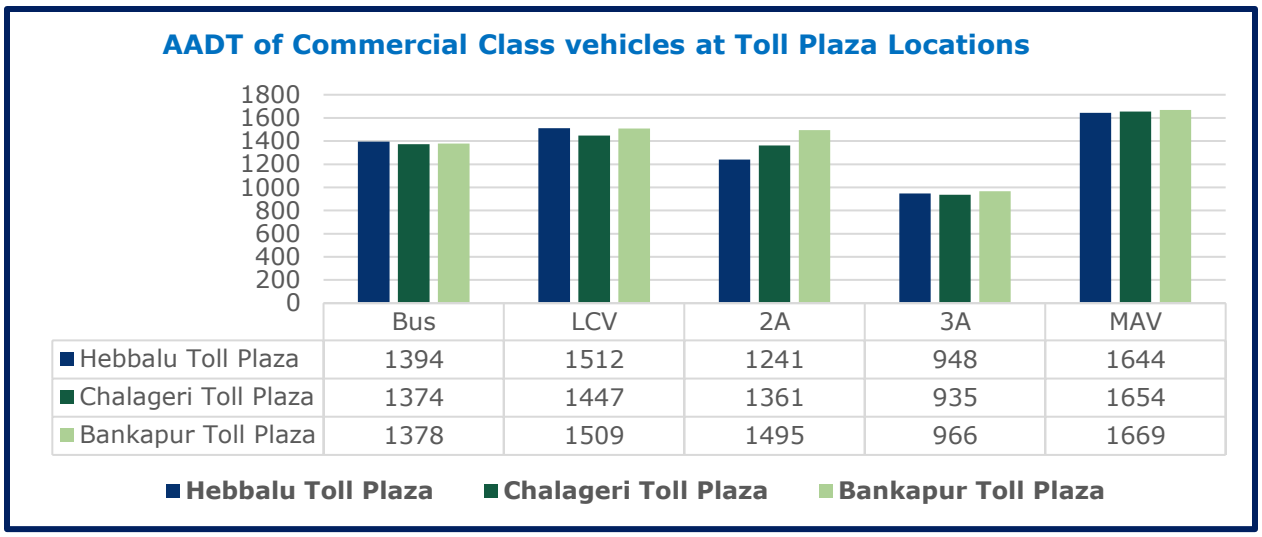








Team for Technical Due Diligence conducted a 48 hrs axle load survey at each of three toll plaza locations. AADT has been taken from the traffic/ revenue consultants & minimum 5% growth rate is considered. The Annual Average Daily Traffic (AADT) of all commercial class vehicles as provided by the traffic / revenue consultants is shown below.



VDF values are obtained as per the analysis of 48hrs axle load survey are presented below:

Vehicle Type	Hebbalu Toll Plaza		Chalageri Toll Plaza		Bankapur Toll Plaza	
	Towards Davanagere	Towards Chitradurga	Towards Haveri	Towards Davanagere	Towards Hubli	Towards Haveri
BUS	0.874	1.074	0.98	1.109	0.891	1.148
LCV	0.676	0.741	0.66	0.703	0.707	0.691
2-Axle	3.658	3.861	3.22	3.599	3.174	3.383
3-Axle	5.781	5.972	5.25	6.249	5.142	5.67
MAV	7.901	9.042	8.072	9.946	9.149	10.438

It is planned to design the overlay till FY-2035. From the obtained remaining life, it is understood that, that existing pavement is not having required design life computed and as given below in the table.

Section	Direction		Side	Design Traffic (MSA) as per Min 5% GR (2035)
Package- I	Chitradurga to Davangere	Chitradurga to Davangere	LHS	41.04
		Davanagere to Chitradurga	RHS	45.23
Package- II	Davanagere to Haveri	Davanagere to Haveri	LHS	40.38
		Haveri to Davangere	RHS	48.34
Package- III	Haveri to Hubli	Haveri to Hubli	LHS	44.65
		Hubli to Haveri	RHS	49.76

The required additional thicknesses are calculated to bring the existing pavement to meet the design projected traffic. The detailed calculated required direction wise thicknesses for LHS & RHS directions are provided with summary of the required overlay in Chapter 10.

1.10 Operation and Maintenance Requirements and Strategy

The concessionaire shall always maintain that during the Operation Period, the Project Highway conforms to the maintenance requirements set forth in Schedule K (the "Maintenance Requirements" of HAM Concession Agreement) and in Schedule F (the "Maintenance Requirements" of TOT Concession Agreement)

A. *Schedule K of the HAM CA*
B. *Schedule F of the TOT CA*

Distresses develop in flexible pavement is described with severity index, and repairing measures are given in Chapter 11. All appropriate technical and contractual parameters are careful reviewed to formulate the strategy of immediate repair and rehabilitation for the existing distresses and roughness. The quantities for LHS Inner, Middle & Outer lanes and RHS Inner, Middle & Outer lanes are presented in Chapter 11.

The Major Maintenance Strategy is assessed in 2 scenarios based on engineering practice and HDM-4 model. The recommended Major Maintenance Strategy till the end of TOT concession period is presented below and also elaborated in Chapter 11.

Major/Periodic Maintenance Strategy for Package 1, 2 & 3

Year	Description	Major/ Periodic Maintenance		Remarks
		Main carriageway / Bus Bay/ Truck Lay bye	Service Roads/ Slip Roads	
Immediate Repairs and Periodic maintenance are to be done by HAM Concessionaire till their end of Concession period as stipulated in HAM Concession Agreement. Handover to TOT concessionaire from HAM Concessionaire is on 24-Jun-36 for Package 1, 28-May-36 for Package 2 and 23-Sep-36 for Package 3. Periodic Maintenance after handover will be done by TOT Concessionaire. Project handover to Authority on 31-Mar-44 by TOT Concessionaire.				
FY 2023-24 to FY 2034-35	Immediate Repairs and Periodic Maintenance are to be done by HAM Concessionaire as stipulated in HAM Concession Agreement			Maintenance requirement will be covered by HAM Concessionaire and Roughness of 2750 mm/km shall be maintained by the HAM Concessionaire prior to handing over to InvIT Concessionaire
FY 2036-37	Structural overlay	40 mm BC on 100% length + Replacement of Bearing & Expansion Joints	-	Maintenance by InviT concessionaire
FY 2036-37	TMS Replacement	-	-	
FY 2037-38	ATMS Replacement	-	-	
FY 2038-39	Periodic Maintenance	-	Micro Surfacing On 100% length	
FY 2043-44	Periodic Maintenance	40 mm BC on 100% length	30 mm BC On 100% length	
FY 2043-44	TMS Replacement	-	-	

1.11 Cost Estimate

The cost estimate is worked out at present rates considering 2023-24 as the base year and is detailed in Chapter 12. Cost Estimate is worked out for expenses on

i. Construction of new 14 lane toll plaza, dismantling of old and maintenance of new plaza – to be executed by TOT Concessionaire
ii. Operational cost for Tolling operations, Incident management, Toll Management Systems, Administrative Expenses – to be done by TOT Concessionaire.
iii. Routine Maintenance and Repairs – to be done by HAM Concessionaire till their end of HAM concession period and thereafter by TOT Concessionaire till FY 2043-44 (handing over of the project).
iv. Periodic Maintenance - to be executed by HAM Concessionaire till their end of HAM Concession and then by TOT Concessionaire till FY 2043-44 (handing over of the project).
v. Immediate repair of pavement & structures – not included in the cost estimate as it is to be executed by HAM concessionaire as per the maintenance requirements stipulated in HAM Concession Agreement.

* (Handover to TOT concessionaire from HAM Concessionaire is on 24-Jun-36 for Package 1, 28-May-36 for Package 2 and 23-Sep-36 for Package 3)

The lump sum cost towards replacement of toll plaza equipment and TMS are estimated INR 26.70 Crore for all three packages and for ATMS replacement it is INR 14.89 Crore till the end of concession period. Capex estimated for New Toll Plaza construction is INR 16.00 crores. Immediate repair cost for Toll Management System is INR 7.90 Crores.

Periodic maintenance for pavement and structures with replacement of TMS and ATMS equipment, from the handover of HAM Concessionaire to InviT is INR 872.30 crores till FY 2043-44. Operational cost till end FY 2043-44 is INR 1284.38 Crores.

2. INTRODUCTION, APPROACH AND METHODOLOGY

National Highways Infra Investment Managers Private Limited have entrusted Ramboll India Private Limited for conducting technical due diligence study for 214.50 km long six lane section of NH-48 between Chitradurga – Davangere – Haveri - Hubli in the State of Karnataka.

Accordingly, Ramboll team has undertaken the work of preparing Technical Due Diligence Report based on study of project related reports and documents, visual inspections, and field investigations.

2.1 Scope of Work and Compliances

The scope of work agreed with National Highways Infra Investment Managers Private Limited for conducting the technical due diligence study is presented in Table 2-1. The table also presents the chapters of the Technical Due Diligence Report where different items of scope of work are covered.

Table 2-1: Scope of Work and Compliances

SN	Scope of Work	Discussed At
1	**Site Visit and Pavement condition Survey – Visual Assessment** Site visit will be undertaken by Highway and Structural Engineers, Pavement Expert, Quantity Survey Experts, TMS & HTMS Expert and engineers to have visual assessment done for the project stretch. Observations will be recorded and critical issues for the Project will be identified and red flagged. Project Structural integrity issues that require rectification / re-mediation will be observed and recorded along with possible risk mitigation strategy & costing thereof. The Consultant shall carry out a detailed reconnaissance of the project area and shall record and highlight important features and point out any issue that may be of importance to the Client in terms of operation and maintenance of the project.	Chapter 3, 5, 6, 7
2	**Conducting inventory, condition surveys and Field Investigations for Project Road** Inventory and detailed condition surveys will be conducted for project highway, bridges & cross drainage structures, project assets, safety appurtenances, TMS & ATMS system including recommendation for either strengthening / rehabilitation or reconstruction / replacement. *Requirements for NDT tests will be identified and informed. Based on the preliminary investigations and walk-through along the stretch, the Consultant shall prepare a project road map indicating the following elements Inventory of existing project assets Existing pavement condition – kilometer-wise (along with Photographs thereof) Intersecting/Crossroads (along with Photographs thereof); Inventory and condition assessment of CD structures (along with Photographs thereof). Condition assessment of pavement.	Chapter 3, 5, 6, 7, 9

SN	Scope of Work	Discussed At
	Condition assessment of structures. Review the extent of balance work. The Consultant should prepare a photo-documentation (Soft copy) of the mentioned areas and any other important findings. The Consultant shall assess the adequacy of Operations &Maintenance, Toll Management System and Advanced Toll Management system. The following field investigations will be carried out for the project stretch. Falling Weight Deflectometer (FWD) Surveys NSV Survey Test Pit investigations Axle Load Surveys Bridge Inspection by MBIU (For Major Structures - length of structure >60m)	
3	**Review of available Project Documents and Reports** The available reports (Concession Agreements, Approved Pavement design report, Monthly Progress Reports, As-built Drawings, Correspondences of stake holders, Asset Management Contracts, Maintenance Manuals, Maintenance history etc) will be reviewed. The Consultant shall assess the completion status of work Vis-à-vis compared with schedule B, C and Schedule D	Chapter 3, 4, 5, 6, 7, 8, 1
4	**Review of construction material and quality, Rehabilitation Plans by Developing strategy for immediate/periodic maintenance.** The Consultant should review of Quality of construction and compaction based on available data and from Laboratory testing of samples collected from trial pits. The Consultant should conduct visual inspection of expansion joints and bearings etc of the structures to assess the condition and requirements for its repair, replacements and / or rehabilitation. The pavement stretches along with the type of distresses will be identified analysing NSV and FWD data. The Consultant should assess maintenance cycles for pavements using HDM analysis. Repair techniques will be suggested for stretches requiring immediate rehabilitation measures. Pavement maintenance strategy (functional overlay/ structural overlay) will be developed for the entire concession period to bring back riding quality of each lane of the carriageway to maximum permissible as stipulated in the Concession Agreement.	Chapter 6, 7, 9, 10, 11
5	**Preparation of BoQ and Cost Estimate**	Chapter 12

SN	Scope of Work	Discussed At
	Bill of Quantities will be prepared for Immediate repairs, Routine maintenance, Periodic/major maintenance, O&M Cost, and Improvement works as per Schedule B of the CA. O&M cost will involve Routine maintenance and Incident Management, Tolling Operations, Admin Expenses and Preventive Maintenance. The Consultant should provide cost till the end of the concession period including any expected extension of Concession periods as informed by the Client. For assessing the cost, Ramboll will use rates available in the market or from the inhouse data base.	

2.2 Deliverables and Timelines

The deliverables and the timelines for the study are as under:

SN	Deliverables	Time period
1	Submission of Red Flag Report /critical issues	Within 14 days from commencement of site visit.
2	Submission of Draft Report	Within 6-7 Weeks from the date of receipt of LOA or all data whichever is later
3	Submission of Final Report	Within one week from the date of receipt of comments from Client or within two weeks from the date of submission of draft report

The above timelines assume that all project related data are available at the start of work.

2.3 Structure of the Report

In line with the requirements of agreed scope of work, this Technical Due Diligence Report is being submitted. The report is organised in the following fashion.

Chapter 1	**Executive Summary:** The chapter presents an overview of the project after review & study of documents, site investigations and estimates for maintenance.
Chapter 2	**Introduction, Approach and Methodology:** The chapter presents a brief approach and methodology adopted for carrying out the Due Diligence Study.
Chapter 3	**Project Description:** The chapter summarises the project features based on Concession Agreement requirements.

Chapter 4	**Review of Concession Agreement:** This chapter contains a short review of the Concession Agreement of all three packages.
Chapter 5	**Assessment of Project Assets - Highway:** The chapter presents the details of various essential features of the project highway recorded through reconnaissance survey and data obtained through NSV Survey.
Chapter 6	**Assessment of Project Assets - Structures:** The chapter presents the details of various essential features of the structures recorded through visual inspection by using MBIU.
Chapter 7	**Assessment of Project Assets – Toll Management Systems:** The chapter presents the details of various essential features of the Toll Plaza Systems and associated facilities recorded through visual inspection.
Chapter 8	**Review of O&M Contracts and Maintenance Manuals:** The chapter contains a short review of the Operation and Maintenance Obligations of the Concessionaire.
Chapter 9	**Soil and Material Investigation:** This chapter discusses the results of soil and material tests carried out for the project stretch.
Chapter 10	**Pavement Evaluation Studies:** This chapter describes the tests carried for pavement evaluation and analyses of the test results.
Chapter 11	**Development of O&M Strategy:** The chapter presents the details of O&M strategy developed based on the Pavement evaluation studies and analysis described in Chapter 10.
Chapter 12	**Cost Estimate:** The chapter outlines the key assumption considered for cost estimate and provides details of cost estimates under various heads viz immediate, O&M and major maintenance for the concession period.

2.4 Documents shared by National Highways Infra Investment Managers Private Limited for Technical Due Diligence of the project.

Ramboll has received the following information/reports/documents of the projects from PIU Dharwad - NHAI, PIU Chitradurga - NHAI, IE site office of package Chitradurga-Davangere, IE of package Davangere-Haveri & IE of package Haveri-Hubli under guidance of National Highways Infra Investment Managers Private Limited.

- Concession Agreement of the project
- Supplementary Agreement to the Concession Agreement
- Drawings

- Letters on COD and PCOD
- Monthly Progress Reports of IE and the Concessionaires
- Consolidated recommendation of COS
- Punchlist Item list during PCOD
- Pavement Design Report
- Operation & Maintenance Manual
- Insurance Policy
- Asset Inventory
- IE's MBIU survey Report
- IE's FWD & NSV Report
- Safety Audit Report
- KMZ file
- Electrical details

2.5 Approach

Our approach and methodology to address the requirements defined in terms of reference are briefly presented below.

- Identification of objectives of Client through detailed study of scope of work and discussions with the Client.
- Identification of Assignment specific team of professionals covering all the skills and specializations required and involving with the assignment from day one.
- A Team Leader is assigned to coordinate various events / activities of various team members.
- Assessment of data / information required is made at the time of Proposal / Engagement letter and the list is shared with the Client.

2.6 Study

The following briefly presents the process followed for the present study.

- The data available for the project are collected from site offices of PIU – NHAI and of respective Independent Engineers of three packages.
- The data is reviewed by the study team and information collated in different categories e.g., asset inventory, contracts, change of scope, communications from NHAI, maintenance strategy and maintenance costs etc.
- Data gaps are identified through the above process and communicated to the Client.
- Detailed review of all the available data is carried out.
- Site visit is made by team of experts to understand the project features and observations are recorded.
- Field tests are carried out as per agreed scope of work.

- The test results are analysed in detail and maintenance strategies are developed.
- Inferences are made on various items of scope of work based on the available data and compared with the requirements of concession Agreement. Issues are flagged wherever required.
- The costs associated with the project under various head (immediate, routine operation and maintenance and Major Maintenance) are worked out in accordance with the requirements of Concession Agreement under current scenario.
- Finally, a comprehensive report is prepared covering all aspects of the agreed scope of work.

2.7 Delivery

Delivery follows the following flow:

- Formats of agreed deliverables are formalized and shared with Client, wherever required.
- Deliverables are shared with the Client within agreed timelines.

2.8 Feedback

Regular and end-of-the-assignment feedbacks are obtained from the client for further enhancing the quality of service.

3. PROJECT DESCRIPTION

The Government of India had entrusted to National Highways Authority of India (NHAI) the development, maintenance, and management of National Highway No. 48 (Old NH-4) from km 189+000 to km 403.400. NHAI had resolved to augment this existing road from Chitradurga Davanagere Haveri Hubli section of National Highway No. 48 (Old NH-4) in the State of Karnataka by Six Laning thereof (the "Project") on Hybrid Annuity Model, which shall be partly financed by the Concessionaire who shall recover its investment and costs through payments to be made by the Authority, in accordance with the terms and conditions set forth in the Concession Agreements.

The project road is 214.50 km long and is in the administrative location of three districts namely Chitradurga, Davangere and Haveri in the state of Karnataka. The project traverse's major settlement areas such as Chitradurga, Kolahal, Emmahatti, Golarahatti, Chikbennur, Hunsukatte, Bharmasagara, Davangere, Anagodu, Harihar, Ranibennur, Haveri and Hubli.
Package 1 - The project starts at Km 0.00 of Chitradurga bypass which is 20.7 km long and ends at km 261.680 of NH-48.
Package 2 - The project starts at Km 261.680 and ends at km 340.593 of NH-48.

Package 3 - The project starts at Km 340.593 and ends at km 403.470 of NH-48.

Figure 3-1: Location Map of Project Stretch

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3.1 Terrain

The project road generally passes through plain terrain. There is a stretch of rolling terrain at Km. 210. The land use along the project stretch is mostly of agricultural land, and the rest land-use of forest land, and built-up areas. The project falls under seismic zone 2.

3.2 Right of Way

The right of way (RoW) available in the project is generally ranges between 60m to 80m as specified in Schedule A of the CA.

3.3 Administrative Details of the Project

Administrative details of the project are listed below.

Table 3-1: Administrative Details of the Project

Feature	Package -1	Package -2	Package -3
Project Name	Six-Laning of Chitradurga - Davanagere including Chitradurga bypass km 189+000 to km 260+000 (Design chainage Km 0+000 to Km 20+700 & Km 208+000 to Km 260+000) of NH-48 (Old NH-4) in the state of Karnataka	Six Laning of Davanagere - Haveri from Km 260.000 to Km 338.923 of NH-48 (Old NH-4) in state of Karnataka	Six Laning & Strengthening of Km 340+000 to Km 403+400 of Hubli - Haveri section of NH-48 (old NH-4) in the state of Karnataka
Mode of the Execution (BOT Toll/ BOT Annuity/ EPC/ HAM/ Others)	Hybrid Annuity Mode under NHDP Phase - V	Hybrid Annuity Mode under NHDP Phase - V	Hybrid Annuity Mode under NHDP Phase - V
Project Phase	Tolling, Operation, Maintenance and Transfer	Tolling, Operation, Maintenance and Transfer	Tolling, Operation, Maintenance and Transfer
No. of Lanes/ Configuration	6 Lane divided carriageway	6 Lane divided carriageway	6 Lane divided carriageway
Length of the Project (in Km)	72.68 km	78.913 km	62.877 km
Client	NHAI		
NH No.	NH-48 (Old NH-4)	NH-48 (Old NH-4)	NH-48 (Old NH-4)
Concessionaire	PNC Chitradurga Highways Pvt Ltd	IRCON Davangere Haveri Highways Ltd	Montecarlo Hubli Haveri Highways Pvt Ltd
Total Project Cost	INR 1434 Crores	INR 1177 Crores	INR 1200 Crores

Feature	Package -1	Package -2	Package -3
EPC Contractor	PNC Infratech Ltd.	Ircon International Limited	Montecarlo Hubli-Haveri Highway Pvt. Ltd & Montecarlo Limited
Independent Engineer (O&M Phase)	URS Scott Wilson India Pvt Ltd in association with G-Eng Advisory Services Pvt Ltd.	URS Scott Wilson India Pvt Ltd in association with G-Eng Advisory Services Pvt Ltd.	L.N. Malviya Infra Projects Pvt. Ltd
LOA	31-Mar-17	29-Mar-17	23-Mar-17
Date of Signing of CA	14-Jun-17	19-Jun-17	5-Jun-17
Appointed Date	27-Dec-17	24-Jan-18	22-Feb-18
Concession Period	Construction period of 912 days and Operation period of 15 years commencing from COD.		
Provisional Certificate of Completion	24-Jun-21	28-May-21	23-Sep-20
Completion Certificate	14-Feb-23	-	27-Apr-22
End Date of Concession period	23-Jun-36	24-May-36	22-Sep-35
HAM Handover date	24-Jun-36	28-May-36	23-Sep-35
No. of Toll Plazas (Number and Location)	Toll Plaza 1: Hebbalu Toll Plaza Ch. 286+000	Toll Plaza 2: Chalageri Toll Plaza at Km 286+160	Toll Plaza 3: Bankapur Toll Plaza Ch. 352+550
Extension of Time (EOT) of Concession Period	-	(i) granted 3 months of interim time extension till 24.10.2020 on account of COVID-19 pandemic. (ii) further period of 3 months beyond 24.10.2020, i.e., up to 23.01.2021, under the provisions of Aathamanirbhar Circular dated 15.10.2020. (iii) Extension of Time for a period from 24.01.2021 to	-

Feature	Package -1	Package -2	Package -3
		28.05.2021 on account of COVID-19 restrictions as per NHAI Policy Guidelines no. 18.53/2020, dated 17.09.2020.	
Settlement agreement for Rescoping of Descoped work awarded		25.04.2023	
Scheduled Date of Completion for re-scoped works		31.10.2024	
Cost of Rescoped work		INR 171.42 crores	

3.4 Salient Features of the Project and Scope of Work

The salient features of the project and scope of work in accordance with Schedules B and C are presented in Table 3-2.

Table 3-2: Salient Features of the Project and Scope of Work

S.No.	Item	Units	Package 1	Package 2	Package 3	Total
1	**Service Road**	km	127.087	127.893	117.4	372.380
2	**Bypasses**	km	27.900	31.02	0.000	58.920
3	**Major Intersections**	Nos.	17	10	8	35
4	**Minor Intersection**	Nos.	66	82	76	224
5	**Bus bay & Bus Shelters**	Nos.	22	0	16	38
6	**Truck Lay Bye**	Nos.	1	0	2	3
7	**Rest Area**	Nos.	1	0	1	2
8	**Toll Plaza**	Nos.	1	1	1	3
	Toll Plaza lane	Nos.	16	12	14	42
9	**Median Opening**	Nos.	9	11	12	32
10	**Entry Exit**	Nos.	50	61	98	209
11	**Avenue Plantation**	km	5.107	1.169	2.82	9.096

12	**Median Plantation**	km	60.563	45.693	48.489	154.745
13	**Chain Link Fence**	km	42.459	43.980	-	86.439
14	**Drainage**					
	MCW Longitudinal Drain	km	57.730	88.110	64.710	210.550
	Service Road Longitudinal Drain	km	65.010	74.590	32.920	172.520
	Median Longitudinal Drain	km	1.755	0.240	11.391	13.386
15	**Gantry Sign Board**	Nos.	19	33	15	67
16	**High mast Lights**	Nos.	11	5	19	35
17	**Street Light Poles**	Nos.	2159	1269	1498	4926
18	**Pedestrian Guard Rail**	km	2.158	0.893	4.617	7.668
19	**Rigid Concrete Barrier**	km	53.559	32.29	30.679	116.528
20	**W Beam Crash Barrier**	km	36.276	46.682	29.993	112.951
21	**Interchange Ramp & Loops**	km	4.170	-	-	4.170
22	**CCTV**	Nos.	39	13	65	117
23	**VMS**	Nos.	4	3	8	15
24	**Blinkers**	Nos.	60	8	4	72
25	**Sign Boards**	Nos.	736	717	579	2032
26	**Delineators**	Nos.	-	310	766	1076
27	**Object Hazard Marking**	Nos.	343	182	299	824
28	**Fuel station**	Nos.	13	5	19	37

3.5 Specification and Standards

The Project Highway conforms to the IRC SP-87-2013, Manual of Specifications and Standards for Six Laning of Highways through PPP, as stipulated in the CA. However, certain deviation to IRC-SP-87-2013 as listed in Schedule D of the CA is given below.

1. Deviations from the Manual

Table 3-3: Deviation and Reference

#	Clause referred in the Manual	Details of Items	Description of Deviation
For Package 1 & 2			

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#	Clause referred in the Manual	Details of Items	Description of Deviation
1.	1.13	Location of Service Roads, Entry exit Ramps and Acceleration /Deceleration Lanes	The Locations are as specified in Schedule - B
2.	1.16	Type and locations of Noise Barrier	Noise Barriers of fibre glass type on iron trestles for a height of 2.4m above ground level, which is aesthetically pleasing, weatherproof & vandal proof, shall be provided at the locations where the noise levels are beyond the prescribed limits anytime during the concession period.
3.	2.3	OW shall be as specified in Schedule - B.	ROW shall be as specified in Schedule - B.
4.	7.1 (iv)	Viaduct Spans are to be provided, if height of solid embankment m built up sections is more than 5m.	Deleted
5.	7.2.1	Measures for protecting the structures and marine environment	As specified in IRC: SP:80-20 l 0
6.	2.10.1 (iii) & 2.10.2 (ii)	PUP/PAX/LCVs	All existing nonstandard PUP/ PAX/ LCVs of lateral clearance less than 7m and vertical clearance less than 3.0m shall be either widened to 6 Lane or retained as specified in schedule B.
7.	2.10.1 (i) & 2.10.2 (i)	VUPs	All existing VUPs of lateral clearance less than 12m and vertical clearance less than 5.5m on LHS carriage way shall be retained and same shall be proposed on the RHS carriage way as specified in Schedule B.
8.	2.12.2.1	The roadway width of service road shall be minimum of 10 m	It shall be as per Typical cross Sections. For TCS IA & 1 B & 16 the roadway width of service road shall be 7m carriageway and earthen shoulder shall be 0.5m on one side & 10m on other side. For TCS 8 the service road width shall be 5.5m. For TCS 2 the service road width shall be 7.0m.
9.	7.3	Width of new structures	The New structures shall have the width as given in Schedule-B.
10	Fig 2.7 Typical cross Section	Non built up Typical cross section with 5.5m median	TCS 1 B is non-built-up section with median width of3.0m
11	Fig 2.9 Typical cross	Built up Typical cross section with 3.0m median	TCS 3 A is built up section with median width of5.5m.

#	Clause referred in the Manual	Details of Items	Description of Deviation
	Section		
For Package 3			
1	2.10	Lateral & Vertical Clearance for Existing Vehicular/ Pedestrian / Cattle Underpasses/ Cattle Pass cum Drain	The Lateral & Vertical Clearance for Existing Vehicular/ Pedestrian/Cattle Underpasses / Cattle Pass cum Drain shall be kept the same, which is not as per Manual of Specification
2	2.10.2	Vertical Clearance	Vertical Clearance for LVUP shall be provided as specified in Schedule B.
3	2.17	Typical Cross Section	Typical Cross Section shall be followed as specified in Schedule-B.
4	7. 19	Proposed Underpasses	Modify the sub-clause as below: Width of Proposed underpasses shall be provided as specified in Schedule B.
5	7.3	Width of Existing Minor Bridges	The existing total width as mentioned Ill Schedule A for Minor Bridges. and which are not proposed for Widening in Schedule B shall be kept the same. This deviates from the structure configuration specified in Manual of Specification.
6	7.3	Width of Major Bridge	The existing major bridge (km 345.573) on RHS is having 7.5 m wide carriageway, 1.5 m wide footpath as mentioned in Schedule A. shall not be widened.
7	7.3	Width of Proposed Minor Bridges	Proposed width of Minor Bridge shall be specified in Schedule B
8	7.19	Width of Existing Flyovers / Underpasses	The existing total width as mentioned in Schedule A for Flyovers/Underpass shall be kept the same which deviates from the structure configuration specified Ill Manual of Specification.
9	10.4.10	Toll Plaza	All Lanes of the Toll Plaza shall be provided with system of payment through Electronic Toll Collection (ETC) with additional provision for Manual Toll Collection.
10	11.1	Landscaping and Tree Plantation	The Landscaping and Tree Plantation as mentioned in Clause 2.5 of Schedule "C" shall not be in the scope of the concess1ona1re. This shall be executed by National Green Highways Mission.
11		Aggregates	Flakiness and Elongation index of

#	Clause referred in the Manual	Details of Items	Description of Deviation
			aggregates shall be maintained as per standards using suitable machinery without any additional cost.

4. REVIEW OF CONCESSION AGREEMENT

This chapter contains a short review of the concession agreements of all the three packages'

4.1 Brief Review of Concession Agreement

It may be noted that The Concession Agreement is primarily divided into Six parts and various Schedules that are available at the end of the CA. Contents of each of the Six parts and the Schedule is briefly mentioned below.

Part I Definitions and Interpretations

Addresses - the Definition and Interpretation, measurements and arithmetic conventions priority of agreements, clauses and schedules.

Part II The Concession

Addresses -, Scope of the Project, Grant of Concession, Conditions Precedent, Obligations of the Concessionaire, Obligations of the Authority, Representations and Warranties and Disclaimer.

Part III Development and Operations

Addresses – Performance Security, Right of Way, Utilities, Associated Roads and Trees, Construction of project, Monitoring of Construction, Completion Certificate, Entry into Commercial Service, Change of Scope, Operation and Maintenance, Safety Requirements, Traffic Census, Monitoring of Operations & Maintenance, Regulation and Management, Independent Engineer.

Part IV Financial Covenants

Addresses – Financial Close, Payment of Bid Project Cost, Article 24, Escrow Account, Insurance, Account and Audit.

Part V Force Majeure and Termination

Addresses - Force Majeure, Compensation for Breach of Agreement, Suspension of Concessionaire's Rights, Termination, Divestment of Rights and Interest and Defects Liability after Termination

Part VI Other Provisions

Addresses - Assignment and Charges, Change in Law, Liability and Indemnity, Rights and Title Over the Site, Dispute Resolution, Disclosure, Redressal of Public Grievances, Miscellaneous and Definitions.

Schedules

Site of the Project, Development of the Project Highway, Project Facilities, Specifications and Standards, Applicable Permits, Performance Security, Project Completion Schedule, Drawings, Tests, Completion Certificate, Maintenance Requirements, Safety Requirements, Monthly Fee Statement, Weekly Traffic Census, Traffic Sampling, Selection of Independent Engineer, Terms of Reference for Independent Engineer, Fee Notification, Escrow Agreement, Panel of Chartered Accountants, Vesting Certificate, and Substitution Agreement.

4.2 Operation and Maintenance

Operation and Maintenance as described under Article 17 and Schedule K need to be addressed during O&M period.

Article 17 – Operation and Maintenance

O&M obligations of the Concessionaire, Maintenance Requirement, Maintenance Manual, Maintenance Programme, Safety, breakdowns and accidents, De-commissioning due to Emergency, Project closure, Damages for breach of maintenance obligations, Authority's right to take remedial measures, Overriding powers of the Authority, Restoration of loss or damage to Project Highway, Modifications to the Project Highway, Excuse from performance of obligations, Installation and operation of CCTV , Advertising on the Site.

Schedule K - Maintenance Requirements

Maintenance Requirements, Repairs of Defects and Deficiencies, Other defects and deficiencies, Extension of time limit, Emergency repairs/restoration, Daily inspection by the Concessionaire, Divestment Requirements, Display of Schedule – K, Repair/rectification of Defects and Deficiencies.

5. ASSESSMENT OF PROJECT ASSETS – HIGHWAY

Ramboll Team studied the documents received from the PIU's Dharwad & Chitradurga and IE site Office of Package 1, 2 & 3 during site visit in November – December 2023. The teams organised their site visits to carry out visual inspection of Road assets.

Overview of the assets are presented hereunder package-wise as per scope of work stipulated:

- Pavement, including main carriageway, service road, slip road, junctions, and road markings.
- Road Furniture, including sign boards, metal beam, crash barrier, pedestrian guardrails, traffic blinkers, slope protections, drains, plantations (median, avenue, and other landscaping), etc.
- Project Facilities, including highway lightings, truck lay byes, rest areas, bus shelters, toll plazas, highway nest, etc.
- Structures, including culverts, bridges, VUPs, PUPs, grade separators, etc. (in Chapter 6)
- TMS (Toll Management System) (in Chapter 7)

PACKAGE: 1

5.1 Service Roads/ Slip Roads

Service road / Slip Road is constructed along the project as flexible pavement. The overall pavement condition is good. Summary of the service/slip roads within the project corridor package-wise is detailed in **Annexure 5.2,** and photographs are provided below for reference.

Figure 5-1: Service roads (PKG 1)

Figure 5-2: Service roads (PKG-2)

Figure 5-3: Service roads (PKG-3)

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5.2 Intersections

PKG 1

There are 87 intersections in package 1 of the project, comprising 17 major intersections and 70 minor intersections. Both major and minor junctions are constructed as flexible pavement. Summary of major junctions are provided in **Annexure 5.4**, while minor junctions is available in **Annexure 5.5**. Photographs are presented below for reference.

Figure 5-4: Major Intersections (PKG-1)

Figure 5-5: Minor Intersections (PKG 1)

PKG 2

There are 99 intersections in package 2 of the project, comprising 10 major intersections and 89 minor intersections. Both major and minor junctions are constructed as flexible pavement. Summary of major junctions are provided in **Annexure 5.4**, while minor junctions is available in **Annexure 5.5**. Photographs are presented below for reference.

Figure 5-6: Major Intersections (PKG-2)

Figure 5-7: Minor Intersections (PKG-2)

PKG-3

There are 93 intersections in package 3 of the project, comprising 9 major intersections and 84 minor intersections. Both major and minor junctions are constructed as flexible pavement. Summary of major junctions are provided in **Annexure 5.4**, while minor junctions is available in **Annexure 5.5**. Photographs are presented below for reference.

Figure 5-8: Major Intersections (PKG-3)

Figure 5-9: Minor Intersections (PKG-3)

5.3 Bypasses

PKG-1

HAM Concession Agreement, Schedule A, Clause 5, narrates three bypasses with a combined length of 14.200 kilometres in the project, However, Schedule B, Clause 3, stipulates only one bypass i.e., Chitradurga bypass of 20+700km which is executed as six lane flexible pavement. Condition of the bypass is good. Details of the bypass is given in **Annexure 5.3.** Some photographs of the bypass is given here.

Figure 5-10: Bypasses (PKG-1)

PKG-2

HAM Concession Agreement, Schedule A, Clause 5, narrates three bypasses with a combined length of 31.020 kilometres. However, as per Schedule B, Clause 3, there are no new bypasses. Details of the bypasses are given in **Annexure 5.3.** Some photographs of the bypasses are given here.

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Figure 5-11: Bypasses (PKG-2)

PKG-3

There are no new bypasses in this project stretch.

5.4 Rest area

PKG-1

One Rest Area is constructed at Chainage 12+500 LHS of Chitradurga Bypass (Design km 201+500) as per Clause 2.6, Schedule C of the CA. The overall condition of the rest area is satisfactory. Details regarding the Rest Area is provided in **Annexure 5.8**, with some photographs hereunder.

Figure 5-12: Rest area (PKG 1)

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PKG-2

There is no rest area in this package as per the CA, schedule B.

PKG-3

One Rest Area is constructed at existing Chainage 353+650 RHS as per Clause 2.6, Schedule C of the CA. The overall condition of the rest area is satisfactory. Details regarding the Rest Area is provided in **Annexure 5.8**, with some photographs hereunder.

Figure 5-13: Rest area (PKG-3)

5.5 Toll Plaza

PKG-1

Toll Plaza at km 237+650 is provided with 7+1 lanes on each side, operational with Hybrid ETC and have canopy lighting, High mast Lighting, Administrative building, Toilet blocks, Toe away cranes, Corridor Management Vehicles, Weigh Bridge, Paramedical booth, Ambulance services etc. Overall condition of the plazas is good. Toll Plazas detail is given in **Annexure 5.9** and photographs are presented below.

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Figure 5-14: Toll Plaza (PKG-1)

PKG-2

Toll Plaza at km 286+110 is provided with 5+1 lanes on each side, operational with Hybrid ETC and have canopy lighting, High mast Lighting, Administrative building, Toilet blocks, Toe away cranes, Corridor Management Vehicles, Weigh Bridge, Paramedical booth, Ambulance services etc. Overall condition of the plazas is good. Toll Plazas detail is given in **Annexure 5.9** and photographs are presented below.

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Figure 5-15: Toll Plaza (PKG-2)

PKG-3

Toll Plaza at km 352+500 is provided with 6+1 lanes on each side, operational with Hybrid ETC and have canopy lighting, High mast Lighting, Administrative building, Toilet blocks, Toe away cranes, Corridor Management Vehicles, Weigh Bridge, Paramedical booth, Ambulance services etc. Overall condition of the plazas is good. Toll Plazas detail is given in **Annexure 5.9** and photographs are presented below.

Figure 5-16: Toll Plaza (Pkg-3)

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5.6 Fuel Station

Fuel stations along the Project Stretch and access arrangement for the same has been captured during inventory survey. The details are listed in **Annexure 5.27.** Photographs are presented below.

Figure 5-17: Fuel stations (PKG-1)

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Figure 5-18: Fuel stations (PKG-2)

Figure 5-19: Fuel stations (PKG-3)

5.7 Bus bay and Bus Shelter

Bus bay and bus Shelters are equipped with necessary signages, and their overall condition is satisfactory. There are 22 Bus-bay and shelters in package 1 and 16 Bus Bays with shelter in package 3. Bus shelters are found missing at 02 locations in each of these two packages. There is no Bus bays in Package 2. Details of Bus Bay and bus Shelters are presented in **Annexure 5.7** for Package 1 and **Annexure 5.6** for Package 3. Representative photographs are shown below**.**

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Figure 5-20: Bus Bay and Bus shelter (PKG-1)

Figure 5-21: Bus Bay and Bus shelter (PKG-3)

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5.8 Truck lay-byes.

In this 214.50 km long six lane road stretch there are 03 Truck lay-byes, which are constructed at existing chainage 252+950 on LHS side, at existing chainage 383+220 on LHS side and chainage 372+000 on RHS side. Truck lay-byes are in good condition with lighting, rest room, water facilities. Truck lay byes are detailed in **Annexure 5.7**. Some photographs of truck lay byes are given below.

Figure 5-22: Truck Lay bye (PKG-1)

Figure 5-23: Truck Lay bye (PKG-3)

5.9 Entry/ Exit Ramp

Entry and Exit ramps to service road from Main Carriageway is provided along the Project Road. Entry and Exit ramps with locations are detailed in **Annexure 5.11**. Some photographs of these Entry and Exit ramps are given below package-wise.

Figure 5-24: Entry/ Exit Ramp (PKG-1)

Figure 5-25: Entry/ Exit Ramp (PKG-2)

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Figure 5-26: Entry/ Exit Ramp (PKG-3)

5.10 Drainage System

Road drainage along the project Highway includes Main carriageway Lined drain, Service Road Lined drain, Median Longitudinal lined drain, and Chute drain. Condition of these drains are good but requires appropriate routine / preventive maintenance by cleaning debris and vegetations to make the arrangement working. Also need attention to look after the disturbed / damaged RCC cover of box drains. List of these Drainage system is provided in **Annexure 5.15**. Illustrative photographs are presented below**.**

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Figure 5-27: Drainage system (PKG-1)

Figure 5-28: Drainage system (PKG-2)

Confidential

Figure 5-29: Drainage system (PKG-3)

5.11 Median opening

Median openings are provided as per scope stipulated in the CA and according to the requirement of local authority and dwellers along the project highway with required approval from competent authority. Median openings are mostly temporarily blocked by New Jersey Barriers for the safety of road users. List of median openings on Project Stretch are given in **Annexure 5.10**. Photographs of median openings are shown below.

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Figure 5-30: Median Opening (PKG-1)

Figure 5-31: Median Opening (PKG-2)

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Figure 5-32: Median Opening (PKG-3)

5.12 Metal Beam Crash Barriers

Metal Beam Crash Barriers are provided at main Carriageway, at underpasses, at Approaches along the project and at locations of high embankment. It is observed that, metal Beam Crash Barriers are damaged at some locations as listed in Annexures. These damaged Crash Barriers can be reinstated through routine maintenance activities. List of metal Beam Crash Barriers installed on Project Stretch are given in **Annexure 5.26**. Photographs of Metal beam crash barrier.

Figure 5-33: Metal Beam Crash Barriers (PKG-1)

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Figure 5-34: Metal Beam Crash Barriers (PKG-2)

Figure 5-35: Metal Beam Crash Barriers (PKG-3)

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5.13 Traffic Signage

PKG-1

Road signs includes roadside signs, overhead Gantry Mounted signs, Kerb mounted signs and median signs along the Project Highway. There are about 736 nos. sign boards, 19 Overhead Gantry signs on Project Stretch which are in good condition. The details of all traffic signs are provided in **Annexure 5.16, 5.17 & 5.18** respectively for Sign Boards, Overhead Gantry Signs and Cantilever Gantry Signs. Photographs are shown below.

Figure 5-36: Traffic Signs (PKG-1)

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PKG-2

Road signs includes roadside signs, overhead Gantry Mounted signs, Kerb mounted signs and median signs along the Project Highway. There are about 717 nos. sign boards, 33 Cantilever Gantry signs on Project Stretch which are in good condition.

Figure 5-37: Traffic Signs (PKG-2)

PKG-3

Road signs includes roadside signs, overhead Gantry Mounted signs, Kerb mounted signs and median signs along the Project Highway. There are about 579 nos. sign boards, 6 Overhead Gantry signs and 9 Cantilever Gantry signs on Project Stretch which are in good condition.

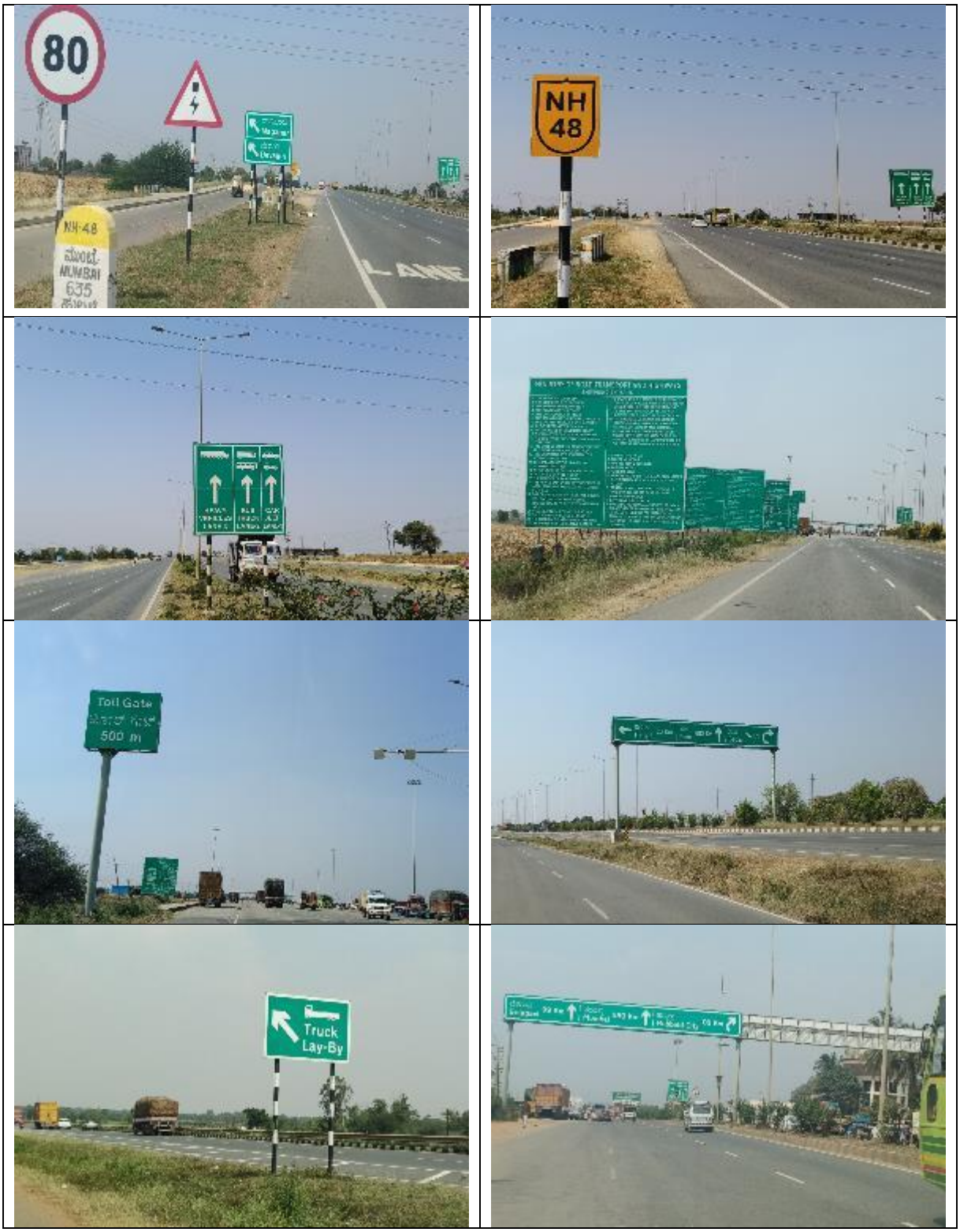

Figure 5-38: Traffic Signs (PKG-3)

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5.14 Highway lighting

Highway lighting is provided at Truck Lay byes, Bus lay byes, Toll Plaza, and at Built-up Locations with single and double arm light poles. Solar Blinker Signals are provided at Entry/exit and Intersections locations. High Mast lightings are provided at Toll Plazas and Major Intersections. These lights are properly maintained and are in good working condition. Summary of Highway lighting on Project Stretch are given in **Annexure 5.19, 5.22** and **5.23** respectively for Street lighting, High Mast Lighting and Solar Blinkers. Photographs are presented below.

Figure 5-39: Highway Lighting (PKG-1)

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Figure 5-40: Highway Lighting (PKG-2)

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Figure 5-41: Highway Lighting (PKG-3)

5.15 Plantation (Median/Avenue)

Landscaping, avenue plantation is visible along the road but sparsely available. Shrubs and flowering plants are also intermittently placed in the median along the project highway with limited varieties. Where available shrubs and plants are either found with overgrowth needs pruning or dried out and needs regular watering / maintenance / replacement. A list of Plantation on Project Stretch is given in **Annexure 5.12 and. Annexure 5.13** respectively and photographs are shown below.

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Figure 5-42: Avenue and Median Plantation (PKG-1)

Figure 5-43: Avenue & Median Plantation (PKG-2)

Figure 5-44: Avenue & Median Plantation (PKG-3)

5.16 Pedestrian Guard Rails (PGR)

Pedestrian Guard Rails (PGR) have been provided at all Bus shelter locations and built-up area on the Project Stretch. List of Pedestrian Guard Rails on Project Stretch are given in **Annexure 5.24**. Pedestrian Guard Rail photographs are shown below.

Figure 5-45: Pedestrian Guard Rails (PKG-1)

Figure 5-46: Pedestrian Guard Rails (PKG-2)

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Figure 5-47: Pedestrian Guard Rails (PKG-3)

5.17 Chain Link Fencing

Chain Link Fencing are provided at separator between main carriageway and service road. Chain-link fencing is noticed in Package 1 and 2 only. List of Chain Link Fencing on Project Stretch are given in **Annexure 5.14**. Illustrative photographs are shown below.

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Figure 5-48: Chain Link Fencing (PKG-1)

Figure 5-49: Chain Link Fencing (PKG-2)

5.18 Kilometre stone/Hectometre stones

Kilometre and hectometre stones are mostly visible along most of the stretch however some of them found uprooted / damaged or script is faded which requires routine maintenance. The existing stones obtained from site visit are presented in the **Annexure 5.33 and Annexure 5.34** and photographs are shown below.

Kilometre Stones, Hectometre Stones

Figure 5-50: Kilometre Stones & Hectometre Stones (PKG-1)

Kilometre Stones, Hectometre Stones

Figure 5-51: Kilometre Stones & Hectometre Stones (PKG-2)

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Kilometre Stones, Hectometre Stones

Figure 5-52: Kilometre Stones & Hectometre Stones (PKG-3)

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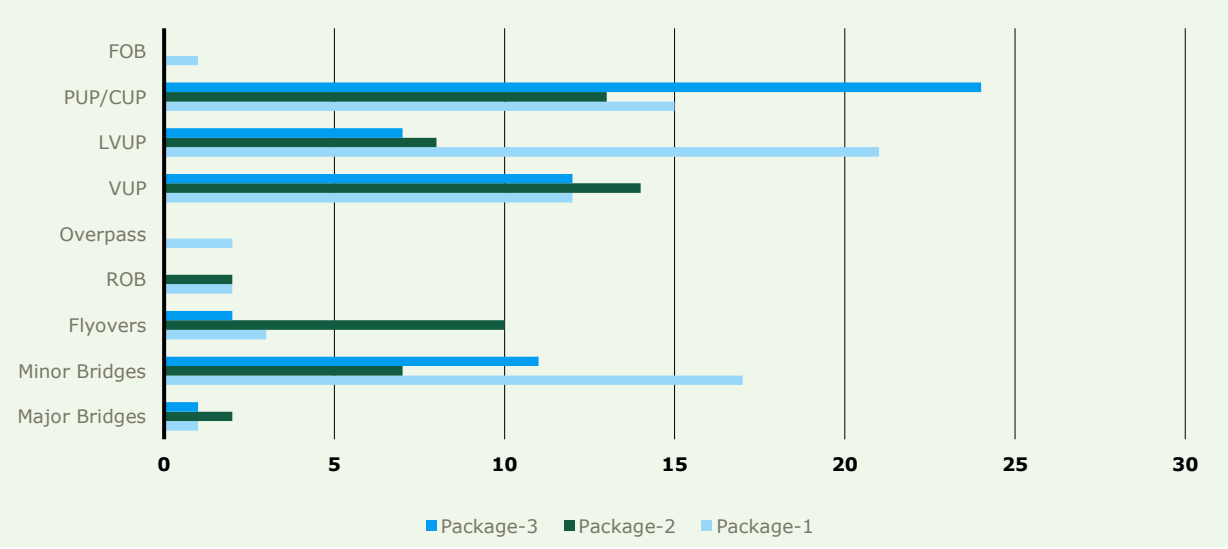
6. ASSESSMENT OF PROJECT ASSETS – STRUCTURES

6.1 Structural Inventory and Assessment

The project comprises of 214.50 Km stretch having starting chainage 189+000 at Chitradurga Bypass and end chainage 403+400 at Hubli, Karnataka on NH-48. The various structures comprising the project are given in Table 6-1.

Table 6-1: Summary of Structures

Sl. No.	Item	Package-1	Package-2	Package-3	Total
1	Major Bridges	1	2	1	4
2	Minor Bridges	18	7	11	36
3	Flyovers	3	10	2	15
4	ROB	2	2	0	4
5	Overpass	2	0	0	2
6	VUP	13	14	12	39
7	LVUP	21	8	7	36
8	PUP/CUP	16	13	25	54
9	FOB	1	0	0	1
10	Culvert	101	142	133	376



Condition survey is carried out for all the structures of project Highway from Chitradurga – Davanagere – Haveri - Hubli section of NH-48 in the state of Karnataka.

The collection and analysis of Major bridges, ROBs and Grade separators condition and inventory data is done using the Mobile Bridge Inspection Unit (MBIU) and comprehensive visual inspection is carried out for assessing the minor bridges, underpasses, overpasses and culverts of the entire project stretch of 214.50 kms. During the inspection and condition survey no major failure/Distresses is observed however minor cracks, exposed reinforcement at parapet, honeycombing repairs at structural components, clogged drainage spout, debris found under culvert and waterways and vegetation found on superstructures with unwanted material found around the bearings. The return walls are inspected to locate any separation of these from the abutment. Any unusual differential settlement which gives rise to cracks in the return or wing walls are inspected along with condition of stone pitching for all the bridges.

Following codes are used for the condition rating of the structural members.

Code	Description
N	NOT APPLICABLE
9	EXCELLENT CONDITION
8	VERY GOOD CONDITION - no problems noted
7	GOOD CONDITION – some minor problems
6	SATISFACTORY CONDITION - structural elements show some minor deterioration
5	FAIR CONDITION - all primary structural elements are sound but may have minor section loss, cracking, spilling or scour
4	POOR CONDITION - advanced section loss, deterioration, Spalling or scour
3	SERIOUS CONDITION - loss of section, deterioration, spelling or scour have seriously affected primary structural components Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present
2	CRITICAL CONDITION - advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored it may be necessary to close the bridge until corrective action is taken
1	IMMINENT' FAILURE CONDITION - major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic, but corrective action may put back in light service.
0	FAILED CONDITION - out of service - beyond corrective action

6.2 Major Bridge

There are 04 nos. of Major Bridge. These Major Bridge are appearing to be sound condition with no distresses. However, like any other structures along the project road, these structures are also in fair state of maintenance. Cleaning of expansion joint, bearings and drainage spouts is required. Protection work is observed damaged due to land slide and scour.

Details of major bridge structures on the Project Highway are as per Table 6.2 -1: given below.

Table 6-2: Details of Major Bridges

Sl. No	Package	Existing (km)	Side	Span Arrangement (m)	Deck Width (m)	Type of Super Structure	Type of Sub Structure
1	Package - 1	210+654	LHS	6 X 11	15	RCC Slab	RCC
			RHS	6 X 11	16	RCC Slab	RCC
2	Package - 2	276+209	LHS	5x19	11.7	RCC Girder	RCC
			RHS	5x19	11.7	RCC Girder	RCC
3		279+514	LHS	1x10+15x30+1x10	16	RCC Girder and Slab	RCC
			RHS	1x10+15x30+1x10	16	RCC Girder and Slab	RCC
4	Package - 3	345+554	LHS	7x40.0	15.2	PSC Girder	RCC
			RHS	7x40.0	15.2	PSC Girder	RCC

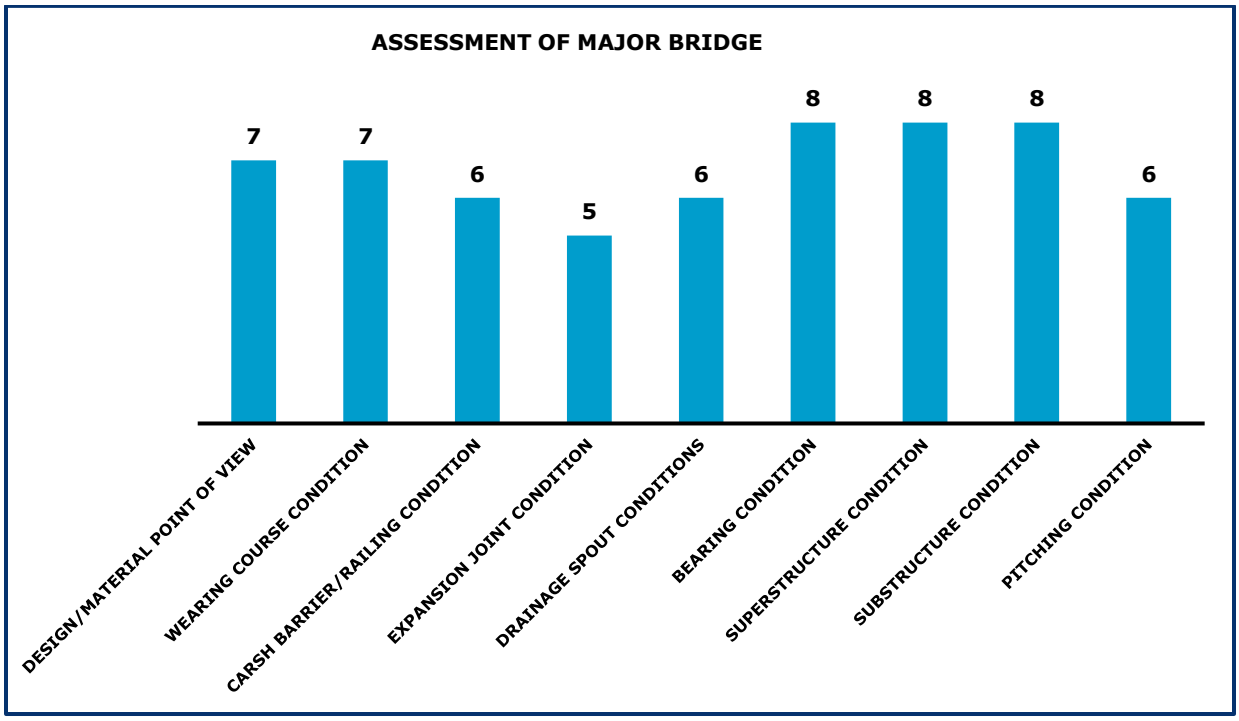


Figure 6-1: Comparative assessment of Major Bridges

Photographs of Major Bridge are presented hereunder.

<table>
<tr><td colspan="2">
</td></tr>
<tr><td colspan="2">Major Bridge at Chainage 210+654 (Span arrangement 6 X 11m)</td></tr>
<tr><td> </td><td> </td></tr>
<tr><td>Drainage Spout Clogged</td><td>Vegetation on bridge.</td></tr>
<tr><td> </td><td> </td></tr>
<tr><td>Silt, Debris, and unwanted material found around the bearings at Major Bridge 276+209</td><td>Footpath filled with debris and vegetation at Major Bridge 276+209</td></tr>
</table>

Drainage spout filled with vegetation at Major Bridge 276+209

Clogged due to silt and debris at Major Bridge 276+209

Silt, Debris, and unwanted material found around the bearings at Major Bridge 279+514

Crash barrier found damaged at Major Bridge 345+554

Expansion joint found damaged at Major Bridge 345+554

Grating of drainage spout found missing and honeycombing found on soffit of girder at Major Bridge 345+554

6.3 Minor Bridge

There are 36 nos. of Minor Bridge on project stretch. Maintenance of these minor bridges are appearing to be fair to satisfactory. Minor repair like cleaning of carriageway, waterway, and repair of leakage in wall and top slab and erosion of side slab of the left side of minor bridge at chainage 214+487.

Details of minor bridge structures on the Project Highway are as per Table 6.3 -2: given below.

Table 6-3: Details of Minor Bridges

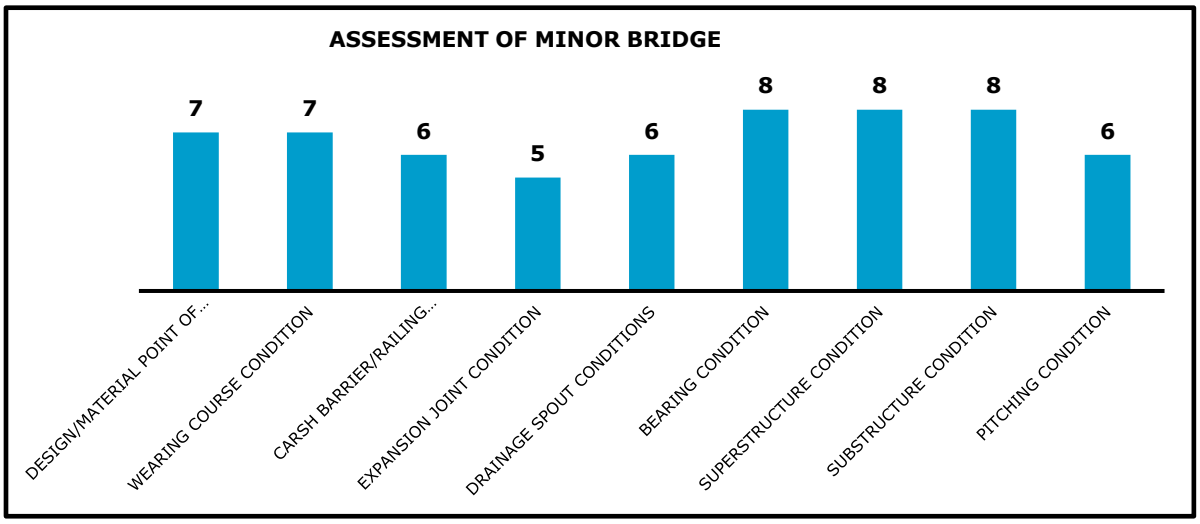
S. No.	Existing (km)	Side	Span Arrangement (m)	Deck Width (m)	Type of Super Structure	Type of Sub Structure
			Package - 1			
1	0+620	LHS SR	2x5.05	9	RCC Box	RCC
		LHS MCW	2x5.05	14		
		RHS MCW	2x5.05	14		
		RHS SR	2x5.05	9		
2	9+752	LHS	2x6.475	21.4	RCC Box	RCC
		RHS	2x6.475	21.4		
3	14+872	LHS	1x14	20.9	RCC Slab	RCC
		RHS	1x14	20.9		
4	214+487	LHS SR	4x4.5	9	RCC Box	RCC
		LHS MCW	4x4.5	13.5		
		RHS MCW	4x4.5	13.5		
		RHS SR	4x4.5	9		
5	216+961	LHS SR	2x4.3	9	RCC Box	RCC
		LHS MCW	1x9.5	14		
		RHS MCW	1x9.5	14		
		RHS SR	2x4.3	9		

S. No.	Existing (km)	Side	Span Arrangement (m)	Deck Width (m)	Type of Super Structure	Type of Sub Structure
6	218+277	LHS SR	3x6.5	10.3	RCC Slab	RCC
		LHS MCW	3x6.5	14		
		RHS MCW	3x6.5	14		
		RHS SR	3x6.5	10.3		
7	221+382	LHS SR	3x3	10.225	RCC Slab	RCC
		LHS MCW	3x3	14		
		RHS MCW	3x3	14		
		RHS SR	3x3	10.225		
8	224+545	LHS SR	4x8.8	10.3	RCC Slab	RCC
		LHS MCW	4x8.8	14		
		RHS MCW	4x8.8	14		
		RHS SR	4x8.8	10.3		
9	232+017	LHS SR	1x9.5	10	RCC Box	RCC
		LHS MCW	1x9.5	14		
		RHS MCW	1x9.5	14		
		RHS SR	1x9.5	10		
10	233+903	LHS SR	1x9.5	10	RCC Slab	RCC
		LHS MCW	1x9.5	14		
		RHS MCW	1x9.5	14		
		RHS SR	1x9.5	10		
11	242+674	LHS SR	2x4.6	6.5	RCC Box	RCC
		LHS MCW	2x4.6	13.5		
		RHS MCW	2x4.6	13.5		
		RHS SR	2x4.6	6.5		
12	243+597	LHS SR	1x3.975 + 1x5.975	10.3	RCC Slab	RCC
		LHS MCW	1x3.975 + 1x5.975	14		
		RHS MCW	1x3.975 + 1x5.975	14		
		RHS SR	1x3.975 + 1x5.975	10.3		
13	247+656	LHS SR	3x3	10.3	RCC Slab	RCC
		LHS MCW	3x3	13.5		
		RHS MCW	3x3	13.5		
		RHS SR	3x3	10.3		
14	249+259	LHS SR	4x4.5	10.3	RCC Slab	RCC

S. No.	Existing (km)	Side	Span Arrangement (m)	Deck Width (m)	Type of Super Structure	Type of Sub Structure
		LHS MCW	4x4.5	14		
		RHS MCW	4x4.5	14		
		RHS SR	4x4.5	10.3		
15	252+763	LHS SR	1x8	10.5	RCC Slab	RCC
		LHS MCW	1x8	14		
		RHS MCW	1x8	14		
		RHS SR	1x8	10.5		
16	253+735	LHS SR	4x4.5	10.3	RCC Slab	RCC
		LHS MCW	4x4.5	14		
		RHS MCW	4x4.5	14		
		RHS SR	4x4.5	10.3		
17	259+685	Cross road	1x9.2	11	RCC Slab	RCC
18	259+700	Cross road	1x9.2	11	RCC Slab	RCC
Package - 2						
1	303+820	LHS SR	4x8.5+2x5.0	10	RCC Box	RCC
		LHS MCW	4x8.5+2x5.0	14.5		
		RHS MCW	4x8.5+2x5.0	14.5		
		RHS SR	4x8.5+2x5.0	10		
2	321+589	LHS SR*	2x6.7	10	RCC Box & Slab	RCC
		LHS MCW	2x6.7	14.5		
		RHS MCW	2x6.7	14.5		
		RHS SR	2x6.7	10		
3	325+221	LHS SR	2x12.6	10	RCC Girder	RCC
		LHS MCW	2x12.6	14.5		
		RHS MCW	2x12.6	14.5		
		RHS SR	2x12.6	10		
4	329+658	LHS SR*	3x3.33	10	RCC Box	RCC
		LHS MCW	1x10	14.5		
		RHS MCW	1x10	14.5		
		RHS SR*	3x3.33	10		
5	330+324	LHS SR*	3x3.33	10	RCC Box	RCC
		LHS MCW	1x10	14.5		

S. No.	Existing (km)	Side	Span Arrangement (m)	Deck Width (m)	Type of Super Structure	Type of Sub Structure
		RHS MCW	1x10	14.5		
		RHS SR*	3x3.33	10		
6	330+573	LHS SR*	3x3.33	10	RCC Box	RCC
		LHS MCW	1x10	14.5		
		RHS MCW	1x10	14.5		
		RHS SR*	3x3.33	10		
7	330+805	LHS SR*	3x3.33	10	RCC Box	RCC
		LHS MCW	1x10	14.5		
		RHS MCW	1x10	14.5		
		RHS SR*	3x3.33	10		
Package - 3						
1	341+898	LHS SR	2x8.8	10.2	RCC Slab	RCC
		LHS MCW	2x8.8	11.5		
		RHS MCW	2x8.8	15.8		
		RHS SR	2x8.8	10.2		
2	355+164	LHS SR	2x6.825+1x6.975	10.2	RCC Box	RCC
		LHS MCW	2x6.825+1x6.975	11.5		
		RHS MCW	2x6.825+1x6.975	11.5		
		RHS SR	2x6.825+1x6.975	10.2		
3	361+935	LHS SR	1x7	10.2	RCC Box	RCC
		LHS MCW	1x7	11.5		
		RHS MCW	1x7	11.5		
		RHS SR	1x7	10.2		
4	362+610	LHS SR	1x6.2	10.2	RCC Box	RCC
		LHS MCW	1x6.2	15.8		
		RHS MCW	1x6.2	15.8		
		RHS SR	1x6.2	10.2		
5	382+856	LHS SR	1x9.3+1x8.15+1x8.1+1x7.9	10.2	RCC Box	RCC
		LHS MCW	1x9.3+1x8.15+1x8.1+1x7.9	11.5		
		RHS MCW	1x9.3+1x8.15+1x8.1+1x7.9	15.8		
		RHS SR	1x9.3+1x8.15+1x8.1+1x7.9	10.2		
6	392+501	LHS SR	1x10.4	10.2	RCC Box	RCC
		LHS MCW	1x10.4	15.8		

S. No.	Existing (km)	Side	Span Arrangement (m)	Deck Width (m)	Type of Super Structure	Type of Sub Structure
		RHS MCW	1x10.4	11.5		
		RHS SR	1x10.4	10.2		
7	394+832	LHS SR	1x6.85	10.2	RCC Box	RCC
		LHS MCW	1x6.85	15.8		
		RHS MCW	1x6.85	15.8		
		RHS SR	1x6.85	10.2		
8	397+299	LHS SR	1x10	10.2	RCC Box	RCC
		LHS MCW	1x10	15.8		
		RHS MCW	1x10	15.8		
		RHS SR	1x10	10.2		
9	398+597	LHS SR	1x10	10.2	RCC Box	RCC
		LHS MCW	1x10	11.5		
		RHS MCW	1x10	15.8		
		RHS SR	1x10	10.2		
10	401+717	LHS SR	1x6.2	10.2	RCC Box	RCC
		LHS MCW	1x6.2	11.5		
		RHS MCW	1x6.2	11.5		
		RHS SR	1x6.2	10.2		
11	401+864	LHS SR	1x2.85+2x2.815	10.2	RCC Box	RCC
		LHS MCW	1x2.85+2x2.815	11.5		
		RHS MCW	1x2.85+2x2.815	11.5		
		RHS SR	1x2.85+2x2.815	10.2		



Photographs of Minor Bridge are presented hereunder.

Vegetation found on front of MNB at Chainage 0+620 of Package -1

Crash barrier damaged sue to vehicle impact at chainage 14+872 of package -1

Erosion of the approach at LHS MNB 214+487 Package-1

Inlet and outlet of Blocked due to vegetation at MNB 232 + 017 package 1

cell of box MNB Blocked due to Soil Island at chainage 303+ 820 package 2

Vegetation found around the structure at chainage 321 + 589 package 3

Unwanted material found around the bearings at MNB chainage 325 + 221 LHS package 2

Crash barrier damaged sue to vehicle impact at chainage 325 + 221 package 2

Crash barrier damaged due to vehicle impact at chainage 341 + 898 package 3

Vegetation found on top of the pier at chainage 341 + 898

Protection slope found damaged at RHS 362+610

Vegetation found at chainage 382 +856

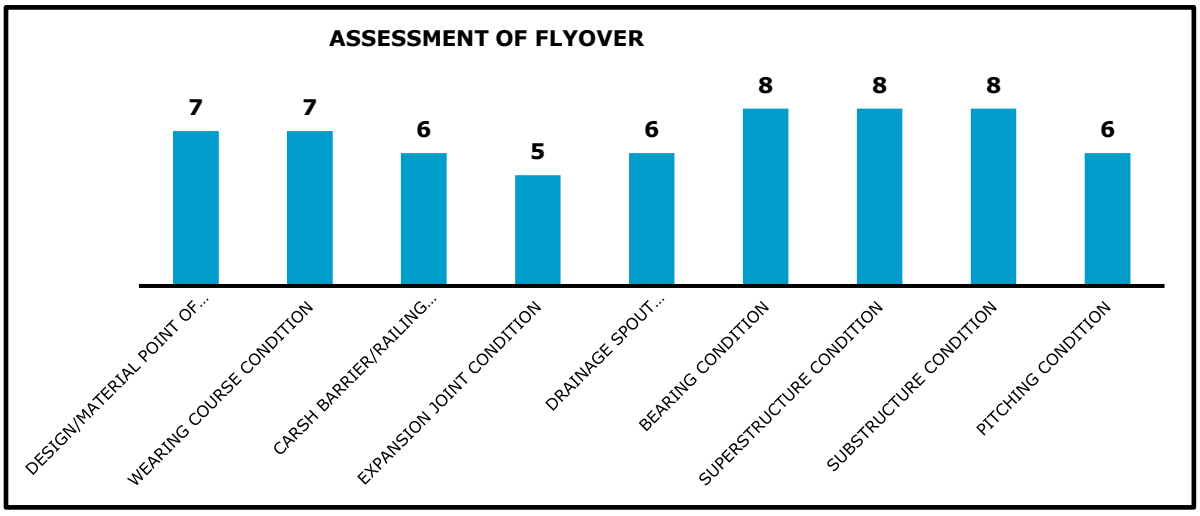
6.4 Flyover

There are 15 nos. of flyover on project stretch. These flyovers are in good state of maintenance. Minor repair like cleaning of carriageway, bearings, Expansion joint and spalled concrete in deck slab is required.

Table 6-4: Flyover

S. No.	Existing (km)	Side	Span Arrangement (m)	Deck Width (m)	Type of Super Structure	Type of Sub Structure
Package - 1						
1	0+550	LHS	(1x16.7) +(1x25.2) +(1x16.7)	14	PSC & RCC Girder	RCC
		RHS	(1x16.7) +(1x25.2) +(1x16.7)	14	PSC & RCC Girder	RCC
2	13+851	LHS	2x36	17.5	PSC Girder	RCC
		RHS	2x36	17.5	PSC Girder	RCC
3	20+400	LHS	(1x16.7) +(1x25.2) +(1x16.7)	14	PSC & RCC Girder	RCC
		RHS	(1x16.7) +(1x25.2) +(1x16.7)	14	PSC & RCC Girder	RCC
Package - 2						
1	262+253	LHS	2x11	14.5	RCC slab	RCC
		RHS	2x11	14.5	RCC slab	RCC
2	273+651	LHS	2x10.5	14.5	RCC slab	RCC

S. No.	Existing (km)	Side	Span Arrangement (m)	Deck Width (m)	Type of Super Structure	Type of Sub Structure
		RHS	2x10.5	14.5	RCC slab	RCC
3	281+900	LHS	1x15+1x24+1x15	14.5	PSC Girder	RCC
		RHS	1x15+1x24+1x15	14.5	PSC Girder	RCC
4	292+946	LHS	2x20.5	14.5	RCC Girder	RCC
		RHS	2x20.5	14.5	RCC Girder	RCC
5	298+785	LHS	2x20.5	14.5	RCC Girder	RCC
		RHS	2x20.5	14.5	RCC Girder	RCC
6	302+264	LHS	1x15+1x24+1x15	14.5	RCC Girder	RCC
		RHS	1x15+1x24+1x15	14.5	RCC Girder	RCC
7	319+245*	LHS	3x12	14.5	PSC Girder	RCC
		RHS	3x12	14.5	PSC Girder	RCC
8	328+480	LHS	1x15+1x24+1x15	14.5	PSC Girder	RCC
		RHS	1x15+1x24+1x15	14.5	PSC Girder	RCC
9	332+680	LHS	2x11	14.5	RCC Girder	RCC
		RHS	2x11	14.5	RCC Girder	RCC
10	337+500	LHS	1x15+1x24+1x15	14.5	PSC Girder	RCC
		RHS	1x15+1x24+1x15	14.5	PSC Girder	RCC
Package - 3						
1	356+335	LHS	6x21.5	11.5	PSC Girder	RCC
		RHS	6x21.5	11.5	PSC Girder	RCC
2	363+573	LHS	6x21.5	11.5	PSC Girder	RCC
		RHS	6x21.5	11.5	PSC Girder	RCC



Photographs of Flyover are presented hereunder.

Leakage found at Deck joint of Flyover 292+946

Honey Combing found in soffit of the girder at Chainage 298+780

Flyover under construction at chainage 319+245 P-2

Vegetation grown on return wall at flyover 332+680

Leakage found through deck joint at flyover 332+680

Crack are found in the soffit of the deck slab at flyover 332+80 LHS

Drainage down take pipe has found damaged at Flyover 336+335 and 363 +573

Drainage spout clogged at Flyover 0+550

Concrete of expansion joint found damaged at flyover 20+400

Silt and unwanted material found around the bearings at flyover 298+785 and 292+946

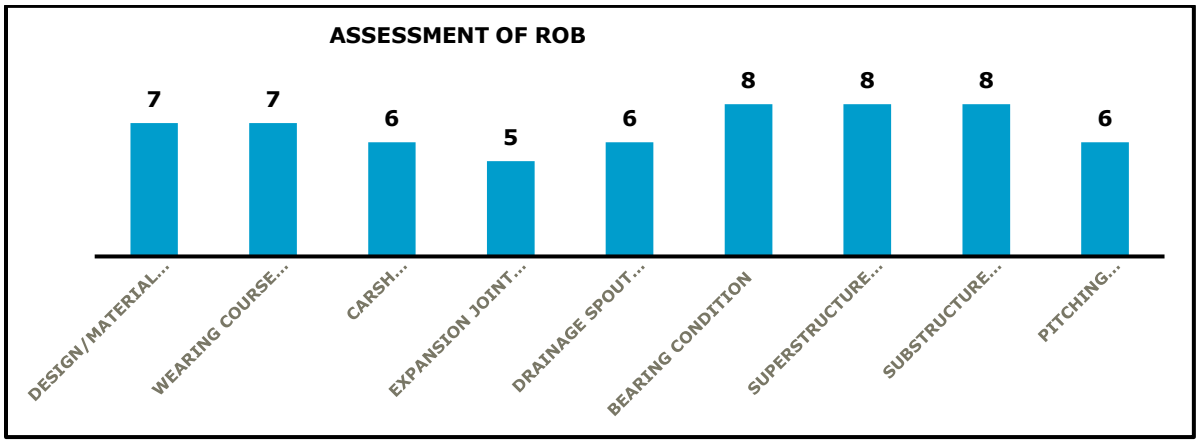
6.5 ROB (Railway Over Bridge)

There are 4 nos. of ROB on project stretch. These ROB are appearing to be fair to satisfactory state of maintenance. Minor repair like cleaning of carriageway, bearings, Expansion joint and repair of leakage also spalled concrete in deck slab required.

Table 6-5: ROB

No	Package	Existing (km)	Side	Span Arrangement (m)	Deck Width (m)	Type of Super Structure	Type of Sub Structure
1	Package - 1	210+654	LHS	(1x16) +(1x18) +(1x3 6) +(1x18) +(1x42)	14.5	PSC Girder	RCC
			RHS	(1x16) +(1x18) +(1x3 6) +(1x18) +(1x42)	14.5	PSC Girder	RCC
2		256+753	LHS MCW	1x32.5	14.5	PSC Girder	RCC
			RHS MCW	1x32.5	14.5	PSC Girder	RCC
			RHS SR	(1x8) +(1x13) +(1x10.5)	10.5	PSC Girder	RCC
3	Package - 2	308+876	LHS	1x14.5+1x37+1x14.5	14.5	RCC Girder	RCC

			RHS	1x14.5+1x37+1x14.6	14.5	RCC Girder	RCC
4		326+626	LHS	1x21.8+1x37.4+1x21.8	14.5	RCC Girder and Slab	RCC
			RHS	1x21.8+1x37.4+1x21.8	14.5	RCC Girder and Slab	RCC
5	Package - 3	NIL					



Typical Photographs of ROB are presented hereunder.

expansion joints and bearings are in good condition.

Concrete Spalled out from soffit of the deck slab 256+753 LHS

Leaching was found in the soffit of the deck slab

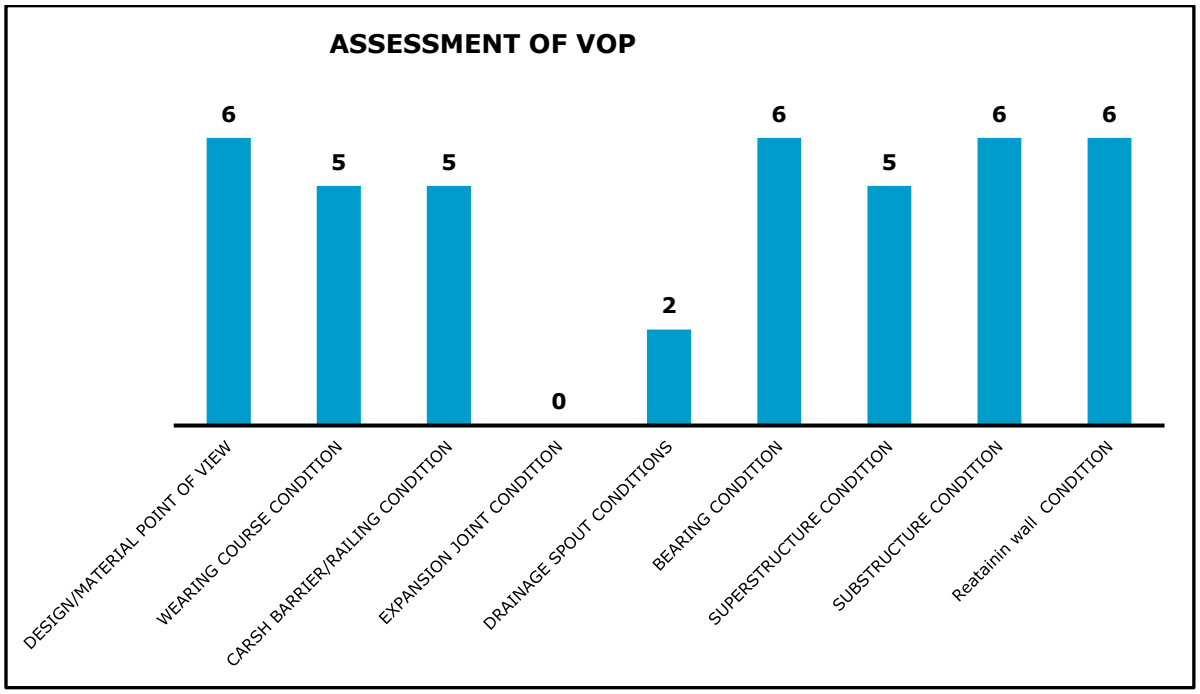
Crash Barrier found damaged | Reinforcement found exposed at diapharm.

6.6 Vehicular Overpass

There are 02 nos. of VOP in package - 01 of the project. During inspection it is noticed that these overpasses require routine maintenance but are structural good in condition.

Table 6-6: Vehicular Overpass

S. No.	Existing (km)	Side	Span Arrangement (m)	Deck Width (m)	Type of Super Structure	Type of Sub Structure
1	217+836	LHS	2x16	14	RCC Box	RCC
		RHS	2x16	14	RCC Box	RCC
2	258+800	LHS	2x16	14	RCC Box	RCC
		RHS	2x16	14	RCC Box	RCC



Photographs of VOPs are presented hereunder.

<table>
<tr><td colspan="2">
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<tr><td colspan="2">Debris, silt and soil formation present on Top deck slab at chainage 217+836</td></tr>
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<tr><td>Honey combing found in soffit of the deck slab 258+800</td><td>Down take pipe not provided for VOP 258+800</td></tr>
</table>

Drainage spout clogged VOP 258+800

Rusted steel railing found

Expansion joint badly damaged of VOP 258+800

Cracks are found on wearing course

Footpath blocked due to heavy vegetation present on it VOP 258+800

6.7 Vehicular Underpass

There are 38 nos. of VUP on project stretch. Minor repairs like cracks in RCC substructure, cleaning / replacement of expansion joints are required with repairs in approach slabs at few locations. Cleaning of Vegetation growth and clogged vents requires routine maintenance. Overall structural condition is good for these underpasses.

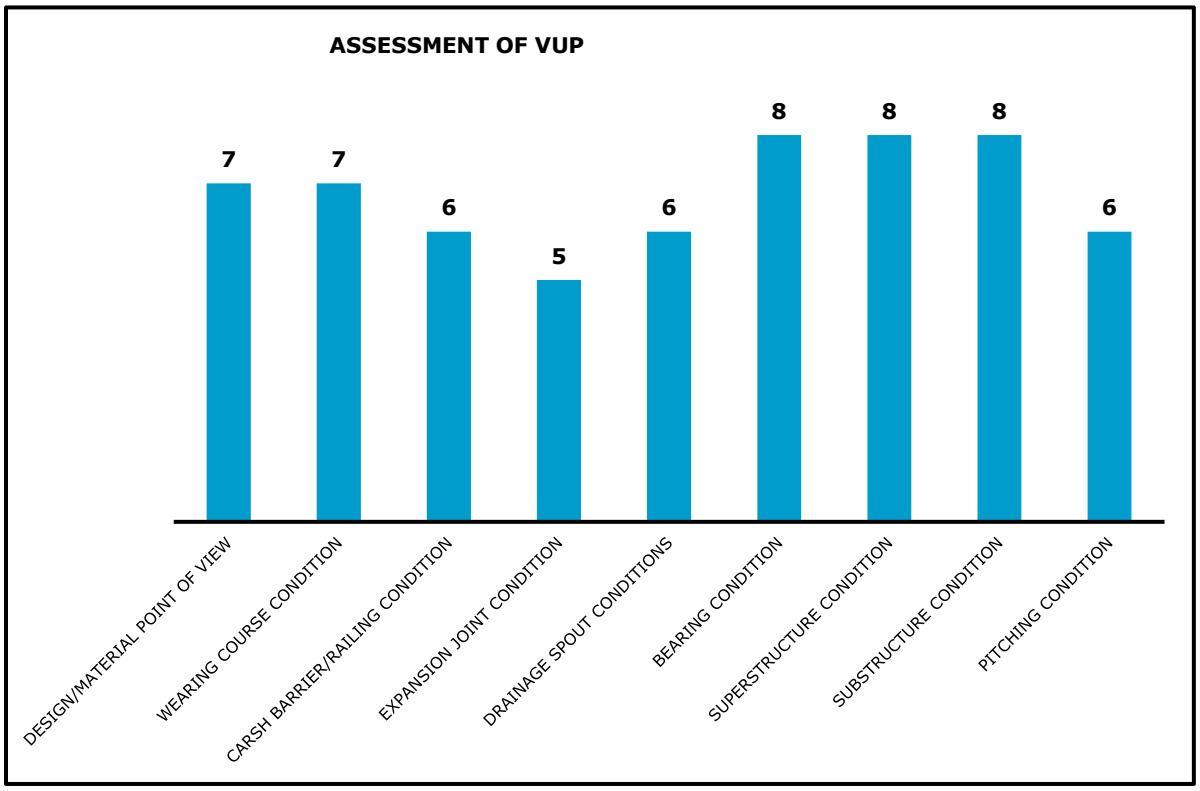
Table 6-7: Vehicular Underpass

S. No.	Existing (km)	Side	Span Arrangement (m)	vertical Clearance	Deck Width	Type of Super Structure	Type of Sub Structure
			Package - 1				
1	3+495	LHS	1x12	5.5	14	RCC Box	RCC
		RHS	1x12	5.5	14	RCC Box	RCC
2	11+313	LHS	1x12	5.5	14	RCC Box	RCC

S. No.	Existing (km)	Side	Span Arrangement (m)	vertical Clearance	Deck Width	Type of Super Structure	Type of Sub Structure
3	17+045	RHS	1x12	5.5	14	RCC Box	RCC
		LHS	1x12	5.5	14	RCC Box	RCC
		RHS	1x12	5.5	14	RCC Box	RCC
4	208+185	LHS	1x12	5.5	14	RCC Box	RCC
		RHS	1x12	5.5	14	RCC Box	RCC
5	212+570	LHS	1x12	5.5	14	RCC Box	RCC
		RHS	1x12	5.5	14	RCC Box	RCC
6	227+740	LHS	1x12	5.5	14	RCC Box	RCC
		RHS	1x12	5.5	14	RCC Box	RCC
7	228+670	LHS	1x10.5	5.5	14	RCC Box	RCC
		RHS	1x10.5	5.5	14	RCC Box	RCC
8	244+709	LHS	1x14	5.5	14	RCC Box	RCC
		RHS	1x14	5.5	14	RCC Box	RCC
9	245+400	LHS	1x14	5.5	14	RCC Box	RCC
		RHS	1x14	5.5	14	RCC Box	RCC
10	255+100	LHS	1x14	5.5	14	RCC Box	RCC
		RHS	1x14	5.5	14	RCC Box	RCC
11	259+635	LHS	1x12	5.5	14	RCC Box	RCC
		RHS	1x12	5.5	14	RCC Box	RCC
12	259+670	LHS	1x12	5.5	14	RCC Box	RCC
		RHS	1x12	5.5	14	RCC Box	RCC
			Package - 2				
1	274+930	LHS	1x12	5.5	14.5	RCC Box	RCC
		RHS	1x12	5.5	14.5	RCC Box	RCC
2	276+646	LHS	1x12.9	5.5	14.5	RCC Box	RCC
		RHS	1x12.9	4.5	14.5	RCC Box	RCC
3	277+595	LHS	1x12.9	4.5	14.5	RCC Box	RCC
		RHS	1x12.9	5.5	14.5	RCC Box	RCC
4	278+398	LHS	1x12.9	5.5	14.5	RCC Box	RCC
		RHS	1x12.9	5.5	14.5	RCC Box	RCC
5	279+946	LHS	1x12.9	5.5	14.5	RCC Box	RCC
		RHS	1x12.9	5.5	14.5	RCC Box	RCC
6	280+727	LHS	1x12.9	5.5	14.5	RCC Box	RCC
		RHS	1x12.9	5.5	14.5	RCC Box	RCC

S. No.	Existing (km)	Side	Span Arrangement (m)	vertical Clearance	Deck Width	Type of Super Structure	Type of Sub Structure
7	285+337	LHS	1x12.9	5.5	14.5	RCC Box	RCC
		RHS	1x12.9	5.5	14.5	RCC Box	RCC
8	287+552	LHS	1x12.9	5.5	14.5	RCC Box	RCC
		RHS	1x12.9	5.5	14.5	RCC Box	RCC
9	295+383	LHS	1x12.9	5.5	14.5	RCC Box	RCC
		RHS	1x12.9	5.5	14.5	RCC Box	RCC
10	300+913	LHS	1x12.9	5.5	14.5	RCC Box	RCC
		RHS	1x12.9	5.5	14.5	RCC Box	RCC
11	304+221	LHS	1x12.9	5.5	14.5	RCC Box	RCC
		RHS	1x12.9	5.5	14.5	RCC Box	RCC
12	311+146	LHS	1x12.9	5.5	14.5	RCC Box	RCC
		RHS	1x12.9	5.5	14.5	RCC Box	RCC
13	319+342*	LHS	1x12.9	5.5	14.5	RCC Box	RCC
		RHS	1x12.9	5.5	14.5	RCC Box	RCC
14	325+500	LHS	1x12.9	5.5	14.5	RCC Box	RCC
		RHS	1x12.9	5.5	14.5	RCC Box	RCC
			Package - 3				
1	340+918	LHS	2x10	5.5	14	RCC Box	RCC
		RHS	2x10	5.5	14	RCC Box	RCC
2	348+400	LHS	1x20	5.5	14	RCC Girder	RCC
		RHS	1x20	5.5	14	RCC Girder	RCC
3	354+095	LHS	1x20	5.5	14	RCC Girder	RCC
		RHS	1x20	5.5	14	RCC Girder	RCC
4	364+345	LHS	2x12	5.5	14	RCC Box	RCC
		RHS	2x12	5.5	14	RCC Box	RCC
5	371+472	LHS	1x20	5.5	14	RCC Girder	RCC
		RHS	1x20	5.5	14	RCC Girder	RCC
6	374+933	LHS	1x10	5.5	14	RCC Box	RCC
		RHS	1x10	5.5	14	RCC Box	RCC
7	378+845	LHS	2x12	5.5	14	RCC Box	RCC
		RHS	2x12	5.5	14	RCC Box	RCC

S. No.	Existing (km)	Side	Span Arrangement (m)	vertical Clearance	Deck Width	Type of Super Structure	Type of Sub Structure
8	384+600	LHS	2x12	5.5	14	RCC Box	RCC
		RHS	2x12	5.5	14	RCC Box	RCC
9	385+614	LHS	2x12	5.5	14	RCC Box	RCC
		RHS	2x12	5.5	14	RCC Box	RCC
10	390+950	LHS	2x12	5.5	14	RCC Box	RCC
		RHS	2x12	5.5	14	RCC Box	RCC
11	392+200	LHS	1x11	5.5	14	RCC Box	RCC
		RHS	1x11	5.5	14	RCC Box	RCC
12	400+835	LHS	1x11	5.5	14	RCC Box	RCC
		RHS	1x11	5.5	14	RCC Box	RCC



Photographs of VUP are presented hereunder.

Leakage through deck joint at VUP 220 + 580

Crack found on wall

Down take pipe found damaged

Honey combing found at soffit of girder

6.8 Light Vehicular Underpass

There are 36 nos. of LVUP in this 214.50 km project stretch. These LVUP are in good condition but requires routine maintenance of cleaning and clearing of debris and vegetations. Erosion of slope noticed at the quadrant also requires restoration. List of these LVUPs is given in the table below with their configuration and respective locations.

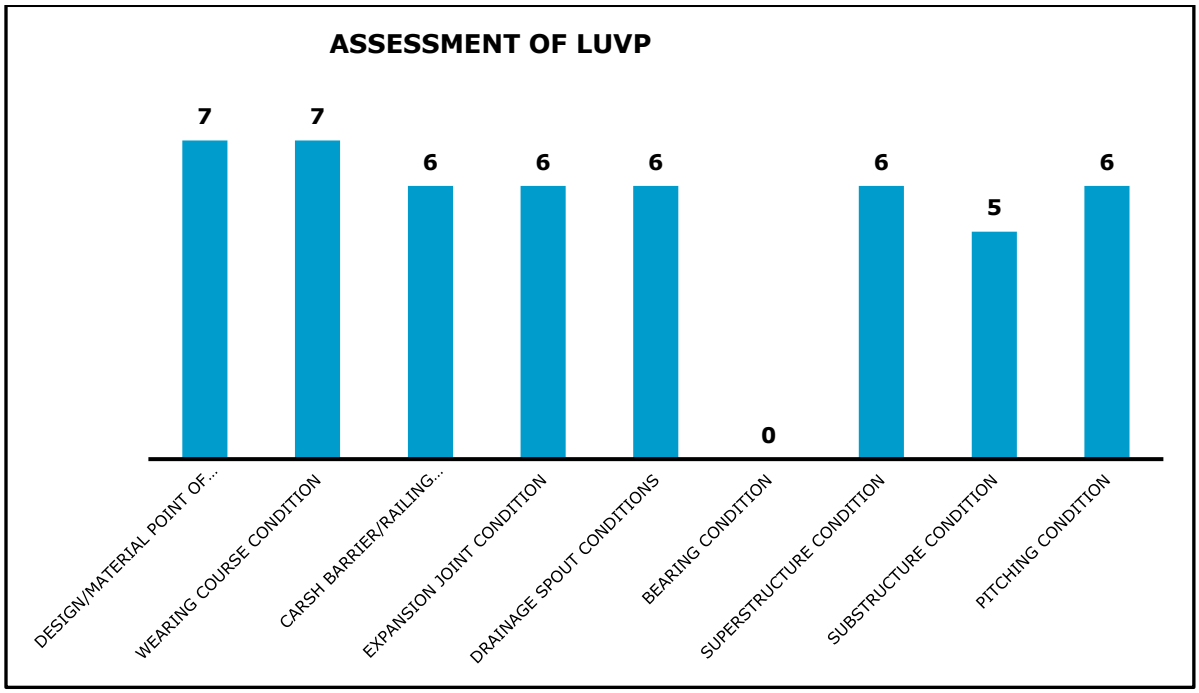
Table 6-8: Light Vehicular Underpass

Sl. No	Existing (km)	Side	Span Arrangement (m)	vertical Clearance	Deck Width (m)	Type of Super Structure	Type of Sub Structure
Package - 1							
1	2+473	LHS	1x12	4	14	RCC Box	RCC
		RHS	1x12	4	14	RCC Box	RCC
2	4+402	LHS	1x12	4	14	RCC Box	RCC
		RHS	1x12	4	14	RCC Box	RCC
3	8+775	LHS	1x12	4	14	RCC Box	RCC
		RHS	1x12	4	14	RCC Box	RCC
4	15+750	LHS	1x12	4	14	RCC Box	RCC
		RHS	1x12	4	14	RCC Box	RCC
5	18+137	LHS	1x12	4	14	RCC Box	RCC

Sl. No	Existing (km)	Side	Span Arrangement (m)	vertical Clearance	Deck Width (m)	Type of Super Structure	Type of Sub Structure
		RHS	1x12	4	14	RCC Box	RCC
6	19+078	LHS	1x12	4	14	RCC Box	RCC
		RHS	1x12	4	14	RCC Box	RCC
7	209+477	LHS	1x12	4	14	RCC Box	RCC
		RHS	1x12	4	14	RCC Box	RCC
8	214+386	LHS	1x12	4	14	RCC Box	RCC
		RHS	1x12	4	14	RCC Box	RCC
9	216+060	LHS	1x12	4	14	RCC Box	RCC
		RHS	1x12	4	14	RCC Box	RCC
10	217+176	LHS	1x12	4	14	RCC Box	RCC
		RHS	1x12	4	14	RCC Box	RCC
11	219+160	LHS	1x12	4	14	RCC Box	RCC
		RHS	1x12	4	14	RCC Box	RCC
12	220+580	LHS	1x12	4	14	RCC Box	RCC
		RHS	1x12	4	14	RCC Box	RCC
13	225+200	LHS	1x12	4	14	RCC Box	RCC
		RHS	1x12	4	14	RCC Box	RCC
14	228+122	LHS	1x12	4	14	RCC Box	RCC
		RHS	1x12	4	14	RCC Box	RCC
15	231+135	LHS	1x12	4	14	RCC Box	RCC
		RHS	1x12	4	14	RCC Box	RCC
16	232+050	LHS	1x12	4	14	RCC Box	RCC
		RHS	1x12	4	14	RCC Box	RCC
17	235+226	LHS	1x12	4	14	RCC Box	RCC
		RHS	1x12	4	14	RCC Box	RCC
18	242+825	LHS	1x12	4	14	RCC Box	RCC
		RHS	1x12	4	14	RCC Box	RCC
19	247+972	LHS	1x12	4	14	RCC Box	RCC
		RHS	1x12	4	14	RCC Box	RCC
20	250+920	LHS	1x12	4	14	RCC Box	RCC
		RHS	1x12	4	14	RCC Box	RCC

Sl. No	Existing (km)	Side	Span Arrangement (m)	vertical Clearance	Deck Width (m)	Type of Super Structure	Type of Sub Structure
21	253+336	LHS	1x12	4	14	RCC Box	RCC
		RHS	1x12	4	14	RCC Box	RCC
Package -2							
1	260+195*	LHS	1x12	4	14.5	RCC Box	RCC
		RHS	1x12	4	14.5	RCC Box	RCC
2	266+042*	LHS	1x12	4	14.5	RCC Box	RCC
		RHS	1x12	4	14.5	RCC Box	RCC
3	291+525	LHS	1x12	4	14.5	RCC Box	RCC
		RHS	1x12	4	14.5	RCC Box	RCC
4	299+701	LHS	1x12	4	14.5	RCC Box	RCC
		RHS	1x12	4	14.5	RCC Box	RCC
5	307+191	LHS	1x12	4	14.5	RCC Box	RCC
		RHS	1x12	4	14.5	RCC Box	RCC
6	310+650	LHS	1x12	4	14.5	RCC Box	RCC
		RHS	1x12	4	14.5	RCC Box	RCC
7	313+473*	LHS	1x12	4	14.5	RCC Box	RCC
		RHS	1x12	4	14.5	RCC Box	RCC
8	325+950	LHS	1x12	4	14.5	RCC Box	RCC
		RHS	1x12	4	14.5	RCC Box	RCC
Package -3							
1	344+365	LHS	1x12	4.5	14	RCC Box	RCC
		RHS	1x12	4.5	14	RCC Box	RCC
2	346+510	LHS	1x12	4.5	14	RCC Box	RCC
		RHS	1x12	4.5	14	RCC Box	RCC
3	354+770	LHS	1x12	4.5	14	RCC Box	RCC
		RHS	1x12	4.5	14	RCC Box	RCC
4	358+550	LHS	1x12	4.5	14	RCC Box	RCC
		RHS	1x12	4.5	14	RCC Box	RCC
5	382+242	LHS	1x12	4.5	14	RCC Box	RCC
		RHS	1x12	4.5	14	RCC Box	RCC
6	395+510	LHS	1x12	4.5	14	RCC Box	RCC

Sl. No	Existing (km)	Side	Span Arrangement (m)	vertical Clearance	Deck Width (m)	Type of Super Structure	Type of Sub Structure
7	399+700	RHS	1x12	4.5	14	RCC Box	RCC
		LHS	1x12	4.5	14	RCC Box	RCC
		RHS	1x12	4.5	14	RCC Box	RCC



Typical Photographs of LVUP are presented hereunder.

Leakage through deck joint chainage 19+078	Crack were found in soffit of the deck slab 225+200 LHS Package -1

Minor honeycombing found at chainage 325+900 P -2

Down take pipe found damaged at 344+465 P-2

Edge of the deck slab damaged at chainage 300 +913 and 291+525 P-2

6.9 Pedestrian/Cattle Underpass

There are 52 nos. of PUP/CUP in this project. Condition of these underpasses are good but requires routine maintenance to clear vegetation growth, clean / replace of expansion joints, clean clogged spouts, repaint crash barriers and walls where faded away, repair approach slabs where there are cracks.

Table 6-9: Pedestrian/Cattle Underpass

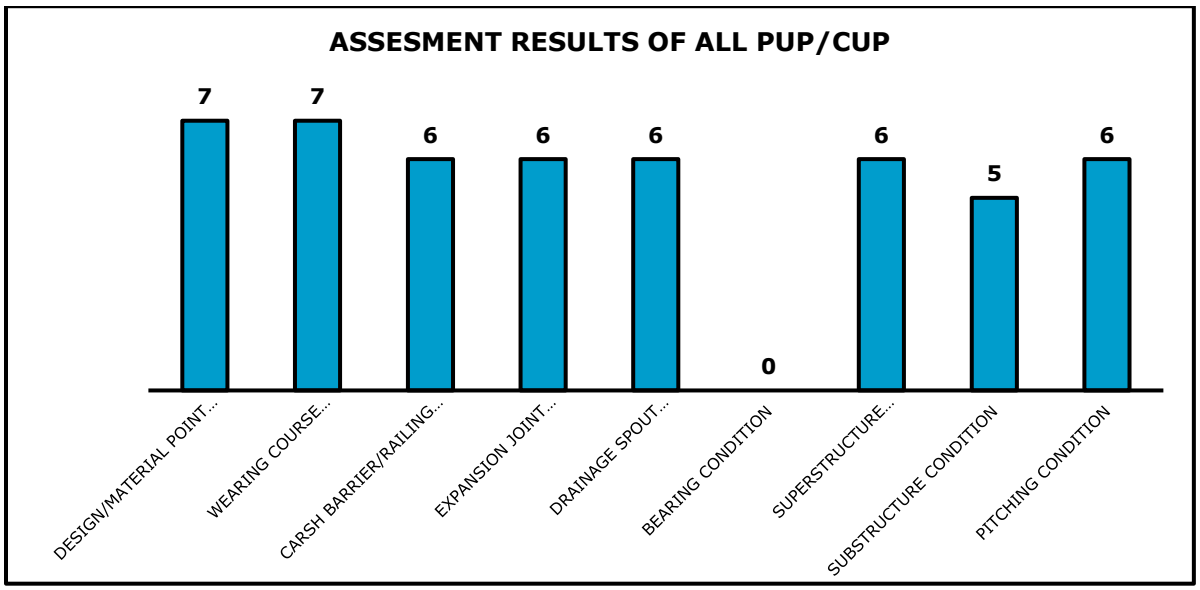
S. No.	Existing (km)	Side	Span Arrangement (m)	Deck Width (m)	Type of Super Structure	Type of Sub Structure
Package -1						
1	212+150	LHS	1x4.5	14	RCC BOX	RCC
		RHS	1x4.5	14	RCC BOX	RCC
2	214+980	LHS	1x4.5	14	RCC BOX	RCC
		RHS	1x4.5	14	RCC BOX	RCC
3	222+915	LHS	1x4.5	14	RCC BOX	RCC
		RHS	1x4.5	14	RCC BOX	RCC
4	225+585	LHS	1x4.5	14	RCC BOX	RCC
		RHS	1x4.5	14	RCC BOX	RCC

5	229+020	LHS	1x4.5	14	RCC BOX	RCC
		RHS	1x4.5	14	RCC BOX	RCC
6	232+250	LHS	1x4.5	14	RCC BOX	RCC
		RHS	1x4.5	14	RCC BOX	RCC
7	234+560	LHS	1x4.5	14	RCC BOX	RCC
		RHS	1x4.5	14	RCC BOX	RCC
8	238+620	LHS	1x4.5	14	RCC BOX	RCC
		RHS	1x4.5	14	RCC BOX	RCC
9	238+780	LHS	1x4.5	14	RCC BOX	RCC
		RHS	1x4.5	14	RCC BOX	RCC
10	241+000	LHS	1x4.5	14	RCC BOX	RCC
		RHS	1x4.5	14	RCC BOX	RCC
11	249+650	LHS	1x4.5	14	RCC BOX	RCC
		RHS	1x4.5	14	RCC BOX	RCC
12	252+380	LHS	1x4.5	14	RCC BOX	RCC
		RHS	1x4.5	14	RCC BOX	RCC
13	256+645	LHS	1x8	16	RCC BOX	RCC
		RHS	1x8	16	RCC BOX	RCC
14	257+453	LHS	1x4.5	14	RCC BOX	RCC
		RHS	1x4.5	14	RCC BOX	RCC
15	257+460	LHS	1x4.5	14	RCC BOX	RCC
		RHS	1x4.5	14	RCC BOX	RCC
Package -2						
1	266+960	LHS	1x4.5	9.5	RCC BOX	RCC
		RHS	1x4.5	9.5	RCC BOX	RCC
2	268+400	RHS	1x4.5	13.5	RCC BOX	RCC
		RHS	1x4.5	13.5	RCC BOX	RCC
3	269+720	LHS	1x4.5	13.5	RCC BOX	RCC
		RHS	1x4.5	13.5	RCC BOX	RCC

4	269+929	LHS	1x4.5	13.5	RCC BOX	RCC
		RHS	1x4.5	13.5	RCC BOX	RCC
5	279+930	LHS	1x4.5	13.5	RCC BOX	RCC
		RHS	1x4.5	13.5	RCC BOX	RCC
6	297+310	LHS	1x4.5	13.5	RCC BOX	RCC
		RHS	1x4.5	13.5	RCC BOX	RCC
7	308+440	LHS	1x4.5	13.5	RCC BOX	RCC
		RHS	1x4.5	13.5	RCC BOX	RCC
8	322+960	LHS	1x4.5	14.5	RCC BOX	RCC
		RHS	1x4.5	14.5	RCC BOX	RCC
9	329+000	LHS	1x4.5	14.5	RCC BOX	RCC
		RHS	1x4.5	14.5	RCC BOX	RCC
10	331+515	LHS	1x4.5	10.5	RCC BOX	RCC
		RHS	1x4.5	10.5	RCC BOX	RCC
11	332+300	LHS	1x4.5	10.5	RCC BOX	RCC
		RHS	1x4.5	10.5	RCC BOX	RCC
12	335+920	LHS	1x4.5	14.5	RCC BOX	RCC
		RHS	1x4.5	14.5	RCC BOX	RCC
13	338+450	LHS	1x4.5	14.5	RCC BOX	RCC
		RHS	1x4.5	14.5	RCC BOX	RCC
Package -3						
1	342+779	LHS	1x5	11.5	RCC BOX	RCC
		RHS	1x5	11.5	RCC BOX	RCC
2	346+148	LHS	1x3	11.5	RCC BOX	RCC
		RHS	1x3	11.5	RCC BOX	RCC
3	350+880	LHS	1x3	11.5	RCC BOX	RCC
		RHS	1x3	11.5	RCC BOX	RCC
4	353+256	LHS	1x5	11.5	RCC BOX	RCC
		RHS	1x5	11.5	RCC BOX	RCC

5	359+305	LHS	1x3	11.5	RCC BOX	RCC
		RHS	1x3	11.5	RCC BOX	RCC
6	361+002	LHS	1x3	11.5	RCC BOX	RCC
		RHS	1x3	11.5	RCC BOX	RCC
7	363+782	LHS	1x3	11.5	RCC BOX	RCC
		RHS	1x3	11.5	RCC BOX	RCC
8	367+303	LHS	1x3	11.5	RCC BOX	RCC
		RHS	1x3	11.5	RCC BOX	RCC
9	367+795	LHS	1x7	13.5	RCC BOX	RCC
		RHS	1x7	13.5	RCC BOX	RCC
10	368+263	LHS	1x3	11.5	RCC BOX	RCC
		RHS	1x3	11.5	RCC BOX	RCC
11	368+788	LHS	1x3	11.5	RCC BOX	RCC
		RHS	1x3	11.5	RCC BOX	RCC
12	369+660	LHS	1x5	14.5	RCC BOX	RCC
		RHS	1x5	14.5	RCC BOX	RCC
13	377+722	LHS	1x5	12	RCC BOX	RCC
		RHS	1x5	11	RCC BOX	RCC
14	379+447	LHS	1x3	11.5	RCC BOX	RCC
		RHS	1x3	11.5	RCC BOX	RCC
15	379+715	LHS	1x7	13.5	RCC BOX	RCC
		RHS	1x7	13.5	RCC BOX	RCC
16	386+540	LHS	1x3	11.5	RCC BOX	RCC
		RHS	1x3	11.5	RCC BOX	RCC
17	388+700	LHS	1x3	11.5	RCC BOX	RCC
		RHS	1x3	11.5	RCC BOX	RCC
18	389+668	LHS	1x3	11.5	RCC BOX	RCC
		RHS	1x3	11.5	RCC BOX	RCC
19	390+678	LHS	1x7	13.5	RCC BOX	RCC

		RHS	1x7	13.5	RCC BOX	RCC
20	392+950	LHS	1x3	11.5	RCC BOX	RCC
		RHS	1x3	11.5	RCC BOX	RCC
21	394+050	LHS	1x3	11.5	RCC BOX	RCC
		RHS	1x3	11.5	RCC BOX	RCC
22	395+490	LHS	1x3	13.5	RCC BOX	RCC
		RHS	1x3	13.5	RCC BOX	RCC
23	397+001	LHS	1x3	13.5	RCC BOX	RCC
		RHS	1x3	13.5	RCC BOX	RCC
24	399+440	LHS	1x7	13.5	RCC BOX	RCC
		RHS	1x7	13.5	RCC BOX	RCC



Typical Photographs of PUP/CUP are presented hereunder.

PUP at Chainage 225 +580	Edge of the deck slab damage due to vehicle impact at Chainage 220+029
Spalling found at abutment A1 at Chainage 320+960	Horizontal Cleanness is not on road level 329 +000 P-2
Leakage through deck joint at PUP 361+002	Down take pipe found damaged on RE wall at Ch. 389+668

6.10 Culvert

There are 376 nos. of culvert which includes box type and Hume pipe culvert. Condition of these culverts are satisfactory but requires maintenance for scours, cleaning of waterway, cleaning of vegetations and repair of slope pitching.

Table 6-10: Culverts

Sl. No.	Existing Chainage (km)	Span Arrangement (m)		Type of Culvert	
		LHS	RHS	LHS	RHS
		Package-1			
1	1+510	1x2x2		Box	
2	1+840	1x2x2		Box	
3	2+840	1x2x2		Box	
4	3+268	1x2x2		Box	
5	3+790	1x2x1.5		Box	
6	3+870	1x3x1.5		Box	
7	4+490	1x2x2		Box	
8	4+970	1x2x2		Box	
9	5+490	1x2x2		Box	
10	6+289	1x3x3		Box	
11	6+740	1x3x3		Box	
12	7+256	1x2x2		Box	
13	8+220	1x2x2		Box	
14	8+905	1x2x2		Box	
15	9+167	1x2x1.5		Box	
16	10+547	1x2x1.5		Box	
17	11+146	1x2x2		Box	
18	11+530	1x3x2		Box	
19	12+008	1x6x3.5		Box	
20	12+175	1x2x1.5		Box	
21	12+910	1x6x3.5		Box	
22	13+307	1x2x1.5		Box	
23	13+592	1x6x4		Box	
24	14+040	1x4x3		Box	
25	14+447	1x2x1.5		Box	
26	15+111	1x2x1.5		Box	
27	15+402	1x2x2		Box	
28	16+317	1x2x2		Box	
29	16+735	1x2x1.5		Box	
30	17+448	1x2x2		Box	
31	17+850	1x2x2		Box	

Sl. No.	Existing Chainage (km)	Span Arrangement (m)		Type of Culvert	
		LHS	RHS	LHS	RHS
32	18+728	1x3x2		Box	
33	19+160	1x3x2		Box	
34	19+467	1x3x3		Box	
35	19+767	1x2x1.5		Box	
36	20+447	1x2x1.5		Box	
37	208+094	1x1.2		Pipe	
38	209+167	2x1.2		Pipe	
39	211+225	3x1.2		Pipe	
40	211+325	3x1.2		Pipe	
41	212+164	1x1.2		Pipe	
42	213+585	2x1.2		Pipe	
43	215+844	2x2x2.3		Box	
44	219+795	1x3x1.5		Box	
45	220+096	1x3x1.5		Box	
46	220+194	1x1.2		Pipe	
47	221+154	1x4x1		Box	
48	222+502	3x1.2		Pipe	
49	223+291	1x4x1		Box	
50	223+681	2x3x2		Box	
51	225+622	1x4x1.2		Box	
52	226+255	3x1.2		Pipe	
53	226+970	1x1.2		Pipe	
54	228+465	5x1.2		Pipe	
55	228+850	1x1.2		Pipe	
56	228+913	1x1.2		Pipe	
57	229+241	2x1.2		Pipe	
58	230+503	2x1.2		Pipe	
59	230+733	2x1.2		Pipe	
60	232+280	2x1.2		Pipe	
61	234+680	5x1.2		Pipe	
62	235+213	1x1.2		Pipe	
63	235+864	1x2x1.2		Box	
64	236+500	1x2.5x2		Box	

Sl. No.	Existing Chainage (km)	Span Arrangement (m)		Type of Culvert	
		LHS	RHS	LHS	RHS
65	238+442	2x3x2.5		Box	
66	239+192	4x1		Pipe	
67	239+866	1x1.2		Pipe	
68	241+429	2x1.2		Pipe	
69	242+012	1x1.0		Pipe	
70	242+407	1x2.4x2.5		Box	
71	244+241	2x3x3		Box	
72	245+339	1x4x1		Box	
73	245+611	1x1		Pipe	
74	245+740	1x1.2		Pipe	
75	246+275	1x1.2		Pipe	
76	246+668	2x1.2		Pipe	
77	249+094	1x1.2		Pipe	
78	249+387	1x1.2		Pipe	
79	251+274	1x2x1.0		Box	
80	252+179	1x1		Pipe	
81	252+563	1x1		Pipe	
82	252+936	1x1		Pipe	
83	254+093	2x1.2		Pipe	
84	254+586	3x1.2		Pipe	
85	254+868	3x1.2		Pipe	
86	255+496	1x1.2		Pipe	
87	255+927	2x3x2.8		Box	
88	255+936	1x4.5x2.8		Box	
89	255+998	1x1		Pipe	
90	256+064	1x1.2		Pipe	
91	256+313	1x1.2		Pipe	
92	256+422	1x1.2		Pipe	
93	256+896	6x1.2		Pipe	
94	257+193	1x1.2		Pipe	
95	257+462	1x1		Pipe	
96	258+243	1x1.2		Pipe	
97	258+393	1x1.2		Pipe	

Sl. No.	Existing Chainage (km)	Span Arrangement (m)		Type of Culvert	
		LHS	RHS	LHS	RHS
98	259+118	1x1.2		Pipe	
99	259+235	1x1.2		Pipe	
100	259+352	1x1.2		Pipe	
101	259+923	2x1.2		Pipe	
Package-2					
102	260+085	1x1.2		Pipe	
103	261+238	4 x 1		Pipe	
104	261+720	1x1.0		Pipe	
105	262+002	4 x 1		Pipe	
106	262+158	1x3x2.5		Box	
107	262+373	1x1.2		Pipe	
108	262+537	2x1.2		Pipe	
109	262+746	3x1.2		Pipe	
110	263+056	1x1.0		Pipe	
111	263+735	1x1.0		Pipe	
112	263+822	1x1.0		Pipe	
113	263+892	1x1.0		Pipe	
114	264+037	1x1.0		Pipe	
115	264+333	4x1.2		Pipe	
116	264+434	1x1.2		Pipe	
117	264+827	1x1.0		Pipe	
118	264+895	1x1.0		Pipe	
119	265+035	1x1.2		Pipe	
120	265+148	3x1.2		Pipe	
121	266+023	1x4.0x3.5		Box	
122	266+060	1x1.0		Pipe	
123	266+359	1x1.2		Pipe	
124	266+561	3x1.2		Pipe	
125	266+684	2x1.2		Pipe	
126	266+980	1x2.7x2.5		Box	
127	267+741	1x1.0		Pipe	
128	267+994	1x2.0x1.5		Box	
129	268+512	1x2.0x1.5		Box	

Sl. No.	Existing Chainage (km)	Span Arrangement (m)		Type of Culvert	
		LHS	RHS	LHS	RHS
130	268+702	4x1.2		Pipe	
131	268+904	1x1.2		Pipe	
132	269+119	1x1.2		Pipe	
133	269+596	1x1.2		Pipe	
134	270+112	1x1.2		Pipe	
135	270+508	2x1.2		Pipe	
136	270+759	1x1.2		Pipe	
137	270+968	1x1.2		Pipe	
138	271+214	1x1.2		Pipe	
139	271+374	1x1.2		Pipe	
140	271+737	2x1.2		Pipe	
141	272+347	1x1.2		Pipe	
142	272+594	1x3x2.5		Box	
143	272+630	1x1.2		Pipe	
144	272+760	1x1.2		Pipe	
145	272+940	1x1.0		Pipe	
146	273+203	1x1.0		Pipe	
147	274+447	4x1.2		Pipe	
148	274+450	1x1.0		Pipe	
149	276+992	2x1.2		Pipe	
150	277+440	1x3.0x1.5		Box	
151	281+820	1x1.2		Pipe	
152	283+722	1x2.2x1.6		Box	
153	285+208	1x1.0		Pipe	
154	286+762	2x1.0		Pipe	
155	287+956	2x1.0		Pipe	
156	288+927	1x1.0		Pipe	
157	289+282	2x1.0		Pipe	
158	289+664	2x1.0		Pipe	
159	290+156	1x3x2.5		Box	
160	290+768	2x1.0		Pipe	
161	291+256	1x3x1.5		Box	
162	291+556	1x1.0		Pipe	

Sl. No.	Existing Chainage (km)	Span Arrangement (m)		Type of Culvert	
		LHS	RHS	LHS	RHS
163	291+975	2x1.0		Pipe	
164	292+635	3x1.2		Pipe	
165	292+645	1x1.0		Pipe	
166	292+888	6x1.2		Pipe	
167	293+918	2x1.0		Pipe	
168	294+299	6x1.0		Pipe	
169	294+529	2x1.0		Pipe	
170	295+116	2x1.0		Pipe	
171	296+006	2x1.0		Pipe	
172	297+136	2x1.0		Pipe	
173	297+486	1x1.0		Pipe	
174	297+671	1x1		Pipe	
175	297+836	1x1		Pipe	
176	298+596	2x1.0		Pipe	
177	298+901	2x1.0		Pipe	
178	300+836	1x1.0		Pipe	
179	301+516	1x1.0		Pipe	
180	301+876	1x1.0		Pipe	
181	302+096	2x1.0		Pipe	
182	302+386	1x1.0		Pipe	
183	302+777	2x1.0		Pipe	
184	304+009	2x1.0		Pipe	
185	304+773	2x1.0		Pipe	
186	305+048	1x4x1.5		Box	
187	305+423	3x1.0		Pipe	
188	306+059	4x1.0		Pipe	
189	307+213	2x1.0		Pipe	
190	307+572	4x1.0		Pipe	
191	307+633	3x1.0		Pipe	
192	308+058	3x1.0		Pipe	
193	309+230	6x1.2		Pipe	
194	310+192	1x5x3.5		Box	
195	310+808	2x1.0		Pipe	

Sl. No.	Existing Chainage (km)	Span Arrangement (m)		Type of Culvert	
		LHS	RHS	LHS	RHS
196	310+841	1x2.0x2.0		Box	
197	311+031	2x1.0		Pipe	
198	311+256	6x1.0		Pipe	
199	312+730	2x1.0		Pipe	
200	312+823	1x3.2x2.5		Box	
201	313+811	4x1.0		Pipe	
202	313+935	3x1.0		Pipe	
203	315+293	3x1.0		Pipe	
204	315+550	2x1.0		Pipe	
205	316+093	1x1.0		Pipe	
206	316+252	2x1.0		Pipe	
207	316+430	1x3x2.9		Box	
208	317+861	1x3x2.5		Box	
209	318+371	2x1.0		Pipe	
210	318+588	1x4.9x4		Box	
211	318+801	2x1.0		Pipe	
212	318+919	2x1.0		Pipe	
213	319+062	2x1.0		Pipe	
214	319+376	1x1.0		Pipe	
215	319+476	2x1.0		Pipe	
216	319+780	2x1.0		Pipe	
217	320+396	2x1.2		Pipe	
218	325+074	1x1		Pipe	
219	326+506	3x1.0		Pipe	
220	327+036	1x1.2		Pipe	
221	327+371	4x1.0		Pipe	
222	328+017	1x1.0		Pipe	
223	331+206	2x1.0		Pipe	
224	332+359	1x1.0		Pipe	
225	333+906	1x1.0		Pipe	
226	333+986	1x1.0		Pipe	
227	334+181	1x1.0		Pipe	
228	334+468	1x1.0		Pipe	

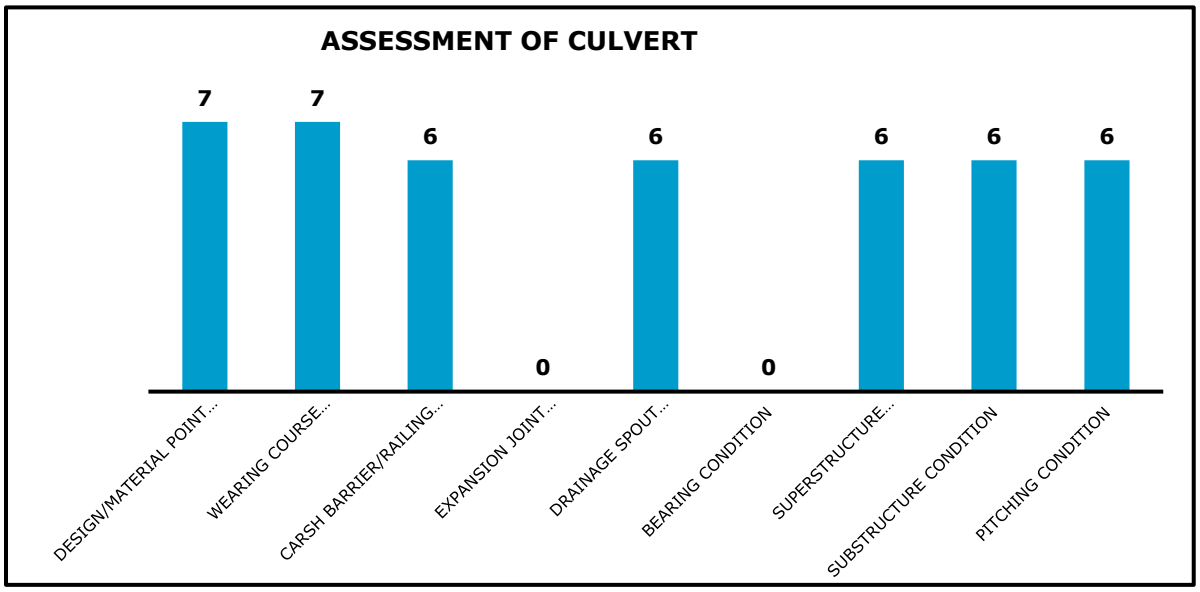
Sl. No.	Existing Chainage (km)	Span Arrangement (m)		Type of Culvert	
		LHS	RHS	LHS	RHS
229	334+721	1x1.0		Pipe	
230	334+979	1x1.0		Pipe	
231	335+271	3x1.0		Pipe	
232	336+656	2x1.0		Pipe	
233	337+166	3x1.0		Pipe	
234	337+446	2x1.0		Pipe	
235	337+706	2x1.0		Pipe	
236	338+240	2x1.0		Pipe	
237	338+451	2x1.0		Pipe	
238	338+529	3x1.0		Pipe	
239	338+703	3x1.0		Pipe	
240	338+240	2x1.0		Pipe	
241	338+451	2x1.0		Pipe	
242	338+892	2x1.0		Pipe	
		Package-3			
243	340+238	1x2.5x1.5	1x2.0x1.0	Box	Pipe
244	343+103	1x1.5x1.5		Box	
245	343+808	2x1.0		Pipe	
246	344+526	1x4.0x1.5		Box	
247	344+852	3.5+1.75+3.5X1.5	5.0x1.2	Box	Pipe
248	345+853	3.0x1.0		Pipe	
249	347+009	1x2.5x1.5	2.0x1.0	Box	Pipe
250	347+414	1x2.5x1.5	2.0x1.0	Box	Pipe
251	349+292	1x1.5x1.5		Box	
252	351+498	1x1.5x1.5		Box	
253	351+756	1x1.5x1.5		Box	
254	359+360	1x2.75x1.5		Box	
255	359+461	1x4.0x1.5		Box	
256	360+521	1x2.5x 1.5		Box	
257	361+496	1x1.5x1.5		Box	
258	362+110	1x1.5x1.5		Box	
259	362+340	1x2.5x1.5	2.0x1.2	Box	Pipe
260	365+689	1x1.5x1.5		Box	

Sl. No.	Existing Chainage (km)	Span Arrangement (m)		Type of Culvert	
		LHS	RHS	LHS	RHS
261	366+104	1x1.5x1.5		Box	
262	366+717	1x1.5x1.5		Box	
263	367+285	1x1.5x1.5		Box	
264	368+277	1x1.5x1.5		Box	
265	369+153	1x1.5x1.5		Box	
266	369+788	1x1.5x1.5		Box	
267	370+080	1x4.0x1.5		Box	
268	370+391	1x1.5x1.5		Box	
269	371+997	1x2.7x1.5	2.0x1.0	Box	Pipe
270	377+558	1x3.2x1.5	2.0x1.0	Box	Pipe
271	377+883	1x3.2x1.5	2x1.0	Box	Pipe
272	379+322	1x5.1x1.5	3x1.0	Box	Pipe
273	381+240	1x1.5x1.5		Box	
274	382+512	1x1.5x1.5		Box	
275	383+182	1x1.5x1.5		Box	
276	383+372	1x2.25x1.5		Box	
277	383+716	1x1.5x1.5		Box	
278	386+569	1x1.5x1.5	1.0 x 1.0	Box	Pipe
279	386+851	1x1.5x1.5	1.0 x 1.0	Box	Pipe
280	387+613	1x1.5x1.5		Box	
281	387+820	1x1.5x1.5		Box	
282	388+679	1x1.5x1.5		Box	
283	389+106	2.0x1.0	1x2.5 x 1.5	Pipe	Box
284	389+296	1x1.5x1.5		Box	
285	389+657	1x1.5x1.5		Box	
286	389+844	1x2.5x1.50	2x1	Box	Pipe
287	392+065	1x5.25x1.5		Box	
288	392+906	2.0x1.0		Pipe	
289	393+395	2.0x1.0	1x2.5 x 1.5	Pipe	Box
290	395+790	1.0X1.0	1x1.5X1.5	Pipe	Box
291	396+207	1x2.5 x 1.5		Box	
292	396+409	1x2.21X1.5		Box	
293	396+485	1x1.5x1.5		Box	

Sl. No.	Existing Chainage (km)	Span Arrangement (m)		Type of Culvert	
		LHS	RHS	LHS	RHS
294	398+902	1x2.25x1.5	2.0x1.0	Box	Pipe
295	399+154	1x1.5x1.5		Box	
296	399+199	1x1.5x1.5		Box	
297	399+319	1x4x1.5	3x1.0	Box	Pipe
298	399+902	1x1.5x1.5		Box	
299	401+131	1.0x1.0		Pipe	
300	405+576	1x2.75x2.45		Box	
301	403+035	2.0x1.2		Pipe	
302	340+238	2.0x1.0		Pipe	
303	343+103	1x1.5x1.5		Box	
304	343+808	2.0x1.0		Pipe	
305	344+526	1x4.0x1.5	4.0X1.5	Box	Box
306	344+852	1x1.75x1.5	5.0X1.2	Box	Pipe
307	345+853	3.0x1.0		Pipe	
308	347+009	2.0x1.0		Pipe	
309	347+414	2.0x1.0		Pipe	
310	349+292	1.0x1.0	1x1.5X1.5	Pipe	Box
311	351+498	1.0x1.0	1x1.5X1.5	Pipe	Box
312	351+756	1.0x1.0	1x1.5X1.5	Pipe	Box
313	359+360	1x2.75x1.5		Box	
314	359+461	1x4.0x1.5		Box	
315	360+521	1x2.5x1.5	2.0x1.0	Box	Pipe
316	361+496	1.0x1.0	1x1.5X1.5	Pipe	Box
317	362+110	1x1.5x1.5		Box	
318	362+340	1x2.5x1.5		Box	
319	365+689	1x1.5x1.5	1.0x1.0	Box	Pipe
320	366+104	1.0x1.0		Pipe	
321	366+717	1.0x1.0	1x1.5X1.5	Pipe	Box
322	367+267	1.0x1.0	1x1.5X1.5	Pipe	Box
323	368+277	1x1.5x1.5		Box	
324	369+153	1x1.5x1.5		Box	
325	369+788	1x1.5x1.5	1.0x1.0	Box	Pipe
326	370+080	1x4.0x1.5		Box	

Sl. No.	Existing Chainage (km)	Span Arrangement (m)		Type of Culvert	
		LHS	RHS	LHS	RHS
327	370+391	1x1.5x1.5	1.0x1.0	Box	Pipe
328	371+997	2.0x1.0		Pipe	
329	377+558	2.0x1.0		Pipe	
330	377+883	2x1.0		Pipe	
331	379+310	3.0x1.0		Pipe	
332	381+240	1.0x1.0	1x1.5X1.5	Pipe	Box
333	382+512	2.0x1.0	1x1.5X1.5	Pipe	Box
334	383+182	1x1.5x1.5		Box	
335	383+372	2.0x1.0	1x2.25x1.5	Pipe	Box
336	383+716	1.0x1.0	1x1.5x1.5	Pipe	Box
337	386+569	1x1.5x1.5	1.0x1.0	Box	Pipe
338	386+851	1x1.5x1.5	1.0x1.0	Box	Pipe
339	387+613	1x1.5x1.5	1.0x1.0	Box	Pipe
340	387+820	1x1.5x1.5	1.0x1.0	Box	Pipe
341	388+679	1x1.5x1.5	1x1.0	Box	Pipe
342	389+106	2x1.0		Pipe	
343	389+296	1x1.0		Pipe	
344	389+657	1x1.0		Pipe	
345	389+844	2.0 x 1.0		Pipe	
346	392+065	1x5.25X1.5		Box	
347	392+906	2X1.0		Pipe	
348	393+395	2X1.0	2.25x1.5	Pipe	Box
349	395+790	1.0x1.0	1.5x1.5	Pipe	Box
350	396+207	1x2.5X1.5		Box	
351	396+409	1x2.21X1.5		Box	
352	396+449	1x1.5X1.5		Box	
353	398+902	1x2.25X1.5		Box	
354	399+154	1x1.5X1.5		Box	
355	399+199	1x1.5X1.5		Box	
356	399+319	1x4.0x1.5	2x1.0	Box	Pipe
357	399+302	1x1.5X1.5		Box	
358	401+131	1x1.0		Pipe	
359	402+576	1x2.75 x 2.45		Box	

Sl. No.	Existing Chainage (km)	Span Arrangement (m)		Type of Culvert	
		LHS	RHS	LHS	RHS
360	403+035	2x1.2		Pipe	
361	340+751	1x2.5x1.5		Box	
362	354+080	1x1.5X1.5		Box	
363	354+316	1x1.5X1.5		Box	
364	356+660	1x2.5x1.5		Box	
365	362+957	1x2.5x1.5		Box	
366	363+297	1x1.5X1.5		Box	
367	364+403	1x2.5x1.5		Box	
368	364+922	1x2.5x1.5		Box	
369	370+982	1x4.0 x 1.5		Box	
370	374+858	1x5.1x1.5		Box	
371	378+589	1x1.5X1.5		Box	
372	378+968	1x1.5X1.5		Box	
373	384+563	1x2.5x1.5		Box	
374	386+008	1x1.5X1.5		Box	
375	390+441	1x1.5X1.5		Box	
376	391+233	1x2.2x1.5		Box	



Typical Photographs of culvert are presented hereunder.

Vegetation grows on waterway of culvert

Head wall missing in culvert

Culvert 318 +590 Road Under Construction

Culvert at 282+000

6.11 Observation

All the structures are visually inspected to find any cracking, spalling, staining, deformation, leaching, exposed reinforcement, honeycombing, condition of expansion joints, wearing coat, approach slabs, drainage, and damaged railing etc. Major Structures like Major Bridges, ROBs, Flyovers are inspected by MBIU and are reported in Annexure 3 to Main Report.

The damages witnessed at the structures are due to minimal or no routine / preventive maintenance of these structures. General observations are summarised as under:

- Vegetation growth on structure and waterway area
- clogged drainage spout of structures.
- cracks on crash barrier.
- Disturbed Quadrant pitching
- scour & bulging observed in protection work.
- exposed reinforcement at parapet of culvert.
- honeycombing at parapet of culvert.
- worn out & Potholes on wearing.
- debris found under culvert due to non-maintenance of waterway.

In general, the structures are found to be in structurally sound condition except for certain aspects requiring immediate repairs as under:

- Repair of Protection work by proper channelling of water flow.
- Minor crack repairs & honeycombing repairs at structural components
- Improving the drainage on the deck slab

- VOP at chainage 258+800 and major bridge expansion joints are badly damaged which need to be repaired as soon as possible.

7. ASSESSMENT OF PROJECT ASSETS - TOLL SYSTEMS

7.1 General

Technical Due Diligence of the TMS (Toll Management System), ETC (Electronic Toll Collection System) and WIM (Weigh-in-Motion) System (as available) along the Chitradurga – Davangere – Haveri - Hubli Section of NH-48 in the state of Karnataka is done through site visits, site surveys, interactions at site and review of documents and reports.

7.2 Project Information

Toll Plaza 1 - KM 286+000 – Hebbalu TP
Toll Plaza 2 - KM 237+650 – Chelagiri TP
Toll Plaza 3 - KM 352+550 – Bankapur TP

No. of Lanes at each Toll Plaza

- TP1 is with 16 Hybrid lanes at the toll plaza, no separate two-wheeler lanes are provided adjacent to the extra-wide lanes.
- TP2 is with 12 Hybrid lanes at the toll plaza, no separate two-wheeler lanes are provided adjacent to the extra-wide lanes.
- TP3 is with 14 Hybrid lanes at the toll plaza, no separate two-wheeler lanes are provided adjacent to the extra-wide lanes.

7.3 Toll System Maintenance

The TMS installation was done by M/s Superwave Communications in the year 2021 and since last one year is running under AMC by the same system integrator till date for all lanes at Toll Plaza 1 (Bankapur) located at KM 352+550.

The other two toll plaza TMS has been installed by M/s Arya Omnitalk but is being refurbished and maintained by M/s Bisotech since last 4 years.

7.4 Weigh In Motion (WIM) system.

Toll Plaza 1 is installed with Medium Speed Weigh in Motion (MSWIM) are installed in 4 lanes i.e. Lanes 4,5,12 and 13 and none of them are in functional condition with no vehicle separators or controllers are installed, make, model and installation date is not known and are found beyond repairs.

Toll Plaza 2 is installed with Medium Speed Weigh in Motion (MSWIM) are installed in 4 lanes i.e. Lanes 2,3,10 and 11 and none of them are in functional condition with no vehicle separators or controllers are installed, make, model and installation date is not known and are found beyond repairs.

Toll Plaza 3 is installed with Medium Speed Weigh in Motion (MSWIM) systems in 14 lanes of M/s Intelliweight and none of them are functional, the installation date of these WIMs is not known and are recommended for replacement.

No stamping certificate present at any site for Weigh In Motion Systems installed at all three Toll Plazas and is in direct non-compliance to the Weight and Measurements department norms and can have legal implications.

7.5 Static Weigh Bridge (SWB)

At Toll Plaza 1 no Static Weigh Bridge is installed, no stamping certificate present at any site for both toll plaza Static Weigh Bridges and is in direct non-compliance to the Weight and Measurements department norms and can have legal implications.

Total 4 No. Static Weigh Bridge are installed (one in each direction) at the Toll Plazas 3 and 2 but not functional and equipment inside the SWB room have been removed at both toll plazas, further, access to SWB at the first toll plaza is blocked due to drain construction activity on the road.

7.6 HTMS System

Based on the Schedule D, the ATMS has to be provided as in six laning section and as per IRC: SP:87-2013 on the project highway.

The ATMS Control room is setup at all three toll plazas through M/s Vaaan Infra with a 3x3 matrix video wall and control room workstations for monitoring the field devices, at TP3 M/s Superwave is maintaining the ATMS, at TP2 & 1 it is being maintained by M/s Vaaan Infra itself (this is as per confirmation by the site team), following is the synopsis of the equipment status visible at the control rooms.

a. ECB – All ECBs found not functional and mostly damaged or inner circuits and batteries stollen.

b. VMS – Working in standalone mode due to communication backbone failure.

c. MET – Found working at all 3-toll plaza locations.

d. PTZ – 50% of the PTZ camera's view is not transmitted to the three control rooms due to communication backbone failure.

e. VIDS – 50% of the VIDS camera's view is not transmitted to the three control rooms due to communication backbone failure.

7.7 Review and Assessment of TMS (incl. AVCC Systems)

1. TMS maintenance is being done by two different vendors i.e. M/s Superwave at TP3 and at other 2 toll plazas it is being maintained by M/s Bisotech, for all the toll equipment with open tolling technology and is in the AMC.
2. Lane hardware is provided as per the industry standards but maintained in poor condition, critical components required to check the vehicle classification e.g. AVC in all lanes is not functional and is not transmitting the any data to the server and not conforming to the supplementary agreement techno-functional requirements.
3. No two-wheeler lanes are provided separately, and uncontrolled movement of these vehicles create violations.
4. All lanes Fastag processing is slow and since there is no AVC input, the revenue reconciliation is based on TC / Fastag class input only.
5. The MS-WIM and SWB to detect and collect overload penalty as per the government norms are not functional and all overloaded vehicles are moving through the lanes freely.
6. The network is Ethernet based and is provisioned with a backbone connectivity through OFC in parallel, this is provisioned to prevent any data loss in case the primary link from plaza to lanes becomes faulty and which will further prevent any data loss.
7. Fastag integration is done through IDFC as an Acquirer bank and ILL is established for round the clock connectivity.

7.8 Assessment of Toll Operation and integration with TMS

The AVC is profiler based with independent storage but not sending data if the lane controller if put down for maintenance and in such cases the control room staff is completely dependent on toll collectors' input for validation of all discrepancies, Violations etc.

The LSDU i.e. Lane Status Display Unit to monitor the entire hardware of each lane is not provided which is an essential part for monitoring of the toll equipment on day to day basis and generating all alerts.

7.9 Backoffice TMS review

a. The TMS is controlled through the control room which is housed with the validator performing real time transaction validations.

b. LSDU as stated above is not provided and equipment status / failures are not known to the shift supervisor.

c. As per the guidelines of IHMCL, the plaza server has to be installed with a hot-standby server arrangement however none of the plazas had the hot-standby server installed.

d. No fake note detectors installed in the lane to detect counterfeit currency.

7.10 Conclusion

The complete TMS systems need to be replaced to have proper inputs from lanes and proper reconciliation from the Backoffice. The WIMs and SWBs need replacements as none of them are found functional and information to the weights and measurements department has to be given about non-functional WIMs and SWB to avoid any penal action on account of no stamping done for any WIMs and SWBs till date.

7.11 Cost Estimate

TMS

a. Assessment of Immediate Repair Cost

Considering that the plaza equipment is under AMC till 2024 and post that the replacements are recommended for the entire TMS, the immediate repairs to be carried out have been calculated individually for both toll plazas as below which are not covered under AMC being non-comprehensive:

TP1 – Rs. 62,74,000/-

TP2 – Rs. 42,80,000/-

TP3 – Rs. 45,23,000/-

The repairs for MSWIM and SWB are not considered as part of AMC scope, and these also need to be replaced as repairs are not recommended as the equipment is rendered irreparable. The cost of repairs for MSWIM & SWB at both toll plazas is mentioned below, these expenses may be considered only when the client wishes to collect Overload penalties at TP2 also:

TP1 – MS WIM - Rs. 1,56,00,000/- for 16 lanes and SWB Equipment (excl. civil works) is estimated for Rs. 19,00,000/- for 2 Nos

TP2 – MS WIM - Rs. 1,35,47,172/- for 12 lanes and SWB Equipment (excl. civil works) is estimated for Rs. 19,00,000/- for 2 Nos.

TP3 – MS WIM - Rs. 1,70,22,534/- for 14 lanes and SWB Equipment (excl. civil works) is estimated for Rs. 19,00,000/- for 2 Nos

b. Assessment of Total Replacement Cost of TMS Equipment for till end of concession period

The TMS replacement cost for a 16 Lane TP is estimated @ Rs. 50,866,137/-

The TMS replacement cost for a 12 Lane TP is estimated @ Rs. 38,149,602/-

The TMS replacement cost for a 14 Lane TP is estimated @ Rs. 44,507,870/-

Assessment of AMC Cost

Though there is no AMC document provided for reference, however the same has been considered as 10% of the replacement cost at each toll plaza and presented below:

TP 1 for 16 Lanes AMC @ 40,69,291/-

TP 2 for 12 Lanes AMC @ 30,51,968/-

TP 3 for 14 Lanes AMC @ 35,60,630/-

Figure 7-1: Typical Site Photographs of Toll Plaza & Equipment

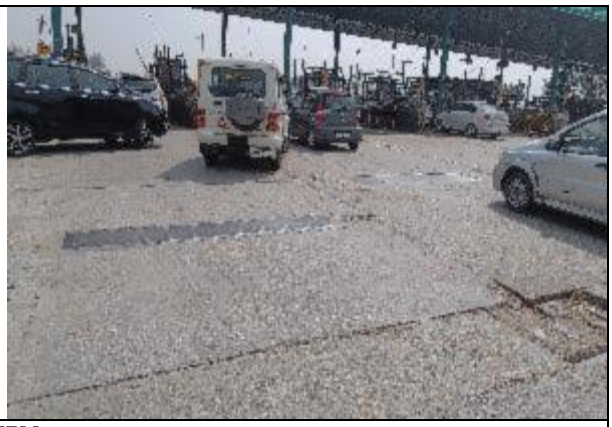
Site Pictures of: Toll Plaza-1

Site Pictures of: Toll Plaza-2

Site Pictures of: Toll Plaza-3

Static Weigh Bridge platform and room

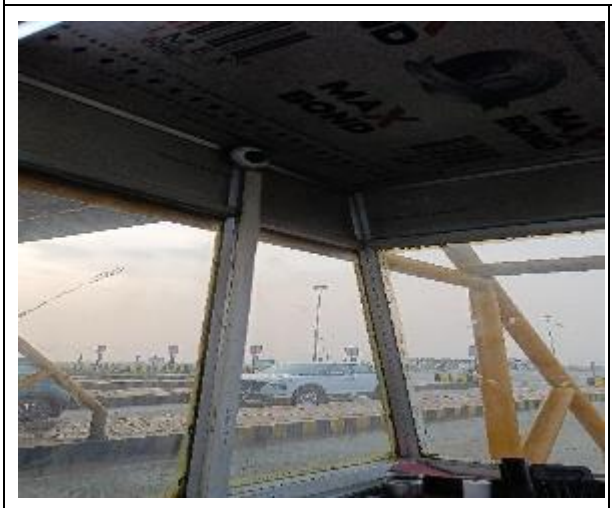
MS-WIM



MS-WIM

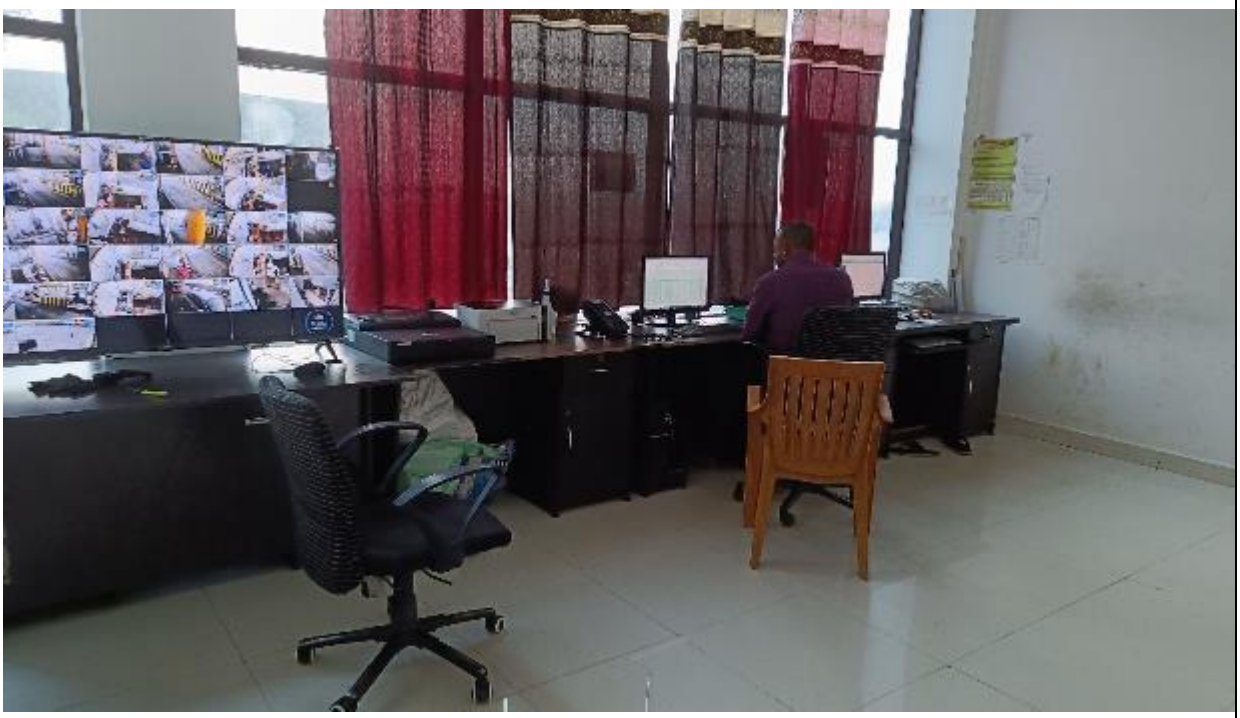
Lane Controller and AVC controllers inside the Tunnel

Tunnel Equipment Layout / Arrangement

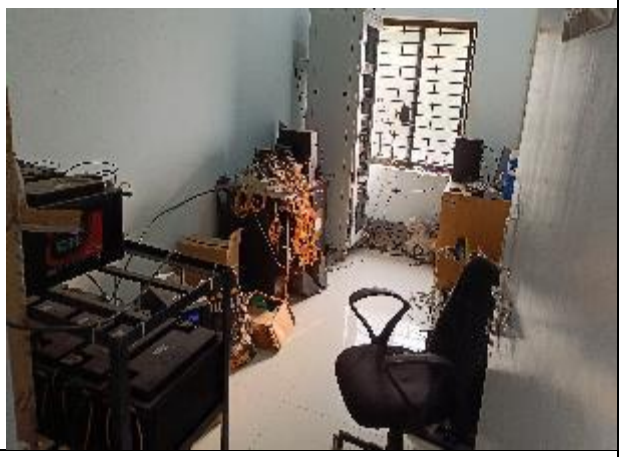


Booth Equipment

Lane Island Equipment incl. AVC sensors



Control Room arrangement



Server Room

ATMS Control Room

Servers / NVR inside the network rack in the Server Room

8. REVIEW OF O&M SUB-CONTRACTS AND MAINTENANCE MANUALS

This chapter contains a short review of the Operation and Maintenance Obligations of the Concessionaire

8.1 Operation and Maintenance Obligations

As per Clause 17.1 of CA, the Concessionaire shall operate and maintain the Project by itself, or through O&M Contractor and if required, modify, repair or otherwise make improvements to the Project Highway to comply with the provisions of this Agreement, Applicable Laws and Applicable Permits and conform to Specifications and Standards, and Good Industry Practice. The obligations of the concessionaire hereunder shall include:

- Procuring and ensuring safe, smooth and uninterrupted use of the Project, including prevention of loss or damage thereto, during normal operating conditions.
- Minimising disruption to traffic in the event of accidents or other incidents affecting the safety and use of the Project Highway by providing a rapid and effective response and maintaining liaison with emergency services of the state.
- Carrying out periodic preventive maintenance of the Project Highway.
- Undertaking routine maintenance including prompt repairs of potholes, cracks, concrete joints, drains, embankments, structures, pavement markings, lighting, road signs and other traffic control devices.
- Undertaking major maintenance such as resurfacing of pavements, repairs to structures, and repairs and refurbishment of system and equipment.
- Preventing, with the assistance of concerned law enforcement agencies, any unauthorised entry to and exit from of the Project Highway.
- Preventing, with the assistance of the concerned law enforcement agencies, any encroachments on the Project Highway.
- Protection of the environment and provision of equipment and materials thereof.
- Operating and maintenance of all communication, control and administrative systems necessary for the efficient operation of the Project and for providing safe, smooth and uninterrupted use of the Project.
- Maintaining a public relations unit to interface with and attend to suggestions from the Users, of the Project Highways, the media, Government Agencies, and other external agencies; and
- Complying with Safety Requirements in accordance with Article 18.

8.2 Operations and Maintenance Manual

	Davangere – Chitradurga	Davangere - Haveri	Hubali – Haveri
	Package 1	Package 2	Package 3
Maintenance manual	Yes, available	Yes, available	Not available

As per CA requirement stated in 17.3.1, the Concessionaire National has evolved a maintenance manual **(the "Maintenance Manual") for Package 1 and Package 2.** The Maintenance Manuals do not provide clarity on works that the Concessionaire intends to subcontract and the works that he intends to carry out inhouse using his own team.

9. SOIL AND MATERIAL INVESTIGATION

9.1 General

As a part of soils and materials investigations report preparation, the consultants have conducted testing on the existing subgrade soils and granular layers along the project corridor. The test results conducted for both in-situ and laboratory tests are detailed here..

9.2 Field Investigation – Sampling and Testing

Field tests were conducted on the subgrade soils and required pavement materials were collected for needful testing. **Table 9-1** presents the sampling criteria, tests and testing procedures adopted for various field and laboratory tests.

Table 9-1: Site Sampling and Testing Criteria

Sl. No.	Type of Soil Sample	Sampling Criteria	Testing Criteria	
			Description of Test	Standard Code Applicable
Existing Subgrade and Pavement Materials				
i)	**Subgrade Strength Test Pits**	Minimum of one subgrade soil sample is obtained at an interval directed by the client & Materials Engineer based on site condition	In-situ Density	IS 2720 (Part- 29)
			In-situ Moisture Content	IS 2720 (Part- 2)
			Soil Classification	IS 1498
			Sieve Analysis	IS 2720 (Part – 4)
			Atterberg Limits	IS 2720 (Part – 5)
			Laboratory Compaction Test	IS 2720 (Part – 8)
			4-day soaked CBR	IS 2720(Part – 16)
			Free swell Index	IS 2720 (Part-40)
ii)	**Existing Granular Layers**	Existing granular layer materials was collected from each subgrade test pit at an interval directed by client	Gradation	MoRTH Table:400-1 & 400-13
			Atterberg Limits	IS 2720 (Part – 5)
			Specific Gravity and Water Absorption	IS 2386 (Part – 3)
			Aggregate Impact Value (AIV)	IS 2386 (Part – 4)

9.3 Investigations On Subgrade Soils

The Subgrade investigations were carried out to know the strength properties of the existing soil mentioned in the **Table 9-1** above, and also it was ensured that the test pits are carried out at an interval in staggered manner under the inspection of material engineer. The various in-situ tests conducted, and laboratory tests included in the testing program on soil samples along the alignment as per the project requirements are summarized in **Table 9-1.** The

pavement composition details (pavement course, material type, and thickness) are also recorded at every test pit.

Discussion on the tests conducted and results obtained are carried out in the following sections.

Field tests were conducted as per the project requirement to determine the subgrade characteristics and strength. The field testing for subgrade soil includes:

- In-situ density determination at possible location of each test pit
- Field moisture content determination at possible location of each test pit

In-situ density (field density) and moisture content using the Rapid moisture metre were determined as per the standards enlisted in **Table 9-1**. Field density is evaluated to assess the degree of compaction and the CBR is conducted by compacting it to field density state. Sample weighing 50kg were collected in a damp proof bag for the laboratory testing. The laboratory tests such as field dry density and field moisture content were conducted following the standards specified in **Table 9-1** , the obtained test results are summarised in the **Annexure 3-1 (a) (b) (c)** and **Table 9-2, Table 9-3** and **Table 9-4** separately for the 3 packages covering the entire project section. The field investigation Photographs are shown in Photo 9-1, Photo 9-2 Photo 9-2 and Photo 9-3

Photo 9-1: Photographs showing Field Investigations from Chitradurga to Davanagere

Photo 9-2: Photographs showing Field Investigations from Davanagere to Haveri

Photo 9-3: Photographs showing Field Investigations from Haveri to Hubli

Observations and Conclusions

(i) Soil Classification and Distribution

From **Table 9-2, Table 9-3** and **Table 9-4** it is evident that subsoil is consistent throughout the project road and is predominantly Sandy in nature from Chitradurga to Davanagere and Gravel and Sandy in nature from Davanagere to Haveri and Haveri to Hubli. Because of this soil type.

Chitradurga to Davanagere section

Liquid Limit (LL) is ranging between 19-34%. The obtained maximum Plasticity Index of the subgrade soils is 16 and the degree of free swell is 27.3%.

Davanagere to Haveri section

Liquid Limit (LL) is ranging between 17-37%. The obtained maximum Plasticity Index of the subgrade soils is 18 and the degree of free swell is 30.0%.

Haveri to Hubli section

Liquid Limit (LL) is ranging between 21-43%. The obtained maximum Plasticity Index of the subgrade soils is 19 and the degree of free swell is 33.3%.

Liquid Limit (LL) values are within the limit as per MoRTH specifications (<50%). All the measured PI and FSI values are also within the acceptable limits as per MoRTH specifications 25% and 50% respectively.

(ii) Strength Parameters

Variance between MDD and FDD is converted in-terms of degree of compaction.

Chitradurga to Davanagere section

The degree of compaction along the project corridor is ranging between 96.1% - 99.0%. Obtained 4-days soaked CBR is ranging from 7.8% to 17.5% with an average value of 13.1%

As per PDR 15% subgrade CBR was considered for section-I & II, and 10% for section-III for pavement design. However, 3 samples out of 4 are not conforming in section-I & II and 2 samples out of 10 are not conforming in section-III with minimum design requirement.

Davanagere to Haveri section

The degree of compaction along the project corridor is ranging between 96.2% - 97.7%. Obtained 4-days soaked CBR is ranging from 6.8% to 23.2% with an average value of 12.4%

As per PDR, 8% subgrade CBR was considered for pavement design. However, 2 samples out of 16 are not conforming with minimum design requirement of 8% CBR.

Haveri to Hubli section

The degree of compaction along the project corridor is ranging between 96.0% - 98.5%. Obtained 4-days soaked CBR is ranging from 6.9% to 12.7% with an average value of 10.0%

As per PDR, 13% subgrade CBR was considered for pavement design. However, all samples out of 13 are not conforming with minimum design requirement of 13% CBR.

Table 9-2: Summary of Subgrade Test Results

Chitradurga to Davanagere																
S. No	Existing Chainage (Km.)	Side (LHS/ RHS)	Soil Classification as per IS: 1498	Gravel content %	Sand content %	Clay & silt content %	Atterberg Limits [IS :2720-Pt-V]			Modified Proctor Test (IS:2720-Pt-VIII)		Field Density		4-Days Soaked CBR at MDD (%)	Free Swell Index (%)	Degree of Compaction (%)
							Liquid Limit (LL) %	Plastic Limit (PL) %	Plasticity Index (PI)	Max. dry density (gm/cc)	OMC (%)	Field Dry Density (gm/cc)	FMC (%)			
1	195+200	RHS	SC	32.5	38.0	29.5	29	21	8	1.98	9.9	1.92	7.0	10.7	15.3	97.0
2	199+000	LHS	SM-SC	38.1	40.8	21.1	25	21	4	2.00	8.9	1.95	7.5	12.3	11.1	97.5
3	203+500	RHS	SM	34.2	42.2	23.6	21	NP	NP	2.04	9.1	1.98	6.0	14.7	9.1	97.1
4	209+380	LHS	SM	14.2	69.2	16.6	20	NP	NP	2.10	8.5	2.03	7.5	16.1	12.5	96.7
5	213+600	RHS	SC	25.2	52.1	22.7	29	20	9	2.03	10.2	1.96	7.0	11.6	18.1	96.6
6	218+100	LHS	SM-SC	10.9	64.9	24.2	26	19	7	2.06	8.8	1.98	7.0	10.6	15.2	96.1
7	223+600	RHS	SM	17.0	65.1	17.9	19	NP	NP	2.09	8.2	2.02	6.0	16.7	10.0	96.7
8	228+400	LHS	SC	7.6	61.2	31.2	29	20	9	1.95	10.4	1.90	7.5	8.6	20.0	97.4
9	234+500	RHS	SM	21.1	60.4	18.5	20	NP	NP	2.06	8.4	1.99	8.0	14.5	10.0	96.6
10	238+000	LHS	SM	21.1	49.3	29.6	29	NP	NP	1.98	10.3	1.91	7.0	10.2	20.0	96.5
11	242+200	RHS	SM-SC	29.4	51.1	19.5	21	16	5	2.07	9.3	2.01	7.0	14.9	12.3	97.1
12	248+100	LHS	SC	7.6	61.2	31.2	34	18	16	1.95	10.8	1.93	8.0	7.8	27.3	99.0
13	253+600	RHS	GP-GC	44.5	43.8	11.7	29	17	12	2.11	8.6	2.04	7.0	16.9	25.2	96.7

Chitradurga to Davanagere																
S. No	Existing Chainage (Km.)	Side (LHS/ RHS)	Soil Classification as per IS: 1498	Gravel content %	Sand content %	Clay & silt content %	Atterberg Limits [IS :2720-Pt-V]			Modified Proctor Test (IS:2720-Pt-VIII)		Field Density		4-Days Soaked CBR at MDD (%)	Free Swell Index (%)	Degree of Compaction (%)
							Liquid Limit (LL) %	Plastic Limit (PL) %	Plasticity Index (PI)	Max. dry density (gm/cc)	OMC (%)	Field Dry Density (gm/cc)	FMC (%)			
14	259+200	LHS	SM	15.7	65.3	19.0	19	NP	NP	2.03	8.8	1.96	7.0	17.5	11.1	96.6

Table 9-3: Summary of Subgrade Test Results

Davanagere to Haveri																
S. No	Existing Chainage (Km.)	Side (LHS/ RHS)	Soil Classification as per IS: 1498	Gravel content %	Sand content %	Clay & silt content %	Atterberg Limits [IS :2720-Pt-V]			Modified Proctor Test (IS:2720-Pt-VIII)		Field Density		4-Days Soaked CBR at MDD (%)	Free Swell Index (%)	Degree of Compaction (%)
							Liquid Limit (LL) %	Plastic Limit (PL) %	Plasticity Index (PI)	Max. dry density (gm/cc)	OMC (%)	Field Dry Density (gm/cc)	FMC (%)			
1	264+840	RHS	SC	20.7	49.5	29.8	33	22	11	1.98	10.7	1.92	6.0	8.9	20.0	97.0
2	270+000	LHS	SM	26.3	43.4	30.3	21	NP	NP	2.09	8.2	2.01	7.5	10.3	0.0	96.2
3	273+000	RHS	SM	25.2	51.0	23.8	21	NP	NP	2.12	8.0	2.06	6.0	16.7	10.0	97.2
4	278+100	LHS	SC	26.9	33.2	39.9	31	17	14	1.93	10.8	1.87	6.0	6.8	30.0	96.9
5	282+060	RHS	SM	40.2	43.7	16.1	19	NP	NP	2.12	8.3	2.05	5.0	16.7	0.0	96.7

Davanagere to Haveri																
S. No	Existing Chainage (Km.)	Side (LHS/ RHS)	Soil Classification as per IS: 1498	Gravel content %	Sand content %	Clay & silt content %	Atterberg Limits [IS :2720-Pt-V]			Modified Proctor Test (IS:2720-Pt-VIII)		Field Density		4-Days Soaked CBR at MDD (%)	Free Swell Index (%)	Degree of Compaction (%)
							Liquid Limit (LL) %	Plastic Limit (PL) %	Plasticity Index (PI)	Max. dry density (gm/cc)	OMC (%)	Field Dry Density (gm/cc)	FMC (%)			
6	289+000	LHS	GC	45.8	37.8	16.4	27	17	10	2.07	10.1	2.01	6.0	13.4	18.2	97.1
7	293+000	RHS	SM-SC	24.8	35.4	39.8	27	21	6	1.98	9.4	1.91	9.0	8.8	15.1	96.5
8	298+000	LHS	SC	21.0	49.1	29.9	28	19	9	2.10	9.5	2.04	7.0	10.3	18.1	97.1
9	303+800	RHS	GM	34.4	33.3	32.3	24	NP	NP	2.01	8.5	1.94	8.0	15.1	10.0	96.5
10	308+000	LHS	GC	36.6	35.8	27.6	30	20	10	2.07	9.2	2.02	7.0	13.8	18.3	97.6
11	313+800	RHS	SM	30.8	33.9	35.3	19	NP	NP	2.12	8.2	2.06	9.0	17.9	0.0	97.2
12	318+000	LHS	CL	15.9	32.1	52.0	29	21	8	1.93	9.7	1.88	8.0	8.0	20.0	97.4
13	323+000	RHS	GM	37.5	33.0	29.5	22	NP	NP	1.99	9.2	1.92	8.5	12.4	10.0	96.5
14	329+650	LHS	SC	17.0	34.0	49.0	37	19	18	1.93	10.4	1.86	8.0	7.3	20.0	96.4
15	332+700	RHS	GC	43.4	29.3	27.3	32	21	11	1.95	10.6	1.90	9.0	8.0	20.0	97.4
16	338+000	LHS	GW-GM	51.9	38.5	9.6	17	NP	NP	2.14	8.1	2.09	7.0	23.2	0.0	97.7

Table 9-4: Summary of Subgrade Test Results

Haveri to Hubli																
S. No	Existing Chainage (Km.)	Side (LHS / RHS)	Soil Classification as per IS: 1498	Gravel content %	Sand content %	Clay & silt content %	Atterberg Limits [IS :2720-Pt-V]			Modified Proctor Test (IS:2720-Pt-VIII)		Field Density		4-Days Soaked CBR at MDD (%)	Free Swell Index (%)	Degree of Compaction (%)
							Liquid Limit (LL) %	Plastic Limit (PL) %	Plasticity Index (PI)	Max. dry density (gm/cc)	OMC (%)	Field Dry Density (gm/cc)	FMC (%)			
1	343+000	RHS	GC	33.6	29.0	37.4	35	23	12	1.98	10.8	1.90	7.5	8.3	22.2	96.0
2	347+550	LHS	SC	35.1	43.3	21.6	31	21	10	2.07	9.9	2.01	8.0	10.5	18.2	97.1
3	351+980	RHS	GM	44.6	36.9	18.5	23	NP	NP	2.11	8.4	2.04	8.0	12.7	11.1	96.7
4	357+900	LHS	SM-SC	33.0	41.5	25.5	26	19	7	1.99	9.2	1.92	5.0	8.5	15.2	96.5
5	360+800	RHS	SM-SC	33.3	43.7	23.0	27	20	7	2.03	8.9	1.98	8.0	10.7	20.0	97.5
6	367+030	LHS	SM	27.7	29.0	43.3	23	NP	NP	1.94	9.1	1.88	7.0	8.6	9.1	96.9
7	373+000	RHS	GM	35.1	17.5	47.4	23	NP	NP	1.96	10.2	1.91	7.5	9.4	7.7	97.4
8	377+400	LHS	SM	26.2	46.6	27.2	25	NP	NP	2.00	10.1	1.97	8.0	12.7	0.0	98.5
9	383+000	RHS	SC	28.1	36.4	35.5	29	21	8	1.97	10.7	1.92	9.0	7.8	20.0	97.5
10	388+000	LHS	SM	18.2	54.5	27.3	21	NP	NP	2.01	8.6	1.94	7.0	11.3	0.0	96.5
11	391+800	RHS	SC	31.1	48.5	20.4	43	24	19	1.96	11.8	1.89	8.0	6.9	33.3	96.4
12	397+900	LHS	SC	17.4	50.9	31.7	27	18	9	2.05	9.3	1.99	6.0	10.1	22.2	97.1
13	402+800	RHS	GM-GC	37.6	36.2	26.2	22	17	5	2.03	9.8	1.99	7.0	12.3	11.1	98.0

9.4 Existing Pavement Composition and Summary

Existing pavement composition (pavement course, material type, and thicknesses) was recorded at an interval directed by the client & material engineer based on the site condition along the project road.

The summary of existing pavement crust thickness is tabulated in the **Table 9-5, Table 9-6,** and **Table 9-7.** The bar graphs showing different layers and thicknesses were illustrated in the **Figure 9-1, Figure 9-2** and **Figure 9.3**.Furthermore, the pavement crust thicknesses and its measurement on- site photographs were shown in **Photo 9-4**, **Photo 9-5** and **Photo 9-6.**

Table 9-5: Summary of Pavement Crust – Chitradurga & Davangere

Chitradurga to Davanagere					
S. No	Location (Km.)	Side (LHS/ RHS)	Pavement Composition (mm)		
			Bituminous layer	Granular layer- I & II	Total Thickness
1	195+200	RHS	150	500	650
2	199+000	LHS	120	500	620
3	203+500	RHS	150	500	650
4	209+380	LHS	110	650	760
5	213+600	RHS	140	550	690
6	218+100	LHS	120	550	670
7	223+600	RHS	170	600	770
8	228+400	LHS	110	600	710
9	234+500	RHS	150	650	800
10	238+000	LHS	100	550	650
11	242+200	RHS	140	460	600
12	248+100	LHS	110	600	710
13	253+600	RHS	140	470	610
14	259+200	LHS	110	550	660

Table 9-6: Summary of Pavement Crust – Davangere & Haveri

Davanagere to Haveri					
S. No.	Location (Km.)	Side (LHS/ RHS)	Pavement Composition (mm)		
			Bituminous layer	Granular layer-I & II	Total Thickness
1	264+840	RHS	210	550	760

2	270+000	LHS	170	600	770
3	273+000	RHS	170	550	720
4	278+100	LHS	210	350	560
5	282+060	RHS	170	400	570
6	289+000	LHS	170	550	720
7	293+000	RHS	170	560	730
8	298+000	LHS	170	550	720
9	303+800	RHS	160	700	860
10	308+000	LHS	200	550	750
11	313+800	RHS	170	650	820
12	318+000	LHS	180	450	630
13	323+000	RHS	160	600	760
14	329+650	LHS	130	600	730
15	332+700	RHS	130	500	630
16	338+000	LHS	130	500	630

Table 9-7: Summary of Pavement Crust – Haveri & Hubli

Haveri to Hubli					
S. No.	**Location (Km.)**	**Side (LHS/ RHS)**	**Pavement Composition (mm)**		
			Bituminous layer	**Granular layer-I & II**	**Total Thickness**
1	343+000	RHS	170	600	770
2	347+550	LHS	170	500	670
3	351+980	RHS	150	640	790
4	357+900	LHS	180	600	780
5	360+800	RHS	170	530	700
6	367+030	LHS	120	550	670
7	373+000	RHS	180	390	570
8	377+400	LHS	200	600	800
9	383+000	RHS	140	530	670
10	388+000	LHS	160	450	610
11	391+800	RHS	170	700	870
12	397+900	LHS	190	600	790

Haveri to Hubli					
S. No.	Location (Km.)	Side (LHS/ RHS)	Pavement Composition (mm)		
			Bituminous layer	Granular layer-I & II	Total Thickness
13	402+800	RHS	120	450	570

Photo 9-4: Photographs showing Pavement Crust Thickness from Chitradurga to Davanagere

Photo 9-5: Photographs showing Pavement Crust Thickness from Davanagere to Haveri

Photo 9-6: Photographs showing Pavement Crust Thickness from Haveri to Hubli

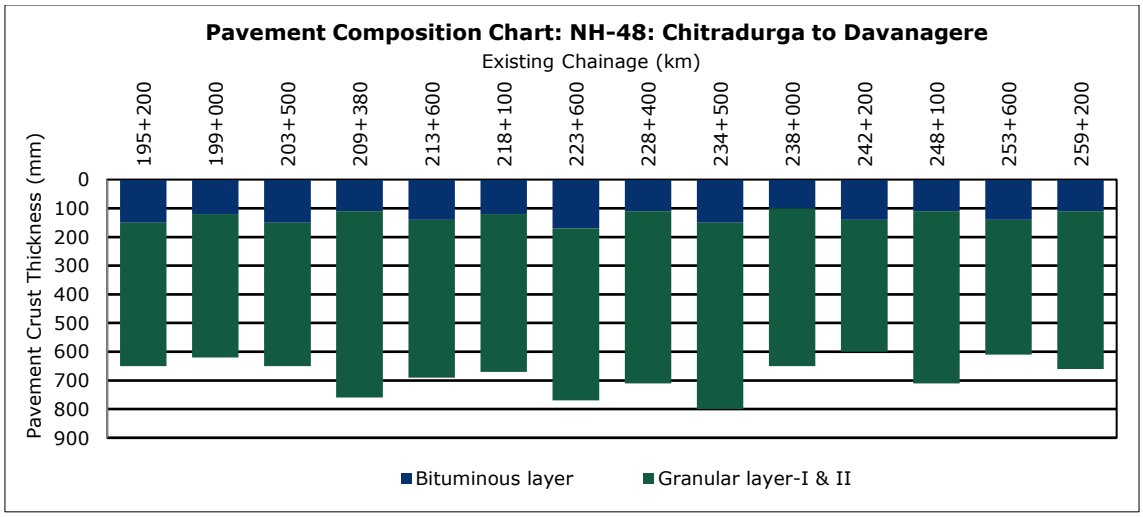


Figure 9-1: Existing Pavement Crust Summary from Chitradurga to Davanagere

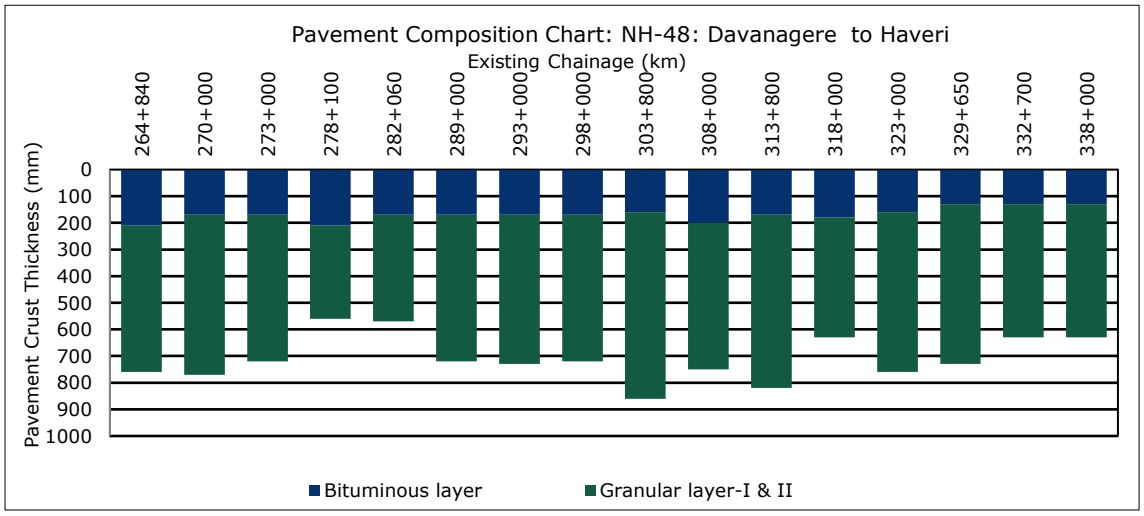


Figure 9-2: Existing Pavement Crust Summary from Davanagere to Haveri

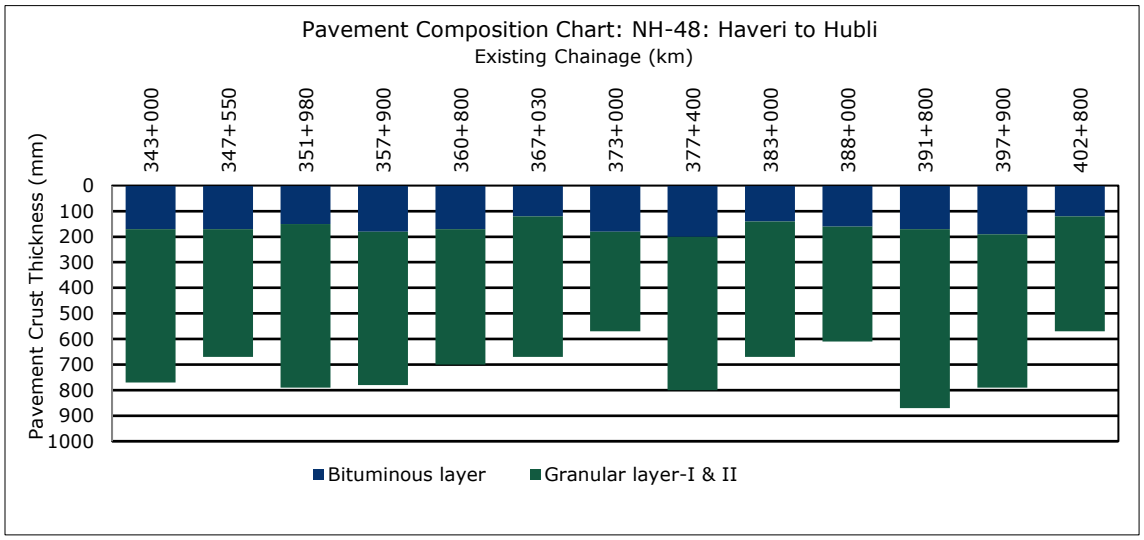


Figure 9.3: Existing Pavement Crust Summary along the project road from Haveri to Hubli

Observations and Conclusions:

- The existing pavement along the project corridor is flexible in nature except at Toll Plaza's.
- The flexible pavement composition comprises of bituminous layer, granular base over the granular sub-base.

Chitradurga to Davanagere section

Throughout the project road it possesses consistent bituminous/ granular layer thickness with an average of 130mm bituminous layer over 552mm of granular layer

Davanagere to Haveri section

Throughout the project road it possesses consistent bituminous/ granular layer thickness with an average of 169mm bituminous layer over 541mm of granular layer

Haveri to Hubli section

Throughout the project road it possesses consistent bituminous/ granular layer thickness with an average of 163mm bituminous layer over 549mm of granular layer

9.5 Existing Granular Layers Testing

Granular layer's (WMM/GSB) samples were collected along the project section with a certain interval in a staggered manner in the presence of material engineer. The samples for each of the relevant layers of GSB and WMM were collected separately with due care, maintaining the sample quality and quantity as per standards detailed in the **Table 9-1**. The test results are shown in **Table 9-8, Table 9-9** and **Table 9-10** are detailed in **Annexure 3-2 (a) (b) (c)**

Table 9-8: Tests results of granular layers for the samples collected between Chitradurga and Davanagere

Chitradurga to Davanagere																				
S. No	Chainage (km)	Side (LHS/ RHS)	Type of Sample	Cumulative Percentage of Passing through IS Sieve (mm)												Atterberg Limits			Specific Gravity	Water Absorption (%)	Aggregate Impact Value (%)
				75.0	53.0	45.0	26.5	22.4	11.2	9.5	4.75	2.36	0.600	0.425	0.075	Liquid Limit (LL) %	Plastic Limit (PL) %	Plasticity Index (PI)			
1	195+200	RHS	WMM	100.0	100.0	96.4	82.3	69.4	35.3	29.6	20.4	16.8	10.6	7.3	0.8	19	NP	NP	2.685	0.68	21.6
2	199+000	LHS	GSB	100.0	96.2	81.3	56.1	45.2	40.4	35.6	32.7	25.8	17.9	11.8	1.8	22	NP	NP	2.706	0.61	18.4
3	203+500	RHS	GSB	100.0	100.0	78.2	59.7	46.4	41.8	36.2	33.1	27.4	22.3	16.5	2.1	20	NP	NP	2.692	0.43	16.2
4	209+380	LHS	WMM	100.0	100.0	98.0	75.6	68.4	45.5	38.1	30.0	22.6	10.9	9.3	1.2	21	NP	NP	2.723	0.46	20.5
5	213+600	RHS	WMM	100.0	100.0	100.0	78.4	66.2	52.6	38.7	20.6	12.2	9.5	6.4	1.8	22	NP	NP	2.718	0.75	22.5
6	218+100	LHS	GSB	100.0	88.0	85.1	34.8	27.3	13.1	10.4	6.9	4.8	2.2	1.8	0.3	17	NP	NP	2.695	0.41	13.4
7	223+600	RHS	GSB	100.0	95.4	91.6	51.6	44.0	22.8	17.8	13.1	9.6	4.7	4.1	0.7	19	NP	NP	2.683	0.28	25.2
8	228+400	LHS	WMM	100.0	100.0	100.0	65.4	54.3	43.6	37.2	28.9	17.5	13.3	8.7	2.1	20	NP	NP	2.714	0.91	21.8
9	234+500	RHS	WMM	100.0	100.0	98.1	75.2	66.3	45.1	36.2	20.4	11.8	9.2	4.7	1.9	22	NP	NP	2.691	0.38	24.7
10	238+000	LHS	GSB	100.0	100.0	68.2	50.3	45.7	42.3	35.8	30.3	20.4	15.2	8.6	1.2	18	NP	NP	2.725	0.35	23.8
11	242+200	RHS	GSB	100.0	100.0	66.3	47.4	43.3	40.7	36.7	32.9	26.4	18.5	12.7	2.3	22	NP	NP	2.731	0.41	20.7
12	248+100	LHS	WMM	100.0	100.0	96.3	80.4	62.1	35.2	30.4	21.6	18.9	13.5	10.3	2.4	20	NP	NP	2.742	0.55	22.6
13	253+600	RHS	WMM	100.0	100.0	100.0	71.3	63.5	36.1	30.8	26.9	20.4	16.7	11.6	1.6	21	NP	NP	2.701	0.49	23.7
14	259+200	LHS	GSB	100.0	100.0	83.2	51.2	47.9	30.3	26.0	19.7	15.8	9.3	4.6	0.9	23	NP	NP	2.724	0.36	22.9

Table 9-9: Tests results of granular layers for the samples collected between Davanagere and Haveri

Davanagere to Haveri																				
S. No	Chainage (km)	Side (LHS/ RHS)	Type of Sample	Cumulative Percentage of Passing through IS Sieve (mm)												Atterberg Limits			Specific Gravity	Water Absorption (%)	Aggregate Impact Value (%)
				75.0	53.0	45.0	26.5	22.4	11.2	9.5	4.75	2.36	0.600	0.425	0.075	Liquid Limit (LL) %	Plastic Limit (PL) %	Plasticity Index (PI)			
1	264+840	RHS	GSB	100.0	100.0	100.0	52.6	39.4	25.6	23.6	21.5	18.6	10.2	8.9	1.0	19	NP	NP	2.661	0.42	21.1
2	270+000	LHS	WMM	100.0	100.0	100.0	80.4	69.6	52.7	30.4	21.6	12.1	9.3	5.2	0.9	20	NP	NP	2.683	0.68	19.3
3	273+000	RHS	WMM	100.0	100.0	96.2	75.9	59.8	31.2	22.8	15.0	10.8	6.0	5.5	1.5	19	NP	NP	2.743	0.31	17.2
4	278+100	LHS	GSB	100.0	96.5	85.4	78.2	66.3	59.8	47.3	16.4	10.8	7.3	5.6	1.7	22	NP	NP	2.732	0.54	26.5
5	282+060	RHS	GSB	100.0	100.0	75.8	52.7	49.8	36.4	20.5	8.7	6.4	4.2	3.1	0.8	20	NP	NP	2.691	0.76	23.2
6	289+000	LHS	WMM	100.0	100.0	95.5	66.1	58.8	33.9	26.8	19.6	15.3	8.2	7.2	2.1	29	NP	NP	2.740	0.35	16.5
7	293+000	RHS	WMM	100.0	100.0	100.0	81.2	72.6	55.2	44.3	30.8	19.6	12.4	8.3	1.2	23	NP	NP	2.726	0.59	19.2
8	298+000	LHS	GSB	100.0	100.0	95.2	78.4	65.2	59.8	48.6	17.4	12.5	8.6	4.7	1.2	22	NP	NP	2.662	0.40	20.8
9	303+800	RHS	GSB	100.0	90.3	70.5	51.3	41.3	37.4	32.5	26.3	20.7	16.2	12.8	3.4	19	NP	NP	2.694	0.75	21.6
10	308+000	LHS	WMM	100.0	100.0	100.0	78.8	66.2	49.7	36.2	21.5	16.4	10.3	6.2	1.4	20	NP	NP	2.673	0.96	18.3
11	313+800	RHS	WMM	100.0	100.0	100.0	75.2	60.4	43.8	40.4	21.8	10.3	5.2	3.9	0.6	18	NP	NP	2.715	0.67	20.5
12	318+000	LHS	GSB	100.0	100.0	100.0	49.4	35.1	9.9	6.3	3.7	2.5	1.6	1.5	0.5	23	NP	NP	2.694	0.85	17.9
13	323+000	RHS	GSB	100.0	100.0	98.6	77.6	61.2	24.7	17.3	9.6	6.4	2.3	2.0	0.8	22	NP	NP	2.691	0.92	19.1
14	329+650	LHS	WMM	100.0	100.0	100.0	71.2	52.1	44.3	39.2	27.6	17.5	10.3	5.8	1.1	20	NP	NP	2.706	0.61	21.3
15	332+700	RHS	WMM	100.0	100.0	100.0	75.6	62.3	35.4	30.3	26.1	11.7	9.4	5.2	0.9	19	NP	NP	2.685	0.88	17.7

Davanagere to Haveri																				
S. No	Chainage (km)	Side (LHS/ RHS)	Type of Sample	Cumulative Percentage of Passing through IS Sieve (mm)												Atterberg Limits			Specific Gravity	Water Absorption (%)	Aggregate Impact Value (%)
				75.0	53.0	45.0	26.5	22.4	11.2	9.5	4.75	2.36	0.600	0.425	0.075	Liquid Limit (LL) %	Plastic Limit (PL) %	Plasticity Index (PI)			
16	338+000	LHS	GSB	100.0	100.0	73.2	51.8	46.4	38.2	21.7	16.5	11.8	7.4	4.6	1.1	21	NP	NP	2.719	0.76	18.9

Table 9-10: Tests results of granular layers for the samples collected between Haveri and Hubli

Haveri to Hubli																				
S. No	Chainage (km)	Side (LHS/ RHS)	Type of Sample	Cumulative Percentage of Passing through IS Sieve (mm)												Atterberg Limits			Specific Gravity	Water Absorption (%)	Aggregate Impact Value (%)
				75.0	53.0	45.0	26.5	22.4	11.2	9.5	4.75	2.36	0.600	0.425	0.075	Liquid Limit (LL) %	Plastic Limit (PL) %	Plasticity Index (PI)			
1	343+000	RHS	GSB	100.0	100.0	100.0	73.8	62.4	41.6	32.8	25.7	17.8	7.4	4.6	0.9	20	NP	NP	2.692	0.92	18.5
2	347+550	LHS	WMM	100.0	100.0	100.0	72.3	63.7	48.6	40.4	21.9	16.3	9.8	5.2	0.9	22	NP	NP	2.701	0.65	20.6
3	351+980	RHS	WMM	100.0	100.0	97.4	81.7	69.9	44.7	38.1	21.2	11.3	9.9	6.4	0.7	21	NP	NP	2.744	0.70	22.2
4	357+900	LHS	GSB	100.0	96.7	86.5	58.3	47.4	32.3	26.4	16.5	12.8	3.2	2.1	0.7	19	NP	NP	2.683	0.87	17.4
5	360+800	RHS	GSB	100.0	100.0	99.0	74.8	66.7	42.9	34.3	26.0	19.2	8.1	6.7	0.5	21	NP	NP	2.762	0.66	19.9
6	367+030	LHS	WMM	100.0	100.0	97.4	80.3	62.4	45.2	36.3	27.2	12.8	8.6	4.3	1.2	23	NP	NP	2.692	0.98	25.3
7	373+000	RHS	WMM	100.0	100.0	96.2	80.4	61.6	36.8	30.4	22.9	19.1	13.7	6.5	1.6	24	NP	NP	2.744	0.25	14.7
8	377+400	LHS	GSB	100.0	100.0	89.7	47.1	43.7	38.3	36.6	19.7	14.2	7.1	3.7	1.2	22	NP	NP	2.713	0.75	20.4
9	383+000	RHS	GSB	100.0	100.0	100.0	55.5	41.7	34.8	20.6	16.4	10.8	6.3	4.2	1.6	21	NP	NP	2.715	0.42	19.3

Haveri to Hubli																				
S. No	Chainage (km)	Side (LHS/ RHS)	Type of Sample	Cumulative Percentage of Passing through IS Sieve (mm)												Atterberg Limits			Specific Gravity	Water Absorption (%)	Aggregate Impact Value (%)
				75.0	53.0	45.0	26.5	22.4	11.2	9.5	4.75	2.36	0.600	0.425	0.075	Liquid Limit (LL) %	Plastic Limit (PL) %	Plasticity Index (PI)			
10	388+000	LHS	WMM	100.0	100.0	100.0	63.6	56.2	29.4	24.0	18.0	13.5	7.4	6.7	0.8	22	NP	NP	2.752	0.23	14.0
11	391+800	RHS	WMM	100.0	100.0	100.0	72.3	62.5	35.7	29.6	22.4	16.5	12.8	7.6	1.5	21	NP	NP	2.695	0.56	16.5
12	397+900	LHS	GSB	100.0	100.0	94.2	64.1	55.9	34.5	27.8	20.3	16.3	8.4	7.2	1.0	20	NP	NP	2.772	0.34	16.7
13	402+800	RHS	GSB	100.0	96.6	78.5	55.6	49.9	34.7	28.3	18.9	13.2	4.1	3.2	0.5	20	NP	NP	2.684	0.91	18.0

Observations and Conclusions

The existing granular layer materials are tested, and the observations are given below.

- The Liquid limit and Plasticity Index for all the granular materials is within the limit Liquid Limit (Max 25%), Plasticity Index (Max 6%) as per MoRTH Specifications.
- The Aggregate Impact Value of Granular material is within the limit (Max 30% for WMM and Max 40% for GSB) as per MoRTH Specifications.

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10. PAVEMENT EVALUATION STUDIES

10.1 Pavement Condition Survey with Network Survey Vehicle

10.1.1 Network Survey Vehicle Description

Road Runner NSV was used for collection of condition data for this assignment. Road Runner (NSV) is multi-faceted road survey equipment which could be configured to collect a wide range of pavement condition data and Asset data.

Road Runner NSV is capable of collecting Roughness, Rutting, Pavement distresses, Assets along with GPS and Reference/ corresponding chainage simultaneously.

The main components which are integrated into Road Runner NSV are

1. Digital Laser Profilers (DLP) -Road roughness and rutting.
2. Digital Imaging System (DIS) -Pavement distresses and road assets data.
3. Differential Global Positioning System (DGPS).
4. High Resolution Distance Measuring Instrument (HRDMI).

1. Digital Laser Profiler (DLP)

- DLP is integrated into the NSV consisting of eleven lasers to collect Road Roughness and Rutting.
- This inertial profiler is capable of recording the data continuously along each wheel path.

(a) Roughness

Road Runner NSV equipment fitted with dual wheel path Laser Profilometer to collect Roughness data. The roughness data was collected and reported for 100 m interval.

The outputs of the lasers and accelerometers located in each wheel path (750 mm either side of the Centre line of the vehicle) are sampled every 15 mm of longitudinal travel and used to calculate the longitudinal profile of the road.

The profile is then passed through the Quarter Car model to calculate the International Roughness Index (IRI) lane roughness as per the methodologies specified in the ASTM E-950.

(b) Rutting

Rutting will be measure and reported through DLP and the data will be recorded at every 100m interval on both the wheel paths.

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2. Digital Imaging System (DIS)

Digital Imaging System (DIS) in Network Survey Vehicle (NSV) consist of 5 high resolution roof mounted cameras to capture pavement distresses and road assets data. These cameras are oriented in a certain configuration to ensure that the information of interest, such as inventory or condition, is being recorded in the camera field of view. Three cameras are forward facing and mounted on front side of vehicle (Left corner, Centre and Right corner), covers 160o angle images and are set to sample at every 10m interval. Another two cameras are mounted on back side of the vehicle (Left corner, Right corner) to capture the distress image of pavement 10m*4m (length*width) i.e., captures @10m interval.

Digital image system is capable of

- Collecting real time digital images.
- Achieving a sampling rate of at least one set per 2.5 meters for Distress camera's and one set per 10 meters for Asset cameras.
- Incorporating real time Differentially corrected GPS (DGPS).
- Capturing & recording at highway speeds.
- Providing real time on-screen displays for operator verification during collection.
- Storing images straight to PC's / NAS (Network Attached Storage).
- Linking into the client's referencing system via distance and GPS.

3. Geo Referencing (DGPS Data)

Road Runner NSV is equipped with DGPS system, and it do collect all the data and images with geo-reference. Reference that image against GPS co-ordinates by logging the latitude, longitude of the specific image.

4. Distance Measuring Instrument (DMI)

Road Runner NSV is equipped with DMI, and it is fitted to rear tyre of the Network survey vehicle. The Distance and speed measurement performed by the distance measuring instrument which is a distance transducer and highly accurate and GPS distance and speed can also be calculated.

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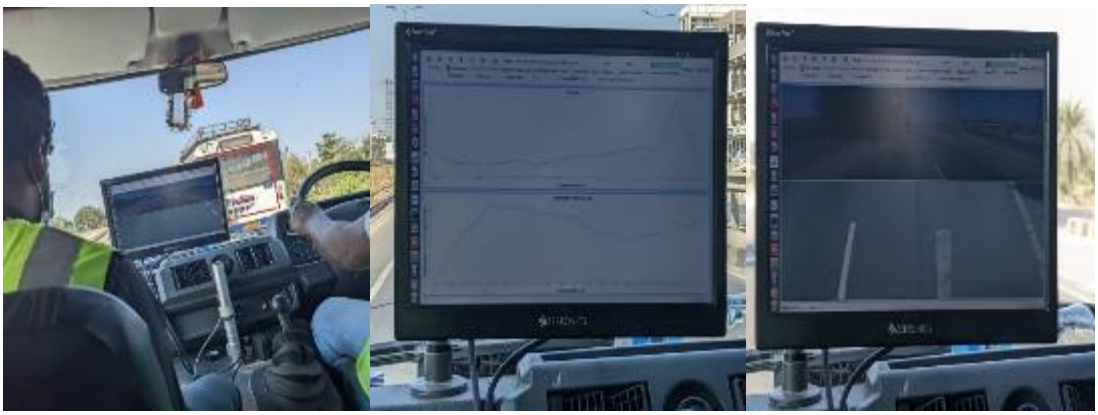
10.2 Methodology for NSV Field Testing

Usually, 4 members are assigned for site to collect the field data. Two of the trained/ experienced field engineers and two drivers during the collection phases of projects. During the survey, engineer is responsible for operating the vehicle's acquisition systems. Road Runner NSV Dashboard tool is used to for data acquisition.

The survey will be carried out by lane wise, and the following steps will be followed during the survey;

- Engineer will setup the equipment and check the data collection system prior to the survey.
- Prior to the survey field engineer do set the project name, direction, lane number and staring chainage with increasing or decreasing details.
- The vehicle will run in middle of the lane and collects data up to a vehicle running speed of 80 Kmph.
- Digital Laser Profiler (DLP), Digital Imaging System (DIS) collect the data with GPS co-ordinates and chainage reference.
- Field Engineer will review the data collection and specifies any remarks/ details in observation column.
- At the end of project chainage, engineer will stop that particular survey and save all the recorded. And the same process is followed for all other lanes of the project stretch.



10.3 Analysis of NSV Survey Data

Pavement condition survey was carried out on each lane of each carriage way with NSV. The NSV survey was conducted on the project corridor from **27/10/2023 to 01/11/2023**. Data was processed, analyzed and presented in 100m interval. Detailed NSV data is presented in the following Annexures and summary of it presented as below.

10.3.1 Roughness

As stated in the earlier section, NSV collected the roughness data at 100m interval on each lane in-terms of IRI (International Roughness Index) value.

In Indian context, the IRI values were converted to BI as per IRC: SP:16-2019 "Guidelines on Measuring Road Roughness and Norms" with the following equation.

$BI = 630*(IRI)^{\wedge 1.12}$

Where

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BI = Bump Integrator Roughness in mm/km

IRI = International Roughness Index.

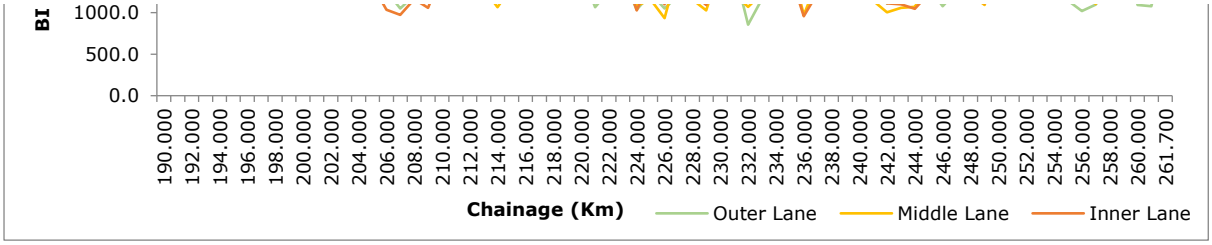

Figure 10-1 to **Figure 10-6** for 3 sections.

Table 10-1: Summary of Roughness data on LHS direction

Chitradurga to Davanagere						
Chainage as per CA (km)		**Design Chainage (km)**		**Avg. BI (mm/km)**		
From	**To**	**From**	**To**	**Outer Lane**	**Middle Lane**	**Inner Lane**
0.000	1.000	189.000	190.000	1594.2	1619.3	1626.6
1.000	2.000	190.000	191.000	1488.1	1911.1	1866.7
2.000	3.000	191.000	192.000	1556.5	1458.4	1608.1
3.000	4.000	192.000	193.000	1553.2	1409.0	1293.6
4.000	5.000	193.000	194.000	1642.4	1566.7	1485.4
5.000	6.000	194.000	195.000	1767.0	1536.4	1160.1
6.000	7.000	195.000	196.000	1946.0	2195.9	1597.1
7.000	8.000	196.000	197.000	1698.3	1849.9	1912.1
8.000	9.000	197.000	198.000	1561.6	1216.8	1399.4
9.000	10.000	198.000	199.000	1583.6	1169.2	1388.6
10.000	11.000	199.000	200.000	1387.7	1151.3	1195.1
11.000	12.000	200.000	201.000	1655.1	1333.7	1368.8
12.000	13.000	201.000	202.000	1751.4	1620.4	1767.7
13.000	14.000	202.000	203.000	1972.9	1696.4	1413.4
14.000	15.000	203.000	204.000	1440.9	1409.0	1365.0
15.000	16.000	204.000	205.000	1562.6	1484.1	1336.4
16.000	17.000	205.000	206.000	1263.7	1271.8	1036.0
17.000	18.000	206.000	207.000	1050.5	1261.0	974.3
18.000	19.000	207.000	208.000	1210.9	1465.0	1162.5
19.000	20.000	208.000	209.000	1478.8	1440.4	1059.7
20.000	208.300	209.000	210.000	1627.8	1719.2	1482.7
208.300	209.300	210.000	211.000	1277.8	1211.7	1280.7
209.300	210.300	211.000	212.000	1653.1	1641.0	1757.2
210.300	211.300	212.000	213.000	1399.2	1289.2	1333.3
211.300	212.300	213.000	214.000	1188.1	1067.4	1221.6
212.300	213.300	214.000	215.000	1379.6	1310.8	1317.0
213.300	214.300	215.000	216.000	1214.9	1348.3	1452.1
214.300	215.300	216.000	217.000	1615.1	1857.5	1490.0

Chitradurga to Davanagere						
Chainage as per CA (km)		Design Chainage (km)		Avg. BI (mm/km)		
From	To	From	To	Outer Lane	Middle Lane	Inner Lane
215.300	216.300	217.000	218.000	1310.0	1154.8	1271.5
216.300	217.300	218.000	219.000	1184.3	1370.8	1390.3
217.300	218.300	219.000	220.000	1516.4	1319.2	1727.4
218.300	219.300	220.000	221.000	1066.3	1138.3	1245.8
219.300	220.300	221.000	222.000	1263.3	1217.0	1250.4
220.300	221.300	222.000	223.000	1415.2	1360.6	1529.5
221.300	222.300	223.000	224.000	1036.1	1084.5	1030.1
222.300	223.300	224.000	225.000	1233.2	1156.1	1413.4
223.300	224.300	225.000	226.000	1050.9	935.0	1101.0
224.300	225.300	226.000	227.000	1208.9	1546.1	1781.3
225.300	226.300	227.000	228.000	1511.0	1158.2	1237.2
226.300	227.300	228.000	229.000	1375.1	1029.1	1092.7
227.300	228.300	229.000	230.000	1668.0	1549.5	1557.9
228.300	229.300	230.000	231.000	1541.7	1228.9	1362.6
229.300	230.300	231.000	232.000	856.4	1071.4	1210.0
230.300	231.300	232.000	233.000	1164.4	1227.5	1320.1
231.300	232.300	233.000	234.000	1160.5	1155.5	1436.4
232.300	233.300	234.000	235.000	1708.9	1651.7	1489.9
233.300	234.300	235.000	236.000	1199.3	975.4	958.3
234.300	235.300	236.000	237.000	1583.8	1384.4	1235.8
235.300	236.300	237.000	238.000	1382.0	1407.2	1246.8
236.300	237.300	238.000	239.000	1534.2	1144.9	1281.0
237.300	238.300	239.000	240.000	2864.6	2642.4	2643.0
238.300	239.300	240.000	241.000	1560.7	1142.5	1484.8
239.300	240.300	241.000	242.000	1109.5	1004.7	1113.4
240.300	241.300	242.000	243.000	1320.0	1059.1	1100.7
241.300	242.300	243.000	244.000	1388.3	1072.6	1046.4
242.300	243.300	244.000	245.000	1303.7	1347.8	1231.9
243.300	244.300	245.000	246.000	1077.9	1264.4	1239.0
244.300	245.300	246.000	247.000	1265.1	1280.7	1218.3
245.300	246.300	247.000	248.000	1349.6	1219.5	1198.2
246.300	247.300	248.000	249.000	1395.9	1093.2	1114.1
247.300	248.300	249.000	250.000	1424.3	1571.3	1792.2
248.300	249.300	250.000	251.000	1293.0	1354.0	1278.5
249.300	250.300	251.000	252.000	1393.6	1351.3	1410.7
250.300	251.300	252.000	253.000	1265.3	1320.1	1336.0
251.300	252.300	253.000	254.000	1447.2	1251.6	1407.2
252.300	253.300	254.000	255.000	1146.1	1139.3	1257.5
253.300	254.300	255.000	256.000	1020.3	1369.9	1502.8
254.300	255.300	256.000	257.000	1098.0	1104.5	1480.1

Chitradurga to Davanagere						
Chainage as per CA (km)		Design Chainage (km)		Avg. BI (mm/km)		
From	To	From	To	Outer Lane	Middle Lane	Inner Lane
255.300	256.300	257.000	258.000	1309.7	1366.1	1473.0
256.300	257.300	258.000	259.000	1841.5	2217.7	2244.6
257.300	258.300	259.000	260.000	1092.8	1201.7	1361.1
258.300	259.300	260.000	261.000	1077.0	1416.6	1480.7
259.300	260.000	261.000	261.700	1761.9	1561.2	1456.7

Davanagere to Haveri						
Chainage as Per CA (km)		Design Chainage (km)		Avg. BI (mm/km)		
From	To	From	To	Outer Lane	Middle Lane	Inner Lane
260.000	260.300	261.700	262.000	4061.5	2012.1	2663.1
260.300	260.800	262.000	263.000	2024.0	2005.9	1578.1
260.800	261.800	263.000	264.000	844.6	1177.4	1194.5
261.800	262.800	264.000	265.000	1220.6	1484.6	1216.7
262.800	263.800	265.000	266.000	766.5	1236.7	1158.0
263.800	264.800	266.000	267.000	833.4	1268.6	1266.5
264.800	265.800	267.000	268.000	-	1631.7	1579.1
265.800	266.800	268.000	269.000	-	2071.8	1821.9
266.800	267.800	269.000	270.000	1330.6	1613.8	1539.5
267.800	268.800	270.000	271.000	1138.5	1143.5	1265.8
268.800	269.800	271.000	272.000	1174.4	1224.3	1494.2
269.800	270.800	272.000	273.000	1314.8	1298.5	1465.3
270.800	271.800	273.000	274.000	844.5	1293.8	997.7
271.800	272.800	274.000	275.000	876.9	1199.2	1202.0
272.800	273.800	275.000	276.000	1016.3	1430.5	1522.2
273.800	274.800	276.000	277.000	1223.7	1234.8	1334.8
274.800	275.800	277.000	278.000	1402.3	1689.1	1705.5
275.800	276.800	278.000	279.000	2141.2	2102.3	1960.3
276.800	277.800	279.000	280.000	1746.4	1645.3	1474.5
277.800	278.800	280.000	281.000	1583.8	1703.1	1362.8
278.800	279.800	281.000	282.000	2204.0	2260.6	1846.6
279.800	280.800	282.000	283.000	1863.1	1691.0	1463.1
280.800	281.800	283.000	284.000	1703.0	1725.4	1551.3
281.800	282.800	284.000	285.000	1506.9	1714.1	1728.5
282.800	283.800	285.000	286.000	985.3	1242.0	1098.8
283.800	284.800	286.000	287.000	1248.3	1277.7	1380.2
284.800	285.800	287.000	288.000	1269.3	2056.4	1365.5
285.800	286.800	288.000	289.000	2755.2	2782.5	2768.2
286.800	287.800	289.000	290.000	937.9	1819.8	1890.5
287.800	288.800	290.000	291.000	1527.8	1755.7	1689.5

Davanagere to Haveri						
Chainage as Per CA (km)		Design Chainage (km)		Avg. BI (mm/km)		
From	To	From	To	Outer Lane	Middle Lane	Inner Lane
288.800	289.800	291.000	292.000	1111.8	1387.8	1179.7
289.800	290.800	292.000	293.000	1140.4	1449.0	1320.9
290.800	291.800	293.000	294.000	1322.1	1465.1	1513.8
291.800	292.800	294.000	295.000	1334.3	1645.9	1683.4
292.800	293.800	295.000	296.000	1701.7	1702.2	1947.6
293.800	294.800	296.000	297.000	1349.5	1721.2	1815.3
294.800	295.800	297.000	298.000	1030.4	1388.0	1211.4
295.800	296.800	298.000	299.000	1060.0	1507.3	1293.8
296.800	297.800	299.000	300.000	1192.7	1697.1	1419.3
297.800	298.800	300.000	301.000	1342.6	1772.3	1583.1
298.800	299.800	301.000	302.000	1811.7	2036.5	1636.0
299.800	300.800	302.000	303.000	1581.2	1581.2	1510.6
300.800	301.800	303.000	304.000	1498.0	1508.8	1276.5
301.800	302.800	304.000	305.000	2430.8	2007.5	1973.5
302.800	303.800	305.000	306.000	1267.0	1349.9	1333.5
303.800	304.800	306.000	307.000	2035.8	2385.2	2223.2
304.800	305.800	307.000	308.000	1488.5	1613.7	1530.7
305.800	306.800	308.000	309.000	1217.6	1695.0	1123.2
306.800	307.800	309.000	310.000	1869.3	1902.9	1560.2
307.800	308.800	310.000	311.000	1535.1	1463.3	1296.4
308.800	309.800	311.000	312.000	1754.1	1509.6	1511.9
309.800	310.800	312.000	313.000	1820.5	1841.8	1783.8
310.800	311.800	313.000	314.000	1788.7	1731.7	1454.7
311.800	312.800	314.000	315.000	2031.5	1790.9	1638.9
312.800	313.800	315.000	316.000	-	-	-
313.800	314.800	316.000	317.000	1130.3	1161.2	999.9
314.800	315.800	317.000	318.000	1382.5	1041.6	1006.3
315.800	316.800	318.000	319.000	1480.3	1200.7	1241.3
316.800	317.800	319.000	320.000	1604.4	1312.8	1251.7
317.800	318.800	320.000	321.000	1290.5	1884.6	1689.4
318.800	319.800	321.000	322.000	-	2249.4	2542.6
319.800	320.800	322.000	323.000	1655.9	1670.6	1586.6
320.800	321.800	323.000	324.000	1549.9	1625.6	1544.3
321.800	322.800	324.000	325.000	1340.9	1246.9	1063.3
322.800	323.800	325.000	326.000	1432.9	1400.0	1439.3
323.800	324.800	326.000	327.000	1761.5	1519.7	1421.4
324.800	325.800	327.000	328.000	2304.6	2361.9	2214.7
325.800	326.800	328.000	329.000	2188.7	2135.7	1985.9
326.800	327.800	329.000	330.000	1421.1	1305.1	1474.8
327.800	328.800	330.000	331.000	2414.7	2139.0	1869.3

Davanagere to Haveri						
Chainage as Per CA (km)		Design Chainage (km)		Avg. BI (mm/km)		
From	To	From	To	Outer Lane	Middle Lane	Inner Lane
328.800	329.800	331.000	332.000	2013.6	1594.7	1527.7
329.800	330.800	332.000	333.000	1633.2	1334.7	1157.2
330.800	331.800	333.000	334.000	1761.4	1402.2	1330.8
331.800	332.800	334.000	335.000	1556.9	1390.3	1276.7
332.800	333.800	335.000	336.000	1301.6	1285.3	1337.4
333.800	334.800	336.000	337.000	1437.9	1280.3	1329.6
334.800	335.800	337.000	338.000	2095.6	1820.3	1592.9
335.800	336.720	338.000	338.920	1333.7	1259.0	1237.2
336.720	336.800	338.920	339.000	-	-	-
336.800	337.800	339.000	340.000	-	-	-
337.800	338.923	340.000	341.123	-	-	-

Haveri to Hubli				
Chainage (km)		Avg. BI (mm/km)		
From	To	Outer Lane	Middle Lane	Inner Lane
340.000	341.000	1856.1	1672.4	2085.1
341.000	342.000	1928.2	1598.1	1761.4
342.000	343.000	1950.0	1533.4	1919.2
343.000	344.000	1728.5	1319.3	1696.3
344.000	345.000	2152.3	2319.8	2353.2
345.000	346.000	1856.7	1750.6	1936.5
346.000	347.000	2215.3	2204.6	2275.8
347.000	348.000	1456.4	1371.3	1521.7
348.000	349.000	2089.9	2189.5	2172.9
349.000	350.000	1441.5	1521.2	1546.0
350.000	351.000	1383.2	1177.1	1560.4
351.000	352.000	1647.1	1475.5	1370.0
352.000	353.000	3128.9	2999.1	2892.6
353.000	354.000	2252.4	2141.6	2367.5
354.000	355.000	2375.1	2099.5	2211.3
355.000	356.000	2064.6	1806.0	2043.0
356.000	357.000	1929.9	1633.9	1850.2
357.000	358.000	1729.9	1387.1	1522.1
358.000	359.000	2354.3	2363.2	2471.4
359.000	360.000	1558.7	1291.7	1918.5
360.000	361.000	1633.9	1172.7	1415.7
361.000	362.000	1713.6	1954.8	2019.2
362.000	363.000	1680.5	1895.0	1786.0
363.000	364.000	1646.2	1726.5	1682.4

Haveri to Hubli				
Chainage (km)		Avg. BI (mm/km)		
From	To	Outer Lane	Middle Lane	Inner Lane
364.000	365.000	2033.0	2407.7	2260.8
365.000	366.000	1697.4	1433.1	1567.2
366.000	367.000	1782.6	1389.7	1553.0
367.000	368.000	1910.2	2121.5	2009.1
368.000	369.000	1393.5	1134.6	1333.4
369.000	370.000	1753.4	1263.7	1453.5
370.000	371.000	1953.3	1995.9	2061.2
371.000	372.000	2331.9	2152.0	2244.4
372.000	373.000	1377.0	1183.2	1446.3
373.000	374.000	1221.5	1114.9	1276.9
374.000	375.000	1848.0	1464.7	1856.6
375.000	376.000	1699.5	1265.1	1440.0
376.000	377.000	1429.5	1266.7	1407.4
377.000	378.000	1456.2	1118.7	1365.6
378.000	379.000	1768.6	2245.5	2240.2
379.000	380.000	1855.2	1996.3	2022.8
380.000	381.000	1257.5	1209.9	1446.6
381.000	382.000	1144.3	1148.2	1269.0
382.000	383.000	2035.0	2137.7	1952.0
383.000	384.000	1367.1	1131.7	1121.3
384.000	385.000	1754.2	1971.4	2034.0
385.000	386.000	1925.2	1341.3	1154.9
386.000	387.000	1751.8	1319.5	1696.1
387.000	388.000	1981.5	1606.8	1779.1
388.000	389.000	1672.9	1852.4	1824.0
389.000	390.000	1520.7	1272.8	1252.0
390.000	391.000	1917.2	2011.4	1980.8
391.000	392.000	1766.7	1774.8	1954.3
392.000	393.000	1792.3	1616.7	1768.0
393.000	394.000	1446.6	1319.3	1529.8
394.000	395.000	1427.4	1272.3	1416.1
395.000	396.000	1768.1	1564.9	1942.1
396.000	397.000	1451.1	1235.7	1558.5
397.000	398.000	1832.3	1716.8	1875.1
398.000	399.000	1698.7	1418.4	1558.7
399.000	400.000	2007.6	2242.2	2266.8
400.000	401.000	1636.7	1631.5	1758.6
401.000	402.000	1667.7	1559.9	1426.2
402.000	403.000	1730.2	1472.6	1716.3

Table 10-2: Summary of Roughness data on RHS direction

Chitradurga to Davanagere						
Chainage as per CA (km)		Design Chainage (km)		Avg. BI (mm/km)		
From	To	From	To	Outer Lane	Middle Lane	Inner Lane
260.000	259.300	261.700	261.000	1693.5	2137.6	1846.2
259.300	258.300	261.000	260.000	1339.6	1438.7	1619.3
258.300	257.300	260.000	259.000	1257.3	1684.8	1595.3
257.300	256.300	259.000	258.000	1298.0	1517.7	1792.8
256.300	255.300	258.000	257.000	1203.2	1373.3	1643.7
255.300	254.300	257.000	256.000	1011.5	1149.8	1333.5
254.300	253.300	256.000	255.000	1282.5	1235.9	1120.3
253.300	252.300	255.000	254.000	1336.7	1410.6	1144.7
252.300	251.300	254.000	253.000	1236.1	1224.2	1256.7
251.300	250.300	253.000	252.000	1487.7	1706.8	1614.3
250.300	249.300	252.000	251.000	1401.2	1271.2	1138.3
249.300	248.300	251.000	250.000	1296.2	1407.4	1425.2
248.300	247.300	250.000	249.000	1395.3	1476.5	1875.3
247.300	246.300	249.000	248.000	1214.3	1266.0	1275.3
246.300	245.300	248.000	247.000	1171.4	1222.8	1268.3
245.300	244.300	247.000	246.000	1343.5	1263.7	1378.5
244.300	243.300	246.000	245.000	1204.1	1271.5	1213.9
243.300	242.300	245.000	244.000	1314.8	1175.2	1214.8
242.300	241.300	244.000	243.000	1465.8	1296.3	1413.3
241.300	240.300	243.000	242.000	1364.1	1242.7	1314.7
240.300	239.300	242.000	241.000	1203.1	1005.8	993.9
239.300	238.300	241.000	240.000	1552.7	1310.7	1348.1
238.300	237.300	240.000	239.000	2566.5	2311.2	2419.0
237.300	236.300	239.000	238.000	1378.1	1289.5	1220.8
236.300	235.300	238.000	237.000	1419.0	1514.3	1271.2
235.300	234.300	237.000	236.000	1308.6	1527.0	1242.2
234.300	233.300	236.000	235.000	1386.5	1103.1	1194.5
233.300	232.300	235.000	234.000	1674.5	1879.2	1541.1
232.300	231.300	234.000	233.000	1523.3	1725.5	1629.6
231.300	230.300	233.000	232.000	1306.1	1419.9	1450.5
230.300	229.300	232.000	231.000	1097.0	1331.1	1648.3
229.300	228.300	231.000	230.000	1098.7	1176.7	1407.3
228.300	227.300	230.000	229.000	1192.2	1562.0	1500.6
227.300	226.300	229.000	228.000	1265.9	1349.4	1299.2
226.300	225.300	228.000	227.000	1427.1	1467.0	1207.3
225.300	224.300	227.000	226.000	1565.0	1827.5	1577.2
224.300	223.300	226.000	225.000	1136.2	919.6	976.0
223.300	222.300	225.000	224.000	1209.2	1165.6	1207.5

Chitradurga to Davanagere						
Chainage as per CA (km)		Design Chainage (km)		Avg. BI (mm/km)		
From	To	From	To	Outer Lane	Middle Lane	Inner Lane
222.300	221.300	224.000	223.000	1090.1	862.8	895.0
221.300	220.300	223.000	222.000	1362.3	1291.3	1482.8
220.300	219.300	222.000	221.000	1224.4	1007.8	1084.6
219.300	218.300	221.000	220.000	1258.4	1198.5	1227.8
218.300	217.300	220.000	219.000	1363.1	1365.6	1301.4
217.300	216.300	219.000	218.000	1379.3	1419.3	1369.8
216.300	215.300	218.000	217.000	1156.4	1670.6	1222.8
215.300	214.300	217.000	216.000	1244.7	1580.7	1419.8
214.300	213.300	216.000	215.000	1345.5	1592.3	1784.2
213.300	212.300	215.000	214.000	1164.6	1474.4	1442.5
212.300	211.300	214.000	213.000	1314.0	1182.8	1200.7
211.300	210.300	213.000	212.000	1017.9	1264.0	1110.1
210.300	209.300	212.000	211.000	1171.9	1260.9	1484.3
209.300	208.300	211.000	210.000	1198.6	1385.5	1320.2
208.300	20.000	210.000	209.000	1665.5	1648.2	1299.7
20.000	19.000	209.000	208.000	1357.9	1406.4	1318.7
19.000	18.000	208.000	207.000	1255.0	1406.8	1301.2
18.000	17.000	207.000	206.000	1330.4	1384.6	1200.6
17.000	16.000	206.000	205.000	1456.2	1285.1	1340.3
16.000	15.000	205.000	204.000	1525.0	1630.1	1379.7
15.000	14.000	204.000	203.000	1460.5	1206.9	1323.5
14.000	13.000	203.000	202.000	1586.0	1449.6	1683.2
13.000	12.000	202.000	201.000	1649.7	1469.8	1663.2
12.000	11.000	201.000	200.000	1353.5	1370.2	1225.0
11.000	10.000	200.000	199.000	2004.6	1806.8	1525.1
10.000	9.000	199.000	198.000	1625.4	1368.2	1428.5
9.000	8.000	198.000	197.000	1819.7	1863.4	1588.3
8.000	7.000	197.000	196.000	1770.9	1555.4	1557.8
7.000	6.000	196.000	195.000	1792.4	1962.5	1959.3
6.000	5.000	195.000	194.000	1753.6	1579.0	1445.7
5.000	4.000	194.000	193.000	1440.3	1474.6	1368.5
4.000	3.000	193.000	192.000	1432.0	1425.3	1407.9
3.000	2.000	192.000	191.000	1407.7	1436.0	1441.2
2.000	1.000	191.000	190.000	1669.1	1689.2	1574.0
1.000	0.000	190.000	189.000	1824.4	1787.0	1680.4

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Davanagere to Haveri						
Chainage as Per CA (km)		Design Chainage (km)		Avg. BI (mm/km)		
From	To	From	To	Outer Lane	Middle Lane	Inner Lane
338.923	337.800	341.123	340.000	-	-	-
337.800	336.800	340.000	339.000	-	-	-
336.800	336.720	339.000	338.920	-	-	-
336.720	335.800	338.920	338.000	1512.7	1341.8	1282.9
335.800	334.800	338.000	337.000	1839.6	1919.0	1867.4
334.800	333.800	337.000	336.000	1490.5	1686.2	1569.1
333.800	332.800	336.000	335.000	1614.8	1385.2	1071.4
332.800	331.800	335.000	334.000	1492.8	1295.5	1249.3
331.800	330.800	334.000	333.000	1590.2	1255.4	1190.8
330.800	329.800	333.000	332.000	1388.5	1339.0	1225.8
329.800	328.800	332.000	331.000	1618.7	1537.3	1645.1
328.800	327.800	331.000	330.000	1857.3	2624.0	2065.3
327.800	326.800	330.000	329.000	1392.8	1452.1	1367.8
326.800	325.800	329.000	328.000	2115.0	2264.6	2058.4
325.800	324.800	328.000	327.000	2166.3	2523.7	2071.6
324.800	323.800	327.000	326.000	1562.0	1899.3	1779.4
323.800	322.800	326.000	325.000	1366.1	1351.7	1320.0
322.800	321.800	325.000	324.000	1287.1	1279.1	1343.9
321.800	320.800	324.000	323.000	1691.4	1598.2	1488.1
320.800	319.800	323.000	322.000	1519.6	1478.0	1461.5
319.800	318.800	322.000	321.000	-	-	-
318.800	317.800	321.000	320.000	1624.6	1438.4	1716.3
317.800	316.800	320.000	319.000	1608.8	1409.7	1733.4
316.800	315.800	319.000	318.000	1640.4	1306.6	1728.8
315.800	314.800	318.000	317.000	1387.2	1319.4	1111.1
314.800	313.800	317.000	316.000	1562.5	1478.5	1299.7
313.800	312.800	316.000	315.000	-	-	-
312.800	311.800	315.000	314.000	1429.7	1078.6	1507.1
311.800	310.800	314.000	313.000	1496.3	1979.3	2147.6
310.800	309.800	313.000	312.000	1450.9	1738.1	1523.9
309.800	308.800	312.000	311.000	1678.6	1517.6	1384.4
308.800	307.800	311.000	310.000	1742.5	1278.6	1263.8
307.800	306.800	310.000	309.000	1720.1	1970.6	1699.5
306.800	305.800	309.000	308.000	1362.6	1635.3	1398.8
305.800	304.800	308.000	307.000	1648.3	1768.3	1428.7
304.800	303.800	307.000	306.000	2497.3	2065.1	1593.7
303.800	302.800	306.000	305.000	1624.8	1618.4	1520.6
302.800	301.800	305.000	304.000	2298.0	2453.4	2315.6
301.800	300.800	304.000	303.000	1514.9	1539.0	1296.2
300.800	299.800	303.000	302.000	1544.3	1323.4	1280.9

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Davanagere to Haveri						
Chainage as Per CA (km)		Design Chainage (km)		Avg. BI (mm/km)		
From	To	From	To	Outer Lane	Middle Lane	Inner Lane
299.800	298.800	302.000	301.000	1962.4	1929.6	1568.7
298.800	297.800	301.000	300.000	1502.7	1601.3	1414.1
297.800	296.800	300.000	299.000	1259.3	1173.9	1211.3
296.800	295.800	299.000	298.000	1174.0	1053.7	1121.5
295.800	294.800	298.000	297.000	1112.6	1479.9	1206.6
294.800	293.800	297.000	296.000	1133.4	1283.2	1670.5
293.800	292.800	296.000	295.000	1530.0	1730.7	2014.0
292.800	291.800	295.000	294.000	1671.3	1759.1	1910.0
291.800	290.800	294.000	293.000	1677.6	1798.3	1848.7
290.800	289.800	293.000	292.000	1051.1	996.9	1017.2
289.800	288.800	292.000	291.000	1248.5	1125.8	1236.2
288.800	287.800	291.000	290.000	1502.3	1416.1	1575.8
287.800	286.800	290.000	289.000	1280.2	2281.1	2492.5
286.800	285.800	289.000	288.000	3173.6	4668.5	4116.9
285.800	284.800	288.000	287.000	1264.5	1183.4	1355.3
284.800	283.800	287.000	286.000	1130.6	1285.7	911.7
283.800	282.800	286.000	285.000	1057.0	1018.9	981.5
282.800	281.800	285.000	284.000	1590.4	1760.0	1605.6
281.800	280.800	284.000	283.000	1509.8	1954.7	1805.6
280.800	279.800	283.000	282.000	1328.1	2358.4	2097.6
279.800	278.800	282.000	281.000	2278.7	2461.4	2317.3
278.800	277.800	281.000	280.000	1410.1	1535.1	1715.5
277.800	276.800	280.000	279.000	1333.5	1659.5	1540.1
276.800	275.800	279.000	278.000	1812.2	2604.2	2202.6
275.800	274.800	278.000	277.000	1383.1	1758.0	1583.4
274.800	273.800	277.000	276.000	1192.1	1460.7	1416.9
273.800	272.800	276.000	275.000	988.4	1317.8	1286.7
272.800	271.800	275.000	274.000	977.1	1289.3	1143.6
271.800	270.800	274.000	273.000	1047.5	1060.8	950.7
270.800	269.800	273.000	272.000	1280.1	1325.8	1243.3
269.800	268.800	272.000	271.000	1229.5	1338.2	1437.1
268.800	267.800	271.000	270.000	1095.9	1255.0	1141.3
267.800	266.800	270.000	269.000	1094.4	1540.1	1577.8
266.800	265.800	269.000	268.000	-	1976.5	1967.7
265.800	264.800	268.000	267.000	-	1757.1	1577.1
264.800	263.800	267.000	266.000	1232.2	1380.8	1488.3
263.800	262.800	266.000	265.000	1016.4	1146.3	1381.5
262.800	261.800	265.000	264.000	1491.9	1217.5	1399.4
261.800	260.800	264.000	263.000	1058.2	1353.7	1338.0
260.800	260.300	263.000	262.000	1632.5	1954.5	1862.7

Davanagere to Haveri						
Chainage as Per CA (km)		Design Chainage (km)		Avg. BI (mm/km)		
From	To	From	To	Outer Lane	Middle Lane	Inner Lane
260.300	260.000	262.000	261.700	-	1764.4	1971.0

Haveri to Hubli				
Chainage (km)		Avg. BI (mm/km)		
From	To	Outer Lane	Middle Lane	Inner Lane
340.000	341.000	1856.1	1672.4	2085.1
341.000	342.000	1928.2	1598.1	1761.4
342.000	343.000	1950.0	1533.4	1919.2
343.000	344.000	1728.5	1319.3	1696.3
344.000	345.000	2152.3	2319.8	2353.2
345.000	346.000	1856.7	1750.6	1936.5
346.000	347.000	2215.3	2204.6	2275.8
347.000	348.000	1456.4	1371.3	1521.7
348.000	349.000	2089.9	2189.5	2172.9
349.000	350.000	1441.5	1521.2	1546.0
350.000	351.000	1383.2	1177.1	1560.4
351.000	352.000	1647.1	1475.5	1370.0
352.000	353.000	3128.9	2999.1	2892.6
353.000	354.000	2252.4	2141.6	2367.5
354.000	355.000	2375.1	2099.5	2211.3
355.000	356.000	2064.6	1806.0	2043.0
356.000	357.000	1929.9	1633.9	1850.2
357.000	358.000	1729.9	1387.1	1522.1
358.000	359.000	2354.3	2363.2	2471.4
359.000	360.000	1558.7	1291.7	1918.5
360.000	361.000	1633.9	1172.7	1415.7
361.000	362.000	1713.6	1954.8	2019.2
362.000	363.000	1680.5	1895.0	1786.0
363.000	364.000	1646.2	1726.5	1682.4
364.000	365.000	2033.0	2407.7	2260.8
365.000	366.000	1697.4	1433.1	1567.2
366.000	367.000	1782.6	1389.7	1553.0
367.000	368.000	1910.2	2121.5	2009.1
368.000	369.000	1393.5	1134.6	1333.4
369.000	370.000	1753.4	1263.7	1453.5
370.000	371.000	1953.3	1995.9	2061.2
371.000	372.000	2331.9	2152.0	2244.4
372.000	373.000	1377.0	1183.2	1446.3
373.000	374.000	1221.5	1114.9	1276.9

Haveri to Hubli				
Chainage (km)		Avg. BI (mm/km)		
From	To	Outer Lane	Middle Lane	Inner Lane
374.000	375.000	1848.0	1464.7	1856.6
375.000	376.000	1699.5	1265.1	1440.0
376.000	377.000	1429.5	1266.7	1407.4
377.000	378.000	1456.2	1118.7	1365.6
378.000	379.000	1768.6	2245.5	2240.2
379.000	380.000	1855.2	1996.3	2022.8
380.000	381.000	1257.5	1209.9	1446.6
381.000	382.000	1144.3	1148.2	1269.0
382.000	383.000	2035.0	2137.7	1952.0
383.000	384.000	1367.1	1131.7	1121.3
384.000	385.000	1754.2	1971.4	2034.0
385.000	386.000	1925.2	1341.3	1154.9
386.000	387.000	1751.8	1319.5	1696.1
387.000	388.000	1981.5	1606.8	1779.1
388.000	389.000	1672.9	1852.4	1824.0
389.000	390.000	1520.7	1272.8	1252.0
390.000	391.000	1917.2	2011.4	1980.8
391.000	392.000	1766.7	1774.8	1954.3
392.000	393.000	1792.3	1616.7	1768.0
393.000	394.000	1446.6	1319.3	1529.8
394.000	395.000	1427.4	1272.3	1416.1
395.000	396.000	1768.1	1564.9	1942.1
396.000	397.000	1451.1	1235.7	1558.5
397.000	398.000	1832.3	1716.8	1875.1
398.000	399.000	1698.7	1418.4	1558.7
399.000	400.000	2007.6	2242.2	2266.8
400.000	401.000	1636.7	1631.5	1758.6
401.000	402.000	1667.7	1559.9	1426.2
402.000	403.000	1730.2	1472.6	1716.3

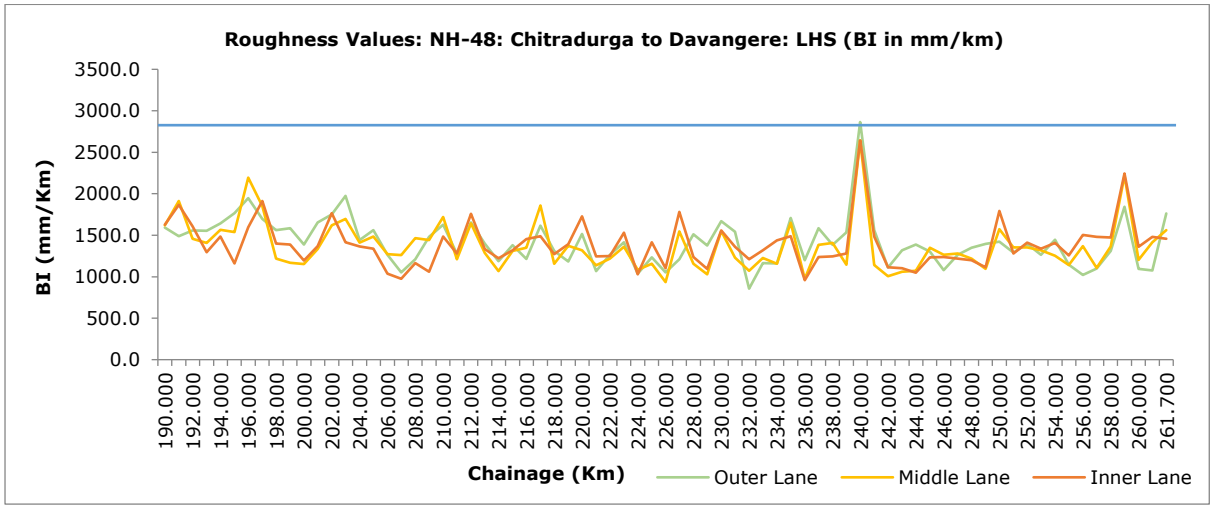

Figure 10-1: Illustrative roughness summary from Chitradurga to Davanagere (LHS)

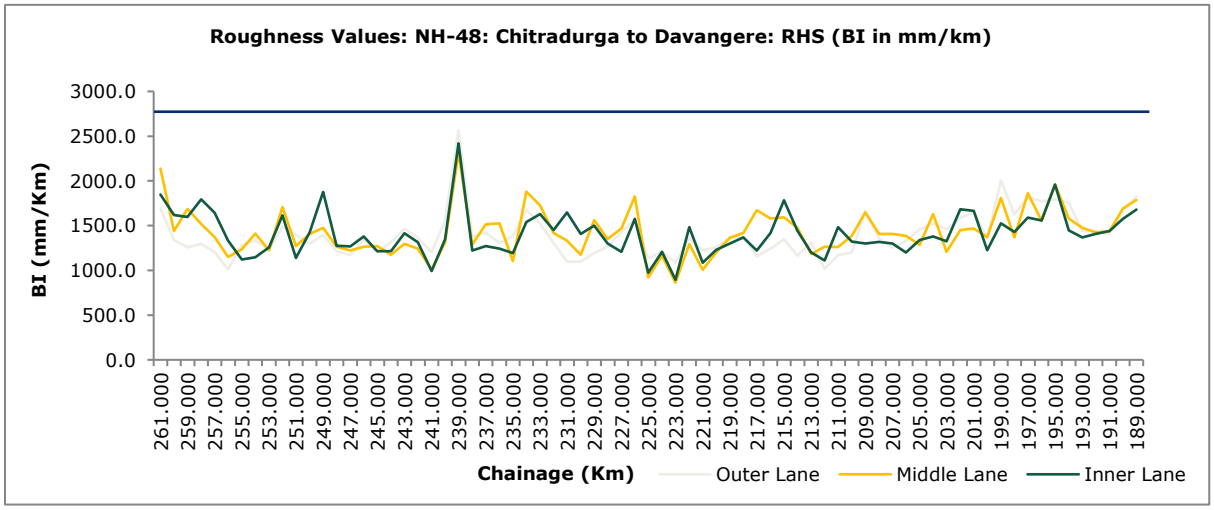

Figure 10-2: Illustrative roughness summary from Davanagere to Chitradurga (RHS)

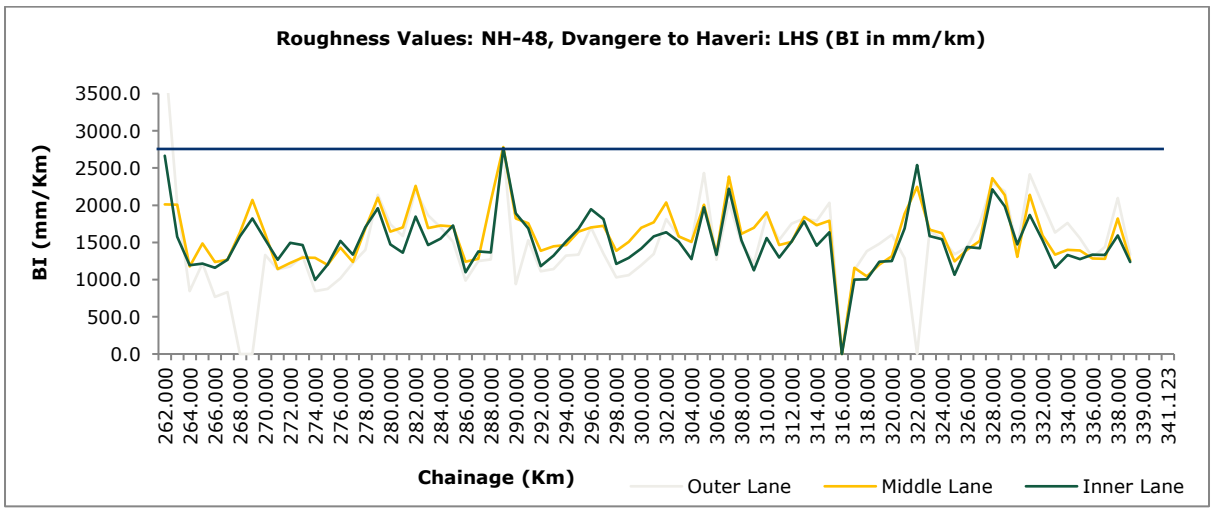

Figure 10-3: Illustrative roughness summary from Davanagere to Haveri (LHS)

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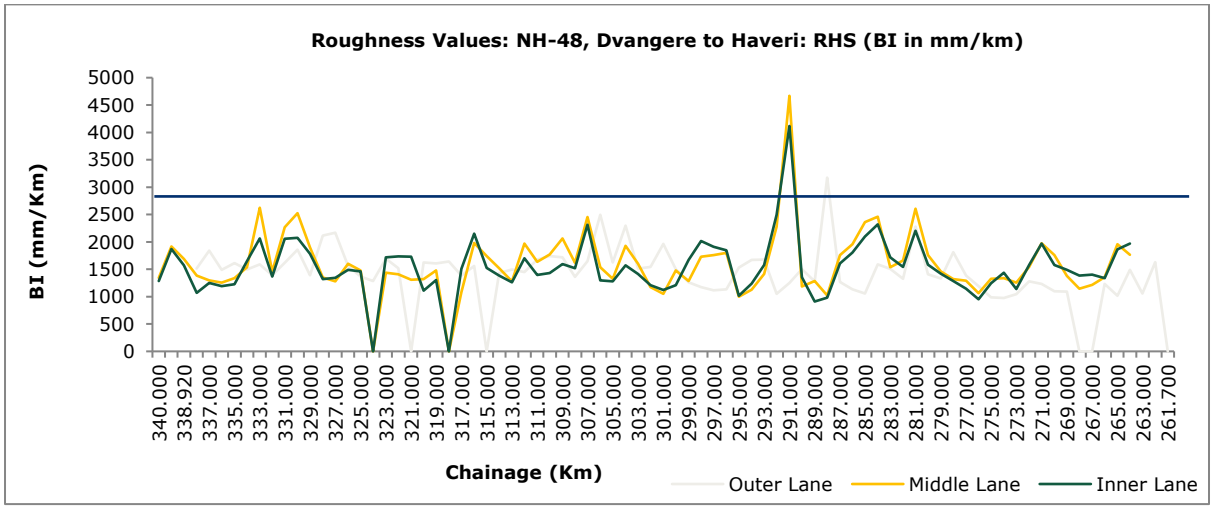

Figure 10-4: Illustrative roughness summary from Haveri to Davanagere (RHS)

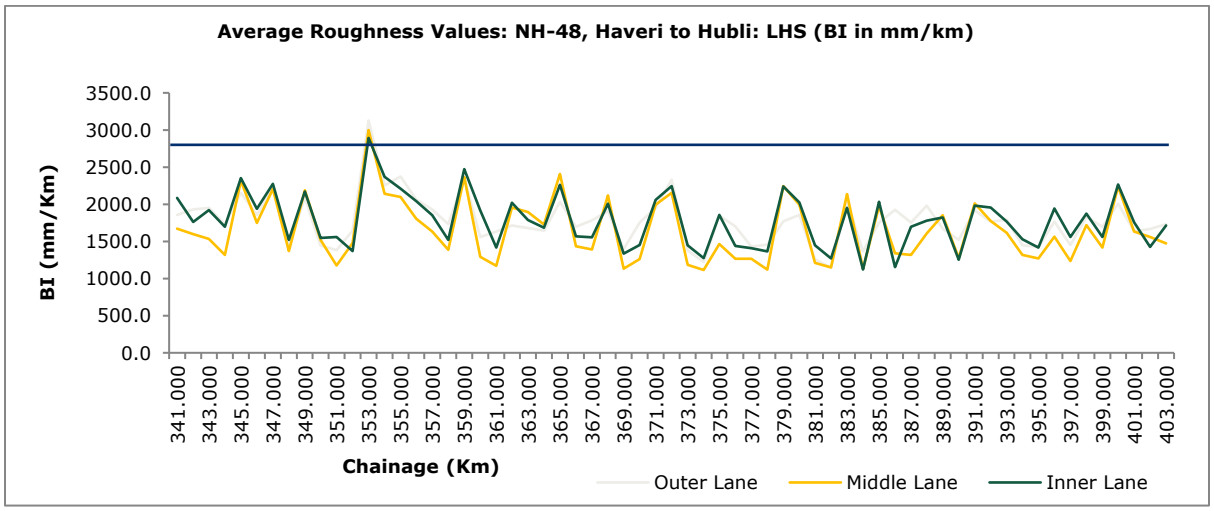

Figure 10-5: Illustrative roughness summary from Haveri to Hubli (LHS)

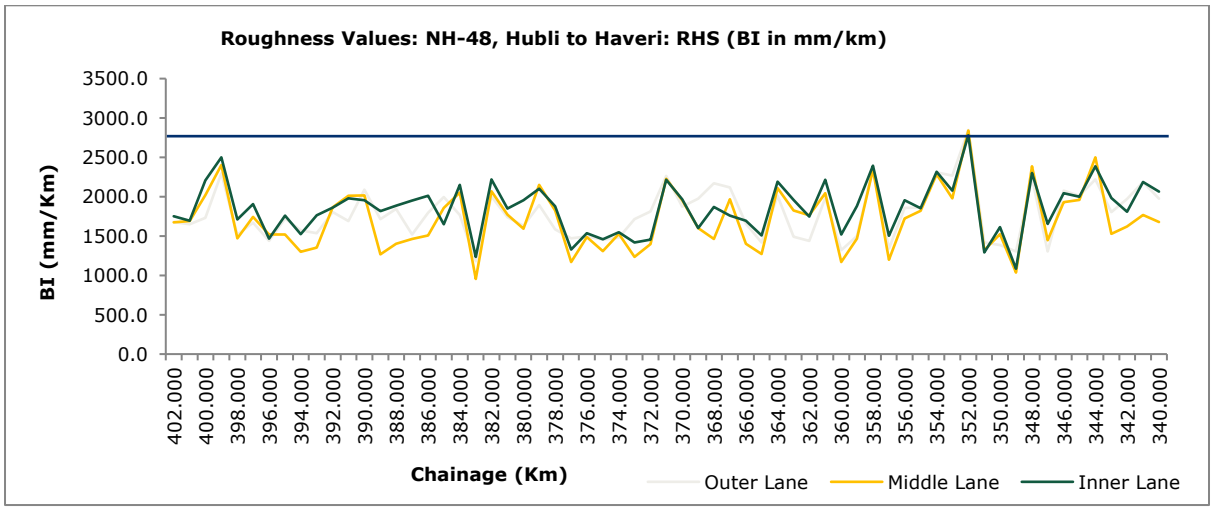

Figure 10-6: Illustrative roughness summary from Hubli to Haveri (RHS)

Observations:

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- As per Schedule-K, limiting value of roughness is 2,750 mm/km. If, the roughness value exceeds more than this during operational period, treatment has to be done within 180 days. Detailed summary is presented below.

Table 10-3: Roughness Summary of 3-Sections

Chitradurga to Davanagere Section						
BI (mm/Km)	LHS (length in %)			RHS (length in %)		
	Outer Lane	Middle Lane	Inner Lane	Outer Lane	Middle Lane	Inner Lane
<1800	94.5	91.7	94.5	94.5	90.8	94.9
1800-2400	4.1	6.9	4.1	4.1	9.2	3.7
>2400	1.4	1.4	1.4	1.4	0.0	1.4
>2750	1.4	0.0	0.0	0.0	0.0	0.0

Davanagere to Haveri Section						
BI (mm/km)	LHS (length in %)			RHS (length in %)		
	Outer Lane	Middle Lane	Inner Lane	Outer Lane	Middle Lane	Inner Lane
<1800	78.6	77.2	83.2	85.8	76.7	77.9
1800-2400	17.1	21.5	14.7	11.3	15.7	20.3
>2400	4.4	1.3	2.1	2.9	7.6	1.9
>2750	1.5	1.3	1.3	1.5	0.7	1.0

Haveri to Hubli Section						
BI (mm/Km)	LHS (length in %)			RHS (length in %)		
	Inner Lane	Middle Lane	Outer Lane	Inner Lane	Middle Lane	Outer Lane
<1800	54.0	66.7	59.8	41.2	60.3	53.9
1800-2400	42.8	30.2	38.6	55.6	34.9	44.5
>2400	3.2	3.2	1.6	3.2	4.8	1.6
>2750	1.6	1.6	1.6	1.6	1.6	1.6

10.3.2 Rutting

Rutting data of flexible pavement are collected through Digital Laser Profilers System (DLP) and the same is presented in **Annexure 4-2(a), 4-2(b), 4-2(c)** at an interval of 100mts. The obtained lane wise rutting summary is presented in **Table 10-4** for LHS and RHS for 3 Sections. Illustrative data of Rutting is presented in **Figure 10-7** to **Figure 10-12** for LHS and RHS respectively.

Table 10-4: Summary of Rutting Data on both directions

Chitradurga to Davanagere Section							
Direction	Rut Depth (mm)	Length of the Road Effected with Rutting					
		Effected Length in Km			Effected Length in %		
		Outer Lane	Middle Lane	Inner Lane	Outer Lane	Middle Lane	Inner Lane
LHS	< 5	61.4	43.8	48.1	84.6	60.2	66.2
	5 to 10	10.3	24.3	22.6	14.2	33.4	31.1
	> 10	0.9	4.6	2.0	1.2	6.3	2.8
RHS	< 5	58.5	42.3	50.5	80.5	58.2	69.5
	5 to 10	13.0	22.6	20.3	17.9	31.1	27.9
	> 10	1.2	7.8	1.9	1.7	10.7	2.6

Davanagere to Haveri Section							
Direction	Rut Depth (mm)	Length of the Road Effected with Rutting					
		Effected Length in Km			Effected Length in %		
		Outer Lane	Middle Lane	Inner Lane	Outer Lane	Middle Lane	Inner Lane
LHS	< 5	63.2	60.5	64.8	88.5	78.8	84.3
	5 to 10	6.8	14.3	10.7	9.6	18.6	14.0
	> 10	1.4	2.0	1.3	2.0	2.6	1.7
RHS	< 5	62.7	54.2	47.8	88.2	72.5	63.6
	5 to 10	7.7	19.4	25.8	10.9	25.9	34.4
	> 10	0.7	1.2	1.5	1.0	1.6	2.0

Haveri to Hubli Section							
Direction	Rut Depth (mm)	Length of the Road Effected with Rutting					
		Effected Length in Km			Effected Length in %		
		Inner Lane	Middle Lane	Outer Lane	Inner Lane	Middle Lane	Outer Lane
LHS	< 5	52.8	45.8	46.7	84.8	72.7	74.2
	5 to 10	8.4	13	13.3	13.6	20.6	21.2
	> 10	1.0	4.2	2.9	1.6	6.7	4.6
RHS	< 5	51.9	43.6	38.6	83.6	69.2	61.2
	5 to 10	9.7	14.4	18.2	15.6	22.9	28.9
	> 10	0.5	5	6.2	0.8	7.9	9.8

Chitradurga - Davanagere Section:

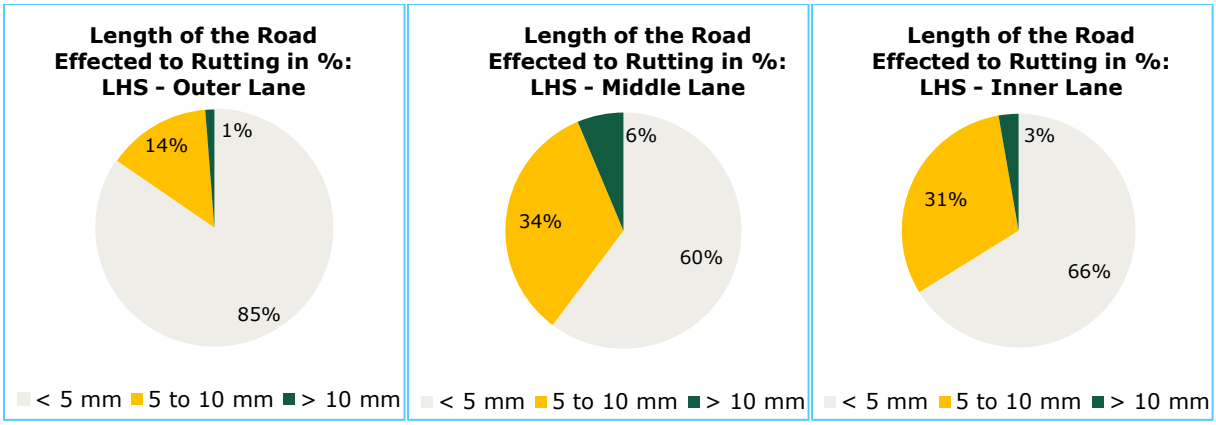

Figure 10-7: Illustrative summary of Rutting on LHS direction- Chitradurga to Davanagere

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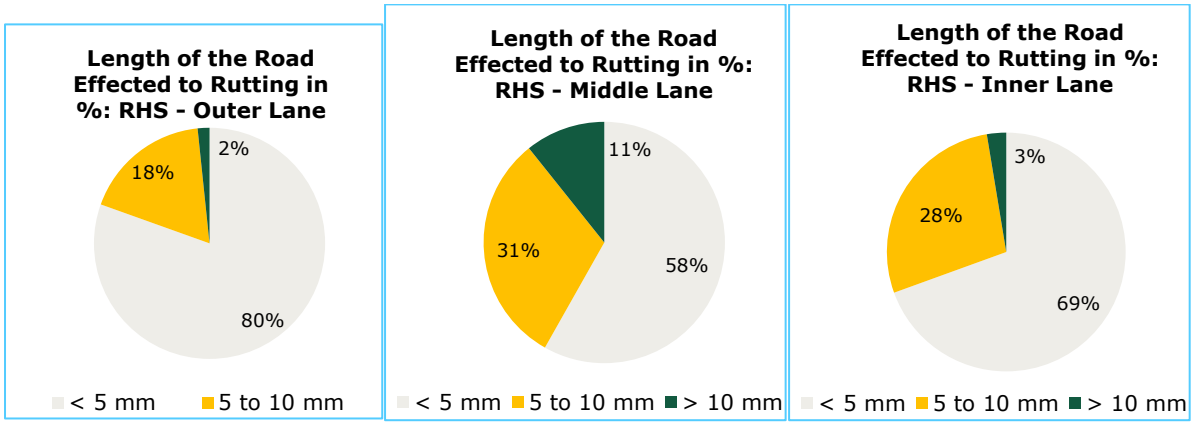

Figure 10-8: Illustrative summary of Rutting on RHS direction- Chitradurga to Davangere

Davanagere -Haveri Section:

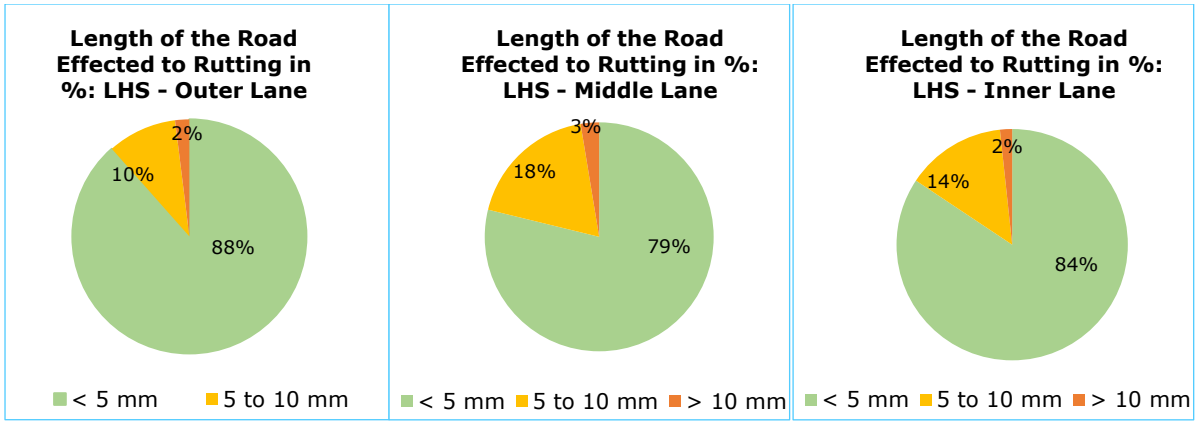

Figure 10-9: Illustrative summary of Rutting on LHS direction- Davanagere to Haveri

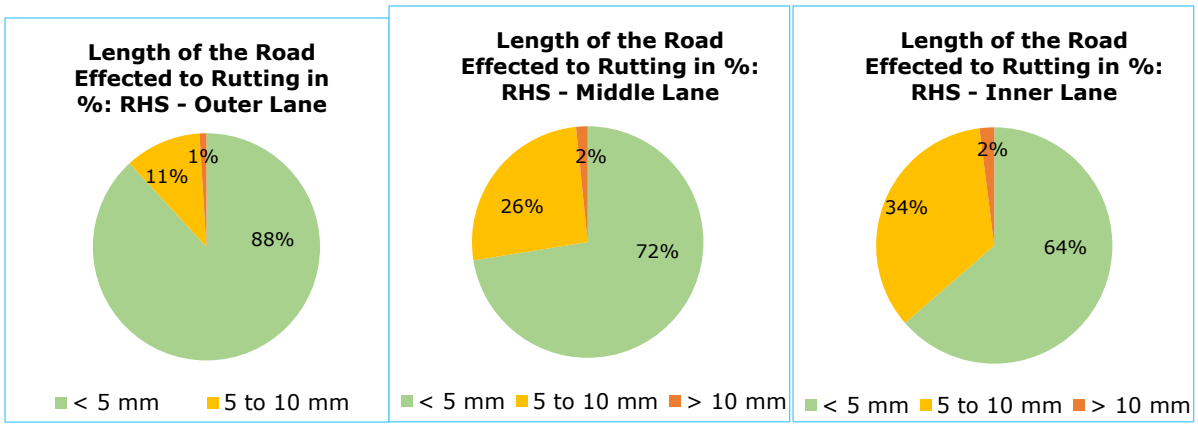

Figure 10-10: Illustrative summary of Rutting on RHS direction- Davanagere to Haveri

Haveri – Hubli Section:

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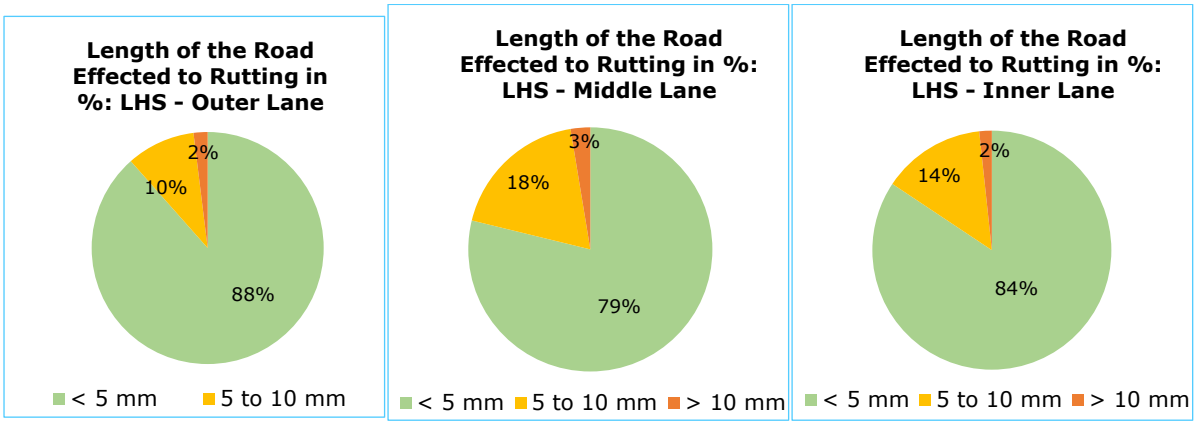

Figure 10-11: Illustrative summary of Rutting on LHS direction- Haveri to Hubli

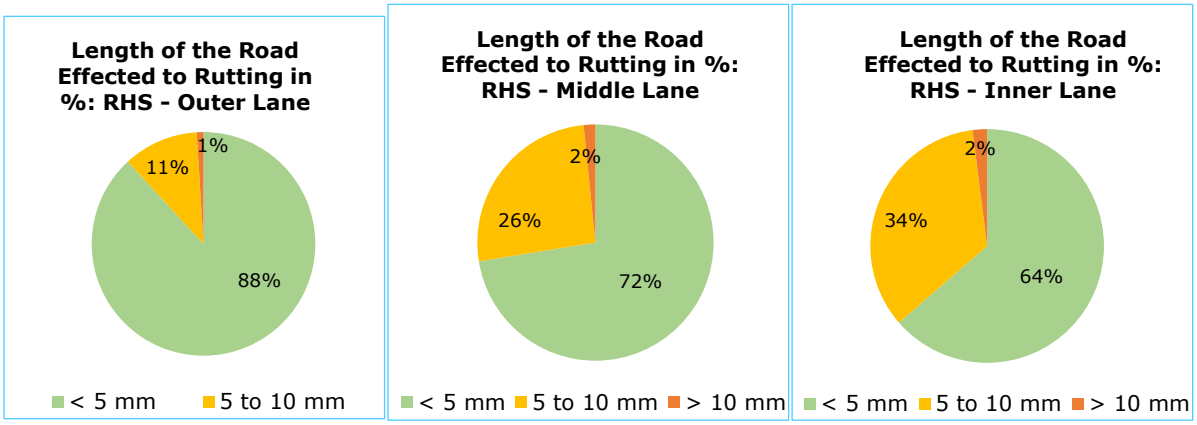

Figure 10-12: Illustrative summary of Rutting on RHS direction- Haveri to Hubli

Observations:

- Middle and Inner Lanes of both LHS & RHS direction are having more rutting compared to the other lanes. Rectifications must be done in the locations whose rut depth is exceeding 10mm within 30 days as per schedule-K.

10.3.3 Pavement Distresses

The NSV Software is processed and geotagged with corresponding co-ordinates and chainage, which will give us the distress type, location, magnitude, and severity.

Pavement distress data

The following Pavement distresses are considered for assessing the flexible pavement condition as per IRC: 82-2015 "Code of Practice for Maintenance of Bituminous Road Surfaces".

- Cracking
  - Longitudinal cracks
  - Transverse cracks
  - Alligator cracks/ Crocodile cracks
  - Multiple cracks
- Ravelling
- Shoving

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- Bleeding
- Slippage/ Delamination
- Potholes
  - Area: Surface Area of the Pothole.
  - Numbers
- Edge break
- Patching
- Settlements, Depressions

All the above pavement distress will be provided at 100 m interval.

The detailed pavement condition analysis and distress rating is carried out as per Table 5.1 given in IRC 82:2015. Pavement distresses are presented in **Annexure 4-3(a), 4-3(b), 4-3(c) & Annexure 4-4(a), 4-4(b), 4-4(c)** of LHS and RHS respectively. The distress summary is presented in **Table 10-5** to **Table 10-10** for LHS and RHS respectively.

Chitradurga – Davanagere Section:

Table 10-5: Summary of Pavement Distresses on LHS direction

Distress	Severity (% of Area)	Length of the Road Effected (km)					
		LHS (length in Km)			LHS (Length in %)		
		Inner	Middle	Outer	Inner	Middle	Outer
Cracking	< 5%	72.260	71.540	71.740	100.0	98.9	99.2
	5% to 10%	0.000	0.100	0.400	0.0	0.1	0.6
	> 10%	0.000	0.700	0.200	0.0	1.0	0.3
Ravelling	< 1%	72.260	72.340	72.140	100.0	100.0	99.7
	1% to 10%	0.000	0.000	0.200	0.0	0.0	0.3
	> 10%	0.000	0.000	0.000	0.0	0.0	0.0
Potholes	< 0.1%	72.260	72.340	72.340	100.0	100.0	100.0
	0.1% to 1%	0.000	0.000	0.000	0.0	0.0	0.0
	> 1%	0.000	0.000	0.000	0.0	0.0	0.0
Shoving	< 0.1%	72.260	72.340	72.340	100.0	100.0	100.0
	0.1% to 1%	0.000	0.000	0.000	0.0	0.0	0.0
	> 1%	0.000	0.000	0.000	0.0	0.0	0.0
Patching	< 1%	72.160	72.040	72.340	99.9	99.6	100.0
	1% to 10%	0.100	0.200	0.000	0.1	0.3	0.0
	> 10%	0.000	0.100	0.000	0.0	0.1	0.0
Settlement and Depression	< 1%	72.260	72.340	72.340	100.0	100.0	100.0
	1% to 5%	0.000	0.000	0.000	0.0	0.0	0.0
	> 5%	0.000	0.000	0.000	0.0	0.0	0.0

Table 10-6: Summary of Pavement Distresses on RHS direction

Distress	Severity (% of Area)	Length of the Road Effected (km)					
		RHS (length in Km)			RHS (Length in %)		
		Inner	Middle	Outer	Inner	Middle	Outer
Cracking	< 5%	72.340	71.740	72.240	100.0	99.2	99.9
	5% to 10%	0.000	0.200	0.100	0.0	0.3	0.1
	> 10%	0.000	0.400	0.000	0.0	0.6	0.0

Distress	Severity (% of Area)	Length of the Road Effected (km)					
		RHS (length in Km)			RHS (Length in %)		
		Inner	Middle	Outer	Inner	Middle	Outer
Ravelling	< 1%	72.340	72.340	72.340	100.0	100.0	100.0
	1% to 10%	0.000	0.000	0.000	0.0	0.0	0.0
	> 10%	0.000	0.000	0.000	0.0	0.0	0.0
Potholes	< 0.1%	72.340	72.340	72.340	100.0	100.0	100.0
	0.1% to 1%	0.000	0.000	0.000	0.0	0.0	0.0
	> 1%	0.000	0.000	0.000	0.0	0.0	0.0
Shoving	< 0.1%	72.340	72.340	72.340	100.0	100.0	100.0
	0.1% to 1%	0.000	0.000	0.000	0.0	0.0	0.0
	> 1%	0.000	0.000	0.000	0.0	0.0	0.0
Patching	< 1%	72.240	72.240	72.040	99.9	99.9	99.6
	1% to 10%	0.100	0.100	0.300	0.1	0.1	0.4
	> 10%	0.000	0.000	0.000	0.0	0.0	0.0
Settlement and Depression	< 1%	72.340	72.340	72.340	100.0	100.0	100.0
	1% to 5%	0.000	0.000	0.000	0.0	0.0	0.0
	> 5%	0.000	0.000	0.000	0.0	0.0	0.0

Davanagere – Haveri Section:

Table 10-7: Summary of Pavement Distresses on LHS direction

Distress	Severity (% of Area)	Length of the Road Effected (km)					
		LHS (length in Km)			LHS (Length in %)		
		Outer	Middle	Inner	Outer	Middle	Inner
Cracking	< 5%	68.020	68.990	73.090	96.2	90.7	96.1
	5% to 10%	1.100	3.200	1.100	1.6	4.2	1.4
	> 10%	1.600	3.900	1.900	2.3	5.1	2.5
Ravelling	< 1%	68.520	69.490	73.590	96.2	90.7	96.1
	1% to 10%	1.100	3.200	1.100	1.5	4.2	1.4
	> 10%	1.600	3.900	1.900	2.2	5.1	2.5
Potholes	< 0.1%	71.220	75.900	76.340	100.0	99.1	99.7
	0.1% to 1%	0.000	0.590	0.250	0.0	0.8	0.3
	> 1%	0.000	0.100	0.000	0.0	0.1	0.0
Shoving	< 0.1%	71.220	76.590	76.590	100.0	100.0	100.0
	0.1% to 1%	0.000	0.000	0.000	0.0	0.0	0.0
	> 1%	0.000	0.000	0.000	0.0	0.0	0.0
Patching	< 1%	71.220	76.590	76.590	100.0	100.0	100.0
	1% to 10%	0.000	0.000	0.000	0.0	0.0	0.0
	> 10%	0.000	0.000	0.000	0.0	0.0	0.0
Settlement and Depression	< 1%	71.070	75.750	76.190	99.8	98.9	99.5
	1% to 5%	0.150	0.840	0.400	0.2	1.1	0.5

Distress	Severity (% of Area)	Length of the Road Effected (km)					
		LHS (length in Km)			LHS (Length in %)		
		Outer	Middle	Inner	Outer	Middle	Inner
	> 5%	0.000	0.000	0.000	0.0	0.0	0.0

Table 10-8: Summary of Pavement Distresses on RHS direction

Distress	Severity (% of Area)	Length of the Road Effected (km)					
		RHS (length in Km)			RHS (Length in %)		
		Outer	Middle	Inner	Outer	Middle	Inner
Cracking	< 5%	67.960	70.140	72.290	95.9	93.9	96.5
	5% to 10%	1.200	2.040	1.740	1.7	2.7	2.3
	> 10%	1.700	2.500	0.920	2.4	3.3	1.2
Ravelling	< 1%	70.860	74.180	74.250	100.0	99.3	99.1
	1% to 10%	0.000	0.400	0.700	0.0	0.5	0.9
	> 10%	0.000	0.100	0.000	0.0	0.1	0.0
Potholes	< 0.1%	70.860	74.580	74.950	100.0	99.9	100.0
	0.1% to 1%	0.000	0.100	0.000	0.0	0.1	0.0
	> 1%	0.000	0.000	0.000	0.0	0.0	0.0
Shoving	< 0.1%	70.860	74.480	74.950	100.0	99.7	100.0
	0.1% to 1%	0.000	0.200	0.000	0.0	0.3	0.0
	> 1%	0.000	0.000	0.000	0.0	0.0	0.0
Patching	< 1%	70.460	73.980	73.650	99.4	99.1	98.3
	1% to 10%	0.400	0.700	0.600	0.6	0.9	0.8
	> 10%	0.000	0.000	0.700	0.0	0.0	0.9
Settlement and Depression	< 1%	70.860	74.680	74.950	100.0	100.0	100.0
	1% to 5%	0.000	0.000	0.000	0.0	0.0	0.0
	> 5%	0.000	0.000	0.000	0.0	0.0	0.0

Haveri – Hubli Section:

Table 10-9: Summary of Pavement Distresses on LHS direction

Distress	Severity (% of Area)	Length of the Road Effected (km)					
		LHS (length in Km)			LHS (Length in %)		
		Inner	Middle	Outer	Inner	Middle	Outer
Cracking	< 5%	58.18	60.95	58.60	93.87	98.23	95.60
	5% to 10%	1.80	0.60	1.70	2.90	0.97	2.77
	> 10%	2.00	0.50	1.00	3.23	0.81	1.63
Ravelling	< 1%	60.98	61.85	59.70	98.39	99.68	97.39
	1% to 10%	0.80	0.20	1.50	1.29	0.32	2.45
	> 10%	0.20	0.00	0.10	0.32	0.00	0.16
Potholes	< 0.1%	61.98	62.05	61.30	100.00	100.00	100.00
	0.1% to 1%	0.00	0.00	0.00	0.00	0.00	0.00

Distress	Severity (% of Area)	Length of the Road Effected (km)					
		LHS (length in Km)			LHS (Length in %)		
		Inner	Middle	Outer	Inner	Middle	Outer
	> 1%	0.00	0.00	0.00	0.00	0.00	0.00
Shoving	< 0.1%	61.98	61.95	61.30	100.00	99.84	100.00
	0.1% to 1%	0.00	0.10	0.00	0.00	0.16	0.00
	> 1%	0.00	0.00	0.00	0.00	0.00	0.00
Patching	< 1%	60.58	61.65	60.30	97.74	99.36	98.37
	1% to 10%	1.30	0.40	0.80	2.10	0.64	1.31
	> 10%	0.10	0.00	0.20	0.16	0.00	0.33
Settlement and Depression	< 1%	61.98	62.05	61.30	100.00	100.00	100.00
	1% to 5%	0.00	0.00	0.00	0.00	0.00	0.00
	> 5%	0.00	0.00	0.00	0.00	0.00	0.00

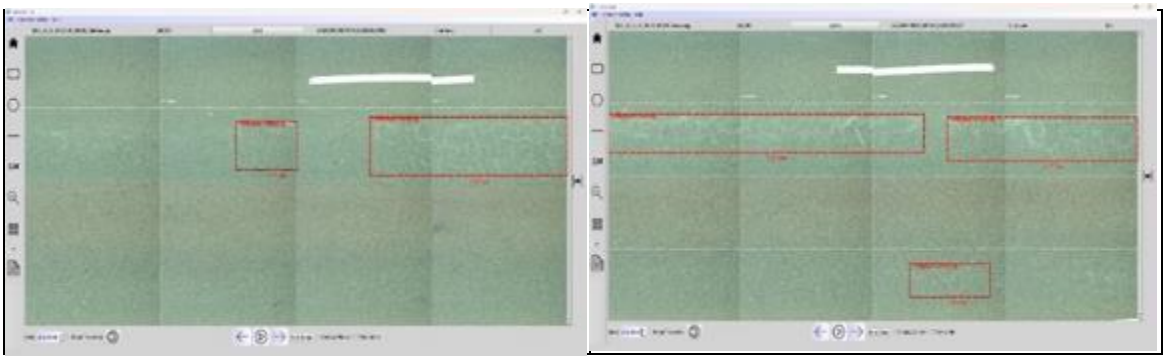
Table 10-10: Summary of Pavement Distresses on RHS direction

Distress	Severity (% of Area)	Length of the Road Effected (km)					
		RHS (length in Km)			RHS (Length in %)		
		Inner	Middle	Outer	Inner	Middle	Outer
Cracking	< 5%	55.90	53.85	59.67	90.16	86.78	97.71
	5% to 10%	3.20	2.60	0.80	5.16	4.19	1.31
	> 10%	2.90	5.60	0.60	4.68	9.02	0.98
Ravelling	< 1%	62.00	61.75	60.67	100.00	99.52	99.35
	1% to 10%	0.00	0.30	0.40	0.00	0.48	0.65
	> 10%	0.00	0.00	0.00	0.00	0.00	0.00
Potholes	< 0.1%	62.00	62.05	61.07	100.00	100.00	100.00
	0.1% to 1%	0.00	0.00	0.00	0.00	0.00	0.00
	> 1%	0.00	0.00	0.00	0.00	0.00	0.00
Shoving	< 0.1%	61.90	61.65	61.07	99.84	99.36	100.00
	0.1% to 1%	0.10	0.20	0.00	0.16	0.32	0.00
	> 1%	0.00	0.20	0.00	0.00	0.32	0.00
Patching	< 1%	61.20	59.95	60.27	98.71	96.62	98.69
	1% to 10%	0.80	2.00	0.70	1.29	3.22	1.15
	> 10%	0.00	0.10	0.10	0.00	0.16	0.16
Settlement and Depression	< 1%	62.00	62.05	61.07	100.00	100.00	100.00
	1% to 5%	0.00	0.00	0.00	0.00	0.00	0.00
	> 5%	0.00	0.00	0.00	0.00	0.00	0.00

Observations:

- There are no major surface distresses observed along the project stretch except cracks.
- Un-acceptable surface distress locations are summarised along with appropriate rehabilitation techniques. The same is presented in **Annexure 4-5(a), 4-5(b), 4-5(c)**.

Photo 10-1: Field testing Photographs



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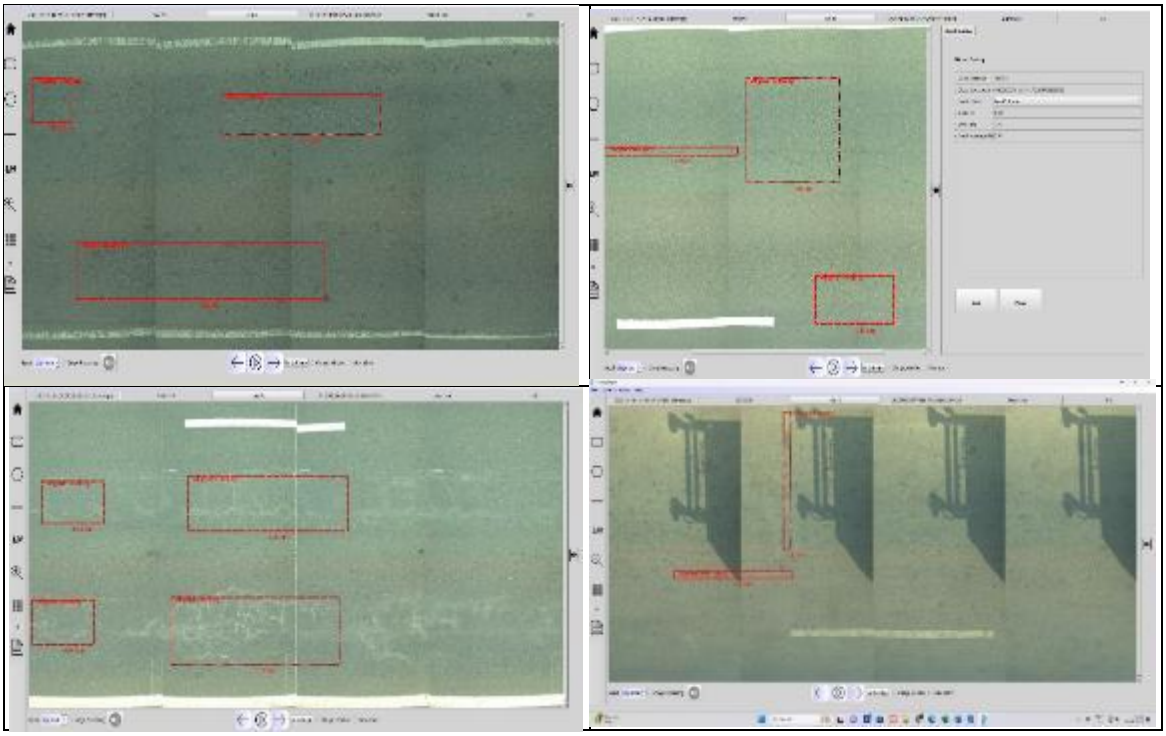

Photo 10-2: Distress Mapping Photographs

10.4 Structural Evaluation of Pavement by Using FWD

The structural evaluation and analysis of remaining life of project is carried out in conformity with IRC: 115-2014, "Guidelines for Structural Evaluation and Strengthening of Flexible Road Pavements Using Falling Weight Deflectometer (FWD) Technique".

10.4.1 Equipment Description and Test Methodology

Principle of Pavement Evaluation Using FWD

Performance of flexible pavements can be evaluated by applying loads on the pavements that simulate the traffic loading, recording the response to such loading by measuring the elastic deflection under such loads, and analysing these data duly considering the factors influencing the performance such as subgrade strength, thickness, and quality of each of the pavement layers, drainage conditions, pavement surface temperature etc.

Among the equipment available for structural evaluation of pavements, the Falling Weight Deflectometer (FWD) is extensively used world-wide because it simulates, to a large extent, the actual loading conditions of the pavement. When a moving wheel load passes over the pavement it produces load pulses. Normal stresses (vertical as well as horizontal) at a location in the pavement will increase in magnitude from zero to a peak value as the moving wheel load approaches the location. The time taken for the stress pulse to vary from zero to peak value is termed as 'rise time of the pulse'. As the wheel moves away from the location, magnitude of stress reduces from peak value to zero. The time period during which the magnitude of stress pulse varies from 'zero-to-peak-to-zero' is the pulse duration. Peak load and the corresponding pavement responses are of interest for pavement evaluation.

The resulting load-deflection data can be interpreted through appropriate analytical techniques, such as back calculation technique, to estimate the elastic moduli of the pavement layers. The computed moduli are, in turn, used for (i) the strength evaluation of different layers of in-service pavements (ii) the estimation of the remaining life of in-service pavement (iii) determination of strengthening

requirement, if any and (iv) evaluation of different rehabilitation alternatives (overlay, recycling, partial reconstruction, etc

Brief Description of Falling Weight Deflectometer (FWD)

Falling Weight Deflectometer is an impulse-generating device with a guide system. This device allows a variable weight to be dropped from a variable height. The apparatus has a loading plate which is used for uniform force distribution on the test layer. When the weight affects this plate, this loading plate ensures that the resulting force is applied perpendicularly to the test layer's surface. It also has a load cell for measuring the actual applied impulse. It also has one or more deflection sensors. (Note: Deflection basin tests require at least seven sensors). It also has a system for collecting, processing, and storing deflection data. Structural evaluation of pavements involves application of a standard load to the pavement and measuring its response in terms of stress, strain, or deflection.

The basic working principle of the impulse loading equipment is to drop a mass on the pavement to produce an impulse load and measure the surface deflections. The mass is dropped on a spring system, which in turn transmits the load to the pavement through a loading plate. The resulting deflection bowl characteristics are observed and used in the back calculation of pavement material properties. The principle is illustrated in **Figure 10-13**.

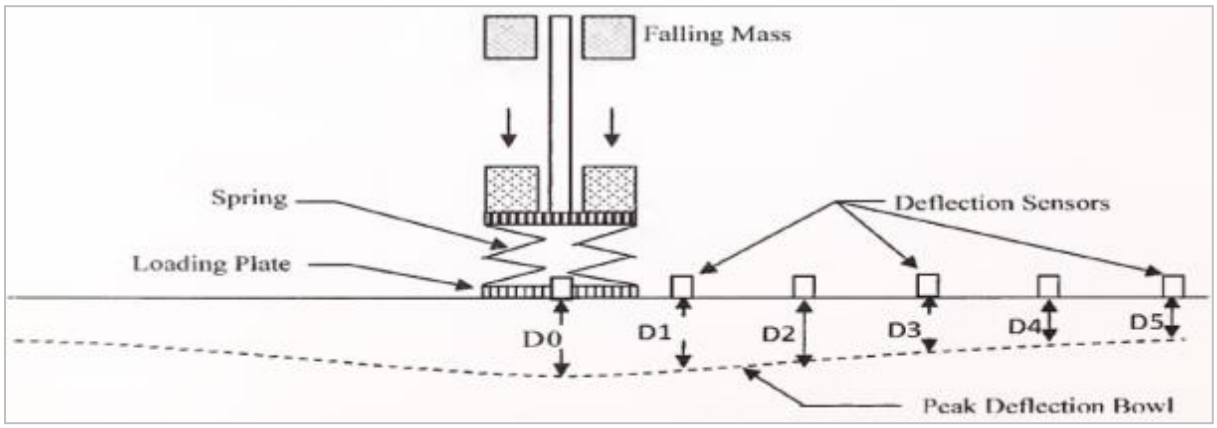

Figure 10-13: Working Principle of FWD

Performance of flexible pavements can be evaluated by applying loads on the pavements that simulate the traffic loading, recording the response to such loading by measuring the elastic deflection under such loads, and analysing these data duly considering the factors influencing the performance such as subgrade strength, thickness, and quality of each of the pavement layers, drainage conditions, pavement surface temperature etc.

FWD Instrument Used for the Deflection Survey: ERAY-FWD20VM.

For the purpose of conducting FWD survey on the project road ERAY-FWD20VM Fully Automatic Vehicle-mounted FWD was used. The FWD can apply a loading in the range of 12-150 KN, enabling it to simulate all type of vehicle loads on pavement surface. This model is complete with back-up battery and Vehicle mounted with all other accessories for evaluation of pavements.

Moreover, this particular instrument mostly exceeds or matches all the criteria given in the IRC: 115-2014. Following **Table 10-11** summarizes the technical specifications of the instrument against the specifications of FWD mentioned by IRC: 115-2014.

Table 10-11: Comparison between IRC and ERAY-FWD20MT Specifications

No	FWD Components	IRC Recommended Specification for FWD	ERAY-20VM FWD Specification	Remarks
1	Plate Diameter	300/450 mm	300 mm	300 mm dia plate is recommended
2	Mass System	Single Mass	Single Mass	Matched
3	Falling Weight Mass	50 to 700 Kg	50 to 350 Kg	Matched
4	Height of fall	100 to 600 mm	Variable	Matched
5	Target peak load	40	40	Matched
6	Load Cell Accuracy	+ 2 %	+ 1 %	Matched
7	Number of Deflection Transducers	6 to 9	9	Matched
8	Deflection Sensor Types	Geophones	Geophones	Matched
9	Reading Resolution of Deflection Transducers	Min 1 um	1 um	Matched
10	Deflection Transducers Accuracy	± 2 %	± 1 %	Matched

Testing Procedure and Methodology

The detailed test methodology and procedure was described in IRC: 115-2014 "Guidelines for Structural Evaluation and Strengthening of Flexible Road Pavements Using Falling Weight Deflectometer (FWD) Technique". However, as per the client's requirement the sampling procedure was customized in this project. In adherence to the same, structural evaluation of the existing 'pavement and subgrade system' by measuring its response in terms of deflection was carried out using FWD for the project road in the end of October and November 2023.

Evaluation of pavement structural strength would be carried out in accordance with requirements of TOR and IRC: 115-2014.

(a) Testing Equipment

The equipment used for the testing is:

- **ERAY-FWD20VM** Vehicle Mounted Falling Weight Deflectometer with 1 loading plate and 9 numbers of geophones placed at the spacing of 0, 200, 300, 450, 600, 900, 1200, 1500 and 1800mm from the centre of the loading plate.
- Air Temperature and Pavement Surface Temperature sensors as part of the FWD instrument.
- Red flags and red cones and flashing lamps for traffic arrangement.

(b) Testing Frequency – as per IRC:115-2014

The entire length has been classified into section of uniform performance. As it is inexpedient to change the sample size for deflection measurement at frequent intervals, the minimum length of uniform section1 has been kept as 1.0km. The interval at which deflection measurements has been carried out was calculated by using the following formula of equation 1 of IRC: 115-2014 and the same are extracted for ready reference:

$n= ((z * CV)^2)/ (ME^2)$

Where,

n =sample size

z =standard normal deviate, 1.285 corresponding to 90 per cent (two-sided) confidence level

ME =10 per cent acceptable margin of error (as percentage of mean)

CV=Coefficient of variation of deflection (standard deviation/mean) expressed as percentage; 15 percent, 30percent and 45 percent for good, fair, and poor condition respectively.

Though the length of uniform section divided by calculated sample size results the interval of FWD test, however the deflection measurement scheme depends upon the type of carriageway, number of lanes and the measurement along a lane. The same is detailed in Table 2 of IRC 115-2014 and the same is presented in **Table 10-12** below. However, 4, 2 and 2 points were tested for deflections per each lane kilometre in Outer, Middle and Inner lanes respectively in both directions.

Table 10-12: Guidelines for Selection of Deflection Measurement Scheme for 4/6-lane divided carriageway.

Recommended Measurement Scheme	Maximum Spacing(m) for test points along selected wheel path for pavements of different classification		
	Poor	Fair	Good
(i)measure along outer wheel paths of outermost lanes	30	65	250
(ii)measure along the outer wheel path of more distressed inner lane	60	130	500
(iii)measure along the centre line of paved shoulder (in case of widening projects)	120	260	500

FWD Deflection Testing Points and Measurement

Based on existing pavement condition, the number of FWD test points was finalized by client's pavement engineer and testing team. As discussed earlier, 4, 2 and 2 points were tested for deflections per each lane kilometre in Outer, Middle, and Inner lanes respectively in both directions

FWD deflection measurement has been carried out for each carriageway. FWD deflection measurement has been carried out at a test point along outer wheel path of each lane which is at an offset of 0.75m from the outer edge of outer lane and at 4.2m from the outer edge of outer lane for central lane and at 5.2m from the outer edge of outer lane for the lane adjacent to median as specified in section 5.4.5 of IRC: 115-2014. At every measurement location, four drops were made, such that the first drop was the '**seating drop'** and with the remaining three drops deflections were recorded.

Photographs of FWD test under progress at some locations are shown in **Figure 10-14.**

Figure 10-14: Photographs showing FWD survey Under progress.

Also, during survey pavement temperature of bituminous layer has been recorded as per the procedure specified in section 5.4.7 of IRC: 115-2014.

The following steps are carried out for measuring deflections at a test point:

i. Mark the test point on the pavement

ii. Centre the load plate over the test point

iii. Lower the loading plate onto the pavement ensuring there should be no standing water on the pavement surface. The loading plate should be in proper contact with pavement surface. The longitudinal and transverse slope of the pavement should not exceed 10 percent at the test location.

iv. Lower the frame holding the geophones so that the transducers are in contact with pavement surface.

v. Raise the mass to a pre-determined height required for producing a target load of 40 KN (+10%).

vi. Drop one seating load, load, and deflection data for which need not be recorded.

vii. Raise the mass and drop. Record the load and deflection data into the computer through data acquisition system. While peak load and peak deflections at different selected radial positions must be recorded. At least 2 drops should be made at one location for precision.

viii. If, during previous 2 steps, the deflections measured are giving variations or the deflections/load pulses are not proper, repeat the drop.

ix. Raise the geophone frame and load plate and move to the next test location.

x. Deflection measurements should not be made when the pavement temperature is more than 45°C.

10.4.2 Existing Pavement Composition Details

During test pit investigation, the existing pavement composition details are obtained at the interface of outer lane to earthen shoulder. Details of the same is presented in **Table 10-13.**

Table 10-13: Summary of Pavement Crust Details along the project corridor

Chitradurga to Davanagere Section						
S No.	Chainage as per CA (Km)	Design Location (Km)	Side (LHS/RHS)	Pavement Composition(mm)		Total Thickness
				Bituminous layer	Granular Layer	
1	6.200	195.200	RHS	150	500	650
2	10.000	199.000	LHS	120	500	620
3	14.500	203.500	RHS	150	500	650
4	20.380	209.380	LHS	110	650	760
5	211.900	213.600	RHS	140	550	690
6	216.400	218.100	LHS	120	550	670
7	221.900	223.600	RHS	170	600	770
8	226.700	228.400	LHS	110	600	710
9	232.800	234.500	RHS	150	650	800
10	236.300	238.000	LHS	100	550	650
11	240.500	242.200	RHS	140	460	600
12	246.400	248.100	LHS	110	600	710
13	251.900	253.600	RHS	140	470	610
14	257.500	259.200	LHS	110	550	660
Davanagere to Haveri Section						
S No.	Chainage as per CA (Km)	Design Location (Km)	Side (LHS/RHS)	Pavement Composition(mm)		Total Thickness
				Bituminous layer	Granular Layer	
1	262+640	264+840	RHS	210	550	760
2	267+800	270+000	LHS	170	600	770
3	270+800	273+000	RHS	170	550	720
4	275+900	278+100	LHS	210	350	560
5	279+860	282+060	RHS	170	400	570
6	286+800	289+000	LHS	170	550	720

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Chitradurga to Davanagere Section						
S No.	Chainage as per CA (Km)	Design Location (Km)	Side (LHS/RHS)	Pavement Composition(mm)		Total Thickness
				Bituminous layer	Granular Layer	
7	290+800	293+000	RHS	170	560	730
8	295+800	298+000	LHS	170	550	720
9	301+600	303+800	RHS	160	700	860
10	305+800	308+000	LHS	200	550	750
11	311+600	313+800	RHS	170	650	820
12	315+800	318+000	LHS	180	450	630
13	320+800	323+000	RHS	160	600	760
14	327+450	329+650	LHS	130	600	730
15	330+500	332+700	RHS	130	500	630
16	335+800	338+000	LHS	130	500	630

Haveri to Hubli Section					
S No.	Location (Km)	Side (LHS/RHS)	Pavement Composition(mm)		Total Thickness
			Bituminous layer	Granular Layer	
1	343+000	RHS	170	600	770
2	347+550	LHS	170	500	670
3	351+980	RHS	150	640	790
4	357+900	LHS	180	600	780
5	360+800	RHS	170	530	700
6	367+030	LHS	120	550	670
7	373+000	RHS	180	390	570
8	377+400	LHS	200	600	800
9	383+000	RHS	140	530	670
10	388+000	LHS	160	450	610
11	391+800	RHS	170	700	870
12	397+900	LHS	190	600	790
13	402+800	RHS	120	450	570

10.4.3 In-put Data for BACK Calculation Analysis

(a) Processing of Load and Deflection data

The FWD test data collected from different drops at each test point primarily consists of peak load and peak deflections at different radial locations. Unrealistic deflection values and obviously erroneous data must be removed.

Average values of load and deflections are calculated from the three drop test data collected. FWD tests were carried out using 40 KN impulse load. However, since the FWD equipment does not impart

the same load at every test point, normalization of all measured deflections was carried out to a common test load of 40 KN. Such 'normalization' of the data was carried out using the following formula:

Dn= 40 KN/Lm× Dm

where,

Dn = Normalized Deflection.

Lm = Imparted Load and

Dm = Measured Deflection

The "normalized deflection data" was then used for determining deflections, deflection bowl and finally in framing of homogeneous sections and calculation of overlay requirements. FWD normalised deflection data is presented in **Annexure 4-6(a), 4-6(b), 4-6(c).**

(b) Back-calculation of Layer Moduli

Layer moduli have been back calculated using KGPBACK program. The pavement has been modelled as a three-layer system with bituminous layer, granular layer, and subgrade. The following inputs have been provided for back analysis.

- Single wheel load 40 KN and contact pressure 0.56 MPa.
- No. of deflection sensors: 9
- Radial Distances of the Geophones i.e., 0, 200, 300, 450, 600, 900, 1200, 1500 and 1800mm
- Measured Surface Deflections normalized to 40kN in mm.
- Pavement Layer Thicknesses (as measured from Trial Pits)
- Poisson's ratio of 0.5, 0.4 and 0.4 is considered for bituminous, granular and subgrade layers.
- Range of Possible modulus value (Min.- Max.) of bituminous layer, granular layer and subgrade

Ranges of different layer moduli have been given as input to KGPBACK for back-calculation. These ranges have been selected judiciously by experienced pavement engineering taking into considerations the approximate age of pavement, visual assessment of the condition of bituminous layer, climatic conditions prevailing at the time of deflection measurements and information available from test pits, and laboratory tests conducted as detailed below:

(c) Range of modulus value of existing subgrade:

The range of moduli of existing subgrade layers is based on clause III.8.4 of IRC 115-2014.The range is taken as 20-100 MPa.

(d) Range of modulus value of existing granular layers i.e., base and subbase:

The range of moduli of existing granular layers is based on clause II.8.4 of IRC 115-2014.The range for combined (base and sub-base) is taken as 100-500 MPa.

(e) Range of modulus value of existing bituminous layers:

The range of moduli of existing thick bituminous layer has been determined based on condition data. If the road condition is good the range is considered as 750MPa to 3000MPa, for sections with pavement condition is Fair- Poor, the range specified for thick bituminous layer 400 MPa to 1500 MPa as stipulated in section III.8.4 of IRC: 115-2014 has been taken into consideration.

10.4.4 Correction for data analysis

Correction for Temperature

Back-calculated moduli values of the bituminous layers evaluated by FWD survey are influenced by the pavement temperature. The standard pavement temperature for India is recommended as 35°C,

hence the back-calculated moduli obtained at temperatures other than the identified standard temperature will have to be corrected using a suitable correction factor using equations 4 and 5 of IRC:115-2014 and the same is extracted below for ready reference.

ET1 = λ ET2

Where,

λ, temperature correction factor, is given as

λ = (1-0.238 lnT1) / (1-0.238 lnT2)

Where,

ET1 = Back-calculated modulus (MPa) at temperature T1 (°C)

ET2 = Back-calculated modulus (MPa) at temperature T2 (°C)

Correction for Seasonal Variation

Moisture content affects the strength of subgrade and granular subbase/base layers. Since the deflection measurements have been carried out in the month of November during winter, hence seasonal correction factor is applicable. Therefore, the back-calculated moduli of subgrade and granular layers have been taken from field moduli using winter seasonal corrections. Seasonal correction equations 6 to 9 of IRC: 115-2014 has been extracted below for ready reference.

$$E_{sub\_mon} = 3.351 * (E_{sub\_win})^{0.7688} - 28.9 \ldots (6)$$

$$E_{sub\_mon} = 0.8554 * (E_{sub\_sum}) - 8.461 \ldots (7)$$

where,

E_{sub_mon} = subgrade modulus in monsoon (MPa)

E_{sub_sum} = subgrade modulus in Summer (MPa)

E_{sub_win} = subgrade modulus in Winter (MPa)

$$E_{gran\_mon} = -0.0003 * (E_{gran\_sum})^2 + 0.9584 * (E_{gran\_sum}) - 32.989 \ldots (8)$$

$$E_{gran\_mon} = 10.5523 * (E_{gran\_win})^{0.624} - 113.857 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

where,

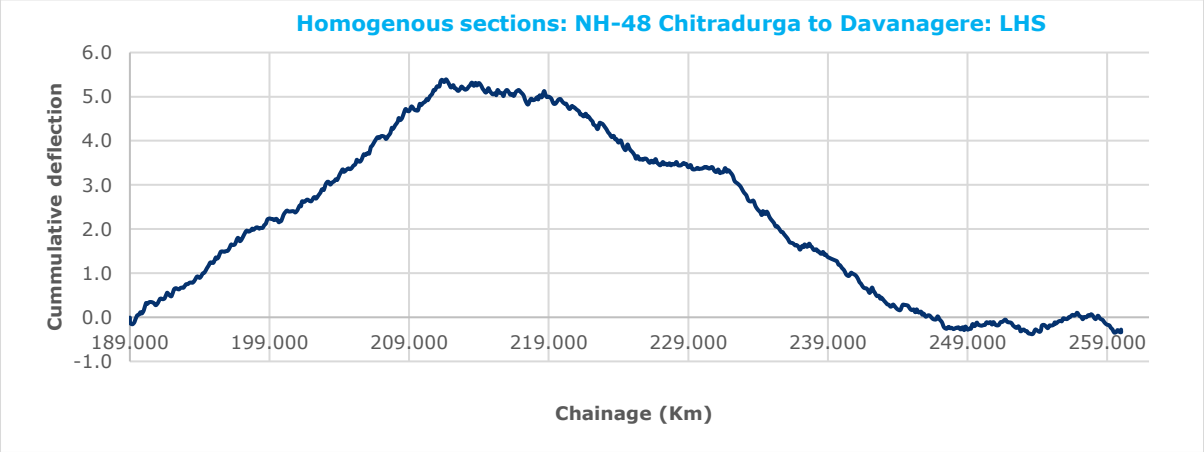
E_{gran_mon} = granular layer modulus in monsoon (MPa)

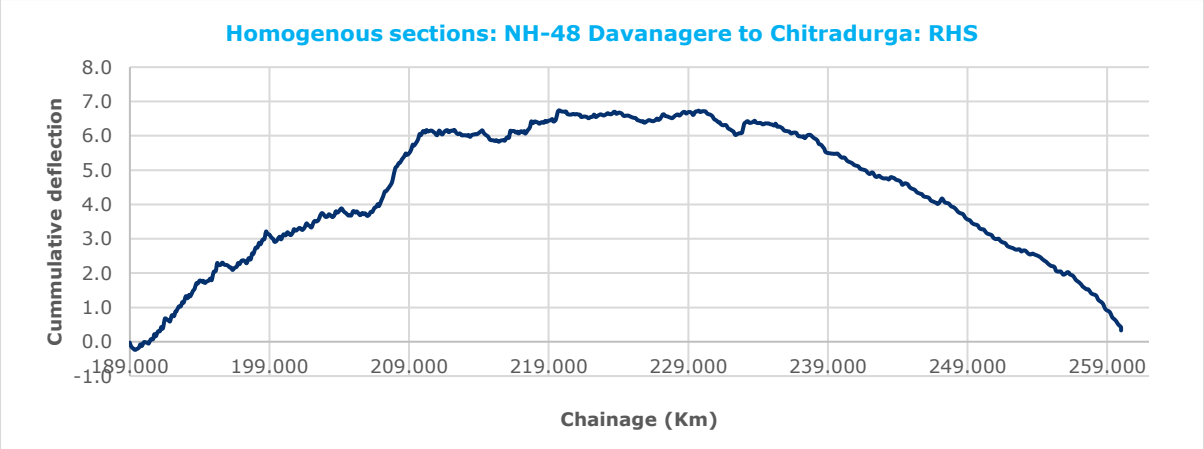
E_{gran_sum} = granular layer modulus in Summer (MPa)

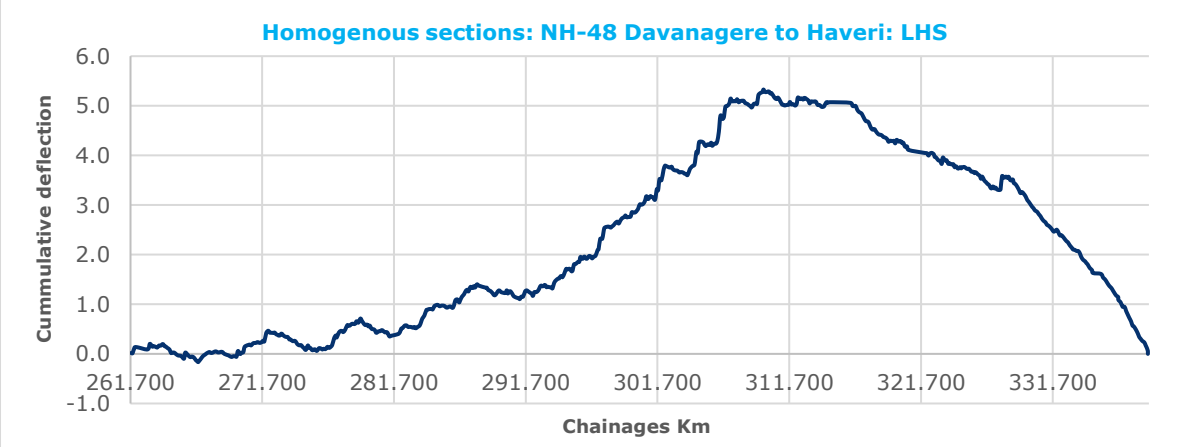
E_{gran_win} = granular layer modulus in Winter (MPa)

10.4.5 Results of 15th Percentile E Moduli Value of Pavement Layers

Homogenous sections are identified by Cumulative difference approach. Cumulative difference graphs are drawn by using D0 deflection values and are presented below.







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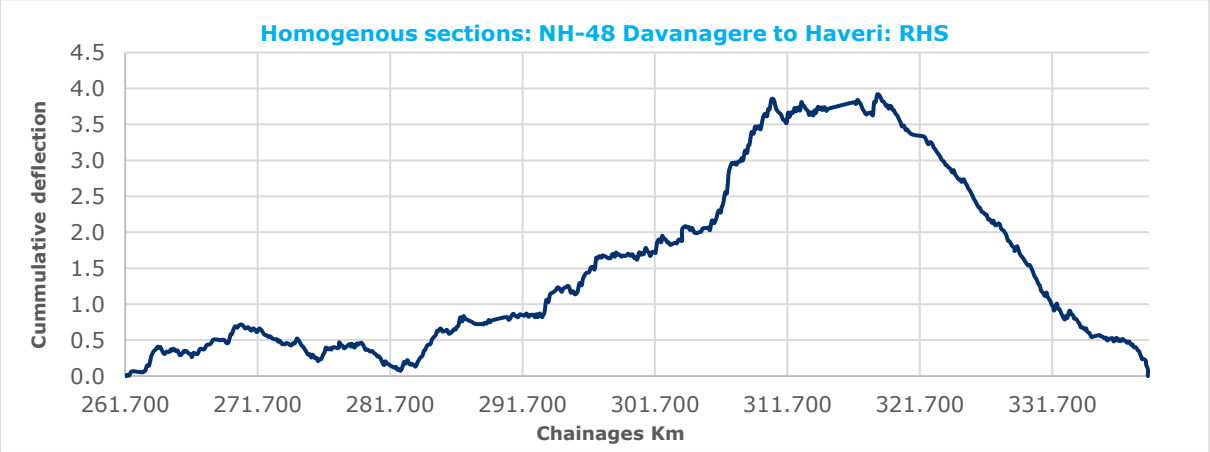

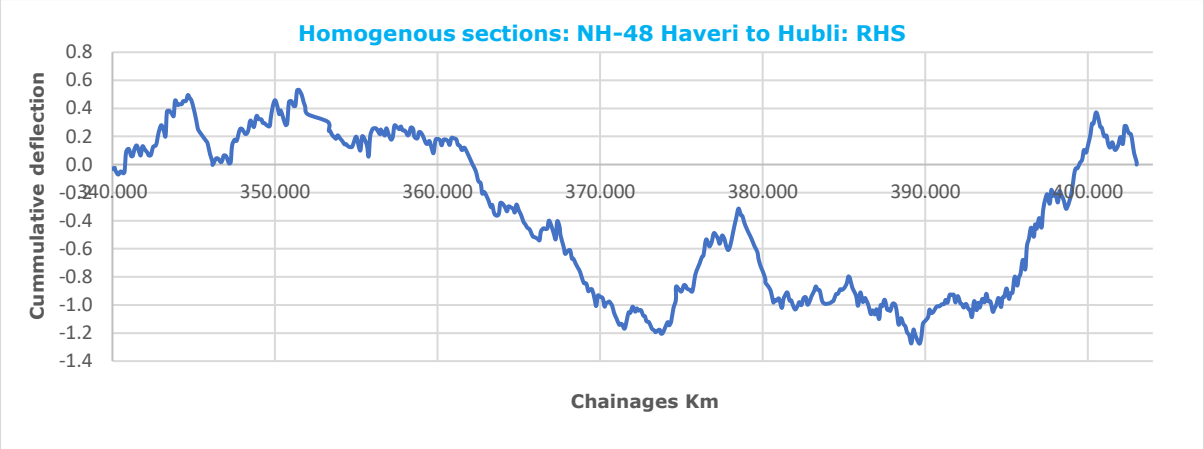

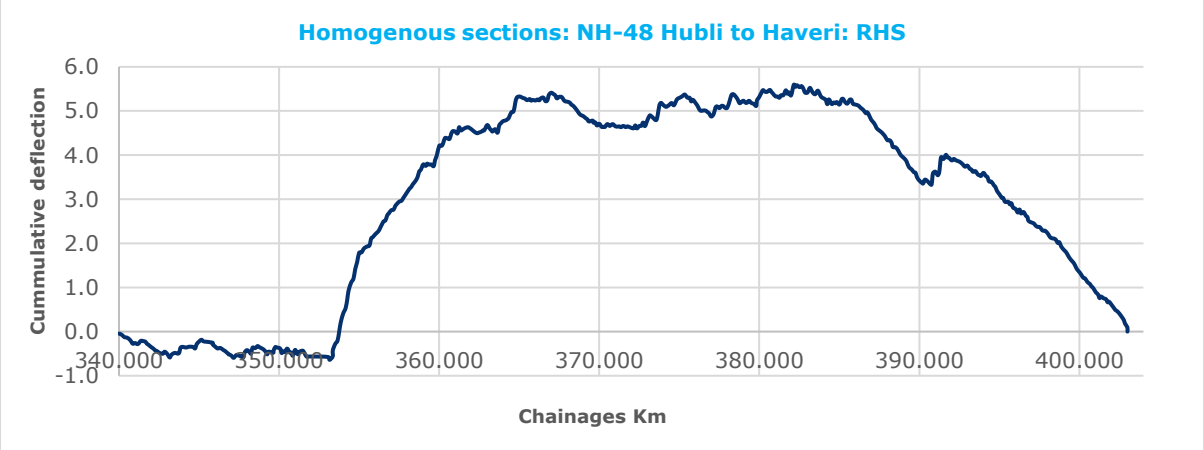

The summary of back calculated E values is presented in **Annexure 4-7(a), 4-7(b), 4-7(c)**. The summary of 15th Percentile Elastic Moduli is presented in **Table 10-14** to **Table 10-19** for LHS and RHS respectively.

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Chitradurga – Davanagere Section:

Table 10-14: 15th Percentile Elastic Moduli of Pavement Layers in LHS direction - Chitradurga – Davanagere

15th Percentile Elastic Moduli of Pavement Layers in LHS direction: Chitradurga – Davanagere						
Chainage as per CA (km)		Design Chainage (Km)		15th Percentile E Value		
From	To	From	To	Bituminous Layer	Granular Layer	Subgrade
0.000	10.000	189.000	199.000	2358.11	202.19	86.56
10.000	15.000	199.000	204.000	2513.9	214.37	86.65
15.000	209.800	204.000	211.500	2494.79	201.41	86.56
209.800	217.500	211.500	219.200	1353.92	264.96	86.56
217.500	230.300	219.200	232.000	1923.57	206.29	86.56
230.300	235.300	232.000	237.000	1949.98	300.89	86.47
235.300	238.800	237.000	240.500	1984.9	279.68	86.47
238.800	242.300	240.500	244.000	2008.37	259.21	86.56
242.300	246.300	244.000	248.000	2043.87	294.15	86.56
246.300	255.300	248.000	257.000	2161.56	187.68	86.62
255.300	260.000	257.000	261.700	2481.36	218.04	86.56

Table 10-15: 15th Percentile Elastic Moduli of Pavement Layers in RHS direction - Chitradurga – Davanagere

15th Percentile Elastic Moduli of Pavement Layers in RHS direction: Chitradurga – Davangere						
Chainage as per CA (km)		Design Chainage (km)		15th Percentile E Value		
From	To	From	To	Bituminous Layer	Granular Layer	Subgrade
0.000	6.000	189.000	195.000	1937.14	116.21	86.59
6.000	10.000	195.000	199.000	1395.02	134.78	86.56
10.000	17.000	199.000	206.000	2159.73	251.92	86.56
17.000	208.300	206.000	210.000	1436.55	86.49	86.47
208.300	218.300	210.000	220.000	1806.94	141.67	86.64
218.300	231.300	220.000	233.000	1651.33	143.28	86.56
231.300	245.300	233.000	247.000	1856.22	139.97	86.65
245.300	254.400	247.000	256.100	1815.11	192.5	86.65
254.400	260.000	256.100	261.700	1849.43	323.05	86.56

Davanagere – Haveri Section:

Table 10-16: 15th Percentile Elastic Moduli of Pavement Layers in LHS direction - Davanagere – Haveri

15th Percentile Elastic Moduli of Pavement Layers in LHS direction: Davanagere – Haveri						
Chainage as per CA (Km)		Design Chainage (Km)		15th Percentile E Value		
From	To	From	To	Bituminous Layer	Granular Layer	Subgrade
260.000	264.800	261.700	267.000	2489.21	276.99	86.56
264.800	269.800	267.000	272.000	2873.53	259.24	86.56

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15th Percentile Elastic Moduli of Pavement Layers in LHS direction: Davanagere – Haveri						
Chainage as per CA (Km)		Design Chainage (Km)		15th Percentile E Value		
From	To	From	To	Bituminous Layer	Granular Layer	Subgrade
269.800	273.800	272.000	276.000	3000.00	378.17	86.65
273.800	279.800	276.000	282.000	1349.89	161.00	86.65
279.800	287.800	282.000	290.000	1940.36	385.62	86.56
287.800	291.800	290.000	294.000	3000.00	387.17	86.47
291.800	294.800	294.000	297.000	1989.48	389.02	86.56
294.800	298.800	297.000	301.000	1794.97	276.28	86.56
298.800	301.800	301.000	304.000	1824.24	194.43	86.56
301.800	305.800	304.000	308.000	919.79	102.28	86.56
305.800	311.800	308.000	314.000	1537.13	249.29	86.56
311.800	320.800	314.000	323.000	2385.17	385.43	86.56
320.800	325.800	323.000	328.000	2262.64	281.50	86.47
325.800	336.723	328.000	338.923	2032.48	367.32	86.56

Table 10-17: 15th Percentile Elastic Moduli of Pavement Layers in RHS direction - Davanagere – Haveri

15th Percentile Elastic Moduli of Pavement Layers in RHS direction: Davanagere – Haveri						
Chainage as per CA (Km)		Design Chainage (Km)		15th Percentile E Value		
From	To	From	To	Bituminous Layer	Granular Layer	Subgrade
260	262.5	261.700	264.200	948.62	171.36	86.65
262	264.5	264.200	266.700	1344.22	205.91	86.56
264.5	267.3	266.700	269.500	1541.02	331.79	86.62
267.3	272.8	269.500	275.000	1934.27	313.14	86.65
272.8	274.3	275.000	276.500	2034.99	378.95	86.56
274.3	280.8	276.500	283.000	1574.70	220.35	86.65
280.8	285.8	283.000	288.000	1761.53	258.33	86.56
285.8	290.8	288.000	293.000	2317.62	386.61	86.56
290.8	293.8	293.000	296.000	1521.64	366.03	86.56
293.8	299.8	296.000	302.000	2260.77	383.82	86.56
299.8	303.8	302.000	306.000	2062.34	223.39	86.56
303.8	305.8	306.000	308.000	1307.86	150.93	86.58
305.8	308.8	308.000	311.000	2034.94	339.97	86.47
308.8	316.8	311.000	319.000	1959.33	213.40	86.56
316.8	322.8	319.000	325.000	1994.04	251.85	86.47
322.8	326.8	325.000	329.000	1851.46	351.41	86.56
326.8	330.8	329.000	333.000	1854.09	303.69	86.47
330.8	336.723	333.000	338.923	1875.06	287.44	86.56

Haveri – Hubli Section

Table 10-18: 15th Percentile Elastic Moduli of Pavement Layers in LHS direction - Haveri – Hubli

15th Percentile Elastic Moduli of Pavement Layers in LHS direction: Haveri – Hubli				
Chainage (Km)		15th Percentile E Value		
From	To	Bituminous Layer	Granular Layer	Subgrade
340.000	342.000	1911.43	252.73	86.56
342.000	345.000	1507.69	251.59	86.60
345.000	347.200	1890.24	384.79	86.50
347.200	350.000	2057.95	198.48	86.65
350.000	353.300	1650.31	323.25	86.52
353.300	355.000	944.15	282.61	86.56
355.000	358.000	1673.62	367.43	86.59
358.000	361.600	988.65	299.40	86.65
361.600	363.700	1943.31	241.90	86.54
363.700	367.000	1809.02	335.91	86.63
367.000	370.000	2040.82	380.47	86.47
370.000	374.000	1166.03	342.04	86.56
374.000	377.500	920.93	185.34	86.56
377.500	380.000	991.76	168.56	86.56
380.000	382.000	1970.45	391.90	86.56
382.000	384.000	964.49	201.09	86.65
384.000	385.500	1176.11	222.95	86.62
385.500	390.000	1267.97	153.58	86.65
390.000	392.000	1402.76	201.80	86.65
392.000	398.700	1063.08	114.00	86.56
398.700	400.600	1185.90	181.79	86.56
400.600	403.000	2369.54	390.26	86.55

Table 10-19: 15th Percentile Elastic Moduli of Pavement Layers in RHS direction - Haveri – Hubli

15th Percentile Elastic Moduli of Pavement Layers in RHS direction: Haveri – hubli				
Chainage (Km)		15th Percentile E Value		
From	To	Bituminous Layer	Granular Layer	Subgrade
340.000	347.700	1460.66	183.42	86.64
347.700	353.300	1921.99	250.61	86.56
353.300	358.000	1599.82	172.14	86.65
358.000	363.600	1628.25	90.55	86.56
363.600	365.000	1761.19	173.72	86.61
365.000	367.300	1573.96	274.11	86.56
367.300	374.000	1549.85	88.18	85.08
374.000	380.000	1757.03	101.91	86.48
380.000	391.000	1776.77	279.88	86.56

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15th Percentile Elastic Moduli of Pavement Layers in RHS direction: Haveri – hubli				
Chainage (Km)		15th Percentile E Value		
From	To	Bituminous Layer	Granular Layer	Subgrade
391.000	399.000	1690.60	252.16	86.56
399.000	401.000	1339.24	299.54	86.65
401.000	403.000	2462.19	224.62	86.56

10.5 Remaining life estimation

The in-service three-layer pavement system has been analysed with the back-calculated corrected layer moduli and layer thicknesses. The critical strains have been calculated by IITPAVE program. From the performance criteria equations, the residual/remaining rutting and fatigue life have been estimated.

Performance Criteria

The layer moduli of in-service pavement back calculated from FWD deflection data are used to analyse the pavement for critical strains which are indicators of pavement performance in terms of rutting and fatigue cracking. The following approach is proposed for design of bituminous overlays for existing flexible pavements. The mechanistic criteria (fatigue and rutting) adopted in the Indian Roads Congress guidelines (IRC:115-2014) for design of flexible pavements forms the basis for the overlay design method. Performance models adopted in these guidelines are given below.

a) Fatigue in Bituminous layer:

As it specified in IRC:37-2012, the fatigue model for 90 percent reliability was used as below.

$$N_f = 0.711 * 10^{-04} x [1/\varepsilon_t]^{3.89} * [1/M_R]^{0.854}$$

Where,

Nf = fatigue life in cumulative standard axle load repetitions, in msa

εt = Maximum Tensile strain at the bottom of the bituminous layer.

MR= resilient modulus of the bituminous layer, in MPa

b) Rutting in Subgrade:

Rutting model for 90 percent reliability level as specified in IRC:37-2012 was used as below.

$$N= 1.41 x 10^{-08} [1/\varepsilon_v]^{4.5337}$$

Where,

N=Subgrade rutting life in cumulative standard axle load repetitions, in msa

εv= Maximum Vertical strain in the subgrade

The detailed analysis was presented direction wise in **Annexure 4-8(a), Annexure 4-8(b)**, **Annexure 4-8(c)** and the obtained remaining life are presented in **Table 10-20** and the Graphical representation is given in **Figure 10-15** and **Figure 10-16.**

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Table 10-20: Obtained remaining life of existing pavement.

Chitradurga to Davanagere Section									
LHS					RHS				
Chainage as per CA (km)		Design Chainage (km)		Remaining Life (MSA) as per 90% Reliability	Chainage as per CA (km)		Design Chainage (km)		Remaining Life (MSA) as per 90% Reliability
From	To	From	To		From	To	From	To	
0.000	10.000	189.000	199.000	9.88	0.000	6.000	189.000	195.000	7.37
10.000	15.000	199.000	204.000	11.83	6.000	10.000	195.000	199.000	5.74
15.000	209.800	204.000	211.500	8.12	10.000	17.000	199.000	206.000	29.17
209.800	217.500	211.500	219.200	8.62	17.000	208.300	206.000	210.000	2.85
217.500	230.300	219.200	232.000	6.67	208.300	218.300	210.000	220.000	7.68
230.300	235.300	232.000	237.000	11.19	218.300	231.300	220.000	233.000	11.43
235.300	238.800	237.000	240.500	8.97	231.300	245.300	233.000	247.000	7.8
238.800	242.300	240.500	244.000	8.34	245.300	254.400	247.000	256.100	11.24
242.300	246.300	244.000	248.000	13.33	254.400	260.000	256.100	261.700	30.48
246.300	255.300	248.000	257.000	5.92					
255.300	260.000	257.000	261.700	9.12					
Davanagere to Haveri Section									
Chainage as per CA (Km)		Design Chainage (Km)		Remaining Life (MSA) of LHS as per 90% Reliability	Chainage as per CA (Km)		Design Chainage (Km)		Remaining Life (MSA) of RHS as per 90% Reliability
From	To	From	To		From	To	From	To	
260.000	264.800	261.700	267.000	66.74	260.000	262.500	261.700	264.200	19.8
264.800	269.800	267.000	272.000	72.65	262.000	264.500	264.200	266.700	42.17
269.800	273.800	272.000	276.000	203.83	264.500	267.300	266.700	269.500	103.43
273.800	279.800	276.000	282.000	26.61	267.300	272.800	269.500	275.000	60.8
279.800	287.800	282.000	290.000	108.84	272.800	274.300	275.000	276.500	93.9
287.800	291.800	290.000	294.000	148.39	274.300	280.800	276.500	283.000	23.75
291.800	294.800	294.000	297.000	97.04	280.800	285.800	283.000	288.000	35.5
294.800	298.800	297.000	301.000	44.12	285.800	290.800	288.000	293.000	111.88
298.800	301.800	301.000	304.000	31.09	290.800	293.800	293.000	296.000	67.42
301.800	305.800	304.000	308.000	6.67	293.800	299.800	296.000	302.000	97.68
305.800	311.800	308.000	314.000	52.95	299.800	303.800	302.000	306.000	29.49
311.800	320.800	314.000	323.000	131.73	303.800	305.800	306.000	308.000	8.29
320.800	325.800	323.000	328.000	28.96	305.800	308.800	308.000	311.000	73.22
325.800	336.723	328.000	338.923	34.69	308.800	316.800	311.000	319.000	31.06
-	-	-	-	-	316.800	322.800	319.000	325.000	34.25
-	-	-	-	-	322.800	326.800	325.000	329.000	50.49
-	-	-	-	-	326.800	330.800	329.000	333.000	20.96
-	-	-	-	-	330.800	336.723	333.000	338.923	21.41

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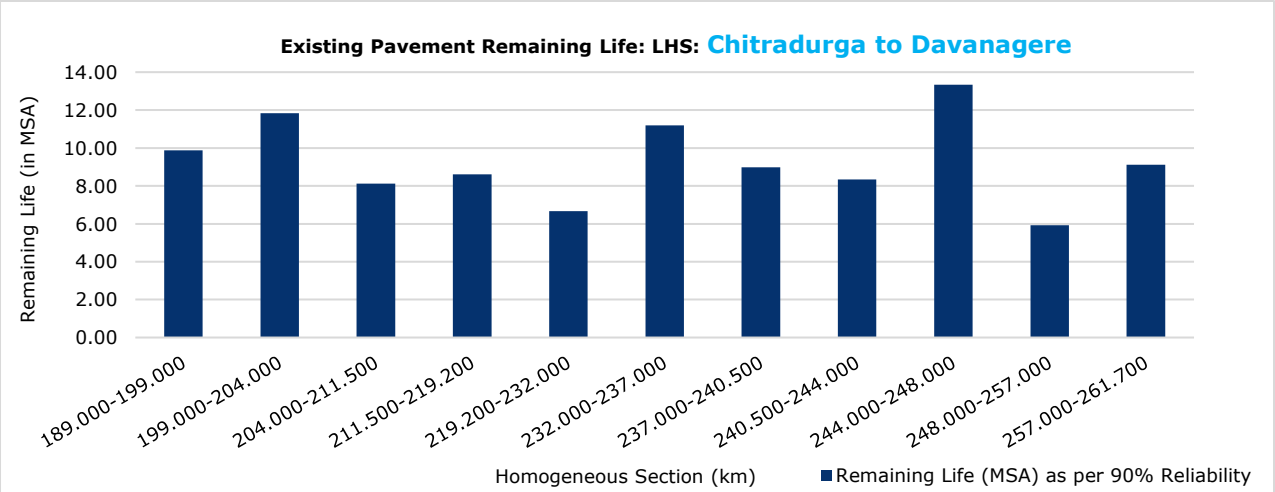
Haveri to Hubli Section					
Chainage (km)		Remaining Life (MSA) of LHS as per 90% Reliability	Chainage (km)		Remaining Life (MSA) of RHS as per 90% Reliability
From	To		From	To	
340.000	342.000	39.45	340.000	347.700	16.25
342.000	345.000	29.91	347.700	353.300	26.03
345.000	347.200	88.71	353.300	358.000	12.16
347.200	350.000	28.96	358.000	363.600	6.87
350.000	353.300	55.45	363.600	365.000	19.14
353.300	355.000	30.95	365.000	367.300	38.68
355.000	358.000	90.35	367.300	374.000	7.89
358.000	361.600	36.65	374.000	380.000	8.5
361.600	363.700	17.82	380.000	391.000	28.77
363.700	367.000	20.14	391.000	399.000	28.72
367.000	370.000	29.46	399.000	401.000	11.85
370.000	374.000	32.89	401.000	403.000	12.25
374.000	377.500	18.24	-	-	-
377.500	380.000	16.72	-	-	-
380.000	382.000	178.94	-	-	-
382.000	384.000	13.45	-	-	-
384.000	385.500	14.54	-	-	-
385.500	390.000	7.9	-	-	-
390.000	392.000	14.46	-	-	-
392.000	398.700	7.11	-	-	-
398.700	400.600	19.38	-	-	-
400.600	403.000	177.95	-	-	-



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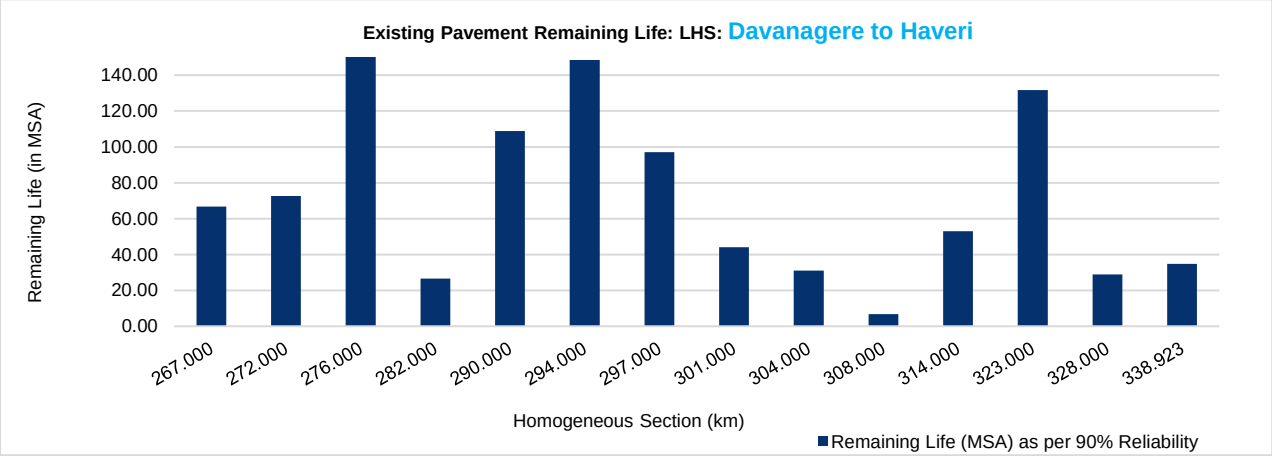


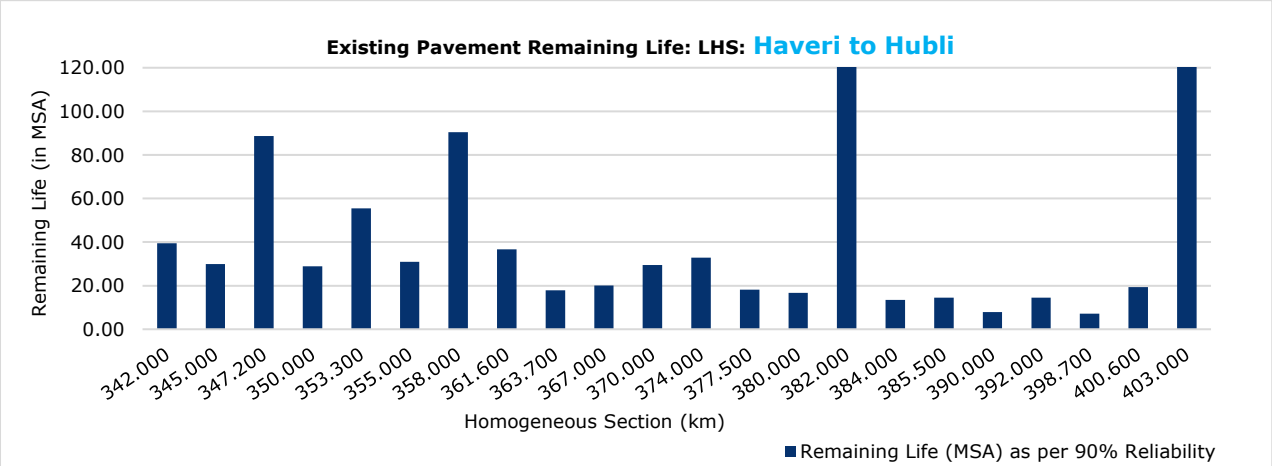
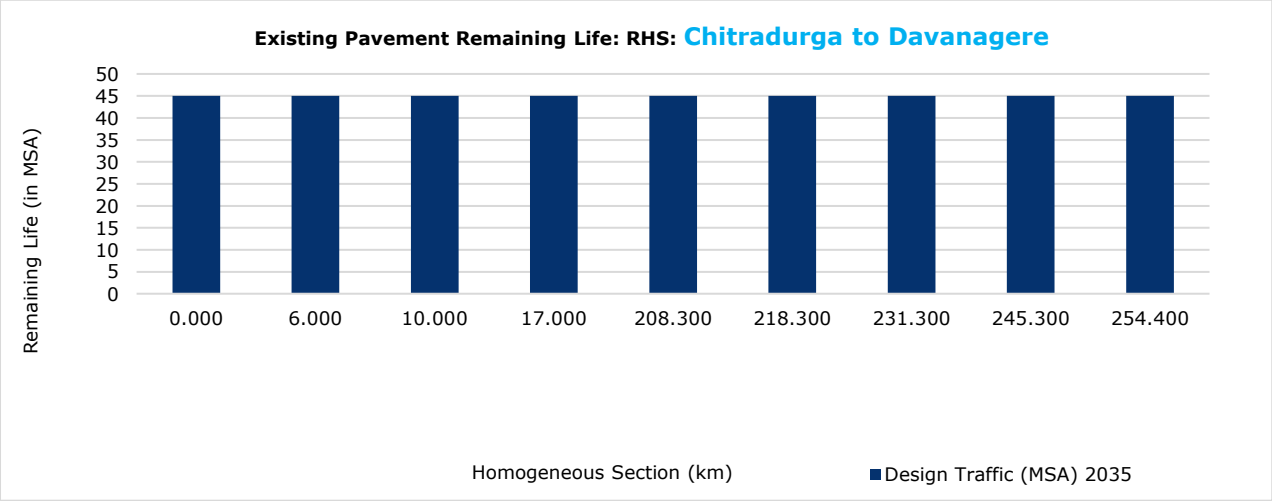


Figure 10-15: Illustrative summary of Remaining Life on LHS direction



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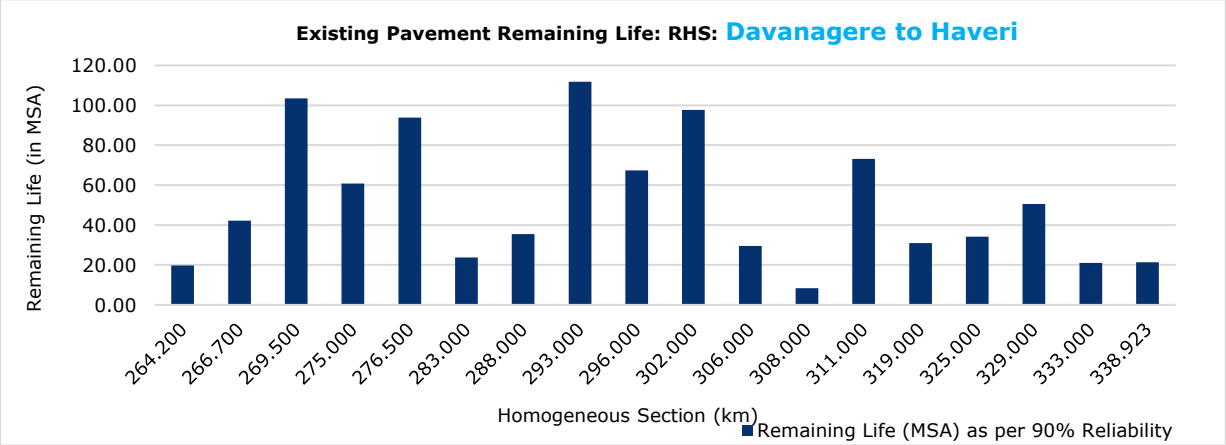

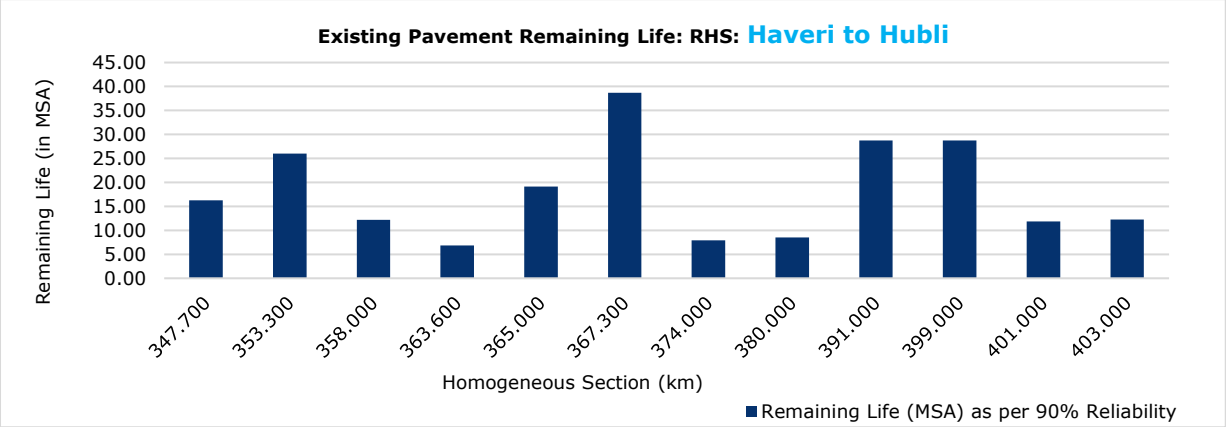

Figure 10-16: Illustrative summary of Remaining Life on RHS Direction

10.6 Traffic Survey and Analysis

Due diligence conducted a 48 hrs axle load survey at one existing toll plaza locations. AADT has been taken from the traffic/ revenue consultants & minimum 5% growth rate is considered.

10.6.1 Annual Average Daily Traffic

The Annual Average Daily Traffic (AADT) of all commercial class vehicles as provided by the traffic/ revenue consultants is as shown in **Table 10-21.**

Table 10-21: AADT of Commercial Class vehicles at Toll Plaza Locations

	Hebbalu Toll Plaza	Chalageri Toll Plaza	Bankapur Toll Plaza
Bus	1394	1374	1378
LCV	1512	1447	1509
2A	1241	1361	1495
3A	948	935	966
MAV	1644	1654	1669

10.6.2 Vehicle Damage Factor

The axle load survey was conducted at toll plaza, the spectrum of axle loads and the numbers of equivalent 8.16 t standard axles for the different categories of commercial vehicles have been determined based on the axle load surveys.

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The equations for computing equivalency factor for single, tandem and tridem axles given below is used as directed in the IRC:37-2012 for converting different axle load repetitions into equivalent standard axle load repetitions.

- Single axle with single wheel on either side = {axle load in kN / 65}^{4}
- Single axle with dual wheel on either side = {axle load in kN / 80}^{4}
- Tandem axle with single wheel on either side = {axle load in kN /148}^{4}
- Tridem axle with dual wheel on either side = {axle load in kN /224}^{4}

VDF values are obtained as per the analysis of 48hrs axle load survey are presented in **Annexure 4-9(a), Annexure 4-9(b), Annexure 4-9(c)** separately and summary presented in **Table 10-22**.

Table 10-22: Summary of Vehicle Damage Factor

Vehicle Type	Hebbalu Toll Plaza		Chalageri Toll Plaza		Bankapur Toll Plaza	
	Towards Davanagere	Towards Chitradurga	Towards Haveri	Towards Davanagere	Towards Hubli	Towards Haveri
BUS	0.874	1.074	0.98	1.109	0.891	1.148
LCV	0.676	0.741	0.66	0.703	0.707	0.691
2-Axle	3.658	3.861	3.22	3.599	3.174	3.383
3-Axle	5.781	5.972	5.25	6.249	5.142	5.67
MAV	7.901	9.042	8.072	9.946	9.149	10.438

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Figure 10-17: Photographs showing Axle load Survey.

10.6.3 Design Traffic (Cumulative Number of Standard Axles)

The traffic loading in terms of the cumulative number of standard axles for the given period has been computed using the following relationship as given in IRC: 37-2018

$$N = \frac{365 \times \left\{(1+r)^n - 1\right\}}{r} \times A \times D \times F$$

Where,

N = Cumulative number of standard axles to be catered for the design life in terms of MSA.

r = Annual growth rate of commercial vehicles

n = Design life in years

A = Initial traffic in the year of completion of construction in terms of number of commercial vehicles per day exceeding 3 ton

D = Lane distribution factor

F = Vehicle Damage Factor

Based on the preceding discussions, the traffic loading in terms of cumulative number of equivalent 8.16 t standard axle loads have been computed up to 2035. Design traffic for flexible pavement design is computed and summarized in **Table 10-24**. The design MSA calculations are furnished in **Annexure 4-10(a), Annexure 4-10(b), Annexure 4-10(c)**.

For the present traffic study, a minimum growth rate of 5% is considered, and the design traffic was projected till the end of FY 2035 which is presented below.

Table 10-23: Minimum 5% Growth rates considered for Design Traffic Computations

Traffic Growth Rates					
FY End	**Bus**	**LCV**	**2-Axle**	**3-Axle**	**MAV**
2025	5.0%	5.0%	5.0%	5.0%	6.6%
2026	5.0%	5.0%	5.0%	5.0%	7.0%
2027	5.0%	5.0%	5.0%	5.0%	6.8%
2028	5.0%	5.0%	5.0%	5.0%	6.7%
2029	5.0%	5.0%	5.0%	5.0%	6.4%
2030	5.0%	5.0%	5.0%	5.0%	6.0%
2031	5.0%	5.0%	5.0%	5.0%	5.4%
2032	5.0%	5.0%	5.0%	5.0%	5.4%
2033	5.0%	5.0%	5.0%	5.0%	5.4%
2034	5.0%	5.0%	5.0%	5.0%	5.3%
2035	5.0%	5.0%	5.0%	5.0%	5.3%
2036	5.0%	5.0%	5.0%	5.0%	5.0%
2037	5.0%	5.0%	5.0%	5.0%	5.0%
2038	5.0%	5.0%	5.0%	5.0%	5.0%
2039	5.0%	5.0%	5.0%	5.0%	5.0%
2040	5.0%	5.0%	5.0%	5.0%	5.0%
2041	5.0%	5.0%	5.0%	5.0%	5.0%
2042	5.0%	5.0%	5.0%	5.0%	5.0%
2043	5.0%	5.0%	5.0%	5.0%	5.0%
2044	5.0%	5.0%	5.0%	5.0%	5.0%

Table 10-24: Design Traffic in Terms of ESAL

Section		**Direction**	**Side**	**Design Traffic (MSA) as per Min 5% GR (2035)**
Package- I	Chitradurga to Davanagere	Chitradurga to Davanagere	LHS	41.04
		Davanagere to Chitradurga	RHS	45.23
Package- II	Davanagere to Haveri	Davanagere to Haveri	LHS	40.38
		Haveri to Davanagere	RHS	48.34
Package- III	Haveri to Hubli	Haveri to Hubli	LHS	44.65
		Hubli to Haveri	RHS	49.76

10.7 Required Overlay Calculation as per FWD Analysis

It is planned to design the overlay till FY. 2035. From the obtained remaining life, it is understood that the existing pavement is not having required design life computed as mentioned in the above in **Table 10-24**.

The required additional thicknesses are calculated to bring the existing pavement to meet the design projected traffic. The detailed calculated required direction wise thicknesses for LHS & RHS directions are presented in **Annexure 4-8(a), Annexure 4-8(b)**, **Annexure 4-8(c)**. The summary of the required overlay is presented in **Table 10-25** and **Table 10-26**.

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Table 10-25: Required overlay as per FWD in LHS Direction for FY-2035

Chitradurga to Davanagere

Chainage as per CA (Km)		Design Chainage (Km)		Length (Km)	Required Overlay thicknesses for FY 2035	
From	To	From	To		BC (mm)	DBM (mm)
0.000	10.000	189.000	199.000	10.000	30	50
10.000	15.000	199.000	204.000	5.000	50	-
15.000	209.800	204.000	211.500	7.500	30	50
209.800	217.500	211.500	219.200	7.700	30	50
217.500	230.300	219.200	232.000	12.800	30	50
230.300	235.300	232.000	237.000	5.000	50	-
235.300	238.800	237.000	240.500	3.500	30	50
238.800	242.300	240.500	244.000	3.500	30	50
242.300	246.300	244.000	248.000	4.000	50	-
246.300	255.300	248.000	257.000	9.000	30	50
255.300	260.000	257.000	261.700	4.700	30	50
Length(km) of Overlay with 30mm BC					-	
Length(km) of Overlay with 40mm BC					-	
Length(km) of Overlay with 50mm BC					14.000	
Length(km) of Overlay with 30mm BC + 50mm DBM					58.700	
Length(km) of Overlay with 30mm BC + 60mm DBM					-	

Davanagere to Haveri

Chainage as per CA (Km)		Design Chainage (Km)		Length (Km)	Required Overlay thicknesses for FY 2035	
From	To	From	To		BC (mm)	DBM (mm)
260.000	264.800	261.700	267.000	5.300		
264.800	269.800	267.000	272.000	5.000		
269.800	273.800	272.000	276.000	4.000		
273.800	279.800	276.000	282.000	6.000	30	-
279.800	287.800	282.000	290.000	8.000		
287.800	291.800	290.000	294.000	4.000		
291.800	294.800	294.000	297.000	3.000		
294.800	298.800	297.000	301.000	4.000		
298.800	301.800	301.000	304.000	3.000	30	-
301.800	305.800	304.000	308.000	4.000	30	50
305.800	311.800	308.000	314.000	6.000		
311.800	320.800	314.000	323.000	9.000		
320.800	325.800	323.000	328.000	5.000	30	-
325.800	336.723	328.000	338.923	10.923	30	-
Length(km) of Overlay with 30mm BC					24.923	

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Chainage as per CA (Km)		Design Chainage (Km)		Length (Km)	Required Overlay thicknesses for FY 2035	
From	To	From	To		BC (mm)	DBM (mm)
Length(km) of Overlay with 30mm BC + 50mm DBM					4.000	

Haveri to Hubli

Chainage as per CA (Km)		Design Chainage (Km)		Length (Km)	Required Overlay thicknesses for FY 2035	
From	To	From	To		BC (mm)	DBM (mm)
340.000	342.000	340.000	342.000	2.00	30	-
342.000	345.000	342.000	345.000	3.00	30	-
345.000	347.200	345.000	347.200	2.20		
347.200	350.000	347.200	350.000	2.80	30	-
350.000	353.300	350.000	353.300	3.30		
353.300	355.000	353.300	355.000	1.70	30	-
355.000	358.000	355.000	358.000	3.00		
358.000	361.600	358.000	361.600	3.60	30	-
361.600	363.700	361.600	363.700	2.10	40	-
363.700	367.000	363.700	367.000	3.30	30	-
367.000	370.000	367.000	370.000	3.00	30	-
370.000	374.000	370.000	374.000	4.00	30	-
374.000	377.500	374.000	377.500	3.50	40	-
377.500	380.000	377.500	380.000	2.50	40	-
380.000	382.000	380.000	382.000	2.00		
382.000	384.000	382.000	384.000	2.00	50	-
384.000	385.500	384.000	385.500	1.50	50	-
385.500	390.000	385.500	390.000	4.50	30	50
390.000	392.000	390.000	392.000	2.00	50	-
392.000	398.700	392.000	398.700	6.70	30	50
398.700	400.600	398.700	400.600	1.90	40	-
400.600	403.000	400.600	403.000	2.40		
Length(km) of Overlay with 30mm BC					23.400	
Length(km) of Overlay with 40mm BC					10.000	
Length(km) of Overlay with 50mm BC					5.500	
Length(km) of Overlay with 30mm BC+50mm DBM					11.200	

Table 10-26: Required overlay as per FWD in RHS Direction for FY-2035

Chitradurga to Davanagere

Chainage as per CA (Km)		Design Chainage (Km)		Length (Km)	Required Overlay thicknesses for FY 2035	
From	To	From	To		BC (mm)	DBM (mm)
189.000	195.000	0.000	6.000	6.000	30	50
195.000	199.000	6.000	10.000	4.000	30	50

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Chainage as per CA (Km)		Design Chainage (Km)		Length (Km)	Required Overlay thicknesses for FY 2035	
From	To	From	To		BC (mm)	DBM (mm)
199.000	206.000	10.000	17.000	7.000	30	-
206.000	210.000	17.000	208.300	4.000	50	60
210.000	220.000	208.300	218.300	10.000	30	50
220.000	233.000	218.300	231.300	13.000	50	-
233.000	247.000	231.300	245.300	14.000	30	50
247.000	256.100	245.300	254.400	9.100	30	50
256.100	261.700	254.400	260.000	5.600	30	-
Length(km) of Overlay with 30mm BC					12.600	
Length(km) of Overlay with 40mm BC					-	
Length(km) of Overlay with 50mm BC					13.000	
Length(km) of Overlay with 30mm BC + 50mm DBM					43.100	
Length(km) of Overlay with 30mm BC + 60mm DBM					4.000	

Davanagere to Haveri

Chainage as per CA (Km)		Design Chainage (Km)		Length (Km)	Required Overlay thicknesses for FY 2035	
From	To	From	To		BC (mm)	DBM (mm)
260.000	262.500	261.700	264.200	2.500	30	-
262.000	264.500	264.200	266.700	2.500	30	-
264.500	267.300	266.700	269.500	2.800		
267.300	272.800	269.500	275.000	5.500		
272.800	274.300	275.000	276.500	1.500		
274.300	280.800	276.500	283.000	6.500	30	-
280.800	285.800	283.000	288.000	5.000	30	-
285.800	290.800	288.000	293.000	5.000		
290.800	293.800	293.000	296.000	3.000		
293.800	299.800	296.000	302.000	6.000		
299.800	303.800	302.000	306.000	4.000	30	-
303.800	305.800	306.000	308.000	2.000	30	50
305.800	308.800	308.000	311.000	3.000		
308.800	316.800	311.000	319.000	8.000	30	-
316.800	322.800	319.000	325.000	6.000	30	-
322.800	326.800	325.000	329.000	4.000		
326.800	330.800	329.000	333.000	4.000	30	-
330.800	336.723	333.000	338.923	5.923	40	-
Length(km) of Overlay with 30mm BC					38.500	
Length(km) of Overlay with 40mm BC					5.923	
Length(km) of Overlay with 30mm BC + 50mm DBM					2.000	

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Haveri to Hubli

Chainage as per CA (Km)		Design Chainage (Km)		Length (Km)	Required Overlay thicknesses for FY 2035	
From	To	From	To		BC (mm)	DBM (mm)
340.000	347.700	340.000	347.700	7.70	50	-
347.700	353.300	347.700	353.300	5.60	30	-
353.300	358.000	353.300	358.000	4.70	30	50
358.000	363.600	358.000	363.600	5.60	30	50
363.600	365.000	363.600	365.000	1.40	40	-
365.000	367.300	365.000	367.300	2.30	30	-
367.300	374.000	367.300	374.000	6.70	30	50
374.000	380.000	374.000	380.000	6.00	30	50
380.000	391.000	380.000	391.000	11.00	30	-
391.000	399.000	391.000	399.000	8.00	30	-
399.000	401.000	399.000	401.000	2.00	50	-
401.000	403.000	401.000	403.000	2.00	30	50
Length(km) of Overlay with 30mm BC					26.900	
Length(km) of Overlay with 40mm BC					1.400	
Length(km) of Overlay with 50mm BC					9.700	
Length(km) of Overlay with 30mm BC+50mm DBM					25.000	

Observations

- Overlay calculation is carried out with VG-40/ PMB grade bitumen consider E value of 3000MPa.
- Remaining life and required overlay are calculated as per 90% reliability.
- A minimum overlay of 30mm BC is required in most of the project stretch to meet the requirements till the end of design life of the pavement layers.
- As per the overlay design in the **LHS** direction the pavement section can sustain the traffic without any overlay for a length of 48.3Km in Davanagere to Haveri and 12.9Km on the Haveri to Hubli. However, on the Chitradurga to Davanagere all through project stretch 30/50mm wearing course along with few locations with 50mm DBM requirement.
- On the other hand, as per the overlay design in the **RHS** direction the pavement section can sustain the traffic without any overlay for a length of 30.8Km only in Davanagere to Haveri. However, on the Chitradurga to Davanagere and Haveri to Hubli all through project stretch a minimum wearing course of 30-50mm must be laid along with few locations with DBM requirement ranging between 50-60mm.

11. DEVELOPMENT OF O&M STRATEGY

11.1 General

The Concessionaire is responsible for Operation & Maintenance of the Project Highway in accordance with the provisions of the Concession Agreement.

11.2 Review of Concession Agreement: Schedule-B/ Schedule-D

Schedule-B of Concession Agreement is a mandatory requirement.

prior to any formulation of design to be applied to the project during the execution. Present section deals with the Concession Agreement Stipulations pertaining to pavement design.

In Schedule-B & D, the following points are specified for pavement design.

a. **Type of Pavement:** Not Specified
b. **Design Traffic (MSA):** Not Specified
c. **Design CBR:** Minimum CBR is not specified.
d. **Minimum Crust Thickness:** Not specified crust thickness for flexible pavement and for rigid pavement.
e. **Specifications and Standards for the project:** The Project Highway shall be constructed in conformity with the Specifications and Standards specified in Annex-I for Six laning of highway of Schedule – D.

Schedule -D confirms that "The Concessionaire shall comply with the Specifications and Standards set further in Annex-I of this Schedule-D for construction of the Six-Lane Project Highway."

Annexure-I of Schedule-D confirms to use "Manual of Specifications and Standards for Six Laning of National Highways through Public Private Partnership" (IRC: SP:87-2013) published in IRC.

The requirements of maintenance are to be followed as specified in Schedule-K.

11.3 Maintenance Requirements

The concessionaire shall always maintain that during the Operation Period, the Project Highway conforms to the maintenance requirements set forth in Schedule K (the "Maintenance Requirements" of HAM Concession Agreement) and in Schedule F (the "Maintenance Requirements" of TOT Concession Agreement)

C. *Schedule K of the HAM CA*
D. *Schedule F of the TOT CA*

Both are represented in **Table 11-1**

Repair/ Rectification of Defects and deficiencies specified in Schedule K within time limit set forth hereunder.

Table 11-1: Maintenance requirements with timelines

A: Schedule K of the HAM CA		
S. No.	**Nature of Defect/ Deficiency**	**Timelines for Repair/ Rectification**
Project Highway		
(a)	**Carriageway and paved shoulders**	

A: Schedule K of the HAM CA

S. No.	Nature of Defect/ Deficiency	Timelines for Repair/ Rectification
(i)	Breach or blockade	Time Limit: Temporary restoration of traffic within 24 hours; permanent restoration within 15 (fifteen) days.
(ii)	Roughness value Exceeding 2,750 mm in a stretch of 1 km (as measured by a calibrated bump integrator)	Time Limit: 180 (One Hundred and Eighty) days
(iii)	Potholes	Time Limit: 48 hours
(iv)	Cracking in more than 5% of road surface in a stretch of 1 Km	Time Limit: 30 days
(v)	Rutting exceeding 10mm in more than 2% of the road surface in a stretch of 1 km	Time Limit: 30 days
(vi)	Bleeding / Skidding	Time Limit: 7 (Seven) days
(vii)	Ravelling / Stripping of Road surface exceeding 10 sq.m road	Time Limit: 15 (Fifteen) days.
(viii)	Damages to Pavement edges exceeding 10 cm	Time Limit: 15 (Fifteen) days.
(ix)	Removal of debris	Time Limit: 6 hours
(b)	**Hard / earth shoulders, side slopes, drains and culverts.**	
(i)	Variation by more than 2% in the prescribed slope of camber / cross fall	Time Limit: 30 (Thirty) days.
(ii)	Edge drop at shoulders exceeding 40 mm	Time Limit: 7 (Seven) days
(iii)	Variation by more than 15% in the prescribed side (embankment) slopes	Time Limit: 30 (Thirty) days
(iv)	Rain cuts / gullies in slope	Time Limit: 7 (Seven) days
(v)	Damage to or silting of culverts and side drains during and immediately preceding the rainy season	Time Limit: 7 (Seven) days
(vi)	Desilting of drains in urban / semi-urban areas	Time Limit: 48 hours
(C)	**Roadside furniture including road signs and pavement marking**	
(i)	Damage to shape or position, poor visibility or loss of retro-reflectivity	Time Limit: 48 hours
(d)	**Street lighting and telecom (ATMS)**	
(i)	Any major failure of the system	Time Limit: 24 hours
(ii)	Faults and minor failures	Time Limit: 8 hours
(e)	**Trees and plantation**	
(i)	Obstruction in a minimum headroom of 5 m above carriageway or obstruction in visibility of road signs	Time Limit: 24 hours

A: Schedule K of the HAM CA

S. No.	Nature of Defect/ Deficiency	Timelines for Repair/ Rectification
(ii)	Deterioration in health of trees and bushes	Time Limit: Timely watering and treatment
(iii)	Trees and bushes requiring replacement	Time Limit: 90 days
(iv)	Removal of vegetation affecting sight line and road structures	Time Limit: 15 (Fifteen) days
(f)	**Rest areas**	
(i)	Cleaning of toilets	Time Limit: Every 4 hours
(ii)	Defects in electrical, water and sanitary installations	Time Limit: 24 hours
(h)	**Other Project Facilities and Approach roads**	
(i)	Damage in approach roads, pedestrian facilities, truck laybys, bus-bays, cattle crossings, (Traffic Aid Posts, Medical Aid Posts) and service road	Time Limit: 15 (Fifteen) days.
Bridges		
(a)	**Superstructure**	*Cracks* Temporary measures Time Limit: Within 48 Hours Permanent measures Time Limit: Within 45 days *Spalling / Scaling* Time Limit: Within 15 days
(b)	**Foundations**	Scouring and/or cavitation Time Limit: 15 (Fifteen) days
(c)	**Piers, abutments, return walls and wing walls**	*Cracks and damages including settlement and tilting.* Time Limit: 30 (Thirty) days
(d)	**Bearings (metallic) of bridges**	*Deformation* Time Limit: 15 (Fifteen) days;
(e)	**Joints in bridges**	*Loosening and malfunctioning of joints* Time Limit: 15 (Fifteen) days
(f)	**Other items relating to Bridges**	
(i)	Deforming of pads in elastomeric bearings	Time Limit: 7 (Seven) days
(ii)	Gathering of dirt in bearings and joints; or clogging of spouts, weep holes and vent-holes	Time Limit: 3 (Three) days
(iii)	Damage or deterioration in kerbs, parapets, handrails and crash barriers	Time Limit: 3 (Three) days.
(iv)	Rain-cuts or erosion of banks of the side slopes of	Time Limit: 15 (Fifteen) days

A: Schedule K of the HAM CA

S. No.	Nature of Defect/ Deficiency	Timelines for Repair/ Rectification
	approaches	
(v)	Damage to wearing coat	Time Limit: 15 (Fifteen) days
(vi)	Damage or deterioration in approach slabs, pitching, apron, toes, floor or guide bunds	Time Limit: 30 (Thirty) days.
(vii)	Growth of vegetation affecting the structure or obstructing the waterway	Time Limit: 15 (Fifteen) days

B: Schedule F of the TOT CA

Asset Type	Performance Parameter	Level of Service (LOS)		Frequency of Inspection	Tools/ Equipment	Standards and References for Inspection and Data Analysis	Time limit for Rectification / Repair	Maintenance specifications
		Desirable	Acceptable					
Flexible Pavement – Routine Inspection (Pavement of MCW, Service Road, Approach of Grade structures, approaches of connecting roads, slip roads, lay byes etc. as applicable)	Potholes	Nil	<0.1% of area and subjected to limit of 10mm in depth	Daily	Length Measurement Unit like Scale, Tape, odometer etc.	IRC 82: 2015 and Distress Identification Manual for Long Term Pavement Performance Program, FHWA 2003	24-48 hours	MORT&H Specification 3004.2
	Cracking	Nil	<5% subject to limit of 0.5 sqm for any 50m length	Daily			7-15 days	MORT&H Specification 3004.3
	Rutting	Nil	<5mm	Daily	Straight Edge		15 -30 days	MORT&H Specification 3004.2
	Corrugations and shoving	Nil	0.1% of area	Daily	Length Measurement Unit like Scale, Tape, odometer etc.		2-7 days	IRC:82-2015
	Bleeding	Nil	<1% of area	Daily			3-7 days	MORT&H Specification 3004.4
	Ravelling/ Stripping	Nil	<1% of area	Daily	Length Measurement Unit like Scale, Tape, odometer etc.		7-15 days	IRC:82-2015 read with IRC SP-81
	Edge Deformation / Breaking	Nil	<1m for any 100m section and/or width <0.1m at any Location restricted to 30cm from the edge.	Daily			7-15 days	IRC:82-2015
Flexible Pavement – Programmed Inspection	Roughness BI	2000 mm/km	2400 mm/km	Bi- Annually	Network Survey vehicle (NSV) with all its module such as Laser Profilometers, Transverse profile logger, Laser crack measurement system, Video logging modules, high resolution Odometer etc.	ASTM E950 (98):2004 –Standard Test Method for measuring Longitudinal Profile of Travelled Surfaces with Accelerometer Established Inertial Profiling Reference and ASTM E1656 - 94:2000- Standard Guide for Classification of Automatic Pavement Condition Survey Equipment	180 days	IRC:82-2015

B: Schedule F of the TOT CA

Asset Type	Performance Parameter	Level of Service (LOS)		Frequency of Inspection	Tools/ Equipment	Standards and References for Inspection and Data Analysis	Time limit for Rectification / Repair	Maintenance specifications
		Desirable	Acceptable					
	Rutting	<10mm for any 50 m section and/or, length of section <5m	<10mm for any 50 m section and/or, length of section <10m	Bi- Annually			15-30 days	IRC:82-2015
	Pavement rating based on distress per IRC 82 / Pavement Condition Index as per ASTM 6433-07	>3/85	>2.1/70	Bi- Annually			180 days	IRC:82-2015/ ASTM D 6433-07
	Other Pavement Distresses	-	-	Bi- Annually			2-7 days	IRC:82-2015
	Skid	60SN	50SN	Bi- Annually	SCRIM (Sideway force Coefficient Routine Investigation Machine or equivalent) British Pendulum Tester	IRC:82-2015	180 days	BS:7941- 1:2006, IRC:82-2015/ ASTM 274
	Deflection/ Remaining Life		-	Annually	Falling Weight Deflectometer	IRC 115: 2014	180 days	IRC:115-2014
Rigid Pavement (Pavement of MCW, Service Road, Grade separated structure, approaches of connecting roads, slip roads, lay byes etc. as applicable.	Roughness BI	<2200mm/km	<2400mm/km	Bi- Annually	Class I Profilometer Mounted on NSV	ASTM E950 (98): 2004 and ASTM E1656 -94: 2000	180 days	IRC: SP:83- 2018
	Skid	Skid Resistance No. at different speed of vehicles Minimum SN / Traffic Speed 36 / 50 33 / 65 32 / 80 31 / 95 31 / 100		Bi- Annually	SCRIM (Sideway force Coefficient Routine Investigation Machine or equivalent) British. Pendulum Tester	IRC: SP:83- 2018	180 days	IRC: SP:83- 2018

B: Schedule F of the TOT CA								
Asset Type	**Performance Parameter**	**Level of Service (LOS)**		**Frequency of Inspection**	**Tools/ Equipment**	**Standards and References for Inspection and Data Analysis**	**Time limit for Rectification / Repair**	**Maintenance specifications**
		Desirable	**Acceptable**					
Embankment / Slope	Edge drops at shoulders	Nil	40mm	Daily	Length Measurement Unit like Scale, Tape, odometer etc.	IRC	7-15 days	MORT&H Specification
	Slope of camber/cross fall	Nil	<2% variation in prescribed slope of camber /cross fall	Daily			7-15 days	MORT&H Specification
	Embankment Slopes	Nil	<15 % variation in prescribe side slope	Daily			7-15 days	MORT&H Specification
	Embankment Protection	Nil	Nil	Daily	NA		7-15 days	MORT&H Specification
	Rain Cuts/Gullies in slope	Nil	Nil	Daily Specially During Rainy Season	NA	IRC	7-15 days	MORT&H Specification
Cut Section / Slope	Unstable Slopes	Nil	-		NA	IRC	2-7 days	MORT&H Specification

11.4 Repair /Rectification of defects and deficiencies

The obligations of the Concessionaire in respect of Maintenance Requirements shall include repair and rectification of the defects and deficiencies specified in Schedule – K & F within the time limit set forth therein.

Other defects and deficiencies

In respect of any defect or deficiency not specified in Schedule, the Concessionaire shall undertake repair or rectification in accordance with Good Industry Practice.

In respect of any defect or deficiency not specified in Schedule, the Independent Engineer may, in conformity with Good Industry Practice, specify the permissible limit of deviation or deterioration with reference to the Specifications and Standards., and any deviation or deterioration beyond the permissible limit shall be repaired or rectified by the Concessionaire within the time limit specified by the Independent Engineer.

Observations on HAM Schedule B/D/K & TOT Schedule F

1. Minimum CBR value was not specified in the Schedules. Hence, concessionaire has an opportunity to explore good borrow areas and utilize the soils with good CBR value.
2. Minimum design traffic for main carriageway (flexible & rigid pavement) was not mentioned in schedule B. Concessionaire needs to assess the traffic and design the pavement.
3. Minimum crust thickness (flexible pavement) was not mentioned in the Schedules and hence, Concessionaire shall design pavement as per the project requirements.
4. Schedule -D has specified that the design standards of the project shall be in accordance with 'Manual of Specifications and Standards for Six Laning of National Highways through Public Private Partnership' (IRC: SP:87-2014).
5. In Schedule -K, it has specified the intervention of concessionaire when the roughness value exceeds 2,750 mm/km in a stretch of 1 km (as measured by a standard rough meter/bump integrator). However, the frequency/ interval of testing the roughness was not specified.
6. In Schedule -F, it has specified the intervention of concessionaire when the roughness value exceeds 2,400 mm/km in a stretch of 1 km (as measured by equipment – Network Survey Vehicle). The frequency/ interval of testing the roughness is 180 days.

11.5 Review of Pavement Design Report Document

Pavement Design Report (PDR) of 'Six Laning of Chitradurga - Hubli from Km. 189+000 to Km. 403+000 of NH-48 (Old NH-4) in the state of Karnataka under NHDP Phase–V on HAM Mode' describes the basis and design for pavement for main road. The existing road is with flexible pavement and cement concrete pavement for toll plaza section.

11.6.1 Design Life of Pavements

As per PDR,

Chitradurga – Davanagere Section

1. Thickness of subbase and base course shall be designed for 15 years
2. Initial bituminous surface shall be designed for period of 10 years.
3. Rigid pavement shall be designed for period of 30 years.

Davanagere – Haveri & Haveri – Hubli Sections

The design period of flexible pavement is considered as 15 years and for rigid pavement is 30 years.

11.6.2 Annual Average Daily Traffic (AADT)

As per the pavement design reports, the concessionaire has conducted traffic survey at specified locations in all three sections of the project road for 24 hours in base year of 2017, the base year traffic is presented in **Table 11-2**.

Table 11-2: Summary of traffic count

Mode of Vehicle	Chitradurga to Davanagere		Davanagere to Haveri		Haveri to Hubli
	Km. 237.650	Km. 172.770	HS I (Km 260.000 to Km 298.000)	HS-II (Km 298.000 to Km 338.923)	Km 352+500 (Existing Toll Plaza)
	7 days	3 days			
Car	5242	6419	-	-	4,165
Minibus	104	150	171	167	-
School Bus	22	22	-	-	-
Standard Bus	1097	1290	1246	1164	954
Multi Axle Bus	155	153	-	-	-
LMV	588	719	-	-	-
LCV (4 Wheels)	86	142	74	80	1,982
LCV (6 Wheels)	1459	1963	1779	1819	
2 Axle	811	1372	932	1207	1,486
3 Axle	1270	2550	1345	1402	1,360
MAV (4 to 6 Axles)	1050	2877	1219	1254	1,031
MAV (>6 Axles)	2	3	5	5	-
Total tollable Vehicles	11886	17660	6771	7098	13,452

11.6.3 Design Sub-grade CBR

As per the pavement design report,

Chitradurga – Davanagere Section

15% effective CBR from Km 0.000 to Km 20.800 and 10.48% from km 208.100 to km. 260.000 have been considered for new pavement design.

Davanagere – Haveri Section

8% effective CBR has been considered for new pavement and Service Road.

Haveri – Hubli Section

13% effective CBR has been considered for both MCW & SR and for approaches 15%.

11.6.4 Vehicle Damage Factor

The design considered VDF values are provided by Concessionaire in direction wise are presented in **Table 11-3**.

Table 11-3: VDF values

Section	Axle Load Survey Location	Direction	BUS	LCV	2-Axle	3-Axle	MAV
Chitradurga to Davanagere	Section-I (172+770)	Bypass to Davanagere	0.59	0.19	1.26	2.15	2.55
		Davanagere to Bypass	0.66	0.55	1.47	3.21	4.92
	Section-II, III (237+650)	Bypass to Davanagere	0.92	0.39	1.18	2.98	4.26
		Davanagere to Bypass	1.12	1.10	2.48	4.79	5.59
Davanagere to Haveri	286+000	Davanagere to Haveri	1.00	0.38	2.57	3.80	5.82
		Haveri to Davanagere	1.00	0.44	1.72	3.84	6.18
	313+000	Davanagere to Haveri	1.00	0.85	1.58	3.10	4.69
		Haveri to Davanagere	1.00	0.41	1.36	2.50	4.78
Haveri to Hubli	Km 356.500	Haveri to Hubli	0.70	0.60	1.50	2.60	3.40
		Hubli to Haveri	0.40	0.40	1.40	1.50	3.00
	Km 384.550	Haveri to Hubli	0.70	0.40	1.30	1.80	3.30
		Hubli to Haveri	0.40	0.40	1.70	3.50	3.80

11.6. 5 Growth Rates

Growth rate values are provided by Concessionaire is presented in **Table 11-4.**

Table 11-4: Traffic Growth Rates Considered in given Design Report (From MSA calculations)

Chitradurga - Davanagere Section					
Year	**Growth Rates (%)**				
	LCV	Bus	2 Axle	3 Axle	MAV
FY 2018-19	6.76%	12.34%	5.00%	5.00%	8.72%
FY 2020-21	6.71%	12.13%	5.00%	5.00%	8.79%
FY 2022-24	6.49%	11.69%	5.00%	5.00%	8.57%
FY 2025-29	6.19%	11.17%	5.00%	5.00%	7.88%
FY 2030-34	5.62%	10.14%	5.00%	5.00%	6.73%
FY 2035-40	5.00%	8.65%	5.00%	5.00%	5.98%
Davanagere - Haveri Section					
Homogenous Section-I (Km 260+000 to Km 298+000)					
2015-2019	5.00%	11.00%	5.00%	5.00%	5.00%
2020-2024	5.00%	10.30%	5.00%	5.00%	5.00%

2025-2029	5.00%	9.70%	5.00%	5.00%	5.00%
2030-2034	5.00%	9.10%	5.00%	5.00%	5.00%
Homogenous Section-II (Km 298+000 to Km 338+923)					
2015-2019	5.00%	10.60%	5.00%	5.00%	5.00%
2020-2024	5.00%	10.00%	5.00%	5.00%	5.00%
2025-2029	5.00%	9.40%	5.00%	5.00%	5.00%
2030-2034	5.00%	8.80%	5.00%	5.00%	5.00%
Haveri - Hubli					
Year wise Growth rate of vehicles for Project corridor					
2017 - 2020	5.00%	8.64	8.64	8.64	8.64
2021 - 2025	5.00%	7.78	7.78	7.78	7.78
2026- 2030	5.00%	7.07	7.07	7.07	7.07
2021 - 2035	5.00%	6.46	6.46	6.46	6.46
2036 - 2040	5.00%	6.14	6.14	6.14	6.14

NOTE: In Chitradurga – Davanagere Section, *the Growth rates provided in the Table 7 of PDR does not reflect the Growth rates considered in the MSA calculations (Table 8 to 17).*

Actual Growth rate is less than 5% however, as IRC: SP:87-2013 min 5% is considered.

11.6. 6 Design Traffic (MSA)

As mentioned in Pavement Design Report, design consultants summarized the calculated design traffic for the next 10 & 15 years for BT, Base & sub base layers respectively, and the same is listed in **Table 11-5** to **Table 11-7.**

Table 11-5: Design Traffic in MSA for Pavement Design (From Table-18 in PDR) Chitradurga- Davanagere

Traffic loading	Design period	Direction	Design traffic in msa		
			Section-I (Prop. Km 0.000- Prop. km 13.825)	**Section-II (Prop. Km 13.285- Prop. km 20.800)**	**Section-III (Ex. Km 208.100-Ex. km 260.000)**
Bituminous layer	10	B-D	22.74	18.59	21.58
		D-B	51.70	30.25	35.52
Subbase/ Base layer	15	B-D	40.69	33.43	38.77
		D-B	93.21	54.67	64.31

NOTE: *The highlighted values in the above table are not matching with the MSA calculations (Table 13 of PDR). (Values obtained in the calculations are 12.32 MSA, 22.00 MSA for 10, 15 years respectively)*

Table 11-6: Design Traffic in MSA for Pavement Design of Davanagere - Haveri

Traffic Homogeneous Section	Direction	Design traffic (MSA)	Adopted for design (MSA)
10 Year Design MSA			

Traffic Homogeneous Section	Direction	Design traffic (MSA)	Adopted for design (MSA)
HS -I (km 260+000 to km 298+000)	UP **(Davanagere to Haveri)**	29	-
	Down **(Haveri to Davanagere)**	30	-
HS –II (km 298+000 to km 338+923)	UP **(Davanagere to Haveri)**	29	-
	Down **(Haveri to Davanagere)**	23	-
15 Year Design MSA			
HS -I (km 260+000 to km 298+000)	UP **(Davanagere to Haveri)**	49	49
	Down **(Haveri to Davanagere)**	52	52
HS –II (km 298+000 to km 338+923)	UP **(Davanagere to Haveri)**	52	52
	Down **(Haveri to Davanagere)**	40	40

Table 11-7: Design Traffic in MSA for Pavement Design of Haveri - Hubli

Carriageway	Design Traffic Loading for 15 years (2020-2035), Rev.R0	Design Traffic Loading for 15 years (2020-2035), Rev.R1	Average Design Traffic Loading for 15 years (2020-2035).
Towards Hubli	43	35	39
Towards Haveri	32	48	40

However, considered 40MSA in both directions of MCW.

11.6. 7 Pavement Composition for Main Carriage way

As per the Pavement Design report, pavement has been designed as per IRC: 37-2012, the crust composition for new pavement presented in report is listed below in **Table 11-8**.

Table 11-8: Crust Composition of New Pavement

Section			Design period	LHS				RHS			
				Pavement Crust thickness in mm				Pavement Crust thickness in mm			
				BC	DBM	WMM	GSB	BC	DBM	WMM	GSB
Chitradurga-Davanagere	Section-I	0+000 - 13+825	BT (10Years), Granular (15 Years)	40	50	250	200	40	100	250	200
	Section-II	13+285 - 20+800		40	50	250	200	40	70	250	200
	Section-III	20+800 - 260+000		40	50	250	200	40	100	250	200
Davanagere-Haveri	Section-I	260+000 - 298+000	15 Years	40	110	250	200	40	110	250	200
	Section-II	298+000 - 338+923		40	110	250	200	40	100	250	200
Haveri-Hubli	Section-I	340+000 - 403+000		50	85	250	400*	50	85	250	400*

**Additional GSB thickness of 200 mm (minimum) was provided to match the existing GSB and to meet corresponding FRL.*

Observations on approved pavement design report Document

The approved pavement design report for flexible pavement is designed as per IRC: 37-2012.

1. To provide scientific design thicknesses 'Mechanistic – Empirical pavement design" procedure is followed as directed in IRC: 37-2012 with IIT-Pave software.
2. For **Chitradurga to Davanagere** Section, as per clause 4.3.3 of IRC: 37- 2012, Stage construction technique is proposed. Clause 5.4.(ii-a) of Stage construction of IRC SP 87- 2013 states that the thickness of subbase and basecourse shall be designed for 15 years and initial bituminous surface shall be designed for period of 10 years.
3. For **Davanagere to Haveri & Haveri to Hubli** sections the project road is designed for a period of 15 years.

11.6 Traffic Survey and Analysis

Due diligence conducted a 48-hour axle load survey at the existing toll plaza locations. AADT is taken from the traffic/ revenue consultant & minimum 5% growth rate is considered. The design traffic was assessed till the FY 2035. All the calculations and analysis are presented in Chapter -10.

11.7. 1 Comparison of Traffic (Design Vs Actual)

The comparison between design traffic considered in design report Vs actual traffic (traffic as provided in MPR), are as under.

Chitradurga - Davanagere

1. Present VDF values of LCV and Bus on both directions are lesser than the study conducted during the design stage.
2. The projected design traffic between design report and present study is relatively more in RHS direction of HS-1 and less in HS-2, HS-3 and LHS of HS-1.
3. As TP-1 at 172.770 does not fall into the current scope of work, AADT for HS-1 is not available for assessment and comparison.

Davanagere – Haveri

1. Present VDF values of bus on both directions are slightly lesser than the study conducted during the design stage.
2. The projected design traffic MSA) up to the end of concession period (FY-2035) between design report and present study, the present study is relatively lesser directions.

Haveri – Hubli

1. Present VDF values in both directions are more than the study conducted during the design stage.
2. The projected design traffic (MSA) up to the end of concession period (FY-2035) between design report and present study, the present study is relatively more.

11.7 Immediate Repair/ Rehabilitation-Combined (Surface Distress)

Functional evaluation of pavement is carried out with NSV equipment to assess the present condition of the road, and it is found that a few distresses are observed on pavement and also at some locations roughness (BI) exceeding the limiting value (>2,750mm/km) specified in Annexure-I of Schedule-K. All appropriate technical and contractual parameters are carefully reviewed to assess and formulate the strategy of immediate repair and rehabilitation for the existing distresses and roughness which may be recommended to HAM Concessionaire to conform their maintenance requirements as stipulated in the HAM Concession Agreement. The quantities of Chitradurga – Davanagere are tabulated from **Table 11-9** to **Table 11-14,** Davanagere – Haveri from **Table 11-15** to **Table 11-20** and Haveri – Hubli from **Table 11-21** to **Table 11-26** respectively for LHS Inner , Middle & Outer lanes and RHS Inner, Middle & Outer lanes. However, the detailed roughness data and condition data is presented in Annexures of **Chapter 10**.

Table 11-9: Recommended Immediate repairing as per NSV in conformity with Schedule-K for LHS Lane-1 of Chitradurga - Davanagere

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Chitradurga to Davanagere : LHS Lane-1															
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**						
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
Quantities due to Settlements																
40mm milling & Inlay at settlement portion	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Compact the WMM layer and reconstruct the BC & DBM layer	Cu.m	0.00								0.0			0.0	0.0	0.0	0.0
Quantities due to Rutting only																
40mm Milling & Inlay	Cu.m	7000.00	0.040		0.040				7000.0						7000.0	280.0
Quantities due to Cracking excluding Rutting locations																
Crack Sealing	Sq. m	84.65														
40mm Milling & Inlay	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Quantities due to Only Ravelling																
Micro Surfacing	Sq. m	0.00														
Quantities due to Only Pothole Filling																
Fill Potholes with premix material	Cu.m	0.00			0.050										0.0	0.0
Quantities due to Roughness excluding Rutting																
40mm BC Overlay	Cu.m	2240.00			0.040										2240.0	89.6

Table 11-10: Recommended Immediate repairing as per NSV in conformity with Schedule-K and Structural Overlay for LHS Lane-2 of Chitradurga - Davanagere

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Chitradurga to Davanagere : LHS Lane-2															
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**						
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
Quantities due to Settlements																
40mm milling & Inlay at settlement portion	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Compact the WMM layer and reconstruct the BC & DBM layer	Cu.m	0.00								0.0			0.0	0.0	0.0	0.0
Quantities due to Rutting only																
40mm Milling & Inlay	Cu.m	16100.00	0.040		0.040				16100.0						16100.0	644.0
Quantities due to Cracking excluding Rutting locations																
Crack Sealing	Sq. m	85.96														
40mm Milling & Inlay	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Quantities due to Only Ravelling																
Micro Surfacing	Sq. m	0.00														
Quantities due to Only Pothole Filling																
Fill Potholes with premix material	Cu.m	0.00			0.050										0.0	0.0
Quantities due to Roughness excluding Rutting																
40mm BC Overlay	Cu.m	2240.00			0.040										2240.0	89.6

Table 11-11: Recommended Immediate repairing as per NSV in conformity with Schedule-K and Structural Overlay for LHS Lane-3 of Chitradurga - Davanagere

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Chitradurga to Davanagere: LHS Lane-3																
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**							
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
Quantities due to Settlements																
40mm milling & Inlay at settlement portion	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Compact the WMM layer and reconstruct the BC & DBM layer	Cu.m	0.00								0.0			0.0	0.0	0.0	0.0
Quantities due to Rutting only																
40mm Milling & Inlay	Cu.m	3150.00	0.040		0.040				3150.0						3150.0	126.0
Quantities due to Cracking excluding Rutting locations																
Crack Sealing	Sq. m	0.00														
40mm Milling & Inlay	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Quantities due to Only Ravelling																
Micro Surfacing	Sq. m	0.00														
Quantities due to Only Pothole Filling																
Fill Potholes with premix material	Cu.m	0.00			0.050										0.0	0.0
Quantities due to Roughness excluding Rutting																
40mm BC Overlay	Cu.m	2240.00			0.040										2240.0	89.6

Table 11-12: Recommended Immediate repairing as per NSV in conformity with Schedule-K and Structural Overlay for RHS Lane-1 of Chitradurga - Davanagere

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Chitradurga to Davanagere: RHS Lane-1															
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**						
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
Quantities due to Settlements																
40mm milling & Inlay at settlement portion	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Compact the WMM layer and reconstruct the BC & DBM layer	Cu.m	0.00								0.0			0.0	0.0	0.0	0.0
Quantities due to Rutting only																
40mm Milling & Inlay	Cu.m	6650.00	0.040		0.040				6650.0						6650.0	266.0
Quantities due to Cracking excluding Rutting locations																
Crack Sealing	Sq. m	30.92														
40mm Milling & Inlay	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Quantities due to Only Ravelling																
Micro Surfacing	Sq. m	0.00														
Quantities due to Only Pothole Filling																
Fill Potholes with premix material	Cu.m	0.00			0.050										0.0	0.0
Quantities due to Roughness excluding Rutting																
40mm BC Overlay	Cu.m	2240.00			0.040										2240.0	89.6

Table 11-13: Recommended Immediate repairing as per NSV in conformity with Schedule-K and Structural Overlay for RHS Lane-2 of Chitradurga - Davanagere

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Chitradurga to Davanagere: RHS Lane-2															
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**						
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
Quantities due to Settlements																
40mm milling & Inlay at settlement portion	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Compact the WMM layer and reconstruct the BC & DBM layer	Cu.m	0.00					Loosening & compact			0.0			0.0	0.0	0.0	0.0
Quantities due to Rutting only																
40mm Milling & Inlay	Cu.m	27300.00	0.040		0.040				27300.0						27300.0	1092.0
Quantities due to Cracking excluding Rutting locations																
Crack Sealing	Sq. m	131.64														
40mm Milling & Inlay	Cu.m	53.38	0.040		0.040				53.4						53.4	2.1
Quantities due to Only Ravelling																
Micro Surfacing	Sq. m	0.00														
Quantities due to Only Pothole Filling																
Fill Potholes with premix material	Cu.m	0.00			0.050										0.0	0.0
Quantities due to Roughness excluding Rutting																
40mm BC Overlay	Cu.m	2240.00			0.040										2240.0	89.6

Table 11-14: Recommended Immediate repairing as per NSV in conformity with Schedule-K and Structural Overlay for RHS Lane-3 of Chitradurga - Davanagere

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Chitradurga to Davanagere: RHS Lane-3															
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**						
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
Quantities due to Settlements																
40mm milling & Inlay at settlement portion	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Compact the WMM layer and reconstruct the BC & DBM layer	Cu.m	0.00					Loosening & compact			0.0			0.0	0.0	0.0	0.0
Quantities due to Rutting only																
40mm Milling & Inlay	Cu.m	4200.00	0.040		0.040				4200.0						4200.0	168.0
Quantities due to Cracking excluding Rutting locations																
Crack Sealing	Sq. m	0.00														
40mm Milling & Inlay	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Quantities due to Only Ravelling																
Micro Surfacing	Sq. m	0.00														
Quantities due to Only Pothole Filling																
Fill Potholes with premix material	Cu.m	0.00			0.050										0.0	0.0
Quantities due to Roughness excluding Rutting																
40mm BC Overlay	Cu.m	2240.00			0.040										2240.0	89.6

Table 11-15: Recommended Immediate repairing as per NSV in conformity with Schedule-K for LHS Inner Lane of Davanagere - Haveri

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Davanagere to Haveri: LHS Lane-1																
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**							
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
Quantities due to Settlements																
40mm milling & Inlay at settlement portion	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Compact the WMM layer and reconstruct the BC & DBM layer	Cu.m	0.00					Loosening & compact			0.0			0.0	0.0	0.0	0.0
Quantities due to Rutting only																
40mm Milling & Inlay	Cu.m	4550.00	0.040		0.040				4550.0						4550.0	182.0
Quantities due to Cracking excluding Rutting locations																
Crack Sealing	Sq. m	531.43														
40mm Milling & Inlay	Cu.m	494.18	0.040		0.040				494.2						494.2	19.8
Quantities due to Only Ravelling																
Micro Surfacing	Sq. m	0.00														
Quantities due to Only Pothole Filling																
Fill Potholes with premix material	Cu.m	0.00			0.050										0.0	0.0
Quantities due to Roughness excluding Rutting and Structural overlay locations																

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Davanagere to Haveri: LHS Lane-1																
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**							
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
40mm BC Overlay	Cu.m	2730.00			0.040										2730.0	109.2

Table 11-16: Recommended Immediate repairing as per NSV in conformity with Schedule-K for LHS Middle Lane of Davanagere - Haveri

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Davanagere to Haveri: LHS Lane-2																
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**							
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
Quantities due to Settlements																
40mm milling & Inlay at settlement portion	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Compact the WMM layer and reconstruct the BC & DBM layer	Cu.m	0.00					Loosening & compact			0.0			0.0	0.0	0.0	0.0
Quantities due to Rutting only																
40mm Milling & Inlay	Cu.m	7000.00	0.040		0.040				7000.0						7000.0	280.0
Quantities due to Cracking excluding Rutting locations																
Crack Sealing	Sq. m	1322.83														
40mm Milling & Inlay	Cu.m	1156.41	0.040		0.040				1156.4						1156.4	46.3
Quantities due to Only Ravelling																

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Davanagere to Haveri: LHS Lane-2																
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**							
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
Micro Surfacing	Sq. m	0.00														
Quantities due to Only Pothole Filling																
Fill Potholes with premix material	Cu.m	0.99			0.050										1.0	0.0
Quantities due to Roughness excluding Rutting and Structural overlay locations																
40mm BC Overlay	Cu.m	2730.00			0.040										2730.0	109.2

Table 11-17: Recommended Immediate repairing as per NSV in conformity with Schedule-K for LHS Outer Lane of Davanagere - Haveri

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Davanagere to Haveri: LHS Lane-3																
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**							
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
Quantities due to Settlements																
40mm milling & Inlay at settlement portion	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Compact the WMM layer and reconstruct the BC & DBM layer	Cu.m	0.00					Loosening & compact			0.0			0.0	0.0	0.0	0.0
Quantities due to Rutting only																
40mm Milling & Inlay	Cu.m	4900.00	0.040		0.040				4900.0						4900.0	196.0
Quantities due to Cracking excluding Rutting locations																

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Davanagere to Haveri: LHS Lane-3															
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**						
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
Crack Sealing	Sq. m	542.18														
40mm Milling & Inlay	Cu.m	204.32	0.040		0.040				204.3						204.3	8.2
Quantities due to Only Ravelling																
Micro Surfacing	Sq. m	0.00														
Quantities due to Only Pothole Filling																
Fill Potholes with premix material	Cu.m	0.00			0.050										0.0	0.0
Quantities due to Roughness excluding Rutting and Structural overlay locations																
40mm BC Overlay	Cu.m	2800.00			0.040										2800.0	112.0

Table 11-18: Recommended Immediate repairing as per NSV in conformity with Schedule-K for RHS Inner Lane of Davanagere - Haveri

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Davanagere to Haveri: RHS Lane-1															
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**						
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
Quantities due to Settlements																
40mm milling & Inlay at settlement portion	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Compact the WMM layer and reconstruct the BC & DBM layer	Cu.m	0.00					Loosening & compact			0.0			0.0	0.0	0.0	0.0
Quantities due to Rutting only																

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Davanagere to Haveri: RHS Lane-1															
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**						
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
40mm Milling & Inlay	Cu.m	2450.00	0.040		0.040				2450.0						2450.0	98.0
Quantities due to Cracking excluding Rutting locations																
Crack Sealing	Sq. m	614.90														
40mm Milling & Inlay	Cu.m	352.18	0.040		0.040				352.2						352.2	14.1
Quantities due to Only Ravelling																
Micro Surfacing	Sq. m	0.00														
Quantities due to Only Pothole Filling																
Fill Potholes with premix material	Cu.m	0.00			0.050										0.0	0.0
Quantities due to Roughness excluding Rutting and Structural overlay locations																
40mm BC Overlay	Cu.m	1715.00			0.040										1715.0	68.6

Table 11-19: Recommended Immediate repairing as per NSV in conformity with Schedule-K for RHS Middle Lane of Davanagere - Haveri

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Davanagere to Haveri: RHS Lane-2															
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**						
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
Quantities due to Settlements		0.00	0.040		0.040				0.0						0.0	0.0
40mm milling & Inlay at settlement portion	Cu.m	0.00					Loosening & compact			0.0			0.0	0.0	0.0	0.0

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Davanagere to Haveri: RHS Lane-2															
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**						
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
Compact the WMM layer and reconstruct the BC & DBM layer	Cu.m															
Quantities due to Rutting only		4200.00	0.040		0.040				4200.0						4200.0	168.0
40mm Milling & Inlay	Cu.m															
Quantities due to Cracking excluding Rutting locations		794.58														
Crack Sealing	Sq. m	733.63	0.040		0.040				733.6						733.6	29.3
40mm Milling & Inlay	Cu.m															
Quantities due to Only Ravelling		0.00														
Micro Surfacing	Sq. m															
Quantities due to Only Pothole Filling		0.53			0.050										0.5	0.0
Fill Potholes with premix material	Cu.m															
Quantities due to Roughness excluding Rutting and Structural overlay locations		1015.00			0.040										1015.0	40.6
40mm BC Overlay	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0

Table 11-20: Recommended Immediate repairing as per NSV in conformity with Schedule-K for RHS Outer Lane of Davanagere - Haveri

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Davanagere to Haveri: RHS Lane-3															
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**						
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
Quantities due to Settlements																

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Davanagere to Haveri: RHS Lane-3															
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**						
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
40mm milling & Inlay at settlement portion	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Compact the WMM layer and reconstruct the BC & DBM layer	Cu.m	0.00					Loosening & compact			0.0			0.0	0.0	0.0	0.0
Quantities due to Rutting only																
40mm Milling & Inlay	Cu.m	5250.00	0.040		0.040				5250.0						5250.0	210.0
Quantities due to Cracking excluding Rutting locations																
Crack Sealing	Sq. m	651.54														
40mm Milling & Inlay	Cu.m	673.98	0.040		0.040				674.0						674.0	27.0
Quantities due to Only Ravelling																
Micro Surfacing	Sq. m	0.00														
Quantities due to Only Pothole Filling																
Fill Potholes with premix material	Cu.m	0.00			0.050										0.0	0.0
Quantities due to Roughness excluding Rutting and Structural overlay locations																
40mm BC Overlay	Cu.m	2695.00			0.040										2695.0	107.8

Table 11-21: Recommended Immediate repairing as per NSV in conformity with Schedule-K for LHS Inner Lane of Haveri - Hubli

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Haveri to Hubli: LHS Lane-1															
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**						
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
Quantities due to Settlements																
40mm milling & Inlay at settlement portion	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Compact the WMM layer and reconstruct the BC & DBM layer	Cu.m	0.00					Loosening & compact			0.0			0.0	0.0	0.0	0.0
Quantities due to Rutting only																
40mm Milling & Inlay	Cu.m	10150.00	0.040		0.040				10150.0						10150.0	406.0
Quantities due to Cracking excluding Rutting locations																
Crack Sealing	Sq. m	451.56														
40mm Milling & Inlay	Cu.m	417.77	0.040		0.040				417.8						417.8	16.7
Quantities due to Only Ravelling																
Micro Surfacing	Sq. m	0.00														
Quantities due to Only Pothole Filling																
Fill Potholes with premix material	Cu.m	0.00			0.050										0.0	0.0
Quantities due to Roughness excluding Rutting and Structural overlay locations																
40mm BC Overlay	Cu.m	350.00			0.040										350.0	14.0

Table 11-22: Recommended Immediate repairing as per NSV in conformity with Schedule-K for LHS Middle Lane of Haveri - Hubli

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Haveri to Hubli: LHS Lane-2															
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**						
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
Quantities due to Settlements																
40mm milling & Inlay at settlement portion	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Compact the WMM layer and reconstruct the BC & DBM layer	Cu.m	0.00					Loosening & compact			0.0			0.0	0.0	0.0	0.0
Quantities due to Rutting only																
40mm Milling & Inlay	Cu.m	14700.00	0.040		0.040				14700.0						14700.0	588.0
Quantities due to Cracking excluding Rutting locations																
Crack Sealing	Sq. m	355.42														
40mm Milling & Inlay	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Quantities due to Only Ravelling																
Micro Surfacing	Sq. m	0.00														
Quantities due to Only Pothole Filling																
Fill Potholes with premix material	Cu.m	0.00			0.050										0.0	0.0
Quantities due to Roughness excluding Rutting and Structural overlay locations																
40mm BC Overlay	Cu.m	350.00			0.040										350.0	14.0

Table 11-23: Recommended Immediate repairing as per NSV in conformity with Schedule-K for LHS Outer Lane - Haveri - Hubli

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Haveri to Hubli: LHS Lane-3																
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**							
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
Quantities due to Settlements																
40mm milling & Inlay at settlement portion	Cu.m															
Compact the WMM layer and reconstruct the BC & DBM layer	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Quantities due to Rutting only		0.00					Loosening & compact			0.0			0.0	0.0	0.0	0.0
40mm Milling & Inlay	Cu.m															
Quantities due to Cracking excluding Rutting locations		3500.00	0.040		0.040				3500.0						3500.0	140.0
Crack Sealing	Sq. m															
40mm Milling & Inlay	Cu.m	495.63														
Quantities due to Only Ravelling		195.01	0.040		0.040				195.0						195.0	7.8
Micro Surfacing	Sq. m															
Quantities due to Only Pothole Filling		0.00														
Fill Potholes with premix material	Cu.m															
Quantities due to Roughness excluding Rutting and Structural overlay locations		0.12			0.050										0.1	0.0
40mm BC Overlay	Cu.m															

Table 11-24: Recommended Immediate repairing as per NSV in conformity with Schedule-K for RHS Inner Lane - Haveri - Hubli

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Haveri to Hubli: RHS Lane-1																
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**							
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
Quantities due to Settlements																
40mm milling & Inlay at settlement portion	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Compact the WMM layer and reconstruct the BC & DBM layer	Cu.m	0.00					Loosening & compact			0.0			0.0	0.0	0.0	0.0
Quantities due to Rutting only																
40mm Milling & Inlay	Cu.m	21700.00	0.040		0.040				21700.0						21700.0	868.0
Quantities due to Cracking excluding Rutting locations																
Crack Sealing	Sq. m	787.21														
40mm Milling & Inlay	Cu.m	567.89	0.040		0.040				567.9						567.9	22.7
Quantities due to Only Ravelling																
Micro Surfacing	Sq. m	0.00														
Quantities due to Only Pothole Filling																
Fill Potholes with premix material	Cu.m	0.00			0.050										0.0	0.0
Quantities due to Roughness excluding Rutting and Structural overlay locations																
40mm BC Overlay	Cu.m	350.00			0.040										350.0	14.0

Table 11-25: Recommended Immediate repairing as per NSV in conformity with Schedule-K for RHS Middle Lane of Haveri - Hubli

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Haveri to Hubli: RHS Lane-2																
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**							
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
Quantities due to Settlements																
40mm milling & Inlay at settlement portion	Cu.m															
Compact the WMM layer and reconstruct the BC & DBM layer	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Quantities due to Rutting only		0.00					Loosening & compact			0.0			0.0	0.0	0.0	0.0
40mm Milling & Inlay	Cu.m															
Quantities due to Cracking excluding Rutting locations		17500.00	0.040		0.040				17500.0						17500.0	700.0
Crack Sealing	Sq. m															
40mm Milling & Inlay	Cu.m	848.30														
Quantities due to Only Ravelling		1405.89	0.040		0.040				1405.9						1405.9	56.2
Micro Surfacing	Sq. m															
Quantities due to Only Pothole Filling		0.00														
Fill Potholes with premix material	Cu.m															
Quantities due to Roughness excluding Rutting and Structural overlay locations		0.00			0.050										0.0	0.0
40mm BC Overlay	Cu.m															

Table 11-26: Recommended Immediate repairing as per NSV in conformity with Schedule-K for RHS Outer Lane of Haveri - Hubli

Immediate Repair/ Rehabilitation BOQ: NH-48: Section from Haveri to Hubli: RHS Lane-3															
Summary	**Unit**				**Proposed Pavement Thickness (m)**				**Obtained Pavement Materials Quantity**						
		Area (Sq.m)	**Proposed Milling Depth (m)**	**Scarification Depth (m)**	**BC**	**DBM**	**WMM**	**GSB**	**Milling Area (sq.m)**	**Scarification (Cu.m)**	**GSB (Cu.m)**	**WMM (Cu.m)**	**Prime Coat (Sq.m)**	**DBM (Cu.m)**	**Tack Coat (Sq.m)**	**BC (cu.m)**
Quantities due to Settlements																
40mm milling & Inlay at settlement portion	Cu.m	0.00	0.040		0.040				0.0						0.0	0.0
Compact the WMM layer and reconstruct the BC & DBM layer	Cu.m	0.00					Loosening & compact			0.0			0.0	0.0	0.0	0.0
Quantities due to Rutting only																
40mm Milling & Inlay	Cu.m	1750.00	0.040		0.040				1750.0						1750.0	70.0
Quantities due to Cracking excluding Rutting locations																
Crack Sealing	Sq. m	172.83														
40mm Milling & Inlay	Cu.m	413.77	0.040		0.040				413.8						413.8	16.6
Quantities due to Only Ravelling																
Micro Surfacing	Sq. m	0.00														
Quantities due to Only Pothole Filling																
Fill Potholes with premix material	Cu.m	0.00			0.050										0.0	0.0
Quantities due to Roughness excluding Rutting and Structural overlay locations																
40mm BC Overlay	Cu.m	350.00			0.040										350.0	14.0

11.8 Major Maintenance Strategy of Pavement(O&M)

The required additional thicknesses are calculated to bring the existing pavement to meet the design traffic of FY 2035. The detailed calculations are presented in **Annexures of Chapter 10**, and the overall summary of required overlay thicknesses for LHS and RHS directions of all three sections are presented from **Table 11-27** to **Table 11-29.**

Table 11-27: Summary of Recommended Major Maintenance (Structural Overlay till the end of design life for pavement layers) of Chitradurga - Davanagere

Rehabilitation/ Repairing Strategy	FY-2035	
	LHS	RHS
30mm BC Overlay	-	12.600
40mm BC Overlay	-	-
50mm BC Overlay	14.000	13.000
30mmBC+50mm DBM Overlay	58.700	43.100
30mmBC+60mm DBM Overlay	-	4.000
Total Length in lane (km)	72.700	72.700

Table 11-28: Summary of Recommended Major Maintenance (Structural Overlay till the end of design life for pavement layers) of Davanagere - Haveri

Rehabilitation/ Repairing Strategy	Treatment length in lane km (FY-2035)	
	LHS	RHS
Length (Km) of overlay with 30 mm BC	24.923	38.500
Length (Km) of overlay with 40 mm BC	-	5.923
Length (Km) of overlay with 30 mm BC + 50mm DBM	4.000	2.000

Table 11-29: Summary of Recommended Major Maintenance (Structural Overlay till the end of design life for pavement layers) of Haveri – Hubli

Rehabilitation/ Repairing Strategy	Treatment length of LHS and RHS in km	
	LHS	RHS
Length(km) of Overlay with 30mm BC	23.40	26.90
Length(km) of Overlay with 40mm BC	10.00	1.40
Length(km) of Overlay with 50mm BC	5.50	9.70
Length(km) of Overlay with 30mm BC+50mm DBM	11.20	25.00
Total Length in lane (km)	50.10	63.00

11.9 Periodic Maintenance Strategy

Table 11-30: Periodic Maintenance Strategy of Chitradurga - Davanagere

Year	Description	Major/ Periodic Maintenance		Remarks
		Main carriageway/ Bus Bay/ Truck Lay bye	Service Roads/ Slip Roads	
Immediate Repairs and Periodic maintenance are to be done by HAM Concessionaire till their end of Concession period as stipulated in HAM Concession Agreement. Handover to TOT concessionaire from HAM Concessionaire is on 24-Jun-36 for Package 1. Periodic Maintenance after handover will be done by TOT Concessionaire.				
FY 2023-24	Immediate Repairs as per NSV	Immediate repairs By Pavement condition		It will cover under HAM concessionaire scope upto YR 2036 and also Roughness of 2750mm/km shall be maintained by the existing HAM concessionaire upto handing over.
FY 2027-28	Periodic Maintenance-I	40 mm BC On 100% length + 5% length DBM	30 mm BC On 100% length	
FY 2034-35	Periodic Maintenance-II	40 mm BC On 100% length	30 mm BC On 100% length	
Immediate repair and periodic maintenance as assessed during this TDD study is given above for FY 2023-24 to FY 2034-35 which may be required by HAM Concessionaire upto their end of Concession period to conform the maintenance requirements as stipulated in HAM Concession agreement.				
FY 2036-37	Structural overlay I	40 mm BC on 100% length	-	It's in the Scope of InviT concessionaire. In YR 2036 structural overlay is needed to provide to withstand the pavement for Future traffic of upto 2044.
FY 2038-39	Periodic Maintenance III		Micro surfacing on 100% length	
FY 2043-44	Periodic Maintenance IV	40 mm BC on 100% length +	30 mm BC On 100% length	
Handing Over project (31.03.2044)				

Table 11-31: Periodic Maintenance Strategy of Davanagere – Haveri

Year	Description	Major/ Periodic Maintenance		Remarks
		Main carriageway/ Bus Bay/ Truck Lay bye	Service Roads/ Slip Roads	
Immediate Repairs and Periodic maintenance are to be done by HAM Concessionaire till their end of Concession period as stipulated in HAM Concession Agreement. Handover to TOT concessionaire from HAM Concessionaire is on 28-May-36 for Package 2. Periodic Maintenance after handover will be done by TOT Concessionaire.				
FY 2023-24	Immediate Repairs as per NSV	Immediate repairs By Pavement condition		It will cover under HAM concessionaire scope upto YR 2036

Year	Description	Major/ Periodic Maintenance		Remarks
		Main carriageway/ Bus Bay/ Truck Lay bye	Service Roads/ Slip Roads	
FY 2027-28	Periodic Maintenance-I	40 mm BC On 100% length + 5% length DBM	30 mm BC On 100% length	and also Roughness of 2750mm/km shall be maintained by the existing HAM concessionaire upto handing over.
FY 2034-35	Periodic Maintenance-II	40 mm BC On 100% length	30 mm BC On 100% length	
Immediate repair and periodic maintenance as assessed during this TDD study is given above for FY 2023-24 to FY 2034-35 which may be required by HAM Concessionaire upto their end of Concession period to conform the maintenance requirements as stipulated in HAM Concession agreement.				
FY 2036-37	Structural overlay I	40 mm BC on 100% length	-	It's in the Scope of InviT concessionaire. In YR 2036 structural overlay is needed to provide to withstand the pavement for Future traffic of upto 2044.
FY 2038-39	Periodic Maintenance III		Micro surfacing on 100% length	
FY 2043-44	Periodic Maintenance IV	40 mm BC on 100% length	30 mm BC On 100% length	
Handing Over project (31.03.2044)				

Table 11-32: Periodic Maintenance Strategy of Haveri - Hubli

Year	Description	Major/ Periodic Maintenance		Remarks
		Main carriageway/ Bus Bay/ Truck Lay bye	Service Roads/ Slip Roads	
Immediate Repairs and Periodic maintenance are to be done by HAM Concessionaire till their end of Concession period as stipulated in HAM Concession Agreement. Handover to TOT concessionaire from HAM Concessionaire is on 23-Sep-36 for Package 3. Periodic Maintenance after handover will be done by TOT Concessionaire.				
FY 2023-24	Immediate Repairs as per NSV	Immediate repairs By Pavement condition		It will cover under HAM concessionaire scope upto YR 2036 and also Roughness of 2750mm/km shall be maintained by the existing HAM concessionaire upto handing over.
FY 2026-27	Periodic Maintenance-I	40 mm BC On 100% length + 5% length DBM	30 mm BC On 100% length	
FY 2033-34	Periodic Maintenance-II	40 mm BC On 100% length	30 mm BC On 100% length	
Immediate repair and periodic maintenance as assessed during this TDD study is given above for FY 2023-24 to FY 2034-35 which may be required by HAM Concessionaire upto their end of Concession period to conform the maintenance requirements as stipulated in HAM Concession agreement.				
FY 2036-37	Structural overlay I	40 mm BC on 100% length	-	It's in the Scope of InviT

FY 2038-39	Periodic Maintenance III		Micro surfacing on 100% length	concessionaire. In YR 2036 structural overlay is needed to provide to withstand the pavement for Future traffic of upto 2044.
FY 2043-44	Periodic Maintenance IV	40 mm BC on 100% length	30 mm BC On 100% length	
Handing Over project (31.03.2044)				

12. COST ESTIMATE

General

Cost Estimate is worked out for expenses on Immediate repair works (CAPEX) and expenses on operations and maintenance (OPEX). The cost estimate is worked out at present rates considering 2023-24 as the base year.

Assumptions (Chitradurga Davanagere) – PKG-1

The cost estimates are based on the following assumptions:

(a) Bitumen is sourced from IOCL Mangalore (Karnataka) Refinery. The distance (to-fro) from the midpoint of Project Highway is taken as 307 km. VG-40 grade bitumen is considered in the cost estimate.

(b) Hire charges for the Machinery and Rates for various items of works have been considered in accordance with SOR 2022-23 Bengaluru in the State of Karnataka using 5% escalation every year to arrive the present rates of 2023-24.

(c) Manpower rates have been taken from Government of India; Ministry of Labour & Employment Office of the Chief Labour Commissioner(C) dated 01st October 2023.

(d) Material Rates are obtained from Schedule of Rates Bengaluru for Karnataka SOR 2022-23.

(e) Sand and Aggregate are sourced from the nearest quarry located on project highway at approximately 40 km form the Project Highway.

(f) Cement is procured from the nearest local market.

(g) Rate of steel is taken from SAIL November-2023.

(h) Some of the rates are based on Consultant's experience on the similar ongoing projects in adjacent locations.

(i) Overheads and profits have been considered based on MORT&H Standard Data Book. Applicable taxes have been considered in the Rate Analysis.

Assumptions (Davanagere Haveri) – PKG-2

The cost estimates are based on the following assumptions:

(a) Bitumen is sourced from IOCL Mangalore (Karnataka) Refinery. The distance (to-fro) from the midpoint of Project Highway is taken as 238 km. VG-40 grade bitumen is considered in the cost estimate.

(b) Hire charges for the Machinery and Rates for various items of works have been considered in accordance with SOR 2022-23 Bengaluru in the State of Karnataka using 5% escalation every year to arrive the present rates of 2023-24.

(c) Manpower rates have been taken from Government of India; Ministry of Labour & Employment Office of the Chief Labour Commissioner(C) dated 01st October 2023.

(d) Material Rates are obtained from Schedule of Rates Bengaluru for Karnataka SOR 2022-23.

(e) Sand and Aggregate are sourced from the nearest quarry located on project highway at approximately 35 km form the Project Highway.

(f) Cement is procured from the nearest local market.

(g) Rate of steel is taken from SAIL November-2023

(h) Some of the rates are based on Consultant's experience on the similar ongoing projects in

adjacent locations.

(i) Overheads and profits have been considered based on MORT&H Standard Data Book. Applicable taxes have been considered in the Rate Analysis.

Assumptions (Haveri Hubli) – PKG-3

The cost estimates are based on the following assumptions:

(a) Bitumen is sourced from IOCL Mangalore (Karnataka) Refinery. The distance (to-fro) from the midpoint of Project Highway is taken as 230 km. VG-40 grade bitumen is considered in the cost estimate.

(b) Hire charges for the Machinery and Rates for various items of works have been considered in accordance with SOR 2022-23 Bengaluru in the State of Karnataka using 5% escalation every year to arrive the present rates of 2023-24.

(c) Manpower rates have been taken from Government of India; Ministry of Labour & Employment Office of the Chief Labour Commissioner(C) dated 01st October 2023.

(d) Material Rates are obtained from Schedule of Rates Bengaluru for Karnataka SOR 2022-23.

(e) Sand and Aggregate are sourced from the nearest quarry located on project highway at approximately 30 km form the Project Highway.

(f) Cement is procured from the nearest local market.

(g) Rate of steel is taken from SAIL November-2023

(h) Some of the rates are based on Consultant's experience on the similar ongoing projects in adjacent locations.

(i) Overheads and profits have been considered based on MORT&H Standard Data Book. Applicable taxes have been considered in the Rate Analysis.

Details of CAPEX are worked out under the following categories.

- Immediate maintenance / defect rectification.
- O&M maintenance

Table 12-1: Summary of CAPEX for (PKG-1, PKG-2 & PKG-3)

S. No.	Particulars	Total	
		With GST	Without GST
A	Initial Improvement Works (Schedule - B)	**16.00**	**13.56**
B.1	Immediate repair works for flexible pavement		
B.2	Immediate repair works for Rigid pavement		
B.3	Immediate repair works for structure		
C	Electrical work		
D	ATMS		
E	TCMS	**7.90**	**6.69**
	Total Amount (in Crore Rs.)	**23.90**	**20.26**

12.4.1 Immediate Maintenance

The estimated cost towards New Construction of Toll Plaza for 14 lanes at Package -3 as mentioned in Technical Schedule for TOT of this project. The cost is approx. INR 160,024,825.62 including 18% GST.

O&M Estimates

Operation and Maintenance estimates are worked out under the following heads:

(a) Preventive Maintenance / Routine Maintenance

(b) Operations

(c) Major Maintenance

12.5.1 Considerations - Preventive/Routine maintenance

Preventive/Routine maintenance cost is based on following considerations:

(a) Assuming 0.075% of total length of carriageway for each package repaired for potholes, Bleeding, Rutting and crack sealing per month on both sides of Main carriageway and service road.

(b) Considering 0.85% of total length on both sides of carriageway per month for Epoxy Treatment / Joints Sealant /crack filling / grinding of uneven slabs etc.

(c) Considering dismantling and relaying 0.25% distressed slabs per year

(d) Considering repair of damaged structures and applying epoxy paint to the concrete for structure maintenance of lumpsum amount INR 5,460 for PKG1, INR 4,209 for PKG-2 and INR 4,087 for PKG-3 per KM per month.

(e) Every year considering 8.5% of the total area for painting of Kerb and Concrete crash barrier.

(f) 0.35% reconstruction of damaged kerbs and concrete barrier is considered every year.

(g) Considering 25% of the total area for road marking every year.

(h) Cost of the removal and safe disposal of dead animals along the highway is also considered.

(i) Repair and Replacement of damaged Metal Beam Crash Barriers and Pedestrian Guard Rails are considered for 0.25% of total length every year.

(j) Toll Plaza Building and Rest area repair works are also considered in the estimate.

12.5.2 Routine Maintenance - Categories

Routine Maintenance covers all activities required to maintain the road in traffic worthy condition to provide desired comforts to the road users. Routine Maintenance can be classified into following three categories:

(a) Routine maintenance with frequency/interval

(b) Pre-monsoon maintenance

(c) Post monsoon maintenance

12.5.2.1 Routine or day to day maintenance

Routine maintenance with certain intervention time is continuously required for the road stretch and structures. It covers the following activities:

(a) Cleaning of the Road

(b) Pavement maintenance to include crack sealing and pothole repairs.

(c) Shoulder repairs

(d) Maintenance of avenue plantation, horticulture, and median plantation

(e) Maintenance of signage, gantry boards and road furniture.

(f) Maintenance of culverts, bridge drainage spouts, expansion joints, side slopes and verges

(g) Surface cleaning, dust or vegetation control, sand removal from structures

(h) Reporting any damage caused to bridges by traffic accidents.

(i) Maintenance of guard rails and crash barrier etc.

12.5.2.2 Pre-monsoon Maintenance

This is carried out prior to the monsoons and includes the following:

(a) Inspection of channels/streams to ensure no accumulation of logs, trees, and other debris in the vicinity of piers and abutments.

(b) Cleaning of roadside / median drains.

(c) Removal of vegetation growth on sub structures.

(d) Cleaning of culverts.

12.5.2.3 Post-monsoon Maintenance

This includes maintenance that is carried out immediately after the monsoons and includes the following:

(a) Inspection of all structures for any damages and taking appropriate actions.

(b) Cleaning of roadside drains, culverts etc.

Estimates on Highway Operations

12.6.1 Toll Plaza

This cost includes the following:

(a) Maintenance of Toll Plaza building, booths, and tolling equipment.

(b) Security of the booths, lanes, and toll plazas.

(c) Collection of toll and handling of cash till bank deposit.

(d) Provision of IT in-charge, IT supervisor, other staff at Toll Plaza location.

(e) Administration and essential facilities for the staff and road users.

(f) Maintenance of Toll Plaza equipment and replacement of expendable and short life items.

(g) Electricity cost including standby generator.

12.6.2 Highway

This cost includes the following:

(a) Providing patrolling vehicle including operating cost for round-the-clock patrolling of the Project Highway.

(b) Providing ambulances at Toll Plaza for accident victims.

(c) Provision of crane with 30 to 50 MT and tow truck facilities for clearing the highway and evacuating the breakdown vehicles at Toll Plaza.

(d) Provision of vehicle for Police personal for patrolling.

(e) Expenditure on medical aid and provision of nursing staff.

(f) Cost of tests and surveys:

- Two RI test every year.
- FWD test every year.
- Traffic survey every year

12.6.3 Energy

As per the Concession agreement, electrification is to be provided at the toll plaza, Junctions, Bus bays, Truck lay bay, Rest area and Built-up area. Following assumptions have been made.

(a) Streetlight luminaries of 125, 150, 200 watts and 1800-watts LED Lamps Light have been considered in Highways.

(b) Electricity tariff @ ₹ 10.00 per unit and provision of standby Generator set tariff @ ₹ 12.5 are also considered in estimates.

(c) Cost of replacing LED Light, high mast lamps and Spare Parts for highway lighting, solar blinkers is included in the estimate.

12.6.4 Miscellaneous

(a) Cost of IE/AE and Professional Fee for Legal, Arbitration, Audit Certification for O&M period is considered.

(b) Actual cost of yearly Insurance policy is included in estimate.

(c) Yearly charges for Survey & Investigation are also included.

Summary of O & M Cost

Summary of Annual O&M cost at present rate is given below in Table 12-2:

Table 12-2: Summary of Cost of Operation & Maintenance (per annum for first year - For Pkg-1, Pkg-2 & Pkg-3)

S. No.	Particulars	Total Amount in Cr. (incl. GST) Base Year 2024-25
A1	**Operations**	
A1.1	Tolling Operations	**15.60**
A1.2	Incident Management	**12.42**
A2	**Maintenance**	
A2.1	Routine Maintenance	**14.83**
A2.2	Repairs	**8.10**
A2.3	AMC of ATMS	**-**
B	Admin Expenses	**15.65**
	Total	**66.60**

Table 12-3: Summary of Cost of Operation & Maintenance (entire concession period)- For Pkg-1, Pkg-2 & Pkg-3)

S. No.	O&M Period	Total Amount in Cr. (incl. GST)	Remarks
1	2024-2025	66.60	
2	2025-2026	66.60	
3	2026-2027	63.72	Change in Tolling Operation cost

S. No.	O&M Period	Total Amount in Cr. (incl. GST)	Remarks
4	2027-2028	63.72	
5	2028-2029	62.28	Change in Tolling Operation cost
6	2029-2030	62.28	
7	2030-2031	62.28	
8	2031-2032	62.28	
9	2032-2033	62.28	
10	2033-2034	62.28	
11	2034-2035	62.28	
12	2035-2036	62.28	
13	2036-2037	65.68	Start year of ATMS maintenance
14	2037-2038	65.68	
15	2038-2039	65.68	
16	2039-2040	65.68	
17	2040-2041	65.68	
18	2041-2042	65.68	
19	2042-2043	65.68	
20	2043-2044	65.68	
	Total Amount	**1,284.38**	

** Based on actuals*

12.8 Estimate towards Replacement of Toll Plaza Equipment

All the three toll plazas are operational. As per industry norms, the toll plaza equipment generally require replacement after about 7 years. The lump sum cost towards such replacement of toll plaza equipment and TMS are estimated as INR 26.71 Crore for all three packages upto the end of concession period.

12.9 Summary of Year-wise OPEX

Year-wise OPEX for the balance concession period are presented in Table 12-4.

Table 12-4: Summary of Year Wise Combined O&M Estimate along with MMR and all Immediate respire works Summary (Package 1, Package -2 and Package -3)

Year		New Toll Plaza 14 Lane	Immediate Repair for TMS	Immediate Repair			Sub Total (A)	Major Maintenance			Sub Total (B)	OPEX										Sub Total (C)	Grand Total (D)= (A)+(B)+(C)
From	To			Rigid Pavement	Flexible Pavement	Str Repair		Periodic Maintenance	ATMS Replacement	TMS Replacement		Tolling Operation Cost	Head office On Roll Staff	Incident Management	Routine Maintenance	Toll Plaza lighting	Preventive Maintenance	AMC for TMS	Power for TMS/ATMS	Other Office and ADMIN expenses	Insurance Fee		
1-Apr-24	31-Mar-25	16.00	7.90	-		-	23.90	-	-	-	-	11.51	1.95	12.42	14.83	0.99	8.10	1.07	-	10.56	5.18	66.60	90.50
1-Apr-25	31-Mar-26	-	-	-	-	-	-	-	-	-	-	11.51	1.95	12.42	14.83	0.99	8.10	1.07	-	10.56	5.18	66.60	66.60
1-Apr-26	31-Mar-27	-	-	-	-	-	-	-	-	-	-	8.63	1.95	12.42	14.83	0.99	8.10	1.07	-	10.56	5.18	63.72	63.72
1-Apr-27	31-Mar-28	-	-	-	-	-	-	-	-	6.68	6.68	8.63	1.95	12.42	14.83	0.99	8.10	1.07	-	10.56	5.18	63.72	70.40
1-Apr-28	31-Mar-29	-	-	-	-	-	-	-	-	-	-	7.19	1.95	12.42	14.83	0.99	8.10	1.07	-	10.56	5.18	62.28	62.28
1-Apr-29	31-Mar-30	-	-	-	-	-	-	-	-	-	-	7.19	1.95	12.42	14.83	0.99	8.10	1.07	-	10.56	5.18	62.28	62.28
1-Apr-30	31-Mar-31	-	-	-	-	-	-	-	-	-	-	7.19	1.95	12.42	14.83	0.99	8.10	1.07	-	10.56	5.18	62.28	62.28
1-Apr-31	31-Mar-32	-	-	-	-	-	-	-	-	-	-	7.19	1.95	12.42	14.83	0.99	8.10	1.07	-	10.56	5.18	62.28	62.28
1-Apr-32	31-Mar-33	-	-	-	-	-	-	-	-	-	-	7.19	1.95	12.42	14.83	0.99	8.10	1.07	-	10.56	5.18	62.28	62.28
1-Apr-33	31-Mar-34	-	-	-	-	-	-	-	-	-	-	7.19	1.95	12.42	14.83	0.99	8.10	1.07	-	10.56	5.18	62.28	62.28
1-Apr-34	31-Mar-35	-	-	-	-	-	-	-	-	13.35	13.35	7.19	1.95	12.42	14.83	0.99	8.10	1.07	-	10.56	5.18	62.28	75.64
1-Apr-35	31-Mar-36	-	-	-	-	-	-	100.43	-	-	100.43	7.19	1.95	12.42	14.83	0.99	8.10	1.07	-	10.56	5.18	62.28	162.71
1-Apr-36	31-Mar-37	-	-	-	-	-	-	236.32	-	-	236.32	7.19	1.95	12.42	14.83	0.99	8.10	1.07	3.40	10.56	5.18	65.68	302.00
1-Apr-37	31-Mar-38	-	-	-	-	-	-	-	14.89	-	14.89	7.19	1.95	12.42	14.83	0.99	8.10	1.07	3.40	10.56	5.18	65.68	80.57
1-Apr-38	31-Mar-39	-	-	-	-	-	-	58.21	-	-	58.21	7.19	1.95	12.42	14.83	0.99	8.10	1.07	3.40	10.56	5.18	65.68	123.89
1-Apr-39	31-Mar-40	-	-	-	-	-	-	-	-	-	-	7.19	1.95	12.42	14.83	0.99	8.10	1.07	3.40	10.56	5.18	65.68	65.68
1-Apr-40	31-Mar-41	-	-	-	-	-	-	-	-	-	-	7.19	1.95	12.42	14.83	0.99	8.10	1.07	3.40	10.56	5.18	65.68	65.68
1-Apr-41	31-Mar-42	-	-	-	-	-	-	-	-	6.68	6.68	7.19	1.95	12.42	14.83	0.99	8.10	1.07	3.40	10.56	5.18	65.68	72.36
1-Apr-42	31-Mar-43	-	-	-	-	-	-	-	-	-	-	7.19	1.95	12.42	14.83	0.99	8.10	1.07	3.40	10.56	5.18	65.68	65.68
1-Apr-43	31-Mar-44	-	-	-	-	-	-	435.76	-	-	435.76	7.19	1.95	12.42	14.83	0.99	8.10	1.07	3.40	10.56	5.18	65.68	501.44
Total Cost (INR Crore)		**16.00**	**7.90**	**Immediate repair works are part of current HAM Concession Agreement**			**23.90**	**830.71**	**14.89**	**26.70**	**872.30**	**155.38**	**39.00**	**248.35**	**296.57**	**19.78**	**162.08**	**21.36**	**27.19**	**211.17**	**103.51**	**1,284.38**	**2,180.58**

No Escalation considered and internet & broadband charges are included in admin expenses.

12.10 Periodic Maintenance (PKG-1, PKG-2 and PKG-3)

Periodic maintenance cost estimate for all packages is presented in Table 12-6.

Table 12-5: Periodic Maintenance (Package 1, Package 2, Package 3)

Year	Description	Major/ Periodic Maintenance		Remarks
		Main carriageway / Bus Bay/ Truck Lay bye	Service Roads/ Slip Roads	
Immediate Repairs and Periodic maintenance are to be done by HAM Concessionaire till their end of Concession period as stipulated in HAM Concession Agreement. Handover to TOT concessionaire from HAM Concessionaire is on 24-Jun-36 for Package 1, 28-May-36 for Package 2 and 23-Sep-36 for Package 3. Periodic Maintenance after HAM Concession will be done by TOT Concessionaire.				
FY 2023-24 to FY 2034-35	Immediate Repairs and Periodic Maintenance are to be done by HAM Concessionaire as stipulated in HAM Concession Agreement			Maintenance requirement will be covered by HAM Concessionaire and Roughness of 2750 mm/km shall be maintained by the HAM Concessionaire prior to handing over to InvIT Concessionaire
FY 2036-37	Structural overlay	40 mm BC on 100% length + Replacement of Bearing & Expansion Joints	-	Maintenance by InviT concessionaire
FY 2036-37	TMS Replacement	-	-	
FY 2037-38	ATMS Replacement	-	-	
FY 2038-39	Periodic Maintenance	-	Micro Surfacing On 100% length	
FY 2043-44	Periodic Maintenance	40 mm BC on 100% length	30 mm BC On 100% length	
FY 2043-44	TMS Replacement	-	-	
Handing Over of the Project is 31.03.2044				

Table 12-6: Periodic Maintenance Cost for all packages

Year	Functional + Structural overlay MCW+ S/R	Major Maintenance of Flexible Pavement	Major Maintenance of Rigid Pavement	Replacement of ATMS	Replacement of TMS	Structure specified repairs	Total Amount
2024-2025	-	-	-	-	-	-	-
2025-2026	-	-	-	-	-	-	-
2026-2027	-	-	-	-	-	-	-
2027-2028	-	-	-	-	6.68	-	6.68
2028-2029	-	-	-	-	-	-	-
2029-2030	-	-	-	-	-	-	-
2030-2031	-	-	-	-	-	-	-
2031-2032	-	-	-	-	-	-	-
2032-2033	-	-	-	-	-	-	-

Confidential

Year	Functional + Structural overlay MCW+ S/R	Major Maintenance of Flexible Pavement	Major Maintenance of Rigid Pavement	Replacement of ATMS	Replacement of TMS	Structure specified repairs	Total Amount
2033-2034	-	-	-	-	-	-	-
2034-2035	-	-	-	-	13.35	-	13.35
2035-2036	-	100.43	-	-	-	-	100.43
2036-2037	-	236.32	-	-	-	-	236.32
2037-2038	-	-	-	14.89	-	-	14.89
2038-2039	-	58.21	-	-	-	-	58.21
2039-2040	-	-	-	-	-	-	-
2040-2041	-	-	-	-	-	-	-
2041-2042	-	-	-	-	6.68	-	6.68
2042-2043	-	-	-	-	-	-	-
2043-2044	-	435.76	-	-	-	-	435.76
Total Amount	-	**830.71**	-	**14.89**	**26.70**	-	**872.30**

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